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The Effect of Proprioceptive and Strengthening Exercises in Knee Osteoarthritis

Aastha Maggo, Shobhit Saxena, Shalini Grover

Department of Physiotherapy, Faridabad Institute of Technology, Faridabad, Haryana

Abstract

Study Design

The study was a randomized controlled trial.

Objective

To compare the effectiveness of proprioceptive exercises and strengthening exercises in treatment of osteoarthritis of knee in terms of pain and functional disability.

Background

Few investigations include both strengthening and proprioceptive exercises in the treatment of knee osteoarthritis. Though previous studies give us some insight in to the role of proprioceptive exercises in knee OA but none of the studies have studied the combined effect of strengthening exercises and proprioceptive exercises in knee OA. Thus, it is intended to check the efficacy of proprioceptive and strengthening exercises in knee OA to reduce pain and functional disability and improve joint position sense.

Methods

In this study 24 subjects who met the inclusion criteria were randomized into three groups. Group A were given conventional treatment (SWD and static quadriceps). Group B were given strengthening exercises along with SWD. Group C; which were given strengthening exercises and proprioceptive exercises along with SWD. Outcome measures were pain, functional disability and joint position sense.

Results

All the groups significantly improved in VAS and WOMAC scores after intervention $p < .05$, knee reposition error score (Joint position sense) only improved in proprioceptive exercises group. The proprioceptive exercises group demonstrated greater improvement in VAS and WOMAC scores as compared to other two groups.

Conclusion

This study between three groups comparing conventional treatment to strengthening and proprioceptive exercises suggest that combination of the two brings better relief to the subjects of knee OA in reducing pain and functional disability.

Introduction

Osteoarthritis (OA) is the most common joint disorder, a prevalence that increases with age and sex specifications^{2,3}. Among adults 45-74 years of age or older, symptomatic disease occurs in approximately 12.1% population⁴. Before 50 years of age the prevalence of OA in most joints is higher in men than in

women. After about 50 years of age, women are often affected with hand, foot and knee OA than men⁵. In subjects with no joint pain who have radiographic changes of OA, quadriceps weakness predicts radiograph progression and pain⁶. These findings suggest that the weakness may occur before arthritic damage.

Nevertheless, exercises to strengthen the quadriceps relieve joint pain in persons with OA of knee⁷. The strengthening exercises are beneficial for knee OA by several pathways, improving strength, improving psychological well-being. All of these may interact and have an additive effect on the symptoms of OA⁷. Barret et al, (1991) has reported impaired proprioception for the patients suffering from knee osteoarthritis. Few investigations have investigated the relationship between impaired proprioception and performance or other measures of functional status in OA. In addition Birmingham et al, (2001) stated that quadriceps sensory dysfunction that is, decreased proprioceptive acuity, has recently been demonstrated in patients with knee OA and proposed as a factor in the pathogenesis or progression of the condition. If correct, restoration of these sensorimotor deficits with strengthening may retard progression of knee OA and reduce disability. Although it is generally accepted that a rehabilitation program improves the functional capacity, pain and sensorimotor function of patients, there is lack of agreement about what such a rehabilitation program should include (Roddy et al., 2005). Many previous studies have generally used sophisticated and expensive apparatus, which limits their application to a community setting^{8,9,10}. Though the above mentioned studies give us some insight in to the role of proprioceptive exercises in knee OA but none of the studies have studied the combined effect of strengthening exercises and proprioceptive exercises in knee OA. Thus, in this study it is intended to check the efficacy of proprioceptive and strengthening exercises in knee OA to reduce pain, functional disability and improve joint position sense.

Patients and Methods

Under convenience sampling, 32 subjects were recruited from the physiotherapy department of Sanjay Gandhi Memorial Hospital (Delhi). The subjects were screened by means of a screening form one of the three groups- group A (conventional treatment group), group B (strengthening exercise treatment group) and group C (strengthening exercise and proprioceptive exercise) by simple randomization method.

Inclusion Criteria

1. Diagnosed cases of osteoarthritis grade 2 and 3 (As reported by radiologist).
2. Age group-45 to 60 years.
3. Bilateral osteoarthritis.
4. Gender-both male and female
5. Patients should able to demonstrate sufficient English skills.

Exclusion Criteria

1. Neurologic disorder (e.g. Parkinson's disease, Alzheimer's disease)
2. Steroid injection in past 2 months

3. Inflammatory arthritis
4. Metal implants in lower limb
5. Osteoporosis
6. Knee ligament/Meniscal injury

Group A received short wave diathermy and static quadriceps exercise, Group B received short wave diathermy and strengthening exercises and Group C received short wave diathermy, strengthening exercises and proprioceptive exercises.

Intervention

1. Before starting the exercises, patients were given treatment for pain reduction by short wave diathermy. The patients were positioned supine and comfortably on the treatment plinth. Patient in each group received 20 min of SWD thrice a week for four weeks (12 treatments) applied by malleable electrodes by contraplanar method (Chitra, 2007)¹¹. The intensity of the SWD was based on each subject's tolerance but all the subjects were advised that they should feel just comfortable warmth (Low and Reed, 2000).
2. Strengthening exercises (Gail D,2005)¹²Static quadriceps in knee extension- Patient is positioned fully supine. Patient contracts the quadriceps femoris muscle and pushes knee down while maintaining the foot in full dorsiflexion, each contraction is held for 6 sec with a 10 sec rest between repetitions. 10 repetitions are done.

Standing terminal knee extension- Patient stands with a resistive band behind a slightly flexed knee. Patient contracts the gluteal and quadriceps femoris muscle to fully straighten the hip and knee. Each contraction is held for 3 seconds, 10 repetitions were done and resistance is increased as tolerated by the patient.

Closed chain exercise, one of the two exercises is performed 3 times per week. Patient should progress to the most challenging activity that he or she can successfully complete with minimal or no pain.

- a. Seated leg press- Patient is seated holding a resistive band in both the hands
A patient places his or her foot against the band, then straightens the knee by pushing the foot down and forward by contracting the gluteal and quadriceps femoris muscles. Each contraction is held for 3 seconds with knee as straight as possible, patient slowly return to the starting position and repeat for 30 sec bout. Progression is made by using bands of high resistance and additional bouts.
 - b. Partial squats - Patient stands with arm support as needed, patient performs a partial squat, keeping the knees centered over the feet return to standing by contracting the quadriceps femoris and gluteal muscles. Each contraction is held for 3 seconds with hips and knees as straight as possible. Progress to full body weight without support and additional bouts.
3. Proprioceptive exercises. (Chita et al, 2007)¹¹
 - a. One leg balance-it involved standing on affected foot with relaxed upright posture and other leg flexed at knee, hip and ankle, this position was held for one minute followed by rest for 10 to 20 seconds and was repeated twice more. After a brief rest three similar repetitions were carried out for unaffected leg(Fig a).
 - b. Blind advanced one leg balance-It was same like one leg balance, expect that the patient was asked to keep his/her eyes completely closed while performing the routine, and then was repeated twice again (Fig b).
 - c. Toe walking-Here the patient was made to walk for 20 meters high up on the toes with toes pointing straight ahead, then walk with toes pointing outwards and then walk with

toes pointing inwards after a short rest repeat it once again(Fig c)

- d) Heel walking - Walking for 20 meters on heels with toes pointing straight ahead, walking on heels with toes pointing out and walking on heels with toes pointing in. After a short rest, the procedure was repeated once more(Fig d)
- e) Cross leg body swing-Leaning slightly forward with hands on wall for support and weight on affected leg, other leg was swung in front of the body pointing toes upwards as foot reaches its farthest point of motion. Then swing this unaffected leg back to the unaffected side as far as comfortably possible, again pointing toes up as foot reaches its final point of movement. Repeat this overall motion 15



(a)

(b)



(c)



(d)



(e)

times with erect body posture and good balance, rest for a few seconds, and then 15 similar repetitions with the unaffected leg as weight-bearing limb was performed (Fig e).

Treatment was given three times per week for four weeks.

In this study the outcome measures were:-

All outcome measures were measured at baseline, end of week 1, end of week 2, end of week 3 and end of week 4.

Pain – was measured using the visual analogue. Functional disability-was measured using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) Joint position sense-was measured using inclinometer by Reposition error test (Higgins and Perrin, 2000).

Procedure for reposition error test- all the subjects were familiarized with the procedure by explanation, demonstration and adequate practice repetition. Inclinometer was attached to the distal thigh of dominant extremity approximately one inch above knee joint line. Patient is standing with back against wall and is blindfolded to eliminate visual cues, Patient squats to 30 degree of knee flexion and maintains this position for 15 sec, return to starting position of 0 degree extension, Following a 15 sec rest period patient then attempts to reposition themselves at the predetermined angle, degree of error from 30 degree knee flexion target angle is recorded and average over three trials is used for data analysis (Higgins and Perrin, 2000)¹³.



Inclinometer for assessing joint position sense(Reposition error test)

Statistical Analysis

A total of 32 patients were screened for possible study eligibility. 28 patients satisfied the eligibility criteria, were recruited into study and underwent baseline measurement. Four patients in this study did not complete the treatment. There were two dropouts from Group A, one each from Group B and Group C. Total of 24 subjects, including both males and females, completed the study. Age of subjects in this study was between 45-60 years. The mean age of subjects in Group A was 51.5(±4.30) years, Group B was 49.5(±2.44) years, and Group C was 51.62 (±3.96) years. There was no significant difference between the mean ages of all the three groups. Group A had 5

females and 3 male patients, Group B had 6 females and 2 male patients, Group C had 6 female and 2 male patients. In total there were 17 female and 9 male patients.

Readings of the variables taken at the baseline and at the end of first, second, third and fourth week were analyzed for intragroup differences using repeated measure ANOVA and paired samples t-test with Bonferroni correction. Intergroup differences were analyzed using one way ANOVA.

For intergroup differences result was considered significant if p value < 0.05 and for intragroup differences result was considered significant if p-value < 0.01.

Results

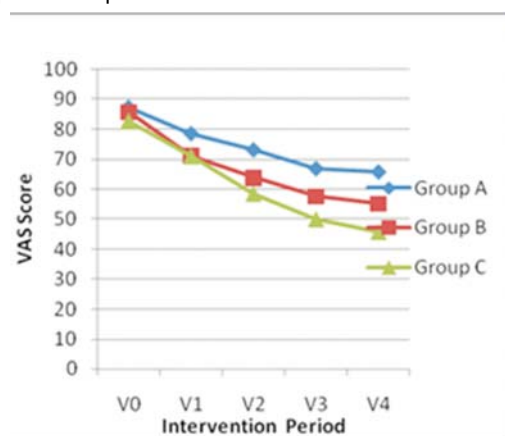
Within Group Analysis of pain scores - The repeated measures ANOVA results for VAS scores revealed a significant difference within all groups.

Between group analysis of pain scores - The analysis of VAS scores Between all the groups suggested that there were no significant differences at the baseline (p=0.397) and at the end of 1st week (p=0.052). At the end of 2nd week there was significant difference between the groups (p=0.002), at the end of 3rd week there was significant difference between the groups (p=0.000), at the end of 4th week there was significant difference between the groups (p=0.000).

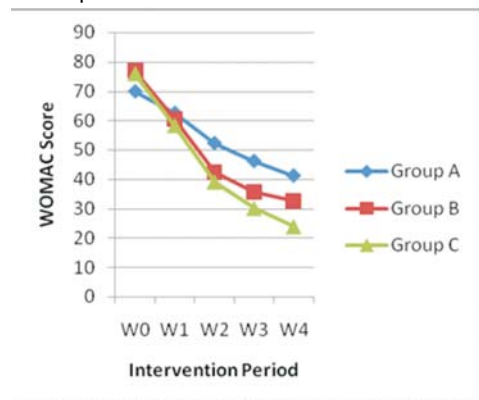
Within Group Analysis of WOMAC scores-the results of repeated ANOVA and post-hoc t-test showed significant differences in WOMAC scores in all the groups.

Between group Analysis of WOMAC Scores-The analysis of WOMAC score between the groups suggested that there were no significant differences between baseline (p=0.110) and week 1 (p=0.467). At the end of 2nd week there was significant difference between the groups (p=0.003). At the end of 3rd week there was significant difference between the groups (p=.000). At the end of 4th week there was significant difference between all the groups (p=.000).

Graph 1: Comparison between mean values of VAS



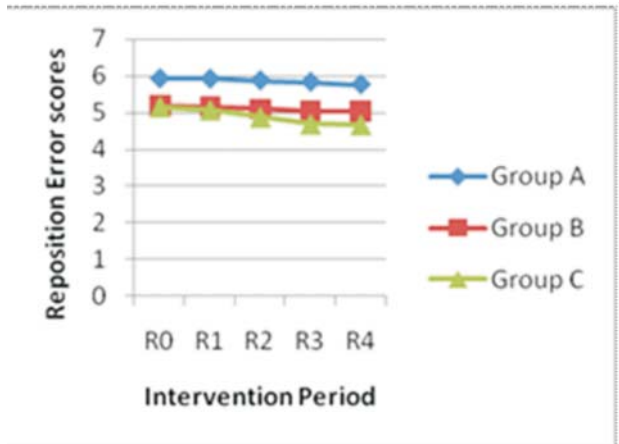
Graph 2: Comparison of mean values of WOMAC



Within Group Analysis of Reposition Error Test scores - The results of repeated ANOVA and post-hoc t-test showed no significant differences in Reposition scores in group A and B. But in Group C there was statistically significant improvement in baseline and week 4.

Between Group Analysis of Reposition error test - The analysis of reposition error score between the groups suggested that there were no significant differences between baseline (p=0.193), week1 (p=0.144), week2 (p=0.135), week 3 (p=0.095) and week 4 (p=0.113).

Graph 3: Comparison of mean values of Reposition error scores



Graph 4: Comparison of percentage improvements in all outcome measures

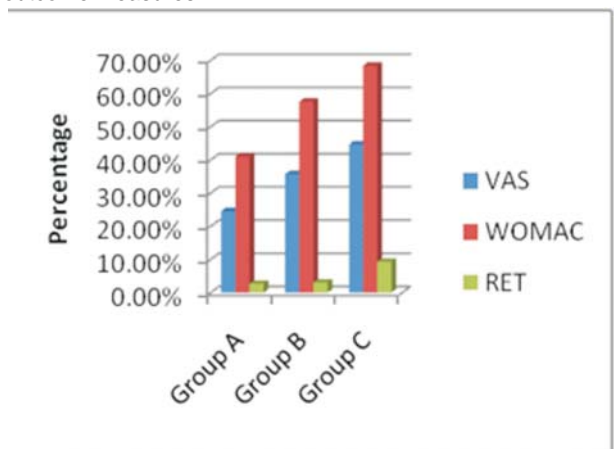


Table 1: Percentage of improvement in all outcome measures across the three groups

Outcome measure	Percentage of improvement		
	Group A (conventional treatment)	Group B (strengthening exercises)	Group C (strengthening and proprioceptive Exercises)
Pain(VAS)	24.64%	35.72%	44.71%
Disability(WOMAC)	41.03%	57.60%	68.48%
Joint position sense(RET)	2.70%	3.08%	9.35%

research hypothesis. Both the treatment groups A and B resulted in significant improvements in all the variables compared to the conventional therapy group. A study by Felson et al (2009) states that proprioceptive acuity as assessed by the accuracy of reproduction of the angle of knee flexion has modest effects on pain and physical function limitation in knee osteoarthritis. This could be due to pain relief, reduction in stiffness, increased lubrication of joint, gain in strength of weak muscles, correct

Discussion

The purpose of this study was to determine the effectiveness of Proprioceptive exercises along with strengthening exercises in improving pain and disability in patients with knee osteoarthritis. In all the three groups- pain, disability and joint position sense were taken as the dependent variables to assess the improvement between the groups and within the group. The findings of the present study suggest that the addition of proprioceptive exercises and strengthening exercises reduces patient's pain and disability more effectively than strengthening exercises or conventional physiotherapy alone over a 4 week period. Statistical analysis revealed no significant differences in key demographic variables and baseline measurements of pain, disability and active angle replication test suggesting that all the groups had homogenous distribution of patients.

In this study VAS was used to measure pain. A statistically significant difference was found between all the groups. Maximum reduction of pain was in group C (37±0.02mm). This is in favor of our research hypothesis. Pain relief in this group is in accordance with a case report of 70 year old lady with osteoarthritis of knee who found moderate pain relief by proprioceptive exercises as done by Childs et al(2002)¹⁴. Reduction in pain in Group A (conventional treatment) and B (strengthening exercise group) is consistent with previous findings which state that both dynamic and isometric resistance training reduced perceived knee joint pain¹⁵. Proprioceptive training activities provide patient with an opportunity to adapt to potentially destabilizing loads on the knee during rehabilitation, give additional exposure to pivoting, quick starting and stopping and quick changes in direction and challenge their balance capabilities. Strengthening exercises are recommended to reduce pain and improve physical function in knee OA, but there is minimal information on its long term impact⁶. It is theorized that because elevated plasma β endorphin, a neuro transmitter inhibitory to pain signal, has been observed in response to prolonged rhythmic exercise (Thoren et al, 1990) leading to increased β endorphin production might decrease pain experienced by persons with osteoarthritis¹⁷.

In the present study WOMAC Score was used to assess overall knee function since its validity and reliability is already established¹⁶. The analysis of disability score reveals no significant difference at baseline. There was significant improvement in Group B (Strengthening exercises) and C (Strengthening exercise and Proprioceptive exercises) as compared to Group A (conventional treatment) but maximum difference in mean score of Group C (52 mm), supporting our

mechanical loading, improved joint stability and thus increased quality of movement and improved proprioception which in turn provides participants an opportunity to adapt to potentially destabilizing load on knee during the study period⁹. Hurlley et al (2004) have reported that proprioception is closely related to functional performance and walking speed. This is in accordance with this study which shows greater mean difference in proprioceptive exercises group than with other two groups.

In this study joint position sense was measured by reposition error test (RET). The analysis of RET at baseline reveals no significant differences between all the three groups. At the end of 4th week mean differences were not significant between all the groups. There was improvement in all the groups which supports the study that proves general exercise training can increase proprioceptive performance (Bernauer et al, 1994). Maximum reduction in mean was in Group C (0.48°). The difference between the moderate improvement in other two groups as compared to Group C and greater improvement in this group was probably due to specific proprioceptive exercises. Proprioceptive information alone (without visual feedback) can correct up to 95% of velocity and timing errors associated with sudden perturbation in resistance during a multi-joint movement sequence¹⁰.

Group A (conventional treatment), Group B (strengthening exercises) and Group C (proprioceptive and strengthening exercises) does not show any statistically significant difference at the end of 4 week study period. This is in accordance with a study done by Sekir et al, 2005 in which 6 weeks of proprioceptive and balance training was given to treatment group while the control group did not receive any exercise but there was no significant differences by the end of training in weight bearing joint position sense. Therefore, it may be concluded that proprioceptive acuity takes longer duration to show significant improvement.

Sample size was small and data was collected from limited place that limits the generalizability of the results. The duration of study was short (4 weeks) therefore long term effectiveness of proprioceptive exercises was not evaluated. Neither the subjects nor the therapist were blinded to group assignment. The cohort of patients with knee osteoarthritis was predominately female, hence generalizability of our findings may not necessarily be applicable to the entire population of individuals with osteoarthritis.

This study showed that patients affected with OA knee, when performed proprioceptive exercises along with strengthening exercises showed significant reduction in pain and functional disability and improvement in proprioception as compared to patients performing strengthening exercises alone. Thus proprioceptive exercises can be incorporated along with strengthening exercises in patients of knee osteoarthritis.

Conclusion

Management of osteoarthritis, which deteriorates with imbalance between the stress applied to the articular cartilage of the joint and its ability to withstand it, requires being more extensive than mere analgesics. This study between three groups comparing conventional treatment to strengthening and strengthening and proprioceptive exercises suggest that combination of the two (proprioceptive and strengthening exercises) brings better relief to the subjects of knee osteoarthritis in reducing pain and functional disability. However, reposition error scores (joint position sense) did not improve significantly in proprioceptive and strengthening exercise group than other two groups. These results partly accept and partly reject the experimental hypothesis suggesting that using proprioceptive exercises and strengthening exercises together will produce statistically significant difference in pain, disability and but joint position sense may take longer duration to show significant differences.

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Cervicogenic Dizziness: Implications for Physical Therapy

Amer A AlSaif¹, Eric G Johnson²

¹PhD Candidate, ²Professor, Loma Linda University, Department of Physical Therapy, Loma Linda California, USA

Abstract

Cervicogenic Dizziness (CGD) is a relatively new, emerging area in the medical literature and physical therapy practice. Approximately 60% of patients with whiplash-associated disorder experience dizziness due to impaired neck proprioceptive input. Patients with CGD typically describe their dizziness as vertigo, lightheadedness, blurry vision, disequilibrium, and/or nausea. Physical therapy interventions for CGD include orthopedic and vestibular rehabilitation strategies. The purpose of this paper is to discuss the etiology of cervicogenic dizziness, describe the proposed pathophysiology, and introduce the physical therapy examination and intervention process for patients with CGD.

Key Words

Cervicogenic Dizziness, Cervical Vertigo, Whiplash Associated Disorder, Orthopedic Manual Physical Therapy, Physical Therapy.

Introduction

Balance is maintained through a complex interaction between the visual, vestibular, and somatosensory systems.^{1,2} Multimodal sensory integration occurs in the central nervous system where motor responses are generated to coordinate head and body orientation, postural stability, and gaze stability during head movements.¹ When normal sensory integration is impaired, imbalance and dizziness often occur.¹⁻⁴ Dizziness is one of the most common medical problems in many countries, including Asia and the United States, especially in the elderly population.^{5,6} Dizziness is a nonspecific symptomatic description resulting from numerous pathologies including viral or bacterial infection, head trauma, neurological disease, psychological conditions, orthostatic hypotension, migraine and/or headache disorders, pharmacology, vertebrobasilar insufficiency, and vestibular disorders.^{1,2,7} Dizziness can also be caused by orthopedic impairments affecting the cervical spine and, in such cases, is referred to as "cervicogenic dizziness."^{1,7} Cervicogenic dizziness has been defined as "a non-specific sensation of altered orientation in space and disequilibrium originating from abnormal afferent activity from the neck."⁷ It is different from vestibular-driven dizziness in that symptoms are usually not as intense and it rarely includes vertigo.⁷ It is an emerging area of clinical practice with a growing body of evidence that supports the pathophysiology and physical therapy management of patients with cervicogenic dizziness. Therefore, the purpose of this paper is to provide a brief overview of the theory and clinical application of managing patients with cervicogenic dizziness.

Etiology of Cervicogenic Dizziness

There are several proposed mechanisms leading to cervicogenic dizziness including mechanical compression of the vertebral artery system, irritation of the cervical sympathetic nervous system, and abnormal proprioceptive input from the upper cervical spine.^{1,2,7-9}

Mechanical compression of the vertebral artery system can produce vertebrobasilar insufficiency (VBI).^{8,9} The vertebral arteries are branches of the subclavian arteries arising from the

aortic arch.⁹ The vertebral arteries travel superiorly through C6-C1 transverse foramen, migrate horizontally around the posterior arch of the atlas, enter the foramen magnum, and merge with one another to form the basilar artery.^{8,9} The vertebral arteries encounter several soft tissue and bony structures capable of producing mechanical compromise.⁹ Muscle tightness in the upper cervical spine can potentially occlude the vertebral arteries reducing brainstem perfusion and causing VBI.^{7,9,10} In particular, the vertebral arteries travel between the anterior scalene and longus colli muscles as well as under the inferior capitis oblique and intertransversarius muscles.⁷ Cervical spine osteophytes and forward head posture are also potential contributors to vertebral artery compression and VBI.^{9,10} (Figure 1).

Irritation of the cervical sympathetic ganglia has also been theorized to contribute to cervicogenic dizziness.^{1,13} The cervical ganglia are paravertebral ganglia of the sympathetic nervous system and travel adjacent to the arterial network and cervical musculature antero-lateral along the vertebral bodies.^{12,13} The cervical sympathetic ganglia consist of the superior, middle, and inferior cervical ganglion. The superior cervical sympathetic ganglion (SCG) is the largest and is located at the level of the second and third cervical vertebrae.^{1,12,13} The SCG is posterior to the internal carotid artery and internal jugular vein, and anterior to the longus capitis muscle.^{12,13} Upper cervical spine muscle tightness, bony anomalies, and/or poor cervical spine posture can potentially compromise this ganglion, leading to hypoperfusion of the vertebral and carotid arterial network causing dizziness consistent with cervicogenic dizziness.^{1,12,13}

Abnormal proprioceptive input from the upper cervical spine also contributes to dizziness. The somatosensory system detects peripheral stimuli from sensory receptors, including mechanoreceptors located in human skin.^{1,2} Mechanoreceptors (Pacinian corpuscles, Meissner's corpuscles, Merkel's discs, and Ruffini corpuscles) mediate peripheral stimuli including pressure, touch, pain, temperature, and proprioception.^{1,2,14-16} There are an abundance of mechanoreceptors in the upper cervical spine that primarily transmit impulses through nerve cells originating from C2 dorsal root ganglion.^{2,16,17} The mechanoreceptor input from the upper cervical segments (Occiput-Atlas, Atlas-Axis, Axis-C3), particularly from the upper cervical spine muscles, report directly to the vestibular nuclear complex and the superior colliculus.^{1,2,17} The upper cervical spine mechanoreceptors also converge in the central cervical nucleus (CCN), which serves as a pathway to the cerebellum for integrating and organizing vestibular, ocular, and proprioceptive sensory input.^{2,13,16,17} The CCN also sends coordinated information to the cortex for maintenance of postural equilibrium and body orientation (Figure 2).^{1,2,17,18} Cervical spine reflexes contribute to head orientation, eye movement control, and postural stability; cervical collic reflex, the cervical ocular reflex, and cervical spinal reflex, respectively (Figure 3).^{1,2} These cervical reflexes work in conjunction with vestibular collic reflex, vestibular ocular reflex, and the vestibular spinal reflex.^{1,2,17,19} Abnormal sensory input from the vestibular and upper cervical spine can lead to dizziness, unsteadiness, and visual disturbance.^{1,2,13,17,19}

Cervical Spine Trauma

Abnormal cervical somatosensory input can alter somatosensory control and negatively impact postural stability

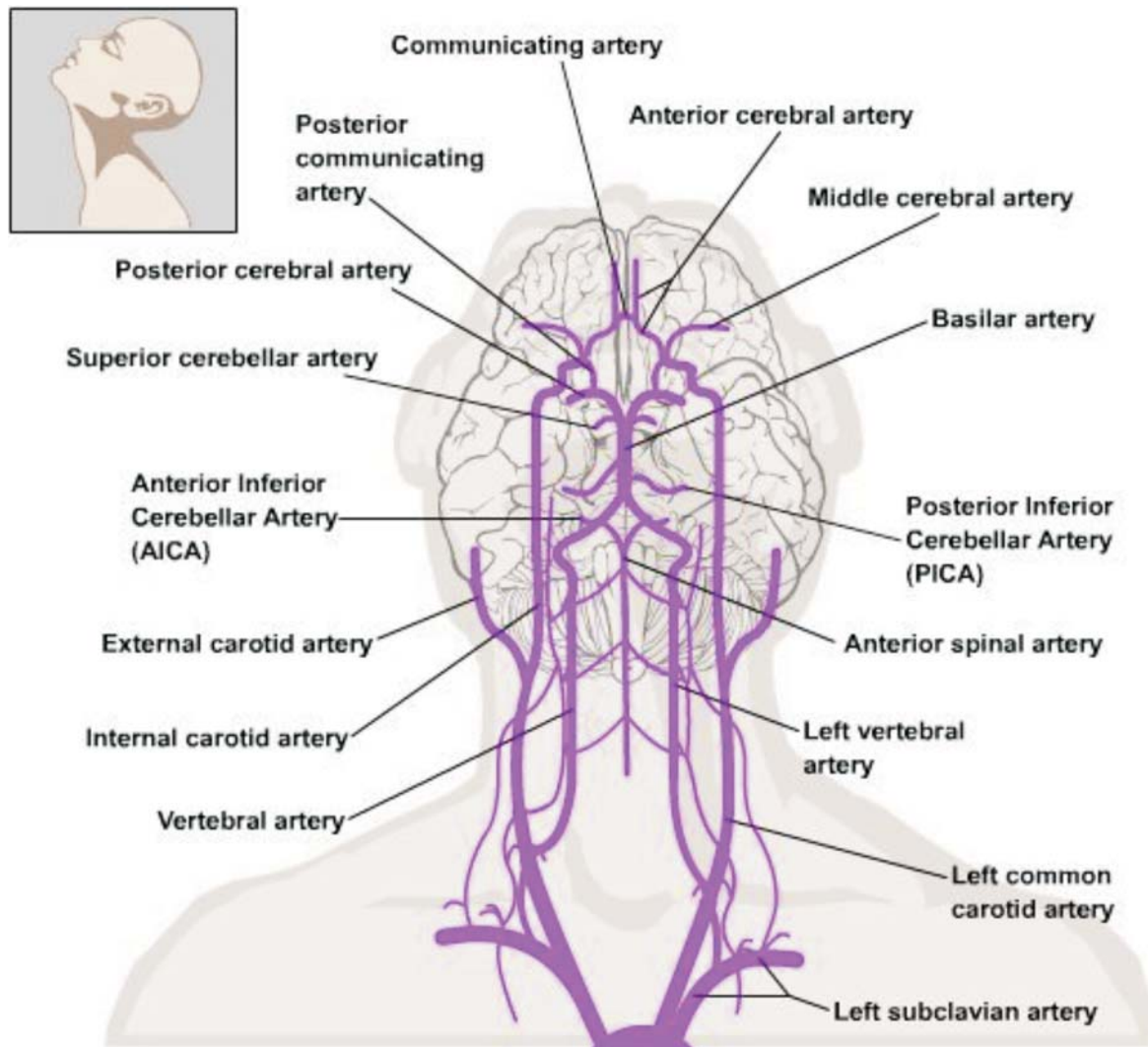


Fig. 1: Vertebrobasilar Arterial System. (Permission granted from Neuroscience Online Section II: Sensory Systems).¹¹

and vision.¹ Cervical spine trauma, such as whiplash-associated disorder (WAD), can impair cervical somatosensory function by causing ischemia, inflammation, and stress.¹ Moreover, evidence suggests that direct trauma to the neck can lead to cervical spine muscle fatigue that ultimately modifies the discharge firing rate of sensory receptors, thus affecting joint position of the head and neck as well as postural stability.^{3,20-22,24-27} Deficits in oculomotor function have also been described in the literature in patients with WAD.^{1,28} Tjell and Rosenhall²⁸ reported abnormal smooth-pursuit eye movements when the neck was rotated under a stable head in WAD patients. Additionally, greater loss of eye motor control was identified among WAD patients complaining of dizziness.^{1,28} Problems of convergence and diplopia have also been associated with WAD patients.¹ It is estimated that approximately 60% of all WAD patients develop dizziness.¹

Physical Therapy Evaluation

The physical therapy evaluation includes subjective and objective components. Because CGD is one of numerous types of dizziness, the evaluation strategy can be challenging.^{1,7} According to Wrisley et al, CGD is a diagnosis of exclusion, meaning that competing causes of dizziness must be ruled out.⁷ Physical therapists need to carefully review the past medical history and ask specific questions about the patient's dizziness in order to determine that the dizziness is cervicogenic.⁷ Episodic dizziness lasting minutes to hours is a common complaint in

patients with CGD.⁷ They may also report a general sense of disequilibrium or lightheadedness as well as visual disturbances. Vertigo is rarely a chief complaint in CGD patients.^{1,7} Circumstances that frequently produce their dizziness include neck pain.^{1,7} An example of a CGD Physical Therapy Subjective Examination Form is provided in Table 1.

The physical examination for CGD patients includes a medical screening component that is performed first (Table 1).^{1,7} The medical screening component includes three different phases: screening of the (1) cervical spine stability, (2) cervical vascular system, and (3) central nervous system. If any of these medical screening tests produce positive or abnormal results, the physical therapist must refer the patient to a physician for further medical consultation. Otherwise, the physical therapist continues with the physical examination. The vestibular system is examined to determine whether the dizziness is being caused by the peripheral or central vestibular system.⁷ If the peripheral vestibular system examination is positive, appropriate vestibular rehabilitation interventions are implemented. If the central vestibular examination is positive, the physical therapist should refer the patient to a physician for further medical consultation. Otherwise, the physical therapist continues the physical examination.⁷

The following tests may help determine whether the dizziness is being caused by the neck. The neck torsion nystagmus test (NTNT) is performed by stabilizing the patient's head and rotating his or her body underneath (Figure 4).²⁸ The NTNT is positive if nystagmus is elicited. The neck torsion

Fig. 2: Important neurological pathways between the upper cervical spine and the central nervous system concerning head and body orientation as well as head-eye coordination. Postural balance and visual stability is dependent upon healthy neural communication.

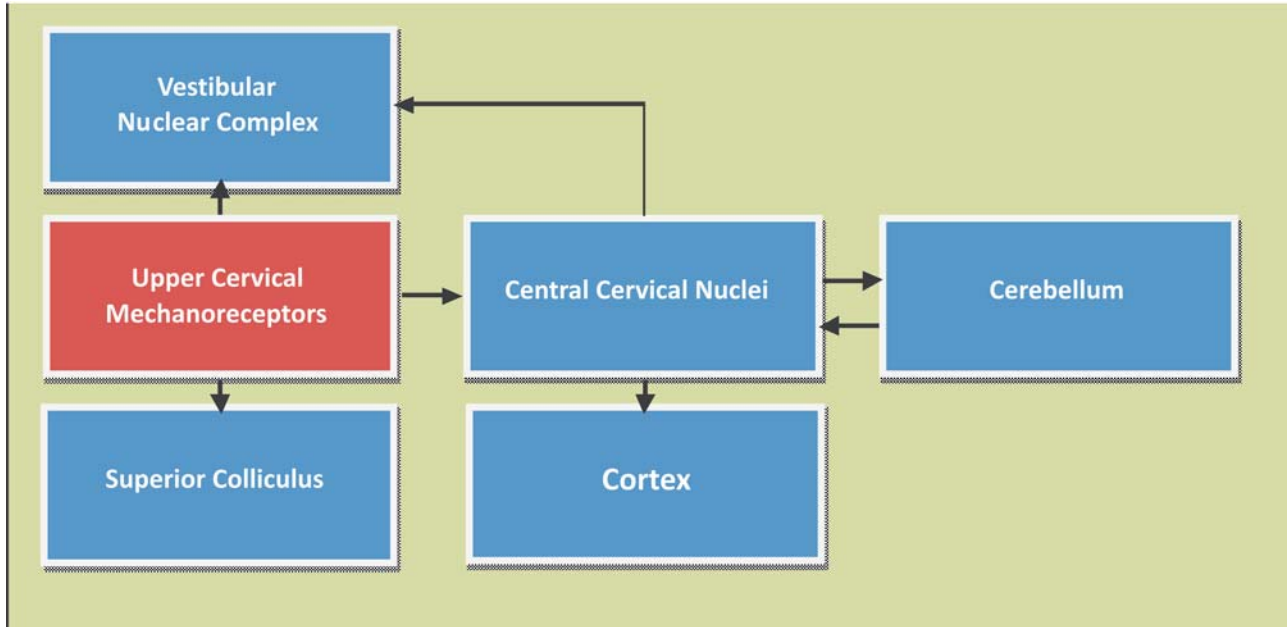
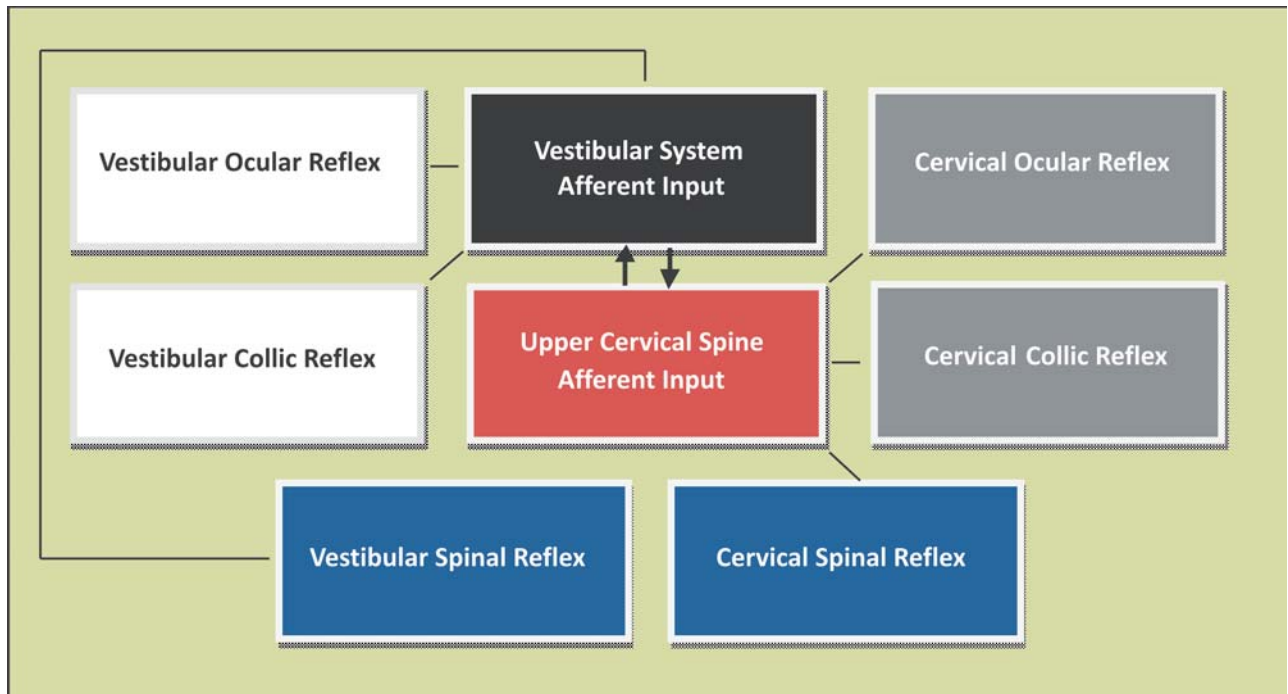


Figure 3. Cooperative reflexes between the vestibular system and the upper cervical spine. These reflexes are dependent upon healthy integrative central nervous system communication, particularly with the vestibular nuclear complex, in order to maintain normal postural balance and visual stability.



smooth pursuit (NTSPT) is performed by observing ocular smooth pursuit with the patient's head in neutral followed by neck rotation under a stable head. A positive NTSPT results when smooth pursuit is normal in the neutral position and abnormal when the neck is in the rotated position.^{1,28} The joint position error (JPE) test examines cervical spine proprioception. The JPE is performed by asking the patient to sit 90 cm away from a fixed target while wearing a head strap with a laser pointer, as shown in (Figure 5).^{22,23} The physical therapist asks the patient to look straight ahead at the center of the fixed target. This is the starting position.²³ The physical therapist then asks the patient to close their eyes, rotate their neck as far as they can, and return their head to the starting position with as much precision as possible.²³ A normal JPE requires the patient to be within 4.5

degrees of the starting position.²³ The manual traction test (MTT) is performed while the patient is seated (Figure 6).¹ The test is considered positive if the compression increases or produces dizziness and traction relieves it.¹

Physical Therapy Intervention

Physical therapy intervention has been shown to be effective in reducing CGD symptoms. According to Wrisley et al⁷, CGD symptoms typically increase with neck pain. Therefore, treating neck pain among this group of patients is one of the main objectives for physical therapists. Intervention strategies may include: (1) orthopedic manual techniques specific to the cervical spine region, (2) head and neck proprioceptive

Fig. 4: Neck Torsion Nystagmus Test



Figure 5: Joint Position Error Test

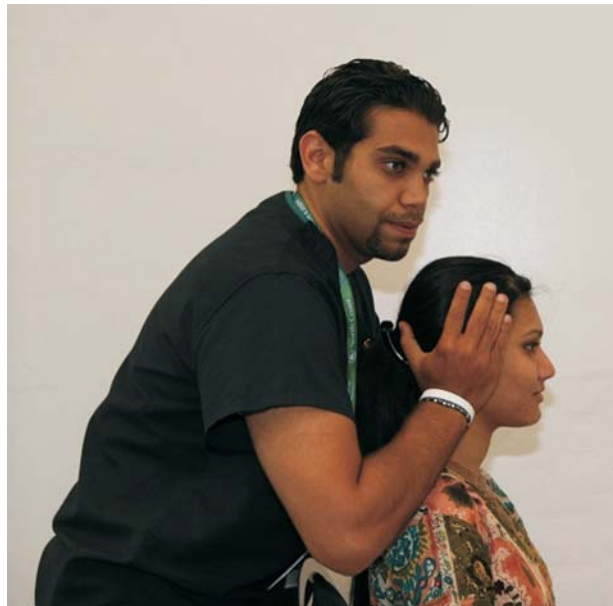


rehabilitation program, and (3) cervical-ocular motor exercises.

Cervical spine pain and inflammation can be treated with a variety of physical therapy modalities, including cryotherapy, thermotherapy, ultrasound, and cervical spine traction.^{1,7} Cervical spine hypomobility is common among CGD patients and may increase symptoms of dizziness.^{1,7} However, cervical hypomobility can be treated with joint specific mobilization techniques and tissue/age-specific stretching programs.^{1,7}

Cervical spine proprioception impairments can be treated with a specific proprioceptive rehabilitation program. The proprioception program includes slow, passive head movements with fixed-target gaze exercises (the clinician passively moves the patient's head while the patient maintains a fixed gaze on a

Figure. 6: Manual Traction Test



stationary target).^{22,23} The program can be progressed by doing active head movements rather than passive head movements. Also, the clinician may progress the program by instructing the patient to perform active head movements while maintaining their gaze on a fixed target with their trunk passively or actively moved.²³ Another way of performing the program is to instruct the patient to close their eyes and actively rotate their head, return to the starting position, and open their eyes.²³ If the patient cannot see the target, they can keep their eyes open and continue rotating their head until they can see the target.^{22,23} This training provides the patient with information about cervical spine joint position sense and can be performed with restricted peripheral vision using foveal glasses.^{1,7,22,23} Input from cervical spine afferent nerves can alter the function of the oculomotor system.^{1,7,23} Thus, oculomotor training is important to reduce potential extraocular muscle weakness.²⁸ Extraocular motor function can be managed using smooth-pursuit (patient keeps head still while eyes follow a moving target), saccades (patient keeps head still and quickly moves eyes between targets), X1 adaptation exercises (patient moves head from side to side while maintaining the gaze on a stationary target), and X2 adaptation exercises (patient moves head and a hand-held target in opposite directions while maintaining gaze on moving target at all times).^{1,22,28} All extraocular exercises can be progressed by increasing the speed of movement, range, duration, and frequency. Also, the exercises could be progressed by gradually decreasing the stability of support and changing from static to dynamic positions.^{1,22,28}

Conclusion

Cervicogenic dizziness is often the result of a sensory mismatch between the vestibular, somatosensory, and visual afferent inputs. Physical trauma involving the cervical spine, such as whiplash injury, is a common mechanism of injury in CGD patients. Physical trauma contributes to impairment in the upper cervical spine proprioceptive input leading to symptoms including disequilibrium and dizziness. In order to determine the origin of the patient's dizziness, the physical therapist must exclude all competing causes of dizziness. Once CGD has been confirmed, appropriate interventions are implemented to reduce cervical spine pain and inflammation, improve cervical spine proprioception, improve cervico-ocular function, and restore joint and soft tissue range of motion and mobility.

Table 1: Physical Therapy Cervicogenic Dizziness Examination Form

Physical Therapy Dizziness Examination Form			
Patient:	Date:	Date of Birth:	
Referral Source:	Diagnosis:	Occupation:	
SUBJECTIVE EXAMINATION			
1. Chief complaint and date of onset:			
2. Mechanism of injury:			
3. Tempo of symptoms: constant/episodic seconds/episodic minutes/episodic hours			
4. Do you experience spells of vertigo?	YES	NO	mVAS range ____/10; currently ____/10
5. Do you experience disequilibrium?	YES	NO	mVAS range ____/10; currently ____/10
6. Do you experience lightheadedness?	YES	NO	mVAS range ____/10; currently ____/10
7. Do you experience oscillopsia?	YES	NO	mVAS range ____/10; currently ____/10
8. Circumstances that exacerbate/produce symptoms:			
9. Fall History:			
10. Past Medical History:			
11. Medications:			
12. Do you have steps in your home?		YES	NO
13. Do you smoke/drink, and if so, how much?		YES	NO
14. Do you have trouble sleeping?		YES	NO
15. Was previous functional level normal?		YES	NO
ORTHOPEDIC ASSESSMENT			
1. Cervical Spine Stability: Alar Ligament/Sharp-Purser/Lateral Shear + OR -			
2. Positional Tolerance Testing: + OR -			
3. Cervicogenic Dizziness Testing: NTNT/NTSPT/NPPT/MTT/JPE ____ cm difference + OR -			
4. Cervical Spine AROM/PROM:			
NEUROLOGICAL ASSESSMENT			
5. Proprioception: + OR -			
6. CNS Testing: Babinski/Clonus/DTR/RAM/Finger to Nose EO and EC + OR -			
VESTIBULAR ASSESSMENT			
7. Central Vestibular Testing:	Ocular Alignment / Spontaneous Nystagmus / Gaze Evoked Nystagmus Smooth Pursuit / Saccadic Eye Movement / VOR Cancellation Test		
8. Peripheral Vestibular Testing:	Hallpike Dix Test / Roll Test / Head Thrust Test/ Dynamic Visual Acuity Head – Shaking Nystagmus Test		
BALANCE TESTS:			
9. Balance Testing: Romberg/Sharpened Romberg/Timed Up and Go/Functional Reach Test + OR -			
10. Berg Balance Scale: ____/56; Dynamic Gait Index: ____/24			
DIZZINESS INVENTORY:			
16. DHI Score: ____/100; ABC Score: ____/100			
TREATMENT PLAN:			
RECOMMENDATION TREATMENT PLAN: _____ DAYS/WK FOR _____ WKS.			

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Intrest of Conflict

Not identified.

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Randomised Controlled Study of Mulligan's Vs. Maitland's Mobilization Technique in Adhesive Capsulitis of Shoulder Joint

Ankit Shrivastava¹, Ashok K Shyam², Shaila Sabnis¹, Parag Sancheti²

¹Sancheti Institute, College of Physiotherapy, 16, Shivaji nagar, Pune, Maharashtra, India, ²Sancheti Institute of Orthopaedic and Rehabilitation, Shivaji nagar, Pune, Maharashtra, India, Indian Orthopaedic Research Group, Thane, Maharashtra, India

Abstract

Introduction

Physical therapy is the most important part of conservative treatment of frozen shoulder. Both Maitland and Mulligan's techniques have been found effective. We here did a comparative study to find the effectiveness of both these techniques in frozen shoulder rehabilitation

Material and methods

A prospective randomized double blind study was performed with 20 patients in each treatment arm. In Maitland group mean age was 59.2 (± 7.18) years (7 males and 13 females) and in the Mulligan group the average age was 51.15 (± 8.53) years (12 males and 8 females). We compared the two groups with respect to pain VAS, shoulder range of motion and Shoulder Pain and Disability Index (SPADI) score.

Results

All the parameters, pain VAS, SPADI score and shoulder range of motion improved significantly for the entire group. In Maitland group, pain improved from 7.35 to 4.05, SPADI improved from 52 to 40 and all range of motion except extension and internal rotation were significantly improved ($p < 0.05$). In Mulligan's group, pain improved from 5.85 to 3.6, SPADI improved from 52 to 42 and all ranges except internal rotation improved significantly.

Discussion

Both the treatment techniques i.e. Maitland and Mulligan are improve the pain VAS score, but response to Mulligan's was better. Mulligan mobilization technique is better than Maitland in terms of improvement in the range of extension while remaining ranges were similarly improved by both techniques. Studies of larger sample size, with a longer intervention period are needed to confirm our findings

Introduction

Adhesive capsulitis (frozen shoulder) is a condition of uncertain etiology characterized by pain and progressive loss of both active and passive shoulder motion.¹ Various method of treatment are available for adhesive capsulitis which includes: heating^{2,3,4} stretching exercises by physiotherapist or auto-stretching by patients^{4,5,6,7,8,9} and scapular setting⁵ exercises along with the pendulum exercises^{4,6,13} which helps in maintaining and improving strength of shoulder girdle muscles and improve function². Joint mobilization is the treatment of choice to restore and improve synovial shoulder joint mobility^{4,5,6,13}. Various schools of manual therapy have been advocated for the treatment of frozen shoulder^{5,6,8}. Various grades of mobilizations such as mid range and end range mobilizations are suggested by Maitland and Kaltenborn to improve joint mobility and reduce pain^{5,16,11,12,16}

Nicholson¹⁰ compared pain and range of movement of the shoulder joint in two groups who received mobilization along with exercises and the other group treated with active exercises only and that the found mobilization group had lesser pain and joint stiffness than control group. Other researchers have also found Maitland's mobilization to be effective in this condition^{4,5,6,9,11,12,13,14}, though different authors have used different grades and names of mobilizations. On the other hand another study by Bulgen et al¹⁵ found no place for Maitland mobilization over steroid injection or no treatment. This is believed that graded mobilization stretches the tightened capsule and other periarticular soft tissues^{5,11,12,13,14,17}. Direction of glides depends on the range to be aimed at. The choice of direction follows convex-concave rule^{12,18}. Johnson et al found posterior glide to be better than anterior glide to improve glenohumeral abduction¹⁸.

Similarly Mulligan's mobilization with movement (MWM) have shown convincing results in improving pain and mobility of different joints in which it was administered^{4,5,19-24}. Mulligan proposes that the MWM technique has its effect by correcting the positional faults in the joints that occur following injuries or strains^{21,24}. MWM is the simultaneous application of the corrective glide to the joint along with active movement by the patient. In the end range passive over-pressure is applied by patient or assistant^{21,24,25}. MWM when used for shoulders with limited range of motion because of pain had shown improvement in range of motion and pressure pain threshold²². Even if MWM is applied to the elbow for lateral epicondylgia, it has improved shoulder external rotation²³. The author attributes this change to the neurophysiological activities which helps to move shoulder through a wider range of motion. In a systemic review of the studies on MWM, the results were inconclusive¹⁹.

In the literature review, we found only a single study which compares both Maitland's and Mulligan's mobilization techniques on adhesive capsulitis of the shoulder and it shows that both the techniques are effective in treating the condition, with MWM also additionally improving the motor strategies of the scapulohumeral rhythm⁵. Whereas, a Cochrane review for shoulder pain found no benefit of any particular physiotherapy technique over other²⁶. Therefore the present study intend to compare the efficacy of the two mobilization techniques i.e. Maitland's grades oscillation and Mulligan's mobilization with movement, in adhesive capsulitis of the shoulder joint.

Materials and Methodology

A prospective randomized double blind study was performed at Sancheti Institute for Orthopedic and Rehabilitation, Pune between 2006- 2008. We included both male and female subjects with second stage of adhesive capsulitis with both primary and secondary cause who were showing capsular pattern^{2,8}. Exclusion criteria were prior shoulder surgery, shoulder arthritis, painful shoulder, severe systemic illness and patients on regular analgesics. Breakthrough analgesic consumption by patients was allowed in our study. The permission to carry out the study was obtained from the concerned authority / ethical committee. A prior written consent was taken from each subject. Double blinding was done with the assessment therapist and the patient both being blinded with respect to treatment protocol followed. Fifty four subjects

of second stage adhesive capsulitis were screened and 40 were selected according to inclusion criteria. Subjects were randomly allotted to the two groups, Maitland group and Mulligan group by computerised random sequence generator. There were 7 males and 13 females in the Maitland group and 12 males and 8 females in the Mulligan group with average age of 59.2 (± 7.18) years in the Maitland group and 51.15 (± 8.53) years in the Mulligan group. A pre-intervention assessment was carried out by the assessment therapist on first day when the patient enrolled for the study. Outcome measures were Pain (on Visual Analogue Scale (VAS), score out of 10 on a 100 mm horizontal line), shoulder ROM (in degrees with Universal 360 goniometer) tested for reliability – Riddle et al (1987) [27] and Shoulder Pain And Disability Index (SPADI), a functional scale for shoulder. The intervention common to both groups included hot fomentation for 10 minutes, Codman pendulum exercises, scapular setting exercises, finger ladder, wand exercises and stretching of the tightened muscles of the shoulder girdle. Frequency of treatment for both the groups was six times a week for two/four weeks. The Maitland group receives grades oscillation technique and the Mulligan group were treated with mobilization with movement.

Technique

Maitland's Graded Oscillations Technique: Grade of glide was decided during the treatment depending on patients symptoms, grade I and II for relieving pain in loose pack position and spasm and grade III and IV in close position for stretching and improving the range. Individual glides are explained as follows:

Posterior Glide

With patient in supine position, therapist holds his/her arm proximally and applying a distraction force, glides the humeral head posteriorly.

Inferior Glide

The patient lays supine, therapist stands at the head end of the patient facing his/her feet. Holding the proximal arm of the patient, therapist gives a distraction force to the glenohumeral joint and glides the humeral head inferiorly.

Anterior Glide

Patient is positioned prone and the therapist holds the distal arm, above the epicondyles with one hand for distraction and with other hand therapist applies anterior glide to the humeral head.

Mulligan's Mobilization with Movement: While applying the technique the range should increase without any pain. Passive overpressure is applied in the end of range and three sets of ten repetitions are given for each mobilization.

Flexion and Abduction

Patient sitting with therapist posterolateral to him/her. Therapist places the Mulligan belt across the humeral head and to his waist. Leaning backward, he applies a posterolateral glide to the shoulder joint and then asks the patient to perform the painful/restricted movement of shoulder flexion or abduction, which would be pain free now.

Internal Rotation

Patient sitting or standing with therapist by his/her side. Therapist applies an inferior glide to the humerus head with the patient's shoulder in available degree of abduction. With the

glide maintained the patient actively rotates the shoulder internally without any pain now.

External Rotation

The patient lies supine with his/her shoulder horizontally flexed till 90°. Therapist places the belt at the humeral head, applying a lateral distraction to the joint the patient was asked to rotate the shoulder externally.

A post-intervention assessment was done, after 4 weeks of intervention, by the assessment therapist for pain, shoulder ROM measurements and SPADI. Final readings were noted in the assessment form, master chart was prepared and data was analysed. We compared the two groups with respect to preintervention factors like VAS score, shoulder ROM and SPADI score and post intervention factors like VAS score, ROM and SPADI score.

Statistical Analysis

The statistical analysis was done with level of significance set at $p < 0.05$ for the analysis with appropriate Bonferreni's correction. Within Group Analysis of VAS, SPADI and Range of motion was done using repeated measures ANOVA for both the group. Analysis of VAS between the groups was done using Mann-Whitney U test. Analysis of SPADI and Range of motion between both the groups was done using unpaired t test.

Results

The study included 40 subjects, 19 males and 21 females with a mean age of 54.93 \pm 9.06 with complaints of shoulder pain (mean VAS=6.5 \pm 1.7) and restriction of shoulder range of motion, with or without diabetes. Table 1 gives the demographic differences between the groups.

Table 1: Various pre intervention parameters in both the groups

PARAMETERS	MAITLAND	MULLIGAN
Age	59.2	51.15
Gender (M:F)	7:13	12:8
Pain (VAS)	7.35	5.85
SPADI	52	52
Flexion	103.5	104.5
Extension	33.75	35.25
Abduction	77.75	79.5
Internal Rotation	42	40.5
External Rotation	22.5	22.75

Table 2: Within group analyses of outcome variables in both the groups

PARAMETERS	MAITLAND			MULLIGAN		
	Pre	Post	p-value	Pre	Post	p-value
Pain (VAS)	7.35	4.05	0.000	5.85	3.6	0.000
SPADI	52	40	0.001	52	42	0.025
Flexion	103.5	121.25	0.000	104.5	122	0.000
Extension	33.75	38	0.171	35.25	41	0.003
Abduction	77.75	91.25	0.000	79.5	99.5	0.001
Internal Rotation	42	46.5	0.281	40.5	41.25	1
External Rotation	22.5	39.75	0.000	22.75	33.5	0.000

In the Maitland group all the variables except the degree of extension and internal rotation improved post intervention [table 2]. In the Mulligan group all except internal rotation improved [table3]. Thus the Mulligan group seems to significantly improve upon the preoperative extension as compared to the Maitland group, however most of the variables improved in both the groups.

Table 3: Comparative analyses of outcome variables between the two groups.

PARAMETERS	MAITLAND	MULLIGAN	p-value
Pain (VAS)	4.05	3.6	<0.05
SPADI	40	42	0.686
Flexion	121.25	122	0.628
Extension	38	41	0.319
Abduction	91.25	99.5	0.42
Internal Rotation	46.5	41.25	0.155
External Rotation	39.75	33.5	0.02

Comparison between the post intervention values between the two groups is given in table 3. Mulligan group had better pain score but the external rotation was better in the Maitland group. Rest of the variables were comparable between the two groups.

We had no technique related complication in both the groups and no patient dropped out of the study due to problems in therapy.

Discussion

The present study was undertaken to evaluate efficacy of the two manual therapy techniques, i.e. Mulligan (MWM) and Maitland mobilization technique on the adhesive capsulitis of the shoulder joint, and also to compare which of the techniques is better in terms of reducing pain, improving functional score (SPADI) and the joint mobility.

The intervention was given for a period of 2 weeks, following which the mobilizations were discontinued and patients were put on a home exercise programme for 2 weeks which was common to both the groups. The effect of both the treatment techniques on pain was positive i.e. they both were effective in relieving the patients' pain with 2 weeks intervention. When the responses were compared between the groups, the result showed significant difference at follow-up, which means that Maitland is better than Mulligan in relieving the pain. Results of the present study are in accordance with the previous reports.³⁶ The study done by Ryans et al showed significant improvement in the outcome measures in the group treated by physiotherapy which included Maitland's mobilization. A similar study done to compare the effectiveness of two of the Maitland's mobilization techniques (high grade and low grade) found that the relief is similar in both of the mobilization techniques.³⁷ In the present study, both Low Grade and High Grade Mobilization technique were used (grade II, III and IV). In one study which compared the effects of three of the mobilization techniques i.e. end range mobilization (ERM), mid range mobilization (MRM) and MWM, the results showed that ERM and MWM is better than MRM in improving the range of motion of the shoulder joint, pain and functional ability, although MRM was also effective in improving the pain, range and the functional ability of the subjects. Thus the results show that both the type of mobilization techniques (Maitland and Mulligan) is effective in the treatment of frozen shoulder. The result also showed that there is improvement in the scapulohumeral rhythm with 3 weeks of MWM.¹⁸ Teys et al found that MWM technique is effective for immediate pain relief and improve ROM of shoulder.⁴⁰ Thus supporting the results of the present study.

In contrast to the findings of the present study, in the study done by Ginn et. al. in 1997 showed no significant difference in the response to pain in the treatment (physiotherapy including Maitland mobilization) and the control group in patients with shoulder pain.²⁹ Green et al in their Cochrane review in 2008 concluded that there is little or no benefit of any physiotherapy intervention either alone or in combination on shoulder pain, although the studies included in the review had weak methodology.⁷ we can attribute the response to pain in this study

to the neurophysiologic effect of mobilization and also to the application of hot fomentation which increases the extensibility of the soft tissues⁴⁵ and supervised physiotherapy.

The present study shows there was a significant difference in the SPADI score at follow-up in both the groups. Whereas, between groups comparison shows that the difference was not significant between the groups. This signifies that both of the above mentioned mobilization techniques are equally effective in improving the functional outcome in the patients. The effect of the techniques on the range of motion is varied in the present study. There is overall improvement in all the ranges with both the techniques at follow-up visits except the extension and internal rotation. The reason for this may be due to the non-adherence of the subjects to the home exercise programme, discontinuance from the mobilization and supervised physiotherapy.

The improvement in the range of motion was seen in almost all the ranges within both the groups from baseline to follow-up. This pattern was similar in both the groups. In the Maitland group, except the extension and internal rotation, flexion, abduction and external rotation ranges improved post intervention. In the Mulligan group, the improvement in the ranges was significant for flexion, extension, abduction and external rotation. The improvement in the Mulligan group, can be attributed to the corrective glide to achieve optimal alignment of the articular surfaces and its maintenance by appropriate recruitment of the muscles by patients active efforts. This goes well with the Mulligan concept of positional fault. The alteration of the shoulder biomechanics can be due to capsular tightness seen in Adhesive Capsulitis. This capsular tightness pulls the head of humerus towards glenoid fossa, thus altering humeral head excursion in the glenoid. This glenohumeral mechanism alteration leads to altered mechanics of the scapulothoracic and acromioclavicular joints which in turn leads positional faults in these joints also. Mobilizations have definite effect on this altered biomechanics. Kalternborn (1989) says that for any normal motion at the joint to occur, proper joint kinetics is necessary. Adequate capsule extensibility is necessary to allow roll sliding to occur between the body surfaces with in the joint. Any restriction of the joint capsule or faulty relationship to the joint surface will interfere with normal motion. Normal mobility can be restored by either general or specific mobilization technique. The biomechanical effect manifests itself when forces are directed towards resistance but within the limits of a subject's tolerance. The mechanical effect may include the breaking up of adhesion, realigning collagen or increasing fiber glide.⁴⁶ In a similar study conducted by Nicholson,⁴⁸ using grade III and IV of Maitland's glides, the results showed improvement in pain and passive shoulder abduction, but the change in rotations were not significant. However, the subjects received intervention for the whole period of 4 weeks, unlike the present study. The results are similar to those of the present study.

Joint mobilization techniques are assumed to induce various beneficial effects. The neurophysiologic effect is based on the stimulation of peripheral mechanoreceptors and the inhibition of nociceptors.⁴⁹ The biomechanical effect manifests itself when forces are directed toward resistance but within the limits of a subject's tolerance. The mechanical changes may include breaking up of adhesions, realigning collagen, or increasing fiber glide when specific movements stress the specific parts of the capsular tissue.⁴⁹ Furthermore, mobilization techniques are supposed to increase or maintain joint mobility by inducing changes in synovial fluid, enhanced exchange between synovial fluid and cartilage matrix, and increased synovial fluid turnover. In the Maitland classification system, the passive mobilization approach is not a recipe of specific techniques but rather a concept of management in which accessory and physiologic passive movements of the joint are applied at various grades of intensity depending on a subject's pain and joint stiffness. A vital component of the Maitland

approach is that the treatment is based on constant assessment and reassessment, with subsequent individual modifications of treatment techniques. Therefore in the present study also the patients' responses to the mobilization were assessed and the grade of mobilization was decided accordingly. Thus a patient complaining of soreness after a treatment session was given a lower grade than earlier (grade I or II) in order to relieve their pain. This can be accounted for better pain response in the Maitland's group than the Mulligan's group.

There are several limitations of our study namely, small sample size, short follow up duration, muscle strength and scapulohumeral rhythm were not considered in outcome

In conclusion, both the treatment techniques i.e. Maitland and Mulligan are improve the pain VAS score, but response to Mulligans is better. Both the techniques are equally effective in improving the functional score. Mulligan mobilization technique is better than Maitland in terms of improvement in the range of extension while remaining ranges were similarly improved by both techniques. Studies of larger sample size, with a longer intervention period are needed to confirm our findings

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Home Environment as a Correlate of Development of Toddlers in Bangalore

S Balsubramanian¹, Y S Siddegowda²

¹Associate Professor, Srinivas College of Physiotherapy and Research Centre, Pandeshwar, Mangalore, ²Professor, Dept. of Studies in Social Work, University of Mysore, Manasagangotri, Mysore-570006

Abstract

Background

Children are born with a sophisticated brain that is pre-programmed to learn and react to its environment. Development in the first three years of life is incredibly quick. An optimal range of development occurs with a stimulating home environment and strong contextual support.

Objective

To observe whether there is difference in home environment between literate and illiterate parents living in urban and rural areas of Bangalore and to correlate the same with the various developmental domains of children aged between one and three years old.

Design

Descriptive cross-sectional study design.

Materials and Method

Through multi-stage cluster random sampling fifty urban families with children aged one to three years old (25 families with both the parents literates and 25 families with both the parents illiterates) and fifty rural families with children aged one to three years old (25 families with both the parents literates and 25 families with both the parents illiterates) were recruited from Bangalore urban and Bangalore rural districts respectively. The parental literacy status was assessed by using the operational definition of literacy stated by UNESCO (United Nations Educational, Scientific and Cultural Organization). The Home environment was measured by using Infant/Toddler HOME (The Home Observation for Measurement of the Environment) Inventory. The development of the children was assessed by using Denver II.

Results

Kruskal – Wallis analysis showed a statistically significant difference among all the four groups in terms of their Home environment (measured by HOME inventory) and development of children in various developmental domains (measured by Denver II) at a significance level of 0.05. Mann Whitney U Post-hoc analysis found that there was a significant difference between all the unique pair comparisons in at least one of the variables except between the pair Urban illiterate and Rural illiterate at a significance level of 0.0125. All the developmental domains were positively correlated with total score obtained in

home inventory for all the groups except for the Rural illiterate group in Gross motor domain.

Conclusion

The Home environment differs from urban and rural families and also between literates and illiterates and further influencing the development of children aged between one and three years old.

Keywords

HOME Inventory, Denver II, Toddlers, Development of Toddlers, Family environment.

Introduction

During the initial 2 years of life, there is a sequential growth, phenomenal proliferation, and overproduction of axons, dendrites, and synapses in different regions of the brain. However, not all the synaptic connections survive, many being subsequently “pruned” due to lack of use¹. During this period of plasticity, or potential for change, the determination of which synaptic connections will persist is environmentally regulated, being dependent on information received by the brain. The progressive neuronal maturation and the establishment of synaptic connections are reflected in changes in the infant’s increasing functional maturity².

Sensitive periods in brain and biological development start prenatally and continue throughout childhood and adolescence. The extent to which these processes lead to healthy development depends upon the qualities of stimulation, support, and nurturance in the social environments in which children live, learn and grow³. Amongst the various social groups, the home occupies the first and the most significant place for the development of the individual⁴. Home environment has been shown to be a major factor that influences the overall development of children. Availability of stimulating objects, books and play materials within the home are critical indicators for the overall quality of the home environment⁵.

Since many years, effort has been made to map the relations between the home environment and selected aspects of the child’s development. For most children, interior of the home and its immediate surroundings are the first environments they experience throughout their early years⁵. The ecological environment is defined by Bronfenbrenner and Ceci⁶ as a set of “nested structures” composed of microsystems, mesosystems, exosystems, macrosystems and chronosystems. The microsystem is “a pattern of activities, roles and interpersonal relations experienced by the developing person in a given setting with particular physical and material characteristics; the home environment including the parent-child relationship is an example of microsystem”⁷.

The recent theories of early motor development suggest that the acquisition of new motor abilities arises from the interaction of multiple elements of the infant, the environment and the task at hand through a process of exploration of movement options and selection of the optimal solution in a given context⁸. The home should have manipulatives that encourage the young child to have a variety of sensory

Address for correspondence:

S. Balasubramanian

Associate Professor

Srinivas College of Physiotherapy and Research Centre, Pandeshwar, Mangalore, Ph-No: 0824-2411381

E-Mail: sbala_2001@rediffmail.com

experiences, and to be able to develop fine and gross motor skills⁹.

Parents who expose their preschoolers to problem-solving strategies are more likely to have children who use them¹⁰. Mothers who interact with preschool children in problem-solving tasks, and expose them to open-ended questions about that task, have children who later demonstrate greater independent performance with similar tasks requiring problem-solving skills¹⁰.

High-achieving children have parents who read to them frequently and help them attain phonemic awareness. In homes where children participate in family discussions, children are better prepared for the language they will hear in classrooms. Parent-child interaction with reading materials is important during the preschool period because it is during these years that children become familiar with story structures, complex syntax, and vocabulary. They will be better prepared to develop concepts that are prerequisites to reading and listening comprehension. In order for reading ability to develop and remain constant throughout the elementary school years, children must hear and practice language from an early age¹¹.

The measures of environmental quality (orderliness, enrichment and overall stimulating quality) and of parent-infant interaction (mother-child interaction patterns, family habits, living patterns as described by the mother), taken in the first year of life are the best predictors of later IQ or language performance¹². In a 3-year longitudinal study conducted with 119 children in the 1 to 4-year age group, a positive correlation was found between cognitive development and the home stimulation variables measured on the HOME scale¹³.

The early home environment is a significant prediction of mental development and at the same time the home is of extraordinary importance in the development of social intelligence¹⁴⁻¹⁷. It is not only providing the hereditary transmission of basic potential for child development but also provides environmental conditions and personal relationships¹⁸. Children from favorable environment homes are found to be warm-hearted, outgoing and socially more intelligent than children from unfavorable homes¹⁹.

Families are the first environments with which children interact from birth. They are critically important in providing children with stimulation, support and nurturance²⁰. These qualities, in turn, are influenced by the resources that families have to devote to child-raising (strongly influenced by income), their style of parenting, and their tendency to provide a rich and responsive language environment (strongly influenced by parental levels of education)²¹.

A greater part of the Indian population lives in villages²². The infants get fewer opportunities to develop their full prospective as their mothers lack knowledge regarding scientific child care, stimulatory activities and conducive environment which are essential for hale and hearty development. Appropriate care and right kind of development opportunities for this susceptible and immense section of population are decisive since these have a direct demeanor upon the future human resource development of a nation²³. The parents' educational levels have an important impact on children's achievement²⁴, and higher levels of adult education have a positive bearing on both the educational future and the income level of the children in a family²⁵. Further, the children of mothers with higher levels of education have greater early success and generally stay in school longer^{26,27}.

The present study was undertaken to observe whether there is difference in Home environment of literate and illiterate parents living in urban and rural areas of Bangalore and to correlate the same with the various developmental domains of children aged between 1 and 3 years old.

Materials and Method

Design of the Study

Descriptive cross-sectional study design

Sampling

Fifty urban families with children aged one to three years old (25 families with both the parents literates and 25 families with both the parents illiterates) and fifty rural families with children aged one to three years old (25 families with both the parents literates and 25 families with both the parents illiterates) were recruited from Bangalore urban and Bangalore rural districts respectively by multi-stage cluster random sampling. Thus totally four groups were formed.

Participants

From these 4 groups, at least one of the parents along with their children between 1 and 3 years had participated in the study. If there were more than 1 child in that age group in the same family, one of the children were selected randomly by using lottery method. The inclusion criteria was children between the age group 1 and 3 years, both the genders, born in term, normal birth weight (2.5 kg to 3.5 kg), appropriate for gestational age. Children born with any congenital anomalies, neonatal seizures, perinatal asphyxia, neonatal hypoglycemia, intracranial hemorrhage, neonatal hyperbilirubinaemia (bilirubin > 20 mg/dl and untreated), hypothermia, neonatal infections, and septicaemia were excluded from the study. If the parents were not certain about the above features or no medical reports were available, the parents were asked whether the child was admitted in the Neonatal Intensive Care Unit (NICU) as admission of a newborn in NICU may be due to any of the above mentioned factors under exclusion criteria.

Tools

- The following tools were used for data collection:-
- ✓ For assessing parental literacy status operational definition of literacy stated by UNESCO²⁸ was used,
 - ✓ Infant/Toddler HOME Inventory²⁹
 - ✓ Denver II³⁰

Procedure

After the approval of the Institution's Ethical and Scientific Review Committee, an informed written consent was obtained from all the parents who were willing to participate in the study after explaining the purpose and procedure of the study. After completing the preliminary assessment, the home environment was observed by using the Infant/Toddler version of HOME Inventory. The presence of primary caretaker (either or both of the parents) was ensured during the visit.

Results

For data analysis, statistical software SPSS (v 16) was used. Descriptive statistics were calculated for all the basic characteristics like age, height, weight, and head circumference. Levene's test for equality of variances was used to determine the homogeneity of the 4 groups, which reveals that all the four groups were homogenous in terms of age, height, weight, and head circumference (Table 1).

Table 1: Descriptive statistics of basic characteristics

Basic Characteristics	Mean ± SD	P value
Age (in months)	23.95 ± 5.92	0.287
Height (in cm)	85.81 ± 4.94	0.341
Weight (in Kg)	12.00 ± 1.08	0.058
Head Circumference (in cm)	47.77 ± 0.93	0.423

á > 0.05; SD: Standard deviation

Kolmogorov-Smirnov test of normality was done for the following variables: Total Score in HOME Inventory, Gross Motor Domain, Fine Motor – Adaptive, Language, and Personal Social Domain in Denver II. None of the variables assumed normal distribution at $P > 0.05$.

Table 2: Kruskal – Wallis Analysis to determine the difference in medians for the study variables among the 4 groups

Study Variables	Chi-square statistic	df	P value
Total score in HOME inventory	50.25	3	0.000
Gross motor domain in Denver II	17.61	3	0.001
Fine motor – Adaptive domain in Denver II	8.65	3	0.034
Language in Denver II	10.36	3	0.016
Personal – Social domain in Denver II	21.84	3	0.000

á < 0.05; df: Degrees of freedom

Kruskal – Wallis test was performed to determine the differences in medians for the study variables (Table 2). The results suggested that all the variables were statistically significant at $P < 0.05$. To examine the difference between the unique pairs Mann Whitney U test was used (Table 3). The group codes were allotted as follows: Urban Literate – 1, Urban Illiterate – 2, Rural Literate – 3, Rural Illiterate – 4.

Table 3: Mann Whitney U Analysis

Study Variables	Median	Minimum	Maximum	IQR	P value					
					1 vs 2	2 vs 3	3 vs 4	1 vs 3	1 vs 4	2 vs 4
Total score in HOME inventory	22.00	5.00	42.00	18.00	0.000	0.000	0.000	0.676	0.000	0.040
Gross motor domain in Denver II	1.00	1.00	2.00	0.00	0.004	0.556	0.302	0.001	0.013	0.641
Fine motor – Adaptive domain in Denver II	1.00	1.00	2.00	1.00	0.387	0.013	0.006	0.091	0.253	0.779
Language in Denver II	1.00	1.00	2.00	1.00	0.049	0.002	0.043	0.230	0.399	0.253
Personal – Social domain in Denver II	1.00	1.00	2.00	1.00	0.061	0.009	0.000	0.389	0.001	0.093

á < 0.0125

The Mann Whitney U post-hoc analysis revealed that there was a statistically significant difference between Urban literate and Urban illiterate groups in total score in HOME inventory

($P=0.000$), and Gross motor domain in Denver II ($P=0.004$); a statistically significant difference between Urban illiterate and rural literate groups in total score in HOME inventory ($P=0.000$), and Language domain in Denver II ($P=0.002$); a statistically significant difference between rural literate and rural illiterate groups in total score in Home inventory ($P=0.000$), and Personal social domain in Denver II ($P=0.000$); a statistically significant difference was found between Urban literate and Rural literate groups in Gross motor domain in Denver II ($P=0.001$); a statistically significant difference was found between Urban literate and Rural illiterate groups in total score in HOME inventory ($P=0.000$), and Personal social domain in Denver II ($P=0.001$); no statistically significant difference was found between Urban illiterate and Rural Illiterate groups in any of the variables at $P < 0.05$.

The Spearman rho correlation was done for each domain in Denver II against Total score in Home inventory (Table 4).

A positive correlation was found for all the domains against Total HOME inventory score except for Gross motor domain in Rural illiterate group where no correlation was found between these variables. A significant correlation was obtained for all the domains in Urban literate group against the Total NOME inventory score.

Discussion

Development of child does not rely on one factor alone but on many factors, which promote or inhibit the child's development. The nature and type of environment provided to children at tender age is very important for their overall development²².

Earlier research on the physical environment of homes and communities primarily focused on environmental hazards, environmental stress and impacts of poverty. This body of research strongly pointed that physical aspects of the home such as cleanliness, water, noise and pollution influence the overall health and development of children^{31,32}. Recently, there has been increasing interest among researchers on the quality of home environments and their impact on child development³³⁻³⁷.

During the investigation of three ethnic groups across the first three years of a child's life Bradley et al³⁸ found that measures of particular aspects of the child's home environment, such as parental response, and availability of stimulating play materials were strongly related to children's developmental status. The findings of another study confirmed that on the HOME scale, particularly accessibility of materials (play objects, reading books, musical instruments, picture decorations, and other educational

materials) was found to be a significant predictor of children's perceived competence³⁹.

The specific interaction of two features of the home environment, availability of toys and amount of maternal

Table 4: Spearman rho correlation

Group	Domains in Denver II	rho	P value
Urban Literate	Gross motor	0.499*	0.011
	Fine motor - Adaptive	0.811**	0.000
	Language	0.659**	0.000
	Personal - social	0.486*	0.014
Urban illiterate	Gross motor	0.174	0.404
	Fine motor - Adaptive	0.331	0.106
	Language	0.167	0.425
	Personal - social	0.318	0.121
Rural Literate	Gross motor	0.043	0.840
	Fine motor - Adaptive	0.240	0.248
	Language	0.156	0.455
	Personal - social	0.318	0.121
Rural Illiterate	Gross motor	0.000	1.000
	Fine motor - Adaptive	0.302	0.142
	Language	0.319	0.120
	Personal - social	0.152	0.470

*Correlation is significant at the 0.05 level; **Correlation is significant at the 0.01 level

involvement were examined in 6 months old children and found that higher locomotor, eye-hand coordination and critical developmental quotients were associated with the additive combination of more optimal play materials and high level of maternal involvement. When examining the independent contribution of the factors, appropriate play materials were associated with more favorable eye-hand coordination⁴⁰.

Parents and the literacy environments they create in their homes are widely believed to play an important role in the development of children's reading and language skills. Evidence to support this belief has often centered on the time that parents spend reading to their children⁴¹. Scarborough, Dobrich, and Hager⁴² found that preschoolers who were read to more and who participated in more solitary book activities at home became better readers by Grade 2 compared to preschoolers with less frequent early literary home experiences. DeBaryshe⁴³ observed that mothers who began reading to their children at an earlier age had children with greater receptive language abilities.

In developing countries, research consistently revealed that the assessment of home environments positively correlated with children's cognitive and social development⁴⁴. In Pakistan, home environments were found to relate positively to the cognitive competence of children⁴⁵. In Philippines, home environments of 177 five and six-year-old preschool children were found to be related to intellectual development⁴⁶. It was also demonstrated that the environmental factors and the home have significant influences on personality development in a Nigerian study conducted by Odeunmi⁴⁷.

Comparison of urban and rural sample revealed that urban babies, in general were better than rural in social skill development⁴⁸.

The findings of all the above studies are in accord with the results of the present study. This study correlated the Home environment with the various developmental domains by taking into account location of the residence (Urban or Rural) which is decisive for the living standard and the parents' literacy status which is one of the influencing factors of the stimulating Home environment. It is recommended to analyze the effects of other family factors such as parenting style, type of family, and number of siblings on the development of children aged between 1 and 3 years old and to envisage the most influencing factor by a regression model.

Conclusion

The Home environment positively influences the development of the children aged between one and three years and which in turn is influenced by the location of the residence i.e., urban/ rural and the parental literacy status.

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A Study of Efficacy of Neuromuscular Electrical Stimulation in Post Anterior Cruciate Ligament Reconstruction

Bibek Adhya¹, Pravin Yadav², M. S. Dhillon³, Vijay Kumar⁴, Upendra Goswami⁵

^{1,2,5}Physiotherapist, ³Professor(Ortho.) & H O D, ⁴Sports Scientist, Department of Physiotherapy, PGIMER, Chandigarh, PIN- 160012, India

Abstract

Introduction & Purpose of the Study

Surgical reconstruction with the bone patellar tendon bone graft is most commonly performed surgery for Anterior cruciate ligament(ACL) injury, patient with ACL reconstruction have been reported to demonstrate a disproportionate loss of strength of quadriceps muscle, but commonly used knee extensor muscle strengthening strategies are contraindicated initially. The purpose of this study is to study the effect of neuromuscular electric stimulation with exercise protocol in rehabilitation of post ACL reconstruction.

Material & Methods

The study design is experimental. The samples were taken from Department of Physiotherapy, PGIMER; Chandigarh .The patients with ACL reconstruction with bone patellar tendon bone graft were selected. For outcome four scales were used (Cincinnati knee rating system, Lysholm knee score, Lower extremity functional scale & Visual analogue scale). Also girth measurement, muscle power and ROM were taken to assess the progress of the patient. A number of 20 subjects, age group 18-40 years, were randomly selected for this study. Subjects were divided in two groups, one group (Group A) combined with neuromuscular electrical stimulation (NMES, interrupted direct current) & exercise while other (Group B) with exercise protocol only. For electrical stimulation Ionostim muscle stimulator (Physiomed electronic, Chennai, India) was used. The intensity was up to tolerable limit and surge was used. Neuromuscular electric stimulation for 15 min daily 6 days a week was given. The exercise time is of a one hour/day for six days a week. The duration of exercise was increased according to protocol with time interval. The entire patient (both groups) underwent 12 week rehabilitation program and assessed with specific scales at 8th and 12th week interval. The statistical analysis was done by using student's t-test.

Results

Inter group analysis shows non significant result ($p > 0.05$).

Conclusion

On the basis of the present study, it can be concluded that both the conventional treatment and conventional rehabilitation protocol with neuromuscular electrical stimulation are equally effective to regain the functional skills in post ACL reconstruction rehabilitation.

Address for correspondence:

Bibek Adhya

Department of Physiotherapy,
P.G.I.M.E.R., Chandigarh,
PIN-160012, India

Email: bibek.adhya@gmail.com

Ph. +919876044966

Key Words

Anterior Cruciate Ligament, Rehabilitation, Neuromuscular Electrical Stimulation.

Introduction

Surgical reconstruction with the bone patellar tendon bone (BPTB)^{1,2} graft is most commonly performed surgery for Anterior Cruciate Ligament (ACL) injury. Reconstruction is common procedure to allow the patient to return to their former active lifestyle. Clinicians face a dilemma because patient with ACL reconstruction have been reported to demonstrate a disproportionate loss of strength of loss of quadriceps muscle, but commonly used knee extensor muscle strengthening strategies are contraindicated. There has been substantial evidences that neuromuscular electrical stimulation can improve quadriceps femoris muscle strength and recovery in patients after ACL reconstruction.^{4,11}

The electrical stimulation, Short Duration Interrupted Direct Current (SDIDC)^{1,3,4,5} helps to recruit more fibers, so when it was incorporated with conventional rehabilitation protocol it helps to gain muscle power easily which may not be possible by volitional contraction only. This early regain of muscle power helped the subjects to start functional activities earlier. Specifically, electrical stimulation of the quadriceps femoris muscle with volitional exercise after reconstruction has been shown to be more effective than volitional training only

The purpose of this study is to study the role of Neuromuscular electrical stimulation (NMES) in ACL post surgical rehabilitation.

Study Design & Methodology

The patients with ACL reconstruction with bone patellar tendon bone graft (BPTB) were taken for this study. All the patients referred from Orthopedics department to physiotherapy department were taken for rehabilitation. Informed consent was taken from patients before starting the treatment. All the patients were described about the mode of treatment .One group with combined NMES and exercise while other with exercise protocol only. All the patient underwent 12 week rehabilitation protocol and assessed with all the scales mentioned below at 8th and 12th week interval.

For outcome four scales were used: Cincinnati knee rating system(CKRS) ,Noyes et al, 1984 ⁶; Lysholm knee score (LKS), Lysholm et al, 1982⁷; Lower extremity functional scale(LEFS), Binkley et al, 1999 ⁸; Visual analogue scale(VAS), Wewers . & Lowe 1990⁹

20 subjects were taken for this study randomly. The patients were taken at physiotherapy department, PGIMER, Chandigarh, after referral from orthopedics department.

Inclusion Criteria: Patient age group: 18-40 years. Patient after ACL reconstruction with BPTB graft. Patient with injury of other ligament and menisci of knee joint only.

Exclusion Criteria: Patient with associated fracture, injuries, dislocations. Patient having any systemic disease, neurological disorder.

Groups: 2 groups were formed for study with equal number of patients in each group.

Gr. A – NMES(SDIDC) + Exercises & conventional protocol & Gr. B- exercises & conventional protocol.

Intervention Protocol: For Group A NMES and exercise was given. Neuromuscular electric stimulation (NMES) for 15 min daily 6 days a week was given. For electrical stimulation Iontostim Muscle Stimulator (Physiomed electronic Pvt. Ltd. Chennai, India) was used. Pad electrodes were used for stimulation of vastus medialis obliques (VMO). Short duration interrupted direct current, the so called faradic current was used. The

intensity was upto tolerable limit and surge was used. The exercise time is of an one hour/day for six days a week. The duration of exercise was increased according to progression in time period. Girth measurement, muscle power and ROM were taken to assess the progress of the patient. All the scoring was done at 8th and 12th week. For Group B only exercise protocol was followed same as above and scoring was done.

Post-reconstruction conventional ACL rehabilitation protocol. (Brukner P et.al, 1993).¹⁰

Fig.1: Iontostim Muscle Stimulator



Fig 2: NMES along with dynamic Exercise



0-2 week

Non weight bearing(NWB) to partial weight bearing(PWB) crutch walking .Heel to toe pattern gait.75% weight bearing.ROM exercises for knee joint. Patellofemoral joint mobilization. Passive flexion and extension . Avoidance of last 30° active extension of knee. Ankle toe movements (Ankle pump). Quadriceps ,hamstrings and glutei Isometrics .Self assisted hamstring and quadriceps exercise. Hip abduction and extension exercise. Straight leg raising with brace .Use limited motion knee brace. Cryotherapy. Leg elevation

2-5 week

Full weight bearing at end of 3rd week .ROM exercises (should be 110 °).PNF(Proprioceptive Neuromuscular Facilitation).Strengthening exercise for quadriceps ,hamstrings ,calf muscles glutei, hip flexor and hip abductors. Squatting 1/4 to 1/3.Closed kinetic chain exercises(CKC).Stationary cycling. Rocker board exercise.

5-8 week

Full weight bearing. No limited motion brace. Use knee cap .Active extension and flexion. Squatting up to half .Progressive resistance exercise(PRE).OKC (open kinetic chain and CKC (closed kinetic chain) exercise. Stretching of quadriceps, hamstrings and calf. Cryotherapy. Hydrotherapy ,swimming ,walking in shallow water. Step up step down .Lunges to practice

8-12 week

Continue all exercise mentioned above .Start leg press. Full squatting.PRE to continue. Increase time of cycling .Static and mild jogging .Road bike at end of 12th week.

Student's t-test was used for data analysis.

Comparison of both treatment groups on 8th & 12th week with different scales

Scales	Inter Group analysis of different scales			
	8 th weeks		12 th weeks	
	t-value	p-value	t-value	p-value
CKRS	0.855	p>0.05	1.192	p>0.05
LKS	0.177	p>0.05	1.067	p>0.05
LEFS	2.916	P<0.05	1.489	p>0.05
VAS	0.709	p>0.05	0.601	p>0.05

p<0.05= significant, p>0.05=non-significant

Discussion

The statistical analysis shows insignificant result for all scales ($p < 0.05$) except one result for LEFS. The electrical stimulation (NMES/SDIDC) in conjunction with conventional rehab protocol shows no significant difference. Though Eriksson et al (1979)¹¹, Delitto et al (1988)⁴ studied and found that electrical stimulation prevent the muscle atrophy after major knee ligament surgery. They concluded that neuromuscular electrical stimulation helped to improve torque generating capability of the quadriceps femoris after operation on the knee ligaments but the fact is those finding were quantified by isokinetic apparatus not by the functional parameters. The present study had some limitations that must be considered. The sample size considered for the study was small so generalizations are difficult. It would be of interest to evaluate the effectiveness of regular application of NMES to investigate whether an application of NMES has a beneficial effect.

Conclusion

On the basis of the present study, it can be concluded that both the conventional treatment and conventional rehabilitation protocol with neuromuscular electrical stimulation are equally effective to regain the functional skills in post ACL reconstruction rehabilitation.

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Effect of Two Different Exercises Protocol For Fall Prevention in Elderly

Chaitali Shah, Vaishali Suthar

Parul Institute of Physiotherapy, Limda, Vadodara

Abstract

Background And Objectives

The term “ageing” refers to the biological process of growing older in a deleterious sense. Balance mechanisms deteriorate with increasing age, sway increases. Poor balance has repeatedly been shown to be a risk factor for falls in adults. The main objectives of this study are to compare the effectiveness of different balance exercises in elderly.

Methods

All subjects were selected randomly for two experimental groups after screening them for inclusion and exclusion criteria. Both groups were treated with different exercises protocol two times a day for consecutive 30 days. All the subjects evaluated by Tinetti balance and gait assessment scale before and after the intervention.

Study Design

Purposive controlled trial pre test and post test experimental design.

Sampling Technique

Simple random sampling technique.

Outcome Measures

1. Tinetti balance scale
2. Tinetti gait assessment scale

Results

The data was analyzed by using t – test. We reject the null hypothesis as no difference was seen in balance performance in group-1 and group-2 after giving balance training for 30 consecutive days. Subject in the training group – 1 will be improve static as well as dynamic stability after giving exercises in age group of 65 years and above.

Conclusions

The study shows improvement in balance performance of elderly persons after 30 days in both groups. But group-1 shows statistically significant improvement than group-2.

Key Words

Aging, Balance, fall, Tinetti balance and gait assessment scale

Introduction

1. Ageing

Although everyone is familiar with ageing, defining it is not so straightforward. In fact, ageing can have a positive connotation as in “ageing wine”. In the context of senescence, and unless otherwise noted, the term “ageing” refers to the biological process of growing older in a deleterious sense. The chronological criterion to identify the old in America has been set at 65 years. However, the onset of health problems of elderly may occur in early 50s or may be only in 40s. The present chronological criterion to identify the old may change in future, as the mean age of population increases each decade and more individuals live in to their ninth decades.

Elderly are further classified as:

Young – old	65-75 years
Middle-old	75-85 years
Old-old	> 85 years

2. Balance

Balance is a state of equilibrium or parity characterized by cancellation of all forces by equal opposing forces. Balance is a set of biological strategies designed to maintain the body in erect posture. Balance and coordination depend on the interaction of multiple body organs and systems including eyes, brain and nervous system, cardiovascular system and muscles.

There are mainly three mechanisms responsible for maintaining balance. Under normal circumstances; the body undergoes oscillation around a fixed point known as the ‘sway pat’. As these balance mechanisms deteriorate with increasing age, sway increases.

1. Ocular Mechanism

Under normal circumstances, visual cues are constantly used to correct minor deviation from the fixed point.

2. Vestibular Mechanism

The vestibular is mainly involved with rotator movements of the head and neck, whereas the otolith organ is involved with acceleration and deceleration.

3. Proprioceptive Mechanism

Position sense is important for maintaining balance. Sensory information from proprioceptors in the central spine and major weight-bearing joints may be impaired with ageing and arthritis. Failure of these mechanism leads to an increased likelihood of falls.

Falls in Elderly

FALL

An event, that result in a person's inadvertently coming to rest on the ground or lower level with or without loss of consciousness of injury. This excludes falls from major intrinsic event (seizure, stroke and syncope) or overwhelming environmental hazard.

- √ Falls are extremely common among the elderly population accounting for substantial morbidity and mortality.
- √ Approximately 30% of people over the age of 65 fall each year.
- √ In about 3% of falls, the older adult lies on the floor for at least 20 min.
- √ Up to 20% of community dwelling elderly persons fall each year in the U.S. and this figure has doubled in institutionalized ambulatory populations.
- √ These falls have serious immediate as well as long term complications.
- √ Nearly 200,000 aged Americans have a fracture of the hip each year usually during a fall and often with little obvious environmental provocation.
- √ About 10% of falls require hospitalization due to fractures and other injuries.
- √ Approximately 50% of fall injuries seen in an emergency room will have continued pain and mobility limitations.

Risk factors

Risk factors associated with the occurrence of falls in elderly are classified as

- (i) Intrinsic or host factors.
- (ii) Extrinsic or environmental factors.

Intrinsic Factors

- √ Poor balance
- √ Weakness
- √ Foot problems
- √ Visual impairment
- √ Cognitive impairment

Extrinsic Factors

- √ Poor lighting
- √ Slippery surface
- √ Obstacles
- √ No safety equipment
- √ Loose carpets
- √ Poly pharmacy

Aims and Need of Study

The main objectives of this study are to compare the effectiveness of different balance exercises in elderly.

Age and lack of physical activity may both be responsible for a poor balance control. The risk of developing problems in one or more of the sensory, motor, or adaptive brain components of balance increases with age as the body is exposed to degenerative or infectious diseases, or the effect of injuries accumulated over a lifetime. Thus, balance problems among older adults are frequently caused by combinations of subtle degenerative, infectious or injury processes that individually not clinically significant. Some elderly individuals experiencing balance problems have obvious medical diagnosis such as diabetes, Parkinson's disease, or even a stroke that is primary source of the problem. Whether balance disorders results from

combination of subtle problems or obvious disease, clinical study indicate that elderly fallers are different from their healthy age-matched counterparts and required medical treatment to maintain their healthy age-matched counterparts and required medical treatment to maintain their functional independence and quality of life.

Poor balance has repeatedly being shown to be a risk factor for falls in community-dwelling older adults. Balance has three basic dimensions-maintenance of a position, stabilization for voluntary movements and reaction to external disturbances. Most injurious falls occur during the performance of routine daily activities such as walking, transferring, stopping, bending or reaching.

The elderly are among those at greater risk for disequilibrium. Although the relationship between muscle weakness in old age and equilibrium maintenance would seem to be closely related, studies related to this topic are rare and incomplete.

Review of Literature

1. Gun Jahansson and Gun – Britt Jarnlo (1990) concluded that 70-years old women improved their performance significantly when standing on one leg and were able to walk faster after a 5 week training period.
2. Orr R, Raymong J etal (2000) concluded that improvements, significantly greater than controls in balance performance following progressive resistive exercise.
3. Tinetti et al. (1997) found a reduction in the rate of falls among community-dwelling older adults who participated in a multifocal intervention project that included the use of exercises to improve balance and ability to transfer safely.
4. James a. Judge, Robert H. Whipple etal (2000) concluded that resistive or balance training did not improve maximal gait velocity or chair rise time in this sample of relatively healthy older persons.
5. Elsevier B.V (2009) concluded that use of Tinetti balance test to screen older people at risk of falling in order to include them in a preventive intervention.
6. L cipriany – Dacko, D. innerst (2009) concluded that fair to good reliability of balance portion of Tinetti's performance Oriented Mobility Assesment scores occurred across many raters of varied experience with a small amount of training.
7. M. Madureira, L. Takayama (2006) concluded that an intervention using balance training is effective in improving function and static balance, mobility and falling frequency in elderly women with osteoporosis.
8. Raiche m, Herbert R et al. (2000) concluded that, in a prospective study of 225 community dwelling people. 75 years and older we tested the validity of the Tinetti balance scale to predict score at 36 or less identified 7 of 10 fallers with 70% sensitivity and 52% specificity, with this cut – off score 53% of the individuals were screened positive and presented a two-fold risk of falling. These characteristics support the use of this test to screen older people at risk of falling in older to include them in a preventive intervention.
9. Dr. mark chignell et al. (2008) concluded that exercises in particular, strength and balance training can not only improve functional independence but also reduce risk of falls.
10. How TE, Rochesterl et al. (2000) concluded that resistive or balance training did not improve maximal gait velocity or chair rise time in this sample of relatively healthy older persons.
11. Shumway – Cook A, et al. concluded that a simple predictive model based on two risk factors can be used by physical therapist to quantify fall risk in community-dwelling older adults. Identification of patients with a high fall risk can lead to an appropriate referral in to fall prevention program. In addition, fall risk can be used to calculate change resulting from intervention.

Design and Methodology

Study Design

This study design was a purposive controlled trial pre test and post test experimental design.

Sample Size & Sampling Method

Thirty subjects of 65 years or above were selected by means of simple random sampling procedure.

Hypothesis

- Null hypothesis (H_0) :
- There is no significant difference in balance performance after balance training between two groups.
- Alternate hypothesis (H_a) :
- There is a significant difference in balance performance after balance training between two groups.

Study Population

The subjects who fulfilled the following criteria were taken as study population.

Inclusion Criteria

- Subjects of 65 years of above of both sexes were taken for the study.

Exclusion Criteria

- Subjects with History of impairment of hip, thigh and knees,
- Recent fracture or any injury to lower limb,
- Inflammatory condition to lower limb,
- Sensory Deficits,
- Previous surgery to cranium, spine or lower limb,
- Hyper mobility to ankle and knee joint,
- Rheumatoid arthritis,
- Any neurological problem,
- Amputation or severe pain in the lower limb.

Outcome Measures

Tinetti Test

Balance of all the subjects was measured on 1st day and on 30th day by Tinetti test.

Group Allocation

The Experimental Group – 1

This group was treated with following exercises two times a day for 30 consecutive days.

- √ Single leg standing,
- √ Tandem walking,
- √ Walking in "fig of 8"
- √ Beam walking

The Experimental Group – 2

This group was treated with following exercises two times a day for 30 consecutive days.

- √ Walk : Sideways,

- √ Normal Standing with Reaching Activities,
- √ Weight Shifting : side-to-side, forward-to-backward,
- √ Full Tandem Standing,

Material

- √ Tinetti Balance Assessment tool
- √ Standard Chair without Armrest
- √ Paper, Pen, Pencil, Chock
- √ Scale, Measure tape
- √ Stop Watch
- √ Beam

Procedure

All subjects were selected randomly for two experimental groups after screening them for inclusion and exclusion criteria. All the subjects evaluated by Tinetti balance and gait assessment scale before and after the intervention. Informed consent was taken from each subjects before starting the treatment, the subject was positioned comfortably and assessed thoroughly about their condition.

The Experimental Group 1

This group was treated with following exercises two times a day for 30 consecutive days.

- √ Single leg standing with 30 second holding time, 5 repetitions for each side.
- √ Tandem walking on the path of 5 meters, 3 rounds.
- √ Walking in "fig. of 8" manner, 5 rounds.
- √ Beam (length: 93", height: 3.5") walking, 3 rounds.

The Experimental Group 2

This group was treated with following exercises two times a day for 30 consecutive days.

- √ Walk: Sideways, on path of 20 meters 2 rounds.
- √ Normal Standing with Reaching Activities, 30 repetitions.
- √ Weight Shifting: side-to-side, forward-to-backward, 20 times for both.
- √ Full Tandem Standing, 30 second holding time, 5 repetitions.

Tinetti Performance Oriented Mobility Assessment (POMA)

Description

The Tinetti assessment tool is an easily administered task-oriented test that measures an older adult's gait and balance abilities.

Equipment Needed

Hard armless chair
Stopwatch or wristwatch
15ft walkway

Completion Time

10-15 minutes

Scoring

A three-point ordinal scale, ranging from 0-2. "0" indicates the highest level of impairment and "2" the individual's independence.

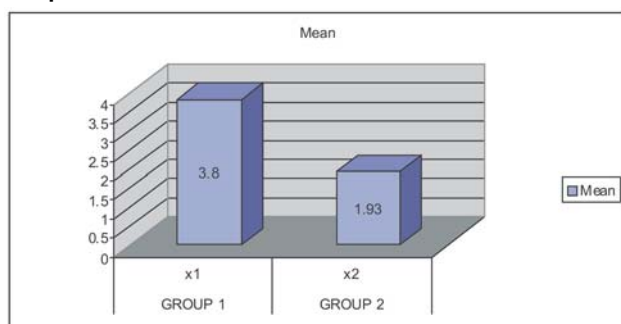
Total Balance Score = 16
 Total Gait Score = 12
 Total Test Score = 28

Interpretation

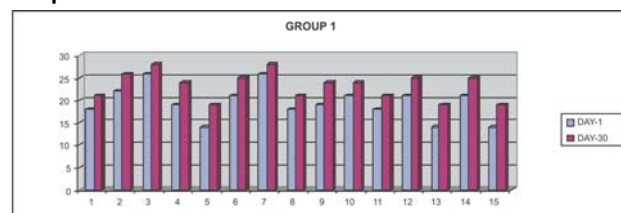
25-28 = low fall risk
 19-24 = medium fall risk
 < 19 = high fall risk

Data Analysis

Graph 1:



Graph 2:



Graph 3:

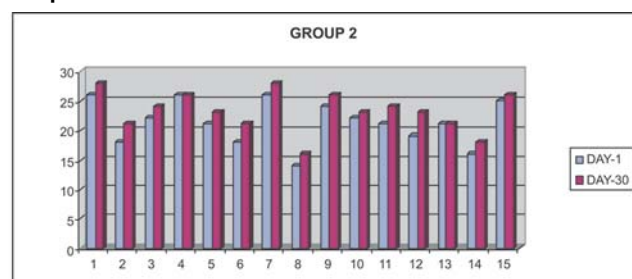


Table 1:

	GROUP 1 x_1	GROUP 2 x_2
Mean	3.8	1.93

Table 2:

Tabulated value t_t	Calculated value t_c
1.7010	4.70

Discussion

The Purpose of study is to see effect of balance training exercises in elderly. The data was analyzed by using t – test. We reject the null hypothesis as no difference was seen in balance performance in group-1 and group-2 after giving balance training for 30 consecutive days.

Group – 1 is treated by balance exercises like Single leg standing, Tandem walking, Walking in “fig. of 8” and Beam walking shows better balance performance than group – 2 which is treated by Side walking, Standing with Reaching Activities, Weight Shifting : side-to-side, forward-to-backward, Full Tandem Standing for 30 consecutive days.

The reason for significant difference may be,

1. Proprioception will increase with these balance exercises. This is supported by the study done by, Gerome C.Gauchard , et.al. (2003) who concluded that proprioceptive exercises appear to have the best impact on balance regulation and precision. Besides, even if bioenergetics activity improves postural control in simple tasks, more difficult postural tasks show that this type of activity does not develop a neurosensory. Proprioceptive input threshold as well, probably an account of higher contribution of visual afferent.
2. Specific muscles which will help body to maintain balance will be trained through these exercises thus balance improves.

This is also supported by the study done by, Kurt Murer, et.al. (2007) who concluded twice – weekly lower extremity strength training of 12 weeks duration in hostel – dwelling elderly and lower extremity physical function when additional functional exercises are added. The Tinetti Balance score and the chair stand test of the physical performance assessment improved significantly.

Subject in the training group reported feeling much comfortable after training and expressed a desire to continue the exercise.

Finally, we found that age group of 65 years and above improve their performance significantly on one leg and were able to walk faster after 30 days training program. Those subjects who had the lowest before training showed the most pronounced improvement.

Subject in the training group – 1 will be improve static as well as dynamic stability after giving exercises in age group of 65 years and above.

Limitation of the Study

- Sample size is very small. A large sample size is required to make the study more reliable.
- Limited time of data collection.
- After completion the measurements are taken only of 30 days.
- This study is limited to only one outcome measure other outcome measures can also be used.

Further Suggestion for Research

- Studies can be conducted in larger sample.
- Further followed by long-term follow up with same balance activities.
- Further studies are needed to determine if other outcome measure can also be used (e.g. Berg Balance Scale).
- Further studies can be conducted with other balance activities to see effect on balance by tinetti balance scale.

Conclusion

Thirty subjects of age 65 years and above participated in this study. The study shows improvement in balance performance of elderly persons after 30 days in both groups. But group-1 shows statistically significant improvement than group-2.

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Functional Performance in Community-dwelling Elderly People: Six-minute Walk Test, Berg Balance Scale, Timed Up and Go Test and Gait Speeds

Garg Chaya, Sindwani Vidhu

Banarsidas Chandiwala Institute of Physiotherapy, Kalkaji, New Delhi-110019

Abstract

Background and Purpose

The interpretation of patient's score on clinical tests of physical mobility in different age groups is limited by a lack of data describing the range of performance among people without disabilities in the different age groups especially the elderly adults. The purpose of this study was to provide data for the values of four clinical tests- 6 Minute Walk Test, Berg Balance Scale, Timed Up and Go test and Normal and Fast walking speeds in community dwelling older adults.

Subjects

Normal males and females (n=45) in the age group of 50-79 yrs with asymptomatic knee function were included in the study after they gave their informed consent.

Methods

The subjects were allocated to the three groups according to their age Group A (50-59 years), Group B (60-69 years), and Group C (70-79 years). Subjects were told to wear comfortable shoes and were tested for: 6-minute walk test, Berg Balance Scale, Comfortable Gait speed, Fast Gait speed, Timed up and go test.

Results

Using a Pearson product moment correlation test the results showed a significant decline in performance for commonly used performance tests with increase in age in community-dwelling elderly people.

Conclusion

Age dependant normative values for performance tests should be developed especially for commonly used tests like the 6-Minute walk test, Berg Balance Scale, Gait speed and the Timed Up & Go test.

Key Words

6 Minute Walk Test, Berg Balance Scale, Timed Up and Go test, Normal and Fast walking speeds, community-dwelling elderly people.

Introduction

Examination at both the impairment level as well as at the functional level is very essential in the decision making process in physical therapy. The interpretation of patient's score on clinical tests of physical mobility in different age groups is limited by a lack of data describing the range of performance among people without disabilities in the different age groups especially the elderly adults.

Many tests are available to assess the functional levels of individuals. Some of these tests have high levels of reliability and various aspects of validity have been established. However, limited data are available on the range of measurement of these tests in different age groups. The normative values available for these groups have been defined by testing of individuals of all age groups including the younger age group. Hence, the validity of these values in the elderly age groups is questionable. The purpose of this study was to provide data for the values of four clinical tests- 6 Minute Walk Test, Berg Balance Scale, Timed Up and Go test and Normal and Fast walking speeds in community dwelling older adults.

The 6-Minute Walk test is a modification of the 12 minute Walk-Run test¹ as a field test to measure maximum oxygen uptake. It helps to test patients with pulmonary or cardiovascular diseases, also to predict morbidity or mortality in patients with left ventricular dysfunction², advanced heart failure or chronic obstructive lung diseases³.

The Berg Balance Scale was developed as a performance-oriented measure of balance in elderly individuals⁴. It helps to identify elderly persons who are at a risk for falling and referring persons who are prone to falls for physical therapy for gait, balance and strength deficits. Several studies have shown that a baseline score contributes to discriminating between elderly people who are prone to falling and those who are not⁵. However, sufficient data is not available to describe the expected decline in performance according to increase in age. Riddle and Stratford⁶ demonstrated that using the recommended cut off score of 45 on the scale was relatively poor for identifying people who are at-risk for falling (sensitivity = 64%) but relatively good for identifying people who are not at risk for falling (specificity = 90%).

The Timed Up and Go test was developed originally as a clinical measure of balance in elderly people and was scored on an ordinal scale of 1 to 5 based on an observer's perception of the performer's risk for falling during the test⁷. Podsiadlo and Richardson⁸ modified the original test by timing the task rather than scoring it qualitatively. According to their study, normal healthy elderly usually complete the task in 10 seconds or less, very weak or frail elderly with poor mobility may take 2 minutes or more. Scores were interpreted as ≤ 10 seconds as normal, ≤ 20 seconds as good mobility (can go out alone, mobile without a gait aid) and < 30 seconds – problems (cannot go out alone, requires a gait aid). Hughes⁹ found a mean TUG score of 13.05 seconds in elderly people, aged 65-86 years. There is no consensus in the literature regarding the effect of aging on TUG scores¹⁰.

Gait speed is a quick, inexpensive and a highly reliable measure of functional capacity that can be easily measured in the clinical setting. Because elderly people frequently utilize physical therapy services to achieve the maximum functional ability, the collection of gait analysis data of healthy elderly subjects is essential to establish realistic rehabilitation expectations of the elderly population. Regardless of the measurement method, gait speed measurements are considered highly reliable in people without known impairments that should affect gait and different patient populations.

Average gait speeds for subjects without known impairments over 60 years of age have ranged from 0.60 to

1.45 m/s for comfortable walking speeds and 0.84 to 2.1 m/s for fast walking speeds¹¹. Older adults without known impairments are reported to be able to increase their walking speed from 21% to 56% above a comfortable pace when instructed¹².

Methodology

Normal males and females (n=45) in the age group of 50-79 yrs with asymptomatic knee function were included in the study after they gave their informed consent. Subjects were excluded from the study if they had history of smoking, dizziness, unable to tolerate standing and walking for 6 minutes without shortness of breath, chest pain or joint pain in the legs, neck or back, were using any assistive aid for walking were undergoing any weight training or conditioning.¹³ The subjects were allocated to the three groups according to their age:

- Group A: 50-59 years
- Group B: 60-69 years
- Group C: 70-79 years

The data was collected for each subject within one session. Subjects were told to wear comfortable shoes for the test session. Demographic data was collected (age, height, weight, medical history, heart rate and resting blood pressure). The tests were administered to each subject in the same order

1. 6-minute walk test
2. Berg Balance Scale
3. Comfortable Gait speed
4. Fast Gait speed
5. Timed up and go

6-Minute Walk Test

It was conducted along a walkway marked with 1m increments. A line was made at each end of the walkway to indicate where the subject was to turn. Subjects walked alone during the 6-minute walk unless the researcher felt that they were unsafe. Subjects were instructed to 'walk as far as possible' in 6 minutes. Each subject had a practice trial and then rested until the heart rate returned to the baseline level followed by a second test trial, the distance for which was recorded as it has been shown that the 2nd trial produces more appropriate results¹⁴.

Berg Balance Scale

The 14 activities were scored on a scale of 0 to 4. Score of 0 was given if the subject was unable to do the task and a score of 4 if the subject was able to complete the task based on the criterion that has been assigned to it. The maximum total score on the test was 56. The items included various simple mobility tasks (e.g. transfers, standing unsupported) and more difficult tasks (e.g. tandem standing, turning 360 degrees)¹⁵

Gait Speeds

2 consecutive trials at each of the gait speeds were done. Data were collected as each subject walked on a marked 10 m walkway at:

- a Normal comfortable speed and
- b Fast speed.

Gait speed was measured with a stop watch. The 2 trials at each speed were averaged for use in data analysis¹³.

Timed Up and Go Test

The timed up and go test¹⁶ was administered using a firm chair with arm rests. A distance of 3m was marked off on the floor in front of the chair. The test began with each subject sitting with back against the chair, arms resting on the lap and feet behind the distance marker on the floor. Subjects were instructed as "on the word 'go', stand up, walk comfortably and safely to

the 3m mark, turn, come back and sit all the way back in the chair". They were informed that the trial would be timed. Timing began on the word 'go' and ended when the subject's back rested against the chair upon returning. A practice trial was performed followed by 2 record trials. Data obtained during the 2 trials were averaged for use in data analysis.

Results

The basic characteristics of the three groups were as summarized in table: 1. The test results for the three groups are summarized in table: 2.

6-Minute Walk Test

There was an age group*test score interaction with $F(2, 42) = 6.451, p < 0.01$. Post hoc analysis revealed that as compared to the Group 1 both the groups had higher test scores for SMWT but group 3 had significantly higher test scores. Whereas the difference between the group 1 & 2 and Group 2 & 3 were found to be non-significant. (Fig 1)

Using a Pearson product moment correlation test on data ($r = -0.433$), the results were significant ($p < 0.01$, for two tailed test) indicating a highly significant negative correlation in SMWT and age. (Fig 2)

Fig. 1: Comparison of 6-Minute Walk Test

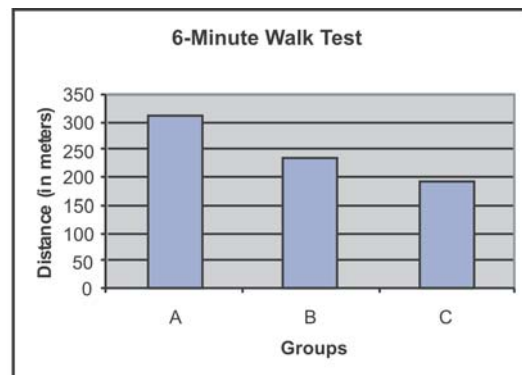
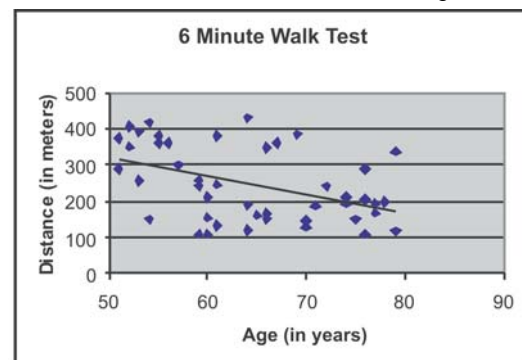


Fig. 2: Correlation of 6-Minute Walk Test with Age



Berg Balance Scale

There was an age group*test score interaction with $F(2, 42) = 23.349, p < 0.01$. Post hoc analysis revealed that as compared to the Group 1 both the groups 2, 3 had significantly higher test scores. Also the difference between the Groups 2 & 3 was found to be significant. (Fig 3)

Using a Pearson product moment correlation test on data ($r = -0.713$), the results were significant ($p < 0.01$, for two tailed test) indicating a highly significant negative correlation in Berg Balance Scale score and age. (Fig 4)

Fig. 3: Comparison of Berg Balance Scale

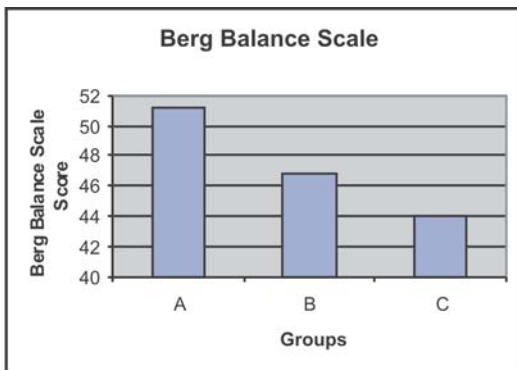
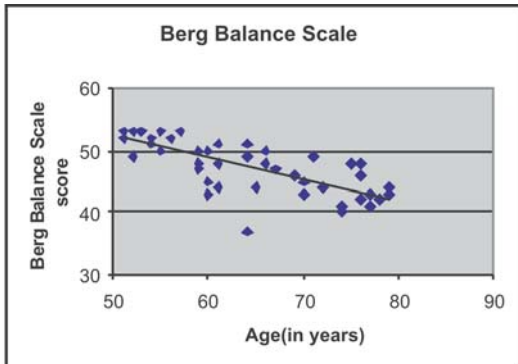


Fig 4: Correlation of Berg Balance Scale with Age



Comfortable Gait Speed

There was an age group*test score interaction with $F(2, 42) = 7.825, p < 0.01$. Post hoc analysis revealed that as compared to the Group 1 both the groups 2, 3 had significantly higher test scores. Whereas the difference between the Groups 2 & 3 were found to be non-significant. (Fig 5)

Using a Pearson product moment correlation test on data ($r = -0.519$), the results were significant ($p < 0.01$, for two tailed test) indicating a highly significant negative correlation in Comfortable Gait Speed and age. (Fig 6)

Fig. 5: Comparison of Comfortable Gait Speed

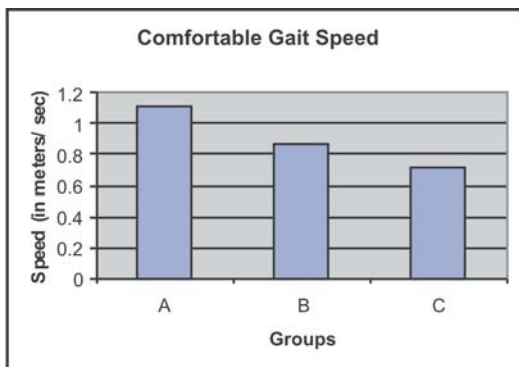
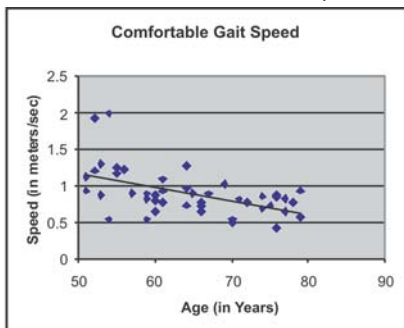


Fig. 6: Correlation of Comfortable Gait Speed with Age



Fast Gait Speed

There was an age group*test score interaction with $F(2, 42) = 15.164, p < 0.01$. Post hoc analysis revealed that as compared to the Group 1 both the groups 2, 3 had significantly higher test scores. Whereas the difference between the Groups 2 & 3 were found to be non-significant. (Fig 7)

Using a Pearson product moment correlation test on data ($r = -0.641$), the results were significant ($p < 0.01$, for two tailed test) indicating a highly significant negative correlation in Fast

Fig. 7: Comparison of Fast Gait Speed

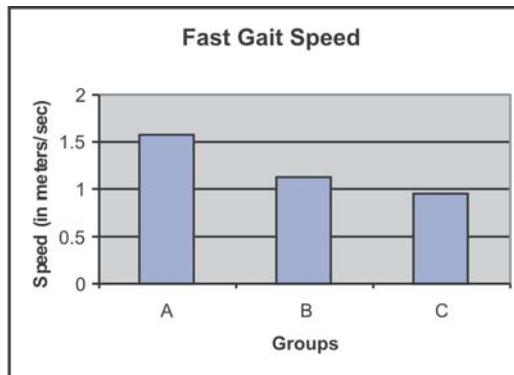
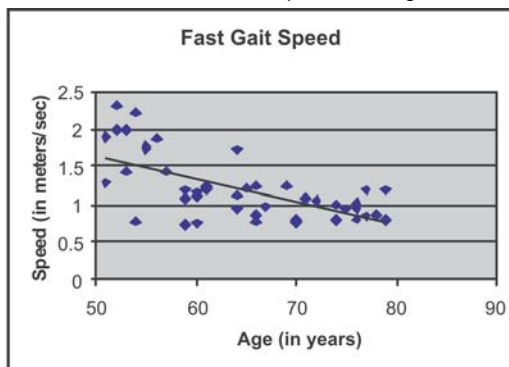


Fig. 8: Correlation of Fast Gait Speed with Age



Gait Speed and age. (Fig 8)

Timed Up And Go Test

Analysis revealed that there was no significant difference between the three groups in the scores for TUG with $F(2, 42) = 2.564, p = 0.089$. (Fig 9)

Using a Pearson product moment correlation test on data ($r = 0.364$), the results were significant ($p < 0.05$, for two tailed test) indicating a positive correlation in Timed Up and Go Test and age. (Fig 10)

Fig. 9: Comparison of Timed Up & Go Test

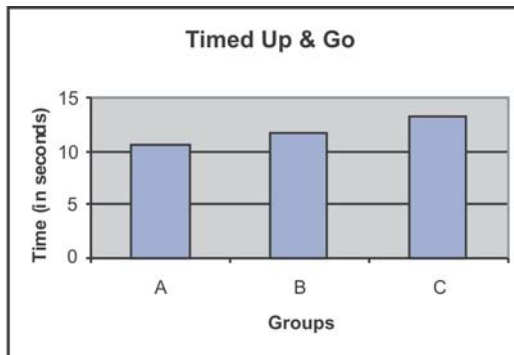


Fig. 10: Correlation of Timed Up & Go Test with Age

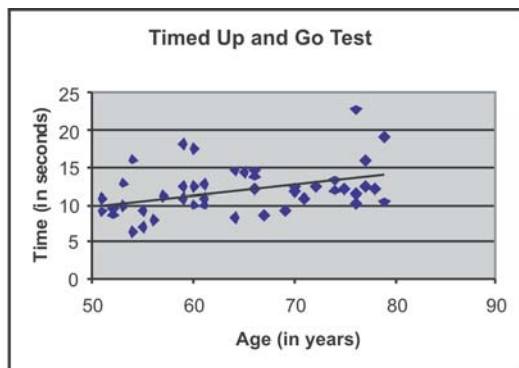


Table 2: Comparison of test results of the 3 Groups

Groups	6-Minute Walk Test (in meters)	Berg Balance Scale score	Comfortable Gait Speed (in m/sec)	Fast Gait Speed (in m/sec)	Timed Up & Go (in sec)
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
A	309.78 (92.47)	51.27 (0.49)	1.11 (0.42)	1.58 (0.49)	10.59 (3.20)
B	235.37 (112.54)	46.87 (3.81)	0.87 (0.17)	1.12 (0.24)	11.76 (2.79)
C	191.06 (62.37)	43.93 (2.76)	0.72 (0.15)	0.94 (0.15)	13.21 (3.46)

Discussion

The normative values available for the four tests used in our study have been obtained by clinical trials on very large age groups, including the younger age groups. This has resulted in referring to the same values for assessing the younger as well older adults. However, all four tests in this study showed a significant decline in performance with increase in age in Community-dwelling normal elderly people. Thus, these preliminary data suggests the need for using age-related values in order to make judgments for older adults.

A study¹³ showed similar results as our study. The methodology of their study and the subject selection was similar to our study and hence the similar results. Although the actual values obtained for the different tests differ from our study, they showed a similar trend of decline in performance as our study.

Our mean data for the Berg Balance Scale are similar to the score reported by Newton in 1997¹⁷ for inner-city dwelling older adults. The much wider range of Berg Balance Scale scores found by Newton suggests the fact that some subjects reported a history of falling. Although Bogle-Thorbahn⁵ did not find a relationship between age and the Berg Balance Scale data in 66 elderly people, our results suggest that age-related norms may be needed for the Berg Balance Scale. This difference may be due to the differences in population from which the subjects were selected in our study and the study conducted by Bogle-Thorbahn and Newton. The subjects in both studies functioned independently. The subjects in our study, however, lived in the community, whereas those studied by them lived in life care institutes.

Our findings of the Timed Up and Go test fall within the ranges reported by Podsiadlo D and Richardson S³ who also used a 3-m walking distance in their test protocol and did not include subjects who required an ambulatory device. Newton in 1997¹⁷ reported the highest mean Timed Up and Go scores (15 seconds) and widest range of scores. The probable causes for the higher scores could be that she used a 3.05 m walking distance in her protocol, a lower chair height than was used in other studies and included subjects who used an ambulatory device. The mean timed up and go score of our subjects were much faster than those obtained for hospitalized elderly patients as reported by Nikolaus¹⁸. The obvious reason for this is the greater amount of functional mobility and daily activity present in community-dwelling elderly people as compared to hospitalized people.

Table 1: Basic characteristics of group

Groups	Age	Height	Weight
	Mean (SD)	Mean (SD)	Mean (SD)
A	54.67 (2.81)	1.56 (0.15)	66.87 (7.43)
B	63.60 (2.92)	1.51 (0.21)	67.13 (11.15)
C	74.93 (3.03)	1.53 (0.20)	66.87 (8.67)

One of the previous studies on gait speeds⁽¹¹⁾ used the same stopwatch method and a similar distance as we did for measuring gait speed. This stopwatch method of measuring gait

speed is easy and inexpensive, making it, in our view, clinically useful. The ability to increase the walking speed from comfortable to fast shown by our subjects was similar to that found by Bohannon. Lipkin¹⁹ reported significantly higher 6-Minute Walk distances as compared to our study. The probable cause for this could be that they did not include a practice trial in their protocol.

Conclusion

Elderly adults represent a sizeable proportion of our population especially with increasing life span. This study showed a significant decline in performance for commonly used performance tests with increase in age in community-dwelling normal elderly people. Therefore, age dependant normative values for performance tests should be developed especially for commonly used tests like the 6-Minute walk test, Berg Balance Scale, Gait speed and the Timed Up & Go test.

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A Case Report on the Role of Occupational Therapy in Revascularised and Replanted Surgical Case of Flexor Tendon of Hand

Deepak Ganjiwale

Occupational Therapist, K.M.Patel Institute of Physiotherapy Shree Krishna Hospital, Karamsad, Anand, Gujarat, India

Abstract

Occupational Therapy intervention, after revascularisation/replant of flexor tendon injury, are very rare. When a primary repair can not be done, tendon reconstruction remains the treatment in such cases. In the past years there have been significant innovations in injury repair and aftercare for patients who sustain different zones of flexor injuries. Based on improvements in our understanding of the mechanism of repair, new differentiated concepts have been developed, but active extension and passive flexion is still the standard in flexor tendon surgery. The new stronger suture techniques today allow immediate active flexion and rehabilitation through Occupational therapy can help in improving the flexion movements faster.

The purpose of this article is to review the occupational therapy intervention of flexor tendon injury after revascularisation / replant.

A case of lacerated wound on right hand, volar aspect near wrist with palmaris longus, flexor carpi ulnaris(FCU), flexor carpi radialis(FCR), flexor digitorum profundus(FDP), flexor digitorum superficialis(FDS), flexor pollicis longus(FPL), ulnar nerve and vessels cut, came to our centre. The tendons were repaired and patient was referred for occupational therapy services. After occupational therapy intervention patient now is able to work independently and has returned to his job back. Even though all the flexor tendons had got cut completely, the patient is today able to perform all functions that he used to do before the accident, again viz: drilling and cutting etc.

Key Words

Occupational therapy, Replant, Revascularisation.

Introduction

Restoring digital function flexor tendon injury continues to be one of the great challenges in hand therapy. When a primary repair of the flexor tendon is not possible, tendon reconstruction becomes the treatment of choice. Since past several years, there have been significant innovations in injury repair and aftercare for patients who sustain different zones of flexor injuries. Based on improvements in our understanding of the mechanism of repair, new differentiated concepts could be developed. Active extension, passive flexion as introduced by Kleinert¹ is still the standard in flexor tendon surgery. New stronger suture techniques today allow immediate active flexion. Here in the present case all flexor parts including artery and vessels were received in completely cut condition. After the reconstructive surgery, three approaches were used to rehabilitate through Occupational therapy²

- 1 immobilization for 2 to 3 weeks before beginning active and passive mobilization
- 2 early passive mobilization
- 3 early active mobilization with ADL's training programme.

There are several cases available in the published history of flexor tendon repair and rehabilitation^{3,4,5,6}, but none of the studies have used occupational therapy solely as a formula to improve the flexion movement.

Case presentation

The present case is of a 22 years young man who was working in Gujarat he came with lacerated wound of RT hand, volar aspect near wrist with palmaris longus, flexor carpi ulnaris, flexor carpi radialis, flexor digitorum profundus, flexor digitorum superficialis, flexor pollicis longus, ulnar nerve and vessels on 22-06-2010 he was operated (tendon replant and revascularisation of artery) on the same day. Later he was discharged from the hospital on 01/07/2010 and was called for Occupational Therapy treatment on OPD basis from 17-08-2010 till 18/09/10.

During the first assessment the patient had very poor gross and fine grip and also limited range of motion. (Table 1)

In wrist his range was 30 degree in flexion and 5 degree in extension, ulnar deviation and radial deviation were 0 on 17/08/10 but on 18/09/10 flexion was increased 50 active and 55 degree in passive, extension range 15 degree in active and 20 degree in passive. ulnar deviation 5 and radial deviation 5 degree. (Table 2)

During sensory examination 2PD test was 8mm at ring finger and he could not feel any sensation at the little finger tip. Touch sensation: there was Anaesthesia at the little and ring finger at volar aspect and Paraesthesia at the 2nd, 3rd and 4th tip of the finger at dorsal aspect. After sensory integration programme sensation improved a little, Tinel sign was present at > 1 inch from the site of cut. After surgery patient had taken tab analgesic for 15 days.

OT intervention was initially focused on active and passive exercise of MCP joints only. After getting the minimum functional range, efforts on improving PIP and DIP joint were started. Along with this, ultrasound over the operated area was given and also the patient was trained for the activities of daily living (ADL) for self care and tools modification.

Discussion

The current case is special in the sense that in all the previously published materials only tendon was seen completely cut and also the patient was rehabilitated through multi speciality techniques viz various contributions of OT, PT, orthosis and prothesis etc (ref 5) whereas in the current case all the nerves, various arteries, tendon of flexor compartment cut when the patient came for the first time and after the revascularisation and replant of nerve and tendon (reconstructive surgery) the patient was rehabilitated with Occupational Therapy alone along with OT only resting splint was given to the patient for support at the initial stage only. At the end of the intervention for a period of 1 month 4 days.

Conclusion

From the improvement in the functions of the injured hand of the patient (tables 1,2), it is evident that OT alone can also play a remarkable role in rehabilitation of such difficult cases. Similar studies should be done to explore the role of OT in extensor group of muscles too.

Table 1: At the time of first assessment on 17/08/10

		Right hand			Left hand		
Gross movement strength*		2+2+2=2 kg			10+12+10=10kg		
Fine movement strength**	Pad to pad	2 +2+2=2 pounds			10+10+10=10 pounds		
	Lat. Pinch	2+2+2=2 pounds			10+10+10=10 pounds		
	Tripod	2+2+2=2 pounds			10+10+10=10 pounds		
	Tip to tip	1+1+1=1 pounds			10+10+10=10 pounds		
Range of Motion (Hand)	Thumb	A	20		30		
		P	50		60		
	Index	A	20-50	25-50	10		
		P	70	60	40		
	Middle	A	30	60-70	25-45		
		P	55	70	50		
	Ring	A	20	70-85	25-50		
		P	45	85	60		
	Little	A	30	50-70	15-20		
		p	50	80	30		

*Gross movement strength measured by JAMAR hand dynamo meter

** Fine movement strength measured by JAMAR pinch o meter

Table 2: At the time of final assessment on 18/09/10

		Right hand			Left hand		
Gross movement strength*		6+6+4=5.3kg			10+12+10=10kg		
Fine movement strength**	Pad to pad	6 pounds (mean of 3 trials)			10+10+10=10 pounds		
	Lat. Pinch	8 pounds (mean of 3 trials)			10+10+10=10 pounds		
	Tripod	8 pounds (mean of 3 trials)			10+10+10=10 pounds		
	Tip to tip	4 pounds (mean of 3 trials)			10+10+10=10 pounds		
Range of Motion (Hand)	Thumb	A	40		35		
		P	65		65		
	Index	A	10-80	35-100	35		
		P	100	110	80		
	Middle	A	65	70-100	20-65		
		P	90	110	90		
	Ring	A	55	70-100	20-50		
		P	80	110	70		
	Little	A	35	50-100	15-40		
		p	80	110	70		

*Gross movement strength measured by JAMAR hand dynamo meter

** Fine movement strength measured by JAMAR pinch o meter

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Effect of Keyboard Slope and Forearm Support on User Performance and Comfort Level

Dheeraj Lamba¹, Babita Mishra², Neetu Arya³, Shammi Chetan⁴, Saloni Priya⁵

¹Incharge, ^{2,3,4,5}Interns-Dept of Physiotherapy, IAHSET Medical College Haldwani

Introduction

Computers are ubiquitous and every computer has a keyboard for text and data-entry. In the past two decades, worldwide has experienced rapid growth in computer use in workplace. This has led to increased incidence of related upper extremity cumulative trauma disorder which are injuries to soft tissues of the body occur over an extended time period.

Cumulative trauma disorders (CTDs) are disorders of the soft tissues (most frequently the tendons and nerves) due to repeated exertions and excessive movements of the body. Studies have suggested that there is an increased incidence of musculoskeletal disorders (MSDs) of the upper extremity in computer users. Keyboard are the most frequent used computer input device and most people have atleast some contact with a keyboard everyday. Proper placement (height and distance) design and use, and key usage are important characteristics to consider for computer keyboard typing. Common measure used to evaluate keyboard are posture, discomfort, keying force and user acceptance.

Keyboard design research has focused on ulnar and radial deviation, wrist extension, wrist support, forearm support, and shoulder and neck effects while using conventional keyboard, fixed and adjustable, split-angle keyboards.

Wrist extension, or positively angled, wrist and hand orientation has become standard when discussing keyboard angle. This fact is eminent when considering the design of the conventional keyboards each row, from bottom to top, is consecutively higher, results in positively sloped keyboard face. This design forces keyboard users to conduct typing tasks predominantly with wrist, hand and fingers extended. Only in the past decade wrist flexion has become a consideration for keyboard design in contrast to accepted standard, said to be between 0 degree and positive 25 degree slope.

Simononeau et al. showed that use of negative slope keyboard angle downwards from +15 degrees to -15 degrees, mean wrist extension decreased approximately 13 degrees.

Cook et al. showed that provision of forearm support during keyboard and mouse has been demonstrated to reduce neck and shoulder muscles activity and also reduce ulnar deviation and less reports of discomfort than the floating condition.

Aims and Objectives

To determine the effect of different computer keyboard slope angles and forearm support on user performance and comfort level.

Hypothesis

The use of negative keyboard slope with forearm support will increase the comfort level or ease of use and also prevent WMSDs.

Methodology

Forty subjects with their mean age (28.17 ± 3.8) year, mean weight (62.95 ± 6.84) and mean BMI (5.63 ± 0.20) participated in this study. All subjects are professional typist and were recruited from various part of the city. The purpose and procedure

of the study were explained to the subjects and a written consent was taken.

The study was conducted in Department of Physiotherapy, IAHSET, Medical College, Haldwani.

Inclusion Criteria

1. Should be 10 digit "touch" typists and typing atleast 2 hour per work day.
2. All subjects will be able to type atleast 40 words per minute (WPM).
3. No prior history of hand/wrist injury, free of pain or discomfort related to typing.
4. Subjects: 18-45 years.

Exclusion Criteria

1. History of any wrist or finger.
2. Cervical rediculopathy
3. Neurological deficit
4. Upper limb arthritis
5. Anti inflammatory medications.

Design

Experimental design.

Instrumentation

1. 2 wooden block (2 cm wide, 12 cm long and 1 ½ cm height).
2. Forearm support is build so that it is on the same plane as the keyboard.
3. An adjustable computer workstation (desk and chair) is used.
4. Typing test TQ 6.3 software – for collection of typing speed and data accuracy.
5. QWERTY keyboard.

Protocol

Based on the inclusion and exclusion criteria subjects were included in this study. Participants were made to sit on a chair in front of the computer monitor. During the testing session all the subjects were made to type 10 minutes with all the slopes (+7 degree, 0 degree, -7 degree) with and without support. The typing speed and accuracy were measured for each subject. Ease-of-use and comfort data was collected after subjects typed on each keyboard angle. Each subject was made to rate keyboard overall comfort and ease of use on a scale 1 to 6.

Procedure

Potential participants received a verbal and written description about the project, its objectives and the procedures used, and were asked to complete informed consent. A thorough assessment was done to establish the absence of any work related musculoskeletal disorders (WMSDs) associated with the hands and wrist.

A three minutes pre-test typing was completed for assessing

typing proficiency. Participants were required to have a net typing speed of 40 words per minute using digit 'Touch' method.

Participants were made to sit on the experimental computer workstation. The participants were seated in chair with a backrest in an upright position, in front of a video-display terminal (VDT) workstation that set up according to widely accepted guidelines for VDT workstations. Chair height was adjusted so that the knees formed a 90 degree angle and the feet were flat on the floor. A footrest, keeping an elbow angle of approximately 80 degree to 110 degree. Keyboard tray height was adjusted such that the elbow point was aligned with the wrist point, parallel to the floor.

During testing session, all subjects were made to type on all 3 slopes (7 degree, 0 degree, -7 degree) with and without forearm support. Different participant were made to type at different keyboard slopes randomly with or without forearm support and each participant was made to practice the typing task at the particular slope for 3 minutes to allow participants to become accustomed to typing angle of the experimental condition. Then the participant typed for 10 minutes. Typing test TQ 6.3 was used to administer a pre-test typing task, practice typing tasks, and test typing tasks for all experimental conditions. The programme provided text passages for participants to recreate. The task was limited to computer screen. Performance measures calculated by the software (i.e test duration, net typing speed, typing accuracy and number of errors) were automatically recorded for each condition in the form of reports. Ease of use and comfort data was collected after the participant typed on each keyboard angle by subjects rated the keyboard overall comfort and ease of use on a 1 to 6 scale. This procedure was

repeated until the subjects typed on the keyboard set at each 3 angle with and without forearm support.

Data Analysis

Data analysis was done using SPSS – 12.0 version. Mean and standard deviation for age, weight and BMI calculated.

Oneway ANOVA was used to compare the speed, accuracy, error, comfort and ease of use at different degrees of keyboard tilts within group A and group B.

Independent t-test was used to compare at each degrees of keyboard angle (7, 0 and -7) between the group A and group B for speed, accuracy, error, comfort and ease of use.

Significant level was set at $p \leq 0.05$.

Results

Mean and standard deviation for age, weight and BMI was calculated for subjects (Table 5.1)

Oneway ANOVA done to compare the variable at different degrees of keyboard slope within group A and group B, showed no significant differences in speed, accuracy and error, but showed significant differences in comfort and ease of use (Table 5.2 and 5.3).

Independent t-test used to compare different variable at different degrees (7, 0 and -7) of keyboard slope between group A and group B, showed no significant difference in speed, accuracy and error but significant difference seen in comfort and ease of use (Table 5.4).

Table 5.1: Mean and SD of age, weight and BMI for the subjects of Group A and Group B.

Age Mean \pm SD	Weight Mean \pm SD	BMI Mean \pm SD
28.17 \pm 3.81	62.95 \pm 6.84	5.63 \pm 0.20

Table 5.2: ANOVA between the variables at different degrees (7, 0 and -7) within Group A.

Variable	7 degree Mean \pm SD	0 degree Mean \pm SD	-7 degree Mean \pm SD	F Value	P Value
Speed	52.50 \pm 6.51	52.25 \pm 6.31	51.45 \pm 6.86	0.279	0.757
Accuracy	84.85 \pm 7.42	85.88 \pm 7.65	85.45 \pm 6.88	0.199	0.820
Error	76.50 \pm 33.48	71.10 \pm 36.46	71.12 \pm 33.06	0.328	0.721
Comfort	5.15 \pm 0.92	4.45 \pm 0.67	5.10 \pm 0.92	8.436	0.0007
Ease	5.27 \pm 0.64	4.30 \pm 0.60	4.40 \pm 0.95	20.409	0.0005

Table 5.3: ANOVA between the variables at different degrees (7, 0 and -7) within Group B.

Variable	7 degree Mean \pm SD	0 degree Mean \pm SD	-7 degree Mean \pm SD	F Value	P Value
Speed	53.00 \pm 6.55	52.12 \pm 6.89	50.52 \pm 6.25	1.459	0.237
Accuracy	86.24 \pm 7.00	84.34 \pm 7.17	83.29 \pm 7.54	1.713	0.185
Error	70.02 \pm 31.93	80.55 \pm 36.55	81.15 \pm 32.94	1.362	0.260
Comfort	4.75 \pm 0.70	4.45 \pm 0.63	3.95 \pm 0.67	14.341	0.0003
Ease	4.95 \pm 0.59	4.37 \pm 0.70	3.52 \pm 0.59	50.96	0.0001

Table: 5.4: Comparison of different 7 degree, 0 degree and -7 degree between Group A and Group B.

Variables		Group A Mean ± SD	Group B Mean ± SD	T Value	P Value
7 degree	Speed	52.5 ± 6.51	53.0 ± 6.55	0.342	0.733
	Accuracy	84.8 ± 7.42	86.2 ± 7.00	0.865	0.390
	Error	76.5 ± 33.48	70.0 ± 31.9	0.885	0.329
	Comfort	5.15 ± 0.92	4.7 ± 0.70	2.178	0.032
	Ease	1.27 ± 0.64	1.9 ± 0.59	2.349	0.021
0 degree	Speed	52.25 ± 6.31	52.1 ± 6.89	0.085	0.933
	Accuracy	85.8 ± 7.65	84.3 ± 7.17	0.924	0.358
	Error	71.1 ± 36.46	80.5 ± 36.65	1.156	0.251
	Comfort	4.45 ± 0.67	4.4 ± 0.63	0.000	1.000
	Ease	4.3 ± 0.60	4.3 ± 0.70	0.510	0.612
-7 degree	Speed	51.4 ± 6.86	50.5 ± 6.25	0.630	0.530
	Accuracy	85.4 ± 6.88	83.2 ± 7.5	1.340	0.184
	Error	71.1 ± 33.06	81.1 ± 32.94	1.358	0.178
	Comfort	5.1 ± 0.92	3.9 ± 0.62	6.329	0.0004
	Ease	4.4 ± 0.95	3.5 ± 0.59	4.908	0.0008

Discussion

The objective of the study was to determine the effect of computer keyboard slope and forearm support on users performance and comfort level. It was hypothesized that negative keyboard angle with forearm support would have significant effects on users comfort level and ease to use and minimized exposure to hypothesized risk factors for work related musculoskeletal disorders.

The only hypothesis that is supported by this study is that using the forearm support increases the 'comfort level' and 'ease to use' when compared with 'floating' posture.

There was no significant change seen in typing performance (speed, accuracy and error) across all 3 keyboard slope with and without forearm support. Positive (+7 degree), neutral (0 degree) and negative (-7 degree) with forearm support increased the comfort and ease of use. Hence the results does not support experimental hypothesis.

Typing Performance

There was no significant change in mean of typing speed, accuracy and error for all the slope with and without forearm support which indicate that subjects quickly adopted to new slope angles, even after 3 minutes of practice.

The result of the study supports the pervious studies conducted by Simoneau and Marklin R.W. and Hedge and Powers where they showed that keyboard with negative slopes did not impair typing performance.

The studies done by Mitchell A. et al. showed an increase in typing performance at 10 degree keyboard angle, while other negative angles (-20 degree, -30 degree)were comparable, its not better, than standard (7 degree). Hence, results of this study disagree with the previous study.

The Ease of Use and Comfort

The ease of use and comfort showed that the keyboard at -7 without forearm support was rated least comfortable and most difficult to use of all the keyboard tested. Most comfortable and ease of use rated for both negative keyboard slope (-7 degree) and positive (+7 degree) with foreram support.

The result of previous study is conducted by Gilad and Haral showed that a negatively sloped keyboard was subjectively evaluated as more comfortable to the findings of the standard keyboard configuration.

The findings n this study is similar to the findings of Simoneau and Marklin R. W. that keyboard at -15 degree was rated less comfortable and most difficult to use than keyboard with at -7.5 degree, 0 degree and 7.5 degree.

Mitchell A. Woods found that level of difficulty for use increased as the keyboard angle become more negative when compared with the standard configuration.

Forearm Support

There was a significant increase in comfort and ease of use following use of forearm support. Cook and Burgess-limerick showed that impact of forearm support on upper limb and wrist posture and muscle activity during keyboard use was compared with a floating posture. Forearm support was led to a reduction in extreme ulnar deviation and reports of discomfort were highest for the floating condition. Hence, this study supports their studies.

Providing forearm support is an effective intervention to prevent musculoskeletal disorders of upper limb and aids in reducing upper body pain associated with computer work.

Previous studies showed that the use of negative keyboard slope decreased wrist extension, forearm muscles activity and decreased the key stick force; decreased carpal tunnel pressure

and there by prevented the upper limb musculoskeletal disorders.

Studies showed that use of forearm support reduced neck and shoulder muscle activity less ulnar and radial deviation and significant decrease in neck, back, forearm and wrist discomfort and reduced upper body pain. Thereby providing of forearm support proves to be an effective intervention to prevent musculoskeletal disorders.

Alternative keyboard designs, which have long been proposed as a way of reducing fingertip forces, repetition, or awkward wrist postures, would ideally reduce these known risk factors without sacrificing productivity, comfort and ease of use.

Conclusion

The result of the study showed that using the forearm support increases the comfort level and easy to use when compared with floating posture and also minimize exposure to hypothesized WMSDS. The keyboard slope with and without forearm support did not have any effect on speed, accuracy and error.

However, within the group results showed that the 6-point comfort and ease of use rating of the keyboard at 0 degree with forearm support is less comfortable and slightly easy to use is compared with + 7 degree and -7 degree of keyboard angle. Keyboard of -7degree angle without forearm support showed less comfort and difficult to use compared with +7 degree and -7degree keyboard angle with forearm support.

It was evident from these results that one keyboard angle could not be identified, based on multiple measures used and varying results. Personal performance could decide which angle was best on the subjective measure. However, this study

concludes a typing angle the range of +7 degree to -7 degree with forearm support provides benefits compared to the floating posture.

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Effect of Deep Cervical Flexor Strengthening on Vertical Mandibular Opening on Subjects With Forward Head Posture

Dheeraj Lamba¹, Satish Pant², Girish Chandra³, Asha Joshi⁴, Divya Dalakoti⁵

¹Incharge, ^{2,3,4,5}Interns Dept of Physiotherapy, IAHSET Medical College Haldwani

Introduction

The temporomandibular disorders (TMD) include a variety of condition associated with pain and dysfunction of the masticatory muscles. An estimate 20% of population is affected by this disorder. A wide variety of physical techniques including joint mobilization, exercise prescription, electrotherapy, education, biofeedback and relaxation, and postural correction, have been used in the management of temporomandibular joint (TMJ) disorders.

Vertical mandibular opening is measured by Interincisal distance between edges of right upper and lower central incisors as measurement with a millimeter ruler. The normal opening of adults is between 35 to 50 mm i.e. 3.5 to 5 cm. but the functional opening is 25 to 35 mm i.e. 2.5 to 3.5 cm or at least two knuckles between teeth.

The resting position of mandibular plays important role to produce movement of vertical mandibular opening. In resting position of mandibular, the lip is in light contact or slightly apart, the opposing teeth are separated, all the jaw muscles are at rest function and the mandible is passively suspended against gravity.

Normally, no occlusal contact exist between the maxillary and mandibular teeth when the muscles are relaxed. The distance has been measured to be 2-4 mm (freeway space or interocclusal distance). When the resting vertical dimension is altered, as clinically observed with faulty posture, it encroaches the freeway space, the mandibular condyle may intrude upward and backward in glenoid fossa, the teeth may be in contact eliminating the rest position and creating tension on the muscle of mastication and stress on teeth and supporting structures. The tongue is suspended like sling by its myofacial and ligamental attachments from the styloid process of the temporal bone and the anterior portion of the mandible. It has been demonstrated that cervical muscle influences masticatory muscle activity. The influence of posture and stress on musculoskeletal pain and dysfunction is a prime etiologic factor that is commonly overlook. Normal mandibular rest position may be altered by respiratory, posture, masticatory and temporomandibular intracapsular disorders.

The forward head posture is commonly associated with a temporomandibular joint dysfunction and the temporomandibular joint dysfunction is commonly associated with a forward head posture.

Aims and Objective

Observe the effect of deep cervical flexor strengthening on vertical mandibular opening on subjects with forward head posture. This study is to determine if the correction of forward head posture may help to improve the temporomandibular function.

Hypothesis

The deep cervical flexor strengthening is effective in improving forward head posture and also has an effect on vertical mandibular opening.

Methodology

Sample

30 subjects with forward head posture (FHP) participated in this study, but 3 were lost in follow-up till end.

Only 27 subjects (14 female and 13 male) completed the exercise protocol of one month.

The subjects were recruited from Sushila Tiwari Memorial Hospital, Haldwani. The subjects were of mean age 23.15 + 2.50 years, mean height 161.85 + 8.60 cm and mean weight 55.96 + 9.31 kgs.

Inclusion Criteria

1. Age- 18-30 years.
2. Both male and female subjects.
3. All subjects having forward head posture (craniovertebral angle less than 49 degrees.).

Exclusion Criteria

1. Any history of trauma of cervical region.
2. History of cervical spine pathology.
3. History of dizziness and vertigo.
4. Postural abnormalities like scoliosis.
5. Torticollis.
6. Known medical problems like Rheumatic arthritis, Ankylosing spondylitis and Tuberculosis of spine, bones or joints.
7. Painful temporomandibular joint (TMJ).
8. Any popping sound or locking of temporomandibular joint.
9. Difficulty with functional activities of temporomandibular joint, like chewing, talking, yawning.
10. Recent teeth excision.
11. Current teeth pain or teeth infection.
12. History of tobacco chewing.
13. Mouth splinting.

Study Design

Experimental study.

Instrumentation

1. Digital camera- A digital Nikon camera (Cool pix L10) with 5 mega pixel and 3x zoom lenses was used.
2. Tripod camera stand- A Simpex tripod camera stand was used.
3. Measuring tape.
4. Adhesive skin markers- Red color adhesive marker was used to denote the anatomical landmarks.
5. Image-tool software- UTHSCSA image-tool software for windows version- 3.00 was used.
6. Plumb line
7. Millimeter ruler- A 15 cm ruler was used.
8. Disposable gloves.
9. Disinfected liquid- Isopropyl alcohol U.S.P. liquid was used

to remove skin secretions from the site of anatomical landmarks fixation and to clean the millimeter ruler, before and after taking mandibular opening of each subject.

10. Pressure biofeedback- A pressure biofeedback unit (manufactured by Chattanooga group, Inc, Hixson, TN) was used for exercise performance.
11. Stop watch- A runner 2000 digital stop watch was used.

Protocol

Based on inclusion and exclusion criteria, the subject were recruited for the study. Each subject was informed about the purpose of the study and proper instructions were given about procedure. All subjects went through the consent form, prior to participation. Anatomical landmarks were marked at C7 and tragus of the ear. Digital photograph was taken for measuring the craniocervical angle. After this subject were checked for vertical mandibular opening.

Procedure

All the subject were ask to sit comfortably on back supported armless chair with both feet flat on floor, hips and knees positioned at 90 degree angle and buttock positioned against the back of chair. The subjects were asked to rest their hands on their lap and to keep their shoulder against the back of the chair. Adequate exposure of neck up to shoulder level to clearly define anatomical landmarks was done. The most prominent spinous process at the base of cervical spine was palpated. After it was identified, the cervical spine was passively flexed and extended to verify which one moved first. C6 vertebra should be more mobile, whereas C7 should demonstrate less motion. Skin over the anatomical landmarks was wiped with cotton soaked in spirit to remove skin secretions for proper fixation of adhesive markers. Anatomical landmarks were marked with marker pen; thereafter adhesive markers were fixed over the anatomical landmarks. Then taken the measurement of the height between ground and C7 in sitting position of each subject was done with help of measuring tape. That same reading was taken to adjust camera height over the tripod. The camera was placed so that the center of the lens was 0.8 meter from the subject in orthogonal to sagittal plane of the subject.

Distance between chair and tripod was fixed at 0.8 meter and not altered in any conditions.

The craniocervical angle was measure by angle between mid point of the adhesive marker at tragus of right ear and mid point of the reflective marker at C7. This angle described the position of head relative to C7 when viewed from right side of head relative to C7. Then the photographs were transferred to laptop for measuring the craniocervical angle by using imagetool software.

After that all subjects were asked to sit comfortably on back supported armless chair with feet flat on floor, hips and knees positioned at 90 degree angle and hands on their lap. The subjects were asked to focus on a point directly in front of them and to open their mouth as widely as possible without feeling any strain. The vertical mandibular opening was measured between the incisal edges of the right upper and lower central incisors teeth by using a millimeter ruler. The same procedure was repeated for three times and mean value of the readings obtained. A pair of sterile hand gloves was worn throughout the procedure. The subjects were not asked to eat or chew gum for at least one hour before the measurement.

The exercise procedure with pressure biofeedback (craniocervical flexor exercise) was explained to the subject. Low load endurance exercises were used to increase the tonic holding capacity of deep neck flexors muscles. In this, subject was positioned in supine lying. Then pressure biofeedback was placed between the plinth and the posterior aspect of the cervical spine just below the craniocervical junction. The subject's head

and neck was positioned to ensure a neutral cervical spine and craniocervical position. The pressure sensor was inflated to 20 mm of Hg so that the space can be filled between the back of the neck and the plinth. As already instructed, subject placed the tongue on the roof of the mouth, lip together but teeth just apart, then asked the subject to posterior retraction of chin to push neck directly back on the sensor. Each subject was given sufficient time to practice the same exercise with pressure biofeedback unit. The dial was kept in front of the subject so that he can monitor any deflection of the pointer during holding phase which was 10 second. The feedback which was given by the pressure sensor showed the subject's ability to hold the position in a controlled manner.

Two sets of 10 repetitions were done, with 2 minute rest in between. This exercise was given to all the subjects for 5 days in a week for one month. A home exercise program was instructed to all subjects for rest of 2 days of the week. For home exercise program the subjects was asked to placed a 4 inches towel roll under the neck at place of pressure biofeedback unit and performer the same procedure of craniocervical flexion exercise.

After 1 month the outcome measures were assessed again for craniocervical angle and vertical mandibular opening by same procedure which was already described.

Data Analysis

Data was analyzed with the SPSS statistical package (version-12). Descriptive statistics (age, height, weight) were calculated in terms of number of subjects, minimum and maximum values, mean and standard deviation.

Student's paired t-test was used to test change in quantitative data preintervention and postintervention i.e. craniocervical angle and vertical mandibular opening.

Pearson product moment correlation analysis was used to study correlation between craniocervical angle and vertical mandibular opening for all the subjects.

Results

Sample comprised of 27 of subjects recruited in one group. The age of subjects ranged from 19 to 28 years, mean age was 23.15 ± 2.50 years. The height ranged from 151 to 178 cm, mean height was 161.85 ± 8.60 cm. The weight ranged from 40 to 85 kg, mean weight was 55.96 ± 9.31 kg. (Table-5.1)

The mean value of pre intervention craniocervical angle (C.V.A.) of the subjects was 45.13 ± 11.05 and the mean value of post intervention craniocervical angle of the subjects was 54.16 ± 10.79 . The mean value of pre intervention vertical mandibular opening (V.M.O.) of the subjects was 3.49 ± 0.24 and the mean value of post intervention vertical mandibular opening of the subjects was 2.99 ± 0.23 . (table-5.2)

Compared with baseline data the mean change in craniocervical angle, after the 30 days of exercise protocol was -9.03 ± 2.47 . Subjects with forward head posture demonstrated a significant progressive increase in craniocervical angle post intervention. ($t = -18.95$, $p < 0.001$).

Following the 30 day of intervention of the exercise mean change in vertical mandibular opening was 0.49 ($SD = 0.09$). All the subjects in the group showed reduction in vertical mandibular opening from pre-intervention and post-intervention ($t = 26.31$, $p < 0.001$). (table-5.3)

Correlations

The correlation of mean change in craniocervical angle with mean change in vertical mandibular opening of the subjects was found 0.27 which is a poor correlation between the variables.

Table 5.1:

Variables	Values (Mean + SD)	Minimum	Maximum
Age (years)	23.15 + 2.50	19	28
Height (cm)	161.85 + 8.60	151	178
Weight (kg)	55.96 + 9.31	40	85

Table 5.2: Mean value of pre intervention and post intervention C.V.A. and V.M.O.

	Preintervention	Postintervention
C.V.A.	45.13 + 11.05	54.16 + 10.79
V.M.O.	3.4 + 0.24	2.99 + 0.23

Table 5.3: Comparison of C.V.A. and V.M.O.

Variables	Mean difference post intervention	t-value	p-value
C.V.A.	9.03 + 0.47	-18.95	0.000
V.M.O.	0.49 + 0.09	26.31	0.000

Fig 5.1: Mean value of C.V.A. pre-intervention to post-intervention

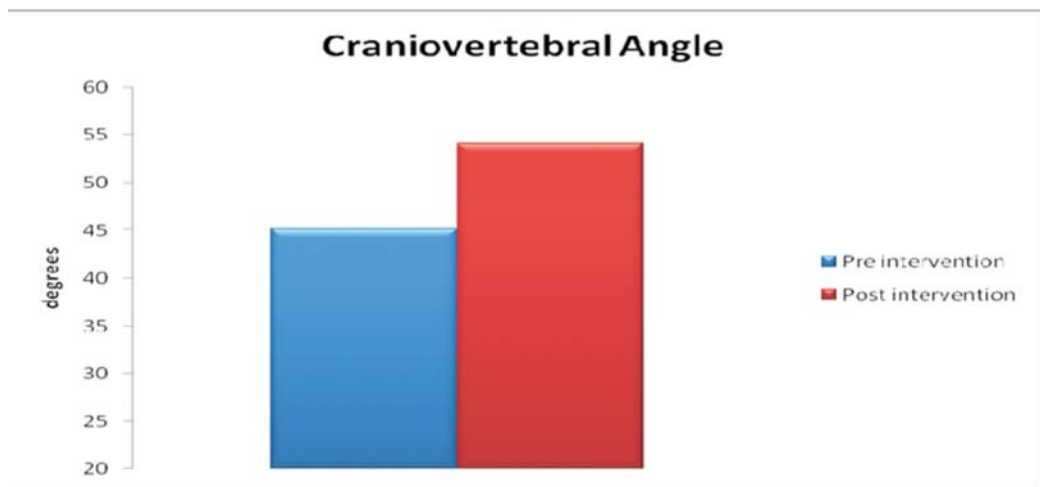


Fig 5.2: Mean value of V.M.O. pre-intervention to post-intervention

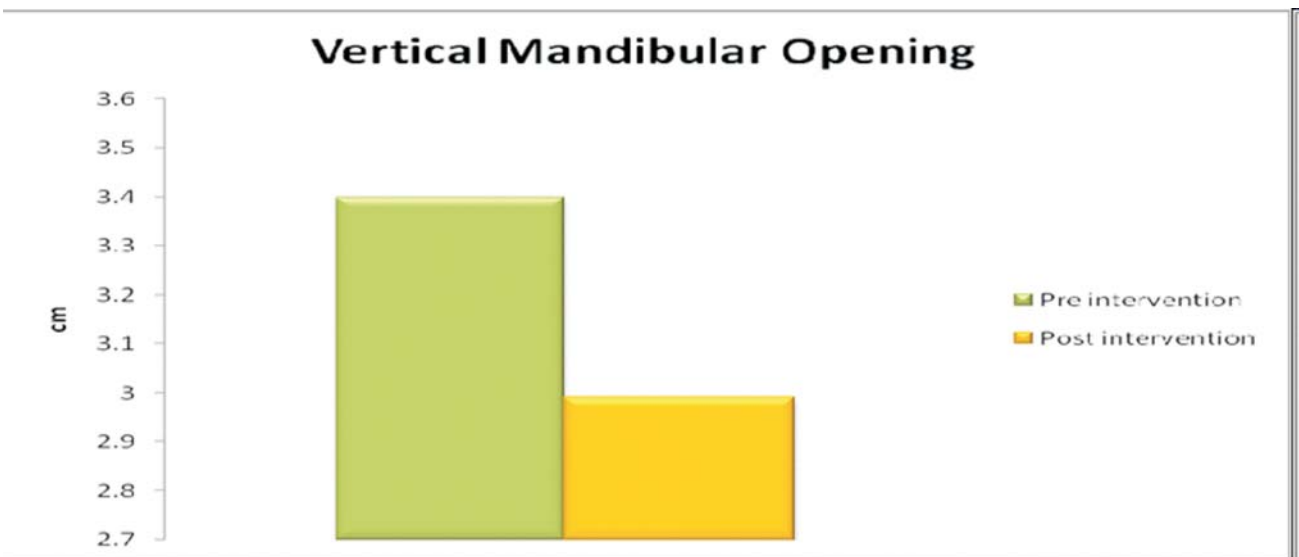
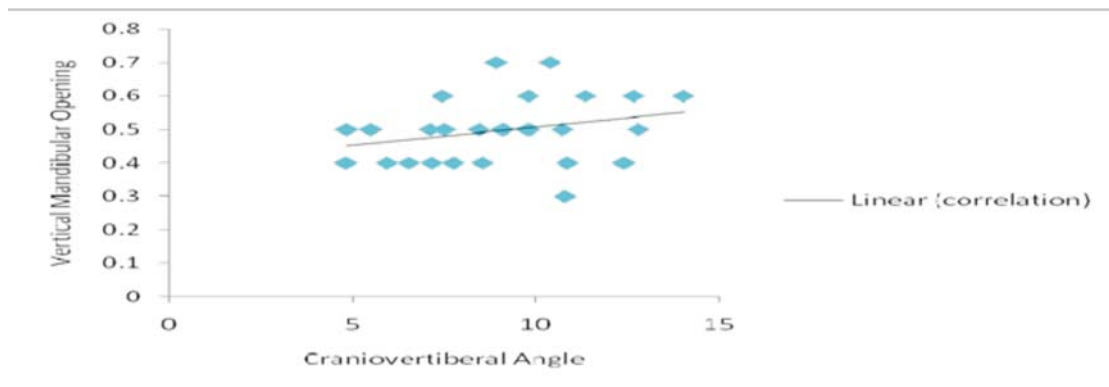


Fig. 5.3: Correlation of C.V.A. and V.M.O. of between pre-intervention to postintervention



Discussion

The result of the study showed a relationship exists between the strengthening of deep cervical flexors and the vertical mandibular opening. The results showed that strengthening of deep cervical flexors cause increase in craniovertebral angle and decrease in vertical mandibular opening. The results of this study also show that there is decrease in vertical mandibular opening after the deep cervical flexors strengthening. This result also support the previous researches that the postural training affects the temporomandibular joint. The present study reported that there is increased in vertical mandibular opening associated with a forward head posture (Craniovertebral angle less than 49°) in subject with a normal temporomandibular joint.

The study proved that there was increased in vertical mandibular opening after correction of a forward head posture. The subject of the study was a 48 years old female having temporomandibular joint dysfunctions. The result of the study showed the relation of stomatognathic system with posture. Some recent study also shows this relationship. The study documented that with anterior position of the head also influences the position of center of gravity and confirm the relationship between the body posture and temporomandibular joint dysfunctions. The results of the present study showed a poor correlation between mean changes in Craniovertebral angle and vertical mandibular opening. This is supported by Darlow et al which showed no correlation between temporomandibular joint dysfunctions in relation to posture. Some of the subjects reported to have neck pain preintervention due to poor postural habits. They reported neck pain with or without muscle spasm around upper back after prolong sitting, computer work or studying. All the subjects associated with neck pain got relief in pain postintervention.

Forward head posture leads to excessive lengthening with associated weakness of anterior vertebral neck flexors and tightness of neck extensors. Additional changes include shortening of suboccipital and suprahyoid musculature and lengthening of infrahyoid muscle with elevation of hyoid bone. There is also isometrical shortening of posterior of posterior cervical muscles while anterior submandibular muscles are stretched to cause retrusive force on mandibular. In erect head posture the initial condyle rotation occur as mandibular elevators (masseter, temporal and medial pterygoid muscles) gradually relax and allowing gravity to depress the mandibular. The excessive mouth opening is also common when joint capsule is stretched and joint become hypermobile. Temporomandibular joint hypermobility has been postulated when the condyle is excessively passing the articulating eminence at the translation phase of mandibular opening.

The forward head posture causes intrusion of condyle upward and backward into the glenoid fossa. The improved head position may decrease the stretch of anterior cervical muscles with a resultant decreased in retrusive force on mandible. Thus the result of the present study shows that the strengthening of deep cervical flexor causes decrease in retrusive force of

mandible and tension length of anterior neck muscles and further it causes decrease in mouth opening.

Conclusion

It is concluded from this study that the strengthening of deep cervical neck flexor muscle has an effect on the vertical mandibular opening. This causes a significant decrease in mouth opening on subject having a normal temporomandibular joint.

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Effects of Limb Dominance on Cross Training

Dheeraj Lamba¹, Heena Maheshwari², Kavita Kandpal³, Babita Mishra⁴, Preeti Joshi⁵

¹Incharge, ^{2,3,4,5}Interns, Dept of Physiotherapy, IAHSET Medical College Haldwani

Introduction

Cross education' or the 'cross training' is an inter limb phenomenon first reported by Scripture. The strength training of one limb produces increased strength of contra lateral homologous group. The increase in strength observed with strength training is due to both hypertrophy and adaptations within nervous system. Adaptation to strength training are most often specific to movement pattern, velocity, contraction type and contraction force used during training. Improvements in strength training can occur with training with high force contractions or even with mental rehearsal of a contralateral task. Improvement in contralateral muscle strength can also occur when muscle contractions are evoked by electrical stimulation. It has hitherto been reported by many authors that strength training of one limb causes a significant increase in voluntary strength not only in trained limb but also in contralateral limb. The magnitude of cross education is normally about 25% but in a few cases, force or skill transfer reached 80%. The hallmarks of these adaptations are that the amount of force or skill transfer is proportional to the gains in the trained muscle. The strength gains in the contra lateral homologous muscle are specific to the involved muscle pair and are independent of limb dominance, age, gender. However, the physiological mechanisms underlying the strength increase in contra lateral limb remain unclear.

Strength is determined not only by quantity and quality of the involved musculature but also by the degree to which the muscle mass has been activated. It is well established that physical activity that incorporates high muscle tensions, i.e., heavy resistance strength training, can lead to an increase in maximal contractile muscle force. However, the specific mechanisms responsible for this adaptation are not fully known. Strength training programmes are commonly used to enhance performance, reduce the incidence of overuse injuries, and assist in the rehabilitation of orthopaedic and athletically induced musculoskeletal injuries. Side-to-side strength imbalances in the range of 10% to 15% in other muscle groups have been associated with increased injury rates. Knapik et al reported increased lower extremity injury rates in female athletes demonstrating 15% strength deficits of either the left quadriceps or hamstrings muscles. 10% side-to-side strength differential in the hamstrings was associated with an increased incidence of hamstring strains. Cross training may have clinical relevance for prescribing resistance exercise in strength rehabilitation. Many authors have proved that there is more strength in dominant limb than non-dominant limb. Ross revealed higher dominant isokinetic knee strength than non-dominant knee strength in young adult men and women. Burnie and Brodie (1986) determined that isokinetic knee flexion or extension strength difference did not exist between the dominant and nondominant leg in preadolescent males. Masuda (2003) found negligible differences between the dominant and non-dominant isokinetic leg strength during knee flexion and extension, hip flexion and extension, hip abduction and adduction in university soccer players. Neumann (1988) found no difference between right and left isometric hip abduction torque across multiple hip angles in young adult men and women. In contrast to these findings, Hunter et al (2000) found slightly higher dominant knee extension isometric torque ($128.1 \pm 3.0\text{Nm}$) compared to the

non-dominant leg ($122.3 \pm 3.0\text{Nm}$) in 217 women between the ages of 20 to 89 years. Comparison of strength between dominant and non-dominant limb was significantly done by many authors. Contralateral training effects have been extensively investigated because they provide important insights into physiological determinants of muscle strength. Nonetheless the available evidence now clearly indicates that the contralateral strength training effect is real, not just an experimental artifact. Munn et al conducted a meta analysis of the entire available literature and concluded that increased contra lateral limb strength by 7.8% corresponds to 35% strength gain on ipsilateral trained side. None of the authors has studied the effect of limb dominance on contralateral strength gain. Therefore, the study was design to investigate whether limb dominance has any effect on cross training.

Aims and Objective

The purpose of study was to compare, in a randomized fashion, the effects of limb dominance on cross training.

Hypothesis

Limb dominance will not have any effect on cross training.

Methodology

Sample

Thirty healthy male and female (7 females + 23 males) subjects from Sushila Tiwari Hospital volunteered to participate in the study. All the subjects were right side dominant and were grouped under two different groups. Each group had 15 subjects each.

Group A- Subjects included with mean age 24.80 ± 1.52 , mean weight 60.13 ± 9.48 .

Group B- Subjects included with mean age 24.73 ± 1.03 , mean weight 62.26 ± 8.73 .

Inclusion Criteria

1. Both male and female subjects included.
2. Age 18-28 years.
3. Height 150-180cm.
4. Weight 55-75 kg.
5. BMI 19.5-24.5

Exclusion Criteria

1. History of lower extremity fracture.
2. History of knee surgery.
3. Presence of any deformity at knee joint.
4. Limb length discrepancy.
5. Hamstring tightness.
6. History of lower extremity muscular strain or ligamentous sprain.
7. Presence of knee instability.
8. Presence of any cardiovascular and respiratory problems.

Study Design

Experimental study.

Instrumentation

Humac Norm (CSMI/Humac Norm testing and Isokinetic rehabilitation system) Humac Norm is used for measuring and improving human performance in the clinic training room and research laboratory.

Protocol

Procedure

30 college students were selected and whole procedure was explained to the subject on the first day and a consent form was signed by each subject. Then, they were randomly assigned into 2 groups. Height and weight of each subject was taken. Blood pressure and heart rate were monitored. To assess the limb dominance subjects were asked to kick the ball and limb used to kick ball was considered as dominant limb. Subjects were divided into two groups:

Group A- This group trained the dominant leg only.

Group B- This group trained the non-dominant leg only.

Training Procedure

The participants warmed up by running on a treadmill for 5 minutes at self selected speed. To localize the contraction to proper muscle groups, the subjects were seated and securely strapped at the thigh, hip and chest. The axis of dynamometer was aligned at the pivot of knee joint. A lever was connected just above the ankle.

Pre-exercise Testing

Group A- Testing was done on non-dominant limb on first day of exercise at speed 60°/sec.

Group B- Testing was done on dominant limb on first day of exercise at speed 60°/sec.

Exercise Protocol

Concentric training to knee flexors and extensors was given to each group. For Group A, dominant limbs were exercised and for Group B nondominant limbs were exercised. Each exercise trial consisted of 6 maximal concentric contraction of

knee flexors and extensors for a total of 12 reciprocal contraction. 30 sec rest period in between training was given 3 times/ week for a period of 2 weeks.

Post-exercise Testing

In each group isokinetic testing was done again after 2 weeks training to assess improvement of peak torque on non-trained homologous muscle group.

Data Analysis

The data was analyzed by using SPSS Version 12.0 software. Paired sample t-test was done to calculate the peak torque within the groups.

Independent sample t-test was done to calculate the peak torque between groups.

The level of significance was set at 0.05.

Results

Paired t-test done to calculate the peak torque for knee flexors and extensors within groups.

For Group A, mean and standard deviation of pre and post extension peak torque were -27.400 ± 19.204 with p value 0.000. Mean and standard deviation of pre and post flexion peak torque were -14.066 ± 14.409 with p value 0.002. Statistical analysis showed significant difference within the group (Table 5.2)

For group B, mean and standard deviation of pre and post extension peak torque were -18.466 ± 8.757 with p value 0.000. Mean and standard deviation of pre and post flexion peak torque were -9.800 ± 7.321 with p value of 0.000. Statistical analysis showed significant difference within the group (Table 5.3).

Independent sample t-test done to calculate the peak torque for flexors and extensors between groups. Mean peak pre extension torque for group A was 44.733 ± 22.691 and for group B was 57.933 ± 23.119 . Statistical analysis showed no significant difference between the groups $P=0.126 (>0.05)$ (Table 5.4). Mean peak post extension peak torque for group A was 72.133 ± 22.812 and for group B was 76.400 ± 18.718 . Statistical analysis showed no significant difference between the groups $P=0.580 (>0.05)$ (Table 5.4). Mean peak pre flexion torque for group A was 17.600 ± 10.655 and for

group B was 23.066 ± 14.728 . Statistical analysis showed no significant difference between the groups $P=0.254 (>0.05)$ (Table 5.5).

Mean peak post flexion torque for group A was 31.666 ± 16.329 and for group B was 32.866 ± 19.988 . Statistical analysis showed no significant difference between the groups $P=0.858 (>0.05)$ (Table 5.5).

Table 5.1: Mean and SD of Age and Weight for the subjects of Group A and Group B.

Variable	Mean \pm Standard deviation	
	Group A	Group B
Age	24.80 ± 1.52	24.73 ± 1.03
Weight	60.13 ± 9.48	62.26 ± 8.73

Table 5.2: Comparison of mean and standard deviation Peak Torque of Extensor and Flexor Muscle group within Group A

Variable	Mean \pm Standard deviation	t value	p value
Pre and Post Extension Peak torque	-27.400 ± 19.204	-5.526	0.000
Pre and post Flexion Peak torque	-14.066 ± 14.409	-3.781	0.002

Table 5.3: Comparison of mean and standard deviation Peak Torque of Extensor and Flexor within Group B

Variable	Mean ± Standard deviation	t value	p value
Pre and Post Extension Peak torque	-18.466 ± 8.757	-8.167	0.000
Pre and post Flexion Peak torque	-9.800 ± 7.321	-5.184	0.000

Table 5.4: Comparison of mean and standard deviation of Pre and Post Extensor Peak Torque between Group A and B

Variable	Mean ± Standard deviation		t value	p value
Pre-test	Group A	Group B	-1.165	0.254
	17.600±10.655	23.066±14.728		
Post-test	31.666±16.329	32.866±19.988	-.180	0.858

Table 5.5: Comparison of mean and standard deviation of Pre and Post Flexor between Group A and B

Variable	Mean ± Standard deviation		t value	p value
Pre-test	Group A	Group B	-1.165	0.254
	17.600±10.655	23.066±14.728		
Post-test	31.666±16.329	32.866±19.988	-.180	0.858

Discussion

The purpose of this study was to determine whether the functionally dominant and non-dominant legs of healthy individuals differ on cross training effect. The results of the present experiment indicate that the limb dominance does not have an effect on cross-training, thereby supporting the hypothesis. There is also evidence that the strength training program improved peak torque of the trained leg as well as the untrained leg in the subjects who participated in the strength training program. The results of this study are in agreement with the majority of previous research that reveals no difference in peak torque between the dominant and non-dominant limbs. Holmes and Alderink, 1984 revealed no difference in isokinetic strength of the quadriceps femoris and hamstring muscles in high school-aged students between dominant and non-dominant limbs. Similar results were found in isokinetic plantar flexion strength. Wei-Hsiu (2009) found no significant difference in unilateral ankle internal/external rotation and static balance control in the dominant and non-dominant limbs in young, healthy adults. B.D. Beynon found no significant difference in single-leg strength training program for the muscles around the untrained ankle between dominant and non-dominant legs. It is likely that peak torque responds more quickly to strength training as compare to power and endurance. Similar studies have also been conducted on athletes in an open kinetic chain test. Masuda assessed isokinetic hip and knee strength and revealed that no difference between dominant and non-dominant leg in elite soccer player. Agre and Baxter (1987) and Ostenberg (1998) also found no difference in isokinetic knee extensor strength between dominant and nondominant leg in men and women soccer players. In a recent study, Magalhaes did not find a significant difference in isokinetic knee extensor strength between the dominant and non-dominant leg in elite volleyball and professional soccer players.

The results of the present experiment may be explained by Previc's neurodevelopmental theory, explained for foot dominance in the unilateral and bilateral context. According to this theory, the idea that there is no clearly dominant limb in bilateral context seems reasonable, that is, one foot provides necessary postural support while the other executes voluntary (mobilizing) action as the complementary role action. K McCurdy

and G Langford revealed that the strength, measured in a weight bearing stance, is similar between the dominant and non-dominant leg in young adult men and women who participate in general activities of daily living and are untrained in unilateral exercises. The results of the present study indicate that the peak torque measured between dominant and non-dominant leg in young adult men and women have no significant difference in individuals who participate in general activities of daily living. Kramer and Baslow 1990 revealed significantly higher 7% knee torque in dominant leg for intercollegiate soccer players and suggested that the difference in the volume of activity between the dominant and non-dominant leg could produce side-to-side imbalance. Imbalance between limbs is also thought to be related to an increase risk of injury. (Agre and Baxter, 1987). Thus the results of the study are in agreement with Previc's neuro developmental theory and the fact that subjects in this study were non athletes as could also be a factor explained by K McCurdy and G Langford. These findings are particularly helpful to the clinician who uses singlelegbalance testing in the evaluation and rehabilitation of lower limb injuries. When asymmetry is present in single-leg balance testing, it is a function of acute or chronic injury and not due to functional leg dominance. Based on the results of present study, it can be said that limb dominance does not have an effect on peak torque gained in untrained limb (cross training), for young adult men and women who participate in general activities of daily living.

Conclusion

It can be concluded from the present study that there is no significant difference in effect of cross training between the dominant and non-dominant leg for non-athletes.

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Relationship Between Motor Impairments of Hand and Manual Ability in Spastic Cerebral Palsy Children

Gagandeep Kaur¹, Poonam Mehta², Chandan Kumar³

¹Student, ^{2,3}Lecturer, M M IPR, M M University, Mullana, Ambala, Haryana, India

Abstract

Introduction

Cerebral palsy is a static neurologic condition resulting from brain injury that occurs before cerebral development incomplete. Hand impairments are related to the manual ability. Hand impairments are not rare in the cerebral palsy but they are not considered significantly. We assessed the hand impairments in relation to manual ability amongst Cerebral palsy children who were spastic diplegics and quadriplegics.

Material and Methods

Thirty cerebral palsy children were assessed. Hand impairments included grip strength, fine finger dexterity, gross manual dexterity and these were assessed by hydraulic hand handle dynamometer, pegboards and box and block test respectively. Manual ability was assessed by

Abilhand kid's questionnaire. All the subjects according to the inclusion criteria were included in the study. One time assessment was taken. For the grip strength and fine finger dexterity three readings were taken and average of these three readings was taken as the final score. For box and block test single reading was taken. Spasticity was assessed by the Modified Ashworth Scale. Results were calculated by using Pearson's correlation.

Results

There is a significant correlation between grip strength, fine finger dexterity, gross manual dexterity and manual ability. Grip strength has correlation of $-0.459 (P < 0.05)$ with the manual ability, fine finger dexterity has the correlation of $-0.732 (P < 0.05)$ with the manual ability and gross manual dexterity has the correlation of $-0.781 (P < 0.05)$ with the manual ability.

Key Words

Cerebral palsy, impairments, manual ability.

Introduction

Cerebral palsy is an umbrella term encompassing a group of non progressive, non contagious motor condition that causes physical disability in human development, chiefly in various areas of body¹. Martin Bax defined "Cerebral palsy as a disorder of posture and movement that occurs secondary to damage to the immature brain before, during or after birth. This disorder is called a static encephalopathy because it represents a problem with brain structure and function². The birth prevalence of cerebral palsy ranged from 1.18 to 1.97 per 1000 live birth each year, with a mean of 1.51 per 1000 live births³.

Address for correspondence:

Gagandeep Kaur

M.P.T. Pediatrics Student

Contact number +91-09896429194.

E-Mail: physiogagan@yahoo.com

Cerebral palsy is a static neurologic condition resulting from brain injury that occurs before cerebral development incomplete. Because brain development continues during the first two years of life, cerebral palsy can result from brain injury occurring during the prenatal, perinatal or post natal periods. Etiology of cerebral palsy include problems in intrauterine development (e.g. exposure to radiation, infection), asphyxia before birth, hypoxia of the brain and birth trauma during labor and delivery, complications in the perinatal period or during childhood¹. Brain development continues during the first two years of life, cerebral palsy can result from brain injury occurring during the prenatal, perinatal or post natal periods⁴.

According to tone classification includes spastic, athetoid i.e. hypotonic/floppy or atonic. Spastic type of cerebral palsy is the commonest type. Spastic Cerebral palsy associated with damage to cortical motor areas and underlying white matter, choreoathetotic cerebral palsy associated with damage to basal ganglia, ataxic cerebral palsy is associated with damage to cerebellar structures⁷ Spastic cerebral palsy consists of hyper tonicity of clasp-knife variety, abnormal postures, weakness in initiation of motion. Changes in hypertonus and posture may occur with excitement, fear or anxiety. Intelligence is impaired than athetoid Impairments include motor impairments and sensory impairments. Motor impairments include abnormal reflexes, disturbances in balance, locomotion, propulsion of objects and sensory impairments include tactile pressure stereognosis, proprioception⁴ cerebral palsy. Perceptual problems, sensory loss, epilepsies, poor ribcage abnormalities and poor respiration^{4,5}.

The aim of physiotherapy is to make patient maximum independent. Physical therapy includes muscle strengthening and fitness programs as popular interventions for cerebral palsy; however advocates of neuro developmental treatment advise against the use of resistive exercises because it is believed to increase spasticity¹⁸. It is also shown that resistive exercise could be beneficial in strengthening when muscle weakness causes dysfunction¹⁹. Stretching exercises, sensory stimulation, PNF, Biofeedback are also used^{4,5}. Orthotic devices such as ankle foot orthosis are often prescribed to minimize gait irregularities²⁰. AFO's have been found to improve several measures of ambulation, including reducing energy expenditure and increasing speed and stride length^{20,21}.

Previous studies show that hand impairments and manual ability are correlated to each other. In previous studies, grip strength was measured by Jamar dynamometer, gross manual dexterity was measured by box and block test, fine finger dexterity was measured by Purdue pegboard. But in present study, the grip strength is measured by Hydraulic hand handle dynamometer which measures the strength in kgs, gross manual dexterity is measured by box and block test, in which one wooden box is there having six inches partition in it with 150 blocks of one inch and fine finger dexterity is measured by pegboards (square pegboard and fine finger test). The square pegboard is twelve inches in length and twelve inches in width. It consists of 25 pegs and 25 holes. The fine finger dexterity test consists of

two square wooden boards, one is having 49 holes in it and other is having one cup which consists of 49 pins in it and one forcep in it.

Manual ability is a major component of daily living activities. Hand impairments are related to the manual ability. Hand impairments are not rare in the cerebral palsy but they are not considered significantly. There are very few studies done to assess the hand impairments and to measure the manual ability. Because there is lack of instrumentation to assess these impairment and manual ability. This study will help to measure the hand impairments and manual ability. And will also help to find the relation between these impairment and manual ability.

The objective of this study is to find the relationship between hand impairments (Grip strength, gross manual dexterity and manual ability) and manual ability in children with spastic cerebral palsy (diplegics and quadriplegics).

Objective of the Study

To evaluate hand impairments i.e. grip strength, fine finger dexterity and gross manual dexterity in relation to manual ability.

Hypothesis

Alternate Hypothesis

There is a significant correlation between hand impairments and manual ability.

Null Hypothesis

There is no significant correlation between hand impairments and manual ability.

Methodology

This chapter contains cerebral palsy children's hand impairments and their relation with the manual ability.

Study Design

Correlation.

Sample Size

A convenience sample of total 30 subjects with already diagnosed cerebral palsy were included in the study.

Study Population

Subjects were taken from the M.M.I.P.R Mullana and M.M. Hospital Mullana.

Inclusion Criteria

Children who fulfilled the following criteria were taken into the study.

1. Children diagnosed with cerebral palsy (Diplegics and Quadriplegics).
2. Age between 5-13y (Both boys and girls).
3. Children with no major intellectual deficits.

Exclusion Criteria

1. Children with learning disabilities.
2. Children undergone surgical procedures (for upper limb)
3. Children with major intellectual deficits.

Outcome Measures

In the study the following outcome measures were taken.

1. Abilhand kids questionnaire.
2. Grip strength.
3. Gross manual dexterity.
4. Fine finger dexterity

Instrumentation

Following instruments were used in the study.

1. Hydraulic Hand Handle Dynamometer.
2. Box and Block Test.
3. Pegboard Test.

Procedure

30 subjects were selected on the basis of inclusion criteria. A thorough assessment was done. The procedure of the study was explained to parents/guardian and written consent was taken. The children were tested individually and instructions that how to perform each test were given to them. Three motor impairments i.e. Grip strength, Gross manual dexterity and fine finger dexterity were assessed on both hands, starting with dominant hand. Handedness was determined by writing hand preference. Grip strength was measured with Hydraulic Hand handle dynamometer. The grip strength score was determined as the average of maximum force exerted on dynamometer across three trials. According to standard position for testing which was recommended by American Society of Hand therapist, the readings were taken. The child sat in a straight backed chair, feet flat on the floor, shoulders adducted in a neutral, arms unsupported, elbows flexed at 90°, forearm rotation neutral, wrist 0-30° dorsiflexion and 0-15° ulnar deviation. Gross manual dexterity was measured by Box and Block test. The child sat straight on the chair and box was kept in front of the child and instructions were given to him that how to perform the test. The score was determined as the maximum number of blocks transported from one compartment to another in one minute. Fine finger dexterity was measured by the pegboard test. The child sat on the chair and pegboard was kept in front of the child and instructions how to perform the test were given to him. The child was instructed to do 2 times practice before performing the final test. The fine finger dexterity score was determined by the number of pegs picked up from a cup and placed into holes of a board in one minute. Manual ability was assessed by Abilhand kids questionnaire. This questionnaire measures the child's capacity to manage daily activities requiring the use of hand and upper limb. Twenty one mostly bimanual activities were rated by children's parents on a 3-level scale (0-impossible, 1-difficult, 2-easy) by providing their child's perceived difficulty in performing each activity.

Data Analysis

A Pearson correlation coefficient was calculated to examine the relationship between grip strength, fine finger dexterity, gross manual dexterity and manual ability. P value was set at <.05.SPSS version statistical software was used for analysis.

Results

All (30) subjects meeting inclusion criteria were invited to participate in the study. All 30 subjects consented and completed all observation. Subjects included were both boys and girls. Subjects included in the study were diplegics and quadriplegics. All the subjects include in the study were of age between 5-13 y. Subjects were taken from out patients departments.

Table 1: Mean and standard deviation of grip strength, fine finger dexterity, gross manual dexterity and manual ability.

	GRIP STRENGTH		FINE FINGER DEXTERITY		GROSS MANUAL DEXTERITY		MANUAL ABILITY
	RT	LT	RT	LT	RT	LT	
MEAN	2.303	1.913	12.777	10.000	22.867	16.933	27.833
S.D	0.712	0.224	1.926	2.777	3.711	2.852	8.073

Mean for RT grip strength is 2.303 ± 0.712 and for LT grip strength is 1.913 ± 0.224 .

Mean for RT fine finger dexterity is 12.777 ± 1.926 and for LT fine finger dexterity is 10.000 ± 2.777 .

Mean for RT gross manual dexterity is 22.867 ± 3.711 and for LT gross manual dexterity is 16.933 ± 2.852

Mean for manual ability is 27.833 ± 8.073 .

Table 2: Correlation for grip strength, fine finger dexterity, gross manual dexterity with manual ability (Lf & Rt).

	GRIP STRENGTH		FINE FINGER DEXTERITY		GROSS MANUAL DEXTERITY	
	RT	LT	RT	LT	RT	LT
Correlation with manual ability	-0.407	-0.567	-0.728	-0.567	-0.766	-0.773

The correlation is significant with p value <0.05

Correlation with manual ability for grip strength is -0.407 (RT) & -0.567 (LT).

Correlation with manual ability for fine finger dexterity is -0.728 (RT) & -0.567 (LT).

Correlation with manual ability for gross manual dexterity

is -0.766 (RT) & -0.773 (LT).

Correlation of grip strength with manual ability is -0.459 .

Correlation of fine finger dexterity with manual ability is -0.732 .

Correlation of gross manual dexterity with manual ability is -0.781 .

Table 3: Correlation for grip strength, fine finger dexterity, gross manual dexterity with manual ability.

Correlation with manual ability	GRIP STRENGTH	FINE FINGER DEXTERITY	GROSS MANUAL DEXTERITY
		-0.459	-0.732

Fig. 1: Correlation b/w grip strength (Rt) and manual ability.

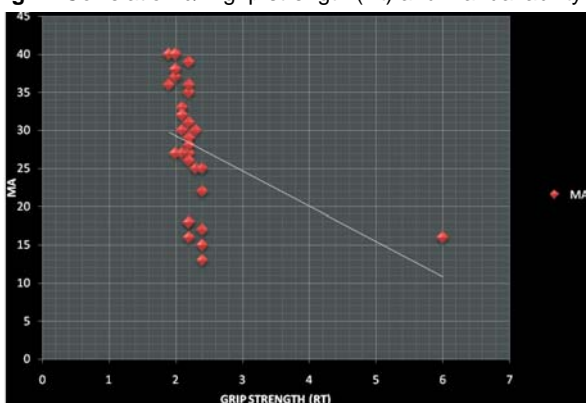


Fig 2: Correlation b/w grip strength (Lf) and manual ability.

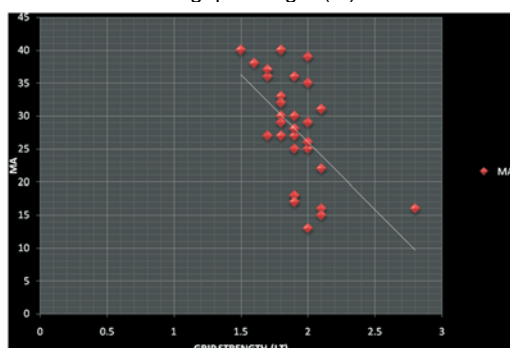


Fig. 3: Correlation b/w fine finger dexterity (Rt) and manual ability

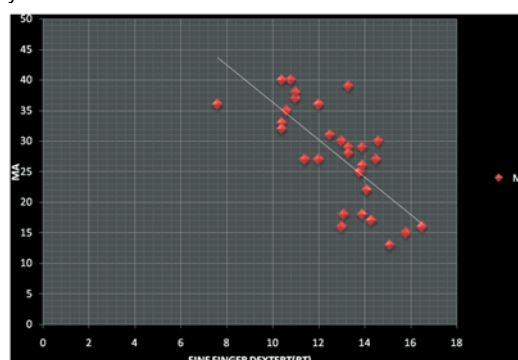


Fig. 4: Correlation b/w fine finger dexterity (Lf) and manual ability

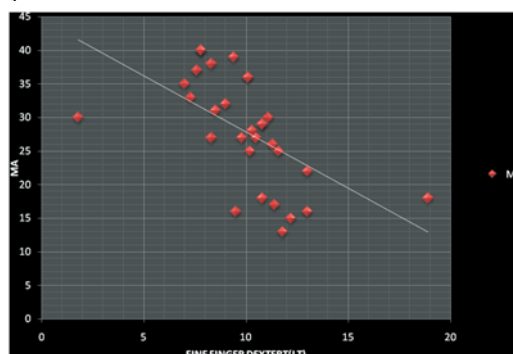


Fig. 5: Correlation B/W gross manual dexterity (Rt) and manual ability

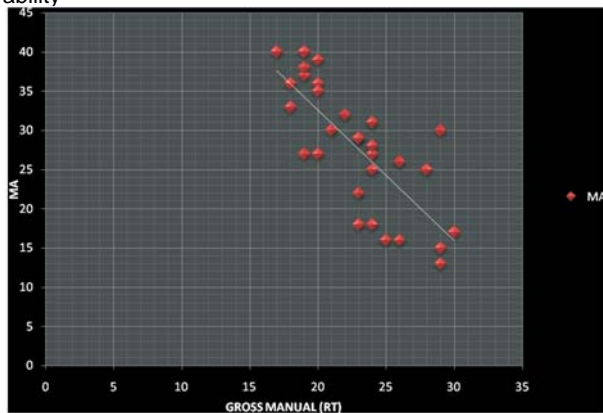
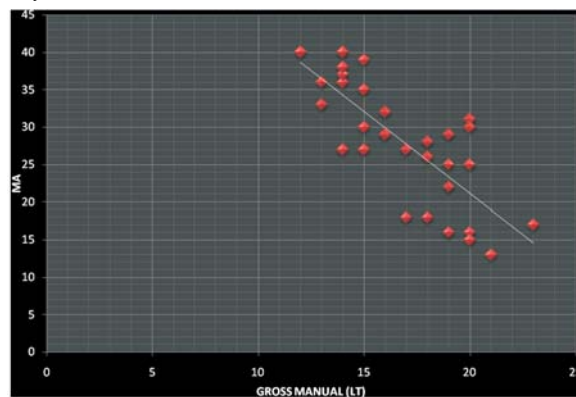


Fig. 6: Correlation B/W gross manual dexterity (Lf) and manual ability



Discussion

This chapter deals with the results of the study. In this study, results showed that there is a significant relationship between the hand impairments and manual ability. We found that hand impairments has significant correlation with manual ability. Grip strength has significant relationship with manual ability when measured with hydraulic hand handle dynamometer and Abilhand kid's questionnaire respectively. Correlation of grip strength with manual ability is -0.459 . There was a significant relationship between fine finger dexterity and manual ability when measured with pegboards and Abilhand kid's questionnaire respectively. Correlation of fine finger dexterity with manual ability is -0.732 . There was a significant relationship between gross manual dexterity and manual ability when measured with box and block tests and kid's questionnaire. Correlation of gross manual dexterity with manual ability is -0.781 .

Results of our study show that the capacity of upper limb and completion of ADL's of upper limb had a significant correlation. A study done by Carlyne Arnould et al suggested that manual ability was significantly correlated with motor impairment and stereognosis, while no significant relationship was found with tactile pressure detection and proprioception. Melanie Ziebell et al suggested that the children with diplegia performed at lower levels in all gross and fine motor assessments as compared to children without diplegia.

Massimo Penta et al concluded that grip strength, dexterity, motricity, depression were significantly correlated with Abilhand measures which was used to measure manual ability in the stroke patients. Gonca Bumin et al showed that there was significant correlation between handwriting parameters and upper extremity speed and dexterity, proprioception, bilateral coordination, visual and spatial perception and visual motor organisation in children with cerebral palsy. Julie Duque suggested that there is a correlation between impaired dexterity and corticospinal tract dysgenesis in congenital hemiplegia between. Jetty Van Meeteren et al suggested that correlations between grip strength parameters and activity limitations were relatively weak.

Our study suggests that impaired grip strength, fine finger dexterity and gross manual dexterity, interfere with the activities of daily living i.e. manual ability and quality of life. This study also suggests that the effect of maturation and hand dominance and gender is also there. Age and hand dominance and gender also affects the grip strength, five finger dexterity, gross manual dexterity and so as manual ability. Both impairment and upper limb activity i.e. manual ability showed a correlation and influence on activities of daily living.

Clinical Implications

Hand impairments i.e. grip strength, fine finger dexterity

and gross manual dexterity were rarely correlated with manual ability. Therefore our study suggests that the other parameters of upper limb are also important to stress upon. So, this knowledge can assist clinician in making specific treatment interventions for improving condition of cerebral palsy children.

Future Research

1. The study can be conducted with a heterogeneous gender bias (either males or females).
2. Subjects included were only spastic diplegic and quadriplegics. The study can be done on any type of cerebral palsy.

Limitations of the Study

1. Small sample size.
2. No gender differentiation.
3. Subjects with age group 5-13y.
4. Influence of external factors.

Conclusion

There is a significant correlation between the grip strength, fine finger dexterity, gross manual dexterity and manual ability.

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Discriminant Ability of Gravitational Insecurity (GI) Assessment

U Ganapathy Sankar¹, A Prema²

¹Vice Principal, SRM College of Occupational Therapy, ²Professor, Department of Pediatrics, SRM Medical College & Hospital, SRM Nagar, Kattankulathur-603 203, Kancheepuram, Tamil Nadu

Abstract

Objective

This study examined the reliability and validity of the Gravitational Insecurity (GI) Assessment (Revised Version) among Indian children.

Method

The GI Assessment consists of nine items rated on two behavioral categories - Emotional Responses (ER) and Postural Responses (PR). Participants were 28 children with GI, 5-10 years of age, and a matched group of typically developing children.

Results

Discriminant analysis results found that both the behavioral categories ($F(1, 54)=1346.09$, $\eta^2=0.039$; $F(1, 54)=357.89$, $\eta^2=0.131$) and all the nine items correctly classified the two groups at 100% level. A stepwise discriminant analysis revealed that the Emotional Response category classified GI children at 96.4% and the Postural Response category classified GI children at 100% from typically developing children

Conclusion

The GI assessment is a reliable and valid measure for identifying children with Gravitational Insecurity. It can be used as assessment tool as well as outcome measure to find out effectiveness of intervention program.

Key Words

Gravitational Insecurity, Reliability.

Introduction

Gravitational Insecurity (GI) is described as an abnormal anxiety caused by dysfunction in the integration of sensation that arises when the vestibular system is stimulated by head position or movement¹. A child with gravitational insecurity overreacts with a fight or flight response. The fight response may manifest as negative or defiant behaviour, particularly when the child is passively moved. The child may resist being picked up, rocked, or pushed in a stroller or may become angry and stubborn when someone suggests riding in the car or sliding down a hill. Flight responses may be observed as extreme caution or avoidance of movement. The child may keep her head up and feet down, firmly planted on the ground. The GI child may avoid riding a bicycle, sliding and swinging².

Identification of gravitational insecurity has been based on a subjective process involving informal assessment and clinical observation of behaviors reflecting symptoms of the disorder. Lee conducted a domain specification study as the first step in the development of an attitude scale to identify children with gravitational insecurity³. May-Benson⁴ developed an objective

15 item assessment of gravitational insecurity in children. In the planning phase of GI tool development, Benson & Koomar constructed the operational definition and characteristics of Gravitational insecurity, based on literature review^{1,3,5}, survey of a panel of master occupational therapist experienced in working with children having sensory integrative dysfunction. In item construction phase, Item format and scoring criteria were developed through literature review, feedback from expert in the field of occupational therapy, and clinical observation of children with suspected gravitational insecurity, resulting in 15 items and 3 behavioral categories. In quantitative evaluation phase, GI assessment was administered on 18 children with GI and Typically Developing Children (TDC). TDC were matched by age, gender with GI children. The assessment was revised to 9 items with 2 behaviour categories based on this study results. Interrater reliability (ICC) was .959. The discriminant ability of Gravitational Insecurity assessment was not determined. Hence, the current study was carried out to identify discriminant ability of GI assessment for strengthen the psychometric properties of GI

Method

Participants

Two groups of children ages 5 to 10 years were included. The first group ($n=28$; $M=6.74$, $SD = 0.61$) consisted of children identified by experienced pediatric occupational therapists as having sensory processing dysfunction with gravitational insecurity based on behaviors observed during clinical observations and ongoing treatment sessions. Children in this group additionally met the following criteria: average intelligence, no physical handicaps, normal (or) corrected hearing, normal (or) corrected vision, or presence of sensory processing dysfunction determined by experience pediatric occupational therapist. All children in this group were receiving direct occupational therapy services with a sensory integrative intervention emphasis and were receiving educational remediation.

The second group consisted of typically developing children ($n=28$; $M=6.74$, $sd = .61$). who were recruited from mainstream schools. These children met the following criteria: average intelligence, no history of physical handicaps, children with good English comprehension skills, no language problems, no history of educational remediation, normal hearing, normal or corrected vision, no past or present occupational or physical therapy services based on parent and teacher reports, and no behaviors characteristic of gravitational insecurity.

Instruments

Gravitational Insecurity Assessment (Revised Version)

Benson & Koomar developed GI assessment, is an individually administering test. Administration time is about 10 minutes. ICC was .959⁴. It has a 3 scoring system with two

behavioral categories. Behavioral categories include Emotional Responses and Postural Responses. The point scoring is: 3 - Typical response, 2 - Moderate / Mild GI, and 1 - Definite GI. The nine items of the assessment are listed in Table 1. The GI Assessment required the following materials: the GI Assessment manual, scoring sheets, pencil, floor mat, standard 100cm meter / yard stick, standard gymnastic ball (65cm), standard hard seat adult chair with seat height 40-45cm, 45 x 45 x 6cm tilt board, and masking tape.

Procedures

Experienced pediatric occupational therapists in Chennai, were contacted, oriented to the nature of study, and requested to identify possible children with gravitational insecurity. The purpose of the study was then explained to the appropriate authorities of the special schools and therapy centers involved and informed consent form was obtained from parents. Testing was conducted at therapy centers or special schools in Chennai, India. Typically developing children, selected from mainstream schools in Chennai, were matched by age and gender. Informed consent was obtained and testing was conducted at the school in the same manner as with gravitational insecurity children.

The evaluation was conducted in the standardized format according to the protocol developed for the GI Assessment by May-Benson. All subjects were oriented to the tasks. The directions were given in English language for each task and children were requested to complete the tasks two times. Twenty

eight gravitational insecurity children and matched typically developing children were tested by investigator for determine discriminant ability of GI assessment.

Data analysis

For internal consistency, Cronbach's alpha was used to evaluate the homogeneity of the test items. Discriminant analysis was used to identify which behavioral response category and which test items were able to discriminate children with gravitational insecurity from typically developing children. SPSS 16.0 version was used to analyze that data.

Results

Discriminant analysis results found that both the behavioral categories ($F(1, 54)=1346.09$, $\eta^2=0.039$; $F(1, 54)=357.89$, $\eta^2=0.131$) and all the nine items correctly classified the two groups at 100% level. A stepwise discriminant analysis revealed that the Emotional Response category classified GI children at 96.4% and the Postural Response category classified GI children at 100% from typically developing children. Further, it revealed that 4 items (jumping off chair with eye closed, forward roll, tilt board step and supine on ball – passive) were better able to discriminate between groups ($\eta^2 = 19.29$) than the other five items ($\eta^2 = 14.79$) (jumping, height jump, stand on chair, backward roll and supine on ball – active). Review of the individual subject classification revealed that the one subject was misclassified using the total score of emotional response.

Table1: Test items of Gravitational Insecurity Assessment

Item No	Items	Description
1	Jumping	Participant jumps up and down with feet together
2	Height Jump	Participant jumps over a stick raised to 10 cms (4 inches) off ground
3	Stand on Chair	Participant step up on seat of chair
4	Jump off Chair – eyes closed	Participant hops off chair with eyes closed
5	Forward Roll	Participant does a forward somersault.
6	Backward Roll	Participant does a backward somersault.
7	Tilt Board Step	Participant steps on tilt board, then steps off backward.
8	Supine on ball - active	Participant lies back on ball, then stands up
9	Supine on ball - Passive	Participant lies supine on ball as rater quickly tips it backward.

Discussion

The GI Assessment had excellent discriminant ability. The emotional response and postural response behavioral categories and all nine items were able to discriminate correctly among the two groups at 100% level. Further, stepwise discriminant analysis found that the Emotional Response category alone correctly classified 96.4% of GI children and the Postural Response category alone classified 100% of the children. While four items were found to be sufficient to classify groups, correct classification of participants was improved when nine tasks were used instead of just four. This study has the limitation of a small sample size and relatively narrow age range.

Conclusion

Discriminant analysis is revealed that two behavioral category and nine items were necessary to correctly discriminate and classify the two groups. Majority of gravitational insecurity children had received occupational therapy services for varying period of time prior to testing. The ability of this tool to discriminate between groups when the gravitationally insecure group has minimal dysfunction is its strength. Finally, results revealed that GI assessment is a reliable measure to identifying children with gravitational insecurity and it can be used as assessment tool.

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Effect of Therapist Applied PNF Stretch Vs Self Applied PNF Stretch on Hamstring Flexibility in Young Males

Ganeswara Rao Melam¹, Syamala Buragadda², B Praveen Kumar³

¹Principal, MM Institute of Physiotherapy and Rehabilitation, ²Assistant professor of Physiotherapy MM University, Ambala, Haryana,

³Assistant Professor, Vagdevi College of physiotherapy; Waranga, I A P State

Abstract

Objective

To find out the variation in Hamstring muscle flexibility using therapist applied PNF stretch and self applied stretch

Study Design

Pretest post test control group design

Purpose and Significance of the Study

To find out the effectiveness of therapist applied PNF stretch and self stretch on the flexibility of Hamstring muscles.

Participants

30 male students between the age group of 18 to 23 years having hamstring tightness and without any musculoskeletal disorders formed the population of this study. Subject's age, height and weight were matched. Informed consent was taken from all the subjects. Group I acts as a Control group consisting of 15 subjects who receives Self stretch & Group II acts as a Experimental group consisting of 15 subjects who receives Therapist PNF stretch.

Key Words

Flexibility, Stretching, Proprioceptive Neuromuscular Facilitation (PNF), Hamstring tightness.

Introduction

⁵In the literature, the terms "flexibility" and "muscle length" are often used synonymously when referring to the ability of muscles to be lengthened to their end range. Flexibility refers to the total range of motion of a joint or group of joints. The structural characteristics of the joints and the mechanical properties of the connective tissues of the muscle tendon structures largely affect the extent of movement around a given joint. The specificity of movement that a person performs in regular physical activities and stretching methods often define the development and improvement of the body's range of motion.

¹Stretching techniques are used in clinical practice to increase flexibility with some support for their use. The flexibility of the hamstring muscles is important in the prevention of injury, muscular and postural imbalance, and maintenance of full range of joint movement, optimal musculoskeletal function and enhanced performance in day to day activities.

⁴³Stretching techniques can be categorized as static, ballistic, slow active and Proprioceptive Neuromuscular Facilitation. Scientific Stretching for Sport (3S) describes a modification of PNF. Numerous investigations establish PNF techniques as more efficacious treatments than traditional static stretching exercise for range of motion or flexibility enhancement.

¹²The Straight leg raising (SLR) test is of great value in assessing normality of the roots of the sciatic nerve and tightness

of the hamstring muscles.⁷The Value of the SLR test can be determined with the goniometer, a gravity type goniometer or a tape measure.

The goal of all stretching programs is to optimize joint mobility while maintaining joint stability. Concern should always be focused on the systematic, safe and effective application of the range of motion techniques utilized.

METHOD

Procedure

Previous history of hip or knee or spine injuries, any contractures or deformities. Neuromuscular, cardiovascular disorders, any subject missing 4 days without stretching, subjects involving in any other physical fitness program were excluded. Prior to assignment to group each subject who met the inclusion criteria in the study was measured for flexibility of the right hamstring muscle. Subjects were randomly assigned to two groups following the initial measurement of hamstring flexibility.

Subjects assigned to Group I [N=15, age = 20.3 ± 2.32 range 18 – 23 years] served as control group and performs PNF self-stretching.

Group II (N=15, age = 19.8 ± 2.94, Range = 18-23) served as experimental group and undergone therapist applied PNF stretch.

Both the groups performed stretching 5 times a week for 6 weeks. Four repetitions per session with relaxation period of 15 sec and stretch period of 15 sec.

The subjects wearing unrestricted clothing were asked to lie supine with the right side of the body parallel with the edge of the height adjustable plinth. The trunk and pelvis were placed in the anatomical position determined by visual inspection.

To avoid compensatory movements [4.5 cm] wide straps were positioned across the anterior superior iliac spine and proximal third of the left thigh ensure that the lumbar spine was in contact with the plinth, the subject was required to posteriorly tilt the pelvis in order to fix a towel placed between T₁₂ and L₅ against the plinth. A standardized explanation and demonstration was given to each subject.

Intervention

Group I was instructed to perform and active straight leg rise applying all three components of motion to the point of tightness in the hamstring muscles. This included inversion and dorsiflexion of the right foot and toes, raising the right leg by turning the heel towards the opposite shoulder and clasping their hands around the back of the thigh. Thereafter, the subject performed a hold contraction by attempting to push the straight leg down towards the plinth against maximal self induced resistance through the hands for 15 sec while the right heel pointed to the right lower edge of the plinth followed by a 15 sec relaxation period when the knee was allowed to bend. Thereafter, the leg was straightened and the procedure was repeated four times.

Group II received the PNF technique applied by the physiotherapist starting from the agonistic pattern of hip flexion,

adduction and external rotation (with knee extension) at the point of tightness in the hamstring muscles. Thereafter, a 'hold contraction' was performed when the subject attempted isotonic contraction of the antagonistic pattern; hip extension, abduction and internal rotation which was maximally resisted by the physiotherapist for 15 sec except the rotational component of eversion and plantar flexion of foot and toes which was allowed to occur voluntary relaxation period of 15 sec was followed by a resisted contraction of the agonistic pattern moving the leg through the lengthened range to the point where tightness in the hamstring muscles was felt. This procedure was performed four times. Each intervention took 2 minutes consisting of four repetitions of 15 sec contraction and 15 sec relaxation period. This procedure was done 5 days a week for 6 weeks.

Subject Position for Passive SLRT

With subjects lying on their left sides, the greater trochanter of the right femur, lateral femoral condyle were identified and marked with black marker to help ensure proper alignment for goniometric measurements. The goniometer was placed with stationary arm parallel to the edge of the table, the moving arm along the lateral midline of the thigh and the axis over the superior half of the greater trochanter. The investigator slowly raised the extended right leg with the foot relaxed to the point where the subject felt tightness in the hamstring muscles.

Before measuring right hip flexion range, the investigator ensured that the lumbar spine was in contact with the plinth by

checking that the towel placed under the subject's lumbar spine could not be removed.

Pilot Study

Before going for the main study a pilot study was conducted with 10 subjects the purpose was to overcome the practical difficulties in the treatment.

Data Analysis

Data analysis was performed manually Pre test and Post test values of the Control group and Experimental group were statistically analyzed by means of t-test.

The Post test values of Experimental and Control group were analyzed by Chi square test (χ^2 test). The Significance level used for this study is $P < 0.05$

Results

A total of 30 subjects between 18 – 23 years were included in this study with their mean age group of $[20.3 \pm 2.32]$ in Control group and mean age group of $[19.8 \pm 2.94]$ in Experimental group.

The study consists of two groups (I and II). Group I consisted of 15 subjects (N=15) who performed PNF self stretch. Group II consisted of 15 subjects (N=15) who were given therapist applied PNF stretch.

Table 1: Comparison of range of motion with in Group I

GROUPS	Pre test	Post test	S.E	t	Level of Significance 0.05
I	60.06+4.98	82.2	1.31	16.90	highly significant
II	60.90+6.55	87.8	1.75	15.37	highly significant

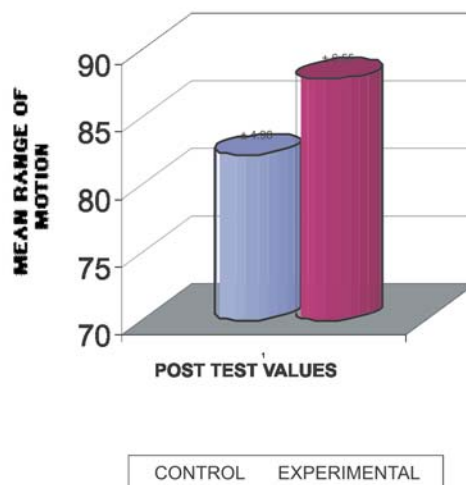
Table 2: Comparison of range of motion between two groups by using chi square

Group	Pre test	Post test	χ^2
Experimental	60.90 (A)	87.8 (B)	
Control	60.06 (C)	82.2 (D)	
Total	120.96 (A+C)	170 (B+D)	

0.045 (no significance)

Fig. 1: Comparing difference between post tests values of control and experimental group

CONTROL AND EXPERIMENTAL POST TEST VALUES



Discussion

This study is an attempt to find out any significant difference between therapist applied PNF stretch and self stretch groups. The results in this study suggest that there is significant difference in the Pre test and Post test scores of therapist applied PNF stretch and self stretch groups

Wallin et al found an increase of 6.2° of hip flexion range after 14 sessions of a contract - relax method. Sady et al found an increase of 9.4° in hip flexion range after 18 sessions of a contract - relax - antagonistic - contract method. In both studies modified PNF-techniques were used. The stretching regimes in this study were only performed once for 2 minutes yet appeared to result in greater changes than the published studies described previously.

Bandy et al who applied static stretching to hamstring muscles found that one stretch session with duration of 30 sec and with a follow up of 5 days a week for 6 weeks is the best intervention method. Boone et al suggested an increase of 3 - 4° measured by the same evaluator to determine real change. There the results of this study may be considered to be clinically important as a range increase beyond 3 - 4° was found. However, although the PNF technique applied by the physiotherapist produced a greater mean change in range than the self stretch incorporating the PNF components the difference was not significant

Limitations of Study

The optimal stretch parameters for stretching exercises are not known. The results of existing research on the effect of duration, frequency and repetitions of stretching regimes vary considerably. The variation in the change in range of hip flexion amongst the subjects indicates that the effectiveness of the stretching regimes varied across individuals, which was also found by other investigators. This may have been influenced by the physical activity level or other characteristics of the sample.

It was not possible to quantify the force applied by the physiotherapist although the point of cessation of stretch was governed by the subjects, which was shown to have an acceptable level of error. The generalizability of the study results is limited and the small sample size means that the results should be interpreted with care.

The subjects taken were only males so the generalisability will be limited to only males. The small sample size reduced the statistical power increasing the risk of a type II error. Although an attempt was made to stabilize the pelvis by placing straps across the left thigh and asking the subject to fixate a towel by posteriorly tilting the pelvis, pelvic movements could not completely be eliminated.

The increase in flexibility of the hamstring muscles should not be extrapolated to other muscle groups as fusiform muscles produce large range than pinnate muscles.

The Universal goniometer used in this study has scope for error; an electronic goniometer would have prevented this aspect of error.

Conclusion

Both stretching regimes, which incorporated the facilitatory components of PNF-techniques, achieved a significant increase in hip flexion range. As both stretching regimes achieved clinically significant improvement in range so individual or organizational factors can be considered when deciding which stretching regime to use.

The findings of the present study are important to physiotherapists who commonly use stretching regimes and teach them to patients as part of the self management programme.

This study concluded that though statistically there is no significant difference between self stretch and therapist applied PNF stretch both are effective treatment methods but therapist applied PNF stretch is clinically more significant over self stretch.

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Normative Values for Maximal Respiratory Pressures in Subjects Age 20 to 70 Years. A Cross-sectional Study

Gopala Krishna Alaparathi¹, Vaishali², V Prem³, Jaya Shanker Tedla⁴, Kalyana Chakravarthy⁵, Ravi Shankar Y⁶
¹Asst. professor, ^{2,3,4,5,6}Associate professor, Department of Physiotherapy, Kasturba Medical College, Bejai, Mangalore-575004

Abstract

Purpose

Respiratory muscle strength is measured as a maximal inspiratory pressure (PI max) and maximal expiratory pressure (PE max). The purpose of this investigation is to obtain normal maximal inspiratory and expiratory pressure with respect to age, sex, height, weight and BMI in Indian population.

Subjects

In this cross sectional study 250 subjects with age from 20 to 70 years were recruited with convenient sampling. They are divided in to five groups i.e. 20-30, 30-40, 40-50, 50-60 and 60-70. Each group had 50 subjects (males-25 and females-25).

Methods

For measurement of PE max the subject will inhale to near total lung capacity (TLC) and then exhale as hard as possible and for PI max the subjects exhales to near residual volume (RV) and then give a maximal inhalation effort. Three measurements were taken for each subjects and the best one was included for analysis.

Results

The mean value for PI max in male is (75 ± 20 cm H2O) and for PE max is (93± 33 cm H2O) and PI max in female is (48 ± 16 cm H2O) and for PE max is (60 ± 20 cm H2O).

Conclusion

Data obtained from this study will be useful as simple, reproducible, rapid assessment and interpretation of respiratory muscle function as well as treatment planning.

Key Words

Maximal inspiratory pressure (PI max), Maximal expiratory pressure(PE max), Respiratory pressure, Muscle strength. Normative data.

Maximal inspiratory and expiratory pressures produced at the mouth during static efforts are regarded as a reflection of respiratory muscle strength. Clinically, respiratory muscle strength is measured as PI max and PE max. The relationship of these maximal pressures to age, sex, and general muscular

development has been described. Normal values have been reported for the relationship of maximal respiratory pressures to age and gender and these are most frequently derived from the regression equations of Black and Hyatt.¹

The functions of the respiratory muscles are difficult to study directly since the muscles have complex origins and insertions. Furthermore, their product, which is the pressure generated within the thoracic cavity, depends on the co-ordinated action of many muscles, the individual functions of which may be difficult to distinguish in life. The respiratory muscle pump is vital for the movement of air to the level of gas exchange in the respiratory system. The respiratory muscles include diaphragm as the major muscle of inspiration along with Intercostals and scalenei. It is possible to assess both the strength and endurance of the respiratory muscles separately.²

Impairment of the respiratory pump compromises ventilation, gas exchange and tissue respiration. In condition where the load on the respiratory muscles is increased or the capacity of the respiratory muscles is decreased, muscle weakness can occur.³

Respiratory muscle weakness increase the relative load for breathing this can lead to clinical consequences such as dyspnea, impaired exercise performance, ineffective coughing, respiratory insufficiency, weaning failure, and death.³

In this modern world there is a greater increase in pulmonary disease, there is raising interest in the assessment and treatment of respiratory dysfunction. Dysfunction of the respiratory muscles is observed in several conditions, such as COPD, Asthma, Cystic fibrosis, Neuro muscular disease including Spinal cord injury, Congestive heart failure and in Critical illness.³

The available studies that reports reference values of PI max and PE max, however, shows wide variability, not only between individuals but also between studies, because of the small numbers and subjects selection in these studies. The normal values for maximal inspiratory and expiratory pressures are based on western population. These values are not very reliable for our clinical assessment, therefore it is essential that normal values for the same be predicted through our study.

Respiratory muscle assessment is required to individually tailor and design pulmonary rehabilitation programme to optimize physical and social performance.⁴ Maximal Inspiratory pressure and expiratory pressures varies with demographic variation such as age, sex. Non-availability of normative data on maximal Inspiratory and expiratory pressures in Indian population had enthused us to conduct this study. Purpose of this study was to obtain normal maximal Inspiratory and expiratory pressures with respect to age, sex, height, and weight in Indian population.

In this cross sectional study 250 subjects with age from 20 to 70 years were recruited with convenient sampling. They are divided in to five groups i.e. 20-30, 30-40, 40-50, 50-60 and 60-70. Each group had 50 subjects (males-25 and females-25).

Inclusion criteria

1. Age : 20 – 70 years
2. Gender: males and females
3. At the time of study subjects should be medically fit

Address for correspondence:

Gopala Krishna Alaparathi

Asst. professor

Department of Physiotherapy

Kasturba medical college (A constituent institute of Manipal University)

Bejai, Mangalore-575004

E mail; gopalalaparathi@gmail.com

Mobile: +91-9916819977

Exclusion Criteria

1. Known diagnosis of Pulmonary diseases
2. Known history of Cardiovascular diseases
3. Subject with history of Neuro Musculoskeletal disorders
4. Uncontrolled Hypertension
5. Uncontrolled Diabetes mellitus
6. Psychiatric disorders
7. History of Thoracic surgery within 5 years
8. History of Abdominal surgery within 2 years
9. Those who are receiving long term medication (steroids) that could interfere with exercise performance

Instrument

1. Morgan P max monitor [P.K Morgan Ltd. ME8 7ED].
2. Height and weight scale

Procedure

Advertisement for volunteers in a local newspaper was given for free screening of respiratory muscle function at K.M.C hospital under the guidance of physician. Patients were selected on the basis of inclusion and exclusion criteria and written informed consent was taken from the subjects prior to test. The subjects

also underwent standard chest physiotherapy assessment.

Age, height, weight was obtained and BMI was calculated. For measuring maximum inspiratory and expiratory pressures the subjects were made to sit upright in a chair with back support. A nose clip worn with normal flanged mouthpiece behind the lips and gripped by the teeth and was ensured that there is no leak around the mouth piece. For measurement of PE max the subjects will inhale to near total lung capacity [TLC] and then exhale as hard as possible. For measurement of PI max the subject exhales to near residual volume [RV] and then given a maximal inhalation effort. Three measurements were taken for each subject and best one was included for the analysis. One minute of rest was ensured between efforts.¹²

Data analysis

The values for the maximal respiratory pressures were obtained by descriptive statistics. SPSS V.11.0 was used for analysis.

Results

Mean and standard deviation of PI max and PE max for male and female subjects with height, weight and BMI are shown in Table 1 & Table 2.

Table 1: Mean and standard deviation of PI max and PE max for males

		PI max	PE max	Height	Weight	BMI
ALL AGE	Mean	75.35	93.39	165.70	64.62	23.54
	SD	20.89	33.08	7.56	9.73	3.21
20-30	Mean	76.03	102.14	167.82	63.28	22.44
	SD	18.05	27.12	7.19	10.54	3.28
30-40	Mean	78.57	103.64	169.03	64.00	22.42
	SD	17.40	24.17	8.17	10.84	3.49
40-50	Mean	78.75	109.25	164.28	66.75	24.65
	SD	19.84	37.44	7.89	11.64	3.45
50-60	Mean	78.36	83.28	164.04	64.64	24.02
	SD	26.05	25.22	7.27	7.83	2.53
60-70	Mean	65.35	67.57	163.14	64.42	24.22
	SD	20.91	31.48	5.75	7.16	2.61

Table 2: Mean and standard deviation of PI max and PE max for females

		PI max	PE max	Height	Weight	BMI
ALL AGE	Mean	48.80	60.65	155.99	56.41	23.17
	SD	16.91	20.28	5.81	9.90	3.89
20-30	Mean	46.89	65.51	156.31	51.96	21.18
	SD	16.45	23.04	6.72	9.06	2.89
30-40	Mean	46.84	59.00	156.08	55.80	22.91
	SD	16.28	16.07	4.67	8.72	3.47
40-50	Mean	49.32	70.08	153.60	57.16	24.24
	SD	14.63	19.90	6.98	9.60	3.97
50-60	Mean	51.20	58.12	157.04	58.16	23.59
	SD	16.73	22.92	5.54	10.13	4.04
60-70	Mean	50.08	49.80	156.88	59.72	24.27
	SD	20.82	11.86	4.25	10.82	4.41

Mean values of PI max and PE max for males and females was specified in figure one. Mean height, weight, BMI and age for males and females were shown in figure two.

Discussion

Maximal respiratory pressures reported in several studies, showed a wide range of variation. We studied the age group between 20 to 70 years. PE and PI max was used to assess respiratory muscle function in adults. The reported mean value for PI max in male is (75 ± 20 cm H₂O) and for PE max is (93 ± 33 cm H₂O) and PI max in female is (48 ± 16 cm H₂O) and for PE max is (60 ± 20 cm H₂O).

Compared to previous studies⁵⁻¹¹ our study has shown lower mean values for adults. The probable reasons could be

geographical variations, poor motivation in our subjects, and deliberate leak in the mouthpiece of the apparatus.

Several factors contribute to the wide range of values described for adults in previous studies. The first concern was, measurement of PI max and PE max may vary markedly with the response characteristics of the pressure measuring device.^{5,11}

Secondly, air leaks at the nose and mouth can produce inaccuracy during forced expiratory manoeuvres. In the majority of our subjects, detectable air leaks were clearly apparent during initial trial studies, but were readily corrected with careful instruction.⁵⁻¹¹

Fig. 1: Mean values of PI max and PE max for males and females

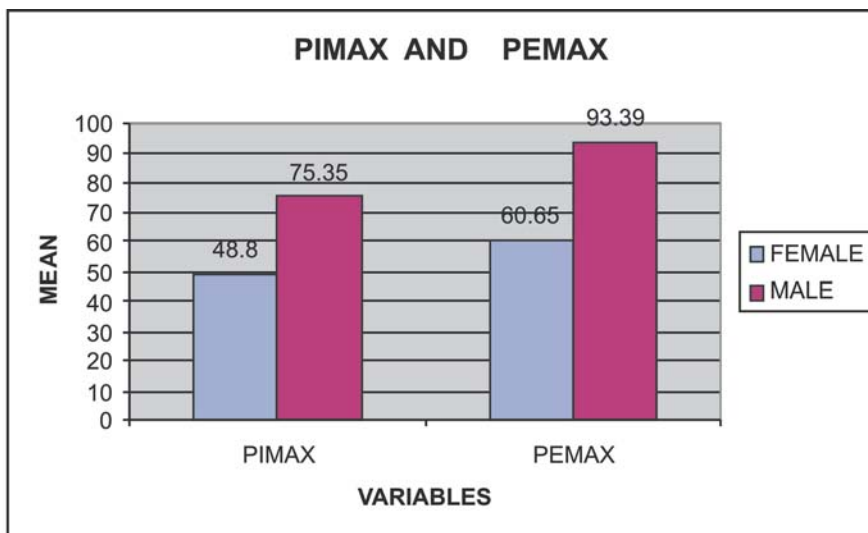
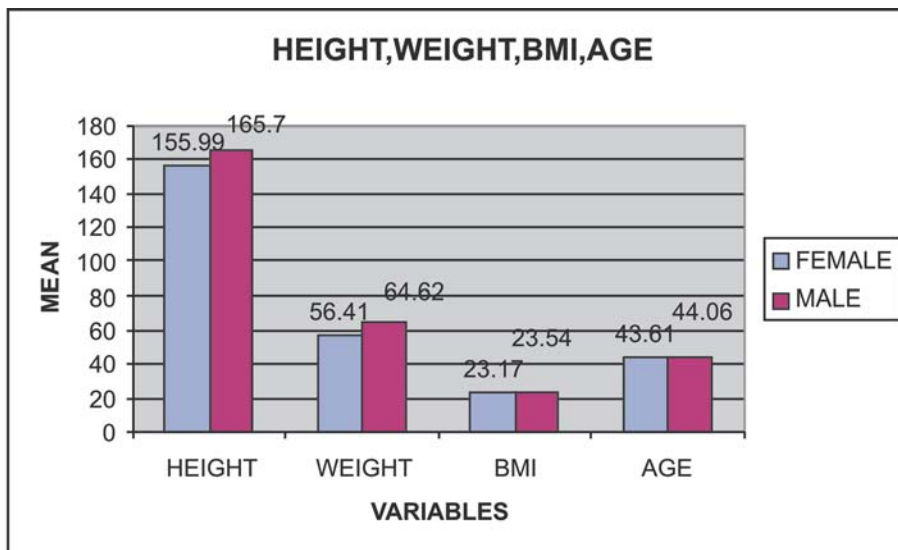


Fig. 2: Mean height, weight, BMI and age for males and females



Thirdly, forced respiratory manoeuvres are influenced by motivation, and finally, the number of trials used to measure PI max and PE max may affect the maximal pressures recorded. It has been shown that maximal values recorded may increase over ten attempts. Thus, Ringqvist⁵, using ten or more trials, reported higher maximal pressures than Black and Hyatt⁶ or Leech et al⁷, who used two and three trials, respectively, to determine their normal values. Normal values based on a small number of trials may be a more appropriate choice for the clinical laboratory, where repeated trials may be impractical or impossible in patients.⁹

We agree with Black and Hyatt⁶ that respiratory muscle strength decreases with age. Our study also showed decreased respiratory muscle strength in male subjects. Several factors may affect respiratory muscle strength in the adults and account for inter subject variability in maximal respiratory pressures. Variable changes may occur in skeletal muscle itself, in the elastic recoil of the lungs and chest wall, and increase in residual volume (RV). These effects differ in individuals and likely contribute to variability in respiratory muscle strength with ageing.

Increase in RV occur with age and this may lead to an altered. Force-Length relationship of the diaphragm and diminished static outward recoil of the chest wall, resulting in decreased PI max at RV. This increased RV is not uniform in all persons and may contribute to differing PI max values in subjects of the same age. Thus, many factors affects respiratory muscle

strength with increasing age, but the relative importance of each is unknown.¹

Our study also showed decreased PE max in both male and female subjects, the probable reasons could be, loss of lung recoil and an increase in lung compliance in elderly, which would tend to decrease the PE max. Changes also occur in the thoracic wall involving calcification and stiffening of the articulations of the rib cage together with changes in the spinal curvature, making the chest wall less compliant. These factors may contribute to large interindividual variations in this study.

The measurement of maximal respiratory pressures allows a simple, reproducible, and rapid assessment of respiratory muscle function which is extremely useful in following the progression of respiratory weakness in patients.

Future Research

1. Future studies with large sample size are required.
2. Multicentric study is required for predicting regressive equations for Indian population.

Conclusion

The mean value for PI max in male is (75 ± 20 cm H2O) and for PE max is (93± 33 cm H2O) and PI max in female is (48 ± 16 cm H2O) and for PE max is (60 ± 20 cm H2O).

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Management of Patients With Concurrent Hypertension and Osteoarthritis of the Knee: Comparative Effect of Using Non Steroidal Anti Inflammatory Drugs and Physical Therapy

Talhatu K Hamzat¹, Adeolu O Ajala², Fatai A Fehintola³

^{1,2}Physiotherapy, Department of Physiotherapy, ³Department of Pharmacology and Therapeutics, College of Medicine, University of Ibadan, Nigeria

Abstract

Objective

Non steroidal anti-inflammatory drugs (NSAIDs) are commonly used in managing osteoarthritis (OA). A patient with OA may have a coexisting hypertension for which antihypertensive drugs are prescribed. However evidence indicates that NSAIDs diminish efficacy of antihypertensive drugs.

Aim

The aim was to determine the respective and combined effects of NSAIDs and physical therapy in management of pain and reduced functional limitation among patients with concurrent hypertension and knee osteoarthritis (CHKO).

Design

This is a quasi-experimental study technique

Location

Physiotherapy and Medical Outpatient units of a tertiary facility.

Methods

Twenty-nine individuals (mean age = 65.71±9.96 years) with CHKO were purposively sampled and assigned to one of three treatment groups *viz.* Physiotherapy and NSAIDs (Group A); Physiotherapy Only (Group B); and NSAIDs only (Group C). All were on antihypertensive drugs during the study period. Resting systolic and diastolic blood pressure, pain rating and functional limitation were assessed using sphygmomanometer, verbal rating scale and the Osteoarthritis Index of Lequesne respectively.

Results

There was no significant difference in the pain and functional performance across the three groups ($p>0.05$). There was significant reduction in pain and increase in functional ability of the patients within each of the groups ($p<0.05$), with greatest within-group difference observed in Group C. The NSAID did not cause a significant difference in blood pressure of all the patients.

Conclusion

The outcome showed that either Physiotherapy or NSAID could bring about the relief of pain and functional improvement in patients with CHKO.

Clinical Rehabilitation Impact

Use of physiotherapy should be considered in managing symptoms of OA in patients with CHKO especially where drug-drug interaction is envisaged.

Key Words

Osteoarthritis; Hypertension; Physiotherapy; Anti-inflammatory.

Introduction

Osteoarthritis, the most common form of arthritis worldwide,¹ causes pain, disability, economic loss and places burden on the individuals as well as society². Osteoarthritis can be treated using pharmacological and or non-pharmacological approaches.^{3,4,5} Pharmacologic interventions include the use of simple analgesic, non-selective and cox-2 selective non-steroidal anti-inflammatory drugs, opioids, corticosteroids and chondroprotective agents.⁴

The NSAIDs work by inhibiting the enzyme cyclo-oxygenase (COX) responsible for prostaglandin synthesis. Cyclo-oxygenase (COX) exists in two isoforms, COX-1 and COX-2. Conventional or non-selective NSAIDs inhibit both COX-1 and COX-2, while COX-2 selective inhibitors (Coxibs) inhibit COX-2 only.⁶ In order to avoid these deleterious effects, COX-2 selective inhibitors have been developed.⁷ However, both non-selective NSAIDs and Coxibs have similar effects on renal function and blood pressure.⁸

Hypertension may co-exist with OA thereby necessitating concurrent prescription of anti-hypertensive drugs and NSAIDs.⁹ Hypertension can be aggravated or the effects of anti-hypertensive drugs countered in patients receiving treatment for both. In a study of drug utilization pattern among hypertensive patients in a tertiary care setting in South-Western Nigeria, OA was found to be the second highest co-existing disease with hypertension, after diabetes. The NSAIDs were reported as being concurrently taken with anti-hypertensive drugs in this group of patients.¹⁰ The simultaneous use of these two drug classes, along with the multitude of medical problems in the elderly population that decrease drug metabolism or require multiple drug therapy, may predispose such patients to the risk of developing drug-drug or drug-disease interactions.^{10,11}

Pain relief is a key goal in the management of OA, and NSAIDs are more often than not prescribed to manage the pain.³ Physiotherapy is an important non-pharmacologic approach to managing OA and has been reported to be effective in its management^{4,5}, irrespective of the blood pressure status of the patients. It may therefore be possible to manage some clinical features of OA such as pain; joint stiffness and functional limitation in hypertensive patients with physiotherapy only and thus avoid NSAIDs - antihypertensive drug-drug interaction. The question however is how effective would such treatment

Address for correspondence:

DR. T.K.Hamzat

Department of Physiotherapy, College of Medicine (UCH)
University of Ibadan, PMB 5017 GPO Dugbe Ibadan 2000001
Ibadan, Nigeria. Tel: +234-8052457016/28708056
Email: tkhamzat@comui.edu.ng/talkzat@yahoo.com

approach be in managing pain and improving functional status in patients with coexisting hypertension and osteoarthritis? The aim of this study was to determine the comparative individual and combined efficacy of Physiotherapy and NSAIDs in the management of pain and functional limitation among patients with hypertension and OA of the knee.

Methods

Thirty-three individuals diagnosed as having coexisting hypertension and knee osteoarthritis, and who were receiving or seeking treatment at the Medical Outpatients Unit of a tertiary health facility participated in this quasi-experimental study.

Eligibility Criteria

- a A physician diagnosed coexisting hypertension and OA affecting one or both knees (with patients having had the symptoms more than three months);
- b Evidence of clinical features and radiological signs of OA, that is having definite osteophytes and some narrowing of the joint space with OA confirmed using American College of Rheumatology criteria.
- c Mild hypertension, with the SBP and DBP not exceeding 160mmHg and 95mmHg respectively.

Prospective patients were excluded (i) if they had any other significant disorders such as congestive heart failure, renal insufficiency, diabetes, asthma, because the presence of such may be worsened by the drug-drug interaction¹³ and (ii) if they had intra-articular injection of steroids or hyaluronidase in the immediate preceding 3 months at the time of recruitment into the study, (iii) if they could not tolerate NSAIDs nor had contraindication to the use of Transcutaneous Electric Nerve Stimulation-TENS.

Procedure

The Institutional Ethics Committee of the institution where this study took place approved of the research protocol before commencing the study. Procedures and rationale for the study was explained to the patients and their informed consent was obtained. Socio-demographic data and clinical history were documented for each participant and their baseline measurements taken.

These include evaluation of the following:

Pain

The intensity of pain experienced by the patient was measured using Box Numerical Scale. This self-administered numerical pain rating scale consisting of eleven boxes numbered from 0 to 10. Zero represents 'no pain' while 10 represents 'maximum pain' perceived.¹⁴ The use of the box numerical pain rating scale was explained to the patient who was then requested to rate pain at rest and pain on activity on a box numerical scale.

Functional Capacity

The Osteoarthritis Index of Lequesne (OIL), which is an ordinal scale, was used to evaluate the subjects' functional capacity and pain or discomfort. It is a condition-specific, valid and reliable outcome measure in patients with knee OA¹⁴ that assesses functions that are of primary concerns to OA patients. It has three domains; the first domain assesses pain or discomfort, the second domain assesses maximum distance walked while the 3rd domain assesses activities of daily living. Scoring is indirectly proportional to health status.

Blood Pressure

A mercury-in-glass sphygmomanometer (Manometre, U.S.A.) with a standard size cuff was used to measure the resting blood pressure of the patients in sitting position.

Treatment Group and Schedule

Due to the fact that participants were recruited as they became available, they could not be randomly assigned into one of the three treatment groups, and hence consecutive assignment method was used.

GROUP A received NSAID and Physiotherapy

GROUP B received Physiotherapy

GROUP C received NSAID.

All participants were on their physician's prescribed anti-hypertension drugs throughout the duration of the study.

Interventions

- A Anti-hypertensive drugs: The patients were already placed on antihypertensive drugs as at the time of including them in this study. These comprised mainly diuretics, centrally acting agents and calcium channel blockers.
- B Non-Steroidal Anti Inflammatory Drugs therapy was ibuprofen (400mg tablet thrice daily). Ibuprofen, the NSAID of choice in this study has been well evaluated in management of joint pain.
- C Physiotherapy. This encompassed:
 - i. Transcutaneous Electrical Nerve Stimulation or TENS was applied to the osteoarthritic knee for 20 minutes.
 - ii. Therapeutic exercises comprising the following:
 - a. Quadriceps Setting: The subject, lying in supine position, performed isometric contraction of the quadriceps muscle of the affected lower extremity by drawing up his patella while maintaining his knee in extension. The contraction was held for a count of 10; the patient relaxed and then repeated the exercise 10 times.¹⁵
 - b. Straight Leg Raising (SLR): The subject in a supine position isometrically contracted his quadriceps muscles (Quadriceps setting) and lifts the lower extremity to about 45 degrees of hip flexion while maintaining knee in extension. The position was held for a count of 10, and the exercise was repeated 10 times. The contra-lateral knee and hip was flexed about 45 degrees to avoid undue stress on the low back.¹⁵
 - c. The subject in a supine position, performed alternate bending and straightening of the affected leg.
 - d. Hamstring curls: The subject in prone lying with a small towel roll placed under the femur proximal to the patella to avoid compression of the patella between the plinth and the femur, the subject was instructed to 'bend' the knee and hold for a count of 10. This was repeated 9 times.¹⁵
 - e. Full-Arc Extension: The subject in a high sitting position, with a towel rolled under the knees, performs leg straightening and the position was held for a count of 10, and the exercise was repeated 9 times.
 - f. Stationary cycling: Subject cycled on a non-loaded stationary bicycle for 10 minutes.

Treatment Duration

Duration of participation for each patient was for 8 consecutive weeks and physiotherapy was administered three times a week for the 8 weeks.

Follow up assessment took place at the 4th and 8th week of

treatment and this was carried out by the same clinician who was blinded to the outcome of the study.

Data Analysis

Descriptive statistics of mean and standard deviation were used to summarize the data. A One-way Analysis of variance and Kruskal-Wallis tests were used for as inferential statistics. Alpha level was set at 0.05.

Results

Out of the 33 individuals who were recruited, only 29 subjects comprising 19 (65.5%) females and 10 (34.5%) males completed the study. Among the four people who dropped out, 2 did so after the baseline, one stopped coming for treatment and could not be contacted by the research team while the 4th person relocated from the region of this country where the study took place. All those who dropped out did so before the end of the 3rd week of the study. The results presented in this report are with respect to those who completed the study.

A one-way ANOVA revealed no significant difference ($p > 0.05$) in the physical characteristics across the 3 groups of subjects (Table 1) likewise Kruskal-Wallis analysis revealed no significant difference in the baseline across the 3 groups in (pre-treatment) pain rating, functional scores, systolic blood pressure (SBP) and diastolic blood pressure (DBP). A similar trend was also observed at the 8th week of treatment (Table 2). The within-group analysis showed no significant difference in the SBP and DBP in each of the three groups. However, there was a statistically significant difference in the pain rating and functional

ability in each of the 3 groups ($p < 0.05$).

Duncan post hoc test showed the significant difference lies in pairs (baseline and 4th week), (4th week and 8th week) for both pain rating and functional scores in each of the groups A, B and C.

Discussion

Non-steroidal anti-inflammatory drugs (NSAIDs) constitute an important group of drugs prescribed to manage pain and inflammation of the joint with osteoarthritis. The patient with OA may however have a co-existing hypertension for which they are placed on anti-hypertensive drugs concurrently with NSAIDs. Drug-drug interaction between the NSAIDs and hypertension may pose significant danger to the patient especially in terms of ineffective blood pressure control. This is a cause for great concern considering that OA is not generally considered a life-threatening disease unlike hypertension which can lead to serious medical complication and eventual death.

The participants in this study were aged above 60 years, which is within the age trend reported in literature as the onset of these co-existing diseases. A strong linkage between knee OA and ageing had been reported.¹⁶ The fact that (65.5%) of the subjects involved in this study were females, giving a 2:1 female-male ratio, could be a reflection of the gender pattern of osteoarthritis among those seeking treatment at the hospital where this study took place. Goodman² had observed that the incidence of OA is higher in women than men. The primary complaint of participants in this study was pain thus corroborating the widely held view that the most important clinical factor of OA that makes patient seeks treatment in pain.³

Table 1: Comparison of mean physical characteristics of the participants in the three groups (n=29)

Group	Age (Years) Mean ± SD	Height (m) Mean ± SD	Weight (Kg) Mean ± SD	Quetelet Index (Kgm ²) Mean ± SD
A	65.90 ± 9.18	1.65 ± 0.08	81.20 ± 13.67	30.05 ± 5.75
B	65.2 ± 11.9	1.64 ± 0.06	73.40 ± 6.45	27.56 ± 3.61
C	66.11 ± 9.64	1.63 ± 0.07	78.44 ± 7.86	29.66 ± 3.69
f-value	0.02	0.18	1.59	0.88
p-level	0.98	0.83	0.22	0.42

Key

Group A: Patients who received Physiotherapy and Non Steroidal Anti-inflammatory Drug

Group B: Patients who received Physiotherapy only

Group C: Patients who received Non Steroidal Anti-inflammatory Drug

Participants in this study had significant pain relief ($p < 0.05$) with a 64.78% decrease in pain rating among patients in Group A who received combined therapy of NSAID and physiotherapy, and a 54.79% pain reduction was recorded for Group B patients who were placed on physiotherapy only while those in Group C who were on NSAIDs only had a 56.07% decrease in their pain rating. This shows that physiotherapy and or NSAIDs would produce appreciable reduction in pain associated with osteoarthritis of the knee.

There was also significant improvement in functional scores ($p < 0.05$) in all the three groups with the Group B patients (physiotherapy only) recording the highest percentage reduction, followed by the Group A (combined NSAID and physiotherapy) and Group C (NSAID only) respectively. The significant pain relief observed among the participants may be responsible for

resultant improvement in their functional ability. Similar to the findings of this study, Walker-Bone et al⁴ had submitted that pain relief and functional improvement can be achieved with either pharmacological or non-pharmacological means, including exercise therapy. According to Puett and Griffin,¹⁷ exercise therapy alone has been found to be very effective in the management of knee OA, especially when electrotherapy is given prior to exercise therapy to facilitate tendon extensibility and muscle relaxation. The transcutaneous electrical nerve stimulation (TENS) used in this study is a type of electrotherapy modality. In a comprehensive review by Osiri et al¹⁸ to determine the efficacy of TENS in management of knee osteoarthritis, it was found out that TENS significantly improved functional status, pain relief and joint stiffness.

The outcome of this study showed that there was no

Table 2: Comparison of baseline and post treatment parameters across the three groups (n=29).

	SBP Mean ± SD	DBP Mean ± SD	PR Mean ± SD	FS Mean ± SD
BASELINE				
Group A	136.40±6.34	84.60±4.08	7.10±1.52	10.45±1.53
Group B	136.00±4.57	85.00±6.25	7.30±1.05	11.25±1.55
Group C	132.00±5.38	84.66±4.21	7.33±1.00	10.66±1.07
KW	3.52	0.61	0.29	1.74
p-value	0.17	0.73	0.86	0.41
POST TREATMENT				
Group A	135.90±7.56	88.90±4.40	2.50±1.08	7.50±0.94
Group B	135.00±3.52	85.40±4.69	3.30±1.15	7.95±1.25
Group C	137.11±6.23	88.55±3.28	3.22±0.97	7.94±1.01
KW	0.43	3.19	2.62	1.01
p-value	0.80	0.15	0.21	0.58

Key

Group A: Received Physiotherapy and Non Steroidal Anti-inflammatory Drug

Group B: Received Physiotherapy only

Group C: Received Non Steroidal Anti-inflammatory Drug

PR: Pain Rating

FS: Functional Status

Table 3: Comparison of clinical parameters within each treatment group at baseline and post treatment (n=29)

	SBP (mmHg) Mean±SD	DBP (mmHg) Mean± SD	PR Mean±SD	FS Mean±SD
Group A				
Baseline	136.40±6.34	84.60±4.08	7.10±1.52	10.45±1.53
Week 8	135.9±07.46	88.90±4.40	2.50±1.08	7.50±0.97
f	0.05	3.19	19.50	15.46
p value	0.95	0.57	0.001	0.001
Group B				
Baseline	136.0±04.57	85.00±6.25	7.30±1.05	10.25±1.55
Week 8	135.30±3.52	85.40±4.69	3.30±1.15	7.95±1.25
f	0.05	3.18	16.83	13.90
p value	0.62	0.95	0.001	0.001
Group C				
Baseline	132.00±5.38	84.66±4.21	7.33±1.00	10.66±1.06
Week 8	137.11±6.23	88.55±3.28	3.22±0.97	7.94±1.01
f	0.06	3.11	17.68	14.02
p value	0.36	0.09	0.001	0.001

significant difference in the pain rating and functional scores across the three groups studied. This is in consonance with the report of the study by Lewis *et al.*¹⁹ in which thirty-six non-hospitalized subjects with chronic pain from OA of the knee participated in a crossover evaluation of TENS and naproxen, which is an NSAID. It is significant to note that while lowest reduction in pain rating was observed in Group B (Physiotherapy only); lowest reduction in functional scores was observed in Group C (NSAIDs only).

There was no statistically significant difference in both systolic and diastolic blood pressure in all the 3 groups. This may be because all the participants were on regular anti-hypertensive drugs. Although exercise therapy which is an important non-pharmacological agent in management of hypertension was included in the treatment of two of the three groups in this study, the exercise protocol administered was local to the knee region rather than the generalized, endurance type of exercise which usually have profound effect on the cardiovascular functions of the subjects. The non-significant differences observed in SBP and DBP of both Groups A and C (Physiotherapy and NSAID, and NSAID alone respectively) is in line with the study of Bhaligat²⁰ who assessed blood pressure after one month treatment of 15 women with arthritis and hypertension with thiazide diuretics and ACE inhibitors (anti-hypertensive) and in random order, but sequentially ibuprofen, sulindac and diclofenac. Mean blood pressure was also reported to be unchanged before and after all NSAIDs and submitted that the blood pressure action of the combination may not be prostaglandin-dependent.²⁰ Also large meta-analyses have suggested that NSAIDs treatment elevates blood pressure by an average of 5mmHg in hypertensive persons whose blood pressure had been controlled by drug therapy.²¹ The variance observed in this study, as well as that reported by Bhaligat²⁰ as against the report by Pope *et al.*²¹ may be due to the fact that effects of NSAID on sodium retention are dose-dependent and low doses of ibuprofen (the drug group used in the present study) may cause less aggravation of hypertension.²² It is however pertinent to indicate that the focus of this study is not to investigate the influence of NSAID on hypertension.

Side effects of long term administration of NSAIDs include nephrotoxicity²³ and diverse upper gastrointestinal adverse effects, including dyspepsia, erosions, peptic ulcer diseases and complications such as bleeding perforation.²⁴ Ibuprofen is a relatively safe and cheap NSAID. Hawkey and Langman¹¹ had submitted that the reduction of risk during routine clinical use of ibuprofen is such that comparisons of safety and efficacy of reduced doses of ibuprofen (£ 1,200mg daily) seem to worth considering in management of OA. The dosage of ibuprofen for this study was 400mg three times daily. The use of TENS/ Exercises as an alternative therapy in patients who have contraindication to the use of NSAID and other pharmacological management may thus be worthy of closer review by all health practitioners involved with management of osteoarthritis.

Limitations of this study include the small sample size, short duration of treatment (eight weeks), non-uniformity in the type of antihypertensive drugs the participating patients were placed on and the use of quasi-experimental research design.

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Comparing Effectiveness of Antero-Posterior and Postero-Anterior Glides on Shoulder Range of Motion in Adhesive Capsulitis - A Pilot Study

Harsimran K¹, Ranganath G², Ravi SR³

¹BPT Student, ^{2,3}Assistant Professor, Department of Physiotherapy, Manipal University, Karnataka, India

Abstract

Objective

To compare the effectiveness of antero-posterior (AP) and postero-anterior (PA) glide mobilization on external rotation range of motion (ROM) in patients with adhesive capsulitis.

Methodology

Patients referred to the department of physiotherapy with the diagnosis of primary adhesive capsulitis were included in the study. Subjects were from both gender groups between 35 to 70 years of age, with capsular pattern of shoulder. Total of 15 participants were included in the study by convenience sampling and were randomized to 2 treatment groups (antero-posterior i.e. AP and postero-anterior i.e. PA) by block randomization. AP group consisted of 8 subjects & PA group consisted of 7 subjects. Out of 15 subjects 10 completed the study & 5 were lost to follow up. Kaltenborn grade III mobilizations were provided to both the groups, with direction of mobilizations directed anteriorly in one group & posteriorly in the other group. Improvement in shoulder external rotation range of motion at 45° of abduction was the primary outcome measure, with secondary outcome measures as Visual Analogue Scale (VAS) pain scores.

Results

Descriptive analysis of 15 subjects using median and interquartile values revealed that there was improvement in the primary & secondary outcome measures in both the groups (AP & PA). There was no clinically significant difference between the 2 groups.

Observation

Both the glides antero-posterior (AP) and postero-anterior (PA) showed to be effective on external rotation range of motion in patients with adhesive capsulitis.

Key Words

Adhesive capsulitis, mobilization, convex-concave rule.

Introduction

Adhesive capsulitis or "frozen shoulder" is one of the common pathologies leading to shoulder pain & dysfunction.¹ Its prevalence in general population is reported to be 2%, with

an 11% prevalence in individuals with diabetes.² Dense adhesions & capsular restrictions in the dependent fold of the capsule is characteristic of this condition.³ Adhesive capsulitis is more common in women between fourth and sixth decade of their life.⁴

The onset of this condition is usually gradual and idiopathic, but it may also be acute and associated with history of minor injury to the shoulder.⁵ Adhesive capsulitis has been divided into 2 types.³ Primary adhesive capsulitis, which refers to the idiopathic form of a painful and stiff shoulder & secondary adhesive capsulitis, indicated as a loss of motion resulting from many predisposing factors such as trauma, diabetes, stroke, upper extremity fractures or surgeries with immobilization.

Adhesive capsulitis is one of the most common, self limiting disorders of the musculoskeletal system with a duration varying from one to three years.⁶ Long term range of motion limitations lasting from 2 to 10 years may be suffered by 20-50% patients with adhesive capsulitis. According to Cyriax, tightness in a joint capsule results in a pattern of proportional motion restriction, called 'capsular pattern' in which the range of motion of external rotation is more limited than abduction, which in turn is more limited than internal rotation.⁷

In Frozen shoulder, there is global loss of both passive and active range of motion of the glenohumeral joint with external rotation usually being the most restricted physiologic movement, following the capsular pattern.^{8,9} This condition can be managed by physical therapy³, medical therapy⁵, corticosteroid intraarticular injections⁵, hydroplasty², manipulation of the joint under anaesthesia¹ & surgical interventions.¹⁰ Physical therapy can include stretching, heating modalities, strengthening exercises and mobilizations.⁵ Common joint mobilization techniques incorporated for improvement in range of motion deficits are inferior, postero-anterior (PA) & antero-posterior (AP) glides. According to Convex-Concave rule, the head of the humerus glides anteriorly during external rotation.¹ However in adhesive capsulitis different areas of capsular adhesions maybe seen, such as superior, anterior, inferior & posterior, causing the humeral head to glide in a direction opposite to the capsular tightness, called the "Capsular Constraint Mechanism".¹¹

Arthrokinematics of the joints are considered according to the convex-concave rule.^{12,13} However deviations from this rule have been reported in the literature.^{14,15} According to Howell et al with elevation and maximal lateral rotation of the arm, the center of the humeral head was positioned 4 mm posterior to the center of the glenoid cavity, which is in contrast to the Convex-Concave rule.^{13,14} Similarly Harryman et al reported that with extension & lateral rotation, the humeral head translated posteriorly, which according to him was due to asymmetrical tightening of the capsule during humeral rotation resulting in translation of the humeral head in the direction opposite to the tightened capsule called "Capsular Constraint Mechanism".^{13,15}

Mid range mobilization (MRM), end range mobilization (ERM), & mobilization with movement (MWM) techniques have been advocated by Maitland,¹⁶ Kaltenborn,¹⁷ Mulligan.¹⁸ respectively. Kaltenborn's concept of joint mobilization includes three grades of mobilization.¹⁷ Grade I are small amplitude distraction applied with no stress on the capsule, grade II are distraction/ glide applied to tighten the tissues around the capsule

Address for correspondence:

Harsimran Kaur

Department of Physiotherapy,
Manipal college of Allied Health Sciences,
Manipal University, Manipal
Karnataka, India.

Email: simran.khurana.k@gmail.com

& grade III are large amplitude distraction/glide to stretch joint capsule & surrounding periarticular structures.

Traditionally postero-anterior (PA) glides of the humeral head have been used to improve external rotation range of motion, which is the direction of choice based on the Convex - Concave rule.¹⁷ However; Roubal et al & Johnson et al on the contrary found that antero-posterior (AP) glide is effective in improving external rotation range of motion in patients with adhesive capsulitis, which is in accordance with "Capsular Constraint Mechanism".^{9,19}

In order to assess the function of patients with shoulder problems objectively, measurement of shoulder range of motion with universal goniometer is advocated. Intratester and Intertester reliability of measuring passive range of motion for lateral rotation of the shoulder complex was found to be similar i.e 0.96 and 0.97 respectively.²⁰

Methods

A pre-test post-test study was conducted, involving the patients referred to Physiotherapy department with the diagnosis of adhesive capsulitis. Subjects included in the study were males & females between 35 & 70 years of age, in their subacute or chronic stage with capsular pattern of shoulder i.e. external rotation range of motion more limited than abduction, which in turn is more limited than internal rotation. Subjects with capsular tightness were differentiated from muscular tightness i.e. subjects with external rotation range restricted that worsened with abduction of shoulder were included in the study. Patients with diabetes, neurological disorders, previous history of trauma or surgery of the affected shoulder were excluded from the study. Total of 15 patients were included in the study by convenience sampling. Procedure was explained in detail & written informed consent was obtained from them. Subjects were then randomized in 2 treatment groups by block randomization, group AP (antero-posterior) & PA (postero-anterior). During Randomization 3 blocks were used, with each block consisting of 6 units (3 AP & 3 PA). Two blocks out of 3 were utilized completely & from the 3rd block only 3 units were used. After allocation, group AP consisted of 8 & group PA consisted of 7 subjects.

Investigators

Two investigators (qualified physical therapists) were involved in the study. Primary investigator performed the mobilization technique and second investigator was blinded to the group allocation of the participants and measured range of motion before and after every treatment session.

Outcome measures & Instruments

Primary outcome measure selected was external rotation ROM at 45°, with secondary measures as Visual Analogue Scale (VAS) pain scores. Universal Goniometer was used for measurement of shoulder ROMs and 10 cm Visual Analogue Scale was used for recording pain scores.

Procedure

Treatment technique selected was Kaltenborn grade III mobilizations. Prior to intervention, demographic data i.e. age (in years), height (in cm), weight (in kg), dominant side, affected side & duration of symptoms (in months) were recorded. Baseline clinical characteristics that were recorded prior to first treatment session included VAS pain scores, shoulder abduction ROM, internal rotation & external rotation ROM at 45° of shoulder abduction.

The shoulder range of motion was measured by the universal goniometer with the patient in supine on the treatment table. The baseline data & subsequent measurements after every treatment session were recorded by the second investigator of the study. Subjects were followed up for 5 consecutive treatment sessions, with 1 session provided per day. Prior to mobilization, moist heat was applied to the target shoulder for a time period of 15 minutes. Patients were positioned appropriately on the treatment table in supine position for AP glide mobilization (Figure 1) & in prone position for PA glide mobilization (Figure 2). Affected limb was taken to available abduction range of motion and grade III Kaltenborn mobilizations were provided for 30 seconds duration. This technique was repeated for 5 times in 1 treatment session. Physiologic movements of the affected extremity were provided for 1 minute after every 30 seconds of mobilization

Fig. 1: Antero-posterior mobilization



Fig. 2: Postero-anterior mobilization



procedure. Post mobilization, moist heat was applied again for 15 minutes, followed by Codman's exercises and finger ladder exercises.³ Subjects were then advised to continue the same exercises at home.

Data Analysis

As being a pilot study, statistical tests of significance were not used. Data analysis was done using SPSS Version 16.0. Analysis was done by descriptive statistics. Median & Interquartile values were observed for all 15 participants. The primary outcome of the treatment was based on the change in median values of external rotation range of motion (at 45° & at end range of available abduction) from 1st treatment session till the 5th session and secondary outcomes were based on change in VAS pain score from 1st treatment session till the 5th session.

There was a loss to follow up of 5 participants out of 15, Median values of the lost data were included in the analysis for intention to treat analysis.

Results

Total of 15 subjects gave written informed consent and participated in the present study. Out of them 10 participants completed all 5 treatment sessions and 5 were lost to follow up. From this lost data 3 were from AP group and 2 from PA group.

Comparison of the median values of the demographic data (age, height, weight, duration of symptoms) of both the groups was done (Table 1). Groups were also compared at baseline for VAS pain scores and shoulder range of motion (abduction, external rotation at 45° & end range of available abduction, internal rotation at 45° & end range of available abduction). (Table 2). Median values of VAS and external rotation range of motion (at 45° & end of available abduction) were compared for change from 1st treatment session to the 5th session. (Figure 3 & Figure 4 respectively)

Table 1: Comparison of demographic data by group (Median & interquartile range)

Group	Gender	Age (in years)	Height (in cms)	Weight (in kgs)	Duration of Symptoms (in months)
AP	M=5	52	164.5	67	3
	F=3	(50-57.8)	(159-175.2)	(55.2-77.8)	(3-3.75)
PA	M=4	56	161.5	62	1.5
	F=3	(49-62)	(149-176.7)	(57-75)	(1-7)

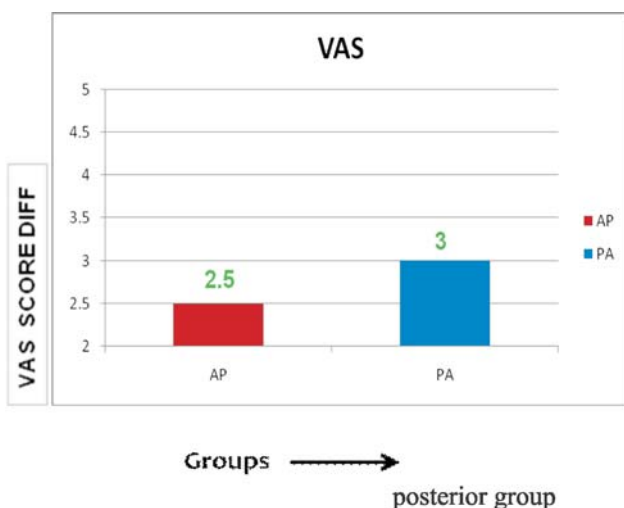
AP = antero-posterior group
 PA = postero-anterior group
 M = Males
 F = Females

Table 2: Comparison of clinical characteristics at baseline by group (Median & interquartile range)

GP	VAS	ABD	IR45	ER45
AP	5.5 (4.25-7)	90 (90-107.5)	60 (41.25-80)	33.5 (30-42.5)
PA	5 (5-6)	90 (85-120)	40 (30-80)	20 (16-55)

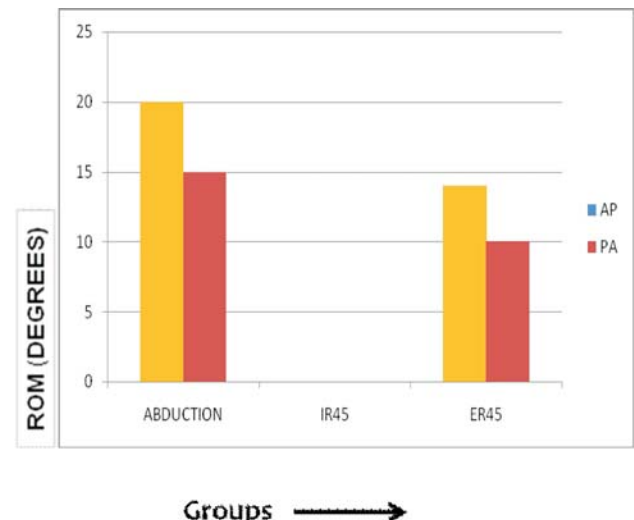
GP = Groups
 VAS = Visual Analogue Scale
 ABD = Shoulder abduction
 IR45 = Internal rotation ROM at 45° abduction
 ER45 = External rotation ROM at 45° abduction

Fig. 3: Comparison of VAS scores by group (Median & interquartile range)



X-axis: Groups, AP = antero-posterior group, PA = postero-anterior group
 Y-axis: Difference in VAS scores pre & post treatment

Fig. 4: Comparison of ROMs by group (Median & interquartile range)



ABD= abduction ROM, IR45= internal rotation at 45° abduction, ER45= external rotation at 45° abduction

Discussion

The results of present study show that both the mobilizations (i.e. AP & PA) are effective in improving external rotation ROM in patients with adhesive capsulitis. Demographic data of both the groups was seen to be similar, with the exception of duration of symptoms (DOS), where median value of DOS in AP group was 3 months and in PA group was one and half. There were 5 males & 3 females in AP group and 4 males & 3 females in PA group. Hence both the gender had almost equal representation. Baseline clinical characteristics, showed similarity in VAS pain scores, abduction ROM & internal rotation ROM at available end range of abduction. But variations were observed in external & internal rotation ROM at 45° abduction and external rotation at available end range of abduction.

Five subjects out of fifteen were lost to follow up. Three were from AP group and two from PA group. Two subjects from AP group underwent Manipulation under anaesthesia and other three subjects could not be followed due to personal constraints. Data of these five subjects was analyzed for intention to treat analysis. None of the patients included in the study reported of any kind of trauma or surgery minor or major of the affected shoulder. All the 15 subjects were right side dominant & nine out of them had their non-dominant side as the affected side. Onset of symptoms was reported to be of gradual in nature in most of the subjects. At baseline both the groups showed similarity with regards to VAS pain scores & reduction in pain scores was observed in both the groups over a period of five treatment sessions. This reduction in pain was seen to be almost similar in both the groups and was considered to be clinically significant.

In case of shoulder ROMs, improvement was observed in all the shoulder ranges in both the groups, with the exception of internal rotation ROM at 45° of abduction, where no change in ROM was observed over five treatment sessions. This result could be attributed to the fact that internal rotation at 45° abduction in most of the subjects was nearly full prior to the treatment & did not change in subsequent treatment sessions. Improvement observed in ROMs seems to be more in AP group as compared to PA group, for abduction, external rotation at 45° & internal rotation at end range of abduction, whereas PA group seems to be better for external rotation at end range of abduction. However, the improvements observed are not clinically significant. These changes observed could be due to small sample size or standard measurement errors.

Results of our study seem to be different from the study by Johnson et al, where improvement in external rotation was found in AP group, as no clinically significant improvement was observed in external rotation ROM at 45° and end range of available abduction in our study. However the two studies are not comparable as no statistical test of significance was performed in our study due to small sample size. Improvements seen in the primary outcome (i.e. external rotation at 45° abduction) in both the groups could be attributable to either of the two mechanisms; Concave-convex rule which might be responsible for improvement in PA group or capsular constraint mechanism which might be responsible for improvement in AP group. There were some limitations of the present study like external rotation ROM was not measured at the same available end range abduction, where the initial value was measured and Daily pre-treatment VAS & external rotation ROM values were not recorded.

Conclusion

Both the glides antero-posterior (AP) and postero-anterior (PA) showed to be effective on external rotation ROM in patients

with adhesive capsulitis. Study with larger sample size and keeping all the limitations in mind is recommended.

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Effect of Head Down Tilt on Hemodynamics in Valve Replacement Surgery Patients

Ajit Thomas¹, Jamal Ali Moiz², Amit Banerjee³

¹Post Graduate Research Student (Cardiopulmonary) Jamia Hamdard, New Delhi, ²Assistant Professor, Centre for Physiotherapy and Rehabilitation Sciences Jamia Millia Islamia, New Delhi, ³Medical Superintendent, LNJP Hospital, New Delhi

Abstract

Purpose

After cardiac surgery 90% of patients show basal atelectasis even on first postoperative day. Removal of secretions in the basal lobes may require the use of head-down positioning i.e. 15-45°. But to position the head down or not still continues to be a dilemma for physical therapist treating the patients with cardiac surgery as it is believed to be hemodynamically unstable for these patients. So the purpose of study is to examine hemodynamic effect after head down tilt in valve replacement patients.

Method

30 patients were included in the study on first post operative day. Baseline reading of variables i.e. heart rate, systolic blood pressure, diastolic blood pressure, respiratory rate, and rate pressure product were taken in supine position. After 15 degrees of Head down tilt all the readings of variables were again taken at 1, 5 and 10 min

Result

Except heart rate there was statistically significant increase in systolic blood pressure, diastolic blood pressure, respiratory rate, and rate pressure product post head down tilt.

Conclusion

Fifteen degrees of head down tilt for 10 min significantly perturbs the cardiovascular system but no detrimental effect of head down tilt (HDT) was observed on cardiovascular system.

Key Words

Hemodynamics; valve replacement surgery; head down tilt.

Introduction

Acquired valvular disease is almost rheumatic in origin. Left heart is more commonly affected than right with mitral 80% of cases, aortic 50%, tricuspid 10% of cases and pulmonary seldom affected.¹⁹ Multiple valve disease accounts for approximately 15% of all operations on cardiac valves; 80% of these operations involve the aortic and mitral operations. According to WHO data, in 2002, about 300,000 people died of

rheumatic heart disease worldwide of which 103,913 were Indians, and about 12 million were still suffering from it worldwide. In 1999 in India, a total 6007 valve replacement or repair surgeries were performed of which 4640 were mitral valve replacement, 1967 were aortic valve replacement and 642 were repair or replacement of other valves.^{1,2}

Types and incidence of postoperative pulmonary complications related to abdominal and cardiothoracic procedures are¹⁷

Atelectasis	up to 90%		
Pneumonia	5%-19%		
Pleural Effusion		49%	
Pulmonary embolism	<1%	Aspiration	<1%
Acute respiratory failure			
Acute respiratory distress syndrome			

Studies using multiple inert gas elimination techniques and CT scanning in cardiac surgery patients on the first postoperative day showed large areas of atelectasis in the posterior portions of the lungs with densities largest in basal scans and diminished gradually towards the apex of lungs.^{18,10} 'Chest physiotherapy' is given to maintain or improve alveolar ventilation. In cases where alveolar ventilation is reduced secondary to retained secretions, various techniques are available to the therapist to assist with secretion removal. Removal of secretions in the basal lobes may require the use of head-down positioning i.e. 15-45°^{19,7} in either right or left side lying to improve ventilation of the non-dependent lower lobes (through the increased passive inflationary forces exposed to the non-dependent lung regions), and/or through facilitating drainage of secretions. Studies on severe cardiac illness and neurological⁴ patient with head down tilt did not show any delirious hemodynamic change.^{5,4} But to position the head down or not still continues to be a dilemma for physical therapist treating the patients with cardiac surgery, as it is believed that it would be hemodynamically unstable for these patients. As hemodynamic effects of head down tilt have not been well explored in cardiac surgery patients, the present study is aimed to see the same.

Material and Method

Design

A pre post test design was used.

Subjects

30 patients (16 female and 14 male aged between 18 to 40 years), who were scheduled to undergo either MVR (n=22) or AVR (n=8) were recruited.

Exclusion criteria included moderate to severe respiratory disease, hemodynamically unstable patient's i.e. Left ventricular ejection fraction <35, a history of smoking, mean BP > 60 mmHg and > 110 mmHg, ventricular tachycardia ventricular fibrillation, emergency surgery, and patients on pacemaker. Written informed consent was obtained from all patients.

Address for correspondence:

Jamal Ali Moiz

Assistant professor,
Centre for Physiotherapy and Rehabilitation Sciences,
Jamia Millia Islamia, New Delhi
Email : jmoiz@jmi.ac.in
Phone No: 01126981208

Table 1: Patient's Demographic Data

Subject Characteristics	Mean ± SD (n=30)
Age(years)	28.03±7.03
Height(cm)	163.5±4.54
Weight(kg)	46.7±6.81
BMI(Kg/m ²)	17.40±1.98

Procedure

All patients included in study were studied 6 hours after extubation before having any oral feed. Patency of all the ECG leads infusion lines and drainage tubes were checked prior to study. Patients were given 30 min rest period in supine before the intervention to achieve baseline readings. The level of dome was adjusted and zeroed at heart level. Pre-test baseline reading of heart rate, systolic and diastolic blood pressure and respiratory rate was taken. Then the patient was tilted in head down position by other physical therapist and the angle of 15° was measured with goniometer by the researcher. Immediately the dome was again adjusted and re-zeroed at heart level. The reading of variables were taken again i.e. heart rate, systolic and diastolic blood pressure and respiratory rate was taken after 1, 5 and 10 min. and the patient was returned back to original position and was monitored for next half hour. Study was discontinued if the patient exhibited mean arterial blood pressure <60 mm and >110 mmHg, oxy-hemoglobin saturation less than 90%, fluctuation in heart rate by ± 20 beats per min, any premature ventricular contractions, any new atrial fibrillations.¹²

Statistical Analysis

All data were collected and analyzed using SPSS windows version 14.0. The dependent variables for statistical analysis were HR, SBP, DBP, RR and RPP. To find out the effect of head down position on the selected variables, a repeated measure ANOVA was used. Pair wise post hoc analysis was used to compare data obtained pre intervention and 1min, 5min, 10min post intervention. A p value <0.05 was considered significant.

Results

Effect of Head Down Tilt on Heart Rate

Repeated measure ANOVA could not find any difference (F=0.736, p=0.503) between the readings of heart rate in response to head down tilt.

Effect of Head Down Tilt on Systolic Blood Pressure

Repeated measure ANOVA showed a statistically significant difference (F=13.387, p=0.0001) between the baseline test and post test readings. To find out effect of time on head down tilt a pair wise comparison was done.

Significant increase in systolic BP was seen in 1min, 5min and 10 min post head down tilt with maximum increase of 6.41 mmHg from baseline.

Effect of Head Down Tilt on Diastolic Blood Pressure

Repeated measure ANOVA showed a statistically significant difference (F=4.909, p=0.003) between the baseline test and post test readings. To find out effect of time on The post test reading taken after one and five minutes of head down tilt was found to be statistically similar to the baseline reading but the readings taken after ten minutes was found to be significantly different from the baseline reading. Further it was found that with 95% confidence interval, the maximum change in diastolic blood pressure was 4.49 mmHg

Effect of Head Down Tilt on Respiratory Rate

Repeated measure ANOVA showed a statistically significant difference (f=6.583, p=0.002) between the baseline test and post test readings. To find out effect of time on head down tilt a pair wise comparison was done using Bonferroni test.

When the post test reading taken after 1 min of head down tilt was compared with baseline reading it was found that there was a statistically significant difference. Further it was found that with 95% confidence interval, the maximum change in respiratory was 2.5 /min. Similarly when the readings taken after 5 minutes and 10 minutes were compared with baseline it was not found to be significantly different. So after initial increment of respiratory rate there was decline of respiratory rate nearly towards baseline value.

Fig. 1: Effect of Head Down Tilt on Systolic Blood Pressure

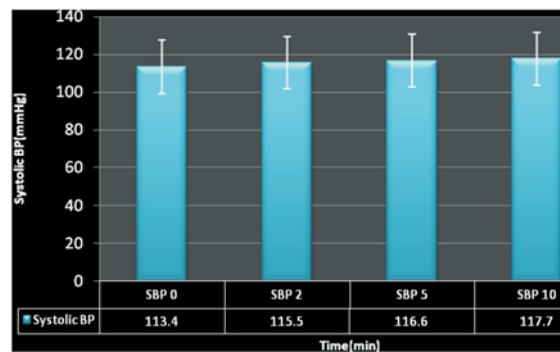
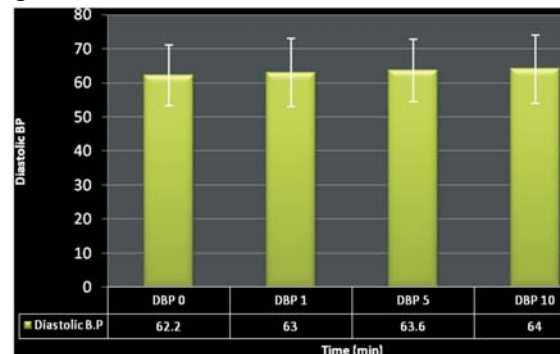


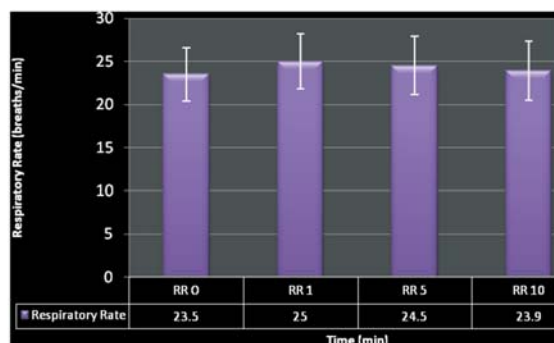
Fig. 2: Effect of Head Down Tilt On Diastolic Pressure



Effect of Head Down Tilt on Rate Pressure Product

Repeated measure ANOVA showed a statistically significant difference (F=7.352, p=0.001) between the baseline test and post test readings. When the reading taken after one and five minutes of head down tilt was compared with baseline reading no statistically significant differences was found. But when the reading taken after 10 minutes of head down position was compared with baseline values, it was found to be significantly different.

Fig. 3: Effect of Head Down Tilt On Respiratory Rate



Discussion

In the present study patients with valve replacement surgery on first post operative day were included, A ten min tilt time was adopted as this has been observed to be an average treatment time for patients with heart disease.⁹ In this study more moderate tilt of 15 degrees was chosen as head-down position has been associated with gastro-esophageal reflux in many populations (Heijke et al 1991)²¹. Dysrhythmias were reported by Hammon et al (1992)⁶ during physiotherapy with head down position in patients with acute heart failure; which included pulmonary edema, particularly when percussions were applied.

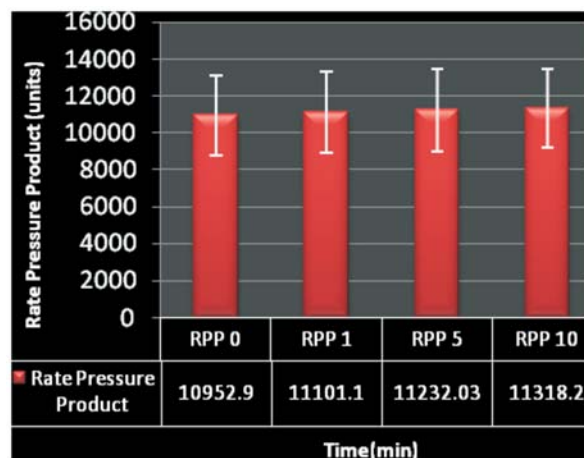
However, recently it has become clear that the hemodynamic changes associated with head-down tilt may be clinically important for patients with limited cardiac reserve (Naylor 2005)⁹. Reducing the degree of head-down tilt reduces the cardiac stress (Naylor 2006).⁵

The results of the study indicate that except heart rate there was significant difference in systolic blood pressure, diastolic blood pressure, respiratory rate and rate pressure product.

There was no significant difference in heart rate from supine to head down tilt which is in accordance with London et al.¹³ who reported a decrease in forearm venous tone in controls, although BP, HR and baroreflex sensitivity did not change in their subjects. The results are not in accordance with studies of Naylor et al.⁷, Weise et al.²⁰ where head down tilt resulted in decrease in heart rate due to loading of cardiopulmonary baroreceptors which decreases muscle sympathetic nerve discharge.^{8,12} The lack of change in heart rate in present study may be due to blunted baroreflex response and /or that the increase in central blood volume was not sufficient to stimulate high pressure baroreceptors.⁵ This observation suggests that no alteration took place in cardiac sympathovagal balance in response to head down tilt.²⁰

The present study demonstrated an increment in systolic and diastolic BP with head down tilt as cardiac output may have increased secondarily to an increase in circulation blood volume by redistribution of blood from peripheral to central areas subsequent to loss of venous pooling in areas below heart, which resulted in increased blood pressure.⁷ It is recognized that head down position relative to upright position performed in healthy subjects, induce acute increase in central blood volume, ventricular preload, myocardial oxygen consumption, cardiac output and stroke volume. In this context change in posture increased ventricular filling by increasing right-sided (cardiac) venous return, thereby influencing the relationship between heart rate and ejection duration. According to Naylor et al⁷ there is longer ejection time for same heart rate in head down posture than supine which reflects a greater degree of myocardial muscle fibre shortening following an increase in ventricular filling. Greater shortening subsequent to an increase in filling increases stroke volume via the Frank-Starling mechanism and thus increasing blood pressure.

Fig. 4: Effect of Head Down Tilt On Rate Pressure Product



This is not in accordance with the studies of Naylor et al⁷, Vijayalaxmi et al¹⁶, where the blood pressure were constant or reduced below baseline level probably due to stimulation of cardiopulmonary baroreceptors which inhibit the vasomotor centre and reduces efferent sympathetic activity.¹⁶ Loading of cardiopulmonary receptors induces a significant reflex forearm vasodilatation, decrease in total peripheral resistance accompanied by decrease in plasma nor adrenalin activity,¹³ which in turn reduces blood pressure. The differences in tilt parameters (degrees and time duration), different population and sample size may explain the apparent inconsistencies.

Functional residual capacity and tidal volume varies considerably with body position. FRC at relaxation point is found to be greatest in standing position and become progressively less on passing to sitting, recumbent and Trendelenburg positions. These changes result from progressive elevation of diaphragm, presumably because of pressure from abdominal viscera. So frequency of respiratory rate may have increased with reduction in tidal volume presumably to maintain minute ventilation for optimization of breathing pattern with compromise between work of breathing and gas exchange. But this increment in respiratory rate was only seen during the first minute of head down tilt and reduced nearly to the baseline values after 5 and 10 minutes. This finding is in accordance with Fadi et al 1998¹⁴ who studied effect of acute head down tilt on animal model and found that with approximately 10 seconds of initiation of head down tilt, central venous pressure increases and reaches a plateau in two minutes. The increase in central venous pressure progressively stimulates phrenic nerve 20 seconds after the onset of acute head down tilt and reaches maximum within 2 minutes and thereafter it tends to decline even though central venous pressure remains at plateau. So the increase in respiratory rate may be due to elevated venous return which stimulates carotid and intra-pulmonary CO₂ chemoreceptor through increasing CO₂ flow (product of CO₂ concentration and blood flow) which transitionally stimulates phrenic nerve activity and increase minute ventilation. And when CVP reaches plateau level the respiratory rate returns to baseline level.

There was significant difference in Rate Pressure Product from supine to head down tilt which is in accordance with Naylor et al⁷ which states that increase in myocardial oxygen consumption may be due to increase in stroke work, due to increase in pre ejection phase associated with increase ventricular end diastolic volume⁷ and increase in afterload. Also, the HDT position is associated with some gravitational stress which is relatively less than sitting, such that O₂ consumption is greater than horizontal positions to support cardiac output in this position¹¹.

Conclusion

The cardiovascular and pulmonary changes observed during head down position of 15 degree for 10 minutes suggests that the maneuver significantly perturbs the cardiovascular system.

While the positional changes were not associated with adverse outcomes in hemodynamically stable open heart surgery patients; they may be detrimental in the presence of abnormal cardiac or baroreflex function. Therefore all vital signs especially the hemodynamics measures should be carefully monitored while rendering the positional changes in intensive care unit

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Efficacy of Motor Relearning Programme on Physical Performance and Weight Bearing on the Lower Limbs in Sitting Position in Post Stroke Hemiparetic Subjects

Jatinder Pal Kaur¹, Senthilkumar CB², Venkadesan R³

¹Lecturer, Department of Physiotherapy, Khalsa College, Amritsar, Punjab, ²Associate Professor, Cherraan's College of Physiotherapy, Coimbatore, Tamilnadu, India, ³Senior Lecturer, Department of Physiotherapy, Lovely Professional University, Punjab

Abstract

The purpose of this study was to evaluate the immediate effect of a 4 week Motor Relearning Programme (MRP) on physical performance and weight bearing on the lower limbs in sitting position in post stroke hemiparetics.

Methodology

Ten subjects with at least 3 months post stroke were assigned in a single group by convenient sampling. All the subjects participated in MRP. Amount of lower limbs weight bearing was measured before and after training by weighing machine and physical performance by using Fugl Meyer Assessment scale.

Results

A mean improvement in physical performance after MRP was 52.00 ± 19.629 and the 't' value of 8.377 was observed in the study with $p < 0.05$. A mean improvement in weight bearing in involved and uninvolved value of AD, ID, CD after MRP was 3.400 ± 3.134 , 1.700 ± 0.674 , 7.800 ± 2.485 , 4.700 ± 3.267 , 4.400 ± 2.547 and 0.000 ± 1.247 and the 't' value of 3.431, 7.965, 9.924, 4.548, 5.462, 0.000 was observed in this study with $p < 0.05$ respectively.

Conclusion

This study provides evidence for the efficacy of MRP on physical performance and weight bearing on the lower limbs in sitting position in post stroke hemiparetic subjects.

Key Words

Hemiparesis, physical performance.

Introduction

According to World Health Organization 'Stroke can be defined as 'rapidly developing clinical signs of focal disturbance of cerebral function of presumed vascular origin and of more than 24 hours duration'.¹

In India the incidence of cerebrovascular disease was found to be 13/100,000 population/ year in a study conducted at Vellore in 1969-71 and 33/100,000 / year in a study conducted at Rhotak. A World Health Organisation study in 1999 quoted incidence of mortality due to stroke in India to be 73/100,000 per year.²

Ischemic stroke occurs due to vascular insufficiency such as cerebrovascular thromboembolism and haemorrhagic stroke

occurs due to intracerebral or subarachnoid haemorrhage.³ Ischemic stroke accounts for 77%, haemorrhagic strokes 22% and unspecified accounted for 2% of all cases. The risk factors identified are hypertension alone in 40%, hypertension with diabetes in 25%, and hypertension with other risk factors (raised cholesterol, ischemic heart disease) accounted for another 20%. Diabetes and ischemic heart disease alone were present in 5% cases.⁴

During reaching activities beyond the upper limbs length in a sitting position, when weight transfer to the feet is at its greatest, the lower limbs help to break forward motion of the body and control balance.⁵ As a result, the patient must devote considerably more effort to remaining upright, with decreased ability to focus on purposeful tasks.⁶ The compensatory involvement of the trunk is greater for patients with more severe motor deficits and may be related to impairments of grasping.⁷

Patients with stroke demonstrate increased postural sway in standing. Delay in the onset of motor activity, abnormal timing and sequencing of muscle activity, and abnormal co-contraction results in disorganization of the postural synergies.⁸

It has been reported that more than 70% of stroke patients admitted to rehabilitation are unable to reach sideways to the floor while sitting.⁹ In addition to paresis, stroke disrupts selective voluntary control and can leave the patient with the primitive patterns of muscle action and spasticity.¹⁰

Likewise, purposeful movements requiring precise control of distal segments (e.g., grasping) are slow, inaccurate and not well coordinated.¹¹

While rehabilitation aims to reduce disability by optimizing the performance of everyday task, on discharge, many individuals are significantly disabled and handicapped.¹²

The persistent disability and handicap experienced by many individuals after stroke arises not only from the impairments resulting from stroke, but also from the deleterious neural, muscle, psychological and cardiovascular adaptations that accompany disuse and use of maladaptive behaviors.¹³

Exercise interventions are the one way to provide on going programs to maintain and improve performance after discharge from rehabilitation. Such intervention is advantageous because it not only provide the opportunity for exercise but also cost-effective.¹⁴

The most common are the neurophysiological approach, which emphasizes facilitation and normalization of motor function,¹⁵ the orthopedic approach, which is based on the mobilization and strengthening of the affected and the unaffected limbs to increase compensatory functions,¹⁶ and the motor relearning approach, which uses active practice of context-specific motor tasks and feedback to regain the lost motor functions.¹⁷

Carr and shepherd proposed that training in motor control requires anticipatory actions and on going practice. To further enhance relearning, the motor task involved are practiced within a context that can be task or environmental specific.¹⁸

Need for the Study

The purpose of physiotherapy is to help the patients bear equal weight on both sides in sitting position thereby improving overall physical performance using MRP.

Address for correspondence:

Jatinder Pal Kaur

MPT (Neurology), Department of Physiotherapy,

Khalsa College, Amritsar, Punjab, India

Mobile No: +91(0)9878096176

E-mail: jatinderpalphysio54@yahoo.co.in

Objective of the Study

To investigate the efficacy of MRP on physical performance and weight-bearing on the lower limbs in sitting position in post-stroke hemiparetic subjects.

Hypothesis

Alternate Hypothesis (H1)

There is significant effect of MRP on physical performance and weight-bearing on the lower limbs in a sitting position in post-stroke hemiparetic subjects.

Null Hypothesis (H0)

There is no significant effect of MRP on physical performance and weight-bearing on the lower limbs in a sitting position in post-stroke hemiparetic subjects.

Significance of Study

In the present study, I evaluated the effects of MRP on physical performance and weight bearing on the lower limbs in sitting position in post stroke hemiparetic subjects. MRP seems to an important treatment intervention to improve affected function and make stroke patients independent in the self care activities.

This study may provide an insight for the physiotherapists into the relationship of MRP with physical performance and weight bearing on the lower limbs in sitting position for making the post stroke hemiparetic patients fit for their self care activities.

Review of Literature

Reisman DS et al (2007) evaluated deficits in surface force production during seated reaching in people after stroke. The results suggest that the normal magnitude and timing of surface production during beyond arm's length are altered in people with even mild hemiparesis after stroke, particularly during reaching towards the hemiparetic side.¹⁹

Michelle et al (2007) investigate the influence of combined afferent stimulation and task-specific training following stroke. Patients in the stimulation group exhibited significantly greater improvements in the group-lift task than control group.²⁰

Joanne M Wagner et al (2007) investigated sensorimotor impairments and reaching performance in subjects with post stroke hemiparesis during the first few months of recovery. Upper extremity sensorimotor impairments and reaching performance were evaluated in The detailed clinical assessment of UE sensorimotor impairments measured at the acute and sub acute phase after stroke did not affect the reaching performance.²¹

Dora YL Chan et al (2006) studied the efficacy of the motor relearning approach in promoting physical function and task performance for patients after stroke. They concluded that physiotherapy treatment using motor relearning approach is preferable to that using conventional approach in rehabilitation of stroke patients.²²

Leonard E Kahn et al (2006) investigate the effect of robotically administered active-assistive exercise and compare those with free reaching voluntary exercise in improving arm movement ability after chronic stroke. The group that performed unassisted reaching exercise improved the smoothness of their reaching movement's more than robot-assisted group.²³

Sylvie Messier et al (2005) verified weight bearing on the feet in a sitting position during bilateral movement of the upper

limbs in post stroke hemiparetic subjects. The result of this study shows that weight bearing on the paretic foot is reduced during unilateral and bilateral pointing in the anterior, produced symmetrical weight bearing on both feet, paretic and non-paretic.⁵

Thielmaj ET et al (2004) evaluated the effectiveness of Target Reach Therapy (TRT) and Progressive Resisted Exercise (PRE) for improving paretic limb reaching by chronic subjects. This study showed that TRT resulted in increased substitutive trunk use at the target ipsilateral to the moving arm and for midline and contralateral targets after PRE.²⁴

Birgitta Langhammer et al (2003) evaluated whether two different physiotherapy regimes caused any differences in outcome in rehabilitation after acute stroke. They concluded that physiotherapy treatment using MRP is preferable to that using Bobath programme in acute rehabilitation of stroke patients.²⁵

Lucia Spinazila et al (2003) studied impairments of trunk movements following right or left hemisphere lesions. The result of this study shows that task related circuit training improved performance of locomotor tasks in chronic stroke.²⁶

Dean CM et al (1997) evaluate effect of task-related training program aimed at performance of seated reaching tasks after stroke. The results show that experimental subjects were able to reach faster and further increase load through affected foot, increase activation of affected leg muscles compared with control group.⁹

Beckerman et al (1996) defined criteria for stability as opposed to change of motor function of the lower limb in stroke patients. Intra-class correlation coefficient for the lower limb scale was 0.86 and 0.34 for the balance scale.²⁷

Mindy F Levin et al (1996) characterize end point trajectories and inter-joint coordination of arm pointing movements to different targets on a horizontal planar surface and to correlate disruption in motor control in the affected arm of hemiparetic subjects. The results that the inter-joint co-ordination of movements made into or out of the typical extensor or flexor synergies were typically disrupted.²⁸

Sandford J et al (1993) found the reliability of Fugl-Meyer assessment of physical performance in patients following stroke. They found that overall reliability was high (overall intra-class correlation coefficient = .96)²⁹

Wade DT, Wood VA et al (1985) evaluated the recovery after stroke. First, it confirms that recovery is fastest in the first few weeks after stroke but it suggest that it can continue beyond the first three months. It also suggests that discharge from hospital coincides with a slowing or stopping of recovery.³⁰

Materials & Methodology

Study Design

Quasi Experimental Design (One group Pre test-Post test Design).

Study Setting

Four subjects were selected from "Physiotherapy Out-Patient Department, Lovely Professional University at Jalandhar" and six subjects were selected from "Gurudwara Singh Sabha Charitable Hospital at Jalandhar"

Population and Sampling

The convenient sampling method has been used. Ten subjects ranging from 45-65 years of age were included in the study.

Criteria For Sample Selection

Inclusion Criteria

Age: 45- 65 years, 12 weeks post stroke, Capable to perform in a sitting position without support(Functional Balance Scale grade 2), Both right and left hemiparesis due to stroke, Spasticity grade 1, 1+ and 2 (Modified Ashworth Scale), A good understanding of simple verbal instructions(Mini Mental State Examination(MMSE) >24).

Exclusion Criteria

Severe cognitive impairment (Mini Mental State Examination score less than 24), Visual or auditory deficits, Contractures and deformities of the upper limb and/or lower limb, Recurrent episodes of stroke, sensory impairments.

Tools for Data Collection

Fugl Meyer Assessment of physical performance The cumulative test score for all the components is 226 with availability of specific subtests scores.

Weighing Scale is a valid and reliable device for measuring the weight in the clinical setting. (Suvarna, Bhaseen Health Pvt. Ltd. INDIA)

Procedure

After informed consent, during pretest each subject was evaluated for physical performance by Fugl-Meyer assessment of physical performance and weight bearing on the affected and unaffected side was measured by weighing machine and they had received MRP as per the protocol. The post test results have been taken at the end of 4 weeks of treatment. Subjects received MRP for a period of 5 days per week (40 minutes per day of 20 sessions).

Data Analysis

Paired 't' test was used to analyze the significant difference between the mean of the pre test values and mean of the post test values to determine out of the MRP given after a period of three months

From table 1, Graph 1, it is inferred that there was gradual improvement in the physical performance after the MRP. On analyzing the pre test and the post test values by paired 't' test there is significant mean difference 52.00 with SD of 19.629 and the t value of 8.377 at P <0.05.

From table 2, it is inferred that there was gradual increase in weight bearing on the lower limb while reaching in anterior direction. On analyzing pre test and post test values of weight bearing on the involved lower limb there is significant mean difference of 3.400 with standard deviation of 3.134 and t value of 3.431 at p <0.05. On analyzing pre test and post test values of weight bearing on the uninvolved lower limb there is significant mean difference of 1.700 with standard deviation of 0.674 and t value of 7.965 at p <0.05.

From table 3, it is inferred that there was gradual increase in weight bearing on the lower limb while reaching in ipsilateral direction. On analyzing pre test and post test values of weight bearing on the involved lower limb there is significant mean difference of 7.800 with standard deviation of 2.485 and t value of 9.924 at p <0.05. On analyzing pre test and post test values of weight bearing on the uninvolved lower limb there is significant mean difference of 4.700 with standard deviation of 3.267 and t value of 4.548 at p <0.05.

From table 4, it is inferred that there was gradual increase in weight bearing on the lower limb while reaching in contralateral

direction. On analyzing pre test and post test values of weight bearing on the involved lower limb there is significant mean difference of 4.400 with standard deviation of 2.547 and t value of 5.462 at p <0.05. On analyzing pre test and post test values of weight bearing on the uninvolved lower limb there is significant mean difference of 0.000 with standard deviation of 1.247 and t value of 0.000 at p <0.05.

From the table 5, it is inferred that the calculated t- value 8.377 at 0.05 level of significance, which was greater than the tabulated t-value of 2.262. This shows that there was significant difference between pre versus post test result.

From the table 6, it is inferred that the calculated t- value for involved side was 3.431 and for uninvolved side was 7.965 at 0.05 level of significance, which was greater than the tabulated t-value of 2.262. This shows that there was significant difference between pre versus post test result.

From the table 7, it is inferred that the calculated t- value for involved side was 4.548 and for uninvolved side was 9.924 at 0.05 level of significance, which was greater than the tabulated t-value of 2.262. This shows that there was significant difference between pre versus post test.

From the table 8, it is inferred that the calculated t- value for involved side was 5.462 and for uninvolved side was 0.00 at 0.05 level of significance. This shows that there was significant difference between pre versus post test result on involved limb and insignificant difference between pre versus post test results on uninvolved limb.

Results and Discussion

Stroke is major cause of disability and handicap in adults. Some stroke patients never regain their ability to balance because it is never stimulated in a sufficiently specific manner. They soon learn to hold themselves stiffly, to avoid threats to their balance by maintaining a wide base, or to use only one side of the body. This results in ineffective limited function and a likelihood of falls. The major reason for ineffective and limited functional ability following stroke is a failure of the patient to reestablish an effective body orienting and balance mechanisms.³¹

The study aimed to evaluate the effect of MRP on physical performance and weight bearing on the lower limbs in sitting position in post stroke hemiparetic subjects. Among the ten subjects 4 are female and 6 are male.

The selected outcome measures are Fugl Meyer assessment of physical performance scores and weight bearing values at the baseline and one month after MRP. The obtained data is analyzed by using paired 't' test.

Fugl Meyer Assessment score was taken as parameter to measure physical performance. Results shows that there is significant difference improvement on the physical performance as calculated 't' value (8.377) for the physical performance measure is greater than the table value at p <0.05 and the weight bearing on the lower limbs in sitting position as the calculated 't' value (ADI-9.924, ADU-3.265, IDI-3.431, IDU-7.965, CDI-5.462) for the weight bearing measure is greater than the table value at p <0.05. Results shows that there is insignificant difference in weight bearing with calculated 't' value (CDU-0.00) is lesser than the table value at p <0.05.

A significant improvement in physical performance and weight bearing on the lower limb in sitting position in post stroke hemiparetic subjects may be a result of intensive training of affected side and making the patient concentrate on using their affected side for daily activities. MRP is effective for enhancing functional recovery of patients who had stroke.

MRP emphasizes sequential and function-based training appeared more effective for enhancing the performance of post stroke patients. Motor learning theory describes the ways in which motor patterns can be acquired and modified through experimental learning such as through observation and repeated

Table 1: Pre and Post test Mean and SD of FMAPPS scores

Variables	Mean	SD
Pre test Upper Limb score	35.8000	12.56804
Post test Upper Limb score	55.6000	5.64112
Pre test Lower Limb score	17.7000	5.29255
Post test Lower Limb score	29.7000	3.26769
Pre test Balance score	10.2000	2.78089
Post test Balance score	12.9000	1.44914
Pre test ROM score	34.9000	5.66569
Post test ROM score	42.6000	1.34990
Pre test Sensation score	24.0000	.00000
Post test Sensation score	24.0000	.00000
Pre test Pain score	42.8000	1.39841
Post test Pain score	37.3000	6.58365
Pre test Total score	155.6000	27.89345
Post test Total score	207.6000	9.41866
Pre test Percentage score	68.8450	12.34193
Post test Percentage score	91.8590	4.17312

Table 2: Weight bearing value in Anterior Direction

Variables	Mean	SD
Pre Involved AD	5.3000	0.94868
Post Involved AD	13.100	2.64365
Pre Uninvolved AD	8.4000	1.64655
Post Uninvolved AD	13.100	2.42441

Table 3: Weight bearing value in Ipsilateral Direction

Variables	Mean	SD
Pre Involved ID	10.1000	3.87155
Post Involved ID	13.5000	2.54951
Pre Uninvolved ID	12.3000	2.94581
Post Uninvolved ID	14.0000	2.49444

Table 4: Weight bearing value in Contralateral Direction

Variables	Mean	SD
Pre Involved ID	10.9000	3.98469
Post Involved ID	15.3000	2.49666
Pre Uninvolved ID	15.9000	4.60555
Post Uninvolved ID	15.9000	4.86370

Table 5: FMAPPS within the group

Pre Vs Post	t value	P value
Upper Limb	-8.193	P < 0.05
Lower Limb	-9.115	P < 0.05
Balance	-5.449	P < 0.05
ROM	-4.880	P < 0.05
Sensation	0.00	P > 0.05
Pain	-3.093	P < 0.05
Total	-8.377	P < 0.05
Percentage	-8.384	P < 0.05

Table 6: Weight bearing in anterior direction within the group

Pre Vs Post	t value	P value
Involved	-3.431	P < 0.05
Un-Involved	-7.965	P < 0.05

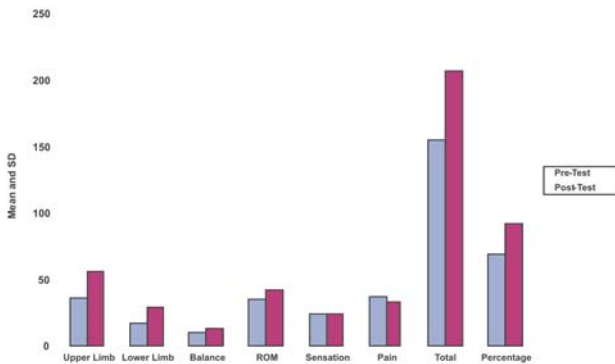
Table 7: Weight bearing in ipsilateral direction within the group

Pre Vs Post	t value	P value
Involved	-4.548	P < 0.05
Un-Involved	-9.924	P < 0.05

Table 8: Weight bearing in Contra-lateral direction within the group

Pre Vs Post	t value	P value
Involved	-5.462	P < 0.05
Un-Involved	0.00	P > 0.05

Graph 1: Comparison of pre and post test Mean and SD of FMAPPS score



practice. People with brain injury have deficits in motor programmes, motor memory and associated feedback and feed-forward mechanisms, which largely impede their functional performance. The motor relearning approach promotes the regaining of normal motor skills through task-oriented practice with appropriate feedback and the active participation of the patients.²⁶

Improvement in physical performance and weight bearing on the lower limbs in sitting position noticed in this study may be due to reason that MRP would have helped to reduce the disease symptoms and thereby improving the physical performance and weight bearing on the lower limbs in sitting position in post stroke hemiparetic subjects.

Evidence shows that large number of post stroke hemiparetic subjects experience balance impairments due to abnormal movement and postural reactions. The abnormal movement and postural pattern is referred as motor dysfunction. We also know that there are effective interventions for these abnormal movements and postural reactions. MRP aimed at correcting the abnormality of movement thereby improving the physical performance and weight bearing on the lower limbs in sitting position in patients with post stroke hemiparesis.

To execute reaching tasks in sitting position requires a coordinated movement of the trunk and the lower limbs to keep the body stable and maintain balance. Reaching movement beyond upper limb length in a sitting position increase postural demands since part of the body weight supported by thighs on the chair is transferred to the base of support provided by feet.⁵

Trunk flexion in anterior direction and towards the paretic side requires activation of the trunk extensors on the non-paretic side to control trunk flexion. However, trunk flexion towards the non paretic side requires greater use of hemiparetic muscles of the trunk. Muscle weakness on the paretic side of the trunk creates an ability to generate enough muscle activity to provide necessary braking when moving the trunk in the non paretic direction. This inability probably created the need to use the paretic foot in hemiparetic subjects to maintain their balance.⁵

Specific training or repetitive exercises are known to increase the cortico-spinal excitability and improve function of the paretic side.²⁴ Task-specific physiotherapy involving repetitive practice of the meaningful daily activities is more effective than

traditional approaches to rehabilitation of the paretic side.

In MRP, the practice of goal-directed, functional movements is carried out in a natural environment. Studies with this population have shown that MRP improves locomotion and lower limb weight bearing in sitting and standing up. Furthermore, a recent study involving positron emission tomography found that MRP induces brain plasticity in stroke patients.²⁸

Limitations

Small sample size, Previous treatment taken was not considered, Right or left hemiparetic population was considered together, Study was done in short period of time which does not prove the long term effect, Results of the study mainly depend on validity of fugl meyer assessment scale, Study has no control group, Modified Ashworth Scale, No follow up was taken.

Recommendations

Based on the outcome of the statistical analysis, it is suggested that the future studies should be modified to accommodate the following changes:

Large sample size can be taken, Study can be done with narrow age criteria Young stroke population can be considered, Comparative studies can be done on right and left hemiparesis, A follow up of study is recommended for a more comprehensive analysis of recovery of upper limb.

Summary and Conclusion

Based on the analysis, it can be interpreted that MRP produces significant improvement. In correlating with literature and statistical analysis, this study conclude that MRP has produced significant improvement on physical performance and weight bearing on the lower limbs in sitting position in post stroke hemiparetics.

It is evident that such an intervention is effective and it helps in reducing disease symptoms and improves the general functional well being among these patients with post stroke hemiparesis. Therefore, from the literature available and the statistical analysis of data, it accepted and stated as,

“There is significant effect of motor relearning programme in improving physical performance and weight bearing on the lower limb in sitting position in stroke patients.”

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The Effect of Low Power Laser Acupuncture on Experimental Pain Threshold in Normal Subjects

Javan Amoli M¹, Ebrahimi I², Marofi N³, Javan Amoli M⁴

¹Emam reza hospital, Mazandaran University of Medical Sciences & Health Services, Amol, Iran, ^{2,3}Rehabilitation faculty, Iran University of Medical Sciences & Health Services, Tehran, Iran, ⁴17 Shahrivar Hospital, Mazandaran University of Medical Sciences & Health Services, Amol, Iran

Abstract

In This research the immediate & latent effect of low power Ga-Al-As laser irradiation applied to acupuncture points on experimental pain Threshold were studied.

Material & Method

Study design was quasi experimental, seventy adult women Ranging in age from 20-40 years assigned randomly to one of two groups. Laser group (n=33) received L.P.L Ga-Al-As to appropriate acupuncture points for wrist pain, control group (n=37) received placebo laser, this research was single blind. We measured experimentally induced pain threshold at ipsilateral nondominant wrist following electrical stimulus, once before treatment and three times after treatment with short intervals.

Parameters for laser were, wavelength, 780 nm; power out put, 5mw and acupuncture points; L.I.4 & L.I.5 each point was treated for 60 sec which amounted to 0.3 j/point, radiation technique was direct contact. Parameters for electrical stimulus were, monophasic square wave with a duration of 5 ms; interpulse interval, 500 ms and intensity, 0-30 mA.

Results

The laser group demonstrated a statistically significant ($p=0.001$) increase in mean value for pain threshold at 10 minutes after treatment, but control group did not. Also changes of pain threshold in laser group were greater than of control group. This increase remained significant only at 10 minutes after treatment measurements ($p=0.001$).

Conclusion

Low power Ga-Al-As laser radiation to acupuncture points can increase experimentally induced pain Threshold.

Key Words

Pain threshold, laser, experimental pain, acupuncture.

Introduction

Acupuncture is an indispensable part of traditional Chinese medicine and has a history of four thousand years. It continues to be used extensively in clinical practice.

Acupuncture treatment is especially applicable to the treatment of musculoskeletal and soft tissue conditions, where it is particularly effective. Many of these conditions can not be satisfactorily treated by drugs due to the large number of side effects and the high cost treatment. Its value in the management of pain has become widely accepted and it is presently offered as a powerful and effective therapy.¹

The commonest alternative related techniques in this points include the use of electric currents, particularly TENS and low energy laser.^{2,3}

Laser acupuncture offers distinct advantages over traditional needling, because the procedure is non invasive,

painless and free infectious complication, so it is more appealing to the patients, Also it can be useful in shortening the time required to resume routine work the patient. Also combined with other therapeutic modalities.^{2,4,15}

Laser acupuncture treatment is inexpensive, highly effective and has no side effects.⁴

Material & Method

This study design was quasi experimental and conducted on 70 women of between 20-40 years old, the persons were announced healthy regarding neurologic and orthopedic problems and pain free, they psychologically had no reaction to electric stimuli and All the persons had written consent. Due to the limitation of subject selection, it was non random and volunteers were selected for the study but they were randomized into two groups using low power laser and placebo in acupuncture points of the wrist pain respectively. This study was single blind and was conducted without the subjects awareness of the possible results. The instruments in this study consisted of:

1. Electrical stimulator which produced a monophasic square wave with a duration of 5 ms and intervals of 500 ms and the frequency 100 Hz. The active electrode was a 2mm diameter pen electrode that created acute pain in ipsilateral nondominant wrist (figure 1).

Fig.1: Location of stimulating electrode-distal end of left radius in this study



The inactive electrode was a carbonized silicon electrode of 6x8 cm size that being placed on 7th cervical vertebra. This examination include four times, once before and three times (immediately, 5 minutes, 10 minutes) after laser radiation.

First detectable sensation threshold as well as pain threshold were determined. Via the methods – limits technique, the current was increased from zero at a constant rate (approximately 1.5 mA/s) until light tapping (sensation threshold) was perceived. Stimulus was then immediately turned off, and the procedure was repeated three times. The average of three current levels was taken as the true sensory threshold in the distal end radius. For pain threshold, the same process was repeated, but the intensity was increased in 0.3mA steps until the first pain (pain threshold) was perceived.

- Gallium- Aluminium – Arsenide laser which produced continue radiation with wave length of 780 nm, the out put of 5 mw and 0.3 j/point energy, radiation technique was direct contact. Laser radiated on L.I.4 (Hegu) and L.I.5 (Yangxi) points that before has determined (figure 2&3).¹⁶ The time intervals were also checked for control group.

Fig. 2: Location of acupuncture point L.I.4 (hegu) on the large intestine channel in this study.

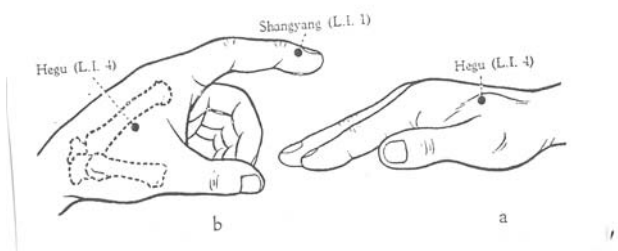
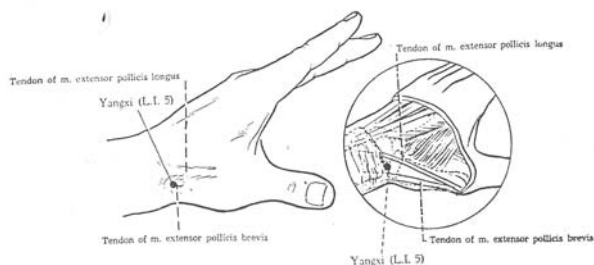


Fig. 3: Location of acupuncture point L.I.5 (yangxi) on the large intestine channel in this study.



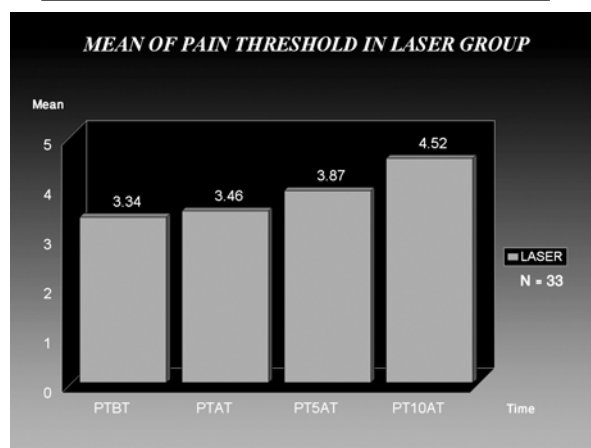
Results

The statistical package for the social sciences (SPSS) was used for the analysis. 75 subjects were volunteered, that 5 cases were excluded from study.

In the study laser group, one way variance analysis test showed that pain threshold in 10 minutes after laser radiation with $p=0.001$ an increasing trend.

Table 1: mean of pain threshold in laser group.

Time (min)	Pain threshold	
	X	SD
Before treatment	3.34	1.22
Immediately after treatment	3.46	1.28
5 minutes after treatment	3.87	1.37
10 minutes after treatment	4.52	1.41



In the control group, no significant change was detected in pain threshold in various time intervals.

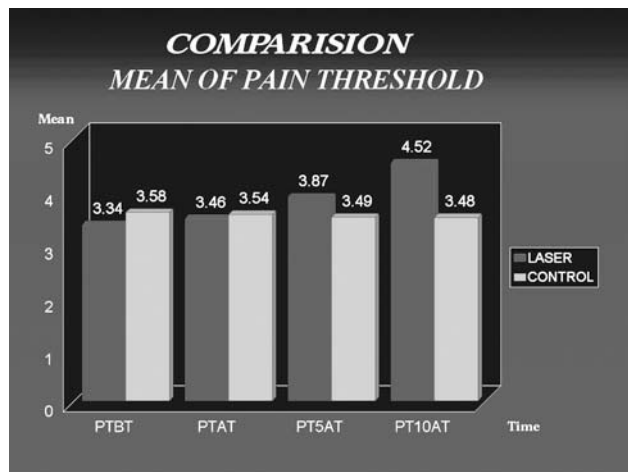
Table 2: Mean of pain threshold in control group.

Time (min)	Pain threshold	
	X	SD
Before treatment	3.58	1.17
Immediately after treatment	3.54	1.13
5 minutes after treatment	3.49	1.15
10 minutes after treatment	3.48	1.08

Also the independent t.test showed that between means of pain threshold two groups, there was a significant difference with $p=0.001$ in 10 minutes after laser radiation.

Discussion

There was significant changes in pain threshold in 10 minutes after radiation, which may be due to the relieving effect of acupuncture points and laser together. The laser not only



gives the acupuncture effect, but also has its own anti-inflammatory effect on the tissues. Low power laser has a photochemical (not thermal) effect on the cells; the light energy is absorbed by the cell and converted to chemical energy. Cell function improves, allowing healing to take place; enzymes such as endorphins and serotonin are released to give pain relief.¹¹

Laser energy transferring through out meridian and lateral channels and creating analgesic effect.⁸ also increases the pain threshold of never ending.⁹

The therapeutic effect of L.P.L is not fully understood but King et al demonstrated that Helium- neon laser radiation on auricular acupuncture points elevates the pain threshold by raising the level of endorphins in the brain.⁸ Stimulation of acupuncture points can raise the endorphin level in the brain¹², and can lead to an increase in activity of the opioidergic system, including panopoid activity and beta endorphin levels in plasma.^{12,14}

We found comparable results with King et al.⁸ Although they used continuous Helium- neon laser on auricular points and detected immediate change in pain threshold, which may be due to laser type used. GAA1AS lasers may be more effective for analgesic effects in the deep and superficial tissue, respectively.^{5,6,7} also treatment parameters, numbers and kind of points that was received laser radiation.

In this study we have focused on the effect of GAALAS laser in healthy individual on experimental pain. Due to the many variables involved in pain and lack of visible objective findings and the effect of many cultural and psychological factors on pain expression, evaluation of pain in real context is not a practical way. So experimental pain stimuli were used in this study.⁸

In control group, in all times test no increase was detected in pain threshold, even small decrease occurred in this group, the repetition of stimuli can result in increase in perception which may be due to hyper sensitization of peripheral pain receptors or in upper nervous levels. since noticed no changes significant in pain threshold before and after placebo radiation, can be describe that in control group there was'nt instruction effect. 10

Conclusion

Low power Ga-Al-As laser radiation to acupuncture points can increase experimentally induced pain threshold.

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Influence of Graded Aerobic Exercise in Post-surgical Adult Acyanotic Congenital Heart Disease - A Prospective Randomized Clinical Trial

K Madhavi¹, Abhachandra², Arun G maiya³

¹Principal, College of Physiotherapy, ²Head of the Department, Cardiovascular and Thoracic Surgery, SVIMS, Tirupathi, ³Associate Dean, MAHE, Manipal

Abstract

Exercise intolerance and Impaired quality of life is the long existing problem in Adult congenital heart disease individuals. Regular physical activities improves the physical capacity of an individual., influence on exercise tolerance and quality of life need to be studied. The aim of the study is to find out the influence of graded aerobic exercise on post surgical adult acyanotic congenital heart diseases.

Materials and Methodology

111 samples were randomly selected from a tertiary care centre SVIMS, Tirupathi, AP and allotted into control and study groups. The outcomes measures in the study were BMI (kg/m²), Ejection fraction (%), Nitric oxide (mmol/L), VO₂ peak (ml/kg/min) and Quality of life (score). BMI was recorded using Quetelet index, Ejection fraction through echo, Nitric oxide analysis by Griess method, Bicycle ergometer to measure the ventilatory oxygen peak uptake (VO₂ peak) and self assessed health related quality of life questionnaire SF-36 form to assess health related quality of life. The above values were recorded before surgery and 12 weeks after surgery. Graded aerobic exercises were implemented from the day 1 after surgery to 12 weeks to study group. Un graded aerobic exercises were implemented from the day 1 after surgery to 12 weeks to control group.

Results and Statistical Analysis

Power of the study is 90%. Paired t-test is used to compare mean values between pre and post tests of each parameter and t test is used to find out the mean percentage change in the parameters. The mean difference of pre and post intervention values of all outcomes between study and control group were found to be significant at p value <0.001. Mean percent change of various study parameters between control and study group were also found to be significant at p value.<0.001.

Conclusion

Implementation of graded aerobic exercises in post surgical adult acyanotic congenital heart disease individuals has improved exercise tolerance and quality of life.

Introduction

The congenital heart disease (CHD) is nothing but a gross structural abnormality of heart or large vessels present at birth. Congenital disease of the heart and circulation are not fixed anatomic defects but, they are dynamic anomalies that originate in foetal life and change considerably from foetal life to adulthood. Approximately 85% of the babies born with cardiovascular anomalies are expected to reach adulthood.¹ The acyanotic congenital heart diseases are classified into mild, moderate and severe lesions. The mild and moderate categories include acyanotic lesions where as the severe ones include all adult cyanotic heart diseases and a few acyanotic lesions. The incidence of mild and moderate forms of ACHDs is 3/1000 live

births. About 40% of them survive without treatment while 75 to 80% can survive with treatment²

The incidence of complex lesions is about 2.5-3/1000 live births. About 40% survive with treatment. Genetic as well as environmental factors cause most of the CHDs.

Many samples with CHD need medical and surgical interventions and follow up for life long. Apart from medical and surgical follow up, the issues that matter most are pertaining to their physical capacity and quality of life (QOL). Though regular physical activity can enhance general health, the long term complications of these samples have become the cause for concern. The most important of them are exercise intolerance and impaired QOL. There are a number of studies done on exercise testing and quality of life. Very few have done on the effectiveness of physical activity on ACHD and the studies have proved to be beneficial. However the studies have not concentrated on structured aerobic exercises and its effect on exercise capacity and QOL.

The pathological reasons behind exercise intolerance among the samples of ACHD are mainly due to shunting lesions. Apart from diversion of blood flow, the physiological changes that occur in CHD are rapid fall in pulmonary vascular resistance, increase workload to left ventricle, decreased oxygen consumption and erythrocytosis.

The diversion of systemic venous blood from pulmonary circulation into the systemic arterial circulation is a fundamental pathologic fault in samples with CHD. Regular exercise may significantly increase the degree of venoarterial mixing and influence the dynamics of oxygen uptake and ventilation. The prolonged onset and recovery of ventilatory oxygen (VO₂) kinetics results in large oxygen deficits and hypoxemia, even with low levels of exercise. The samples with right to left shunts may rely to an unusual degree of anaerobic metabolism to perform exercise. Right to left cardiac shunting of CO₂ and increase dead space within the lung are the major factors accounting for high ventilatory requirements during exercise. Hence the implementation of aerobic exercise helps to decrease the anaerobic metabolism, decrease lactic acid buildup and thereby reduce the fatigue levels in ACHD. With exercise, local blood flow is controlled by chemical factors, metabolites, paracrines, and physical factors such as heat or cold and stretch effects on endothelial membrane. The paracrine regulation is mainly regulated by NO, histamine release and prostacycline. The ventilatory equivalent and physiologic dead space are reduced to normal levels after corrective surgery that eliminates the right to left shunts. The application of aerobic exercise post surgically helps to enhance oxygen uptake. On the whole the exercise increases work capacity of the muscles, increase cardiac output and increase exercise capacity of the individual.

Previous studies have revealed that regular physical activity like walking is safe, feasible and easy to adapt. Studies have not revealed about the specific intensity, duration and frequency of exercises in post-surgical in adult population of ACHDs.

Structured exercise programme is the treatment of choice, though many studies have revealed that regular physical activity can improve the range of health, very few have emphasized on aerobic exercise capacity and QOL in ACHD individuals. Hence it is necessary to study the influence of graded aerobic exercise in post-surgical adults with acyanotic congenital heart disease on exercise capacity and QOL.

Materials and Methodology

Informed consent was secured from all the patients participated in the study. The study protocol was approved by the ethics committee of the institute. Moreover, the study was also registered under clinical trial registry of India.

The design adopted for the study was prospective randomized clinical trail. The course of selection of study samples, their laboratory/ hospital investigations, physiotherapeutic exercises, data recording etc. were conducted during a period of 2006 to 2009.

Adult acyanotic congenital heart disease samples were drawn among those admitted and operated in the cardio thoracic ward at the Tertiary Care Centre, Sri Venkateswara Institute of Medical Sciences, university, Tirupathi, Andhra Pradesh.

In the present study all samples, who were clinically and objectively diagnosed and selected by cardiothoracic surgeon were randomly divided into study and control group preoperatively by simple randomization method where lottery method is the procedure adopted to randomly select the samples. It was ensured that there was no residual deficit existed after the surgical correction.

A total of 111(excluding 9 dropout samples) samples, male- 39 no. i.e. 35.1%, female- 72 no. i.e. 64.9% were finally selected for the investigation. The mean age groups of the samples were 28.92 ± 10.98 in the study group. In control group mean age of the samples are 28.88 ± 10.38 . The control group is represented by 60 samples while the study group consists of 51 samples (with dropout of 9 samples).

The samples with the CHD conditions considered for investigation are all of acyanotic heart diseases, atrial septal defect (ASD) with pulmonary stenosis, ventricular septal defect (VSD), patent ductus arteriosus (PDA), left to right shunts.

The samples with the following CHD conditions were excluded from the study are cyanotic heart disease, severe pulmonary vascular disease, cardiomyopathy, severe atrioventricular valve regurgitation; exercise induced ventricular arrhythmia, samples with moderate to severe obstructive lesions.

The outcomes measures in the study were BMI (kg/m^2), Ejection fraction (%), Nitric oxide (mmol/L), VO_2 peak ($\text{ml}/\text{kg}/\text{min}$) and Quality of life (score). BMI was recorded using Quetelet index³, Ejection fraction through echo⁴, Nitric oxide analysis by Griess method⁵, Bicycle ergometer to measure the ventilatory oxygen peak uptake (VO_2 peak)⁶ and self assessed health related quality of life questionnaire SF-36 form to assess health related quality of life⁷.



Control Group

- The samples were advised to continue the exercises and medication as per the surgeon and researcher advice. A log book was given to record their activity and exercises during the 12 week period and was reassessed after 12

weeks. The samples were given conventional post operative physiotherapy care after surgery. Initially the samples were taught breathing exercises, mobility of upper limb and lower limb, and progressive walking during in-patient phase and progress the above exercises for the period of 12 weeks within the limit of tolerance of the samples.

Study Group

- After initial base evaluation samples were prescribed individualized structured exercise protocol and were modified weekly as per the individual tolerance. The samples were observed for any adverse effect of exercise during training and also educated about the sign and symptoms to terminate exercise. The structured protocol was prescribed for 12 weeks period and then samples were reassessed for outcome measures.

Exercise based cardiac rehabilitation programme with structured graded aerobic exercise protocols for adult acyanotic CHDs after surgery was implemented. ⁸ The exercise protocols

with specific intensity, duration and frequency were implemented from day 1 of surgery to a period of 12 weeks in a phased manner. The exercise based cardiac rehabilitation is implemented in 3 phases.

Data Analysis

All statistical computations have been done using SPSS 13.0 version. Data is analyzed with p value <0.001 and power of the study is 90%. Paired t-test is used to compare mean values between pre and post tests of each parameter and t test is used to find out the mean percentage change in the parameters.

Demographic information of the subjects (gender wise percentage distribution of subjects in each group)

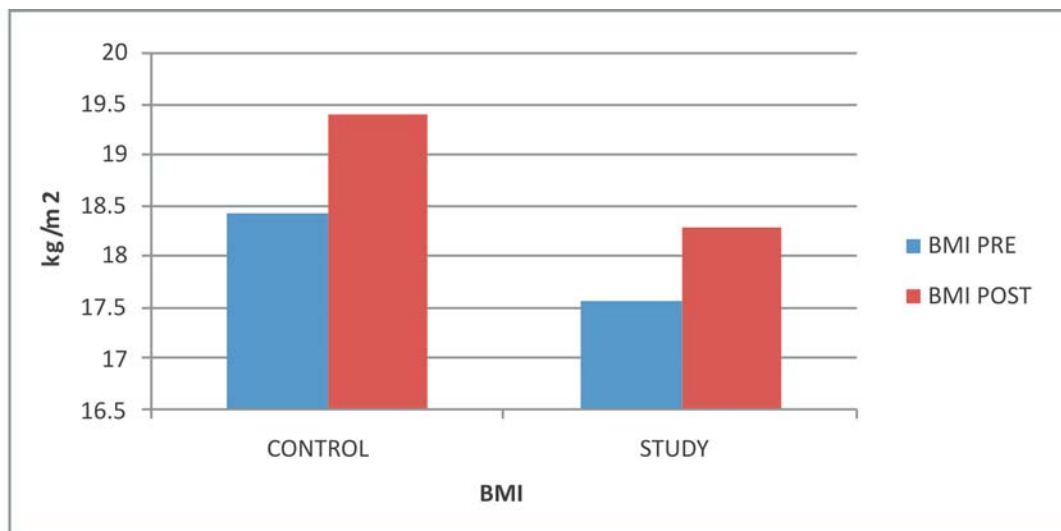
Study group (N=51)		Control group (N=61)	
Male(%)	Female (%)	Male(%)	Female (%)
38	62	33	67

Comparison of pre and post intervention values of all outcomes between study and control group

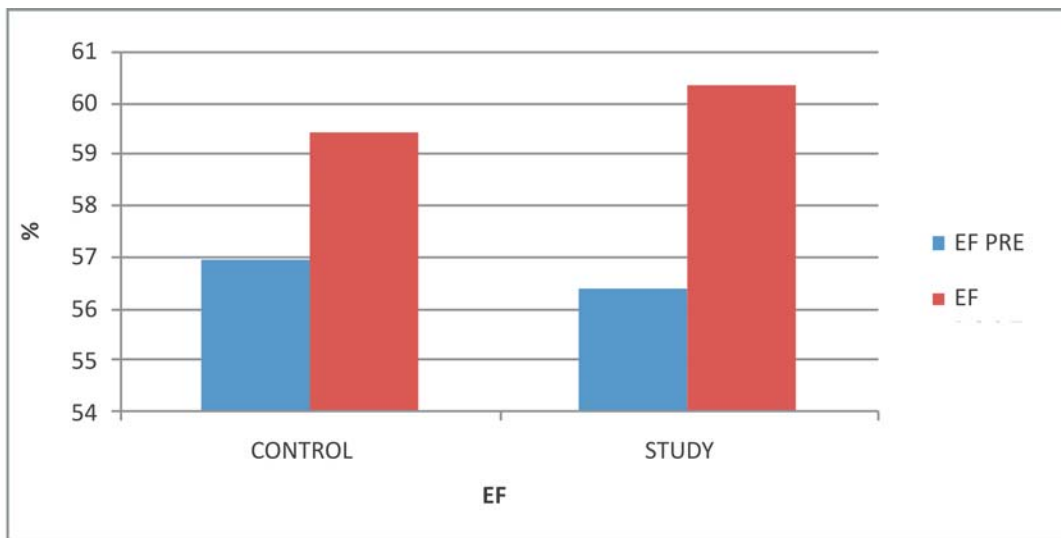
parameter	Study group				Paired t - test	Control group				Paired t - test	p
	pre		post			pre		post			
	mean	SD	Mean	SD		mean	SD	Mean	SD		
BMI	17.573	± 3.140	18.296	± 3.269	-6.13	18.432	± 2.661	19.387	± 2.682	-7.2	0.0000**
EF	56.420	± 7.109	60.340	± 6.403	-10.06	56.970	± 7.525	59.460	± 6.958	-4.5	0.0000**
NO	25.220	± 8.343	32.940	± 8.700	-20.06	24.620	± 8.654	29.160	± 8.307	-14.32	0.0000**
VO _{2 peak}	28.644	± 5.406	43.838	± 10.334	-12.32	21.823	± 6.224	30.991	± 7.958	-11.90	0.0000**
QOL	48.980	± 14.727	72.280	± 8.071	-12.45	46.670	± 14.205	57.930	± 11.019	-6.16	0.0000**

** Mean Difference between control and study groups is significant at 0.001 level.

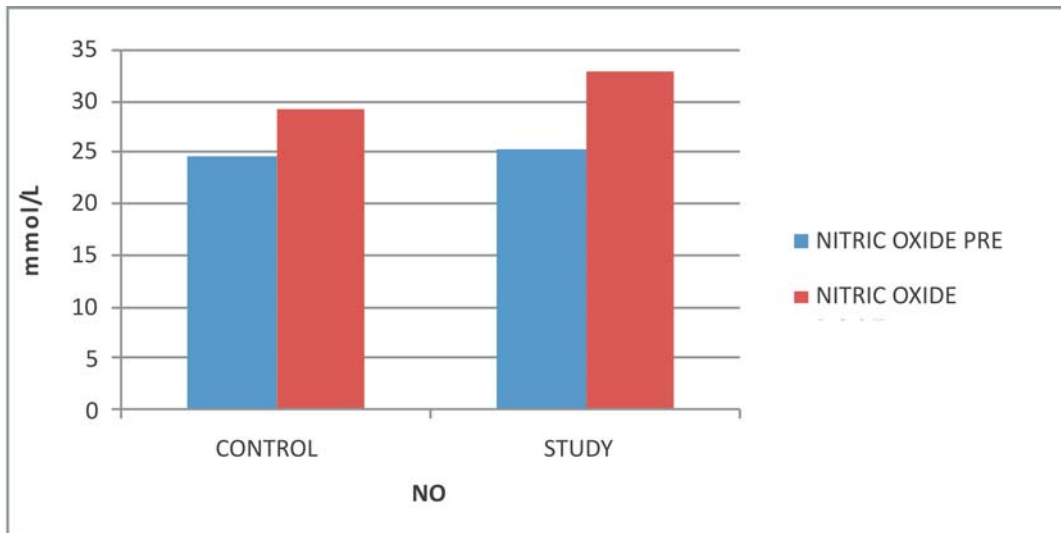
Comparison of pre and post intervention values of BMI between study and control group



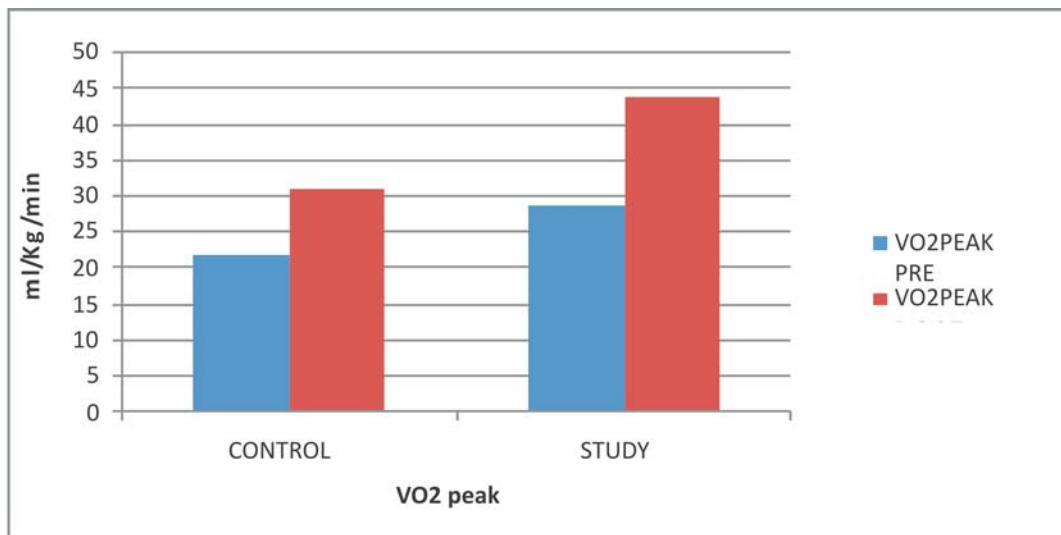
Comparison of pre and post intervention values of EF between study and control group



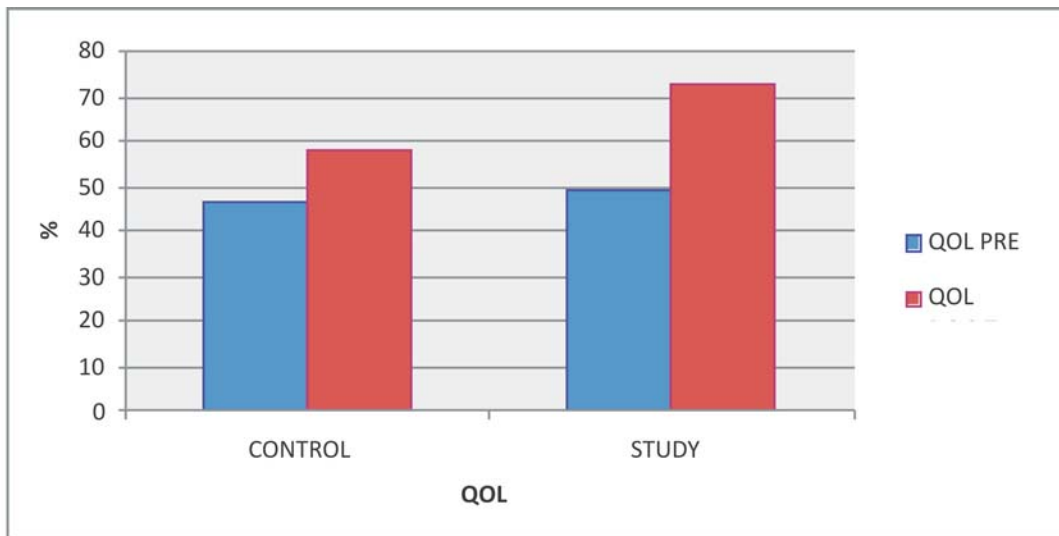
Comparison of pre and post intervention values of NO between study and control group



Comparison of pre and post intervention values VO2peak between study and control group



Comparison of pre and post intervention values of QOL between study and control group

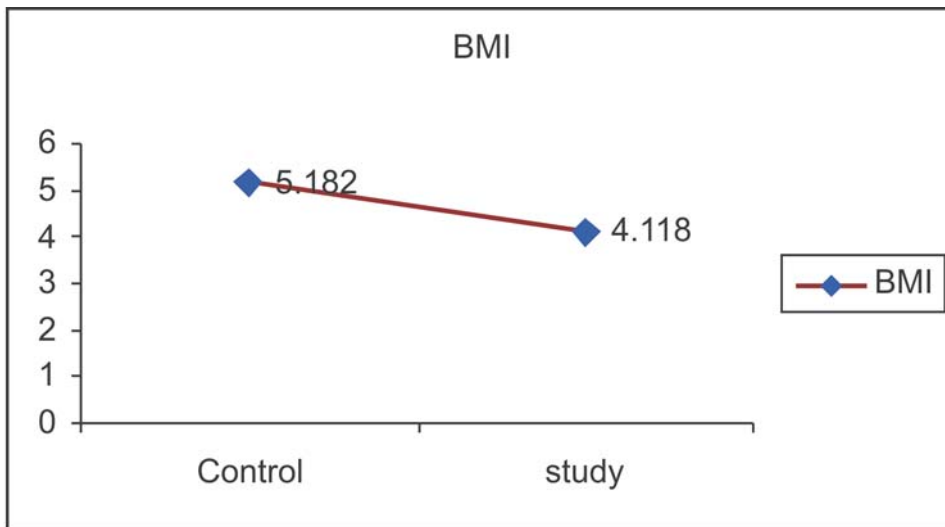


Mean percent change of various study parameters between control and study group (BMI, EF, Nitric oxide, VO₂peak and QOL.)

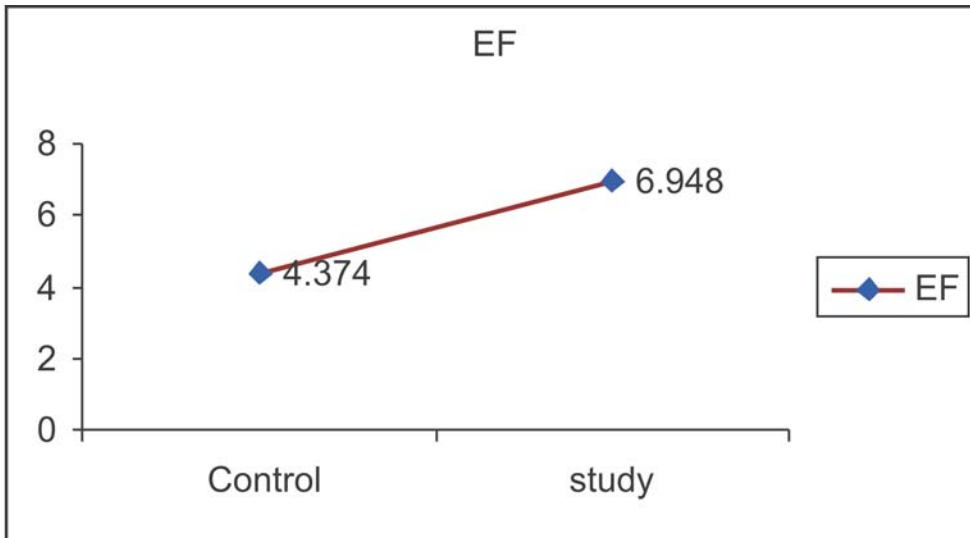
PARAMETER		CONTROL	STUDY	T-TEST	P-VAL
		Mean ± SD	Mean ± SD		
BMI	PRE	18.432 ± 2.661	17.573 ± 3.140	-1.284	0.2020
	POST	19.387 ± 2.682	18.296 ± 3.269		
	DIFFERENCE	0.955 ± 1.028	0.724 ± 0.834		
	(Post – Pre)	(5.182%)	(4.118%)		
EF	PRE	56.970 ± 7.525	56.420 ± 7.109	2.978	0.0040**
	POST	59.460 ± 6.958	60.340 ± 6.403		
	DIFFERENCE	2.492 ± 2.307	3.920 ± 2.747		
	(Post – Pre)	(4.374%)	(6.948%)		
NITRIC OXIDE	PRE	24.620 ± 8.654	25.220 ± 8.343	6.521	0.0000**
	POST	29.160 ± 8.307	32.940 ± 8.700		
	DIFFERENCE	4.541 ± 2.475	7.720 ± 2.650		
	(Post – Pre)	(18.444%)	(30.611%)		
VO ₂ PEAK	PRE	21.823 ± 6.224	28.644 ± 5.406	4.296	0.0000**
	POST	30.991 ± 7.958	43.838 ± 10.334		
	DIFFERENCE	9.168 ± 6.014	15.193 ± 8.714		
	(Post – Pre)	(42.011%)	(53.041%)		
QOL	PRE	46.670 ± 14.205	48.980 ± 14.727	4.569	0.0000**
	POST	57.930 ± 11.019	72.280 ± 8.071		
	DIFFERENCE	11.262 ± 14.272	23.300 ± 13.225		
	(Post – Pre)	(24.132%)	(47.570%)		

** Mean percentage change between control and study groups is significant at 0.001 level.

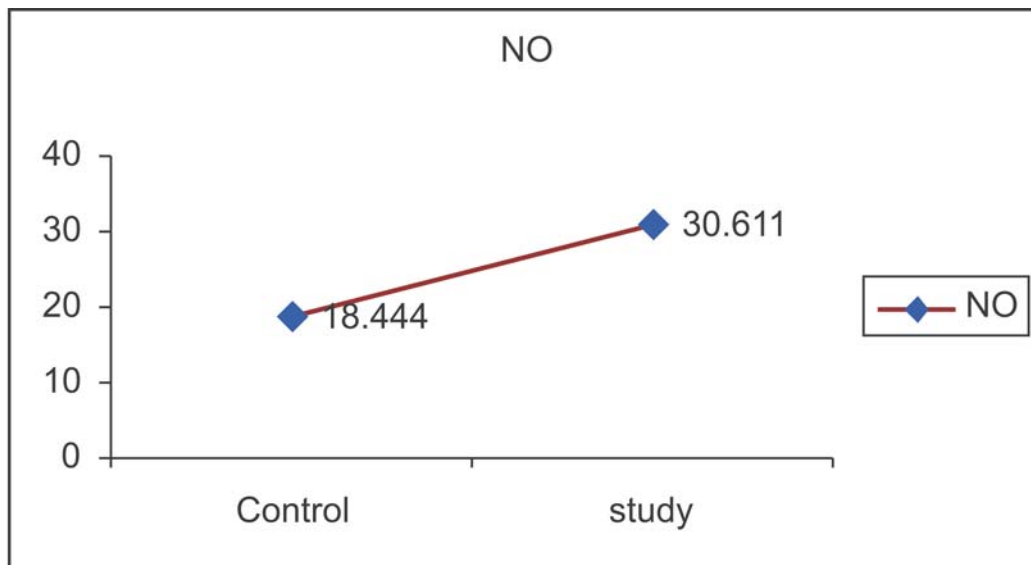
Mean percent change of BMI between control and study group



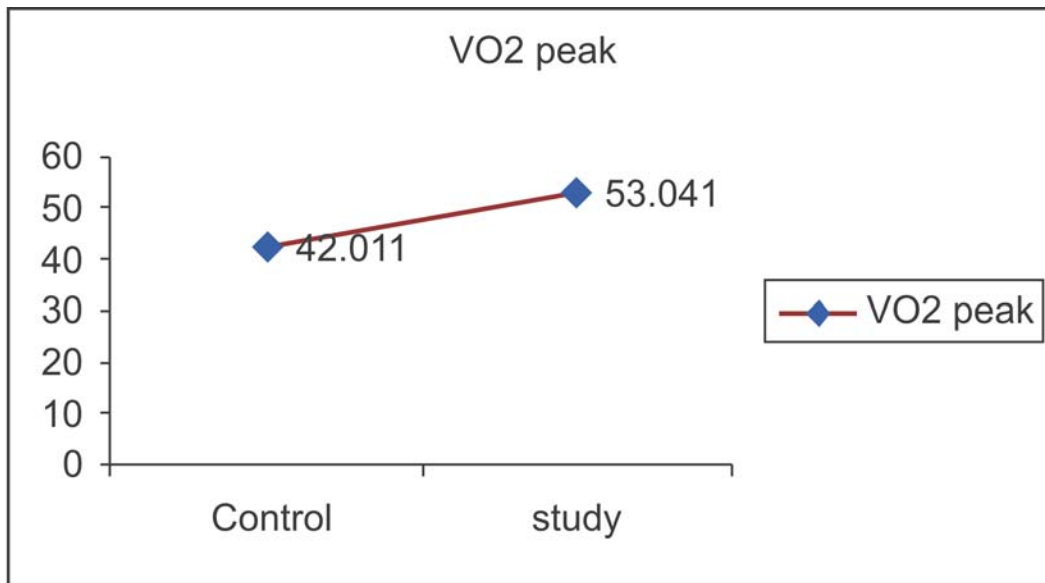
Mean percent change of EF between control and study group.



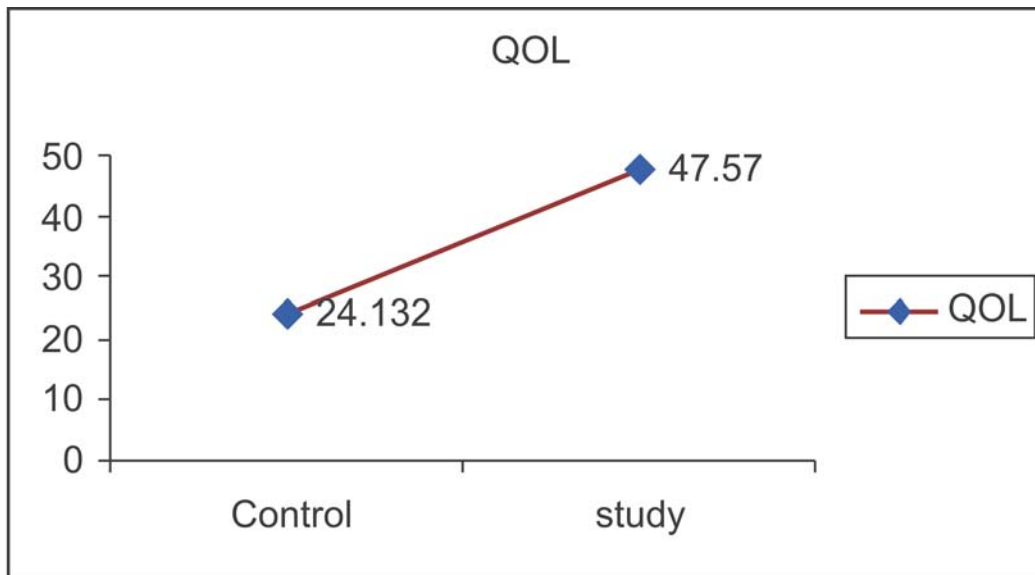
Mean percent change of Nitric oxide between control and study group



Mean percent change of , VO₂ peak between control and study group



Mean percent change of QOL between control and study group.



Discussion

The result of analysis of the study generally shows significant improvement in physiological and functional characteristics of the study group over the control group individuals. For the sake of convenience, the results of each of the outcomes are comparatively evaluated with earlier works.

In the present study, it has been reported that exercise based cardiac rehabilitation with “unstructured” (control) graded aerobic exercise in adult ACHD individuals has shown increased mean value of 18.43 ± 2.66 (pre surgery) to 19.38 ± 2.66 (after post surgery therapy). So also the study group “structured” aerobic exercises have shown an enhanced mean value of BMI from 17.57 ± 3.13 (pre surgery) to 18.29 ± 3.26 (after post surgery therapy). The mean percentage change of BMI values has decreased from 5.18 % (control group) to 4.11% (study group).

Earlier studies by Chen et.al (2004)., Manal Kandilet.al (2009) and Karen et.al (2005) ⁹ supports the above statistical data. The reports of the studies are discussed below.

The pre operative adult individuals with acyanotic congenital heart disease showing mean BMI value of 18.4 in control group and 17.5 study group suggest growth retardation present in acyanotic congenital heart diseases, presurgically The underlying causes may be due to hypoxemia, insufficient calorie

intake, dyspnoea, frequent infections, psychological disturbances, malabsorption or hypermetabolism. Both the groups of the present study indicated gained weight following the surgery. There is a tendency for increase of weight gain after the surgery due to the reasons of post surgical immobility, less physical activity and tendency for increased intake of food. The weight gain in control group may be due to less physical activity than the study group. However, the decrease of BMI in the study group is due to the implementation of structured aerobic exercises which in turn increases energy expenditure.

Thus the structured graded aerobic exercise in post-surgical adult acyanotic congenital heart disease regulates BMI and hence forth improves aerobic capacity and QOL.

Exercise based cardiac rehabilitation in individuals of control group (un structured aerobic exercise) with adult acyanotic congenital heart disease shows significant mean Nitric oxide values both with the pre and post therapy (i.e. 24.62 ± 8.65 to 29.16 ± 8.30). The structured aerobic exercise / study group of adult ACHD individuals had shown greater increase in mean pre and post therapy nitric oxide values (25.22 ± 8.34 to 32.94 ± 8.70) than control group. The mean % change in Nitric oxide values between control and study group varies from 18.44% to 30.61% .

In the present study, the mean EF values shows an increase of pre therapy level (56.97± 7.52) to post therapy level (59.41± 6.95) in the control group. Significant increase is found in mean values of EF from 56.42±7.10 to 60.34 ± 6.40 from pre surgery to post surgical levels in study group. Significant increase is found in mean % of EF from 4.37 % (control group) to 6.94% (study group).

This shows that adults with acyanotic CHD have a reduced functional capacity as compared to the normal individuals. This phenomenon appears to be associated with right ventricular and pulmonary abnormalities.

Rainer Hambercht et al (1995) reported that stable chronic heart failure samples benefit from ambulatory cardiac rehabilitation programs similar to those prescribed for samples with coronary heart disease.¹¹ Even samples with severe depression of left ventricular performance are benefited from training-induced increase in aerobic capacity of peripheral muscles. Cardiac output increases significant change in maximal cardiac output with significant correlation with the change in peak oxygen uptake.

Very few studies have used ejection fraction to measure the cardiac output. The cardiac rehabilitation programs in various types of CVD have shown positive influence on the EF. The increase in EF is associated with increase in exercise capacity. The structured aerobic exercise increases ejection fraction. This in turn increases exercise capacity in post surgical adult CHD population. The values of the study in the present shows that it.

The mean VO₂peak values of pre and post-therapy of control group has increased from 21.82±6.22 to 30.99±7.95. where as in the study group mean values of VO₂peak shows phenomenal increase in pre therapy level to post therapy level from 28.64±5.40 (pre) to 43.83±10.33(post).

The mean % of change of VO₂peak is statistically significant in study group (53.04%) unlike in the control group (42.01%).

Our study showed a significant improvement in cardiopulmonary capacity in post surgical ACHD population, which concurs with the finding of the Helber et al (1997). He reported among pre operative adult samples with non restrictive ASD there was some improvement seen at 4 months after operation, with complete restitution to normalcy., 10 years after shunt closure.¹² Further Fredrikson et al (2001) revealed that samples with fontan circulation had shown greatly diminished values of aerobic capacity but with an early surgical procedure there is improvement in VO₂ peak. A number of studies have been conducted on exercise capacity of adult ACHD population and concluded that the exercise capacity which diminishes pre-operatively, is enhanced significantly with exercise protocols.

Hence, exercise capacity increases after surgical closure of the defect. With corrective surgery, there is an increase in the oxygen extraction of muscles and there by cardiac output and exercise capacity is enhanced. Therapeutic training contributes to gross increase of aerobic capacity in post surgical adult ACHD population.

The mean pre and post therapy QOL value in control group varies from 46.67 ± 14.20 to 57.93 ± 11.01 respectively. Whereas the corresponding mean values of study group varies from 48.98±14.72 to 72.28±8.07 (post operatively). The study group shows highly significant changes unlike the control group.

The mean % change from 24.13% to 47.57% of control to study groups is found to be statistically significant.

Lane et al (2002) reported that samples with inoperable or cyanotic conditions seemed surgically cured, had the poorest quality of life.¹³ They had significantly poorer levels of physical functioning and overall general health perception than similarly aged people in the general population. This observation correlates with the finding of our study.

Hager et al (2005) revealed that exercise tests and QOL instruments should be used together to get an appropriate overview of health status of patient with congenital heart disease.¹⁴ Jaspal S. Dua (2007) observed that limited data is available

on the physical activity levels and attitude to exercise.¹⁵ There are also studies that shows improvement in quality of life improves with increased physical activity levels.

The foregoing comparative discussion on physical (BMI), physiological (NO & EF) and functional parameters [VO₂peak] has enlightened that there is a gross improvement in the above values after implementation of graded aerobic exercise protocol in study group. The increase in physical and physiological parameters has overall enhanced QOL among ACHD samples of study group.

Conclusions

The findings of the study shows % change/improvement in physical (BMI), physiological (NO and EF) and functional characteristics before and after cardiac rehabilitation therapy among post surgical ACHD individuals.

In a nutshell, it has to be admitted that structured graded aerobic exercise has grossly improved the Exercise Capacity and Quality of Life in the post surgical adult acyanotic Congenital Heart disease individuals.

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Efficacy of Mirror Therapy on Motor Recovery of Hand Functions in Sub Acute Stroke Individuals-a Randomized Controlled Trial

Kusumalatha Nookala¹, Srikumari Vadlamudi²

^{1,2}Assistant Professor, Sri Venkateshwara Institute of Medical Sciences, Alipiri Road, Tirupathi-517501, Andhra Pradesh

Abstract

Aim of the Study

The aim was to find out the efficacy of mirror therapy (congruent visual feedback from the moving non-paretic hand) on motor recovery of paretic hand functions in sub acute stroke individuals.

Objective

1. To analyze the motor recovery of hand functions in subacute stroke individuals after mirror therapy.

Design

- Randomized controlled experimental study.

Setting

- Outpatient clinic, neurology department and general wards in SVIMS.

Participants

- Total number of subjects 30.
- 15 in experimental and 15 in control group.

Interventions

The treatment session was 6 days a week, 30 minutes a day, for 6 weeks excluding the time for conventional program. The conventional program consisted of physiotherapy like passive movements, active movements, strengthening techniques for the same period.

Main outcome Measures

1. Motor assessment scale(hand movements)
2. Modified ashworth scale for wrist flexors..
3. Brunnstrom stages of motor recovery for hand.

Results

Comparison was made between control and experimental groups at 0.05 level of significance. Mann –Whitney U statistic was applied to compare and results were found insignificant in ASHWORTH parameter ($p= 1.00$ NS) and significant results are observed for MAS ($p < 0.05$) and BRUNSTORM ($p < 0.05$) parameters.

Conclusion

Mirror therapy along with conventional rehabilitation (congruent visual feedback) led to greater improvement in the motor recovery of hand functions in sub acute stroke subjects than sham therapy.

Introduction

Stroke is defined as a rapidly developing clinical signs of focal disturbance of cerebral functions lasting more than 24 hours or leading to death with no appropriate cause other than that of vascular origin.¹

Stroke is the third leading cause of death world wide. A WHO study in 1990 quoted incidence mortality due to stroke in India to be 73/100,000 per year. The incidence of cerebrovascular disease was found to be 2/1000 population per annum and 4/1000 population per annum in people aged 45 to 84 years.²

A stroke causes disturbed neural command generation in the sensory motor cortex is impaired arm and hand motor function. Optimal restoration of arm and hand motor function is essential for stroke subjects in order to independently perform activities of daily living. The paretic upper limb is a common and undesirable consequence of stroke that increases activity limitation.¹⁶ Mirror therapy is a simple, inexpensive and most importantly, patient directed treatment and using of unaffected limb.⁵

Mirror therapy is based on mirror neurons present in the pre-motor cortex. Which are tiny neurological structures that fire when we perceive an action and take it. These mirror neurons were discovered in mid 1990's by the scientists at the University of Parma in Italy.²⁷ Later Marco Iacoboni, a neuroscientist at University of California led to the discovery's impact on psychology. The major implication of mirror neurons is that the same brain region that controls action also supports perception.⁶ The principle of exciting mirror neurons is based on motor imagery, which means increase in the excitability of the homologous motor system pathways when uni-manual movements are performed.²⁸

The physiology of mirror neurons is based on stimulation through simulation or motor imagery.⁷ Motor imagery is the mental representation of movement without any bodily movement. Mirror therapy consists of evaluation of hand impairments and functional limitations of stroke individuals. Guided training sessions of mirror therapy to improve the impaired hand movement using unaffected extremity in order to improve the motor function of the hemi paretic arm¹⁴. Hence, in order to improve the hand functions of the hemi paretic arm, mirror therapy is used to evaluate the motor recovery of the hand in sub acute stroke individuals.

Materials and Methodology

Thirty subjects were recruited from SVIMS who were provided with informed consent. and were grouped in two groups: Experimental (mirror) group and control (sham) group, of 15 each by random number allotment.

Study Design

Randomized controlled experimental study.

Sample Collection

Total number of subjects 30, 15 in experimental Group and 15 in control group.

- Gender** : Only male
Stroke duration : Three to nine months of post stroke¹⁸
Materials : A plane mirror (35 x 35cm)
 A table and a chair with back support.
 Modified ashworth scale for wrist flexors¹¹
 Motor assessment scale (hand movements)¹⁰
 Brunnstrom stages of motor recovery for hand²²
- Study duration** : 6 weeks.

Inclusive Criteria

- Subacute(3 to 9 months) stroke individuals who had a first episode of unilateral stroke with hemi paresis during the previous 3 to 9 months.¹⁸
- Subjects of age group between 45 to 65 years.
- Subjects who are able to understand and follow simple verbal instructions.
- Subjects with right middle cerebral artery stroke (ischemic)¹⁹
- Brunnstrom stages for hand between 2 to 4 grades for both the groups
- Modified ashworth scale for wrist flexors between 1 to 2 grades for both the groups.¹¹
- Motor assessment scale for hand movements between 1 to 3 grades for both the groups.¹⁰
- Medically stable.

Exclusive Criteria

- Perceptual and cognitive deficits.
- Subjects who are not co-operative
- Subjects with visual impairments
- Acute and chronic stroke individuals
- Subjects with recurrent episodes of stroke
- Subjects subjected to no other disorders (traumatic, neoplastic)
- Subjects with age group above 65 years.
- Subjects with sensory deficits.
- Musculoskeletal problems like contractures, pain & subluxation .

Methodology

Subjects are randomly assigned to Experimental Group treated with mirror therapy and conventional therapy and Control Group treated with sham therapy and conventional therapy.

Subjects of both the groups were graded on the basis of the outcome measures i.e. Modified ashworth scale for wrist flexors, Brunnstrom stages of motor recovery for hand, Motor assessment scale (hand movements).

The treatment session was 6 days a week, 30 minutes a day, for 6 weeks excluding the time for conventional program. The conventional program consisted of physiotherapy like passive movements, active movements, strengthening techniques for the same period.

During the mirror therapy subjects were seated close to a table on which a mirror (35 x 35 cm) was placed vertically. The involved hand was placed behind mirror i.e. the non reflective side and the non-paretic hand in front of the reflective side of the mirror.

The practice consisted wrist flexion and extension followed by finger flexion and extension movements of non-paretic hand, while subjects looked into the mirror, watching the image of their non-involved hand, thus seeing the reflection of the hand movements projected over the involved hand. Subjects could see only the non-involved hand in the mirror. During the session subjects were asked to try to do the same movements with paretic hand while they were moving the non paretic hand.²⁵

The control group performed the sham therapy, which included the same exercise for the same duration and the same conventional therapy but used the non-reflected side of the mirror in such a way that the paretic hand was hidden from sight.

After 6 weeks duration the outcome measures i.e. Modified ashworth scale for wrist flexors, Brunnstrom stages of motor recovery for hand, Motor assessment scale(hand movements) were again taken from both the groups.

Mirror Therapy



Sham Therapy



Results and Analysis

- Statistical analysis was performed to observe the significance between pre and post values of the outcome measures. SPSS16.0 package and MS –EXCEL were used to carryout the computations. The entire data is carried out at 0.05 level.
- Of the 30 subjects 15 were randomized in to experimental group (mirror therapy) and the other 15 were randomized in to control group (sham therapy). Of these all 30 completed the entire study protocol. The outcome measures of the study were Modified Ashworth scale, Motor

Assessment scale and Brunnstrom stages of motor recovery.

- In table 1 the pre and post values of experimental group were compared for each parameter using Wilcoxon signed ranks test. The results were found to be highly significant

in motor assessment scale and brunnstrom stages of motor recovery and found insignificant in modified ashworth scale at 0.05 level.

- Pre and post values of all the parameters in experimental group

	N	Mean	Standard Deviation	Z - value Sig	(2-tailed)
ASHWORTH_PRE	15	1.53	0.516	1.732	0.083 ^{NS}
ASHWORTH_POST	15	1.33	0.488		
MAS_PRE	15	2.33	0.816	3.520	0.000*
MAS_POST	15	3.73	1.033		
BRUNNSTROM_PRE	15	3.20	0.862	3.508	0.000*
BRUNNSTROM_POST	15	4.93	0.884		

* Represents significance at 0.05level.

In table 2 the pre and post values of control group were compared for each parameter using Wilcoxon signed rankstest. Modified ashworth scale was found to be insignificant at 0.05

level whereas the other 2 motor assessment scale and brunnstrom stages of motor recovery were found highly significant at 0.05 level.

Pre and post values of all the parameters in control group

	N	Mean	Standard Deviation	Z - value Sig	(2-tailed)
ASHWORTH_PRE	15	1.60	0.507	1.732	0.083 ^{NS}
ASHWORTH_POST	15	1.40	0.507		
MAS_PRE	15	2.13	0.834	3.071	0.002*
MAS_POST	15	3.07	1.033		
BRUNNSTROM_PRE	15	3.13	0.834	2.810	0.005*
BRUNNSTROM_POST	15	3.87	1.060		

* represents significance at 0.05level.

Fig. 1:

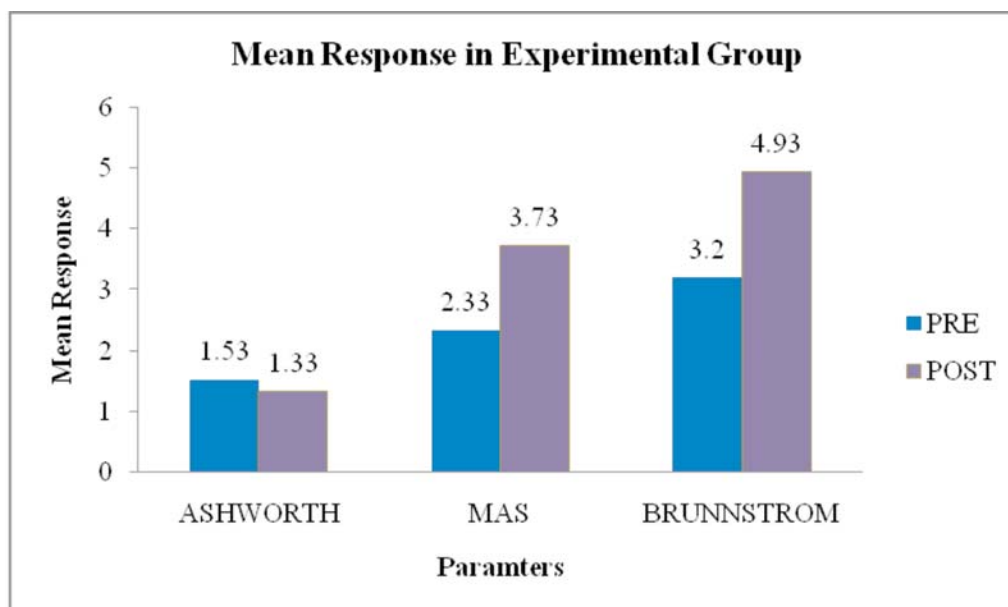


Figure-2

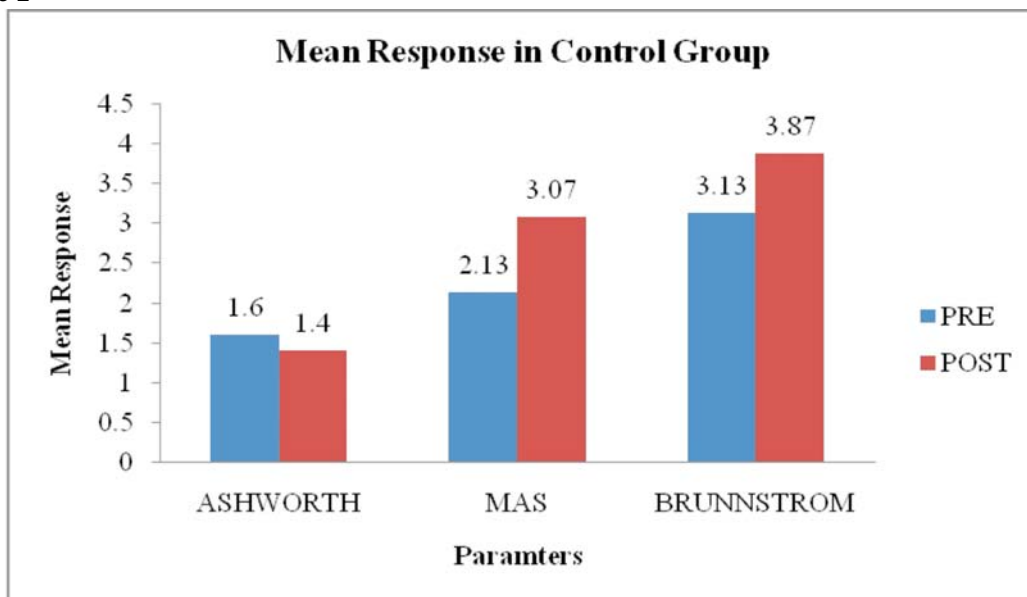


Figure 1 and 2 represents the mean response of the three parameters for experimental control group

Table 3: Comparison of all the parameters in experimental and control groups (Mann Whitney U test)

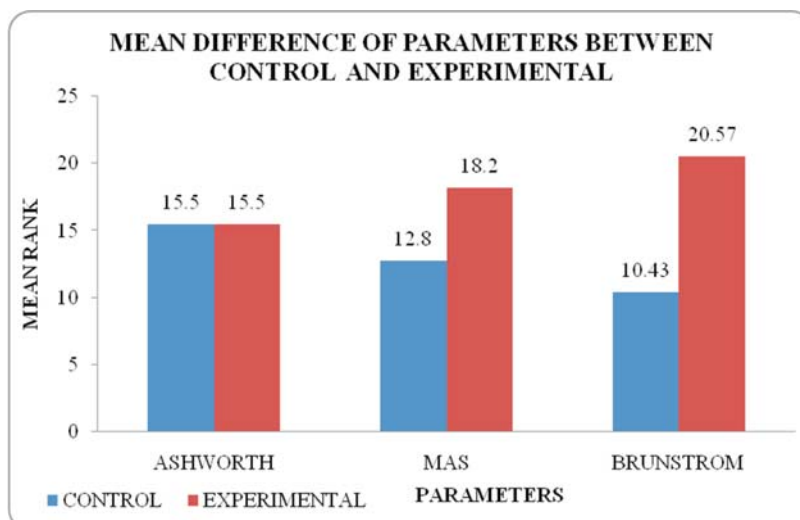
	GROUP	N	Mean Rank	Mann-Whitney U - statistic	Sig (2-tailed)
ASHWORTH_DIFF	CONTROL	15	15.50	112.500	1.000 ^{NS}
	EXPERIMENTAL	15	15.50		
MAS_DIFF	CONTROL	15	12.80	72.000	0.039*
	EXPERIMENTAL	15	18.20		
BRUNSTROM_DIFF	CONTROL	15	10.43	36.500	0.001*
	EXPERIMENTAL	15	20.57		

** represents significance at 0.05 level

Analysis has been carried out by taking the differences of pre and post of control and experimental groups and comparison was made between the two groups at 0.05 level of significance. Mann –Whitney U statistic was applied and results were found insignificant in ASHWORTH parameter (p= 1.00 NS) and

significant results are observed for MAS (p < 0.05) and BRUNSTORM (p<0.05) parameters.

Using the mean ranks of all parameters in control and experimental Bar graph representation was made and is shown below.



It is evident that motor assessment scale and brunnstrom stages of motor recovery for hand post mean responses were significantly differing at 0.05 levels.

Discussion

The purpose of the study was to find the efficacy of mirror therapy compared to sham therapy on hand functions of upper extremity in sub acute stroke patients. This study shows that mirror therapy is more beneficial in motor recovery and hand related functioning than sham therapy after a post treatment for 6 weeks. However there was no effect on spasticity.

The underlying principle is that movement of the affected limb can be stimulated via visual cues origin from the opposite side of the body.²⁴ Hence, it is thought that this form of therapy can prove useful in stroke individuals who have lost movement of an arm or leg including those who have had a stroke earlier. The parameters taken in the study are Modified ashworth scale¹¹, Brunnstrom stages of motor recovery and Motor assessment scale. ¹⁰Prior to the exercise program the scores of the above three parameters were noted and after the study span i.e. after six weeks scores were again noted.

At the end of six weeks it was found that according to table-1 the scores of motor assessment scale and brunnstrom stages of motor recovery were found to be highly significant. However, the scores were insignificant in modified ashworth scale.

Several underlying mechanisms, for the effect of mirror therapy on motor recovery after stroke have been proposed, of them Altschuler et al. (1999) suggested that the mirror illusion of a normal movement of the affected hand may substitute for decreased proprioceptive information.⁵ There by helping to recruit the premotor cortex and assisting rehabilitation through an intimate connection between visual input and premotor areas.

From table-2 modified ashworth scale scores were found to be insignificant where as the scores of motor assessment scale and brunnstrom stages of motor recovery were found to be highly significant. Stevens and Stoykov (2003) suggested that mirror therapy related motor imagery and that mirror creates visual feedback of successful performance of the imagined action with the impaired limb. Motor imagery itself has proven to be potentially beneficial in the rehabilitation of hemiparesis.⁹

According to table-3, where mean differences of all the three parameters in both the groups were compared, significant results were observed for MAS ($p < 0.05$) and BRUNSTORM ($p < 0.05$) parameters.

According to Carson (2005) studies when the non paretic limb engaged during motor training crossed facilitatory drive from the intact hemisphere will give rise to increase excitability in the homologous motor path way of the paretic limb, facilitating recovery of function.¹⁵

Stimulation through simulation mechanisms based on increased visual or mental imagery feedback, which is another possible mechanism for the effectiveness of mirror therapy might be bilateral arm training.⁷

The only drawback for this study was the unavailability of fMRI results in order to prove the mirror neuron excitability for better outcome.¹⁷

Hence, the improvement in the motor recovery of hand in the experimental group could be attributed to mirror therapy which is based on motor imagery. Rothgangel A, De Bie RA et al, (2006) found that during movement observation using mirror visual feedback a significant increase in cerebral blood flow was observed in the ventral motor cortex, further more activation in the visual cortex was lateralized opposite to the seen hand using fMRI.¹⁹

In control group there was improvement in the outcome parameters due to repetitive goal oriented activities and also due to the conventional therapy. Hilde Feys, Willy De Weerd et al, (2004) said that repetitive sensory motor training of the arm during the acute phase after a stroke resulted in a clinically meaningful and long lasting effect on motor function. The effect can be attributed to early repetitive and targeted stimulation.²⁰ The limitations of this study are small sample and shorter duration. This study could be further analyzed by measuring

the excitability of mirror neurons using functional brain imaging post mirror therapy,³⁰ and to investigate on stroke individuals with cognitive deficits using as home treatment.

Conclusion

Mirror therapy along with conventional rehabilitation (congruent visual feedback) led to greater improvement in the motor recovery of hand functions in sub acute stroke individuals than sham therapy.

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Effect of Unilateral and Bilateral Auricular Acupuncture Like TENS on Pain Threshold

Malik Manoj¹, Kaur Jaspreet²

^{1,2}Assistant Professor, Deptt. of Physiotherapy, GJU S& T, Hisar-125001

Abstract

Background

Pain, although a protective mechanism of our nervous system often prevents treatment of accompanying or underlying disorder and therefore it is imperative to attain analgesia. . Various modalities are used by physical therapists to relieve patient from pain. TENS is one of the most widely used modality by physical therapists for attaining analgesia.

Methods

This experimental trial investigated the effect of unilateral and bilateral auricular acupuncture like TENS on pain threshold in sixty young adults. Subjects were randomized to either of three groups namely:- Group 1(Bilateral application of TENS), Group 2 (Unilateral application of TENS), and Group 3 (control - NO TENS group). Low frequency TENS was applied on auricular acupuncture points for 45 secs on Group 1&2. Readings for pain threshold were taken before and after completion of TENS treatment.

Results

There was a statistically significant difference in pain threshold values of auricular TENS group as compared to control group on comparison with one – way ANOVA (F=35.273). On pair wise comparison using Duncan's new multiple range test, statistically significant differences were found ($p < .05$) between the pain threshold changes between group three (control group) as compared to group 1(bilateral TENS group) and group 2 (unilateral TENS group). However, no significant difference was observed between mean pain threshold changes of group 1 and 2.

Conclusion

Auricular application of Acupuncture TENS as a part of physiotherapy treatment significantly increases pain threshold whether applied unilaterally or bilaterally.

Key Words

Pain, TENS, Auricular Acupuncture.

Address for correspondence:

Dr. Manoj Malik

M.P.Th. (NEUROLOGY), MIAP

H. No.-103, Sector –13, Part II

Hisar, Haryana.

PIN: -125001

Email: - malik_manoj@indiatimes.com

Ph No.: - 09896221262

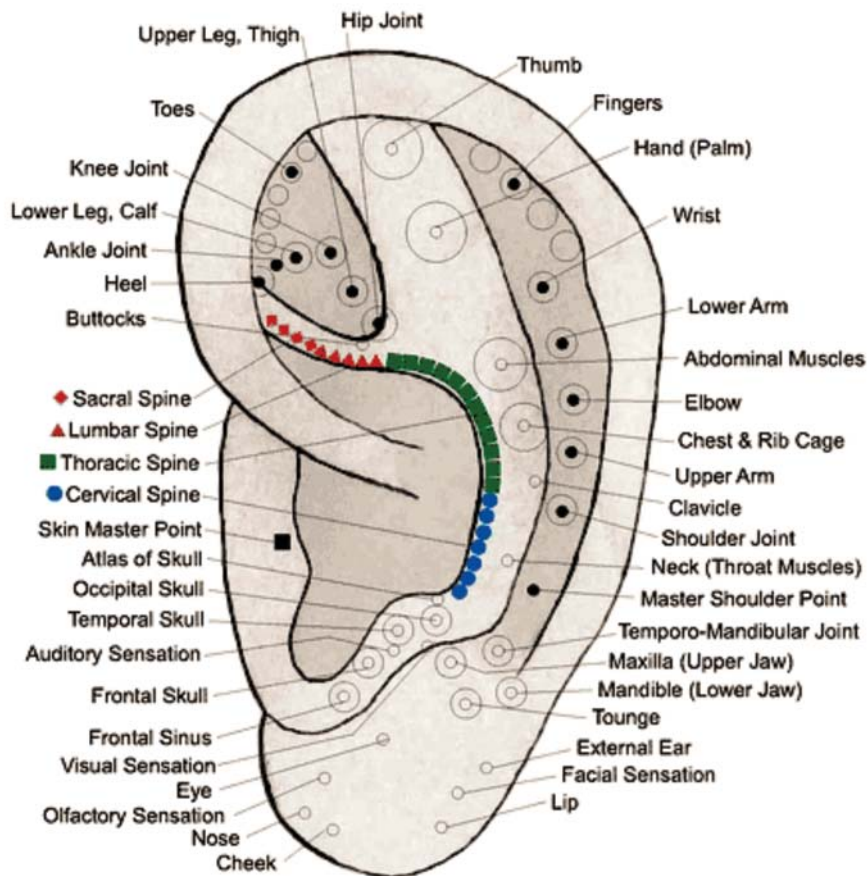
Introduction

Throughout the ages, pain has had a variety of meanings to those experiencing it and those seeking to alleviate it¹. Various modalities are used by physical therapists to relieve patient from pain. TENS is one of the most widely used modality by physical therapists for attaining analgesia , it is application of pulse rectangular currents via surface electrodes. TENS is a noninvasive and nonaddictive treatment for pain used by many physical therapists. Many clinical studies have reported significant decrease in pain following application of high intensity low frequency TENS²⁻³. Low frequency-high intensity TENS provides long lasting pain relief in many clinical situations⁴⁻⁹ Low frequency high intensity TENS applied to somatic acupuncture points is called acupuncture like TENS¹⁰. It is defined as the induction of forceful but non-painful phasic muscle contractions at myotomes related to the origin of pain^{7,8,11,12}. The purpose of AL-TENS is to selectively activate small diameter fibers (A&) arising from muscles by the induction of phasic muscle twitches. Thus TENS is delivered over motor points to activate A (alpha) efferents to generate muscle twitches so bursts of pulses are used⁷. Yi et al have presented the most direct evidence to date that acupuncture analgesia is mediated by increased production of serotonin. He stimulated conscious rabbits with acupuncture needles while measuring serotonin from cerebrals ventricles and found that for over half of the 18 experimental rabbits acupuncture stimulation produced a simultaneous increase in analgesia and in central serotonin¹³.

Acupuncture points on auricle of the ear are sometimes the sites for acupuncture like TENS. Oliveri et al¹⁴ and Krause et al¹⁵ showed that stimulation of acupuncture points on auricle or auriculotherapy also is used for pain relief and also showed that low frequency high intensity TENS applied to appropriate auricular points increased experimental pain threshold in healthy subjects. So, the main aim of study was to find effect of auricular, acupuncture like TENS on pain threshold. The Research hypothesis taken were a) pain threshold measured at wrist of subjects with unilateral and bilateral auricular TENS will be significantly greater than pain threshold of control group b) bilateral auricular TENS treatment will significantly increase pain threshold in comparison of unilateral auricular TENS.

Review of Literature

Electricity as method of pain relief has been used from ancient times. Around 2500 BC, Egyptians used electrogenic fish to treat ailments¹⁸ Its popularity declined in nineteenth century , but later in 1965 Melzack and Wall reawakened the interest in use of electricity . Melzack and Wall proposed that transmission of noxious information could be inhibited by activity in large diameter peripheral afferents or by activity in pain inhibitory pathway descending from the brain¹⁹ Study done by Albere J.A.Koke, Jan S.A.G. Schouten et al on 180 subjects found that pain severity decreased between baseline and post treatment within all groups and types of TENS, but there was no difference between different types of TENS. As few studies indicate that TENS not only decreases pain but also increases



pain threshold^{20,21} Further studies were done to find out if TENS given on auricular acupuncture points was of any benefit to the patient. Auricular acupuncture is a form of alternative medicine based on the idea that the ear is a microsystem with the entire body represented on the auricle, the outer portion of the ear. Ailments of the entire body are assumed to be treatable by stimulation of the surface of the ear exclusively. Similar mappings are used in reflexology and iridology. These mappings are not based on or supported by any medical or scientific evidence^{22,23} Study done by Anthony G Longobardi, Jo Ann Cheryl J Knowles, James R Jackson on 15 subjects to determine the effectiveness of auricular acupuncture like transcutaneous electrical nerve stimulation on pain, concluded that there was significant pain reduction after application of high intensity, low TENS on auricular acupuncture points²⁴ Auriculotherapy has been effective in treating variety of conditions, but its primary use is for pain relief²⁴ Paris and co-workers reported that auricular TENS, in conjunction with traditional physical therapy and electrical stimulation of certain body loci, decreased both pain and rehabilitation time in patients with ankle inversion sprains². There is a lot of scope to research a suitable method of pain management, the popular pain management methods like use of NSAIDs, opioids and surgeries like rhizotomy, although effectively relieving pain, have many side effects. Thus requiring the need for alternative methods for pain relief. Research on auricular acupuncture can open the avenues of a pain relief technique which is non invasive, non addictive, and moreover it has no side effects and very few contraindications.

Methodology

Design

Experimental Study Design.

Sample

Sample consisted of Sixty young adults (38 Females & 22 Males) recruited from T.D.T.R. Institute of Physiotherapy and Rehabilitation Campus, Yamunanagar.

Inclusion Criteria

- Age Group between 18-22 years.
- Healthy young adults (Males and Females) without any neurological deficit.

Exclusion Criteria

- Subjects with pacemakers, metallic implants, rods, artificial joints or any other surgical implants.
- Pregnant Females.
- Subjects with altered pain perception, skin infection.
- Subjects with any psychiatric or psychological problem.
- Subjects under any medication.

Method of Selection

Subjects were thoroughly evaluated and those meeting inclusion and exclusion criteria and willing to give consent to participate in the study were included in the study. The subjects were then randomly allocated to either of three groups: - Group 1 (Bilateral application of TENS), Group 2 (Unilateral application of TENS), and Group 3 (control - NO TENS group).

Instrumentation for Data Collection

- Tens – Enraf Nonius B.v. (Ens 911) (Fig.1)
- Phyaction Guidance E – Gymnauniphy N.v. (FIG.2)

Fig. 1: Pain Threshold Measurement



Fig. 2.A: AURICULAR POINT (Ear Shenmen)

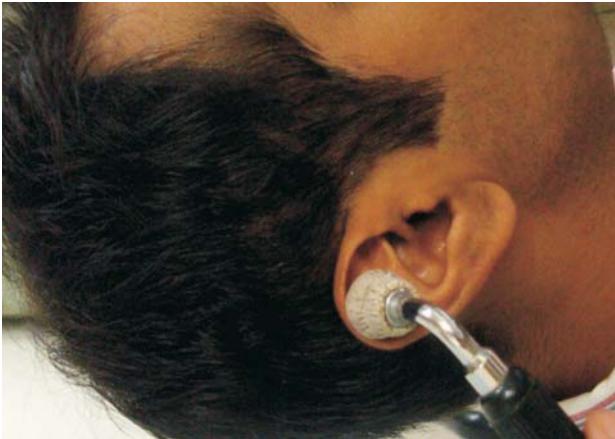
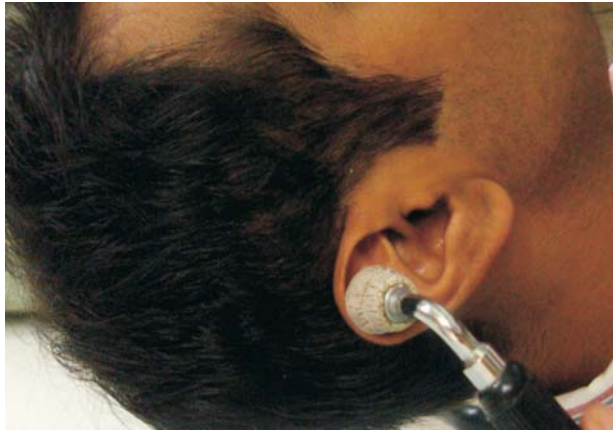


Fig.2.B: AURICULAR POINT (Dermis)



Variables

- a Independent Variables: - Unilateral and Bilateral Auricular Acupuncture TENS.
- b Dependent Variables: - Pain Threshold.

Procedure

Ethical approval was obtained from the institution. Participants were explained about the purpose and nature of study and each subject signed an informed consent form before participating. At the time of study no subject reported with any usage of pain relieving drugs or alcohol 24 hrs before study.

Protocol for TENS Therapy

a. Pain Threshold Measurement

Pain threshold was measured with Phyaaction. Carbon rubber electrodes were used, intensity was as much as patient's tolerance. Valcro straps were used to keep electrodes in place. Stimulus consisted of rectangular surge current of 100 Hz frequency and 5 msec duration. Dispersive electrode was placed behind the subject neck from the level of 7th cervical vertebra and upper thoracic vertebra, while stimulation was applied on skin overlying volar surface of distal end of radius (FIG. 1). Subjects were allowed to feel the current before measurement to familiarize them with the sensation. Intensity of stimulus was increased systematically stopping every 0.1 msec, subjects were asked to report verbally the moment they felt any electric current and then the moment they felt painful pinprick sensation. The intensity at which they felt pin prick was recorded three consecutive times and the mean threshold value for each subject was recorded. Pain threshold measurements were measured at wrist in all subjects at two time intervals: - before treatment (PRE Treatment) and after (POST Treatment).

b. TENS Therapy

The dispersive electrode of auricular TENS was placed on subject's left hand. Any jewellery was removed by subject. An auricular stimulation point was noted using acupuncture chart and was applied via probe electrode (FIG 2A&B). Frequency was set on 2 Hz. Each subject was asked to report verbally the first moment stimulus was felt by saying feel it. The stimulus was increased until the subject's tolerance reached tolerant limit. Each auricular point was stimulated for 45 sec, with the intensity as high as subject's tolerance. High intensity low frequency TENS was given on different auricular points. Group 1 received bilaterally, group 2 received unilaterally, group 3 subjects rested on treatment table for 10 min maximum time required to complete an auricular TENS treatment. All subjects were given TENS therapy, with each treatment session of 10 minutes duration. The total time taken for recording the data was 1 week.

Data Analysis

Descriptive statistics was calculated for pre treatment and post treatment measurements for change in mean pain threshold for each group. One-way ANOVA (analysis of variance) was used. Pair wise comparison between groups was made with Duncan's new multiple range test. An alpha level of .05 was selected for all tests. SPSS 11.0 version software was used for data analysis.

Results

Descriptive characteristics regarding sex and age are shown in Table 1. Group 1 had 13 females, 07 males with mean age of 21.83. Group 2 had 13 females, 07 males with mean age of 19.61 while group 3 had 08 males, 12 females with mean age of 19.61.

The mean pain threshold values for Group 1 receiving Bilateral TENS therapy PRE and POST treatment were 2.0 and 2.78, respectively. For Group 2 receiving Unilateral TENS, the mean values PRE and POST treatment were 2.20 and 2.94 respectively. The pain threshold values for Group 3 (control group) were 2.044 and 2.047, PRE and POST treatment, respectively (TABLE 2 and GRAPH 1).

Group 1 receiving Bilateral TENS had an increase in Mean pain threshold values by 0.78. In Group 2, receiving unilateral TENS the Mean pain threshold increased by 0.74. In Group 3, Mean pain threshold increased by only 0.003 (Table 2 And Graph 2).

Table 1: Descriptive Statistics

S.No	Characteristics	Group 1 N=20	Group 2 N=20	Group 3 N=20
1.	No. of female subjects	13	13	08
2.	No. of male subjects	07	07	12
3.	Mean Age	21.83	19.61	19.61

Descriptive statistics regarding pain threshold measurements and average initial pain threshold of groups, final pain threshold and mean increase pain threshold with pain threshold ranges are given in Table 2.

Table 2: Mean pain threshold measurements

Group 1, Bilateral points (n=20)	Mean pain threshold	Range
Pretreatment	2.0	1.46-3.2
Post treatment	2.78	2.2-4.2
Change	0.78	0.26-1.47
Percentage Increase	39%	
Group 2, Unilateral points (n=20)	Mean pain threshold	Range
Pretreatment	2.20	1.46-3
Post treatment	2.94	2.0-4.53
Change	0.74	0.14-1.53
Percentage Increase	33.6%	
Group 3, Control group(n=20)	Mean pain threshold	Range
Pretreatment	2.044	1.4-3
Post treatment	2.047	1.4-3.13
Change	.003	0.27-0.2
Percentage Increase	0.14%	

Table 3A: Difference in pain threshold - ANOVA

S.No	N	Mean	Std.deviation	Std.error	95% confidence interval for Mean		Minimum	Maximum
					Lower bound	Upper bound		
1.	20	0.7470	0.42383	0.09477	.5486	.9454	.06	1.471
2.	20	0.7378	0.33962	0.07594	.5788	.8967	.14	.53
3.	20	0.0025	0.12435	0.02780	-.0557	.0607	-.27	.201
Total	60	0.4958	0.47297	0.06106	.3736	.6179	-.27	.53

Table 3B: Difference in pain threshold - ANOVA

	Sum of square	df	Mean Square	F	Sig.
Between group	7.300	2	3.650	35.273	.000
Within group	5.898	57	.103		
Total	13.198	59			

Table 4: Multiple comparison

(I)GROUP	(J)GROUP	Mean diff (I-J)	Std.error	Sig	95% confidence interval	
					Lower bound	Upper bound
1	2	-.1460	.10698	.178	-.3602	.0682
	3	.5445*	.10698	.000	.3303	.7587
2	1	.1460	.10698	.178	-.0682	.3602
	3	.6905*	.10698	.000	.4763	.9047
3	1	-.5445*	.10698	.000	-.7587	-.3303
	2	-.6905*	.10698	.000	-.9047	-.4763

* The Mean difference is significant at the .05 level.

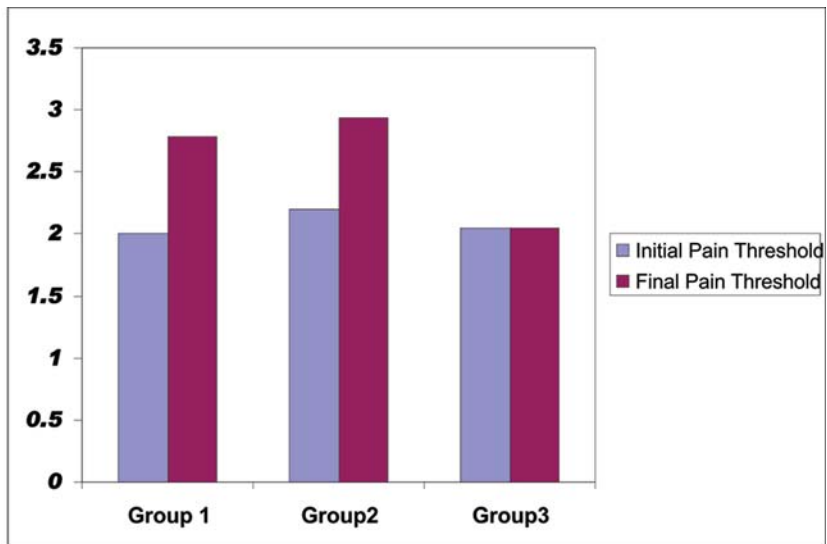
The percentage increase in Mean pain threshold values of Group 1, 2 and 3 compared to baseline was by 39%, 33.6% and 0.14% respectively (TABLE 2 AND GRAPH 3).

On comparing Mean pain threshold values with One -Way ANOVA statistically significant difference was found between groups. Therefore a statistically significant difference existed

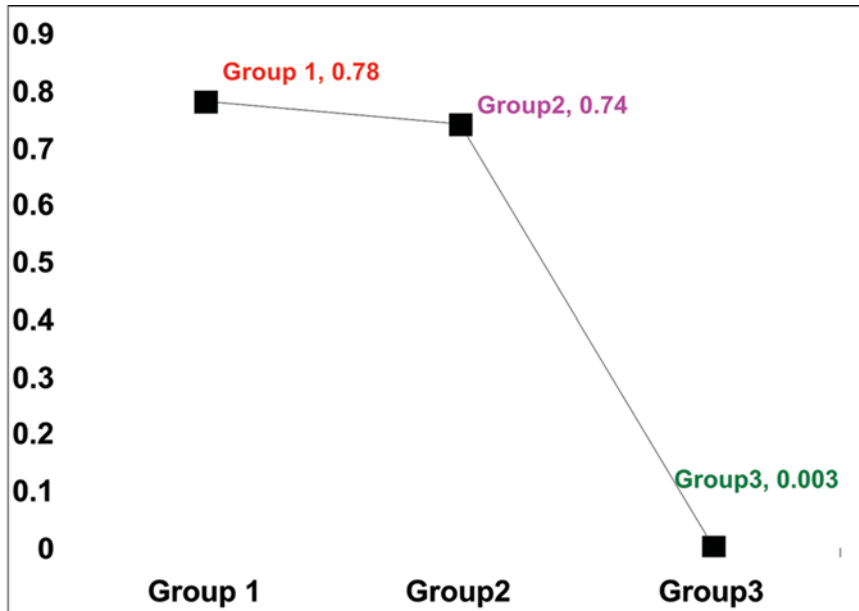
among groups in terms of pre treatment and post treatment pain threshold changes.

Following pair wise comparison was done using Duncan's new multiple range test. It showed statistically significant difference (p<.05) between the pain threshold changes between Group 3 as compared to Group 1 and Group 2. However, no

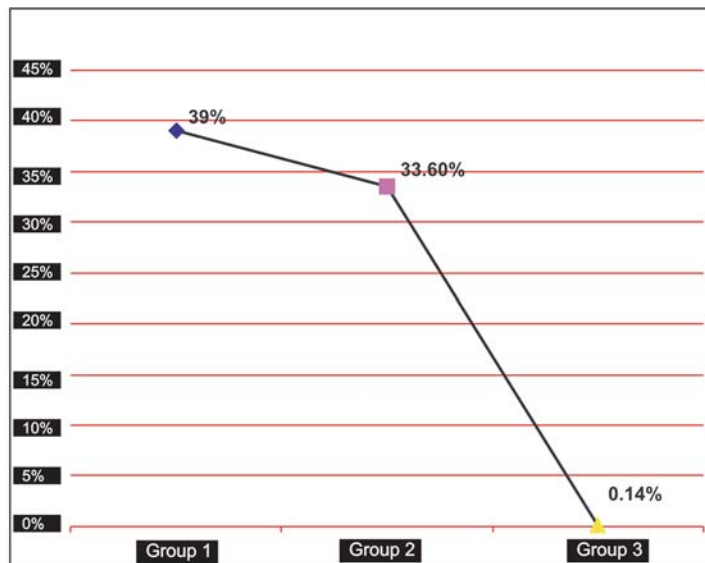
Graph.1: Pre and post treatment pain threshold mean values



Graph.2: Mean difference in pain threshold values



Graph 3: Percentage Increase in Mean Pain Threshold Values



significant difference was observed between mean pain threshold changes of group 1 and 2 (TABLE 4).

The result shows a statistically significant difference in pain threshold values of auricular TENS group as compared to control group, thus the hypothesis that pain threshold with unilateral and bilateral auricular TENS will be significantly greater than pain threshold of control group was supported, while no significant difference was seen between unilateral and bilateral auricular TENS group, thus the second hypothesis that bilateral auricular TENS treatment will significantly increase pain threshold in comparison of unilateral auricular TENS was not supported.

Discussion

The study results indicate that auricular application of acupuncture TENS significantly increased pain threshold. This lead us to accept the research hypothesis that pain threshold measured at wrist of subjects with unilateral and bilateral auricular TENS is significantly higher than the pain threshold of control group. The results of study lead to acceptance of null hypothesis stating that both bilateral and unilateral TENS are equally effective in increasing pain threshold. This is in accordance with previous studies, previous researchers have also proved that experimental pain threshold after stimulation of auricular point would be significantly greater than changes noted when placebo treatment was given^{10, 14,24,25}

Previous researchers have also compared difference between auricular TENS, somatic TENS and a combination of somatic TENS and auricular TENS and found them equally effective in experimental pain threshold¹⁰. Results suggest that unilateral auricular acupuncture TENS may be as effective as bilateral auricular TENS for increase in experimental pain threshold. Researchers have advocated bilateral TENS application if symptoms are bilateral or produced by a midline lesion, while unilateral TENS is applied if patient's pain is unilateral, though Chinese traditional treatment advocates both side of body to be treated when administering acupuncture.

Regarding time of stimulation Noling et al applied auricular TENS on same four acupuncture points and found an increase of 26% after 10 minutes²⁵. In this study unilateral and bilateral TENS have found an increase of around 25% increase in mean pain threshold. The findings that all these values are in a narrow range suggest that 45 seconds of auricular stimulation at each point is sufficient to increase pain threshold. Further studies are needed to assess whether less than 45 seconds of stimulation would increase pain threshold.

Limitations

1. Small sample size
2. Only young male and females were taken for study.

Clinical Implication

Findings of the study can be clinically correlated and auricular TENS can be used in pain relief in musculoskeletal and systemic disorders by stimulating corresponding auricular points with reference to auricular map. This can be especially useful for the therapist in treatment of patients with chronic pain. The application of TENS can be done with equal benefit with either unilateral or bilateral application.

Conclusion

In two groups of healthy adult subjects auricular, acupuncture like TENS, resulted in statistically significant increase in pain threshold while control group demonstrated no significant increase in pain threshold. Statistically significant difference existed between comparison between group

1(bilateral TENS) and group 3(control group) and between group two (unilateral TENS) and grup three (control group) regarding increase in mean pain threshold while no significant difference was observed between group one and group two. These results imply that auricular TENS is effective in increasing pain threshold when compared with control group and both unilateral and bilateral auricular TENS are equally effective in increasing pain threshold.

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Correlation of Body Mass Index to the Fasting Blood Sugar in Young Adult Population

Maliyannar Itagappa¹, Vasudeva Murthy C R²

^{1,2}Associate Professor, Department of Biochemistry, Department of Forensic medicine and Toxicology, S.S.Institute of Medical Sciences and Research Centre, Davangere-577005

Abstract

An increase in body fat is generally associated with an increase in risk of metabolic diseases such as type 2 diabetes mellitus; hypertension and dyslipidaemia. Body mass index (BMI) criteria are the primary focus as it is related to presence or absence of obesity-related comorbid disease. Although several studies have shown a strong correlation between body mass index (BMI) and development of critical illness. The goal of our study is to examine this relationship prospectively with fasting blood sugar in particular attention to the influence of concomitant diabetes mellitus (DM).

Key Words

Body Mass Index, Fasting Blood Sugar and Diabetes.

Introduction

Body mass index, which relates weight to height, is the most widely used and simple measure of body size and is frequently used to estimate the prevalence of obesity within a population¹. It is the most commonly used indicator of health risk associated with overweight (type-2 DM, insulin resistance and cardiovascular disease) and underweight (osteoporosis, infertility)². A higher body mass index has been shown to account for up to 16% of the global burden of disease, expressed as percentage of disability-adjusted life years³. Recent studies have indicated that the life expectancy of adult with severe obesity might be 15 to 20% years lower than normal individuals⁴. A body of information now available suggests the need for a consideration not only of diabetes, but also of other disturbance of glucose metabolism, such as impaired glucose tolerance, that have emerged as independent risk factors for cardiovascular disease mortality⁵. Diabetes mellitus is a common endocrine metabolic disorder and a leading cause of death worldwide (Fraghilimani et al 2006). There are more than 154 million diabetics worldwide and its prevalence is on the increase in the developing countries⁶. Diabetes is reaching epidemic proportions globally, particularly in south Asian region. A balanced diet and an active lifestyle can help all to maintain a healthy weight. But for kids with diabetes, these things are even more crucial because weight can influence diabetes, and diabetes can influence weight. Weight issues can affect kids and teens that have type-1 or type-2 diabetes. Type-2 diabetes is characterized by insulin resistance (IR) and relative insulin deficiency, hence early identification is important for the management strategies of DM.

The accumulation of visceral fat is particularly assumed to play an important role in the etiology of Insulin Resistance notably

by the overexposure of the liver to free fatty acids, which results in insulin resistance and hyperinsulinemia. In this study an effort is made here to explore the correlation between the body mass indexes with fasting blood sugar.

Objective

1. To study the correlate of fasting blood sugar with obesity, body mass index (BMI), body weight (BW).
2. To study the variation of Fasting Blood Sugar and Body Mass Index (BMI) in relation to male and female.

Materials and Method

The present study was conducted at Department of Biochemistry, S.S.Institute of medical sciences and research center, Davangere.

Sample Size

257 students which included 130 were male students and 127 were female students.

Procedure

Out of 300 students enrolled, 257 students were selected. The study was conducted at department of biochemistry, S.S.Institute of Medical sciences and research center, Davangere, India. After the Selection of the study group, they were given with verbal and written information about the study prior to providing written consent and invited for verbal and written feedback of individual results at the end of the study. Selected subject were screened based on Clinical history including age, sex, drugs, smoking, alcohol consumption level of physical exercise, previous history and family history of diabetes, dyslipidemia, coronary artery disease and peripheral vascular disease.

Inclusion Criteria

1. Study population with informed written consent with age group between 18 to 20 years (mean-19).

Exclusion Criteria Were

1. Age group outside the range of 18-20 years.
2. Subjects with hypothyroidism, liver, kidney or heart failure, neoplasm and the students receiving long term medications are excluded from the study.

Procedure

Height and weights of the selected subjects were determined by wearing light clothing without shoes. Each participant's weight and height were recorded and BMI was calculated using height (m) and weight (kg). After 12 h of overnight fasting, blood samples were collected under aseptic conditions between 8 am - 8.30 am and deposited in dry tubes. The plasma was separated immediately using centrifugation at

Address for correspondence:

Maliyannar Itagappa

Associate Professor,

Department of Biochemistry,

S.S.Institute of Medical Sciences and Research Centre,

Davangere-577005

Email id: itagappam77@gmail.com

4,000 rpm for a period of 10 min. FBG was assessed by absorbance method (diagnostica - Merck).

Normal Values of Fasting Blood Sugar ⁽¹⁾

F.B.S: 80-120 mg/dl

SISI Units	BMI = $\frac{\text{Mass (kg)}}{(\text{Height (m)})^2}$
Imperial Units	BMI = $\frac{\text{Mass (lb)} \times 703}{(\text{Height (inch)})^2}$ BMI = $\frac{\text{Mass (lb)} \times 4.88}{(\text{Height (ft)})^2}$

Body Mass Index

On the basis of BMI all students were divided into three groups i.e., underweight whose BMI was less than 19 Kg/m², normal whose BMI was between 19-26 Kg/m² and overweight whose BMI was more than 26 Kg/m².

Statistical Analysis

For analysis of statistical significance both Oneway ANOVA test and Tukey's post hoc test were used.

Results and Discussion

Table 1: Correlating with Body Mass Index with Fasting Blood Sugar in Males

Parameter	Under Weight N=11	Normal Subject N=94	Over weight N=25
FBS	78.27±8.86	80.93±8.9	89.00±9.02

Table 2 Shows the higher levels of fasting blood sugar in the overweight group than the normal female subjects.

BMI shows more significance in female and male and FBS shows not significant in both. The present study shows higher values of FBS level in overweight group as well obesity but it is of normal range comparatively in normal and underweight subjects.

Table 3: Comparison of with different Body Mass Index with Fasting Blood Sugar In Male & Female Medical students

Parameter	Males	Females	Mean Difference	tValue	P* Value
	Mean±SD	Mean±SD			
BMI	22.66±3.36	21.36±3.49	1.32	3.07	P<0.05 S
FBS	82.25±9.48	83.07±10.62	0.82	0.65	0.5 NS

Table 4: Correlation Coefficient of BMI and FBS in both male and female medical students.

Parameters	Males	Sig	Females	Sig
	Correlation Coefficient		Correlation Coefficient	
FBS	0.38	P<0.01S	0.52	P<0.01 S

Correlation coefficient of FBS is significant (P<0.01 S) in male and female

Discussion

It the present study the normal limit of BMI was taken between 19-26 Kg/ m² but many recent studies have shown that Asian Indians have a significantly greater proportion of body fat than is found in Western populations. It is also clear that the healthy levels of BMI and upper body adiposity are significantly lower for Asian Indians than for Westerners. Recently it has been calculated that the normal cut-off value for BMI in Asian Indian adults is < 23 kg/m². This has also been confirmed by recommendations from the World Health Organization. Overweight excess energy intake, and physical inactivity have been associated with the rapidly rising number of diabetes patients⁷. Obesity is steadily becoming the greatest health problem in the developed world. The prevalence of overweight and obesity has reached pandemic proportions worldwide⁸. It has recently been estimated 1.1 billion people are overfed and overweight⁸. Overweight becomes obesity when extent that it may adversely affect health and is most commonly defined by the use of criteria involving the body mass index (BMI=kg/m²). BMI e" 25 can be associated with a reduced life expectancy and a risk of exacerbating many disease⁸.

Elevated fasting serum glucose level and a diagnosis of diabetes are independent risk factors for several major cancers and the risk tends to increase with an increased level of fasting serum glucose⁹. Lowering blood sugar levels could reduce the coronary heart diseases in both diabetes and non diabetics, according to researchers at the Johns Hopkins Bloomberg School of public health and other institution¹⁰. The prevalence of diabetes mellitus is highest among Indians (3.5%-16%), followed by Chinese and Malaysia¹¹.

Prevalence of obesity in western populations varies greatly, but a weighed estimate suggests prevalence between 15% and 20%¹². Today more than 11 billion adults worldwide are overweight, of which 312 millions are obese³. There is a lot of data on the prevalence rates of obesity in the general population in Bahrain and other Arabian Peninsula States¹² where the prevalence rate among adults is among the highest in the world. Prevalence of trend of overweight and obesity has been increasing among adults Arab, probably due to the effects of modernization, affluence, increased food consumption and the concomitant changed to sedentary life styles¹².

A recent study conducted in Greece and in particular in the Attica region verified this major health issue and showed that the prevalence of adult overweight and obesity were 53% and 20% in men and 31% and 15% in women respectively¹³. In the United States, about one third of the population was overweight and another third was obese. The prevalence of adult overweight (BMI range 25-29, 9) and obesity is increasing regardless of age socioeconomic or ethnicity differences¹⁴. As the prevalence of obesity is increasing worldwide, data from epidemiological studies in grebe demonstrate that a considerable proportion of the population is overweight or obese¹³.

As 19.06% students of our total study populations are overweight, so number of risk individuals is much higher. Therefore strategical design to limit diabetes mellitus and cardiovascular risk should address weight reduction during childhood and adolescence. However, the influence of obesity on cardiovascular risk begins before adulthood and overweight during adolescence is associated with an increased risk of coronary heart diseases in male and female subjects¹⁵.

In this study the prevalence of overweight and obesity is 9.72% and 1.5% in male and that in female 9.3% and 1.16% of

about 257 students, was higher than that reported in European countries¹⁶ where the prevalence overweight and obesity were 8% and 1% respectively, and among the medical students of Greece University, the prevalence of obesity was 43%. It was lower than that reported in some Arab gulf countries¹⁶. For example, among Kuwait college students overweight and obesity were prevalent as 38.5% and 11% respectively¹⁶. Obesity is a major health problem in Kuwait, more than half of adult females and almost 1/3rd of adult males are obese¹⁴.

Conclusion

Body mass index is one of the most accurate ways to determine the health risks. Results of this study indicate that the strong relation between elevated fasting blood sugar with increased BMI. The findings of this study calls for further investigation to determine the mechanisms that underlie this complex relationship between obesity, diabetes, and other critical illness.

Our study shows more underweight and overweight in female than male and the fasting blood sugar were found more in female than male. From Present study we can say that females are more prone to develop diabetes mellitus than males. Thus this study focus on Obesity as a risk factor for impaired FBS in adult population hence requires implementation of local and national level programs to prevent overweight and obesity.

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To Compare the Effects of High and Low Frequency Transcutaneous Electrical Nerve Stimulation on Acupuncture Points in Experimental Pain Threshold

Manish Jain¹, Nidhi Sharma², Sumit Kalra²

¹BPT Student, ²Lecturer, Banarsidas Chandiwala Institute of Physiotherapy, New Delhi

Abstract

This study compared the effects of high and low frequency transcutaneous electrical nerve stimulation on acupuncture points in experimental pain threshold at the wrist. 70 healthy subjects, aged 18-24 years, were distributed into 2 groups: 1) High Frequency TENS, 2) Low Frequency TENS. Pain threshold was measured immediately before and after the treatment. Pain threshold significantly increased in both the groups following treatment, with statistically significant differences in mean pain threshold changes between the two groups also. The results suggest that low frequency TENS is more effective than high frequency TENS for increasing experimental pain threshold.

Key Words

High frequency, low frequency, transcutaneous electrical nerve stimulation, acupuncture points, pain threshold.

Introduction

Transcutaneous electrical nerve stimulation, more commonly referred to as TENS is defined as transcutaneously applied electrical stimulation of the skin to relieve pain by interfering with the neural transmission of signals from underlying pain receptors^{1,2}.

TENS units produce a continuous train of pulsed current at frequencies in the range 1 to 120 Hz, some as high as 200 Hz².

Generally TENS is applied at high frequency (>50 Hz) with an intensity below motor contraction (sensory intensity) or low frequency (<10 Hz) with an intensity that produces motor contraction³.

In clinical practice, TENS is predominantly used for its symptomatic relief of pain through the pain gate mechanism. The "gate control theory of pain"⁴ proposed that pain perception is not simply a direct result of activating pain fibers, but modulated by interplay between excitation and inhibition of the pain pathways.

The purpose of this study is to compare the effects of high and low frequency TENS on acupuncture points in experimental pain threshold.

Acupuncture is the procedure of inserting and manipulating filiform needles into various points on the body to relieve pain or for therapeutic purposes⁵. The acupuncture technique that has been most often studied scientifically involves penetrating the skin with thin, solid, metallic needles that are manipulated by the hands or by electrical stimulation⁶.

The four acupuncture points used in this study are⁷:-

1. LI 5 Acupuncture Point - Yang Xi
2. LI 4 Acupuncture Point - He Gu
3. TH 4 Acupuncture Point - Yang Chi
4. TH 5 Acupuncture Point - Wai Guan

Acupuncture like TENS (AL-TENS) is defined as the induction of forceful but non-phasic muscle contractions at myotomes related to the origin of the pain^{8,9,10,11,12,13}. However, there is inconsistency in the use of the term 'AL-TENS', as some commentators describe AL-TENS as the delivery of TENS over acupuncture points irrespective of muscle activity^{14,15,16,17}.

The purpose of AL-TENS is to selectively activate small

diameter fibres (A α or group III) arising from muscles (ergoreceptors) by the induction of phasic muscle twitches. Evidence suggests that AL-TENS produces extra segmental analgesia in a manner similar to that suggested for acupuncture⁸.

TENS induced activity in small diameter afferents has also been shown to produce extra segmental analgesia through the activation of structures which form the descending pain inhibitory pathways, such as periaqueductal grey (PAG), nucleus raphe magnus and nucleus raphe gigantocellularis^{18, 19, 20}.

A study was conducted by James R Jackson, Cheryl J Knowles, Jo Ann Clelland and Donald H Lein, Jr compared the effects of high intensity, low frequency transcutaneous electrical nerve stimulation of auricular, somatic, and combined auricular and somatic acupuncture points on experimental pain threshold measured at the wrist. The results indicate that TENS applied to any of the three sets of acupuncture points equally increases pain threshold, thus possibly increasing options in choosing stimulation sites for treating patients with pain²¹.

A study was conducted by Berlin FS, Bartlett R, Black JD to determine acupuncture and placebo effects on delaying the terminating response to a painful stimulus. Response latencies were recorded before and after needling, which included electrical stimulation. Needles placed in specific acupuncture points delayed onset of the pain-terminating response slightly more than needles inserted as placebos. Even with needles in appropriate acupuncture points, analgesia was slight and subjects still experienced pain²⁴.

A study conducted by Chapman CR, Benedetti C, Colpitts YH, Gerlach R. to demonstrate that naloxone fails to reverse pain threshold elevated by acupuncture. Because endorphins can be released in response to a stressor, endorphin presence sometimes correlates with acupuncture treatment in animal studies and some human studies, especially those involving pain patients. The primary analgesia elicited by acupuncture stimulation seems to involve other mechanisms²⁵.

A study was conducted by Kiser RS, Khatami MJ, Gatchel RJ, Huang XY, Bhatia K, Altshuler KZ to determine that acupuncture relief of chronic pain syndrome correlates with increased plasma met-enkephalin concentrations. Plasma beta-endorphin concentrations were unchanged. The degree of symptom relief was correlated with the increase in plasma met-enkephalin²⁶.

Method

Source & Selection Criteria

70 healthy individuals of age 18-24 years from Banarsidas Chandiwala Institute of Physiotherapy.

Inclusion Criteria

- Asymptomatic Healthy Individuals
- Age Group 18-24 Years
- Both Males And Females

Exclusion Criteria

- Any subjects who used cardiac pacemakers / metal implants
- Any neurological disorders / mental retardation cases
- Subjects who took opiate pain medications or central nervous system depressants or stimulants

Instrumentation

- Electrical Stimulator (International Electro Medical made)
- Trans cutaneous electrical nerve stimulator (International Electro Medical made)
- Acupuncture points chart
- Stool
- Watch

Procedure

- Subjects were divided into two groups, i.e., Group 1 and Group 2 of 35 subjects each.
- Group 1 received high frequency TENS on acupuncture points of the wrist while Group 2 received low frequency TENS on acupuncture points of the wrist.
- The 4 acupuncture points used were :-
 1. Wiaguan (TH 5)
 2. Yangchi (TH 4)
 3. Yangxi (LI 5)
 4. Hegu (LI 4)
- All subjects sat comfortably on the stool with their arm supported on a pillow and experimental pain threshold was measured immediately before and after the treatment.

Pain Threshold Measurement

- Before the experiment began, the subjects were allowed to feel the electrical current at their right wrists to familiarize themselves with the sensation.
- We instructed the subjects to recognize and verbally report the instant they perceived any electrical sensation at the right wrist and then again when they experienced a mildly painful pinprick sensation.
- To determine each subject's experimental pain threshold, electrical stimulation was applied to the skin over the distal end of the left radius.
- The dispersive electrode was applied behind the subject's neck, between the levels of the seventh cervical vertebrae and upper thoracic vertebrae.
- The point over the distal radius was marked with ink to ensure all measurements were taken at the same point.
- Acupuncture point LI 5, located near the distal end of the radius was avoided.
- The intensity was increased systematically by 0.1 mA increments at one second intervals until the subject reported a distinct painful pinprick sensation.
- This sensation was recorded as the subject's experimental pain threshold.
- We obtained and averaged three pain threshold measurements in each session to determine each subject's mean experimental pain threshold.

Treatment

- The subjects removed all jewelry before treatment. The dispersive electrode was tied to the left hand of each subject.
- Acupuncture point charts are used to locate the appropriate acupuncture points for each subject.
- High and low frequency TENS was used to stimulate the acupuncture points for the two groups.
- The high frequency TENS current used to stimulate the acupuncture points was a positive polarity current delivered

at 100 Hz with a pulse width of 150 μ s.

- The low frequency TENS current was a positive polarity direct current delivered at 5 Hz with a pulse width of 150 μ s.
- Subjects responded verbally when the first began to feel the stimulus and then again when the intensity reached each subject's tolerance.
- Each point was stimulated for 60 seconds at this intensity. Stimulus intensity was lowered slightly during treatment if required by the subject.
- Stimulus intensity was lowered slightly during treatment if requested by the subject.
- Experimental pain threshold levels were measured again immediately after the treatment.

Data Analysis

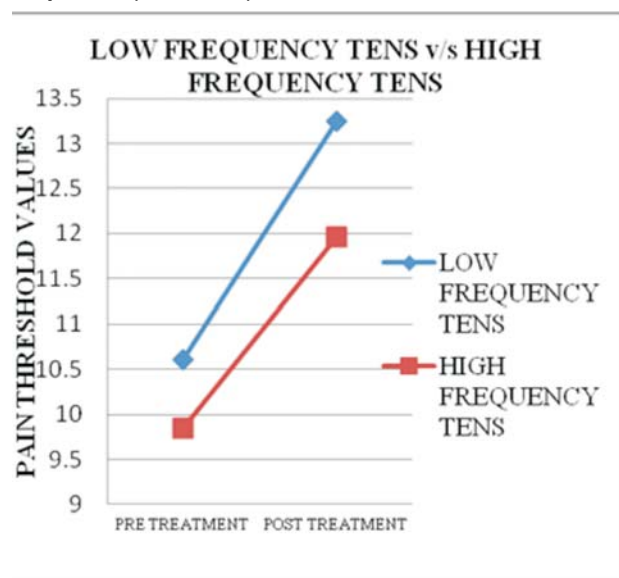
Mean pain threshold values for all the groups are shown in Table 1. Descriptive statistics for pain threshold were calculated for the pre treatment and post treatment measurements and for the change between measurements. A t-test and z-test was used to test the data for statistical significance. The t-test can be used to determine the differences between the pre treatment and post treatment means within each case. The z-test is used to determine the differences between the mean of changes in the pre treatment and post treatment measurements between two groups.

Pre treatment and post treatment comparisons in an individual case were made with the help of paired t-test.

Table 1: Mean Pain Threshold Measurements (mA)

GROUP	MEAN	STANDARD DEVIATION	MEDIAN
LOW FREQUENCY			
Pre treatment	10.61	3.07	10.2
Post treatment	13.25	4.06	12.7
Change	2.8	1.93	2.5
HIGH FREQUENCY			
Pre treatment	9.85	2.71	9.4
Post treatment	11.96	3.70	11.2
Change	2.15	1.72	2.4

Graph 1: Experimental pain threshold



Comparison of changes in the pre treatment and post treatment measurements between two groups were made with the help of z-test. 5 percent level of correction was used for all the tests. The mean pre treatment and post treatment pain thresholds are shown in Graph 1.

Results

The paired t-test showed a statistically significant effect, therefore there was statistically significant difference in individual groups in terms of pre treatment and post treatment measurement in both the cases. The z-test also showed that the mean change for the groups differed statistically from each other in both the cases.

The changes recorded in the pain threshold levels are:

1. An increase of 26.39% in the pain threshold levels in low frequency TENS.
2. An increase of 21.82% in the pain threshold levels in high frequency TENS.

This study supported our expectations that significant changes would occur in the experimental pain threshold, measured at the wrist, after stimulation of the acupuncture points in the two cases we divided according to our aims.

The hypothesis that low frequency TENS is more effective than high frequency TENS in elevating experimental pain threshold levels was supported. Significant differences were found among the groups mean change values from pre treatment to post treatment measurements.

Discussion

Other studies have shown that stimulation of acupuncture points resulted in statistically significant increases in experimental pain threshold. We also found out that statistically significant pain threshold elevation occurred following stimulation of acupuncture points by either low frequency TENS (t-value 3.0684 with 99.69% confidence level) and high frequency TENS (t-value 2.7218 with 99.18% confidence level).

The results of our study suggest that stimulation of acupuncture points by low frequency TENS is more effective than high frequency TENS in increasing pain threshold levels (z-value 2.142 with 96.8% confidence level). In our study stimulation of acupuncture points by low frequency TENS resulted in greatest pain threshold change. This change, was statistically different from the pain threshold changes in the other group that received high frequency TENS. Clinically, this finding implies that a physical therapist may prefer low frequency TENS over high frequency TENS to stimulate the acupuncture points of an individual patient as it is expected to give better results. The analgesic effects will be better after stimulation of the acupuncture points by low frequency TENS.

Studies done by researchers done in the earlier years have shown that a delay exists before maximum analgesia occurs in experimental pain threshold following acupuncture point stimulation. Nailing et al reported that the change in mean pain threshold increased from 11.7% immediately following acupuncture point stimulation to 25.6% 10 minutes after treatment²². Kitade and Hyodo measured experimental pain threshold both during and after either acupuncture point stimulation²³. They also reported that maximum analgesia was not achieved immediately post treatment²³. Kitade and Hyodo observed that experimental pain threshold reached its maximum at 30 or 50 minutes into acupuncture point stimulation²¹. In these entire studies maximum pain threshold levels were not achieved immediately, regardless of whether pain threshold was measured following or during either auricular or somatic acupuncture point stimulation²³. This delay before maximum analgesia could be the time required for the maximal release and function of endorphins. All of these studies also showed that pain threshold remained elevated after cessation of acupuncture point

stimulation²³. Our study showed that stimulation of acupuncture points resulted in immediate increase in experimental pain threshold; further post treatment measurements were not taken. Future studies should determine whether it will continue to increase or remain significantly elevated over time following acupuncture point stimulation.

Duration of treatment also has been shown to be a factor in effective acupuncture point stimulation. In our study the application of low frequency and high frequency TENS for 60 seconds resulted in 27.63% and 23.85% increase respectively in experimental pain threshold. Studies should also be performed to determine the duration of treatment required to achieve optimal increases in pain threshold with high and low frequency TENS.

Comparisons between experimental pain and clinical pain were not made in this study because they may differ in their response to the mode of TENS used in acupuncture point stimulation. Clinical studies may show that, of the mode of TENS investigated in this study, one set may be more effective in alleviating pain. Nonetheless, experimental pain suppression studies, such as this study may be an important first step in evaluating and understanding potentially effective means of pain alleviation in the clinic⁹.

Conclusion

In a group of 70 healthy subjects, low and high frequency TENS administered to a set of acupuncture points resulted in statistically significant increase in experimental pain threshold. Also, statistically significant differences existed in the elevated pain threshold change values among the groups receiving low and high frequency TENS. These results suggest that low frequency TENS is more effective than high frequency TENS for increasing experimental pain threshold. Because these results imply that stimulation of the acupuncture points by low frequency TENS is more effective than high frequency TENS, this finding implies that a physical therapist may prefer low frequency TENS over high frequency TENS to stimulate the acupuncture points of an individual patient as it is expected to give better results. Further research to compare low and high frequency TENS with patients with specific pain condition is needed.

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Undertaking

I undertake that all the below mentioned people are co-authors of my study.

1. Dr. Nidhi Sharma (Lecturer- Banarsidas Chandiwala Institute of Physiotherapy)
2. Dr. Sumit Kalra (Lecturer- Banarsidas Chandiwala Institute of Physiotherapy)

Assessment of motor function in Multiple Sclerosis patients treated with Methylprednisolone

Frank van Eijkeren¹, Ruud Reijmers¹, Erik van Munster², Mirrian Hilbink³

¹Physiotherapist, Department of Physiotherapy, ²Neurologist, Department of Neurology, ³Clinical Epidemiologist Jeroen Bosch Academy, Jeroen Bosch Hospital, 's-Hertogenbosch, The Netherlands

Abstract

The objective of the current study was to exhaustively assess whether Methylprednisolone produces changes in physical functioning in different populations of people with MS, by using a battery of established instruments. Therefore, various measurement instruments regarding functioning of the movement system as well as movement activities were applied to a group of Multiple Sclerosis patients treated with Methylprednisolone. Participating patients completed the battery of selected instruments before the start of treatment with Methylprednisolone and they were then followed up 12 weeks after treatment initiation. Scores on the various instruments included in the physiotherapeutic measurement protocol enables a valid assessment of the course of motor functioning of Multiple Sclerosis patients. Motor functioning of patients in the relapsing-remitting phase of Multiple Sclerosis showed significant improvement in nearly all components after treatment with Methylprednisolone, whereas motor functioning of patients in the secondary-progressive phase of the disease remained unchanged.

Methylprednisolone seems to improve the motor function of Multiple Sclerosis patients in the relapsing-remitting phase. As outcomes of the measurements included in the physiotherapeutic measurement protocol can serve as a guideline in decision making about treatment, the physiotherapeutic measurement protocol has added value in the treatment of patients suffering from Multiple Sclerosis.

Key Words

Multiple Sclerosis; measurement protocol; motor functioning; physiotherapy; Methylprednisolone.

Introduction

Multiple Sclerosis (MS) is a chronic disease of the central nervous system.¹ Based on the course of the disease, different types of MS can be distinguished.² Relapsing-remitting (RR) MS is the phase in which exacerbations occur, which leave few or no remaining symptoms. Secondary progressive (SP) MS is the phase in which exacerbation can still occur, but in which the disease symptoms gradually increase. This phase often follows the RR phase. Furthermore, primary progressive (PP) MS is characterised by a gradual deterioration without exacerbations, whereas acute MS occurs suddenly and runs a very progressive course.

MS has a strong influence on patients' motor functioning. A number of previous studies investigated the course of motor

functioning in MS patients. Unlike the situation for Parkinson's disease, a test battery composed of established instruments for monitoring functions of the movement system and movement activities of MS patients is unavailable as yet. Therefore, the large majority of prior studies assessed the course of motor functioning in this patient group by using a single instrument. A large part of these studies concerned MS patients treated with Methylprednisolone, as this is a commonly used treatment option in MS patients. Methylprednisolone is prescribed for both an exacerbation of the disease and maintenance treatment in the chronic phase of the disease.^{3,4,5,6} The Expanded Disability Status Scale (EDSS), the Visual Analogue Scale (VAS) and the Neurological Rating Scale (NRS) were used in previous studies in order to assess motor functioning in Methylprednisolone-treated MS patients with an exacerbation of their disease.^{7,8,9,10} The aim of treatment in this phase of the disease is to speed up recovery from the exacerbation and to achieve recovery with as few remaining symptoms as possible. Goodkin used the nine hole peg test to investigate the motor function in patients during the SP phase of MS, where the aim of treatment is to slow down deterioration of the functioning.^{11,12}

To our knowledge, prior studies did not make use of a test battery composed of established instruments pertaining to a broad range of functions of the movement system and movement activities of patients suffering from MS. As motor functioning is an essential part of the evaluation of the course of the disease during outpatients' clinic follow-up visits, the availability of a thorough insight in this domain of functioning is desirable.^{13,14} The aim of the current study was to exhaustively assess whether Methylprednisolone produces changes in physical functioning in different populations of people with MS, by using a battery of established instruments.

Material and Methods

Measurement instruments

The following measurement instruments, having proven value in the examination of motor functioning of neurological patients, and where possible particularly of MS patients, were used.

- Hand grip strength meter (GRIP) for the measurement of muscle strength in the hands. Mathiowetz^{15,16} showed that grip strength can be measured in a reliable and valid manner with an inter-evaluator reliability of 0.99.
- Handheld dynamometry (EXTKN and FLEXEL) for the measurement of muscle strength of the extensors of the knees and the flexors of the elbows. Bohannon¹⁷ and Andrews¹⁸ demonstrated that muscle strength can be reliably measured with a handheld dynamometer if a standardised measurement is performed; the inter-evaluator reliability is 0.94 for the flexors of the elbow and 0.90 for the extensors of the knee.
- 10-metre walking test, maximum walking speed (10M WALK) for walking ability. Wade¹⁹, Collen²⁰ and Holden²¹ demonstrated that walking speed can be measured simply, reliably and validly for the neurological patient in general and also for the MS patient more specifically. The test-retest reliability is 0.97 and the construct validity compared to the functional ambulation categories is 0.80.

Address for correspondence:

Mirrian Hilbink

Jeroen Bosch Hospital

Jeroen Bosch Academy

P.O. Box 90153

5200 ME 's-Hertogenbosch

The Netherlands

Telephone: +31 (0)73-5532970

E-mail: m.hilbink@jzbz.nl

- Nine hole peg test (NHPT) for manual dexterity. Mathiowetz(22) demonstrated good reliability of this instrument. The inter-evaluator reliability is 0.97 for the right hand and 0.99 for the left hand. The construct validity compared to the Purdue Pegboard is 0.61 for the right hand and 0.53 for the left hand.
- The berg balance scale(23,24) (BBS) for functional balance measures 14 everyday balance moments. Taking into account the clinimetric properties: the inter-evaluator and intra-evaluator reliability are 0.98 and 0.99, respectively and the construct validity compared to the Timed Up and Go Test and Tinetti Balance Test is 0.76 and 0.91, respectively. The instrument provides an ordinal result, with a range of 0 – 56; 0 = very poor and 56 = optimal.
- Functional ambulation categories (FAC) for the degree of assistance or supervision whilst walking. Holden(25) demonstrated that this instrument can be used in a reliable and valid manner for MS patients. The inter-evaluator and intra-evaluator reliability are 0.79 and 0.96 respectively, and the construct validity compared to the 10-metre walking test is 0.80. The instrument provides an ordinal result, with a range of 0 – 5; 0 = very poor and 5 = optimal.

Patients

The study population consisted of patients who were admitted to the day care centre for treatment. They were treated with Methylprednisolone, via intravenous administration (daily 1000 mg during three consecutive days).

Inclusion criteria were a diagnosis of MS (RR or SP phase) and aged 16 years of older.

Exclusion criteria were being unable to complete the motor tasks properly due to cognitive problems; being unable to walk and having another pathology or use of medication that affects the course of MS. Written informed consent was obtained from all participants.

Measurements

The measurements were performed by an experienced physiotherapist. The first measurement took place before the start of treatment with Methylprednisolone (T_0). As Methylprednisolone remains active for approximately 3 months, a follow-up measurement was performed 12 weeks after the start of Methylprednisolone treatment (T_1). The order of the measurement instruments was remained the same in all cases. All measurements were performed by the same physiotherapist.

Statistical Analyses

Statistical calculations were performed using SPSS for Windows (version 16.0).

A *P*-value of less than 0.05 was considered to indicate statistical significance. Firstly, descriptive statistics were performed. After that, all continuous variables were judged for fit to the normal distribution by using stem-and-leaf plots and quantile-quantile (QQ) plots.

In case of abnormal distribution, the Signed Rank Test (Wilcoxon for paired observations) was used for testing. In case of normal distribution, the Student's *t* test for paired observations was used for testing. All tests were two-sided.

Findings

Patients in the RR phase of MS

Eighteen patients were in the RR phase of MS. One of them dropped out because he became severely ill during the course of the study and required hospitalisation. The large

majority of patients in this phase of MS were female (88,2%). The mean age of this patient group was 37,3 years and they were suffering from MS on average for 2.8 years.

Both baseline and follow-up scores of this group are presented in Table 1. The functional balance (BBS) improved in this group from 51 to 55 ($P=0.008$). The muscle strength of the extensors of the knees showed for both the right and left leg a significant improvement, from 233 to 267 N on the right (EXTKN right; $P=0.03$) and from 223 to 259 N on the left (EXTKN left; $P=0.03$). The degree of assistance for walking (FAC) did not change significantly ($P=0.46$). The muscle strength of the flexors of the elbows increased for both right and left, from 180 to 191 N for the right (FLEXOR right; $P=0.39$) and from 160 to 176 N for the left (FLEXOR left; $P=0.50$). The grip strength in the hands improved for both right and left hand significantly, from 212 to 254 N for the right (GRIP right; $P=0.049$) and from 190 to 244 N for the left (GRIP left; $P=0.03$). The manual dexterity for the right arm (NHPT right) significantly changed ($P=0.01$), whereas the manual dexterity for the left arm (NHPT left) changed only slightly ($P=0.13$). The walking speed (10M WALK) improved from 9 to 7 seconds ($P=0.001$).

Patients in the SP phase of MS

Eleven patients were in the SP phase of MS. Two patients dropped out due to progression of the disease during the course of the study. They were no longer able to stand and walk independently or come to the hospital. The large majority of patients in this phase of MS were male (77,8%). The mean age of this patient group was 46,7 years and they were suffering from MS on average for 11.3 years.

Both baseline and follow-up scores of patients in the SP phase are presented in Table 2.

The functional balance (BBS) in this group changed slightly from 36 to 38 ($P=0.55$). The muscle strength of the extensors of the knees increased for both the right and left leg for this group, from 239 to 249 N on the right (EXTKN right; $P=0.62$) and from 254 to 262 N on the left (EXTKN left; $P=0.62$). The degree of assistance required for walking (FAC) remained unchanged ($P=1.00$). The muscle strength of the flexors of the elbows increased for both right and left, from 203 to 216 N for the right (FLEXOR right; $P=0.53$) and from 206 to 215 N for the left (FLEXOR left; $P=0.23$). The grip strength of the right hand changed from 274 to 272 N (GRIP right; $P=0.74$) and for the left hand from 277 to 303 N (GRIP left; $P=0.03$). The manual dexterity for the left arm (NHPT left) changed from 41 to 37 seconds ($P=0.19$), whilst right (NHPT right) remained unchanged ($P=1.00$). The walking speed (10M WALK) improved from 19 to 18 seconds ($P=0.90$).

Conclusion

The Patient Population in the RR phase of MS

The functional balance, the muscle strength of the extensors of both knees, the grip strength of the hands and the walking speed all improved significantly. The responsiveness of the FAC seems to be too small for this group. Furthermore, the manual dexterity for the right arm showed significant improvement, whereas the left did not. Of the 17 patients, 15 were right-handed and 2 were left-handed. The question remains whether the daily, more intensive use of the dominant hand resulted in improved recovery on this study. One of the limitations of the current study is that it remains impossible to evaluate whether the medication resulted in a more rapid improvement and a better result, in comparison to a natural recovery from an exacerbation. Nevertheless, it remains clinically relevant that the score for several functions and activities improved within 3 months.

Table 1: Mean scores (standard deviation) of Methylprednisolone-treated patients in the RR phase at T₀ and T₁ (n=17)

	T ₀	T ₁	P-value
Functional Balance	51 (5)	55 (3)	P = 0.008*
Muscle strength right knee	233 (65)	267 (48)	P = 0.03*
Muscle strength right knee	223 (77)	259 (50)	P = 0.03*
Assistance for Walking	4.4 (0.5)	4.5 (0.5)	P = 0.46
Muscle strength right elbow	180 (42)	191 (54)	P = 0.39
Muscle strength left elbow	160 (39)	176 (59)	P = 0.50
Grip strength right hand	212 (76)	254 (97)	P = 0.049*
Grip strength left hand	190 (82)	244 (100)	P = 0.03*
Manual dexterity right arm	24 (5)	22 (5)	P = 0.13
Manual dexterity left arm	49 (68)	31 (24)	P = 0.01*
Walking speed	9 (5)	7 (2)	P = 0.001*

* P < 0,05

Table 2: Mean scores (standard deviation) of Methylprednisolone-treated patients in the SP phase at T₀ and T₁ (n=9)

	T ₀	T ₁	P-value
Functional Balance	36 (12)	38 (15)	P = 0.55
Muscle strength right knee	239 (53)	249 (46)	P = 0.62
Muscle strength right knee	254 (52)	262 (53)	P = 0.62
Assistance for Walking	4 (0)	4 (0)	P = 1.00
Muscle strength right elbow	203 (64)	216 (65)	P = 0.53
Muscle strength left elbow	206 (51)	215 (38)	P = 0.23
Grip strength right hand	274 (43)	272 (31)	P = 0.74
Grip strength left hand	277 (34)	303 (38)	P = 0.03*
Manual dexterity right arm	43 (19)	43 (23)	P = 1.00
Manual dexterity left arm	41 (17)	37 (12)	P = 0.19
Walking speed	19 (14)	18 (14)	P = 0.90

* P < 0,05

The Patient Population in the SP phase of MS

For these patients, only the grip strength of the left hand improved significantly. All other functions of the movement system or movement activity remained unchanged for this patient group. A possible explanation for this finding might be that patients in this phase of the disease experience more unsatisfactory results or unpleasant side effects of Methylprednisolone and therefore decided not to pursue treatment. A serious limitation of this study is its design: a comparison with a control group would be preferable, to determine whether differences between the two groups exist. When our study results should be replicated in a controlled study, one can recommend not to continue the prescription of Methylprednisolone to patients in the SP phase of MS, as it seems to be cost-ineffective for this patient group. We recommend to investigate this topic more thoroughly in future research.

Practical Implications

A physiotherapeutic measurement protocol seems to allow in-dept monitoring of the motor function of Methylprednisolone-treated MS patients. Scores on the various instruments provide a good indication of the patient's motor functioning. This is extremely relevant in daily clinical care. Performance of the measurement protocol by the physiotherapist stimulates cooperation with other disciplines in the care for MS patients. Additionally, outcomes of the measurements can serve as a guideline in decision making about treatment.

Finally, the motor function, expressed in a number or measure, is considered very valuable by the patients. For these reasons, we assume that the physiotherapeutic measurement protocol has added value in the treatment of MS patients.

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Conflict of Interest

There is no conflicts of interest.

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Test-retest Reliability of the Onset of Lower Limb Muscles' Preactivation During Landing from A Jump in Volleyball Players With Functional Ankle Instability

Mohammad Sadeghi Goghari¹, Smaeil Ebrahimi², Nader Maroufi³, Ali Ashraf Jamshidi⁴

¹PhD student of Physical Therapy, ²Professor of Physical Therapy, ³Assistant Professor of Physical Therapy, ⁴Faculty of Rehabilitation Sciences, Tehran University of Medical Sciences, Tehran, Iran

Abstract

The Abnormal timing of muscle preactivation during landing from a jump may be one of the main mechanisms of ankle instability in volleyball players. Thus, the purpose of this study was to investigate the test-retest reliability of the onset timing of lower limb muscles' preactivation during landing in volleyball players with functional ankle instability (FAI). Eighteen professional volleyball players with unilateral FAI participated in this study. They performed four jump-landing trials in forward direction and the reliability of the onset time of five lower limb muscles' preactivation including gluteus maximus(G.max), gluteus medius(G.med), vastus medialis(VM), peroneus longus(PL) and medial gastrocnemius (MG) was assessed using Intraclass correlation coefficients (ICC), standard errors of measurement (SEM) and co-efficient of variation (CV) after one week interval. During the jump-landing task, high and very high reliability was found for G.max, G.med, VM, PL, MG onset times of preactivation with ICC level of .80, .72, .92, .91 and .80 respectively. The CVs of all onset times of muscle preactivation were less than 10% except for G.med and MG (14.72% and 11.50% respectively). The EMG onsets during landing had high to very high reliability and these parameters were found to be useful in the assessment of timing patterns in subjects with FAI.

Key Words

Reliability, Preactivation, Landing, Ankle Instability.

Introduction

In sports such as volleyball, the ankle sprain frequently occur because it involve jumping and landing with high ground reaction forces, resulting in lateral ankle sprain rate of 87%¹. Following an acute lateral ankle sprain, the most common debilitating condition is functional ankle instability (FAI) that it is developed in 15-60% of cases². The Main sign of the FAI is feeling of instability combined with episodes of the ankle giving way during sport activities or during the simple act of walking.

The neuromuscular mechanisms behind the pathology of ankle instability are unknown. Therefore, evaluating muscle activation pattern during dynamic activities, such as landing, may help elucidate the mechanism of disorder. There is evidence to suggest that pre-programmed motor plans may be altered in individuals with FAI, predisposing them to ankle inversion moments^{3, 4}. The muscle preactivation in the aerial phase of jump-landing is a measure of the feedforward mechanism of central nervous system to control the stability of lower limb joints⁵. Furthermore, the effect of these altered open-loop control strategies should be evaluated.

Reliability refers to the extent to which a measurement is inherently reproducible, or the degree to which a measurement is influenced by measurement errors^{6, 7}. In this regard, the Stability of a performance variable can be assessed by test-retest reliability methods across repeated trials over time⁸.

If electromyography (EMG) parameters are used for discriminative and evaluative purposes, determining of the measurement error is a major concern. Intrinsic and extrinsic factors along with variability of EMG signal are potential sources that may subject the EMG to measurement error. To our

knowledge, no work to date has evaluated reproducibility of the timing of muscle preactivation during landing from a jump in volleyball players with FAI. Thus, the purpose of this study was to investigate the test-retest reliability of the onset timing of lower limb muscles' preactivation during landing in volleyball players with FAI.

Methods

Subjects and Study Design

Eighteen male volleyball players with unilateral FAI (age: 23±2.8 years; height: 189.18 ±6.36 cm; body mass: 81.87±7.71 kg) participated in this study. All the study subjects were members of different teams of Volleyball League First Division in Iran. To be characterized as having unilateral FAI, the subjects satisfied the following criteria: (1) having at least one significant lateral (inversion) ankle sprain of either the right or left ankle, but not both, in which the subjects were unable to bear weight or were placed on crutches, within the last year; (2) having at least two repeated injuries or the perception of ankle instability or giving way in either the right or left ankle, but not both; (3) showing no evidence of mechanical instability, as assessed using as anterior drawer and talar tilt tests; and (4) not having participated in a rehabilitation program. All the subjects were pain free and full weight bearing at the time of the study and they were examined by the same clinician to exclude cases with neurological or vestibular impairment, past orthopedic surgery or fracture. Subjects gave their informed consent to the experimental procedure, and the study was approved by the ethics committee of Tehran University of Medical Sciences.

Procedure

Subjects were referred to the research laboratory for the testing procedures. First, an assessment of vertical jump height was performed to determine the target for the subjects during jump-landing trials. Maximum vertical height ($vert_{max}$) was determined as the difference between the maximum height reached during the three maximal double-limb vertical jumps and standing-reach height; this value was used to designate a target for the subjects to reach during the jump-landing trials^{1, 9}.

Immediately after $vert_{max}$ testing, the jumping-landing task was demonstrated to the subjects for them to be familiarized with the task. The jumping-landing task consisted of a double-limb countermovement jump with landing on a single limb in forward direction. To adjust jump height tantamount to 50% $vert_{max}$, two vertical wooden bars were placed on either side of the force plate that was connected to each other's by a tape. To begin the task, each subject stood 70 cm away from the center of the force plate and jumped with both legs toward the center of the plate. Subjects were asked to reach up and touch the tape indicating 50% of the $Vert_{max}$ with their dominant hand before landing on the force plate. They were also required to land on the stance leg, and stabilize as quickly as possible, and assume a single leg stance position with their hands on their hips while facing straight ahead^{1, 9}. The stance leg is defined as the leg with functional instability. Each subject performed four trials of jump-landing in each session. In order to prevent fatigue while

repeating the test, a rest interval of 30 seconds was considered between the trials. Test-retest repeatability was assessed after one week for each subject and retest was done with the same method as test session.

EMG Recordings

Preparation of subjects' skin for electrode placement was done in a standard fashion. EMG activity of five selected muscles including gluteus maximus (G.max), gluteus medius (G.med), vastus medialis (VM), peroneus longus (PL) and medial gastrocnemius (MG) were recorded using surface Ag/AgCl electrodes (10 mm in diameter, with the center-to-center interelectrode distance of 20 mm). The surface electrodes were held in place with double adhesive tape. A ground electrode was placed on the medial malleolus of the subjects. Electrode placement was visually confirmed on monitor using manual muscle testing techniques. An eight channel EMG system (datalink system, biometrics Ltd., UK) recorded muscle activity during the test, and raw EMG were checked for artifacts at the start of each recording session.

Data Analysis

Data were collected for four successful jump-landing trials in test and retest sessions. EMG signals were band-pass filtered at 20-450 Hz. The gain of the system was 1000x. The sampling frequency of the EMG data was 1000 Hz for each channel and they were stored in a portable computer for offline analysis. The synchronization of the EMG and the force plate systems was done by starting the two measurement systems with a common electrical trigger signal. The onset time of muscle preactivation related to the landing moment was determined. The criteria suggested by Santello were used¹⁰. The onset time of EMG activity of each muscle under study was defined as the instant in time in which the distance between the integrated normalized EMG signal inclination and the reference line was the highest¹⁰.

Table 1: test-retest intra-class correlation coefficients (ICC) with 95% confidence interval (CI), coefficient of variation (CV) and standard errors of measurement (SEM) of onset time variables during jump-landing

Variable	Test	Retest	ICC	95%CI	SEM	CV (%)
	mean± SD (ms)	mean± SD (ms)				
G.max onset	-171.91±43.47	-167.08±53.92	.80	.32-.94	19.44	9.03
G.med onset	-118.41±34.63	-110.08±44.28	.72	.05-.92	18.32	14.72
VM onset	-98.5±23	-95.5±27.17	.92	.73-.97	6.50	8.71
PL onset	-118±28.64	-114.08±29.87	.91	.72-.97	8.59	8.16
MG onset	-120.83±24.53	-114.5±24	.80	.34-.94	10.97	11.50

Note: SD=standard deviation; ms=millisecond; G.max=gluteus maximus; G.med=gluteus medius; VM=vastus medialis; PL=peroneus longus; MG= medial gastrocnemius

Discussion

The purpose of the present study was to investigate the reliability of the onset timing of lower limb muscles' preactivation during landing in volleyball players with FAI. To our knowledge, this research is the first study which reported the consistency of the onset timing of lower limb muscles' preactivation during a functional and dynamic task such as jump-landing in athletes with FAI. The results obtained show high to very high reliability of the EMG onset timing measures in the jump-landing task. This suggests that our measurement error was small and therefore there is a limited probability of type II error (random error).

The average value of four trials was applied for statistical analysis and assessment of reliability.

Statistical Analysis

Paired t-test between test and retest mean scores were calculated to verify the absence of systematic bias and alpha level was set at 0.05 for all statistical analysis.

Relative reliability was assessed using the (3, 4) model of Intraclass Correlation Co-efficient (ICC_{3,4}). According to Munro's classification of reliability co-efficient, the degree of reliability was interpreted¹¹. For each ICC, 95% confidence interval (CI) was calculated to take the sampling distribution into account. To assess absolute reliability, the standard error of measurement (SEM) was calculated as the square root of the mean square error term derived from of the analysis of variance table⁶. In addition, the co-efficient of variation (CV) was determined for comparison of absolute reliability between EMG variables of test and retest sessions (SD /mean *100). This was achieved by calculating the mean of CV from individual CVs⁶. SPSS version 17 (SPSS Inc.) was used for statistical analysis.

Results

Table 1 depicts the mean and standard deviation (SD), ICC, 95% CI, CV and SEM values of the onset time of five lower limb muscles obtained for test and retest sessions during forward jump-landing.

As illustrated, there was no significant difference between test and retest mean scores for any onset timing measures, which indicated the absence of any systematic bias (p > 0.05). During the jump-landing task, high and very high reliability was found for G.max, G.med, VM, PL, MG onset times of preactivation with ICC level of .80, .72, .92, .91 and .80 respectively. The CVs of all onset times of muscle preactivation were less than 10% except for G.med and MG (14.72% and 11.50% respectively). The most consistent measure was PL onset time (8.16%) and the most variable measure was G.med onset time (14.72%).

High reliability in this study may be due to several factors. Standardization of electrode placement in test and retest parts of this study may lead to increased probability of sampling from the same group or groups of motor units. This has been highlighted in previous studies^{12,13}. In this study, congenital bony landmarks have been used to standardize the repositioning of the electrodes.

To prevent signal cross talk, electrodes were placed over the center of muscle belly. It has been stated that when electrodes located over the center of muscle belly and in parallel with muscle fibers, EMG signal is more reliable¹²⁻¹⁴.

The number of trials averaged and used for data analysis may affect reliability as well. Greater number of trials may display less variability. In the present study, each subject performed four trials of jump-landing in forward direction and the mean of them were calculated for the assessment of reliability. In the basis of ICC analysis, Roger James et al indicated that an average of four trials were necessary to achieve maximum ICC values⁸.

Caution should be taken when comparing results from reliability studies examining well-learned activities with the study results where a newly learned or less commonly performed activity is examined. In our study, trained male athletes used to assess the reliability of EMG onset time during jump-landing. All participants were professional volleyball players who were performing repetitive jump-landing in practices and competitions. Therefore, they were familiar with the tasks. Ortega et al. mentioned that volleyball involves approximately 60 maximal jump-landing per hour in a game and a volleyball team in the United States perform 300 to 500 jumps in a four-hour session of training¹⁵. This point may be one of the main reasons of the excellent reproducibility of the measures in this research.

The kinematics and pattern of motion in jump-landing may be a source of variability of onset times and affect reliability. Thus, standardization of the task in test and retest sessions should be taken into consideration. In this research, subjects were asked to reach up and touch a tape indicating 50% of the Vert_{max} with their dominant hand before landing on the force plate^{1,9}.

The most common methods of analyzing absolute reliability are the SEM and the CV. They provide an indication of the variability and an estimation of measurement error in repeated measurements^{6,7}. Some authorities have arbitrarily selected an analytical goal of the CV being 10% or below, but they are not consensus on it⁶. The CVs of all onset times of muscle preactivation were less than 10% except for G.med and MG (14.72% and 11.50% respectively). Nevertheless, these measures seem to be less suitable than others for clinical assessment but they lie within our arbitrary benchmarks.

It is difficult to compare the results of this study with previous investigations because, to our knowledge, this research is the first study which reported the reliability of EMG onset of lower limb muscles in a jump-landing task. Some previous studies which evaluated the onset times during landing task did not report measurement reliability in their papers.

Certainly, this study has its own limitations. In our study, only one examiner measured, processed and analyzed the EMG data; therefore, our finding may only be applicable to single examiner (intra-rater reliability) studies and is not suitable for studies evaluating reliability with more than one examiner (inter-rater reliability).

Another possible limitation associated with our study may be movement of the electrodes over the skin since the jump-landing task was dynamic; hence, we tried to avoid moving the electrodes on the skin with using double adhesive tape as far as possible.

The Findings of presence study have important applications for both clinicians and researchers. Reliable determination of the motor control of lower limb muscles during a jump-landing task might help clinicians to realize abnormal or compensatory strategies that may be unique to athletes with FAI and increase the efficiency of rehabilitation.

Conclusion

Results of this study showed acceptable reliability of the EMG onset times during the jump-landing task. So, the onset time measurement may be applicable in evaluation of motor control and treatment of athletes with FAI. Since reliability is

population dependent and is not a fixed property, the results of each research can be generalized only to the same target population, not to other ones. Thus, it is unknown if similar ICCs would be obtained using other methodologies.

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Evaluation of Wet Cupping Therapy (Hijama) as an Adjuvant Therapy in the Management of Bronchial Asthma

Mohamed Elsayed Mohamed Abd al-Jawad¹, Adel Mohamed Saeed², Ahmed Elsayed Badawy³, Nevine M Mohamed Abd Elfattah²

¹Department of Chest, Giza Chest Hospital, Giza, Egypt, ²Department of Chest, Faculty of Medicine, Ain Shams University, Cairo, Egypt, ³Department of Pharmacology, Faculty of Medicine, Ain Shams University, Cairo, Egypt

Abstract

The aim of this study is to evaluate the effectiveness of cupping therapy as an adjuvant therapy in the management of patient with bronchial asthma. To achieve this target, a total of 50 patients suffering from moderate persistent bronchial asthma were included in this study. They were selected from chest clinics in Giza Chest Hospital and Ain Shams University Hospital.

Patients were selected according to positive history of asthma, and other clinical examinations. They were divided into two randomly equal matched groups, 25 patients each, according to the time of attendance to the outpatient clinic.

Group I: 25 patients each subjected to complimentary cupping therapy besides the conventional medication set by Global Initiative For Asthma 2006.

Group II: 25 patients each received conventional medication only set by Global Initiative For Asthma 2006. The conventional treatment is recommended by GINA 2006.

All our patients were subjected to clinical evaluation (daytime symptoms, nocturnal symptoms, need for rescue medications, limitation of activity and exacerbations) and respiratory function tests before and after 3 months of treatment. In addition to serum ECP were measured using IMMULITE/IMMULITE 2000 Analyzers and complete blood picture with emphasis on esinophilic count at base line before and after 3 months of treatment, as well as just before and after the 1st and 3rd cupping sessions.

In the present study, we found that there was clinical improvement of highly significant statistical value in both groups, however, group (I) showed better response regarding all clinical parameters. Regarding the improvement in the pulmonary function tests before and after treatment in both groups there was statistically significant difference in the improvement in group (I) compared to group (II) especially as regard FEV1, FEV1 \ FVC% and FEF25 – 75 %. Regarding relative esinophilic count in peripheral blood film before and after 3 months' treatment, there was statistical significant reduction in group (I) and non significant statistical reduction in group (II), but as a salient feature, there was significant statistical reduction in esinophilic count in group (I) after as compared to before the 1st session (30 minutes average). Regarding serum ECP levels of venous sample before and after 3 months' treatment there was significant statistical reduction in serum ECP levels in the group (I), and non significant statistical reduction in group (II). Regarding complete blood picture CBC results (hemoglobin %, RBCs count, WBCs and platelets) of venous samples drawn from all patients before and after cupping in group (I) showed non significant differences in them. On the other hand there was significant statistical difference between cupping and venous samples regarding the platelet count where the platelet count of the cupping blood was less than the platelet count of the venous sample. Therefore cupping is considered as a filter to keep the beneficial elements to the body and get rid of the harmful elements. In the present study in comparison between the two groups after the period of 3 months treatment it was found that group (I) had a significant statistical difference than group (II) as regard daytime symptoms, nocturnal symptoms, need for reliever, exacerbations, ECP, Peripheral Esinophilic count, FVC

% and FEF25%-75%. On the other hand a high significant statistical difference as regard FEV1/FVC% and FEV1 % was found.

Key Words

Islamic medicine, Prophetic Medicine, complimentary medicine, cupping therapy, wet cupping therapy, Hijama, bronchial asthma, blood esinophilic count, serum ECP, pulmonary functions.

Introduction

Asthma (from the Greek ἄσθμα, ásthma, "panting") is the common chronic inflammatory disease of the airways characterized by variable and recurring symptoms, reversible airflow obstruction, and bronchospasm¹. Symptoms include wheezing, coughing, chest tightness, and shortness of breath². Asthma is clinically classified according to the frequency of symptoms, forced expiratory volume in 1 second (FEV1), and peak expiratory flow rate³. Asthma may also be classified as atopic (extrinsic) or non-atopic (intrinsic)⁴.

In spite of laudable efforts to improve asthma care over the past decade, a majority of patients have not benefited from advances in asthma treatment and many lack even the rudiments of care⁵.

The use of CAM in asthma patients is increasing as an adjunct and also as a substitute for effective and proven therapies⁶.

The three methods of healing known to have been mentioned by the medical advice of Muhammad (r) were honey, cupping, and cauterization, though he was generally opposed to the use of cauterization⁷.

Cupping is used to treat asthma, common cold, chronic cough, indigestion problems, and skin conditions⁸. Cupping is beneficial for dry coughs, asthma, rheumatism, localized swellings, and pain⁹.

Subjects and Methods

This work had been carried out at Giza Chest Hospital and Ain Shams University Hospital, in a seven months period from February to August 2008.

Patients were provided with information sheets detailing the research procedure, subject understanding of the research was considered and a consent form was provided prior to commencing the study.

This study included 50 asthmatic patients selected from chest clinics in Giza Chest Hospital and Ain Shams University Hospital. They were diagnosed clinically according to the revised diagnostic criteria set by (GINA, 2006) that included:

Measurements of lung function provide an assessment of the severity, reversibility, and variability of airflow limitation, and help confirm the diagnosis of asthma.

The patients studied were divided into two randomly equal matched groups, 25 patients each, according to the time of attendance to the outpatient clinic.

Group (1): (combined treatment group) Included 25 asthmatic patients suffering from moderate persistent bronchial asthma subjected to complimentary cupping therapy besides the

conventional medication set by Global Initiative For Asthma 2006.

Group (2) : (medically treated group as control) Included 25 asthmatic patients suffering from moderate persistent bronchial asthma received conventional medication only set by Global Initiative For Asthma 2006. The treatment is recommended by GINA 2006.

All patients were subjected to the following

1. Medical history: (history of episodic breathlessness, wheezing, cough, and chest tightness. Episodic symptoms after an incidental allergen exposure, seasonal variability of symptoms and a family history of asthma and atopic diseases).
2. Clinical examination: (complete general and local chest examination especially auscultation of wheezes or prolonged expiration on quite or forced exhalation).
3. The number of exacerbations during the treatment.
4. How many times the patient needed relieve medications?
5. Was there any Limitation of activity ?
6. How many times asthma awakened the patient at night?
7. X-ray chest to exclude any local chest diseases .
8. ECG in selected cases to exclude cardiac problems .
9. Spirometric study were performed using the computerized spirometry (DATOSPIR mod. 120C).
10. Laboratory studies:
 - a. Complete blood picture (CBC): with emphasis on eosinophilic count for the blood coming from cupping therapy (cupping blood) and (2 venous blood samples) before and after cupping in the same session of the cupping.
 - ♦ Serum Eosinophilic Cataionic Protein (ECP) : measurement in the serum of the blood coming from cupping therapy (cupping blood) and (one venous blood sample before cupping in the 1st session and after cupping in the 3rd session).
 - ♦ N.B : Steps 9 and 10 were repeated after 3 months of treatment.

Exclusion Criteria

- ♦ Smokers.
- ♦ Patient's refusal or lack of cooperation.
- ♦ Patient with major organ dysfunctions (e.g. cardiac , respiratory, hepatic, renal, or other significant systemic disorders).
- ♦ Local sepsis or systemic septicemia.
- ♦ Overt coagulopathy or patients on coagulant therapy that contraindicate cupping therapy.
- ♦ Any neuro – psychiatric deficits.
- ♦ Parasitic infestation.
- ♦ Alternative causes of recurrent wheezing must be considered and excluded as gastroesophageal reflux, recurrent viral lower respiratory tract infections ,tuberculosis and foreign body aspiration.

Specimen Collection and Preparations

1. Serum

Blood samples were collected by venipuncture with 5 ml disposable syringes into a clean, dry centrifuge tubes and allowed to stand at room temperature for about 30 minutes, then centrifuged at 5000 r. p. m for 10 minutes.

Serum was separated from the cells and was stored in epindorff tubes in deep freeze at - 20C for the Quantitative

measurement of eosinophilic cationic protein (ECP) in serum using IMMULITE / IMMULITE 2000 Analyzers.

2. Whole blood

For the complete blood picture determination, whole blood was withdrawn into clean plastic tubes containing EDTA and well shaken.

Bloodletting Cupping Therapy

A specific protocol for medical bloodletting cupping therapy was applied according to the modern bloodletting cupping procedure¹⁰.

Patients of group (I) were subjected to bloodletting cupping on 3 basic points which were selected according to traditional Arab medicine :

- The first point is : “ Al-Kahel “ between shoulders (7th cervical spine) where Ibn Al-Koff stated that cupping on it comfort dyspnea¹¹.

The second and third points are : on the region between the two shoulder – blades where Ibn Sina stated that the cupping on it can comfort dyspnea and asthma¹¹.

The Procedure of Bloodletting Cupping

A high quality and durable cupping set was used figure (4). It has a vacuum pump (suction pump) and cups which were lightweight, break resistant and anti – aging plastic. These cups were supplied in different sizes and comes with a detailed user's manual which I had followed exactly:

1. It was made sure the inside of the cup is clean and the handle is completely unfastened .
2. The skin of the patient must be dried , cleaned by antiseptic solution and the hair is shaved in the selected area of the skin for ideal maximum performance of the cups.
3. An appropriate size or type of cup was selected . The cup was put on the selected previous three points. With the rim of the cup facing downward, press tightly with one hand and screw the handle of the vacuum with the other until the cup sucks onto the skin.
4. The handle of the cup was screwed or unscrewed to adjust the pressure inside the cup.
5. The cups were left for few minutes until the skin engorged.
6. The selected points were scarified very superficially .
7. The cup was put on the selected previous three points again and the handle of the cup was screwed or unscrewed to adjust the pressure inside the cup.
8. The cup was removed when was one to two thirds full and another cup was set on the spot.
9. The cupping procedure was repeated until the scarificated indurations bleeds no more.
10. The cups were unscrewed after the desired elapsed time.
11. The small wound is gently rubbed with an antibiotic ointment and then covered with a sterile bandage that would be left for one day.

Results

This table shows that group (I) had a significant statistical difference ($p > 0.05$) as regard daytime symptoms, nocturnal symptoms, need for reliever, exacerbations, ECP, peripheral eosinophilic count, FVC % and FEF25%-75% , than group (II) after 3 months of treatment , as well as a highly significant statistical difference ($p > 0.01$) as regard FEV1 % and FEV1/ FVC%.

Table 1: Comparison between the two groups after 3 months of treatment as regard daytime symptoms, nocturnal symptoms, need for reliever, exacerbations, ECP, peripheral eosinophilic count, FEV1 %, FVC %, FEF25%-75% and FEV1/FVC% after the period of treatment.

Parameters After	Group (I) Mean± SD	Group (II) Mean± SD	T	P value	Sig.
Daytime symptoms	1.64 ± 2.03	3.36 ± 3.03	2.35	< 0.05	S
Nocturnal symptoms	0.64 ±1.11	1.80± 1.97	2.55	< 0.05	S
Need for reliever	1.36 ±1.31	3.08 ±2.25	3.29	< 0.05	S
Exacerbations	0.04±0.2	0.28 ±0.45	2.4	< 0.05	S
ECP	36.36 ± 27.86	48.31 ±9.86	2.02	< 0.05	S
Peripheral Eosinophilic count	1.68 ±0.62	3.60±3.10	3.02	< 0.05	S
FEV1 %	84.4 ±6.93	70.68 ±8.97	6.04	< 0.01	HS
FVC %	96.80 ±2.92	94.64 ±3.12	2.52	< 0.05	S
FEF25%-75%	59.88 ±6.60	53.46±12.68	2.24	< 0.05	S
FEV1/FVC%	78.32 ±8.56	65.24 ±9.97	4.97	< 0.01	HS

Fig. 1: Comparison between the two groups after 3 months of treatment as regard daytime symptoms , nocturnal symptoms, need for reliever, exacerbations and peripheral eosinophilic count.

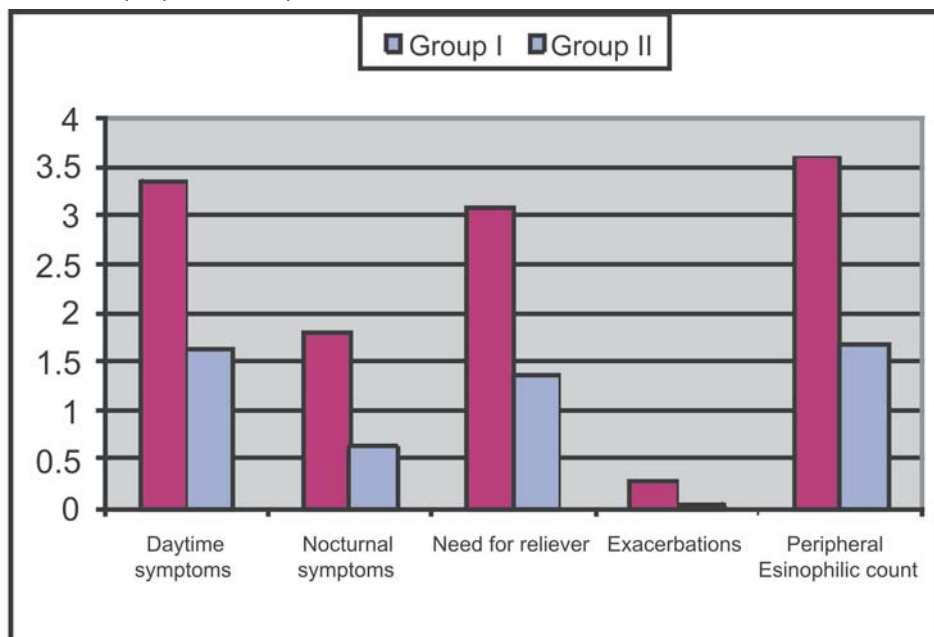


Table 2: Comparison of the two groups as regard limitation of activity after 3 months of treatment.

		Group I Case N=25	Group II Control N=25	X ²	P	Sig.
Limitation After treatment	0	19	10	6.66	< 0.05	S
	1	3	7			
	2	3	8			

0 = non. 1 = minor limitation. 2 = some limitation.

This table shows that group (I) had a significant statistical difference than group (II) as regard the limitation of activity.

Fig. 2: Comparison between the two groups after 3 months of treatment as regard ECP , FEV1 % , FVC % , FEF25%-75% and FEV1/FVC%.

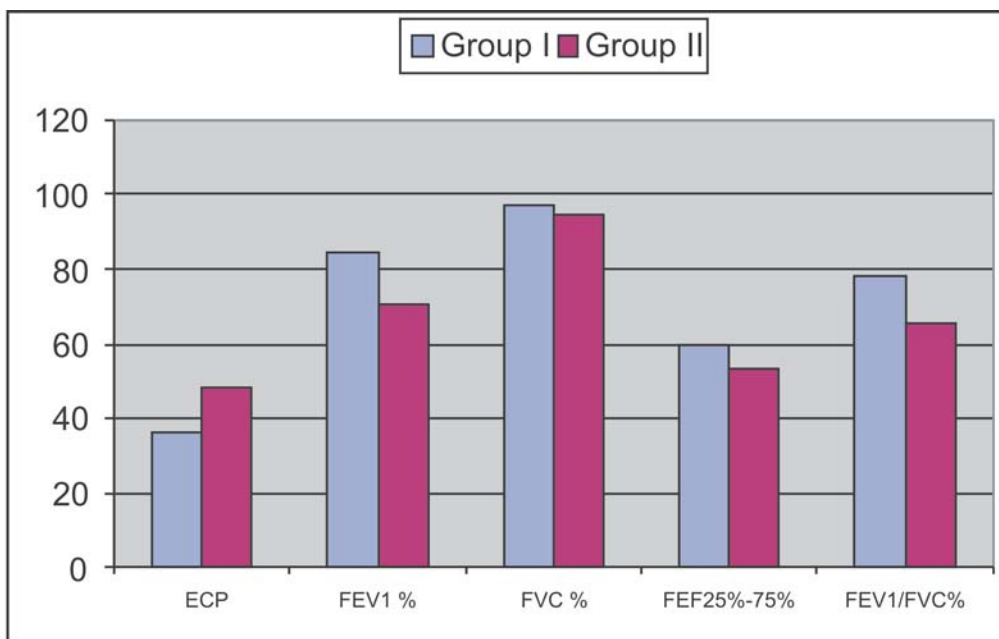


Fig. 3: Comparison between the two groups after 3 months of treatment as regard limitation of activity after 3 months of treatment.

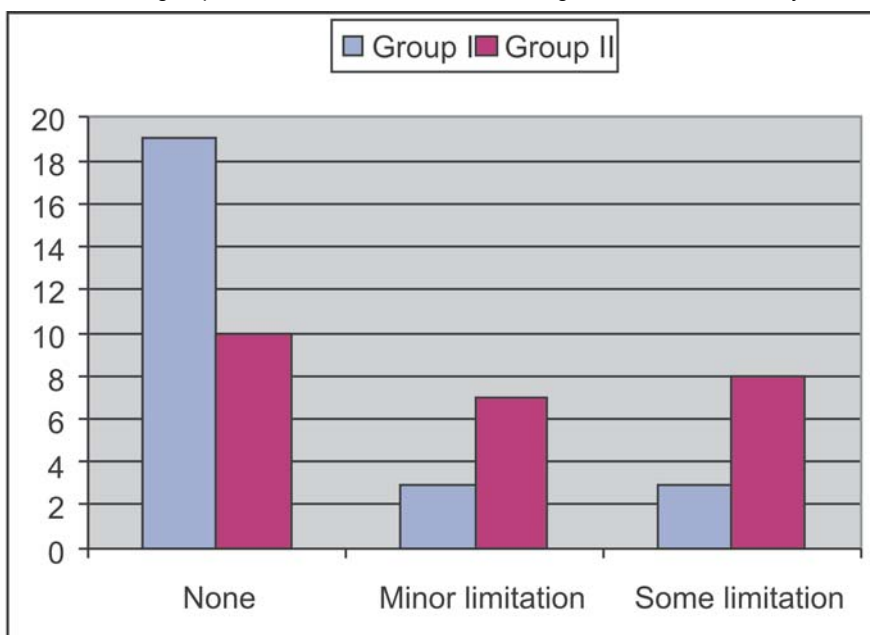


Table 3 : Comparison between venous and cupping samples as regard platelets count in the 1st and 3rd cupping sessions among group (I).

	Venous sample	Cupping sample	T	p	Sig.
Platelets (before treatment)	277.8±74.7	139±72.46	6.2	< 0.01	HS
Platelets (after treatment)	263.7±65.7	80.8±55.14	9.36	< 0.01	HS

This table shows a highly significant statistical difference between venous sample and cupping sample as regard platelets in the 1st and 3rd cupping sessions.

Fig. 4: The cupping set.



Conclusions

Finally We Can Conclude That

1. Cupping therapy may be an adjuvant therapy in treatment of bronchial asthma.
2. Cupping therapy play an important role in improving both pulmonary functions of asthmatic patients and symptoms relief, as well as act as an anti inflammatory factor in asthma by decreasing peripheral esinophilic count and serum ECP.
3. Cupping has the ability to help tissues to get rid of toxins and considered as a filter to keep the beneficial elements to the body.
4. CAM is economic , practical and easy to apply as a common practice in medicine.
5. Cupping therapy is simple procedure , and may be effective in treatment of bronchial asthma.
6. The procedure of cupping doesn't seem to be harmful if done appropriately.
7. There are many CAM treatments for which benefits for health are claimed. However, it is important to find out what scientific studies have been done on the safety and effectiveness of the CAM treatment.

Interest of Conflict

None.

Acknowledgement

All praise is due to Allaah Subhanahu Wa Ta'ala, we praise Him and seek His aid and forgiveness.

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Comparative Analysis of Muscle Energy Technique and Conventional Physiotherapy in Treatment of Sacroiliac Joint Dysfunction

Mullai Dhinkaran¹, Aarti Sareen² Tanu Arora³

¹Assistant professor, College of Physiotherapy, ²Graduate, Bachelor of Physiotherapy, ³Demonstrator, College of Physiotherapy, Christian Medical College & Hospital, Ludhiana

Abstract

Purpose of Study

Lumbar manipulation and conventional physiotherapy, both had reported significant results for low back pain (LBP) due to sacroiliac joint dysfunction (SIJD). In lumbar manipulation, Muscle Energy Techniques (MET) is frequently used for pain relief and increase range of motion. MET is an active technique in which the patient voluntarily contract specific muscle against the resistance of clinician. Unfortunately, no study has examined the effectiveness of MET in comparison to conventional physiotherapy.

Material and Method

This study was to compare the MET and conventional physiotherapy in treating low back pain due to SI joint dysfunction. It was a comparative study in which 30 subjects were recruited from Department of Physiotherapy, Christian Medical College and Hospital, both male and female age between 18-35 years complaining of low back pain (more than 3 months) due to SI joint dysfunction (anterior innominate type) and fulfilling the inclusion and exclusion criteria were taken. Oswestry disability index (ODI) and numeric pain rating scale (NPRS) reading were taken before the treatment. Subjects randomly grouped into 2 groups, Group A (n=15) (MET & corrective exercises were given) Group B (n=15) (TENS & corrective exercises were given). Total 6 treatment sessions were given and then the ODI & NPRS readings were taken at the end to treatment sessions (6th day of treatment).

Result

After data analysis with student's 't' test the mean difference \pm standard deviation for ODI relief (%) for Group A and Group B were 7.49 ± 5.709 and 7.49 ± 3.391 and that for numeric pain rating relief for Group A and Group B were 0.80 ± 0.737 and 0.8 ± 0.507 . The average of Oswestry Disability Index (%) relief decrease for Group A is 27.15% and for Group B it is 19.67 % and the average of numeric pain rating scale relief for Group A is 3.40 and for Group B is 2.60.

Conclusion

The result of the study showed that along with corrective exercises, MET is moderately significant over conventional physiotherapy i.e. TENS with corrective exercises in improving functional ability and decreasing pain.

Key Words

Sacroiliac joint dysfunction (SIJD), Low back pain (LBP), Muscle energy techniques (MET), Transcutaneous electrical nerve stimulator (TENS).

Introduction

Most common source of low back pain is SI dysfunction, a condition presumed to be caused by acquired mechanical instability, with no history of major trauma, which leads to either fixed subluxation or hyper mobility of the joint¹⁻². The cause of sacroiliac joint dysfunction is likely in the correlative movements of the sacroiliac joints (either too much or too little movement in the joint or assumption of an antagonistic position by the innominate bones when they normally should be symmetrical). Extensive analysis and computation in a recent study,

Lavignolle et al concluded "the sacroiliac joints remain quite a mystery and knowledge of their precise mode of function is still incomplete".³ Wilson Eric et al study 10 men and 9 women diagnosed with acute low back pain were randomly assigned with stratification to 1 of 2 treatment groups. Patients were matched according to age, gender and initial Oswestry score. They concluded that MET combined with supervised motor control and resistance exercises may be superior to neuromuscular re-education and resistance training for decreasing disability and improving function in patients with acute low back pain. In this was not discussed about causes of low back pain⁴.

Richard L DonTigny describes the biomechanics and function of the sacroiliac joint, the dysfunction and pathomechanics of sacroiliac joint as a common cause of low back pain. Dysfunction of sacroiliac joint is a common biomechanical lesion, which is frequently brought on insidiously, is related to in quality of leg length, pelvic torsion, and pelvic obliquity, is described as increased pain on sitting, leaning forward, coughing or sneezing and is associated with pain on passive SLR and pain during pregnancy. Correction and prevention of SI joint dysfunction is quiet simple and effective. The treatment for correction and prevention of SI joint dysfunction is corrective exercise program, use of corrective corset support, heel lifts therapy and transcutaneous electrical nerve stimulator (TENS) with corrective exercises⁵.

In lumbar manipulation muscle energy techniques (MET) is one of the commonest treatments of choice for the pain relief and to increase range of motion³. Muscle energy techniques are a class of soft tissue manipulation methods that incorporate precisely directed and controlled, patient initiated, isometric and/or isotonic contractions, designed to improve musculoskeletal function and reduce pain³.

For many years, MET has been advocated to treat muscle imbalances of the lumbopelvic region such as pelvis asymmetry. The theory behind MET suggests that technique is used to correct an asymmetry by targeting a contraction of the hamstring or the hip flexors on the painful side of the low back and moving the innominate in a corrected direction⁶.

There are many researches on the individual treatment options as of the conservative managements are always given preferences in comparison to the non conservative implications or surgical interventions, but their was no comparative study or to check a better treatment option out of two. After the study the effectiveness and the most preferred treatment option would be clear as if TENS with corrective exercises is good option or MET with corrective exercises in pain due to SI joint dysfunction.

Methodology

Subjects 30 were selected according to the inclusion and exclusion criteria, Department of Physiotherapy, Christian Medical College and Hospital, Ludhiana. The study design was Randomized controlled trial with simple random sampling techniques. The independent variables were Muscle energy techniques, Transcutaneous electrical nerve stimulation, Corrective exercise. The dependent variables were Numeric pain rating scale, Oswestry Disability index.

Patients complaining of chronic low back pain (of more than 3 months) were properly assessed for sacroiliac joint dysfunction (of anterior innominate dysfunction type) i.e. whether the pain is lumbopelvic pain in origin. Tests used to diagnose the SIJD were the common tests include determination of posterior superior iliac spine (PSIS) level in a standing or sitting position, the Gillet test (also known as the march or stork test), the standing flexion test, the sitting flexion test (or Piedallu's sign), and the supine-to-sit test^{6,17,21}.

Inclusion criteria were age group 18- 35 years, Both male and female, Chronic low back pain for more than 3 months, Pain on performing pain provocative tests for sacroiliac dysfunction, Oswestry disability index above 20% but below 80%, BMI was 25-29.9 kg/m². The exclusion criteria were participants suffering from specific low back pain like PIVD with instability or any radicular symptoms, lumbar spondylosis, lumbar canal stenosis, spondylolisthesis, sensory deficits, malignancies and tuberculosis Any traumatic conditions around the pelvis and lower limbs, any infectious, tumors conditions around the pelvis, Cardiac pacemakers, thrombosis, recent haemorrhage, Associated neurological symptoms, Patient who do not understand the study/non co-operative, Pregnancy, any lower limb abnormalities, any recently underwent abdominal and low back surgery.

Procedure

30 patients were taken on the basis of inclusion and exclusion criteria from department of physiotherapy, Christian Medical College and Hospital. They were divided into 2 groups, Group A and Group B each consisting of 15 patients. All of them were asked to sign the consent form after explaining the nature, aim and objectives of the research and the complete treatment they will be undergoing.

Before giving the treatment the pain rating according to numeric pain rating scale and Oswestry disability index along with the complete assessment was recorded. Group A were given muscle energy technique with corrective exercises

Group B were given transcutaneous electrical nerve stimulation with corrective exercises. Subjects in Group A were treated with MET for the anterior innominate dysfunction they were having .In the anterior innominate dysfunction ASIS is inferior, PSIS superior whereas in posterior innominate dysfunction ASIS is superior, PSIS inferior.

Patient is in prone and the therapist stands at the side to be treated at the waist level. The affected leg and hip are flexed and brought over the edge of the table. The foot/ ankle area is grasped between the therapist's leg. The treatment site hand stabilize the sacral area while other hand support the flexed knee and guides it into greater flexion, inducing posterior iliac rotation, until the restriction barrier is sensed. By palpating the sacral contact hand or by virtue of a sense of greater effort in guiding the flexed leg, and observation of pelvic movement as the barrier of the resistance is passed. Once, the barrier is engaged the patient is asked to attempt to straighten the leg against unyielding resistance, for 10 seconds using no more than 20% of the available strength. On releasing the effort and on complete relaxation and on exhalation, the leg/innominate is guided through its new barrier. These movements are repeated 3 times until no further gain in the range of motion is possible⁶.

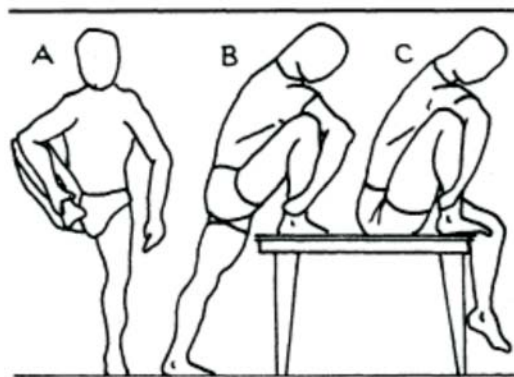
Fig. 1: Anterior innominate rotation correction with Muscle energy technique



Conventional TENS, parameters between 50-100 Hz and 100-200 μ s are considered to be effective in the treatment of chronic low back pain⁷.

Subjects in group B were made to lie prone and TENS was given. Our protocol used stimulation given in continuous trains at high frequency (80 Hz, using square wave 100 μ s pulses). Patient lies in prone lying and two surface electrodes (5cm x 5 cm²) were placed in or adjacent to the painful area at a distance of 5 cm- 20 cm apart. The intensity of TENS was adjusted to produce a tingling sensation⁸. Following the MET and TENS treatment corrective exercises were performed by the patient under the supervision of the therapist and one set of exercises at home which includes⁹.

Patient is asked to flex the hip and bring the knee into the ipsilateral axilla from a supine, sitting or standing position. This is done 2-3 times.



Patient lies supine, grasp the hands around one knee and pull with the hands while pushing with the knee. This must be done 2-3 times on each side, alternating each time with other knee and should be repeated 15 or 20 times a day for about a week.



- Abdominal strengthening exercises with bent knee sit ups. This is done 10 times.
- Isometric abdominal exercises with 5 sec. hold and is done 10 times.
- Following ergonomic advice was given to the patients who should be followed strictly during the whole treatment plan.
- Have a pillow placed between the knee when side lying.
- Have a pillow placed under the lower edge of the buttocks.
- Prone lying should not be done for one week of treatment protocol.
- All leg raising exercises should not be done for one week of treatment protocol because it may precipitate the anterior innominate dysfunction.

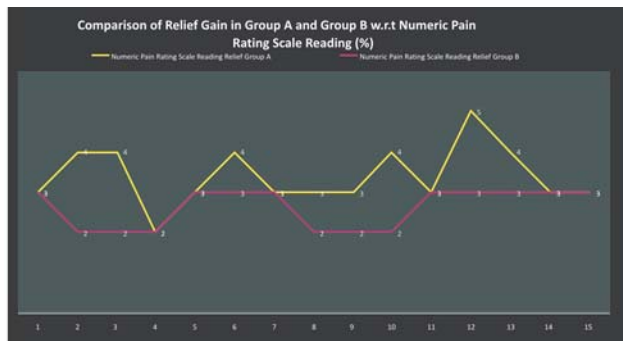
Statistical Analysis

To assess the changes within each group after the complete treatment plan the data noted on the 1st and last day of treatment was used and analysed with the student's "t" test using SPSS version 12.0 software. The level of significance was set at $p < 0.01$ for all comparisons.

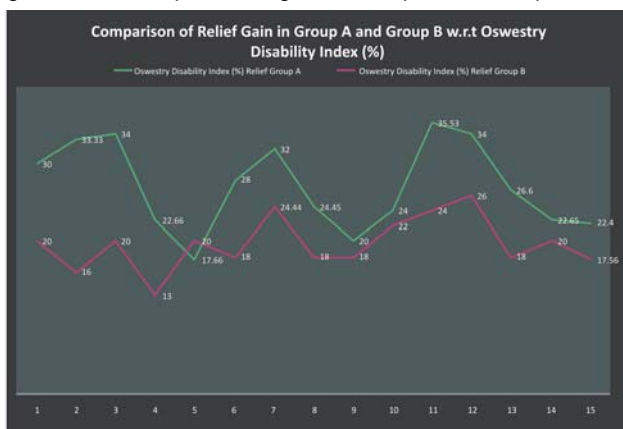
Result

From the study done to compare the effectiveness of muscle energy technique and conventional physiotherapy in treating the sacroiliac dysfunction the results are significant. The average of Oswestry Disability Index (%) relief/ decrease for Group A is 27.15% and for Group B it is 19.67%. The mean difference \pm standard deviation of Oswestry Disability Index relief for Group A and Group B are 7.49 ± 5.709 and 7.49 ± 3.39 , respectively. The average relief in pain according to numeric pain rating scale in Group A was 3.40 and for Group B was 2.60. The mean difference \pm S.D Numeric pain rating for Group A WAS 0.80 ± 0.737 and for Group B was 0.80 ± 0.507 respectively.

Graph 1: Showing comparative differences between pain relief gain in Group A and Group B



Graph 2: Showing comparative differences in functional ability gained between pain relief gain in Group A and Group B



Discussion

Data from the study showed that pain and percentage of the disability significantly improved with muscle energy techniques and corrective exercises on abnormal anterior innominate dysfunction of sacroiliac joint. However, muscle energy techniques on sacroiliac joint dysfunction were found better in terms of reduction of disability as compared to the TENS and corrective exercises.

To date, no studies have examined the effects of TENS and corrective exercises and MET and corrective exercise on sacroiliac dysfunction. MET has been advocated as a safer and commonly used form of manual therapy for the treatment of somatic dysfunction and muscle pain. Most studies have examined its effect in increasing range of motion although limited research exists into the effect of MET on pain and increasing the functional activities.

Noelle M. Selkow, et al 2009; In this 20 subjects with self reported lumbopelvic pain were randomized into two groups (MET and control) after magnitude of pain was determined. MET of the hamstrings and iliopsoas consisted of four 5-second hold/relax periods, while the control group received a sham treatment. Tests for current and worst pain, and pain with provocation were administered at baseline, immediately following intervention and 24 hours after intervention. The visual analog scale reading for pain in MET group decreases whereas in the control group the visual analog scale reading for pain increases⁷. In our study the abnormal anterior dysfunction of SI joint was treated with MET for anterior dysfunction and got significant results in treating the disability as compared to conventional physiotherapy.

Kanchan Rana, et al 2009; concluded that muscle energy techniques is moderately effective than G.D.Maitland concept in treating sacroiliac joint dysfunction. Their result of the study showed that along with active exercises MET is moderately significant over the G.D.Maitland's technique of mobilization in improving functional ability⁹. In our study MET comes out to be more effective in reducing disability as compared to conventional physiotherapy where as both the treatment were significant in treating pain.

Heinzman, K.J., 2006, Concluded the MET could be an effective treatment in acute injuries and athletes, chronic pain, hypertonicity and muscle spasm¹⁰.

Pain relief in both the groups was statistically significant that within the groups. Results after comparison between the groups revealed significant changes in pre and post interventions which indicate Group A is effective in reducing the pain which was measured using numeric pain rating scale and functional activities which was measured by using Oswestry disability index score.

The present study was decrease in pain and disability significant with the MET and corrective exercises. Since, MET is a form of manual therapy which can be mastered by training and practice its application at the community level which would be much benefit where adequate physiotherapy and rehabilitation facility are not available. As this study is done with MET with corrective exercises and TENS with corrective exercise, future studies on effect on other manual therapy technique such as myofascial release, mobilization techniques on sacroiliac joint dysfunction. The effect of the techniques can be analysed on more objective variable such as electromyography changes. The study can be done with large sample size with regular follow up to check the long term effect of MET.

Conclusion

The results of the study showed that both the experimental group are significant in treating low back pain due to sacroiliac dysfunction but muscle energy techniques along with corrective

exercises is moderately significant over conventional physiotherapy like TENS along with corrective exercise.

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Importance of Neural Biomechanics for Under Graduate Students of Physiotherapy – A Descriptive Study

N A Ramasubramania Raja

Assoc.Professor, Gian Sagar College of Physiotherapy, Banur, Distt.Patiala-140601, Punjab

Abstract

Introduction and Purpose of the study

The current trend for physiotherapists in manual therapy is Neural Mobilization, which is applying widely in Radiculopathy patients after neural tension tests with may not having adequate knowledge about Neural-Biomechanics and can leads to treatment less effective. The primary purpose of this study was to describe the importance of neural-biomechanics for under graduate students of physiotherapy.

Materials and Method

A descriptive study was done for Physiotherapists in three month duration. Initially One-hundred-and-fifty-five Physiotherapists were responded for the questionnaire through email from all over India by snow ball sampling. Then thirty-four respondents were excluded (Therapists not consulting / treating radiculopathy patients were excluded) and finally one-hundred-and-twenty-one respondents were selected on the basis of inclusion and exclusion criteria.

Results

After taken the percentages of respondents from the questionnaire, Chi Square test was performed in various focuses to find out the relationship between them. There was a highly significant relationship between the experience of the therapists and the level of knowledge about neural-biomechanics, $\chi^2 = 107.58$ with d.f-3, ($P < 0.001$) and a significant relationship between the reasons for not assessing the neural tension tests and complications of neural tension tests, $\chi^2 = 43.1$ with d.f-1, ($P < 0.001$)

Conclusion

The Neural-Biomechanics was not included in Physiotherapy curriculum of under graduates in all over India. This may be the important reason for less effective of neural mobilization and also the cause for complications of Neural Tension tests in Radiculopathy Patients. All the respondents of this study were given suggestion to give more importance to include as a separate chapter of Neural-Biomechanics in Biomechanics of Under-graduate curriculum.

Key Words

Neural-Biomechanics, Neural Tension Tests, Neural-Mobilization, Under-Graduate Curriculum.

Introduction

When the therapist deals with the radiculopathy patients, he/she may have to assess neural tension tests, and may have to apply neural mobilization for the same is the current trend. We are applying the joint mobilization in various conditions along with the knowledge of structure and function of that mobilizing joint. This may be the important reason for successful in outcome of Joint mobilization.

The Neural Biomechanics is the basic for Neural Tension tests and Neural Mobilization. So if the therapist assessing neural tension tests and applying neural mobilization with the knowledge of neural biomechanics that may more effective in the clinical aspects.

Mark T. Walsh PT, MS, CHT, ATC (2005), the use of upper limb neural tension testing (ULNTT) and neural mobilization by physical and occupational therapists has become common in clinical practice. There is sufficient biomechanical evidence that the peripheral nerve under tension undergoes strain and glides within its interfacing tissue. Evidence supports that ULNTT causes strain within the peripheral nervous system however; it is also evident that ULNTT places strain on other multi-segmental tissues. There is limited evidence reporting favorable outcomes when using neural mobilization to treat specific patient populations, and the appropriate parameters of dosage (i.e., duration, frequency, and amplitude) remain to be confirmed. Clinical application of these techniques must be applied in a practical manner that relies on continual clinical reasoning. The clinician should integrate basic science and experimental evidence as we work to achieve a sufficient level of confidence in the development of evidence-based practice.

Problem of the Study

- Whether the neural biomechanics is included in the under graduate curriculum of physiotherapy or not.
- Whether the therapists are assessing the neural tension tests and applying the neural biomechanics with the knowledge of Neural Biomechanics or not.
- Whether it is important to include a topic of Neural Biomechanics in the under graduate curriculum of Physiotherapy or not.

Statement of the Study

Importance of Neural-Biomechanics for under graduate students of Physiotherapy.

Aims and Objectives

- To find out the importance of Neural-Biomechanics for under graduate students of Physiotherapy.

Significance of the Study

- Improve the clinical skills of therapists to assess the Neural Tension Tests and to apply the neural mobilization.
- To include a separate chapter as a "Neural Bio-Mechanics" in the curriculum of under graduate students of Physiotherapy.

Literature Review

Mark T. Walsh PT, (2005) The clinician should integrate basic science and experimental evidence as we work to achieve a sufficient level of confidence in the development of evidence-based practice.¹⁹

Kathleen I. Devine, (1984) stated the "Physical Therapists must be competent in applying biomechanics to a variety of situations"¹

Rebecca I. Craik, (1984) stated that "Neural Biomechanics can provide sensitive measures of motor performance"²

David S. Butler, (1989) stated that Adverse Neural Tension is excessive nerve tightness or sticking, which can be caused by disc bulge, spine changes, or scar tissue.¹⁵

McLellan DL, Swash M (1976), suggested that, where longitudinal movement of a peripheral nerve is restricted, continual trauma results from normal movements of the limb.¹⁷

Coppieters MW, Stappaerts KH, Everaert DG, Staes FF. (2001) Stated that If the nerve bedding is elongated throughout its whole length, the available ROM is markedly reduced and sensory responses can be elicited throughout the entire arm.¹⁸

Research Methodology

Nature of Study

This was a descriptive Study on an importance of Neural-Biomechanics for under graduate students of Physiotherapy. The primary data were collected from the therapists with help of questionnaires through e-mail. The secondary data were collected through the electronic databases (APTA, Australian Physiotherapy Association, PubMed, search engines, etc.)

Ethical Consent

Consent was taken from all the subjects through the email prior to this study.

Study Approach

Survey Method.

Study Tool

Structured Questionnaire.

Study Location

Gian Sagar College of Physiotherapy, Banur, Distt.Patiala.

Sampling Methodology

Snow ball sampling was used by sending the questionnaire to Three hundred and seventy six Physiotherapists with requested to forward the same to other therapists. Then one hundred and fifty five therapists were responded for that questionnaire through email from all over India and finally one hundred and twenty one respondents were selected on the basis of Inclusion and Exclusion criteria.

Sampling Criteria

Inclusion Criteria

- Physiotherapists who were completed their under graduates from the Indian Universities
- Physiotherapists consulting and treating the Radiculopathy patients
- Both male and female therapists were taken as subjects

Exclusion Criteria

- Physiotherapists who were not treating the Radiculopathy patients were excluded.

Contact Method

Through email: A follow-up to the original mailing was done with a reminder mail, which was sent to those who did not respond by the deadline noted on the questionnaire.

Types of Question

To collect accurate data from the respondent and also to make them convenient, questions have been framed by using different type of questionnaire like multiple choice questions, dichotomous and open ended. The questionnaire was designed to focus on the following points:

1. Experience
2. Institutions from where they have completed their under graduation
3. Consulting, treating and numbers of radiculopathy patients
4. Knowledge and source of knowledge gained about neural biomechanics.
5. Applications and outcome of Neural tension tests and neural mobilization
6. Importance of Neural Biomechanics.

Analysis of the study

By Using Chi Square test

Analysis No.1

To find out the clinical experience of the respondents has any relation on the level of knowledge.

Table value @ p 0.001 Significance and d. o. f of 3 = 16.27, which is lesser than the calculated value 30.605, Therefore, There is significant relationship among the experience of the therapists and level of knowledge about neural biomechanics.

Analysis No.2

To find out the Level of Knowledge about neural biomechanics of the respondents has any relation on how the knowledge gained about neural

Table value @ p 0.001 Significance and d. o. f of 3 = 16.27, which is lesser than the calculated value 107.58, Therefore, There is significant relationship among the level of knowledge about neural biomechanics and how the knowledge gained about neural biomechanics.

Analysis No. 3

To find out the Knowledge from where gained about neural biomechanics of the respondents has any relation on outcome after neural mobilization.

Table value @ 5% Significance and d. o. f of 6 = 12.59, which is greater than the calculated value 6.85. Therefore, there is no significant relationship among the knowledge from where gained about neural biomechanics and outcome after neural biomechanics.

Analysis No. 4

To find out the Level of Knowledge about neural biomechanics of the respondents has any relation on Application of neural mobilization

Table value @ p 0.001 Significance and d. o. f of 2 = 13.82, which is lesser than the calculated value 53.90, Therefore, There is significant relationship among the level of knowledge about neural biomechanics and application of neural biomechanics.

Data Analysis And Interpretation

Experience after under graduation			
S.No	Options	No. of Respondents	%
1	<1 year	10	8.3
2	1-2 years	26	21.6
3	2-5 years	52	42.8
4	>5 Years	33	27.3
Level of Knowledge about Neural Mobilization			
1	Excellent	0	0
2	Good	19	15.7
3	Average	102	84.3
4	None	0	0
Knowledge from where gained about Neural Biomechanics			
1	During under graduate from your teacher	6	5
2	During under graduate by your self reference	12	10
3	By additional short duration course	17	14
4	By CME/Journal after under graduation	86	71
Reasons for not applying neural mobilization			
1	Not necessary for that patient	51	42.1
2	Not having practical knowledge about it	64	52.9
3	Not aware about neural mobilization	6	5
4	Contraindication	0	0
Segment mobilizing in Radial nerve mobilization			
1	Oscillation of segment	62	51.2
2	Head rotation to the opposite side	21	17.4
3	According to irritability	28	23.1
4	Not aware about neural Mobilization	10	8.3
Outcome after neural mobilization			
1	More effective	95	78.5
2	Less effective	17	14.1
3	No effective	0	0
4	Not aware	9	7.4
Complications of neural mobilization			
1	Never get complicated	61	50.4
2	Rarely complicated	51	42.2
3	Mostly complicated	0	0
4	Not applying	9	7.4

Analysis No. 5

To find out the Reason for not assessing neural tension tests has any relation on complications of neural tension tests

Table value @ p 0.001 Significance and d. o. f of 1 = 10.83, which is lesser than the calculated value 43.10, Therefore, there is significant relationship among the reason for not assessing the neural tension tests and complications of neural tension tests.

Analysis No. 6

To find out the Reason for not applying neural mobilization has any relation on complications of neural mobilization

Table value @ p 0.001significance and d. o. f of 4 = 18.47, which is lesser than the calculated value 98.23, Therefore, There is significant relationship among the reason for not applying neural mobilization and complications of neural mobilization.

Analysis No. 7

To find out the segment mobilizing in radial nerve mobilization has any relation on complications of neural mobilization.

Table value @ p 0.001significance and d. o. f of 3 = 16.27, which is lesser than the calculated value 107.77, Therefore, There is significant relationship among the segment mobilizing in radial nerve mobilization and complications of neural mobilization.

Summary and Findings

- The respondents are in different age groups and most of the respondents (49%) are between 26 – 30 years of age. 20% of the respondents are above 30 years and rest 31% are below 25 years.
- The gender of the respondents is approximately equal.
- The respondents are done their under graduation from twelve various universities in India and most of the (53.7%) respondents are completed their under graduation from The TN Dr. M.G.R Medical University, Chennai.
- The most (84.3%) of the therapists are having only average knowledge about the Neural-Biomechanics.
- Approximately 50% of the respondents with more than 5 years experience having good knowledge about neural biomechanics.
- The most (71%) of the therapists are gained the knowledge about neural biomechanics by CME /Conference after the under graduation period and next to that the majority (14%) of the therapists gained by additional course.
- Among 15.7% of the respondents having good knowledge about neural biomechanics, 90% of the respondents are gained by additional course after under graduation, rest 5% by the teacher during under graduation and 5% by CME.
- Among 71% of the respondents having average knowledge about neural biomechanics, 85% of the respondents are gained by CME or conference after under graduation, 11% gained by self reference during their under graduation and 4% gained by the teacher during under graduation.

- 90% of the respondents having with good knowledge about neural biomechanics applying neural mobilization for all the patients.
- 70% of the respondents having with average knowledge about neural biomechanics applying neural mobilization for few patients.
- 100% of the respondents are given the statement that the topic of Neural-Biomechanics was not included in their curriculum of under graduation.
- 100% of the respondents with good knowledge on neural biomechanics are given statement as more effective in outcome of neural mobilization.
- 100% of the respondents those who gained the knowledge about neural biomechanics by additional course, given statement as more effective of neural mobilization in outcome.
- 75% of the respondents those who gained the knowledge of neural biomechanics by CME or conference, given statement as more effective of neural mobilization in outcome.
- 100% of the respondents are given suggestion to give more importance of neural biomechanics for under graduate students as it may improve the skills to assess neural tension tests and to apply neural mobilization.
- 70% of the respondents those who are not assessing the neural tension tests as they are not having sound knowledge about it, getting complications in rarely during tension tests.
- 65% of not having practical knowledge about neural mobilization, getting complications rarely after neural mobilization.
- 50% of the respondents of oscillating the segment while radial nerve mobilization getting complications rarely.
- Rarely complications after radial nerve mobilization by 75% of the respondents of head rotation to mobilize.
- Never get complications after neural mobilization by 92% of the respondents of mobilizing the segment according to the irritability of the nervous tissue.

Limitations of the Study

- √ Sampling size is not equal in all the regions of India.
- √ Interview is done through only by email
- √ Level of Knowledge about neural biomechanics is not assessed by objective in detail.
- √ Only Cervical and Lumbar Radiculopathy patients were considered for analysis
- √ Only important special tests were asked in the questionnaire.
- √ Outcome of the patients after neural mobilization is not analyzed in detail
- √ Complications of neural mobilization are not analyzed in detail.

Conclusion

- √ There is significant relationship among the level of knowledge about neural biomechanics and how the knowledge gained about neural biomechanics.
- √ There is significant relationship among the level of knowledge about neural biomechanics and application of neural mobilization
- √ There is significant relationship among the reason for not applying neural mobilization and complications of neural mobilization.
- √ This study shows that Neural-Biomechanics was not included in Physiotherapy curriculum of under graduates in all over India.

- √ This may be the important reason for less effective of neural mobilization and also the cause for complications of Neural Tension tests and neural mobilization in Radiculopathy Patients.
- √ 100% of the respondents of this study were given suggestion to give more importance to include as a separate chapter of Neural-Biomechanics in Biomechanics of Under-graduate curriculum.

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Comparing the Effectiveness of Lumbar Stabilization Exercises with General Spinal Exercises in Patients with Postero-lateral Disc Herniations

Muhammad Naveed Babur¹, Danyal Ahmed², Farah Rashid³

¹Isra School of Rehabilitation Sciences, Isra University, Islamabad Campus, ²National Hospital, Lahore, ³Shifa College of Medicine, Islamabad, Pakistan

Abstract

Objective

To compare the effectiveness of lumbar stabilization exercises (LSE) with general spinal exercises (GSE) in patients with postero lateral disc herniations.

Methods

The randomized controlled trial was conducted. A sample of 50 patients was taken from February 2010 to April 2010; and they were randomly placed either in control or experimental group, 25 patients in each group. The sample was exclusively taken from the Physiotherapy Department of National Hospital and Medical Center DHA Lahore.

Results

The progress of all the patients was measured on a unified scale describing 5 disability variables, pain intensity, walking, standing, sleeping and social activity according to modified Oswestry Scale. All participants performed their particular therapeutic exercise with their regular sessions of physical therapy for 4 weeks. By summing up the total of 5 variables, a total pre-exercise and post exercise score were obtained. This total disability score of the two groups were analyzed statistically and t-test was applied which shows statistically significant results with $p = 0.000007$.

Conclusion

Hence patients who performed LSE protocols improved significantly better with lower disability scores compared with patients who had GSE protocols.

Key Words

Lumbar stabilization exercises (LSE), General spinal exercises (GSE), chronic lower back pain (CLBP), prolapsed intervertebral disc (PIVD).

Introduction

"Lumbar stabilization exercises" is a modern concept in the management of patients with poster-o-lateral disc herniation. Unfortunately this method of treatment is not routinely in practice in clinical settings. Substantial work in this area is needed to establish significance of this method. Current research has reported that in most cases of low back pain (LBP) due to disc herniations, certain muscles of the back that stabilize the spine are reflexively inhibited after injury. Interestingly patients get back to their normal daily activities without having their muscles completely healed. These specific muscles work together to support and stabilize the spine to help prevent LBP. These muscles include the lumbar multifidi and the transversus abdominus. The lumbar multifidi are the deepest layer of muscles of the back. They attach from the vertebral arches to the spinous

processes. Each multifidi connects 1-3 vertebrae, controlling movement between the vertebrae.

The lumbar "stabilization exercises" is a program of back muscles exercises designed to aware patients how to improve strengthening and enhance flexibility in a pain-free range. It not only improves the patient's physical condition and symptoms but also helps the patient to have efficient movement. It provides the patient with movement awareness, knowledge of safe postures, functional strength and coordination that promotes management of LBP.¹

Patients undergoing conservative management of their herniations are routinely treated by physical therapists. Their regular physical therapy sessions include heat, ultrasound, manual therapy, postural care advice and therapeutic exercises. The conventional therapeutic exercises are either William's flexion or Mackenzi's extension. Combination of both is also recommended by many. To some extent patients are benefited by these exercises protocols and they become pain free very soon. But majority of the back pain patients especially due to herniation have to suffer a lot due to their weak muscles of extensor compartment and peak intensity of pain now and then in the following years.²

The purpose of the study is that the addition of these lumbar stabilization exercises will really benefit these patients and can provide them with permanent relief. Once the core stability muscles are activated the overall spinal proprioception is improved and the patients are more functionally independent, gain additional muscular strength and are free of pain.

Subject and Methods

Randomized controlled single blind trial, only the researcher knows whether participants are in control or experimental group. Participants of the study are of both gender and any age having established diagnosis of postero lateral disc herniations. They are divided in two groups control and experimental. Control group had general spinal exercises and experimental group lumbar stabilization exercises with their regular physical therapy sessions consisting of heat, ultrasound and manual therapy. Participants were assigned their groups randomly.

The study was conducted at Physical Therapy Clinic National Hospital and Medical Center DHA Lahore, It took about two months to collect clinical data and analyze it for conclusion from the participants of the study. For continuous 4 weeks participants were taught and practiced either GSE or LSE with their regular sessions of physical therapy. Through simple random technique 50 patients were selected.

Experimental group received the LSE protocols whereas control group received conventional therapeutic exercises with their regular sessions of physical therapy. The progress of the patients will be measured on modified Oswestry scale.

As this study is based on the subjective evaluation of the patients in their activities of daily life so modified Oswestry scale is the only instrument otherwise no else instruments has been used.

Case record form for each patient having regular physical therapy sessions was maintained. And their progress was noted on this. Choice of the therapeutic exercise was the only difference between two groups.

The modified Oswestry Scale, which was used in the study as an assessment tool.

Modified Oswestry Scale

Pain Intensity

1. I have no pain at the moment
2. The pain is very mild at the moment
3. The pain is moderate at the moment
4. The pain is fairly severe at the moment
5. The pain is very severe at the moment
6. The pain is the worst imaginable at the moment

Walking

1. Pain does not prevent me walking any distance
2. Pain prevents me from walking more than 2 kilometres
3. Pain prevents me from walking more than 1 kilometre
4. Pain prevents me from walking more than 500 metres
5. I can only walk using a stick or crutches
6. I am in bed most of the time

Standing

1. I can stand as long as I want without extra pain
2. I can stand as long as I want but it gives me extra pain
3. Pain prevents me from standing for more than 1 hour
4. Pain prevents me from standing for more than 30 minutes
5. Pain prevents me from standing for more than 10 minutes
6. Pain prevents me from standing at all

Sleeping

1. My sleep is never disturbed by pain
2. My sleep is occasionally disturbed by pain
3. Because of pain I have less than 6 hours sleep
4. Because of pain I have less than 4 hours sleep
5. Because of pain I have less than 2 hours sleep
6. Pain prevents me from sleeping at all

Social Activity

1. My social life is normal and gives me no extra pain
2. My social life is normal but increases the degree of pain
3. Pain has no significant effect on my social life apart from limiting my more energetic interests e.g. sport
4. Pain has restricted my social life and I do not go out as often
5. Pain has restricted my social life to my home
6. I have no social life because of pain

The progress of the patient was measured subjectively on this modified scale pre test and post test. All the participants were asked to fill this form before and after end of the exercise trial.

The lower the total disability score which is the aggregate of all 5 variable the greater is the improvement of the patient in his activities of daily living.

Results

To check the difference between means of the total disability score of the two groups, student t test as it is the most appropriate test for this type of analysis, was applied in SPSS. The confidence interval was set to be at 95% with 48 degree of freedom. The resultant P value came out to be 0.000007 which is less than 0.05 (statistically significant) showing that the difference between means does exist. Table 1 and figure 1 corresponds to the total disability score at the start of the study.

Figure 2 shows post test total disability score in experimental group and, figure 3 is the post test total disability score in control group. Total disability post-test scores were lower in experimental group than control which indicates that LSE group recovered more efficiently and reached functional independency more as compared to general spinal exercises group.

Fig. 1: Total disability score in all participants at start of the trial.

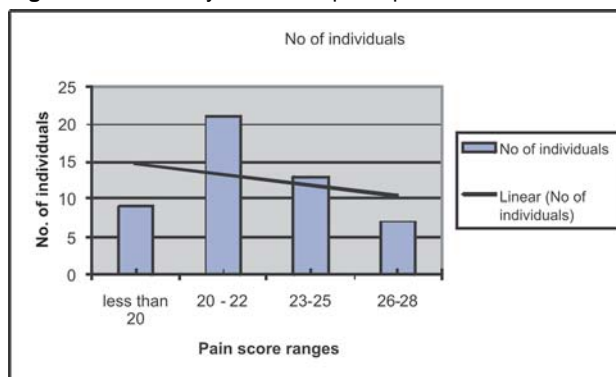


Fig. 2: Total disability score experimental group after trial.

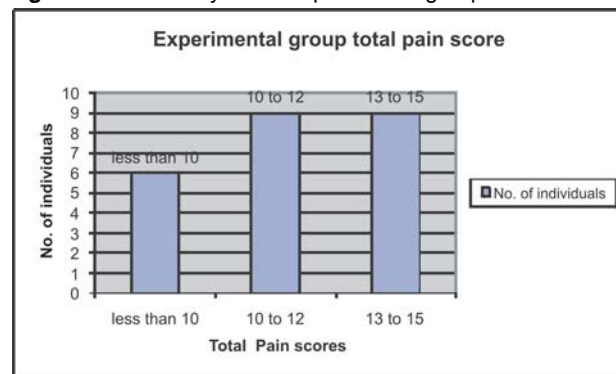
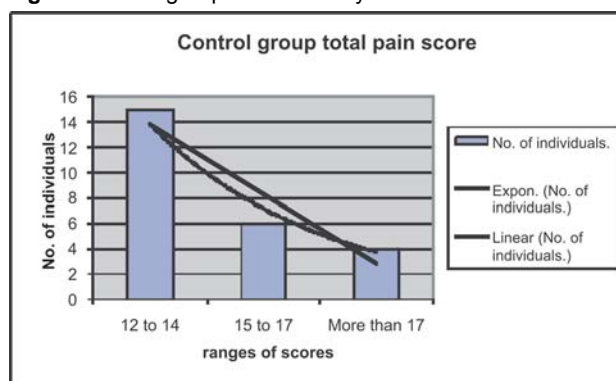


Fig. 3: Control group total disability score after trial.



Discussions

Result of the study depicts effectiveness of lumbar stabilization group over general spinal exercise group. Obviously designing a general plan for all back pain patients is routine in our clinics insufficient to meet the demands of diverse group of back complain patients. Especially lumbar disogenic patients feel really bad pain and disability after having prolapse. These LSE protocols specifically focus on the core stability musculature of the spine so that lumbar spinal muscles are actively engaged in exercise; hence these start building up and are not reflexogenically inhibited. By this mechanism spine is able to control disc contents even with dynamic postures. These results are consistent with the study of Yilmaz F; Yilmaz A; Merdol F;

Parlar D; Sahin F; Kuran B. They showed that the dynamic lumbar stabilization exercises are an efficient and useful technique in the rehabilitation of patients who have undergone microdiscectomy. These relieve pain, improve functional parameters and strengthen trunk and back extensors.⁷ Although the diagnosis in their study was concerned primarily with post operative rehabilitation but the underlying cause is the disc, the muscle work is same and biomechanics to support the disc is also same.

On the other hand GSE are mainly flexibility exercises and study showed that benefits of these are not better, these old fashioned exercise do not have potential to actively engage lumbar spinal muscles so these are able to control spine in different postures. The beauty of these exercises is that these are typically done in various different positions, in prone, supine, kneeling, half kneeling so these train the spinal musculature to adapt itself to various activities of daily life. Much new information was also gathered to show that most of patients were obese and in the 4th decade of life and in Pakistan sedentary life style is mainly responsible for this. Women suddenly gain weight after menopause that is also a contributory factor.

Except when patient is in acute condition, these exercises are perfectly safe, comfortable and easy to learn for all patients. This finding was consistent with all participants in experimental group. Regarding safety and efficacy another study has concluded these primarily benefits by Liebensohn C; Hyman J; Gluck N; Murphy DR.⁵ in their study on spinal stabilization. This study also proved that Spinal stabilization exercises are safe and have demonstrated effectiveness in patient with low back pain including those with nerve root compression. Spinal stabilization is a low technology rehabilitation approach to spinal rehabilitation that has been shown to outperform passive therapy and higher technology rehabilitation conditioning programs.

So it is an established fact that these exercises of lumbar stabilization does not have any contraindications and can readily be included in any therapeutic exercise program.

But many important facts are also disclosed at the end of the study like many patients fell bored when told to exercise. They took these exercises very light nonetheless their progress was satisfactory. This proves therapeutic efficacy and potential of stabilization exercises to activate the core stability effects.

Hydrotherapy is largely being advocated in Pakistan for patient with CLBP due to disc and their effects are very excellent but not every patient has the affordability of a swimming pool but LSE are very easy to do, hence these strongly suggests their cost effectiveness and convenience. In future a clinical trial can be conducted in discogenic patients to compare their post exercise pain disability score in pool and at home utilizing LSE protocols. This will further yield useful facts.

Besides therapeutic efficacy of these exercises it is also very mandatory for all working therapist to be fluent and accurate with their techniques in such patients. The researcher used many techniques described by Freddy M. Kaltenborne and found these having excellent results. Obviously if the mechanical problem

is not be addressed and resolved patient will tend to go in chronicity of back pain. Regarding management of such patients; choice of therapeutic exercise is selected in trial but in future role of modalities and manipulative management can also be clinically established. Progress of patients can vastly differ who will receive different techniques in manual therapy and different modalities in physical therapy. So, new horizons are open for future researchers, to conclude further useful evidence in crippling condition of disc herniation.

Conclusion

The result of the statistical analysis concludes that the lumbar stabilization exercises are of better choice when compared with general spinal exercises in patients with postero lateral disc herniations. The result is statistically significant with t value (0.000007) much less than 0.05. The study also supports the facts that these stabilization exercises are better option, therapeutically safe and easy to perform. The findings of the study suggest that "lumbar stabilization exercises" should be incorporated with treatment plan of patients having posterolateral discogenic pain syndromes.

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Comparison of Efficacy Between Simple and Complex Plyometrics Training on Concentric Hamstring Torque, Angular Velocity and Power using Isoinertial Dynamometer

N P Singh

Reader, Jammu College of Physiotherapy, Jammu

Introduction

One of the primary goal of any rehabilitation program is to return muscular strength to pre injury level. The development of muscular strength is also an essential component of any conditioning program prentice.²

Strength is the ability of muscle to develop peak force or torque during a maximal voluntary contraction under a given set of conditions sale.¹ Strength in relation to sports activity has been discussed and authors have stated that stronger athletes are better performers and have fewer injuries. Studies have indicated that stronger muscles provide better protection of articulation if the line of application of resulted muscular tension is in integrity with the joint.

In sports training and rehabilitation of athletic injuries, the concept of specificity has emerged as an important parameter. Peak power in sports require technical skill and power and is dependent upon the speed at which muscular force can be generated. The form of training that combines speed of movement with strength is plyometrics. Normal physiological movement rarely begins from static starting position but rather is preceded by an eccentric pre stretch that loads the muscle and prepares it for the ensuring concentric contraction. This cycling of eccentric-concentric contraction is known as stretch shorten cycle prentice.² Plyometrics take advantage of elasticity of muscles and the stretch reflex Bosco.³ This stretch reflex mechanism is one by which force is produced during stretch shortening cycle. The mechanoreceptors that are responsible for stretch reflex are muscle spindles and golg tendon organ lundon.⁴ The stretch shortening cycle involves storing potential energy in a stretched muscle. Stretch shortening cycle involves three phases, eccentric phase where stretching of muscle occurs which stimulates muscle spindle that ultimately causes muscle to contract. Amortization phase which refers to time period between eccentric and concentric contraction, longer the Amortization phase greater the loss of stored energy. Concentric phase where stored energy combined with voluntary contraction contribute to provide force necessary for subsequent movement or jump Mathew.⁵ Though the plyometrics training has gained popularity as a method to heighten the excitability of the nervous system for improved reactive ability of neuro muscular system. The complex plyometric training is gaining popularity as a training strategy combining weight training and polymeric training for improving muscular power and athletic performance.⁶ William⁷ Participation in combined program of polymeric and weight training improves strength and power.

Strength ratios of power, torque and angular velocity on quadriceps among players of different sports have been studied earlier. No such report is available for hamstrings torque, angular velocity and power in normal individuals. Therefore this study was undertaken to determine the efficacy of training on hamstrings torque, angular velocity and power between simple and complex polymeric training.

Materials and Method

An experimental study with different subject design was conducted. A group of 20 young healthy active collage going male students were taken for this study, with mean age of (23.4± 2.11), mean height (170.8± 5.61) and mean weight of (66.64 ±

7.23). The selection was done on random basis. The sample was then randomly divided into two equal groups A (simple plyometrics) and group B (complex plyometrics).

Any recent or previous injury to lower limb or subject unable to perform 5 squats on continuity and unable to complete single leg stance for 30 sec or lack of flexibility among muscles of lower limb formed an exclusion criteria in selecting the subject.

A pneumatic resistance based 'HUR' isoinertial dynamometer was used for testing purpose. Prior to testing subjects underwent 5 min warm up and Knee flexion exercise with mild resistance followed by mild hamstrings stretching. Torque, Angular velocity and power for each subject was measured using HUR Dynamometer. Group A (Simple plyometrics) subjects were made to perform box jumps for 4 weeks with intensity of 4 times a week in 3 set of 10 repetitions with 1 min rest interval between the sets.

Group B (Complex plyometrics) was put on training of box jumps having same criteria as for simple plyometrics, but soon after box jumps, the subjects were made to perform resisted hamstring curls with 5 kgs sand bag in 3 sets of 10 repetitions each with 30 sec rest interval between the sets performed to have maximum gain in strength.

After 4 weeks of training protocol the subjects were again tested for hamstrings torque, angular velocity and power using HUR extension/curl dynamometer using same testing protocol as used earlier before 4 weeks training. Related 't' test was used for intragroup comparison for simple and complex training groups and unrelated 't' test was used for intergroup comparison between simple and complex training groups.

Results

Intragroup comparison for group A (simple plyometrics) did not show any statistically significant differences for hamstrings torque, angular velocity and power at pressure 2 bars and 4 bars after simple plyometrics training for 4 weeks with p-value > .05. However there is statically insignificant increase in power of about 37% for right side hamstrings at 2 bars and 13% for right hamstrings at 4 bars. Similarly there is 21% increase in 2 bars and 12.8% in left hamstrings at pressure 4 bars.

Similarly the intragroup comparison for group B (complex plyometrics) did not show any statistically significant differences for hamstrings torque, angular velocity and power at pressure 2 bars and 4 bars after complex plyometric training for 4 weeks with p-value > .05.

However the results show statistically insignificant increase in power of about 50.3% for right hamstrings at 2 bars and 30.8% for right hamstrings at 4 bars. Similarly left hamstrings at 2 bars show increase in power of about 27.6% where as for left hamstrings at 4 bars there is increase of about 22.5%.

While doing the intergroup comparison between simple and complex plyometrics groups no statistically significant results were noted for torque, angular velocity and power for right and left side hamstrings at pressure 2 bars and 4 bars.

Discussion

The results of the study show statistically insignificant increase in power of about 37% for right side hamstring at 2 bars and 13% for right hamstrings at 4 bars. Similarly, there is

Torque (nm)

Side and Pressure	Before Training		After Training		t- value	Remarks
	Mean (nm)	S.D.	Mean(nm)	S.D.		
RT HAMS AT 2 BAR	11.5	4.95	13.61	4.96	.952	NS
RT HAMS AT 4 BAR	27.8	9.15	27.80	5.75	.000	NS
LT HAMS AT 2 BAR	9.60	4.94	9.50	4.60	.047	NS
LT HAMS AT 4 BAR	30.70	5.20	27.90	6.35	1.078	NS

Angular Velocity (d/sec)

Side and Pressure	Before Training		After Training		t- value	Remarks
	Mean(d/sec)	S.D.	Mean(d/sec)	S.D.		
RT HAMS AT 2 BAR	163.9	73.575	186.29	60.75	0.742	NS
RT HAMS AT 4 BAR	162.9	52.407	193.48	39.152	1.477	NS
LT HAMS AT 2 BAR	152.16	71.673	173.36	76.079	0.641	NS
LT HAMS AT 4 BAR	162.57	65.601	181.38	59.970	0.182	NS

Power (w)

Side and Pressure	Before training		After training		t-Value	Remarks	%age increase
	Mean (w)	S.D.	Mean (w)	S.D.			
RT HAMS AT 2 BAR	39.40	24.432	54.02	23.8	.353	NS	37%
RT HAMS AT 4 BAR	97.85	40.47	111.79	37.143	.802	NS	13%
LT HAMS AT 2 BAR	30.81	25.415	37.58	25.87	.590	NS	21%
LT HAMS AT 4 BAR	78.95	32.02	89.13	31.499	.717	NS	12.8%

Torque (nm)

Side and Pressure	Before training		After training		t-value	Remarks
	Mean (nm)	S.D.	Mean (nm)	S.D.		
RT HAMS AT 2 BAR	9.50	3.13	11.20	4.05	1.050	NS
RT HAMS AT 4 BAR	29.50	5.82	29.40	3.50	.093	NS
LT HAMS AT 2 BAR	9.2	4.9	11	4.73	.830	NS
LT HAMS AT 4 BAR	29.40	2.71	28.4	4.06	.647	NS

Angular Velocity (d/sec)

Side and Pressure	Before training		After training		t-value	Remarks
	Mean (d/sec)	S.D.	Mean (d/sec)	S.D.		
RT HAMS AT 2 BAR	160.11	72.6	194.5	51.05	1.225	NS
RT HAMS AT 4 BAR	155.7	58.4	206.2	59.230	1.992	NS
LT HAMS AT 2 BAR	103.91	64.3	138.24	36.109	1.471	NS
LT HAMS AT 4 BAR	146.2	50.05	173.1	40.2	1.324	NS

Power (w)

Side and Pressure	Before Training		After Training		t-value	Remarks	%age increase
	Mean (w)	S.D.	Mean (w)	S.D.			
RT HAMS AT 2 BAR	28.6	26.01	43	27.3	1.207	NS	50.3%
RT HAMS AT 4 BAR	85.9	41.26	112.3	52.103	1.259	NS	30.8%
LT HAMS AT 2 BAR	39.25	60.5	29.41	20.9	0.486	NS	27.6%
LT HAMS AT 4 BAR	76.5	31.3	93.7	30.5	1.247	NS	22.5%

21% increase in power for left hamstrings at pressure 2 bars and 12.8% in left hamstrings at pressure 4 bars which is in accordance with the study of Hewett et al. (1996) who stated that plyometrics jump training has been shown to safely and effectively improve lower limb strength and power in young high school aged women.⁸

However, hamstrings did not show any statistically significant differences before and after simple plyometrics at resistance 2 bars and 4 bars after 4 weeks training which is in disagreement with the study of Lubbers et al. (2003) who found that anaerobic power improved significantly after 4 weeks plyometrics training.⁹

The reason for these insignificant results can be attributed to the fact that the time period for training was less, which is not in accordance with previous studies which have reported improvement in both peak power and vertical jump in all training groups after 8 weeks of plyometrics exercise (William et al. 1996).¹⁰ Leah et al. (2004)¹¹ suggested that performance indicators of Power, Torque and Angular Velocity increased in both training groups after 8 weeks of plyometrics training on land and in aquatic sitting.

The drop height for simple plyometric box jumps used in the present study was 10 inch and is in agreement with the study of Dursenev and Raesky (1979) who stated that the

distance dropped can be as little as a few centimeters or as large as 3 m.¹² But the reason for the insignificant results may be due to the fact that the optimal drop height used in the present study was less as compared to study by Bobbart (1990)¹² that optimal drop height used by athletes is around 0.3 to about 1.0 m. It was found that 0.6 m is likely to be the maximum drop height that would yield a performance optimum (Komi and Bosco, 1978).¹²

In the present study untrained normal active college going students were taken as subjects which is well supported by the study of Tamrakar and Brar (1999)¹³ who studied 30 male school going students and found that plyometric training improves leg power and is more effective than traditional training program.

But the reason for the insignificance of results may be attributed to the fact that the untrained individuals lack the necessary strength required in lower limbs prior to plyometrics training, as stated by Schmidtbleicher (1992) that plyometric training places considerable force on the musculoskeletal system, so athlete should have participated in strength training such as squat lift with atleast 150% of their body weight.¹⁴

In another study Medvedev et al. (1981) indicated that sequenced training program in which an emphasis on strength training precedes power training can produce superior results, particularly in measure of explosiveness.¹⁵

Another important reason which may be considered responsible for insignificant results is longer Amortization Phase in untrained individuals. Schmidtbleicher and Gollhofer (1982) carried out a study and found that during a depth jump of 110 cm, an untrained individual responds with a period of inhibition during eccentric phase after landing. In contrast, the trained individual who responds with a period of facilitation or increased against activation.¹⁶

Fatigue of the hamstrings muscles during plyometric training might also be considered as a possible reason for insignificant results. O. Spendiff, Longford and Winter (2002)¹⁷ found that greater decline in torque during subsequent exercise at high velocities could be due to greater exhaustion of fatigue sensitive Type II fibres.

In a similar study Armstrong et al. (1983) reported that repeated eccentric contraction may cause fatigue which leads to reduction in maximal muscle force and peak power.¹⁸

The results of the present study show statistically insignificant increase in power of about 50.3% for right hamstrings at 2 bar and 30.8% for right hamstrings at 4 bar. Similarly left hamstrings at 2 bar show increase power of about 27.6% where as the left hamstrings at 4 bar then is increase of about 22.5% which is in agreement with William (2002) who found that complex training improves muscular power and athletic performance.¹⁹ Similarly agreed by Jay et al. (1987) who stated that participating in combined 8 weeks program of plyometrics and weight training will improve leg strength and power.⁶

However the result of the present study show that the strength ratios for both legs Hamstrings Torque, Angular Velocity and Power after 4 weeks of complex plyometrics training did not show any statistically significant results.

The reason for insignificant results may be due to the fact that the rest period between sets of hamstrings curls used in the present study was small (30 sec) which is in disagreement with the study of Robinson et al. (1995)²¹ that there was 7% increase in squat performance after 5 weeks of training when 3 min rest period was used as compared to only a 2% increase when 30 sec rest period was used.

According to Pincivero et al. (1997) significantly greater strength gains (5-8%) were seen with 160 sec rest interval as compared to 40 sec interval.²²

Dawson et al. (1997), Fleck (1983), Volek and Kraemer (1996) and Robinson (1995) documented that strength and power performance is dependent on anaerobic metabolism. As majority of phosphogen repletion occur with in 3 mins rest period

and removal of lactate and hamstrings may require at least 4 mins.²⁰

The reasons for insignificant results in the present study may be due to the fact that fixed resistance load for hamstrings curls was used for all the subjects through out the training protocol. This study is in disagreement with the study conducted by Mathew R. et al. (2003) that there is need to increase the training load (progression) to sufficiently overload the neuromuscular system as one becomes more accustomed to training.²³

Similarly agreed by Borst et al. (2001) and Marx J. et al. (2001) that long term progression oriented studies support the contention that higher training volume is need for further improvement.²⁴

The present study was carried out with the aim of studying the comparison of efficacy between simple and complex plyometrics training. The results of the study did not show any significance and are in agreement with study of Kramer et al. (1993)²⁵ that no significant changes were observed post training between standard (weight training plus ergometer training) and standard plus plyometrics training for 24 females rowers after 9 weeks.

Similarly agreed by Ebben et al. (2000) that performing plyometrics in complex training is as effective as performing them in non-complex fashion.²⁶

The results of the present study may be insignificant due to the variations in height, age and weight of the individuals selected for the study. The influence of which has not been taken into consideration in the present study. Intra individual discrepancies from the general trend may be due to varying muscle fibre composition (Tihanyi and Fekete 1982) and (Scharf and Noach 1994).

Present study is limited to the strength characteristics of hamstrings. It was found that hamstrings muscles are tonic muscles containing mainly type I fibres responsible mainly for endurance (P. Kannus et al. 1992).²⁷

Semmler and Enoka (2000)²⁸ found a strong positive correlation between body mass to height ratio and muscles physiological cross-sectional area and muscle force generating capabilities. Similarly agreed by (Abernathy et al. 1994) who found that fibre characteristics and changes in fibre characteristics have been identified as factors which may modulate strength and power performance.²⁹

Conclusion

It was observed that there was no significant difference for Hamstrings Torque, Angular Velocity and Power before and after simple plyometrics training for right and left side at resistance 2 bars and 4 bars. Similarly the values for Torque, Angular Velocity and Power for right and left side hamstrings did not show any significant differences before and after complex plyometrics training at both levels of resistance i.e. 2 bars and 4 bars. The results of the study showed non-significant difference in hamstrings Torque, Angular Velocity and Power between both groups of simple and complex plyometrics training. However, the findings of the study show statistically insignificant increase in power for both right and left side hamstrings in both Group A and Group B after 4 weeks of training.

Clinical Relevance

Though the results of the present study are statistically insignificant, there lies some non-significant increase in power for both legs hamstrings for simple and complex plyometrics groups. But this statistically insignificant increase in power is more in case of complex plyometrics group which signifies the fact that complex training is better than the simple training and thus can be useful in strengthening and rehabilitation of hamstrings after ACL injury and also post hamstrings injury. Heidt

et al. (2000)³⁰ reported that female soccer players whose personal conditioning program included plyometrics training for hamstrings had a 2.4% ACL injury rate where as who had not been trained with plyometrics had 3.1% ACL injury rate. It was found that female athletes who did not participate in jump training program had an ACL injury rate 3-6 times greater than for trained female athletes (Hewett, 1996).³¹

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Translation and Adaptation of Shoulder Pain and Disability Index (SPADI) into Hindi-Part 1

Neha Sharma¹, Shallu Sharma², Chitra Kataria³

¹MPT, Musculoskeletal, ISIC Institute of Health and Rehabilitation Sciences, New Delhi, ²Research guide, Lecturer, ISIC Institute of Health and Rehabilitation Sciences, New Delhi, ³Research guide, Principal, ISIC Institute of Health and Rehabilitation Sciences, New Delhi

Abstract

Objective

To translate and adapt the original English version of Shoulder Pain and Disability Index (SPADI) into Hindi.

Methods

The procedure followed for the translation of SPADI into Hindi was in accordance with the

Guidelines laid by American Academy of Orthopaedic Surgeons (AAOS) Outcomes Committee. The

SPADI was successfully translated from source language into Hindi. Minimal discrepancies were found

during the process with respect to the concept and construct which were taken care with successive forward

and backward translations. The translation produced using the AAOS model was pretested on selected subjects

in order to achieve a promising Hindi version of SPADI.

Results

The translation undertaken using the six step process revealed no major difficulties in the construct

and concept transference. Necessary efforts were made to achieve semantic, conceptual and experimental

Equivalence between the source and target language versions. Following mutual consensus and repeated

pretesting, the finalized Version (SPADI-Hindi) was prepared.

Conclusion

SPADI-Hindi is a well translated and adapted instrument for use in patients with musculoskeletal shoulder pathologies.

Key Words

Translation, Adaptation, SPADI-Hindi, Self reported Shoulder Pain Questionnaire.

Introduction

The Shoulder pain is a common entity amongst various musculoskeletal disorders reported.^{1,2} It is a frequent complaint by old age people, drivers, manual material handlers, farmers, athletes and significant others who are involved in repetitive tasks involving shoulder joint.³⁻⁸ The documented rate of affliction with Subacromial Impingement Syndrome for competitive

swimmers in India is as high as 35%.⁹ According to a study by Dhillon et al, the Shoulder is the second most common joint affected in golf after low back pain with an incidence of 22.7%.¹⁰

In the assessment of Shoulder pathologies, objective measures for muscle strength and range of motion depend on therapist skills/ practice and competence (MMT, Goniometry). In the light of recent trends, the focus is gradually tilting towards the use of patient rated outcome measures which in turn provide a holistic perspective of the patient's discomfort. These patient centered questionnaires are more decisive for both the diagnosis and subsequent therapeutic management and are effective tools to adjudicate the treatment outcome.¹¹⁻¹⁴

Among the various patient reported outcomes available for Shoulder; the Shoulder Pain and Disability Index (SPADI)¹⁵ and the Disabilities of Arm, Shoulder and Hand (DASH)¹⁶ are most extensively used for upper extremity disorders, of which, SPADI is specific to the shoulder joint. The SPADI in English is a valid, reliable, responsive and feasible to implement outcome tool in clinical practice.¹⁷⁻²² It consists of 13 items which are subdivided into pain and disability domains. The Pain dimension comprises of five items which measure the intensity of pain in varied situations. The disability subscale consists of eight shoulder specific activities. Disability associated with functional tasks is assessed from the degree of difficulty an individual faces in these activities. To answer the questions, the patient is required to place a mark on a 10 cm line (visual analog scale) next to each question. The line is divided into 12 equal length segments and the item score is the response marked by the patient divided by 11. The percentage scores for both the dimensions are averaged to derive the total score.¹⁵

The SPADI English (Source Language Questionnaire/SLQ) has been validated in various musculoskeletal pathologies affecting shoulder complex including Subacromial Impingement Syndrome (SIS), Adhesive capsulitis, Acromioclavicular joint arthritis, Glenohumeral Dislocations/Subluxations, Fractures, Post operative cases like Arthroplasties etc.¹⁷⁻²² It has been successfully translated into German, Turkish and Slovene languages.²³⁻²⁵

With the view of expanding the use of self reported outcome measures for shoulder in India, the present study aims at translating and adapting the Shoulder Pain and Disability Index (SPADI) into Hindi language.

Methodology

In order to produce a sensitive Hindi version, all the necessary prerequisites (Permission, Identification of guidelines, Selection of translators, Formulation of bylines etc.) were fulfilled.²⁶ The target language for translation was operationally defined as standard Hindi which is the official language as per the constitution of India.²⁷⁻²⁹ The developers were actively involved for concept clarifications during the process. For the study, the original VAS version of SPADI was used as it provided with an interval/ratio data^{30, 31}. The translation was carried in accordance with the guidelines by the American Academy of Orthopaedic Surgeons³². The procedure recommends a staged process with written report at every step.

Address for correspondence:

Neha Sharma

MPT, Musculoskeletal, ISIC Institute of Health and Rehabilitation Sciences, New Delhi

E: mail. neha11ns@gmail.com

Step One: Forward translation

In this step, the English version of the SPADI (SLQ) was translated into standard Hindi (target language) by four bilingual translators who had Hindi as their mother tongue and were proficient in spoken and written English along with Hindi. The translator one (T1) was from medical background. An Orthopaedic Surgeon (T1), thus helped in obtaining a more likely concept equivalent of SPADI in clinical settings. The other three translators (T2, T3 and T4) were qualified professional translators from various government institutions (Naive translators) who provided with layman Hindi language translations with multiple options for various words in the questionnaire. All the translators were given instructions to produce a concept equivalent of the SLQ with no particular emphasis on literal meanings.

Step Two: Synthesis of translation

A reconciliation process was undertaken in presence of two physiotherapists (Methodologists) and a peer counselor. Working from the translations produced by T1, T2, T3 and T4, a consensus on to a single Hindi version was achieved through final discussion.

Step Three: Back translation

The single Hindi version of SPADI thus prepared, was translated back to English (Source Language) by two independent Back translators, B1 and B2. These translators were blind to the original source language version of SPADI and were not aware of the concept being explored. According to the guidelines, the back translators should have source language (English) as their mother tongue and also be aware of the target language i.e. Hindi. For the study this condition could not be fulfilled, therefore with permission from the developer, professional Hindi speaking Indian translators with MA/PHD qualifications in English were selected to translate SPADI back into English. The process of Synthesis - Back Translation - Synthesis was repeated multiple times with the help of forward and back translators to achieve a Synthesized Hindi version of SPADI which most closely reflected the construct and concept of SPADI (SLQ).

For the study, the process was repeated thrice until the translated document was mutually agreed to be equivalent and unambiguous.

Step Four: Expert committee review

The expert panel in the process of translation of SPADI comprised of all the Forward translators (T1, T2, T3, and T4), Back translators (B1 and B2), a Peer counselor, an Orthopaedic surgeon, the Methodologists and a Hindi language professional. All the members of the expert committee were given a booklet which outlined their role on establishing equivalence between the source and the synthesized version. The booklet enclosed a preface, the Source language SPADI and the Synthesized Hindi version of SPADI. Forward and backward translations were made available to them on respective demand. The booklet included a table which had all the 13 items from the synthesized Hindi version of SPADI on the extreme left which had to be rated by the expert panel on six questions as described below. The members were asked to place a tick (✓) if the items on the left agree to the questions above or else, a cross (×).

1. Do you think the words in synthesized Hindi version have the same meaning as Source language version?
2. Are there any words with multiple meanings?
3. Are there any grammatical errors?
4. Any idioms/ colloquial noticed?

5. Do you think it measures the same concept as source language version?
6. Do you think the items capture the experiences of daily life in the target language culture?

The panel members were asked to write the additional comments with respect to each item in a separate column of suggestions provided for every item. Considering all the recommendations suggested by the expert committee, a final consensus was achieved from all the members on every questionable item, which resulted in formulation of the Pre-final version.

Step Five: Testing of the Pre final version.

The Pre-final version of SPADI prepared by the expert committee was now used for field testing. The Pre-final version, along with source language questionnaire was provided to 20 bilingual subjects (10 symptomatic shoulder pain patients and 10 asymptomatic subjects). Each individual was asked to rate the 13 items with respect to six questions given in the Table-1. Suggestions for improvement were stated by writing the item number and the relevant suggestions in the subsequent column.

Adjusting the suggestions put forward by the pretesting group, the finalized version, SPADI-Hindi was prepared which was accepted by all the expert committee members.

Table 1: Testing of the Pre final version.

a) Do you think SPADI-Hindi is relevant to your shoulder condition?	Yes	No	Suggestions
b) Are you able to understand the instructions and marking scheme for SPADI- Hindi?	Yes	No	Suggestions:
c) Are you able to clearly understand and comprehend the words of SPADI-Hindi?	Yes	No	Suggestions:
d) Is the layout and font size of SPADI-Hindi appropriate?	Yes	No	Suggestions:
e) Do you think both the questionnaires are measuring the same concept equally?	Yes	No	Suggestions:

Step Six: Submission of reports of the finalized version (SPADI-Hindi) to the Developer for their approval.

The Finalized version (SPADI-Hindi) prepared, was put up for appraisal to the developer of SPADI (Ms. Kathryn Roach, Associate Professor, Assistant Chair – Research, University of Miami, Coral Gables, FL) along with the written reports.

Results

The SPADI-Hindi was acknowledged and accepted by the

developer of SPADI. The SPADI-Hindi produced to the Hindi speaking population suffering with Shoulder pain provided a good evidence for its face validity.

The initial step of forward translations highlighted the options which were culturally relevant to the Indian context.³²⁻³⁴ In the Synthesized Hindi version of SPADI, Indian dressing attire like, “*Baniyaan*”, “*Kurta*”, “*Salwar*” and “*Pajamas*” were included in the item three, four and five of the disability subscale. “*Ten pounds*” of weight was replaced by “*Four Kilograms*” in the item seven of the disability subscale in accordance with SI units. In step one, the translators found it difficult to interpret and translate the “*Worst pain imaginable*” phrase in the response option. From the various options available, “*Asehniye dard*” was accepted as the nearest concept and language equivalent of the same. The Step 2 highlighted the word “*Manak*” for scale in the Synthesized Hindi version of SPADI which was replaced by “*Mapak*”. Step 4 of the translation revealed certain grammatical errors, which were corrected simultaneously.

During the testing of the Pre-final version, all the subjects agreed that the Hindi questionnaire was relevant to their condition of shoulder. 50% of the subjects reported difficulty in reading and understanding certain literally translated words in the instructions of Pre-final version (“*Pratyek*”, “*Bilkul*”, “*Nimnikhiit*”, “*Darshay*”) which were hence exempted from the instructions while producing a conceptually equivalent translation in step 5. 95% of the subjects agreed that both the questionnaires equally measure the same concept. 40% of subjects reported inability to interpret and understand the marking scheme which was in line with the SLQ. They reported two issues. One was of language and the second was the dimensions along the line to mark the scores. The first problem was overcome by simplifying the language and replacing the word “*Mark*” by “*Point*”. For the second issue, the confounding dotted lines and the score space as on the SLQ were erased. It was seen that by providing prior instructions of considering the line as the available range and placing a point on it, tremendously increased the clarity to respond. The patients were now able to rate on the line between no pain and intolerable pain with 100% clarity and no reported difficulty.

Keeping in mind the suggestions given by the pretesting group, the font of the pre-finalized version was changed for better visibility and legibility of the words.

With the stated amendments, a Finalized version (SPADI-Hindi) was prepared, which the patients were able to complete in an average time of five minutes. Considering the issue of calculating scores on VAS, the scoring of SPADI was discussed with the developer. With the developer’s consent, the scoring of SPADI-Hindi was simplified by dividing the item responses by 10 instead of 11, with division of line into 11 segments instead of 12. This eased the calculations using a standard ruler.

Discussion

The Shoulder pain has been identified as a universal condition causing discomfort and physical disability resulting in extensive use of health care resources.^{35, 36} Many validated outcome measures exist for evaluating the level of pain and functional disability in patients with Shoulder pathologies.^{15, 16, 37-40} The Shoulder pain and disability index (SPADI) is one such self reported, joint specific measurement tool which has been proven to be valid and highly responsive in various musculoskeletal pathologies affecting Shoulder complex.^{17, 19-22}

It was interesting that many self reported tools for Shoulder including SPADI, were developed in English language, which limits their clinical use in non English speaking countries like India. The present study described the translation and adaptation of SPADI for its use in Hindi speaking population of India.

Hindi is one of the 22 official languages, most widely spoken in India, accounting for 41% of native speakers. Apart from India, it is spoken in 16 other countries mostly in the region of South

Asia. It has around thirteen dialectal forms including Khariboli, Kanauji, Bundeli, Bagheli, Chattisgarhi etc. but the study placed special emphasis on translating SPADI into standard Hindi in Devnagiri script which is considered official by the constitution of India since 1958. According to the Indian census (2001), 422,048,642 people in India regarded Standard Hindi as their mother tongue and is spoken in all the Northern states of India.²⁷²⁹

There are numerous sets of guidelines available for translation, but the framework remains same with major emphasis on gaining the equivalence between the source and target language version.^{26,41,42} The procedure and guidelines as stated by the AAOS committee were chosen for the current study in an effort to achieve highest degree of agreement with the source language version..

During the reconciliation of the forward translations in step 2, certain words were supplemented to remove the gender bias in dressing and to meet the cultural needs of Indian people. This Decentring process helped in solving the Semantic and conceptual issues when translating questionnaires.^{43,44} Four kilograms or more weight which was the appropriate metric equivalent to 10 pounds was added to equate the item to the same degree of construct between the source and target language. In order to achieve a closest translation of SLQ, back translations of the synthesized version were performed in source language (English) to highlight the discrepancies in the forward translations. The procedure further ensured conceptual equivalence of the translation and underlined the wrong words or mistranslations which were overlooked in the previous steps.

Since SPADI is a fixed response questionnaire, this translation using the sequential steps of forward and back translations ensured maximum equivalence with SLQ which we believe will help in achieving high internal consistency of the translated version.

The use of equally qualified multiple professional translators helped in negating the individual bias of writing style, preference of words, and competence. The importance of literal, cultural and conceptual adaptation has been emphasized and addressed during the whole process to avoid word to word translation.

The cross cultural adaptation of SPADI could not be established since the content and layout of items as seen by the methodologists were less cultural specific and more concepts specific. Even though cultural difference between source language and Hindi do exists, repetition of steps 3, 4, 5 and 6 helped in attaining a homogenous and cohesive version of SPADI-Hindi. Moreover cross cultural adaptability can best be ensured when simultaneous translation process is followed for questionnaire development and translation.

The study provides us with the translated and adapted Hindi version of SPADI (SPADI-Hindi) which has good face validity. It is highly recommended that before its application in the clinical setting, its psychometric properties be explored.

Conclusion

The six step process adopted produced an effective translated and adapted Hindi language translation (SPADI-Hindi) of the Shoulder Pain and Disability Questionnaire through a collaborative team approach.

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Comparision of Musculoskeletal Symptoms Among Adult Female Caregivers of Physically Challenged Children and Normal Children

Parul Raj¹, Amitesh Narayan², Sailakshmi Ganesan³

¹Lecturer, Dept. of Physiotherapy, Manipal College of Allied Health Sciences, Manipal, India, ^{2,3}Associate Professor, Dept. of Physiotherapy, Kasturba Medical College, Mangalore

Abstract

Purpose

To compare the musculoskeletal symptoms in adult female primary caregivers of physically challenged children with that of normal children.

Methods

30 caregivers (18-40Yrs) of physically challenged children (1-5 Yrs) and 30 caregivers of normal children of same age group were selected through convenient sampling method. Nordic Questionnaire was administered to each group. Data analysis done using Mann-Whitney U test and Student unpaired t-test to compare the mean difference between the groups.

Results

Caregivers of physically challenged children developed musculoskeletal symptoms (93%) compared to that of normal children (60%)($p=0.002$). Among all musculoskeletal symptoms, Low Back trouble (a/c Nordic questionnaire) was most

Common (76.7%) in caregivers of challenged children ($P=0.008$), the next commonly involved part was shoulder (36.7%).

Conclusion

Our study concluded that female caregivers of physically challenged children had higher rate of musculoskeletal symptoms as compared to normal. Therefore it is suggested that caregivers must adapt measures to prevent musculoskeletal symptoms.

Introduction

Commonly all children enjoy healthy life with little or no special needs, but some children have difficulty in early life as well as later on due to developmental disorders requiring special attention/assistance by parents/caregivers for all their functional activities and self care.¹ These activities cause additional physical stress on the parents/caregivers leading to development of various musculoskeletal symptoms (due to increasing needs of a challenged child with growing age).

It is not known why some caregivers who are involved with the care of a physically challenged child cope well while others do not. It is also known that psychological and physical health of caregiver is strongly influenced by a physically challenged

child's behavior and demands of care.¹ Greater knowledge of caregiver's health related needs would allow for the improvement of existing services and the development of new strategies to sustain caregivers in their vital role.² It has been found that an educated mother or caregiver commonly follow better ergonomic techniques related with child care and so have less work related injury.³ It was also observed that knowledge of ergonomics in child care reduces the chances of musculoskeletal pain. Suggestions were also made for the need for childcare task analysis and identification of effective methods to reduce the risk of musculoskeletal pain.⁴

There are significant literature dedicated to studying the burden placed on caregivers of both elderly persons and children with disabilities. However, most of these studies have focused on the psychological aspects of caregiver burden such as stress, depression, and social isolation.⁵ Also it is noted that many parents are not able to cope well and their mental and physical health is at risk.⁶ Females are commonly involved with caregiving needs of special children and so they are subject to psychological and physical stress.^{1, 7} Therefore the need to analyze musculoskeletal symptoms among them become important.

Nordic questionnaire serves as an instrument in screening of musculoskeletal disorders in an ergonomic context in occupational setting so it may help us in screening the musculoskeletal symptoms in these caregivers who requires repeated lifting or carrying the child.

Literature suggests that about 10% of children experience developmental disorders requiring access to the health care system and extensive caregiving, often throughout childhood and into adult years.⁸ Caregiving demands of such children contribute directly to both psychological and physical health of the caregivers.¹

Sanders et al found that 66% parents/caregivers of normal children (<4 years of age) had high prevalence of musculoskeletal symptoms. They also noted incidence of low back symptoms (48%), neck (17%), upper back (16%) and shoulder (11.5%) among these caregivers.⁹

Factors associated with musculoskeletal pain while performing child-care tasks was defined as having high biomechanical risks.⁹

Studies indicate that females (94.4%) are more involved in care-giving needs of disabled child compared to male.^(1, 7)

Another study reported high prevalence of low back pain (80.3%) among caregivers who were involved with physically challenged child's care while the same was 40.5% among the caregivers of normal children.¹⁰

Shigeki et al noted the one-month prevalence of Low back Pain (LBP) among staffs in schools for physically and mentally handicapped children, which was approximately 45%. Thereby confirming the need to treat and manage LBP.¹¹

King et al (2005) reported musculoskeletal symptoms among childcare workers and hence, stressed the need for ergonomic interventions.⁴

Children in age group 1-5 years require increased amount of lifting and caregiving activities. But children with physical challenges are relatively more dependent on their parents for these activities. The available literature has mainly focused on psychological components of these caregiving activities while little or no retrieval data could be obtained which suggest the physical well being of the caregivers. Thus the need for such studies is essential.

Address for correspondence:

Mrs.Parul Raj

Lecturer

Department of Physiotherapy, MCOAHS, Manipal-576104 (India)

E-mail: parulmahe@gmail.com

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The purpose of this study is to compare the musculoskeletal symptoms in adult female primary caregivers of physically challenged children with that of normal children and we hypothesize that there will be no differences between the musculoskeletal symptoms in female caregivers of physically challenged children and normal children.

The findings from this study will help to identify the presence of musculoskeletal symptoms among caregivers and so will indicate the need for prevention and intervention among such population.

Methods

It is a cross-sectional study.

Standardized Nordic Questionnaire

This is used to screen musculoskeletal disorders in an ergonomic context and for occupational health care services. It can be used as self-administered questionnaire or through interviews.

It has acceptable reliability and validity with kappa value of 0.88 to 1.

In some studies the questionnaire has revealed a high prevalence of symptoms and disorders in certain anatomical regions, which clearly correlate to the local physical demands.¹²

A cross-sectional study was conducted from August 2005 to December 2007.

Subjects

30 caregivers for physically challenged children (Group 1) and 30 caregivers for normal children (Group 2) were selected through convenient sampling. Group 1 was selected from Neuro-Sensory development unit and Child Developmental Centre. For normal children, Schools and Anganwadi (Anganwadi is a government sponsored child-care and mother-care center in India. It caters to children in the 0-6 age group. The word means "courtyard shelter" in Hindi) were selected.

Inclusion Criteria

Adult female primary caregiver, age of Caregiver 18-40 Yrs, Caring for physically challenged / normal child in age group (1-5 Yrs), Caregiver involved with only one/two child and Caregiver involved in caring for minimum of 1 year.

Exclusion Criteria

Male caregivers, Caregivers having history of any surgery related to musculoskeletal system, Primary caregivers diagnosed with musculoskeletal symptoms, Caregivers giving history of musculoskeletal /neurological symptoms before pregnancy.

Instruments

Screening form, which included the demographic data of caregivers & child and some questions, based on inclusion and exclusion criteria.

Standardized Nordic Questionnaire

It consists of general questionnaire, and a specific ones focusing on the low back, neck and shoulder trouble. This questionnaire serves as an instrument in the screening of musculoskeletal disorders in an ergonomic context and for occupational health services.

Weighing Machine - to measure weight of child and caregiver

Measuring Tape- to measure height of child and caregiver

Procedure

The parents/caregivers of challenged children visiting the Neuro Sensory Developmental Unit were communicated in person about the purpose and utility of this study. Thereafter, parents who had agreed for their participation were selected, and after obtaining their signature on consent form they were included in this study for further data collection.

Similarly parents or caregivers of children visiting Child Developmental Center were recruited and their data were collected accordingly.

Demographic data of children, parents/caregivers was collected. Thereafter, based on inclusion or exclusion criteria the normal and challenged children were screened through demographic data collection.

Each group was introduced to Nordic Questionnaire and was filled by investigator.

Data Analysis

Statistical analysis was done using SPSS (version 15) software.

Chi-square and Fisher exact test was done to find out the association between the groups.

Mann Whitney U test and Student unpaired t-test was used to compare the mean difference among groups.

Result Analysis

The major findings of this study was that caregivers of physically challenged children developed more musculoskeletal symptoms (93%) compared to that of normal children (60%) with highly significant p value=0.002 (Table 1)

Other important finding was that among all the musculoskeletal symptoms Low Back trouble was most common (76.7%) compared to any other areas of musculoskeletal trouble in caregivers of disabled children, which was statistically highly significant with P value =0.008 (figure 2)

The next commonly involved part was shoulder (36.7%). The data analysis indicated that other than Low back and shoulder symptoms, no other musculoskeletal symptoms were statistically significant.

The data was further analyzed based on child's anthropometric measures (mainly height & weight) and found that in the age group of 1-5 years the anthropometric dimension of the children was not significant in causing development of musculoskeletal symptoms among parents/caregivers (p=0.936 for height & p=0.895 for weight).

The comparative analysis between mothers and paid caregivers was not possible as, among all the caregivers of physically challenged and normal children, only one caregiver was paid caregiver.

In the group 1 the largest number of children was spastic diplegics (33.4%) among which 8 out of 10 caregivers had symptoms of Low back trouble (26.7%).

The other diagnosis in disabled children category were Delayed milestone (DMS), Down syndrome, Hypotonic, Knock knee, Spastic Paraparesis, Spastic quadriplegic and in each category maximum number of sample were varied between 1-7, thus statically it was not possible to compare.

With regards to number of hours of work involved with physically challenged and normal children, musculoskeletal symptoms were insignificant (p= 0.297).

The musculoskeletal symptoms in other areas like neck (p=0.038), elbow (p=0.163), wrist (p=0.117), hip (p=0.05), Knee (p=0.481) and ankle (p=0.492) were statistically non significant whereas, low back (p=0.008) and shoulder (p=0.001) trouble showed significant values.

None of caregivers had associated risk factors like history of accident due to caregiving needs of normal/physically challenged children.

Discussion

The primary aim of this study was to compare the prevalence of musculoskeletal symptoms in adult female primary caregivers of physically challenged children with that of normal children.

This study indicated that caregiver of physically challenged children have high risk of musculoskeletal symptoms (97%) compared to the caregivers of normal children (60%). $P=0.002$

Among the identified musculoskeletal symptoms in caregivers of physically challenged children, low back trouble was found to be most common and its percentage was 76.7%, while the same was 43.3 % in caregivers of normal children. The reason could be that caregiving activities for the caregiver required use of spine to bend and use of shoulder to hold the children and so the symptoms in these areas.

Normal children after the age of 1 year are mobile and require relatively less amount of lifting or carrying compared to physically challenged children, hence low evidence of musculoskeletal symptoms are noted in caregivers of normal children.

This indicates that the caregiving nature and demands related with physically challenged children are main reason for high percentage of low back trouble among caregivers of physically challenged children.

The other findings that have been derived from this study was that shoulder is the next commonly involved area among caregivers of disabled children and its prevalence rate was 36.7% but in normal children it was 3.3%.

The prevalence rate of 71% of low back pain was seen among the female caregivers of physically challenged children on the basis of literature¹⁴. Thus our findings are in synchrony with the previous study. The probable reason for this to happen can be linked with nature of caregiving required (like sitting for long time, lifting, feeding while baby is sitting on mothers lap, bathing, dressing, toileting and carrying out in arms). All these activities have negative impact on the spine and so higher chances of back pain. In our country most of the caregiving activities are at floor level, which requires lot of bending as compared with western countries where most of the equipments are ergonomically designed for caregiving of baby's needs and so is beneficial in preventing musculoskeletal symptoms among them.

Regarding involvement of shoulder in our study groups, the reason can be linked with the cultural habits of carrying children in their arms while going out unlike in western culture where they carry in pram. Thus our caregivers constantly stress not only their spine but also their shoulder and arm muscle, which could have caused increased number of shoulder trouble (36.7%).

Since we selected female caregivers having children in age group of 1-5 yrs, we found that anthropometric measures of child didn't contribute in causing musculoskeletal symptoms among caregivers. The possible reason for this could be actual caregiving activities (like lifting or carrying child) with physically challenged children needs, not the weight and height of the child. In this study we found the positive musculoskeletal symptoms in shoulder of caregiver of physically challenged children caregiver while no such symptoms were found in caregivers of normal children, similarly increased percentage of low back trouble was noted among caregivers of physically challenged children.

Since in this study physically challenged children were from various category of diagnosis, thus the study couldn't derive if any specific diagnosis can contribute towards development of musculoskeletal symptoms.

In spite of having musculoskeletal symptoms like Low back and shoulder trouble among caregivers of physically challenged children, it was found that statistically insignificant number of parents or caregivers had felt the need to consult a physician for their musculoskeletal symptoms ($p=0.845$ for Low back) and so none of them were hospitalized indicating that the health status of all these caregivers were very good and most of the caregivers were in young age of their life so their musculoskeletal system was significantly strong to take care of their child's caregiving needs, while no symptoms of such nature were found in control group caregivers.

No parents or caregivers felt the need to change their jobs because of special needs of challenged children. Similar thing was found with normal children's caregivers, indicating that parents or caregivers of age group 1-5 years could manage the needs of the children or special children without affecting their jobs or leisure activities.

When the data was analyzed among the parents or caregivers with more than one child, it was found that siblings doesn't cause additional work burden on their parents or caregivers and so none of them developed any kind of musculoskeletal symptoms because of multiple siblings.

So this study suggests that, parents/caregivers of physically challenged children can be recommended for preventive exercises for spine & arms so that development of musculoskeletal symptoms can be minimized maximally. The same can be identified through future study using exercise regimen for caregivers of physically challenged children.

Limitations of the Study

Mental state and social status of caregivers was not considered, Only diagnostic aspect of a developmental disorder was considered (i.e. type of diagnosed disorder) but not the quality aspect of disorder which could have been done using GMFCS scale (level 1 to level 5), Educational level of caregivers in both challenged and normal children was not uniform, and the motor development in relation with caregiving nature was not considered in this study.

Future Research

Future research recommended are-

Comparing the effects of therapeutic exercises and placebo treatment, for the caregivers of physically challenged children.

By quantifying the quality of disability by using GMFCS scale and then analyzing the state of musculoskeletal symptoms among caregivers of normal and disabled children.

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A Comparative Study of Left and Right Hand Grip Strength in Different Positions of Shoulder and Elbow

Prashant B Mukkannavar¹, Umasankar Mohanty²

¹Lecturer, S.D.M College of Physiotherapy, Dharwad, Karnataka, India, ²President, Manual therapy foundation of India, Mangalore Karnataka, India

Abstract

Background and Objectives

There are numerous daily tasks that require a stronger grip in various positions other than the standardized testing protocol for handgrip strength. Therefore, in the clinical practice it is necessary to understand how deviations from standard position can affect grip strength. This study has investigated the differences in left and right grip strength in different positions of shoulder and elbow combinations.

Method

Grip strength of forty healthy subjects was tested with a hydraulic dynamometer in six testing positions. The tests consisted of three positions, in which the elbow was maintained in full extension combined with varying degrees of shoulder flexion (i.e. 0°, 90° and 180°) and other three positions in which the elbow was maintained at 90° flexion combined with varying degrees of shoulder flexion (i.e. 0°, 90° and 180°).

Results

In right hand, the highest mean grip strength measurement of 38.9 with SD 14.1, when the shoulder was positioned in 180° of flexion with elbow fully extended. Whereas, the lowest mean grip strength measurement of 35.6 with SD 12.0 was recorded in 180° of shoulder flexion with elbow flexed at 90°. In left hand, the highest mean grip strength measurement of 36.4 with SD 11.9 when the shoulder was positioned in 180° of flexion with elbow fully extended. Whereas, the lowest mean grip strength measurement of 33.5 with SD 9.2 was recorded in 180° of shoulder flexion with elbow flexed at 90°. The results of ANOVA, in left hand showed significant difference ($p=0.005$) in grip strength across all six testing positions and significant difference ($p=0.0000$) for the total subjects. For right hand findings of ANOVA suggested significant difference ($p=0.00092$) in grip strength across all six testing positions and significant difference ($p=0.0000$) for the total subjects. Consequently, the Bonferroni correction for multiple comparisons was done, yielding an experiment-wise alpha level of 0.05. This value indicated statistically significant differences existed in the total sample and among the all positions for both left and right hand. In both left and right hand more significant differences were found in 180° shoulder flexion with elbow flexed at 90° and 180° shoulder flexion with elbow fully extended.

Conclusion

The changes in left and right hand grip strength observed with variations in shoulder and elbow position. Grip strength improved with the increasing flexion angle of shoulder joint. It is vital that when measuring grip strength, one understands how small changes in body position can result in altered grip strengths.

Key Words

Dominant hand, non dominant hand, grip strength

Introduction

Grip strength is the integrated performances of muscles by determining maximal grip force that can be produced in one muscular contraction.¹ It is widely accepted that grip strength provides an objective index of the functional integrity of the upper extremity.^{2,3} In addition to being an economical measure that is easy to administer, grip strength is one of the best indicators of the overall strength of the limb.⁴ Among hand function tools, measurement of grip strength is an important component of hand rehabilitation. Because it helps to establish a baseline for treatment and it is measure of the effectiveness of therapy.⁵ Many of the items included in an upper extremity assessment are based on observation and subjective impressions; however, a grip-strength measurement, when properly taken, can provide objective and quantifiable information regarding hand function.

To obtain an objective assessment of hand function there is a need for a standardized measure of hand strength. American society of hand therapist suggested a standardized testing protocol for handgrip strength in which subject is seated with the shoulder adducted and neutrally rotated, the elbow flexed at 90 and forearm and the wrist in neutral position.⁶ However, there may be subjects who are unable to assume or hold this standardized testing position. Standardized grip strength testing procedures have been recommended to provide even greater objectivity of measurement. In a clinical setting, however, there are a number of reasons why it may be impossible to follow standardized testing procedures, such as a patient's inability to tolerate an upright position or the presence of contractures in upper extremity joints.

Alternative testing position may be useful, however, in identifying positions, which maximize biomechanical abilities and may assist in the design of environment and tools.⁷ Various reports have discussed the effect of testing posture and joint position on grip strength. Standing has been found to result in higher grip strengths than when sitting when using the same instrument. Differences of up to 2lb/in (140gm/cm) have been reported.^{8,9} Teraoka examined the effect of three body position on grip strength: standing, sitting, and supine, with the elbow joint held in full extension in each test position. He found that grip strength was strongest with the subject in the standing position.¹⁰

One study has directly examined the influence of the shoulder position on grip strength. Su et al compared the strength of the grip while the shoulder was in 0°, 90° and 180° of flexion. They found that the strongest grips were obtained while the shoulder was in 180° of flexion and the elbow extended. The weakest grips were found while the shoulder was in 0° and the elbow in 90° of flexion. In this study only the dominant hand was tested.¹¹

Studies on the effect of elbow position on grip strength remain controversial. Mathiowetz et al¹² tested the grip strength of 29 female college students with the elbow joint flexed at 90° in one test and fully extended in another. Significantly higher grip strength was obtained in the 90° elbow flexed position than in the fully extended position.¹² Balogun, et al⁹ tested the grip

strength of 61 college students in four positions: (1) Sitting with elbow in 90° flexion; (2) Sitting with elbow in full extension; (3) Standing with elbow in 90° flexion; and (4) Standing with elbow in full extension. Lowest scores were recorded when the measurement was taken while the subject was sitting with the elbow joint in 90° flexion.

There are numerous daily tasks that require a stronger grip in various positions other than standard position. If grip strength measure were found to vary depending on upper extremity position, interpretation of this information could affect treatment planning in the clinical section. Therefore, in clinical practice it is necessary to understand how deviations from standard position can affect grip strength.

The main objective of the current study is to establish the variation in grip strength in different positions of shoulder (i.e. 0°, 90° and 180° flexion) and Elbow (90° flexion, 0° extension) and as well as to compare left and right grip strength in different positions of shoulder (i.e. 0°, 90° and 180° flexion) and elbow (90° flexion, 0° extension).

Methodology

Subjects

A convenience sample of 40 healthy subjects from the student population of Srinivas College of Physiotherapy (21 males, 19 females; mean age 19.87, SD 1.66 years) in age group of 18-25 years participated in the study. Subjects signed informed consent forms after being provided with a brief description of the study.

Inclusion Criteria

1. Healthy subjects in age group of 18 to 25 years.

Exclusion Criteria

1. Upper extremity abnormalities
2. Any history of inflammatory joint diseases, neurological disorder or injury to upper limb and other health conditions.
3. Ambidextrous

Device

A standard adjustable hydraulic hand dynamometer which was manufactured in USA (fabrication Enterprises Inc) was used for measuring grip strength. This device was set at study and was factory calibrated. The device was set at second handle position (of the five positions available) and same dynamometer was used throughout the study.

Measurement Procedure

All subjects reported themselves to be in good health. By self report, majority of subjects were right hand dominant. Prior to the procedure subjects who met the inclusion criteria were assessed and evaluated thoroughly. Each subject's name, gender and age were recorded. Standard anthropometric data of the subject's body weight, height, upper arm length, forearm length, and circumference of wrist were collected. Hand size was measured in hand at maximal width and by measuring the distance separating distal extremes of the first and fifth digits¹³. Hand length was measured from distal crease of the wrist to the tip of the middle finger.¹⁴ Variable related to strength, such as hand dominance was also recorded. The study was approved by ethical committee of Srinivas College of physiotherapy.

Subjects in the standing position were instructed to adduct and neutrally rotate their shoulders while holding their forearm and wrist joints neutral in the six testing positions:

1. 0° of shoulder flexion with elbow flexed at 90° (PS 1).
2. 0° of shoulder flexion with elbow fully extended (PS 2).
3. 90° of shoulder flexion with elbow fully extended (PS 3).
4. 90° of shoulder flexion with elbow flexed at 90° (PS 4).
5. 180° of shoulder flexion with elbow fully extended (PS 5).
6. 180° of shoulder flexion with elbow flexed at 90° (PS 6).

Prior to the commencement of data collection, a practice trial was given to familiarize with the dynamometer. Before testing, the examiner (the first author) demonstrated how to hold the handle of the dynamometer. The same instructions were given for each trial. After the subject was positioned with the dynamometer, the examiner instructed the subject to "squeeze as hard as you can ... harder ... harder.. Relax". To control for the effects of fatigue, subjects were asked to rest for 2 minutes. For each hand, three trials were performed in each position. Mean of 3 trials were recorded for calculation purpose.

Results

Stratifying the 40 subjects by age and gender resulted in 21 male 19 females in the age group of 18-25 years. The age of males and females is equivalent across the age group of 18-25 years, with mean age of 19.87 years (see table 1). Anthropometric variables such as height and weight are higher among males than females. Out of total sample large majority of subjects are right handed (82.5%).

Table 1: Descriptive data of study subjects.

Variables	Women (N=19)	Men (N=21)	Total (N=41)
AGE	19.7(1.3) ^a	19.9(1.9615) ^a	19.8(1.6) ^a
HEIGHT	155.9(4.7) ^a	172.0(9.4146) ^a	164.3(11.0) ^a
WEIGHT	49.2(10.5) ^a	61.6(6.3587) ^a	55.7(10.5) ^a
DOMINANCE			
RIGHT	13(68.4) ^a	20(95.2) ^a	33(82.5) ^a
LEFT	6(31.5) ^a	1(4.7) ^a	7(17.5) ^a

^aMEAN (SD) Range

Table 2. Represents mean and standard deviations of subject's grip strength in six positions. In right hand, the highest mean grip strength measurement of 38.9 with SD 14.1 when the shoulder was positioned in 180° of flexion with elbow fully extended. Whereas, the lowest mean grip strength measurement of 35.6 with SD 12.0 was recorded in 180° of shoulder flexion with elbow flexed at 90°. In left hand, the highest mean grip strength measurement of 36.4 with SD 11.9 when the shoulder was positioned in 180° of flexion with elbow fully extended. Whereas, the lowest mean grip strength measurement of 33.5 with SD 9.2 was recorded in 180° of shoulder flexion with elbow flexed at 90°.

The results of ANOVA for both left and right hand grip strength are represented in table 3 and table 4 respectively. In left hand findings suggests significant difference (p=0.005) in grip strength across all six testing positions and significant difference (p=0.0000) for the total subjects (Table 3). For right hand findings suggests significant difference (p=0.0092) in grip strength across all six testing positions and significant difference (p=0.0000) for the total subjects (Table 4).

Consequently, the Bonferroni correction for multiple comparisons was done, yielding an experiment-wise alpha level of 0.05. This value indicated statistically significant differences existed in the total sample and among the all positions for both left and right hand. In both left and right hand more significant differences were found in 180° shoulder flexion with elbow flexed at 90° and 180° shoulder flexion with elbow fully extended.

Discussion

Measurement of grip strength is an important component for hand rehabilitation. It assesses the patient's initial limitations

Table 2: Mean and standard deviation of grip strength scores for both left and right hand, in all six positions.

TESTING POSITION	SIDE	TOTAL SUBJECTS (N=40)		t VALUE	p VALUE
		MEAN	SD		
0° shoulder flexion with elbow fully extended	LEFT	34.6	12.2	2.44	0.019*
	RIGHT	37.1	15.0		
0° shoulder flexion with elbow flexed 90°	LEFT	35.4	10.9	1.41	0.17
	RIGHT	37.0	14.3		
90° shoulder flexion with elbow flexed 90°	LEFT	35.4	11.8	1.85	0.072
	RIGHT	37.1	14.0		
90° shoulder flexion with elbow fully extended	LEFT	36.3	12.5	1.53	0.13
	RIGHT	37.6	13.2		
180° shoulder flexion with elbow flexed at 90°	LEFT	33.5	9.26	2.49	0.017*
	RIGHT	35.6	12.0		
180° shoulder flexion with elbow fully extended	LEFT	36.4	11.9	2.42	0.020*
	RIGHT	38.9	14.1		

*Significant at 5% level of significance (p<0.05)

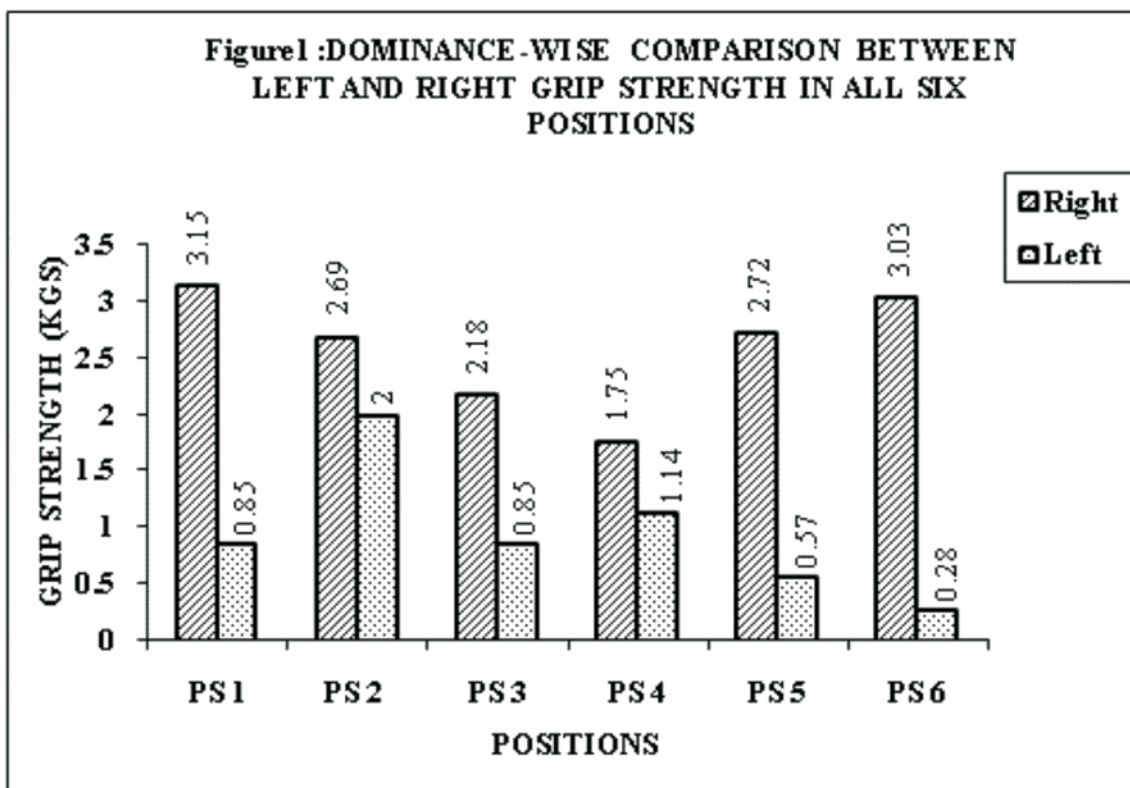
Table 3: Left hand repeated measured ANOVA determining grip strength differences in all six positions.

Source	DF	SS	MSS	F	P
Position	5	240	3.453	3.453	0.0051
Subjects	39	28370.7	52.194	52.194	0.0000

Table 4: Right hand repeated measured ANOVA determining grip strength differences in all six positions.

Source	DF	SS	MSS	F	P
Position	5	226.3	45.3	3.146	0.0092
Subjects	39	42169.3	1081.3	75.090	0.0000

Abbreviations: PS 1, 0° shoulder flexion with elbow fully extended; PS 2, 0° shoulder flexion with elbow flexed 90°; PS 3, 90° shoulder flexion with elbow flexed 90°; PS 4, 90° shoulder flexion with elbow fully extended; PS 5, 180° shoulder flexion with elbow flexed at 90°; PS 6, 180° shoulder flexion with elbow fully extended.



and provides a quick reassessment of patient's progress throughout the treatment. The power grip is result of forceful flexion of all finger joints with maximum voluntary force that the subject is able to exert under normal bio-kinetic condition.^{7,15} The grip strength is affected by many conditions and some studies had been designed to identify these factors. Muscle strength is the one of these factors. The synergistic action of flexor and extensor muscles and the interplay of the muscle groups is an important factor in the strength of the resulting grip.⁷

This study has investigated the comparison of left and right hand grip strength in different positions of shoulder and elbow. From study, results revealed that significant difference found in 0° shoulder flexion with elbow fully extended, 180° shoulder flexion with elbow flexed at 90° and 180° shoulder flexion with elbow fully extended (Table No. 2). This result is in accordance with the study performed by Su et al.¹¹ In his study grip strength was measured in four testing positions. The four hand strength tests consisted three positions in which the elbow was maintained in full extension combined with varying degrees of shoulder flexion (ie. 0°, 90°, and 180°) and of one position in which elbow was flexed at 90° with shoulder in 0° flexion. But this study was done only in right-handed persons and as well as test was conducted only in dominant hand.

From the study significant differences found in 0° shoulder flexion with elbow fully extended, 180° shoulder flexion with elbow flexed at 90° and 180° shoulder flexion with elbow fully extended (Table No.2). On further analysis, these same positions were found to be significant in right hand dominant subjects (Figure No.1.). The highest mean grip strength score was obtained when the shoulder was flexed at 180° with the elbow in fully extended. Grip strength decreased as the shoulder was positioned in 0° flexion and 90° flexion (Table No.2). These findings indicated that shoulder joint angle does affect grip strength performance. In one study Bheem et al reported on the effect of upper extremity posture on maximum grip strength revealed, that shoulder joint angle has an influence on grip strength performance.¹⁶ It may be speculated that the synergistic muscles of the back and shoulder may be able to act to their best advantage, when the shoulder is elevated at 180° shoulder flexion during grip. This overhead position appears to allow those proximal muscles involved to be stretched beyond their normal resting length, which would theoretically increase their efficiency for optimum exertion according to the principle of length tension relations.^{17,18}

In our study lowest mean grip strength score was recorded when shoulder was in 180° flexion and elbow was flexed at 90° and highest mean grip strength score was recorded in 180° shoulder flexion with elbow fully extended. This effect can be explained by length tension-property of muscle contraction. This pattern could produce if shortening the fibers elbow flexors decreased their maximum force potential and/or lengthening the elbow extensors increased their maximum potential.

For all subjects no significant difference found in grip strength measurement between 90° shoulder flexion with elbow flexed at 90° and 90° shoulder flexion with elbow fully extended (Table No.2). The most likely explanation for this that for both shoulder positions an almost equal amount of synergistic activities took place in the back and shoulder muscles. Proof of this requires further electromyographic studies to investigate muscle activities of the upper extremity and back with regard to their integrated functions during grip in these six combined elbow and shoulder positions.

An unexpected finding was that there was no significant difference in left and right grip strength measurement during 0° shoulder flexion with elbow flexed at 90° in (Table No. 2). Further studies are required to explore this phenomenon. In our study measuring grip strength with elbow joint at 90° flexion is significantly different from measuring it in full extension. Since grip strength was measured in combination of shoulder and

elbow positions. Highest mean grip strength of left and right hand was recorded 180° shoulder flexion with elbow fully extended. Grip strength with the elbow extension regardless of shoulder was significantly higher than the elbow flexion position. It may be attributed to the fact that the length-tension relationship of the forearm muscles involved in producing grip strength is most favorable when the elbow in a position of extension.^{11,18} This result in accordance with the study performed by Su et al¹¹.

Previous studies have established that there is a relationship between handgrip strength with elbow in full extension.^{9,19} From the study 0° shoulder flexion with elbow fully extended position, showed significant difference in grip strength (Table No.2). But this result is in contrast to the standardized testing protocol.⁶ In standardized testing protocol in which the subjects' shoulder adducted and neutrally rotated, the elbow flexed at 90°, and the forearm and wrist in neutral position. These kind of alternative positions from standardized positions are useful in identifying positions which maximize biomechanical abilities and may assist in the design of environments and tools.⁷

Our study was limited to symptomatic subjects as well as ambidextrous people. The use of convenience sample limits the generalization of the results of this study to the population at large. In our study majority of subjects were right-handed. These norms should be used with caution for left handed persons. During testing, we did not strictly control wrist movement, but it was found that all subjects naturally held their wrists in certain degrees of extension when asked to give their maximal effort. Future studies are recommended on symptomatic individuals and even to look at the results of grip strength on elbow position in combination with shoulder angle separately.

Conclusion

The changes in left and right hand grip strength observed with variations in shoulder and elbow position. Grip strength improved with the increasing flexion angle of shoulder joint. It is vital that when measuring grip strength, one understands how small changes in body position can result in altered grip strengths. Hence the findings are valuable in the evaluation and rehabilitation training of hand injured athletes or patients.

Acknowledgement

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Correlation Between the Counting Talk Test and Body Mass Index in Young Adults

Preeti Chauhan¹, Pinki Bhasin²

¹Final year student, Department of Physiotherapy, College of Applied Education and Health Sciences, Gangotri Colony, Roorkee Road, Meerut, Pin code: 25001, ²Lecturer, Srinivas College of Physiotherapy, Mangalore

Abstract

Background

Talk test has been used as a method of exercise prescription in a variety of populations. This is an easy informal guideline which suggests that if the exercise intensity is sufficient so that the patient can “just respond to conversation,” then the exercise intensity may within accepted ranges of exercise training intensity. Body mass index is used to classify a person as healthy or unhealthy. It is the commonly used measure of obesity. The study attempted to correlate the counting talk test and the body mass index.

Method

BMI value was determined from the height and weight. The subjects were made to perform a counting talk test at rest and during treadmill walking. The total CTT scores and BMI were analyzed by Karl Pearson's coefficient of correlation.

Result

No statistically significant correlation exists between the counting talk test and body mass index.

Conclusion

Exercise prescription using the talk test can be done in individuals with different categories of BMI. BMI will have no effect on the counting talk test scores.

Key Words

Counting talk test, body mass index, exercise prescription, young adults.

Introduction

Many people are currently involved in cardio respiratory fitness and resistance training programs and efforts to promote participation in all forms of physical activity are being developed and implemented¹.

Aerobic exercise is a decisively important component of any fitness program. However, establishing and maintaining ideal work out intensities for the most effective and safe workouts can prove to be a challenge for both exercisers and fitness professional's alike.²

There are well accepted guidelines for exercise prescription, both for healthy individuals and for patients with cardiovascular or other chronic diseases.^{1,3} These guidelines are generally related to achieving well defined percentages of the peak heart rate (HR), peak oxygen consumption (VO_2 peak) or of the HR or VO_2 reserve. Conformance with these guidelines maximizes the likelihood that the healthy and fitness goals of exercise training will be achieved while minimizing the risk of exertion related complication.⁴ Until now the rating of perceived exertion has been the dominant tool for subjective monitoring of exercise training intensity.^{1,3}

Another method advocated for prescribing an exercise training intensity is based on the talk test method or ability of an individual to carry on a conversation during exercise; the counting talk test⁵. The rationale for this method is based on the premise that exercising at or above the ventilatory threshold generally does not allow to complete conversational sentences without pausing for breaths and thus serves well as a means of estimating the ceiling training intensity⁵. As a method of making the exercise prescription more simple, an informal guideline, widely referred to as the TALK TEST, has arisen within the exercise community.

The talk test is a simple and informal guideline which suggests that if the exercise intensity is sufficient so that the patient can “just respond to conversation,” then the exercise intensity may be “just about right” (i.e., within accepted ranges of exercise training intensity). Within the last several years, the validity of this simple guideline has been systematically evaluated. The ability to converse during exercise (i.e., to pass the Talk test) has been shown to produce exercise intensities consistently within the parameters suggested in clinical guidelines for exercise training in a variety of populations including University students⁶, clinically stable patients with cardiovascular disease⁷ and athletes⁸. The talk test has been shown to be well correlated with the ventilatory threshold, with accepted guidelines for exercise prescription and with ischaemic threshold².

The main advantage of this method is its simplicity of use. Recently it has been shown that when using the talk test method to estimate exercise intensity, individuals exercised at 85-88% of HR_{max} at the maximal point at which they could speak comfortably or were equivocal in their response. When subjects could no longer speak comfortably their exercise intensity was greater than the 90% HR_{max} limit advocated by the ACSM.⁶ Also, the talk test appears to be a simple practical, and yet fairly precise method of exercise prescription as it does not require preliminary exercise testing or sophisticated monitoring strategies further adds to its appeal.

Obesity is defined by the World Health Organization (WHO) as BMI > 30kg/m², and overweight is classified as BMI > 25kg/m².⁹

BMI is a ratio of a person's weight to height. BMI is commonly used to classified weight as “healthy” or “unhealthy.” BMI is a ratio of a person's weight to height. BMI values between 18.5 and 24.9 are considered as “normal” or “healthy” weight. BMI values between 25 and 29.9 are considered “overweight” and above 29.9 are considered as “obese.” BMI above 25 are unhealthy and have been shown to increase the risk of certain chronic diseases. BMI values under 18.5 are considered as “underweight.”¹⁰⁻¹⁷

Address for correspondence:

Preeti Chauhan

Final year student

Department of Physiotherapy, A-122, College of Applied Education and Health Sciences, Gangotri Colony, Roorkee Road, Meerut, Pin code: 25001

Though, studies have been done on 'Talk test' and which have suggested it as a convenient method of exercise prescription, but there is lack of knowledge about the correlation of the Talk Test with Body Mass Index. Hence, there arises a need to conduct the study. The study aimed to uncover the "Correlation between the Counting Talk Test and Body Mass Index in young adults."

Materials and Methods

Design of the study

Correlation study.

Sampling Design

Convenient sampling.

Apparatus used

1. Weighing machine.
2. Height scale.
3. Treadmill.

Outcome Measures

The given outcome measures were assessed

1. Counting Talk Test score
2. Body Mass Index

Procedure

A total of 30 young adults in the age group 19-24yrs were recruited for the study, who were screened for inclusion and exclusion criteria. Informed consent was obtained from each of them prior to participation in the study. Demographic details were obtained from each subject and the purpose of the study was explained. After the selection of subjects, according to the inclusion criteria, verbal instruction and demonstration was given about the testing procedure. BMI of each subject was calculated

as weight (kg) divided by height squared (m^2) and categorized using WHO guidelines as

- Lean <18.5kg/ m^2
- Normal 18.5–24.9kg/ m^2
- Overweight 25.0–29.9kg/ m^2
- Obese e"30kg/ m^2

1. Assessment at Rest

At the beginning of the test, the given procedure was performed to record the CTT score of the subjects at rest. Subjects were asked to take in a full breath and count out loud, at their normal pace, using the following sequence: one-one thousand, two-one thousand, three-one thousand, etc. The number the subject was able to count before having to take a second breath was recorded. Only complete counts (eg. "Three-one thousand") were used to record the highest number attained before taking a second. Partial counts (eg. "Three-one" breath) were not included. The score was recorded as CTT score at rest.

2. Assessment during treadmill walking

Each of the subjects was then made to walk on the treadmill at a comfortable speed. The procedure described above for CTT was repeated while the subject was walking on the treadmill at a comfortable speed. The treadmill walking was discontinued when the subject complained of any unexpected symptoms such as shortness of breathlessness, chest pain, leg fatigue, etc. The CTT was repeated at the last 30 sec of every 2 min. until discontinuation of the treadmill walking. The total score was recorded as CTT score during the test.

The CTT score at rest, total CTT score obtained during treadmill walk and body mass index value of each subject was recorded and analyzed.

Findings and Result

Data was collected and then analyzed by Karl Pearson coefficient of correlation.

1. BODY MASS INDEX

Table 1: Body mass index.

	N	Minimum	Maximum	Mean	Std. Deviation	Median
BMI	30	17.10	31.20	21.54	3.31	21.20

The above table shows that the mean of BMI (N=30) is 21.54 and the standard deviation is 3.31.

2. COUNTING TALK TEST

Table 2: Comparison of Counting Talk Test scores at rest and during test.

	N	Minimum	Maximum	Mean	Std. Deviation	Median	Mannwhitney U test value	p value
CTT REST	30	5.00	20.00	13.10	3.84	12.50	9.342	.000
CTT TEST	30	21.00	203.00	86.43	45.14	87.50		

The above table shows that mean of CTT rest (N=30) is 13.10 and mean of CTT test with (N=30) is 86.43. The standard deviation of CTT rest is 3.84 and that of CTT test is 45.14.

3. CORRELATION OF BODY MASS INDEX AND COUNTING TALK TEST

The above table shows that the Karl Pearson coefficient of BMI and CTT rest is 0.114 and that of BMI and CTT test is 0.178.

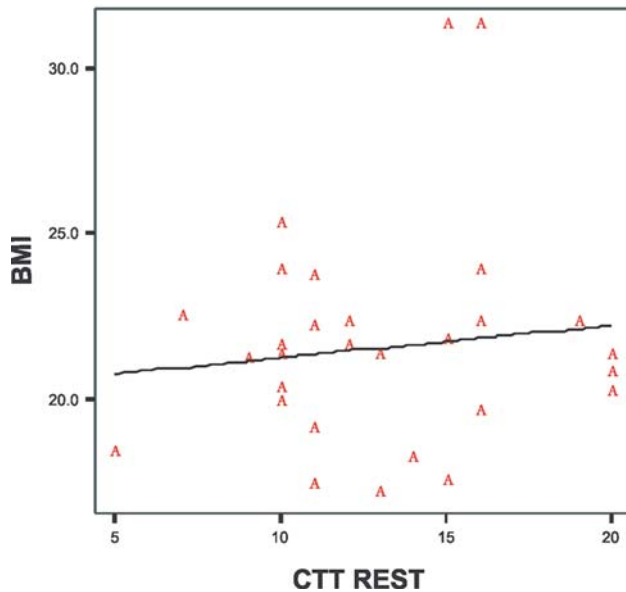
'p' value of BMI and CTT rest is 0.550 and that of BMI and CTT test is 0.347 both of which are non statistically significant.

The above data indicates that there exists no correlation between the BMI and CTT at rest as well as during the test.

Table 3: Correlation of Body Mass Index and Counting Talk Test at rest and during test.

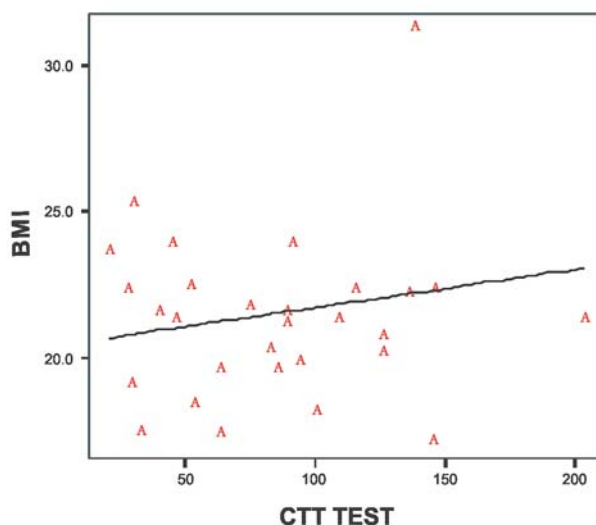
		Karl pearson correlation coefficient	p value	
BMI	CTT REST	.114	.550	NS
	CTT TEST	.178	.347	NS

Scatter diagram 1: Comparison of BMI and CTT at rest.



It is clearly evident from the above scatter diagram that during rest, the total CTT score is between 10 and 15 with the BMI value ranging from 20.0 - 25.0 i.e, in the normal or healthy BMI category.

Scatter diagram 2- Comparison of BMI and CTT during the test.



It is clear from the diagram that during the treadmill walking the total CTT score ranged from 50 to 100.

Discussion

A total of 30 young adults in the age group of 19- 24 years were recruited for the study. The study aimed at finding out that whether be present, a correlation between the counting talk test

and body mass index in young adults. It is evident from the literature that the talk test can be used as a method for establishing the exercise intensity and can be used as a suitable means of exercise prescription. Our study is a novel effort; no previous studies have attempted to correlate the talk test and body mass index.

In our study the BMI ranged from 17.1-18.3 (N=5) to 25.2-31.2 (N=3). The sample size was small (N=30) and the number of adults in the lowest range (17.1-18.3) of BMI i.e, was only 5. In the range of BMI 25.2- 31.2 the number of adults was only 3. The highest number of adults, N= 22 were in the 19-23.8 BMI range i.e, "normal" or "healthy" weight.

The results of our study suggested that there is no statistically significant correlation between the Talk test and the BMI and hence it can be stated that exercise prescription can be done in people with different ranges of BMI, by means of the talk test. A question arises here, that it is known that obesity produces a restrictive lung disorder. The lung volumes and capacities, as well as the excursion of the diaphragm is affected by the degree of abdominal fat. Breathing pattern is rapid and shallow in obese individuals. All of this could, thus possibly have an impact on the talk test scores due to increased work of inspiration in obese persons. Additional studies on the topic, in adults with higher BMI values are required.

Another issue of concern is that age has an impact on the pulmonary function and the exercise capacity which may affect the talk test scores. In our study young adults participated, further studies should be done on older individuals as it is recognized fact that respiratory mechanics and function worsens after 50 years of age. Also, all the adults recruited for the study were non smokers. Smoking deteriorates the lung function and hence might indirectly affect the scores of the talk test. Upcoming studies should address the above mentioned observations.

There were certain limitations of the study. The study was done on adults in the age group of 19-24 years and with different BMI categories. The sample size was small (N=30) and most of the young adults were in the normal range of BMI i.e, 19-23.8. Further studies should be done in a particular age group of adults and with extensive inclusion of adults with different categories of BMI.

Conclusion

The study concluded that there is no significant correlation between the talk test and body mass index. The body mass index will have no effect on the talk test scores.

Acknowledgement

We thank our subjects who participated in the study.

Conflict of Interest

The authors declare no conflict of interest.

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Comparison of the Depressive Symptoms and Physical Performance in Mothers of Disabled and Non-disabled Children

Rasmi Muammer¹, Kiymet Muammer², Yasemin C Yildirim³, Osman Hayran⁴

¹Assistant Prof, Yeditepe University, Faculty of Health Sciences, Department of Physiotherapy, ²Istanbul University, Cardiology Institute, Department of Physiotherapy and Rehabilitation, ³Psychologist, Kyzyl Irmak Rehabilitation Centre, Istanbul, ⁴Prof Dr, Dean of Faculty of Health Sciences, Yeditepe University, Turkey

Abstract

The aim of this study was to investigate the depressive symptoms and physical performance in mothers of disabled and non-disabled children. The study and control population consisted of 40 mothers (study group: n=20, mean age 38.35 ± 6.76 years, and mean body mass index (BMI) 27.72 ± 3.97- control group: n=20, mean age 38.70 ± 7.64 years, and mean body mass index 25.95 ± 4.25). Depressive symptoms were evaluated using the Beck Depression Inventory (BDI). Physical performance was evaluated with the use of the Fifty-Foot Walk (FWS), the Sit to Stand (STS) and the Bend Forward Test (BFT). Mean Beck depression score was significantly higher among cases than controls (p<0.001) and mean scores of three parameters of physical performance tests were also significantly higher among cases than controls. (p<0.001). The results showed that the mothers of disabled children have lower physical performance and higher depressive symptoms than mothers of non-disabled children.

Key Words

Retarded Child, Parents, Physical Performance, Depressive Symptoms.

Introduction

Parents and siblings of retarded children individually, as well as the family as a whole, are at-risk of numerous difficulties such as depression, stress and anxiety in comparison to families with non-retarded children (Veisson, Marika, 1999; Crnic et al., 1983). Numerous studies have been performed to investigate the effects of retarded children on their families such as marital and family strength and parental personality characteristics (Andersson, 1993). Findings Indicated significantly greater stress in the families with handicapped children (Dyson et al., 1986) as well as association had been found between depressive symptoms and physical performance. Rose et al., 2005; Chen et al. (1992) studied the personality and characteristics of parents of children with learning disabilities and attention deficit disorder with hyperactivity and they found that mothers of learning disabled children and attention deficit disorder with hyperactivity had higher hypochondriasis, depression, problems with assuming social responsibilities, dependency, anxiety, intervention, dominance, and/or neurotic-like personality disorders. Some previous research presents certain conflicting results. On contrary to the studies which found that mothers of disabled children were more depressed than control mothers, others revealed that there was no significant difference between the parents of disabled children and control groups (Veisson, Marika, 1999). Andersson (1993) demonstrated that there were no differences between the mean values for parents of mentally retarded and nondisabled children, neither concerning anxiety nor depression. According to Abbott et al., (1986) Parents with retarded children were less critical of family members, and they had fewer persistent family problems.

Feelings of anxiety and depression were analyzed in a group of 13 mothers of children with Down syndrome. Thirteen

women without handicapped children served as a comparative group. The results were also compared with results obtained in 18 mothers of motor handicapped children and 18 mothers of children with mental retardation and psychotic symptoms. Mood disturbances such as anxiety and depression seemed to be uncommon in the mothers of primary school children with Down syndrome. Their experience of social support was not negative although the need for more empathy was expressed by some of them. There were no major differences between the mothers of children with Down syndrome and the mothers of motor handicapped children. The results indicate that mothers of children with Down syndrome fare better than mothers of children with mental retardation and psychotic symptoms (Brandt, 1991). Additionally Depression has been linked to poor health outcome in a number of studies (Wing, 2002). Depressive symptoms may contribute to a lack of motivation or effort which in turn results in less activity (Geisser et al., 2003). Depression leads to illness and physical decline, either because of behavioral factors or biological factors (Penninx et al., 2000). In this study, we investigated the relationship between depressive symptoms and physical performance in mothers who have physically or mentally retarded children and the others who have normally children.

Materials and Methods

Subjects

Forty women participated in this study. The study group (n=20, mean age 38.35 ± 6.76 years, and mean BMI 27.72 ± 3.97) consisted of the mothers who have physically or/and mentally retarded children. The mothers provide regularly continuous attention and care of their children by making contact with a special education and rehabilitation center twice a week. The control group (n=20, mean age 38.70 ± 7.64 years, and mean BMI 25.95 ± 4.25) included the mothers who have healthy children. Subjects were excluded from the study if they had severe neurological, metabolic, cardiovascular, mental or psychiatric diseases, motor and sensory dysfunction, pain or pregnancy. Depressive symptoms and physical performance tests were performed by a psychologist and physiotherapist. All subjects gave their informed consent for participating to the study.

Emotional Status

Depressive symptoms were evaluated using the Beck Depression Inventory-Turkish version (BDI) a well-validated measure (Hisli, 1988) which is a self-report measure of cognitive, affective and neurovegetative symptoms of depression. It is composed of 21 statements about how respondents might have been feeling during the past week. The BDI statements were ranked from 0 to 3, with 0 representing least serious and 3 the most serious symptoms. The cutoffs are used are 0-13: minimal depression; 14-19: mild depression; 20-28: moderate depression; and 29-63: severe depression (Sagmanli et al., 2009).

Physical Performance Tests

Walking velocity

The Fifty-Foot Walk Test (FWS) is a measure of gait velocity and function (Grace et al., 1988). Subjects were instructed to walk the 25 feet distance and turn back as fast as they comfortable could without an assistive device. Time was measured by chronometer (Silva et al., 2008; Sagmanli et al., 2009).

Balance Ability

The Sit-to Stand (or chair rise) Test (STS) is commonly used to assess lower extremity strength and balance (Lord et al., 2002). We used five times of the STS while the subjects crossing their arms on their chest and sitting with their back against the chair. Subjects began while they were in the seated position and ended in the seated position as quickly as possible (Holzberg et al., 1996; Sagmanli et al., 2009). Time was measured by chronometer.

Muscle Endurance

This test requires the subject to bend forward and return to standing 10 times as fast as possible. Time was measured by chronometer (Sagmanli et al., 2009).

Statistical Analysis

Collected data were analyzed by SPSS program. Arithmetic mean and standard deviation were calculated for summarizing descriptive data. Unpaired t test was used for comparisons of mothers of the disabled children with the controls and association between Beck Depression scores and physical performance tests were analyzed by Pearson's correlation analysis. Statistical significance was considered when $p < 0.05$ for all tests of significance.

Results

The personal characteristics of mothers of disabled children and controls are given in Table 1. There was no significant difference between mean age, mean number of children and mean BMI of mothers of disabled children and controls ($p > 0.05$). All of the women in both groups were married. Beck Depression test and physical performance test results of the women who have a mentally or physically disabled child in comparison with women who do not have a disabled child are presented in Table 2. As it is seen from the Table, mean Beck depression score was significantly higher among mothers of the disabled children than controls ($p < 0.001$). Mean scores (duration of performing the tests) of three parameters of physical performance (walking velocity, balance ability and muscle endurance) were also significantly higher among mothers of the disabled children than controls ($p < 0.001$). Positive and significant correlations between Beck Depression scores and physical performance tests has

Table 1: Personal characteristics of mothers of disabled children and controls

	Mothers of disabled children (n=20) Mean \pm SD	Controls (n=20) Mean \pm SD	P value
Age (yrs)	38.35 \pm 6.76	38.70 \pm 7.64	$p > 0.05$
BMI (kg/m ²)	27.72 \pm 3.97	25.95 \pm 4.25	$p > 0.05$
Number of children	2.40 \pm 1.04	1.89 \pm 0.99	$p > 0.05$

Table 2: Beck depression score and physical performance test (duration of performing the tests) results in mothers of disabled children and controls

	Mothers of disabled children (n=20) Mean \pm SD	Controls (n=20) Mean \pm SD	Pvalue
Beck	19.00 \pm 11.44	7.40 \pm 7.30	$p < 0.001$
Walking velocity	14.90 \pm 2.07	10.85 \pm 2.18	$p < 0.001$
Balance	14.50 \pm 3.48	8.60 \pm 2.43	$p < 0.001$
Endurance	24.70 \pm 6.62	17.30 \pm 4.97	$p < 0.001$

Table 3 : Correlations between Beck Depression scores and physical performance tests (duration of performing the tests) (n=40)

Physical performance tests	Beck Depression Score	
	r	p
Walking velocity	0.618	< 0.001
Balance	0.534	< 0.001
Endurance	0.654	< 0.001

been found among all subjects (< 0.001) (table 3), indicating that high depression scores associated with low performance level.

Discussion

Parents in every society play complex roles in training and socialization of their children. These responsibilities become more difficult, perplexing and arduous in the case of retarded children. The parents of a handicapped child face more problems than normal ones (Alam et al., 2005). Depression frequently is seen in parents with physically or mentally disabled child (Veisson, Marika, 1999; Crnic et al., 1983). Veisson, Marika

(1999) demonstrated that especially mothers of disabled children, have significantly more negative emotional states and also significantly more depressive symptoms. Significant differences in depression symptoms between the disabled and control parent group were found in most symptoms. Parents in the control group were significantly more happy, glad, satisfied, proud, grateful, happy for their child, pleased and hopeful. The results of current study showed that depressive symptoms was significantly higher among mothers with disabled child than control group. These result are parallel to those are found in the literature. Mothers of disabled children are less likely to be in employment than their peers, yet research shows that

employment provides both material and social resources and is associated with lower level of distress (Sloper, 1999; Beresford, 1995; Walker et al. 1989). Inadequate housing and transport are also associated with high levels of distress (Sloper, 1999; Bradshaw, 1978). In this study all mothers of disabled children were unemployed housewives and were prevented from working outside the home due to lack of provision of services to cater for the child's needs during working hours, and inflexibility of service systems such as hospital appointments and school transport (Sloper, 1999; Kagan, 1998). All mothers of the control group were working women. These factors may have played an additional role in the high scores of BDI presented in the study group.

When evaluating the physical performance results in both group we found that recorded time of walking velocity, balance ability and muscle endurance tests were significantly higher among mothers of disabled children than controls thus the physical performance parameters in the control group better than those in the study group. We did not encounter studies evaluated directly the physical performance of the parents of disabled children in the literature but it is well known that poor physical function itself is associated with higher levels of depressive symptoms and worsening of symptoms over time. (Rose et al. 2005). Depression is directly related to poor health outcome and contributes to a lack of motivation or effort which in turn results in less activity (Wing, 2002; Geisser et al., 2003; Penninx et al., 2000, 1998). It was demonstrated that there is reciprocal association between depression and disability (Turner, 1988; Graney, 2000; Lenze et al., 2001; Ormel et al., 2002). A relationship between depression and physical performance has been found among the aged persons. Several studies (Penninx et al., 2000, 1998; Bruce et al., 1994) provided evidence that older persons who report depressive symptoms are at higher risk of subsequent physical decline. These results suggest that prevention or reduction of depressed mood could play a role in reducing functional decline in older persons. A similar relationship was found in this study between Beck Depression scores and physical performance tests and high depression scores correlated with low walking velocity, balance, and endurance levels. An important point we observed in our study that body mass index in each group reflected overweight so precautions must be taken. As a conclusion the results showed that the parents who have retarded children had low physical performance and high depressive symptoms in relation to others who have healthy children so we suggest that care must be taken to provide psychosocial support in addition to exercise program to increase the physical performance of this population.

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Assessment of Maximal Inspiratory Mouth Pressure in Healthy Individuals of Different Age Group: Normal Values

Ravi Savadatti¹, Gajanan S Gaude¹, Prashant Mukkannavar²

¹Department of Respiratory Medicine, J.N.Medical College, Belgaum (Karnataka), ²S.D.M.College of Physiotherapy, Manjushree Nagar, Sattur, Dharwad (Karnataka)

Abstract

Background

The strength of the inspiratory muscle is measured by maximal inspiratory pressure. In this study we analyzed the normal values of Maximal inspiratory mouth pressure in healthy participants of different age groups and either gender.

Subject and Methods

160 healthy individuals between the age group of 30 to 69 years of either gender were taken for the study. Males and females participants were separated in groups and each group was divided into four sub groups of 20 individuals according to age (Subgroup:30-39 years, 40-49 years, 50-59 years and 60-69 years). Maximum inspiratory pressure was measured using a mechanical pressure gauge. The largest negative pressure sustained for 1 second on the pressure gauge was recorded. All participants were allowed to rest for about one minute, and then repeated the maneuver 5 times.

Results

The normal mean MIP values in 30-39 age group of male subjects was 125 cmH₂O, in 40-49 age group it was 120 cmH₂O, in 50-59 age group it was 110 cmH₂O and in 60-69 age group it was 93 cmH₂O. Similarly the mean PI max value in 30-39 age group of female subjects was 85 cmH₂O, in 40-49 age group it was 79 cmH₂O, in 50-59 age group it was 75 cmH₂O and in 60-69 age it was 71 cmH₂O. MIP reduced with advancing age and males had greater MIP values than compared to females(P<0.01).

Conclusion

The MIP values obtained in our literature can be used as base line values to measure inspiratory muscle strength. MIP is greater in males when compared to females and these values decline in advancing age.

Key Words

Respiratory muscle strength, Maximal inspiratory pressure and reference values.

Introduction

One of the most commonly used assessment of respiratory muscle strength is maximal inspiratory pressure (MIP) also called

as P/ Max. The MIP provides information based solely on maximal output of the inspiratory muscle.¹

According to Cook CD et al and Byrd RB et al by Irwin Scot² et al stated that, the strength of the respiratory muscle contraction is directly related to the intrinsic muscle properties. The pressure generated with the respiratory system depends on the forces generated during muscle contraction and the elastic properties of the lung and the chest wall. Thus respiratory muscle strength has been defined as the maximum or minimum pressure developed within the respiratory system at a specific lung volume. MIP is measured as the static pressure developed in the mouth at a given lung volume. The subject breaths through a mouth piece attached to a pressure tap and a shutter.²

According to Farkas GA et al, Road. J et al and Braun NMT et al study, as cited by American Thoracic Society/ European Respiratory Society(ATS/ERS) statement³ on respiratory muscle testing of 2002, stated that 'Maximal strength in the skeletal muscles is the force developed under isometric conditions with a muscle at its optimal length. In generating pressure during respiratory maneuver, muscle shortening or lengthening may occur with changes in force velocity and force length relationship.'

The ATS/ERS statement³, on the study done by De Troyer A et al stated that the 'mechanical linkage of each individual respiratory muscle within the chest wall and with other inspiratory or expiratory muscles influences the net pressure produced. Thus, even though activation may be maximal, the pressure produced is derived from a complex set of interactions within and between muscles and the chest wall and its contents. Nevertheless, it is the pressure developed by the inspiratory muscles that drives ventilation and, in spite of the many assumptions, these measures can usefully reflect global respiratory muscle strength for clinical evaluation as well as physiological studies. Thus, when respiratory muscle weakness occurs, the P/max can be more sensitive than the vital capacity (VC) because the relationship between VC and PI max is curvilinear' so that decrease in respiratory muscle strength occurs before decreases in lung volume can be identified. Subjects find it easier to maximize their inspiratory efforts at low lung volumes and expiratory efforts at high volumes; therefore, by convention and to standardize measurement, MIP is measured at or close to residual volume(RV).³

Rounded 'tube' mouth pieces inserted in the mouth for MIP generally give the highest values and have been used for most published reference data.⁴ Hence in our study we have used a rounded mouth piece to measure MIP.

A variety of methods for subject selection and test procedures have been used for the determination of normal values for maximal inspiratory pressure (MIP). The objectives of this study were to utilize mechanical pressure gauge with custom mouthpiece adaptor for the measurement of MIP in a well-characterized healthy group of men and women with a wide age range (20 to 69 yr).

Several studies have aimed at assessing the normal values in the past for interpretation of maximal inspiratory pressure measurement on healthy individuals. Considering these normative values, we need to know whether these values match the healthy Indian population. We are not aware of any previous research that has investigated and predicted normal values on Indian population of different age groups. Hence the purpose of

Address for correspondence:

Ravi Savadatti

Assistant Professor

S.D.M.College of Physiotherapy,

Manjushree nagar, Sattur, Dharwad (Karnataka),

E.mail:raviraj1978@rediffmail.com

this study is to assess the normal values of maximal inspiratory mouth pressure in healthy individuals of different age groups.

Methodology

Subjects

A total of 160 healthy individual between the age group of 30 and 69 years of either gender from Physiotherapy department of S.D.M.College of Medical Sciences and Hospital were conveniently taken for the study as per their inclusion and exclusion criteria. They were separated into two groups: male (N=80) and females (N=80). Each group was divided into four sub groups of 20 individuals according to age. Subgroup:30-39 years (Subgroup:30-39 years, 40-49 years, 50-59 years and 60-69 years).

Inclusion/Exclusion criteria

Healthy individuals with normal Lung function values were included for the study. Subjects showing FEV1 or FVC < 70% of the predicted values on pulmonary function testing or Large pressure swings in the thorax or abdomen (aneurism, uncontrolled hypertension, urinary incontinence) were excluded from the study. Subjects were excluded if they had history of smoking or any respiratory, cardiovascular, neuromuscular, or musculoskeletal diseases. All the individuals with deformities of shoulder girdle and upper quadrant were also excluded from the study. Participants with cognitive deficits and those who do not understand the maneuver procedures were not allowed to participate in the study. Individuals who had pulmonary infections in the previous six months were excluded from the study.

Procedure

Subjects willing to participate in the study were briefed about the study and the investigation. After briefing their written consent was taken. A routine method of physical examination was performed by the physician and those who were declared physically and medically fit were taken for the study. Additional evaluation was done by the principle investigator to identify possible alteration in the thoracic and abdominal region.

Prior to the measurement of maximal inspiratory pressure (MIP) and pulmonary function test, body height was determined using a stadiometer with the subject standing bare foot and wearing light cloths. Body weight was measured using a weighing machine, the participant was asked to remove all his/her ornaments, metals and coins and was then made to stand bare foot on the weighing machine.

The pulmonary function test was done using spirometer in sitting position, forced vital capacity (FVC) and forced expired volume in 1 sec (FEV1) were considered for the study.

MIP was measured using a simple apparatus that consists of a well fitting disposable cardboard mouth piece connected to a small plastic chamber, to which a mechanical pressure gauge is connected through a rubber tube of 2mm diameter. A small leak was done to the mouth piece that prevents closure of the glottis during inspiration. The subject was made to sit in upright position and demonstration of the correct maneuver was done. The subject was instructed to avoid collapsing the cheeks during the measurement of MIP. Then the subject was asked to exhale slowly and completely (to Residual volume), a nose clip was attached, seal lips firmly around the new mouthpiece (to prevent air leak), and then "pull in hard, like you are trying to suck up a thick milkshake." The largest negative pressure sustained for 1 second on the pressure gauge was recorded. The participant was allowed to rest for about one minute, and then repeated the maneuver 5 times. The highest value recorded, was taken for the study. The mechanical pressure gauge has minor tick

marks at 5cmH₂O increments, so results were rounded to the nearest 5cmH₂O. ^{5,6}

Statistical analysis

Results

A total of 160 healthy participants with a mean age, height, weight and BMI as shown in table 1 and 2 completed the study protocol. No adverse effects or complications were observed during the measurement of maximal inspiratory pressure. 20 Males (n=20) and 20 Females (n=20) were recruited in each age group.

Table 1: Mean of Age, Weight, Height and BMI in healthy male participants

Age Group	Age Mean (SD)	Weight Mean (SD)	Height Mean (SD)	BMI Mean (SD)
30-39 (n=20)	34.25(2.6)	74.8 (4.2)	1.66 (0.05)	27.21(1.9)
40-49 (n=20)	44.65(2.3)	71.7 (5.3)	1.657 (0.06)	26.10(1.1)
50-59 (n=20)	54.95(2.6)	74.7 (6.2)	1.674 (0.05)	26.62(1.1)
60-69 (n=20)	64.6(2.9)	74.3 (5.9)	1.66 (0.0)	26.80(1.1)

Table 1, Shows Mean and SD of male subjects with respect to age, height, weight and BMI of different age groups. In age group of 30-39, BMI was found to be slightly higher than the other groups.

Table 2: Mean of Age, Weight, Height and BMI in healthy female participants.

Age Group	Age Mean (SD)	Weight Mean (SD)	Height Mean (SD)	BMI Mean (SD)
30-39 (n=20)	35.1 (3.0)	69.1 (5.3)	1.67 (0.03)	24.75 (1.5)
40-49 (n=20)	44.8(3.0)	69.0 (7.2)	1.64 (0.08)	25.37(1.4)
50-59 (n=20)	54.95(2.9)	70.35 (5.4)	1.69 (0.06)	24.42(1.9)
60-69 (n=20)	65.1(2.3)	70.45 (5.7)	1.67 (0.05)	25.15(2.8)

Table 2, Shows Mean and SD of female subjects with respect to age, height, weight and BMI of different age groups. In age group of 40-49, BMI was found to be slightly higher than the other groups

Table 3: Normal values of maximal inspiratory mouth pressure sustained for 1.0s (PI, max. 1.0) measured at residual volume in males among various age groups.

Age groups	Min	Max	Mean MIP	Std. Dev.	SE	95% Confidence intervals	
30-39 (n=20)	100	145	125.0	11.5	2.59	119.58	130.42
40-49 (n=20)	90	145	120.75	14.6	3.27	113.91	127.59
50-59 (n=20)	90	135	110.7	13.2	2.95	104.57	116.93
60-69 (n=20)	75	135	93.50	17.8	3.99	85.15	101.85

The mean PI max value in 30-39 age group of male subjects was 125 cmH₂O (95% CI= 119 to 130 cmH₂O), in 40-49 age group of male subjects was 120 cmH₂O (95% CI= 113 to 127 cmH₂O), in 50-59 age group of male subjects was 110 cmH₂O (95% CI= 104 to 116 cmH₂O) and in 60-69 age group of male subjects was 93 cmH₂O (95% CI=85 to 101 cmH₂O).

Table 4: Normal values of maximal inspiratory mouth pressure sustained for 1.0s (PI, max.1.0) measured at residual volume in females among various age groups

Age groups	Min	Max	Mean MIP	Std. Dev.	SE	95% Confidence intervals	
30-39 (n=20)	70.0	95.0	85.00	8.74	1.95	80.91	89.09
40-49 (n=20)	60.0	95.0	79.75	11.29	2.53	74.46	85.04
50-59 (n=20)	60.0	90.0	75.00	8.43	1.88	71.05	78.95
60-69 (n=20)	60.0	95.0	71.75	8.93	2.00	67.57	75.93

The mean PI max value in 30-39 age group of female subjects was 85 cmH₂O (95% CI= 80 to 89 cmH₂O), in 40-49 age group of female subjects was 79 cmH₂O (95% CI= 74 to 85 cmH₂O), in 50-59 age group of female subjects was 75 cmH₂O (95% CI= 71 to 78 cmH₂O) and in 60-69 age group of female subjects was 71 cmH₂O (95% CI=67 to 75 cmH₂O).

Table 5: Comparison of male and females with PI Max values in different age groups

Age groups	Sex	Mean(SD) (P/Max or MIP)	t-value	p-value
30-39	Male	125.00 (11.58)	12.3288	0.0000*
	Female	85.00 (8.73)		
40-49	Male	120.75 (14.62)	9.9229	0.0000*
	Female	79.75 (11.29)		
50-59	Male	110.75 (13.20)	10.2047	0.0000*
	Female	75.00 (8.42)		
60-69	Male	93.50 (17.85)	4.8735	0.0000*
	Female	71.75 (8.92)		

* Significant at 5% level (p<0.01)

Statistical analysis was performed to know the difference of MIP among male and female participants (Table 5). The MIP scores in males and females using independent 't' test showed a highly significant difference (p=0.0000) in all age groups (Table 7). The mean MIP values of males in all age groups was greater when compared to females.

Discussion

Assessment of inspiratory muscle strength is done by measuring MIP. We assessed the maximal inspiratory mouth pressure in healthy individuals of different age groups. The measurement of the MIP is strongly dependent on the skill of the examiner and the motivation of the participant. We specifically chose healthy subject population of different age groups to derive normal values of MIP in this population.

Since the pressure developed by the respiratory muscles depends on their resting length and mechanical advantage, it is bound to be abnormal in patients with any disease that changes the resting volume and shape of the rib cage and diaphragm.⁴ These values may help us to differentiate between the normal and abnormal values in pathological conditions of the respiratory system.

Assessment of respiratory muscle function is difficult and complicated. A routine examination involves knowing the

mechanics of chest wall movement. This is followed by investigations that include PFT's, MIP and maximal expiratory pressure measurement (MEP).⁴ Invasive techniques or non invasive costly devices are used to measure MIP or MEP. In our study we have used a low cost mechanical pressure gauge to measure MIP.

Inspiratory efforts are easier to do at low lung volumes and hence a standardized measurement of MIP is done at or close to residual volume.³ In our study the MIP was measured at residual volume. In the present study, we measured MIP in a group of healthy individuals of different age group in order to define a range of normal values.

JE Cotes et al⁷ commented on the number of trials that need to be done while measuring MIP, he quoted that the measurement is the maximal sustained pressure for 1 sec and the result is the maximal value from 3 determination that agree to within 20%. Robert J et al in their study, stated that small number of trial to measuring MIP is more appropriate than many trials as many trials are impractical or impossible for the patients. Hence, we used a maximum of three trials for measuring MIP in our study.⁸

The reported normal values of MIP are -80 to -100cmH₂O.¹ Donna Frown Filter et al statement⁹ comments on the reference values of normal MIP by various authors. According to Black and Hyatt(1969) the normal values of MIP for males was 124±22, and 87±16 for females. Bruschi (1992) reported MIP values for men as 120±37 and females as 84±30.

Various mouth pressures between the studies are not directly comparable. Differences in the age distribution of each study cohort, methods and equipment may explain these observations in a better manner. The MIP values obtained in our study were, however, almost similar to those of other investigators. This applies particularly to the data of Black and Hyatt. The MIP values obtained of men in our study were approximately similar to those of Rodrigo P Simoes¹⁰ et al study. In our study, the mean MIP values of the 30-39 years age group among males and females subjects were 125±11.58 and 85±8.74 respectively, while the age group of 40-49 was having a mean of 120.75±14.62 in males and females having 79.75±11.29. The MIP in the age group of 50-59 years was slightly reduced with males having 110.75±13.21 and females having 75.00±8.43. These values reduced subsequently as the age increased. The values obtained for the age group 60-69 years showed a drastic reduction of MIP with males having 93.50±17.85 and females with 71.75±8.93(Table3,4.). Our data supports the fact that, the mean values of the MIP reduced with the advancing age.

Comparison of normal MIP values in males and females was done, our results showed that, there was highly significant difference seen in both the genders. MIP was greater in males than in females (table 5). A study done by Charfi MR¹¹ et al showed a similar kind of results, they stated that MIP and maximum expiratory pressure (MEP) is greater in males than in females.

Certain limitation of the study must be considered. MIP values in older individuals above the age of 70 years were not derived in our study. There was no comparison of MIP values with age, height, weight and body mass index. In future, studies should emphasize on more samples to know the relationship of age, height, weight and BMI with MIP values.

Conclusion

There is a strong relation between age and sex with MIP. As the age advances there is decrease in the MIP values and the values of MIP is greater in males as compared to female population. The present reference can be used as normal values of MIP in different age group of Indian population provided the measurement is done in the same fashion as that which is done in the study because different methodology may alter the normal

values. Hence we suggest that the normal values from this literature should be used for comparison with caution.

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Physiotherapy Management of Chronic Back Pain: Systematic Literature Review

Acharya Ranjeeta¹, AL-Oraibi Saleh²

¹Lecturer, Dhulikhel Hospital, ²Associate professor, Head of Physiotherapy Department, Applied Medical Sciences College, Hail University, Saudi Arabia

Abstract

Background

Systematic reviews offer a concise summary of the evidence on treatment effectiveness and it provides guidance to physiotherapists and other clinicians on evidence based management of chronic low back pain. The main objective of this review was to critically appraise systematic reviews of conservative therapies for chronic low back pain.

Methods

Literature searches through various online database. Articles were reviewed by three blinded therapists using three inclusion criteria: 1) chronic low back pain, 2) systematic review, and 3) Randomized Control trails published in English.

Results

The search strategy retrieved 300 titles and abstracts; 54 met inclusion criteria. A review of the full text of these articles excluded an additional 41 articles. Only 13 articles fulfilled the original inclusion criteria and included in this review.

Conclusions

The overall quality of the current systematic reviews was satisfactory. Clinically, the implication is that physiotherapy including physical activities and exercises should be recommended for patients with chronic low back pain. This review outcome will be beneficial to researchers in the field of orthopedics, clinicians and policy makers to provide best quality services for patients with chronic low back pain.

Key Words

Chronic Back Pain; Low Back Pain; Physical therapy techniques; "Systematic review, Back Pain"

Introduction

Chronic low back pain is a common musculoskeletal disorder associated with disability in developed countries.¹ However, there is limited information about the physiotherapy management of chronic Low Back Pain (LBP) in developing countries.² To further improve the effectiveness of interventions provided to clients suffering from chronic LBP, physiotherapists have sought for evidence to inform their practice so they could provide the best possible management for their patients.

Address for correspondence:

Saleh AL-Oraibi

PhD, Associate professor

Head of Physiotherapy Department, Applied medical Science College, Hail University, KSA

E-mail: s.aloraibi@uoh.edu.sa

Globally, management of back pain is lacking coherence; patients with LBP seek help from medical doctors and other allied health providers. However, differences in the training, education and scope of practice have lead to heterogeneity in the management of chronic LBP.^{2,3} Health research in developing countries is relatively new and there is lack of research outcomes in the field of rehabilitation including physiotherapy. Systematic reviews, which provide the most concise summaries of research evidence, are an alternative. Additionally, a critical appraisal of systematic reviews is as important as appraising the individual trials included in those reviews.⁴

The main objective of this review was to critically appraise systematic reviews of conservative therapies for chronic low back pain.

Methods

Randomized control studies(RCT) studies, dealing with adults (16–80 years of age) who have chronic LBP, equal to or greater than 3 months duration ,studies involving any physiotherapy modalities for the treatment of chronic LBP and studies published in English language were included .⁵ Studies dealing with mixed populations of acute/subacute/ chronic low back pain, surgical and invasive interventions studies and studies with radicular pain syndrome resulting from nerve root compression were excluded. Other studies looked at alternative therapies such as Acupuncture, Osteopath technique were also excluded.

Search strategy include, a computerized search of the electronic databases MEDLINE, EMBASE, Psycinfo, and the Cochrane Database of studies were electronically searched from January 2000 up to December 2010 using the following terms: Review, literature review, back, chronic low back pain, spine, chronic pain.

The article selection process and its strategies were adopted from other systematic LBP reviewers.⁶ Review process conducted by three reviewers ,all reference lists in relevant reviews were screened, the search strategy was conducted by the first author of this article (RA), and the results were given to two reviewers (NS and SA). Each reviewer independently applied the selection criteria to the retrieved studies, and consensus was used to solve disagreements.

Data Analysis

The following data were extracted by two independent reviewers (SB, and NS), databases and years searched, type of patients, inclusion/exclusion criteria of trials in the study, types of interventions, types of outcomes, design of studies and authors' conclusions and recommendations.

Results

The searches yielded 300 unique abstracts and articles. From these, 54 were retrieved for detailed reading. A review of the full text of these articles resulted in the exclusion of an additional 41 articles. Only 13 articles fulfilled the original inclusion criteria. Ten were published in 8 different peer-reviewed journals and three in the Cochrane Library. Homogeneous populations were involved in the different studies regarding

duration of low back pain which include patients with low back pain more than 3 months (chronic LBP). All reviewed trials reported pain and function by using reliable and valid established standardized tools. For example, Roland Morris Disability questionnaires (RMDQ)⁷, was applied in five studies (2,3,4, 5 and 8); Visual Analogue Scale (VAS)⁸, was applied in three studies. Only two studies included one measurement (2 and 7) while others included more than one measurement tools.

Type of Interventions

A total of seven separate types of interventions were investigated in the 13 studies. To ensure the use of high quality research, the research design of all reviewed articles was Randomized controlled studies which consider the highest quality research design.

Table 1: Summary of included trials related to information and education intervention. RCT: Randomized control study; RMDQ: Roland Morris Disability Questionnaires; VAS: Visual analogue Scale; N: number of population

Study number	Study year (references)	Type intervention	Study design	N	Age group(y)	Outcome measure	Main outcomes
1.	Little, P, et al, 2001 ⁷	Information	RCT	310	16-80	Aberdeen pain and function Scale	a booklet was associated with reductions in a combined pain/ function score.
2.	Smeets RJ, et al 2008 ⁸	Education	RCT	172	16-85	RMDQ	During the one-year follow-up, there were no significant differences between each single treatment and the combination treatment on the primary outcome.
3.	Johnson, et al., 2007 ⁹	Education	RCT	196	18-65	RMDQ & VAS++	The intervention arm received a program of eight 2-hour group exercise session over 6 weeks comprising active exercise and education delivered by physiotherapists. Both arms received an educational booklet and audio-cassette.

Studies Outcomes

In 678 patients with chronic LBP three studies (1- 3) looked at the impact of providing information and education to reduce pain and increase function. In two studies (2 and 3), the authors compared education and information to physical activities while in one study (1) it was compared to no active control.

Education and information (Table1):

Table 2: Summary of included trials related to physical activity and exercise intervention. RCT: Randomized control study; RMDQ: Roland Morris Disability Questionnaires; VAS: Visual analogue Scale; N: number of population

Study number	Study year, references	Type intervention	Study design	N	Age group(y)	Outcome measure	Main outcomes
4.	Hurwitz EL, et al.2005 ¹⁰	Physical activity and exercises	RCT	681	18-70	RMDQ, number of days of pain in the past four weeks, quality of life, Von Korff scale and the Deyo 'troublesomeness' scale.	Participation in physical activities was inversely associated--both cross-sectionally and longitudinally--with low back pain, and there are reduced pain and improved function.
5.	UKBEAM Trial Team, 2004 ¹¹	Back exercise	RCT	1334	18-65	RMDQ, QoL 36, Von Korff disability, VAS and back beliefs score	Compared to Best Care, the exercise programme produced statistically significant improvements in mean RMDQ score , in mean Von Korff disability and pain scores and back beliefs score .
6.	Kuukkanen, et al, 2007 ¹²	Home exercise program	RCT	57	20-55	Borg's scale Oswestry Disability Index	Results showed that pain intensity and functioning decreased significantly in all subjects during the study period
7.	Maul, I, et al.,2005 ¹³	Back exercise	RCT	183	20-55	Modified Nordic Questionnaire	Results showed that supervised physical training effectively improved functional capacity in terms of muscular endurance and isokinetic strength

Physical activity and exercise (Table 2)

In 2275 patients with chronic LBP, four studies (4-7) investigated the effect of physical activities and exercises to reduce pain and increase function. Most studies compared physical activities to other interventions. The physical activities and exercise group in these studies were consistently significant

better than control groups.

Manual therapy, soft tissue mobilization and stretching intervention (Table 3)

In 1607 patients with chronic LBP, three studies investigated

Table 3: Summary of included trials related to manual therapy, soft tissue mobilization and stretching intervention. RCT: Randomized control study; RMDQ: Roland Morris Disability Questionnaires; VAS: Visual analogue Scale; N: number of population

Study number	Study year (references)	Type intervention	Study design	N	Age group(y)	Outcome measure	Main outcomes
8.	Little, P., et al, 2008 ¹⁵	Manual therapy, massage and back exercises	RCT	579	18-65	RMDQ and days in pain	Results showed significant changes in the RMDQ score and days in pain for manual therapy and back exercises compared to the control group and massage group.
9.	Sherman K, et al, 2005 ¹⁶	Yoga, therapeutic exercise or a self-care book	RCT	101	20-64	functional status (modified 24-point Roland Disability Scale) and "bother someness" of pain (11-point numerical scale)	Yoga was more effective than a self-care book for improving function and reducing chronic low back pain, and the benefits persisted for at least several months.
10.	Calmels P, et al., 2004 ¹⁷	Isokinetic	RCT	17	16-75	VAS, trunk mobility Schöber index, Biering-Sorensen and Shirado-Ito test and Quebec scale	Isokinetic exercise is not better than physiotherapy in reversing motor inhibition in chronic low back pain

the effect of some manual therapy intervention, soft tissue mobilization and stretching exercises compared to other interventions in terms of pain and function (8-10). Results showed that: manual therapy and back exercises significantly better than the control group and massage group; Yoga was more effective than a self-care book for improving function and reducing pain and Isokinetic exercise is not better than physiotherapy in improving function.

Electrotherapy Therapy and Traction

In 427 patients with chronic LBP, three studies investigated the effect of electrotherapy modalities and traction to reduce pain and improve function. There were minimal improvements in chronic LBP patients following the use of traction. Regarding the effects of electrotherapy modalities, TENS showed improvement in all the outcomes measure compared with the control group and there were significant effect of therapeutic ultrasound compared to control group.

Discussion

For this chronic low back pain systematic review, 13 RCTs were found that compared physiotherapy interventions with a control group; the overall quality of the trials was high. The outcomes of this systematic review is very important to guide therapists and medical professions who deal with patients of LBP with the best available scientific evidence to be able to treat patient safely and efficiently, especially in developing countries where research activities and grant funds are very limited.

In this systemic review LBP interventions related to back pain education and information were investigated in three trials.^{9, 10, 11} In all trials education and information using booklet or audio-cast showed reductions in pain and reduced of disabilities. However, when education compared to physical activities it was no significant differences in pain and function. This indicate that education and information is important but physical activities play even more important role in reducing LBP and improve function in adult patient with low back pain. This finding is in line with other studies findings, that physical activity improve the functional ability and reduce pain of patients with chronic LBP.¹² In terms of physical activity and exercises, this intervention was significantly better than control groups in terms of reducing pain and increasing functional abilities of patients with LBP.¹³⁻¹⁵ These findings were in agreement with other previous studies which looked at the impact of physical activities and exercises for mixed condition of LBP.¹⁶

Regarding manual therapy, soft tissue mobilization and stretching interventions were significantly better than the control group and massage group.¹⁷ Another interesting finding, that stretching including Yoga was more effective than a self-care book for improving function and reducing pain.¹⁸ However, the effectiveness of Yoga intervention may be different if the type of control group was different, in the current study the control group was provided with "inactive intervention" which include self care book, meaning unmonitored patient participation or limited therapist input. In another study(14), they found that interventions for back pain may lead to significant results if therapeutic

exercises compared to inactive participation. As Yoga is part of culture in many people around the world further randomized control studies are needed to compare Yoga with active treatments such as therapeutic exercise.

In terms of electrotherapy therapy and traction, the result showed slight improvement for the use of traction in chronic LBP,¹⁹ and TENS showed improvement,²⁰ and there were significant effect of therapeutic ultrasound compared to control group.²¹ However, there are limited researches in this area and further research to look at the impact of traction and other electrotherapy modalities is recommended.

Conclusions

Clinically, physiotherapy including physical activities and exercises should be recommended for patients with chronic LBP. Other interventions such as Yoga, traction and electrotherapy may be recommended but requires further investigations before their implementation in clinical practice.

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A Comparative Study to Ascertain Differences Between Rheobase, Girth and Isometric Strength Amongst Dominant and Non Dominant Upper Limb in Normal Subjects

Shivani Chowdhury Salian¹, Sujata Yardi², Vinita P. Kadam³

¹Assoc Prof, ²Prof and Director, ³PT, Department of Physiotherapy, Dr. D.Y. Patil University, Nerul, Navi Mumbai, India

Introduction

In everyday life hand functions are integral and important part in all functional activities. In case of impaired hand function due to brain lesion, peripheral neuropathies and other cases it becomes imperative that the hand strength, girth and rheobase should be evaluated in order to, determine the severity of hand dysfunction and establish an effective rehabilitation program.

Grip strength is a useful tool for assessing a variety of sport and medical (clinical) situations. Grip strength can also be used in clinical setting such as rehabilitation, to determine the extent of an injury or disease process and potential for and progress of the individual in rehabilitation¹. Ultimately it helps to establish a baseline or guideline for the treatment program and acts as a measure to decide the therapy is effective². Studies that focus on the effect of handedness on grip strength can be beneficial in assisting coaches, doctors and therapist determine how serious the injury or disease is as well as assisting them in designing and monitoring the individuals progress in rehabilitation. On the other hand if it is known that there is no difference between the grip strength in the dominant and non dominant hands then the therapist must come up with an alternate way to find out what the individual's original strength of the hand was, as well alternate ways to measure the extent of the injury and the progress of rehabilitation. It is also beneficial to know if there is a difference in grip strength or general strength of the dominant and non dominant hands so that we know what each hand is capable of in everyday life situation.

Hence reliable and valid evaluations of hand is utmost important. It is useful for determining the effectivity of different treatment strategies. It is also widely accepted that grip strength provides an objective index of functional integrity of the upper extremity.

Recent studies have attempted to provide a definitive picture of differences between the dominant and non-dominant hand strength. Crosby et al³ invested normative values of handgrips and claimed that significant differences were found between the dominant and non dominant hand. In their study grip strength was 6% higher for dominant hand.

There were controversies regarding the differences in the hand grip strength values between the dominant and non dominant hand in right and left handed people. So this study was designed to evaluate the differences in the grip strength between right and left-handed population.

The strength duration test was first used for the clinical purpose by Adrian (1916)⁴, and later developed by Ritchie (1944)⁵. The classical galvanic –faradic test, first was used about 1859 by Bacerlacker (Licht, 1961)⁶ was considered by Hickock in 1961⁷ to be the most commonly used electro-diagnostic procedure. Today this test has been almost completely superseded by the strength duration test. The strength duration test is a method of testing electrical reactions that are simple and reliable and indicates the proportion of denervation, while a series of test shows changes in the condition.

Rheobase is the threshold intensity for the pulse of infinite duration (100 milliseconds or higher). Normal values vary considerably. Harris (1961)⁸ gives a range of mean values from 8 to 35 volts and Richardson⁹ and Wynn Parry (1959)¹⁰ gives from 15 to 30 volts. In denervation the rheobase may be less

than that of innervated muscle, and it often rises as re-innervations commences. These changes are not; however, sufficiently predictable to be reliable guides. The rheobases varies considerably in different muscles and according to skin resistance and temperature of the part, while a rise may be due to fibrosis of the muscle. Thus the parameter of rheobase was considered in the study to compare differences in the dominant and non-dominant hand muscles.

Girth measurements are taken to compare the girth of dominant and non dominant hand at particular reference points they are the proximal palmar crease, midcarpal and distal palmar crease¹¹.

Hence, the above mentioned three parameters –Isometric strength, Rheobase and Girth were used to compare and ascertain differences in dominant and non-dominant upper extremity.

Aim

- To compare and ascertain differences between the Rheobase, Girth and strength in dominant and non dominant hand intrinsic muscles.

Objectives

- To assess the Rheobase of Adductor Pollicis, Palmar Interossei, Flexor Digitorum Profundus in Right and Left hand.
- To assess the Girth as per reference points proximal palmar crease, midcarpal and distal palmar crease.
- To evaluate the isometric strength of hand intrinsic muscles using Jamar dynamometer.
- To compare the Rheobase, Girth and Isometric strength of dominant and non dominant hand in normal subjects.

Methodology

Research Approach

Prospective

Sample Size

150 subjects.

Inclusion Criteria

Normal subjects in the age group of 18-25 years. Dominant hand was preferred for the activities of daily living.

Exclusion Criteria

- No participant reported ambidexterity
 - No restriction of upper limb movement.
 - No history of inflammatory disease.
 - No neurological disorder.
 - No history of trauma to upper extremity.
- Duration: 6 months.

Materials used

- Girth of hand – Measured with thread and measuring tape.
- Isometric strength of hand – Jamar dynamometer.
- Rheobase of hand intrinsic muscles and long flexor- Diagnostic muscle stimulator, carbon electrodes, straps.



Procedure

- Subjects personal information i.e. their name, age, sex and dominance was documented.
- Grip strength was measured using a standard adjustable Jamar dynamometer. With shoulder adducted and neutrally rotated, elbow in 90 degree flexion and wrist in slight ulnar deviation and extension^{12, 12.a} Results were recorded in kilograms. All the measurements were performed for the dominant and non dominant hands. Subjects performed 3 attempts and the average was recorded.

Measurement of Isometric Strength using Jamar Dynamometer



- Girth was measured using thread and measuring tape. Results were recorded in centimeters. The thread was placed on proximal carpal crease, midcarpal and distal palmar crease. The thread was placed on measuring tape to document the measurement.
- Rheobase of adductor pollicis, palmar interossei and flexor digitorum profundus is recorded using diagnostic muscle stimulator, carbon electrode, pen electrode, water and straps.

Girth measurement



Rheobase measurement



Reference points for girth measurement



Proximal palmar crease



Mid-carpal palmar crease



Distal palmar crease

Diagnostic Stimulator with pen electrode and carbon electrode.



Rheobase of palmar interossei



Rheobase of Adductor Pollicis



Rheobase of flexor digitorum profundus

Results

- There is no significant difference in the girth of dominant and non dominant hand with p values at proximal, middle and distal level are 0.20, 0.22 and 0.82 respectively.

Girth	Mean	Standard Deviation
Dominant-		
Proximal	16.20	1.20
Middle	20.59	1.50
Distal	19.29	1.74
Non Dominant-		
Proximal	16.25	1.31
Middle	20.34	2.86
Distal	19.24	1.68

Girth in Dominant & Non Dominant hands	p-value	Conclusion
Proximal	0.20	Statistically non Significant
Middle	0.22	Statistically non Significant
Distal	0.82	Statistically non Significant

- There is no significant difference in the rheobase of dominant and non dominant hand with p values of muscles Adductor pollicis, Palmar interossei and Flexor digitorum profundus are 0.08, 0.7 and 0.1 respectively.

Rheobase	Mean	Standard Deviation
Dominant-		
Adductor pollicis	11.62	2.48
Palmar interossei	12.19	3.04
Flexor digitorum profundus	10.13	2.44
Non Dominant-		
Adductor pollicis	11.19	3.10
Palmar interossei	12.25	2.93
Flexor digitorum profundus	10.35	2.69

Girth in Dominant & Non Dominant hands	p-value	Conclusion
Adductor pollicis	0.08	Statistically non Significant
Palmar interossei	0.7	Statistically non Significant
Flexor digitorum profundus	0.1	Statistically non Significant

- There is a significant difference in the isometric strength of dominant and non-dominant hand with a p value of 0.00.

Discussion

Firstly the study results show that there is no significant difference in the girth of dominant and non-dominant hand. According to the statistics there is a minor difference in the girth of dominant and non dominant hand recorded at the three reference points that are at proximal palmar crease, midcarpal level and distal palmar crease with p values of (0.2), (0.8), (0.08)

Isometric strength	Mean	Standard Deviation
Dominant	21.23	6.37
Non Dominant	19.18	5.78

Isometric strength	p-value	Conclusion
Dominant and Non Dominant hand	0.00	Statistically Significant

which are not significant. Clinically the dominant hand tends to be larger than the non-dominant hand¹³. However the difference is not large enough to interfere with hand rehabilitation.

Secondly the study shows that there is no significant difference in the rheobase of the dominant and non-dominant hand, the rheobase value of each muscle is different irrespective of the dominance factor. The muscles considered were adductor pollicis, palmar interossei and flexor digitorum profundus. The p values are the adductor pollicis (0.75) palmar interossei (0.75) and flexor digitorum profundus (0.12), which are not significant. The rheobase varies considerably in different muscles and according to skin resistance and temperature of the part, while a rise may be due to fibrosis of the muscle¹⁴. This is evident from the different rheobase values of the three muscles. Rheobase values are taken into consideration when a patient needs to undergo treatment techniques involving interrupted galvanic stimulation. Theoretically, rheobase value is taught to be a prognostic measurement while undergoing treatment for any kind of nerve injury. Our finding about rheobase values not being different in dominant or non-dominant hand in normal subjects, establishes the fact that rheobase values is a tool for judging prognosis clinically in patients suffering any kind of nerve injury. Therefore, rheobase values from contralateral to affected hand can be effectively considered as a baseline parameter before starting hand rehabilitation.

Thirdly the study results showed significant differences in the strength of dominant and non-dominant hand. The p value is (0.001) which is highly significant. The power grip is the result of forceful flexion of all fingers with the maximum voluntary force that the subject is able to exert under normal biokinetic condition^{15, 16}. The synergistic action of flexor and extensor muscle and the interplay of muscle groups is an important factor in the strength of the resulting grip¹⁷. Many factors including fatigue, hand dominance, time of the day, age, state of nutrition, pain, co-operation of patient and presence of amputation, restricted range of motion, sensory loss can influence the strength of the grip. A general rule often used suggests that dominant hand is approximately 10% stronger than the non-dominant hand^{16, 17}. The 10% rule dates back to 1954 when Bectol observed that most patients presented a difference of 5% to 10% between the dominant and non dominant hand some previous studies^{17, 18, 19} presented their data on hand dominance as major/ minor hand or dominant / non dominant hand. This difference of strength should be considered while a patient has to go undergo hand rehabilitation for any type of nerve injury. Such a finding is therefore suggestive of amount of importance to be laid down while evaluating strength of the affected hand with respect to its contralateral side. This enables us to establish that comparison of isometric strength of muscles in hand rehabilitation would not be an effective tool of prognosis as the baseline strength of muscles in dominant & non-dominant hands are not equal in normal individuals.

Conclusion

- There is no significant difference between the values of rheobase of the muscles adductor pollicis, palmar interossei

and flexor digitorum profundus of dominant and non-dominant hand.

- There is no significant difference between the values of girth as per the reference points proximal palmar crease, midcarpal and distal palmar crease of dominant and non-dominant hand.
- There is a highly significant difference between the values of isometric strength of hand intrinsic muscles assessed with Jamar dynamometer in dominant and non-dominant hand.

Clinical Application

1. The contra lateral side can be used as reference for determining evaluative values as far as girth & rheobase are concerned. The aspect of dominance would not interfere with traditional treatment parameters and the total phase of treatment would be changed with the outcome being very effective.
2. Our finding about rheobase values not being different in dominant or non-dominant hand in normal subjects, establishes the fact that rheobase values is a tool for judging prognosis clinically in patients suffering any kind of nerve injury. Therefore, rheobase values from contralateral hand to affected hand can be effectively considered as a baseline parameter before starting hand rehabilitation.
3. Comparison of Isometric muscle strength of hand muscles cannot be considered as baseline parameters for assessing prognosis of patient undergoing hand rehabilitation.

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Physiological Quadriceps Lag

Shweta Basu Roy¹, Sona Kolke²

¹Lecturer, Sancheti Institute, College of Physiotherapy, Pune, ²Principal, College of Physiotherapy, Vishwakarma Institute of Health Science and Research, Pune, Maharashtra

Abstract

Aim

To evaluate whether quadriceps lag exists in normal healthy individuals.

Objective

1. To analyze if quadriceps lag exists in healthy adults
2. To analyze if this quadriceps lag increases with a sustained contraction of 5 seconds.
3. To analyze the difference in quadriceps lag between males and females.

Design

Repeated measures design.

Method

A study of active and passive limit of knee extension was carried out on 48 healthy adults. With the subject seated for the passive test the examiner lifted the heel until the relaxed knee sagged into full extension under its own weight. The active test component comprised maximum active extension held for at least 5 seconds. Videotaped reference markers on the lateral aspect of the limb were computer analyzed to derive the active and passive knee extension.

Result

The active limit of knee extension was less than the passive limit by an average 5.04 degrees at the instant of maximum knee extension and by 6.34 degrees and 7.22 degrees at 3 and 5 seconds respectively. At 0 and 5 seconds 45.7% and 72.9% of the subjects manifested a quadriceps lag of at least 5 degrees. There is also no significant difference, in the quadriceps lag manifested in males and females.

Introduction

The knee joint, composed of the distal femur, proximal tibia and the patella, is stabilized and powerfully motored by muscles that cross the joint from their origin above the hip joint and the shaft of the femur to insert upon bony structures below the knee joint. These muscle groups are commonly classified as extensors, flexors, abductors and adductors.

Of the above mentioned muscles the extensors are of greatest importance to the stability of the knee joint. The quadriceps femoris muscle represents the primary knee extensors, although the Tensor Fascia Latae also contributes to knee extension. The quadriceps femoris is composed of 4 heads: Rectus Femoris, Vastus Lateralis, Vastus Medialis and Vastus Intermedius. These muscles along with the patella and patellar tendon form the extensor mechanism in the knee. The quadriceps muscle group functions as a knee extensor when the leg is elevated. When the foot is on the ground, contraction

of the quadriceps stabilizes the knee, functioning as a decelerator¹⁵.

Mechanically the efficiency of the quadriceps muscle is affected by the patella, so much, so that the contribution to an increase of extension strength made by the patella increases with progressive extension of the knee, being almost 30% at full extension¹⁷.

The patella lengthens the moment arm of the quadriceps, increasing the distance of the quadriceps tendon and the patellar tendon from the knee joint. The patella acts as an anatomic pulley, and deflects the action line of the quadriceps muscle away from the joint, increasing the angle of pull and the ability of the muscle to generate an extension torque. However as mentioned earlier, the contribution of the patella to improving torque production by the quadriceps, will vary with the joint range of motion.

Thus a 60% increase in quadriceps force over that needed in the rest of the range of motion, is required to complete the last 15 deg. of knee extension.

The fact that the quadriceps as a whole has been seen to undergo reflex inhibition with any injury to the knee along more than mild force with a 60% increase in quadriceps force required to complete the terminal range, explains why extension lag is a common symptom with any kind of knee pathology.

And how exactly do we define muscle lag? Muscle lag is an inability to actively move a joint to its passive limit, where the passive limit has been achieved without producing significant discomfort, and without exerting more than mild force against resistance from joint stiffness or other soft tissue tightness. The active limit should be determined with the patient positioned so that the moving segment is resisted by gravity, but no other external load¹¹.

The causes of quadriceps lag would be any injury to the extensor mechanism of the knee which is most commonly due to a sudden or violent force. In older individuals it could be due to a sudden increase in their activity level.

It is widely believed that lag is always abnormal. But does quadriceps lag exist in healthy adults?

Active extension goes beyond the position of reference (position in which axis of the leg is in line with the axis of the thigh) rarely, whereas it is possible to achieve passive extension from this position, of 5 to 10 degrees¹⁰. Fiber length has a significant influence on the magnitude of joint motion that results from a muscle contraction.

Nicolas Babault et al carried out a study; "Effect of quadriceps femoris muscle length on neural activation during isometric and concentric contraction", published in the "Journal of Applied Physiology", in the year 2002, where they have concluded that muscle length has a predominant effect on neural activation that would modulate the angular velocity dependency¹⁸.

Keitaro Kubo et al. performed the study: "Activation of agonist and antagonist muscles at different joint angles during maximal isometric efforts" published in the "European Journal of Applied Physiology" in the year 2004.

The purpose of this study was to investigate the influence of different angles of the knee joint on the activation level of an agonist (quadriceps femoris muscle) and antagonist (biceps femoris muscle) from electromyographic activities and activation levels (twitch interpolation).

The activation levels at the knee-flexed position (80-110°) were higher than that at the knee-extended position (40-70°). The co-activation levels at 90, 100, and 110° were significantly higher than that the other knee angle. These results suggest that the activation level of an agonist (quadriceps femoris) muscle and the co-activation level of an antagonist (biceps femoris) muscle were higher in longer muscles than in shorter muscles¹¹.

Each sarcomere can shorten to approximately the length of its myosin molecules. Because the sarcomeres are arranged in series in myofibril, the amount of shortening that a myofibril and ultimately a muscle fiber can produce is the sum of shortening in all of the sarcomeres. A fiber can roughly shorten to 50% to 60% of its length. Likewise an isometrically contracting muscle is weaker when it progressively contracts at shorter lengths¹⁹. This normal phenomenon termed as "Active Insufficiency" is due to a diminished capacity of shortened muscle to develop actin-myosin cross bridges(Lieber 1993).Muscle lag is one manifestation of active insufficiency²³. In the process of rehabilitating a knee, as a regular practice, we insist that the active range of knee extension has to be equal to the passive range of knee extension i.e. the muscle has to have a minimum grade of 3 where grade 3 is defined as strength of the muscle where "The muscle can move the joint it crosses through the full range of available motion against gravity but not against any additional resistance"¹¹. But we must analyze whether active insufficiency can lead to a lag even in normal individuals, and thus should we rely more on functional scales and tests to determine the level of activity the individual is at?

Janice K. Loudon et al. carried out a study, "Intrarater Reliability of Functional Performance Tests for Subjects with Patellofemoral Pain Syndrome" published in the "Journal of Athletic Training" in 2002, where they have conclude that the step-down test has the highest reliability and the bilateral squat the lowest.⁸

Also the method of testing and the time lapse in recording the reading need to be analyzed.

Thus this study is to determine, whether quadriceps lag exists even in normal individuals, and whether this lag increases on sustained contraction of the muscle.

Aims and Objectives

Aim

To evaluate whether quadriceps lag exists in normal healthy adults.

Objectives

- To analyze if quadriceps lag exists in healthy adults.
- To analyze how duration of sustained muscle contraction, can affect the magnitude of quadriceps lag.
- To analyze if there is any difference in the magnitude of quadriceps lag between male and female subjects.

Methodology

Sample Size

50 subjects with 32 females and 18 males.

Age Group

20-30 years of age.

Inclusion Criteria

Healthy adults in the above mentioned age group with BMI between 19.9 to 29.9.

Exclusion Criteria

- Subjects with history of any trauma which would influence the normal capacity of the knee to passively or actively extend.
- Subjects with knee pain of any origin.
- Subjects with systemic disease which might affect the integrity of soft tissues.
- Subjects on long term steroid therapy.
- Any subject with more than moderate hamstring tightness.

Procedure

- All subjects have been included, keeping in mind the exclusion and inclusion criteria.
- All subjects have been evaluated for any dysfunction at the knee and functional limitation, with the help of the evaluation form, The Cincinnati Knee Rating Scale and functional tests.(Appendix1,Appendix2,Appendix3)
- Functional tests have been used for the purpose of evaluation as, the common objective measures of knee function, which include pain assessment, goniometry, girth measurement, manual muscle testing, and isokinetic evaluation, are poor predictors of function. Functional testing is an attempt to evaluate the knee joint under conditions that mimic realistic functional demands. Performances on functional tests depends on many variables, including pain, swelling, crepitus, neuromuscular coordination, muscular strength and joint stability.
- The evaluation form helps to rule out any pre-existing pathology.
- The Cincinnati knee rating scale has been chosen, as it has been shown to have a high reliability.
- Dominance will be ascertained based on the preferred lower limb for kicking a ball.
- For consistency all tests were performed on the non-dominant limb.
- Each subject is made to sit in a reclined position with the trunk supported in approximately 45degrees of flexion to eliminate hamstring tightness.
- Reflective reference markers are placed on the lateral aspect of the limb: one over the greater trochanter, one 10inches distal to the greater trochanter, one on the head of the fibula and one just proximal to the lateral malleolus.
- The passive limit of knee extension has been determined by straightening the relaxed knee, with a hand behind the heel, until the subject's thigh is just off the plinth. In this position the unsupported knee is allowed to fall into extension by the weight of the limb. The digital camera is used to record this.
- The subject was then asked to perform an active knee extension. Instructions were given to perform as strong a contraction as possible. The digital camera is used to record this.
- The subject is then asked to perform an active knee extension and hold the leg in that position for 7 seconds. The subject is also instructed not to do any second contraction. A video tape recording of this has been obtained.
- Constant reinforcement was performed by the examiner, to standardize each subject's maximum voluntary contraction, at every instance.
- For every subject, the quadriceps lag i.e. angle of passive extension minus the angle of active extension has been calculated.
- The angle taken into consideration is that formed ventrally, between the axis of the leg and the thigh.
- The quadriceps lag has been measured at 1,3 and 5 seconds.

- The software used to measure the angle is photoshop 5.5. The win DVD software has been used to get still shots at the 1st, 3rd, and 5th second.
- A comparison has been made between quadriceps lag at 1 second, 3 seconds and 5 seconds.
- Also a comparison between the magnitude of quadriceps lag between male and female subjects, has been made.

Data Analysis

The photoshop 5.5 software has been used to measure the passive, and active limit of knee extension at 1, 3 and 5 seconds. To facilitate data processing the straight knee position was represented as 0 degrees flexion-extension, the flexed knee represented by angles with a positive sign and knees beyond the straight by angles with a negative sign. For each subject, the magnitude of quadriceps lag, that is the angular limit of active extension minus the angular passive limit, was calculated at 1, 3 and 5 seconds.

The behavior of quadriceps lag over time was tested using repeated measures analysis of variance (repeated measures ANOVA). This test will first identify if there are differences in the quadriceps lag over 1, 3, and 5 sec hold. The p value is set at <0.05. If this test is significant, then post hoc analysis will be done to identify where the difference lies. This post hoc analysis is done using paired t test with Bonferroni's correction. Since there are 3 comparisons, p value is set at $0.05/3 = 0.013$.

The difference in lag over time between males and females was analyzed using unpaired t-test with p set at <0.05.

Results

Percent of subject (n=48) who had at least the specified lag at 1, 3 and 5 seconds after maximum active extension (Table 1).

Degree	Time After Maximum Active Extension		
	1 second	3 seconds	5 seconds
2	83.33%	91.67%	93.75%
4	64.58%	77.08%	85.41%
6	41.66%	50%	56.25%
8	18.75%	29.17%	39.58%
10	6.25%	12.5%	12.5%
12	0	4.17%	8.33%

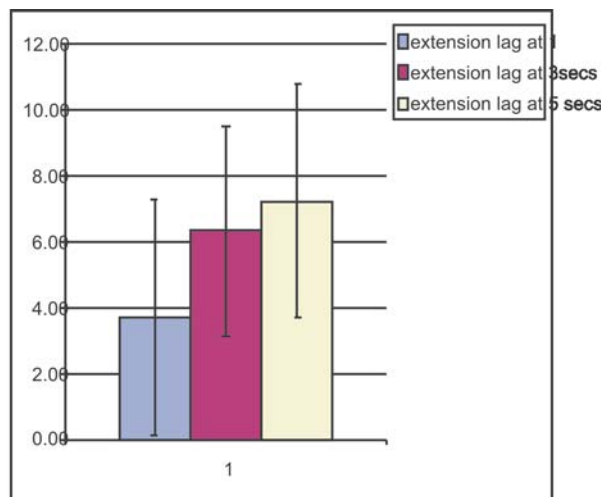
Comparison of Extension Lag Between 1, 3 and 5 seconds

Ext. Lag at 1Sec (Mean ±SD)	Ext. Lag at 3 sec (Mean ±SD)	Ext. Lag at 5 Sec (Mean ±SD)
5.04 ± 3.11	6.34 ± 3.23	7.22 ± 3.56

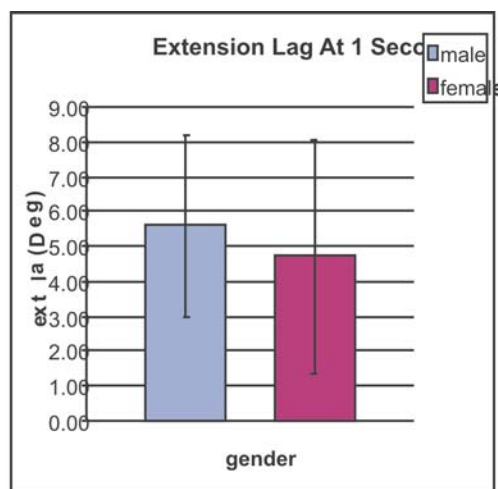
The Difference In Extension Lag between males And Females At 1 Second

	Males	Females
Mean±S.D	5.59±2.61	4.71±3.38

It was found that there is significant difference in the quadriceps lag, between 1 second and 3 seconds, 3 seconds and 5 seconds and also between 1 second and 5 seconds



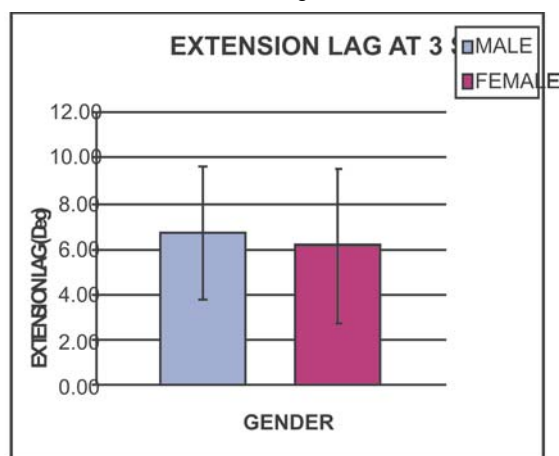
There was no significant difference in Extension lag between males and females At 1 second



The Difference In Extension Lag Between Males and Females At 3 Seconds

	Males	Females
Mean±S.D	6.66 ±2.91	6.11 ±3.32

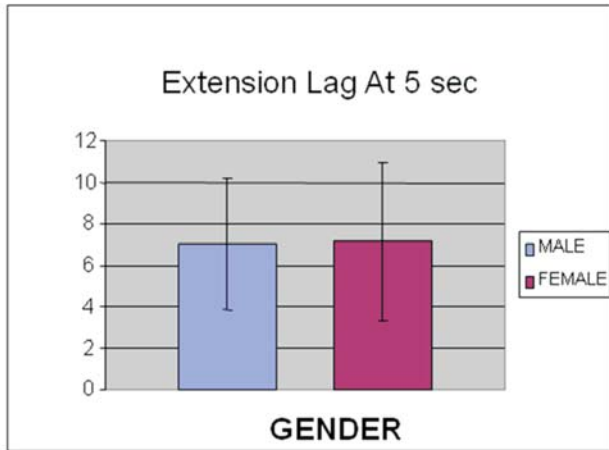
The difference between males and females in extension lag at 3 seconds was not found to be significant.



The Difference In Extension Lag Between Males And Females At 5 Seconds

	Males	Females
Mean±S.D	7.00 ±3.17	7.15 ±3.80

The difference in extension lag at 5 seconds between males and females is non significant($p>0.5$).



Discussion

It has been concluded, from the study that, quadriceps lag does exist even in normal healthy adults, who have no complaints pertaining to the knee, or any other health problems and are performing all their daily activities. Also the quadriceps lag increases over a time period of just 5seconds, significantly.

Quadriceps Lag At 1 second After Maximum Active Extension:

As we are aware that, the maximum number of cross-links between the actin and myosin filaments and hence the maximum contractile force in the sarcomere occurs when the full length of the actin strands at each end of the sarcomere are in contact with the myosin molecule. Increased shortening causes the actin strands from each end of the sarcomere to interfere with each other. This reduces the number of available sites for cross-bridge formation, and the force of contraction decreases, and thus the number of cross-links that can be made again diminishes. Consequently the force of contraction decreases leading to what is termed as active insufficiency of a muscle^{7,19}.

Also quadriceps femoris is a pennate muscle with a large physiological cross-sectional area, but short fibers, which facilitates large force producing capacity but limits its ability to provide a large excursion¹⁹.

In checking the strength of the quadriceps femoris muscle we have to also consider that, the force of gravity acts through the center of gravity, which, in an open chain activity, is found on the side of the moving segment. In a seated knee extension exercise, the center of gravity will be found on the tibial side of the knee. In the seated position with the knee at 90 degrees, the center of gravity is aligned with the axis of the knee in such a way that it creates no rotation of the knee. In other words the quadriceps does not need to contract against the force of gravity to maintain the knee in this position. During knee extension, the leg moves toward a position in which it is parallel to the ground. As this occurs, the resistance by gravity will increase and reach its maximum when the leg is parallel to the ground. Therefore in order to extend the knee in this position, the quadriceps must produce an increasing amount of force with the greatest force required when the resistance of gravity is greatest (knee in full extension)^{7,19}. Thus a muscle that might function perfectly and

give rise to no functional deficits, may still not be able to effortlessly completely that last 5 degrees of knee extension.

In addition to the above, the role of the patella, as an anatomical pulley to increase the moment arm of the quadriceps, decreases in the last 15 degrees of knee extension, and thus the muscle requires to increase the force production by 60% to complete this range⁴.

Increase in Quadriceps Lag Over Time:

As stated in literature when a bone on which a muscle is inserted, moves from a position of suspension in the vertical plane toward the horizontal plane, as in the quadriceps, deltoid and hip rotators tested in the sitting position and the triceps and shoulder rotators tested in the prone position, the weight of the part of the increases, as the part moves toward completion of arc, and the muscle strength required to hold the contraction against gravity usually is sufficient to perform the movement. Thus in case of the quadriceps where the tibia moves from the vertical to the horizontal position it is more difficult to hold the position than to perform the movement¹¹.

Thus the above study was conducted to make the clinician aware of the following vital points which will aid in judging the strength of the quadriceps better:

A delay of several seconds is not unusual as clinicians attempt to estimate knee joint angles visually, or to measure these angles with some form of goniometer.

Several seconds can easily be used to align the instrument correctly and another several seconds to read the scale correctly. The present study has revealed that delays of 3 seconds or more produce significantly larger values of quadriceps lag. In patients with knee pathology, where the rate of quadriceps fatigue may be greater than in normal individuals, this problem is likely to be more profound.

Accordingly, it is recommended that clinicians note the time taken to derive measures of maximum active knee extension during quadriceps lag test, and attempt to standardize this time during all subsequent measures for the same subject. As stated in the study done by Stilman et al., it could also be helpful in minimizing time delays during measurement, to employ such strategies as:

- ✓ Pre-marking surface landmarks on the skin to facilitate positioning of a goniometer.
- ✓ Attaching the instrument to the limb before commencing the tests
- ✓ Asking a second person to assist

Conclusion

- Thus from the above study it has been concluded that:
- ✓ Quadriceps lag does exist, in healthy adults with intact knee function
 - ✓ The quadriceps lag increases over time i.e. within a time span as less as 5 seconds.
 - ✓ No correlation exists between hyperextension and quadriceps lag.
 - ✓ The quadriceps lag, does not differ on the basis of gender.

Limitations of the Study

- ✓ The study can be conducted on a larger population, as the number of subjects included in the current study may not be enough to reach conclusive statements.
- ✓ A comparative study of quadriceps lag in the different age groups can be conducted, to give us a better idea about how age could affect the lag.
- ✓ A study on people of different fitness levels need to be carried out, to prepare us at to what we should expect, when evaluating subjects with different activity levels.

- √ A more advanced software if available can be used to improve the accuracy of the study.

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Effect of Play Therapy on Functional Reach in Stroke Cases

Surinder Pal Singh

Occupational Therapist, National Institute for the Orthopedically Handicapped, B.T.Road, Bon-Hoogly, Kolkata (WB)

Abstract

Objective

To study the effect of play therapy on functional reach in stroke patient

Design

Pretest-posttest experimental group design

Setting

Occupational therapy department, SVNIRTAR, Cuttack, Orissa

Subjects

Thirty male patients with stroke were included in the study. The mean age of experimental group was 46.13 and control group was 43.60.

Intervention

Experimental group received play therapy along with conventional therapy and Control group received conventional therapy only for 5 days a week for 4 weeks

Outcome Measure

Out come was measured using functional reach test.

Results

Within group comparison shows statistically significant improvement in both the groups ($p < 0.05$). On between group comparison experimental group shows statistically greater improvement in functional reach score as compare to control group ($p < 0.05$).

Conclusion

Addition of play therapy along with conventional therapy shown greater improvement as compared to conventional therapy alone. So Play therapy can be efficiently added in clinical practice for treating stroke patients.

Key Words

Stroke, Play therapy, Functional reach.

Introduction

Stroke is defined by the National Institute of Neurologic Disorders and stroke (NINDS), USA as a sudden loss of brain function resulting from an interference with blood supply to the brain. (Sethi PK, 2002).

A review of information available on stroke was conducted

by Anand K et al to estimate the morbidity due to stroke in India. The prevalence of stroke in India was estimated as 203 per 100,000 population above 20 years, amounting to a total of about 1 million cases. The male to female ratio was 1.7. Around 12% of all stroke occurred in population below 40 years. The estimated stroke mortality was 102,000, which represented 1.2% of total deaths in the country. (Sethi PK, 2002).

The reaching movement, a complicated multi joint movement directed to a defined point in space (Georgopoulos A P, 1986), is the major action of the arm to bring the hand into interaction with the environment (Shepherd R B, 1995).

Problems with reach, grasp and manipulation affect many of the activities performed in daily life such as dressing, eating and grooming. As such they are a major focus of intervention for clinicians involved in the rehabilitation of patients with neurological pathology (Duff S et al, 2000). Reaching is, thus, an important movement to study in persons who have suffered stroke (Wu C Y et al, 2000).

Games have been shown to be effective therapeutic tools for children and adults. Games can be used to increase strength and stamina, promote functional movement patterns, improve dexterity and grasp, and foster cognitive and psychosocial skills (Avedon, 1971). Extension form of Games are "playful therapy" (Hoppes S et al, 2001).

The use of meaningful activity to enhance the value of therapy and improve performance lies at the heart of Occupational therapy (Bundy AC, 1993).

Can play be a meaningful activity for adults? Can play, in fact, be used therapeutically with adults to increase functional reaching ability and prevent disability?

So purpose of this study was to see the effect of play therapy on functional reach in stroke cases.

Methodology

Research Design

A prospective, structure, different subject, experimental design. The subjects were measured for 'Functional Reach' pre and post treatment in both groups.

Independent variable- Play therapy

Dependent variable- Functional reach

Subjects and Setting

A total of 30 hemiplegic patients were selected from inpatient and outpatient coming to Occupational therapy department. The patients were explained the purpose of the study and were requested to participate in the study and a written consent was obtained from each patient.

Patients were randomly assigned into two groups-

A. Experimental group (15 subjects)

B. Control group (15 subjects)

Experimental group received designed protocol based on 'play therapy' (for 30 minutes in afternoon session) in addition to 'conventional occupational therapy' (for 30 minutes in morning session) per day and control group received 'conventional occupational therapy' alone (for 30 minutes in morning session) per day for 4 weeks (5 days a week).

Inclusion Criteria

1. Adult stroke patients of either sex.
2. Right or left sided hemiplegia.
3. Subjects undergoing rehabilitation after first episode of stroke.
4. Duration of stroke not less than three months.
5. A score of more than 24 in Mini Mental State Examination.
6. Able to maintain standing for at least 10 minutes.
7. Spasticity 1 to 1+ on Modified Ashworth Scale.

Exclusion Criteria

1. Unable to maintain standing for atleast 10 minutes.
2. Unable to sit unsupported for atleast 10 minutes.
3. Concurrent cerebellar and brainstem lesion.
4. Visual spatial hemineglect or apraxia.
5. Sensory impairment in involved limb.
6. Any other medical condition which affect the participation in the therapy.

Instrumentation

Screening tools

- a Modified Ashworth Scale (Bohannon RW and Smith MD, 1987).
- b Perception of Joint Position Sense Test (Leo K and Soderberg, 1981).
- c The Single Letter Cancellation Test (Diller et al, 1974).

Outcome Measures

Functional reach test (Duncan et al, 1990).

Procedure

Evaluation

Before doing evaluation demographic data like name, age, sex, duration of stroke from onset, side of body involvement, was recorded. Patients were evaluated for functional reach, both at the beginning and end of intervention.

Test

Mini Mental State Examination was administered to know the patient's awareness regarding orientation, registration, attention, etc. (Folstein et al, 1975).

Protocol for group A in each session:

Sl. No.	Name of game	Duration of game (in minutes)
1	Ball into basket	5
2	Balls into well	5
3	Throw and catch	5
4	Hit the target	5

After completing two games there was a rest period of 10 minutes. Thus a total of 30 minutes play therapy session was there in afternoon with 30 minutes of conventional therapy in morning.

Protocol for group B in each session:

The conventional therapy included therapy for both upper and lower limbs based on integrated approach.

Procedure for Group A:

1. Ball into basket.
While sitting unsupported on a stool of appropriate height, seat depth, and width; patient threw a ball into a basket by both hands. The basket was placed at a height of 5 feet from ground and 8 feet away from patient. The number of times patient succeeded in putting the ball into basket in a period of 5 minutes was taken as score.

2. Balls into well.
While sitting unsupported on a stool, patient picked up small balls one at a time with his impaired limb, reaching forward, backward, side wards. Balls were scattered on the floor all around the patient. After picking up the ball, the patient threw it into a large box (well) 8 feet in length, 4 feet in height, 3 feet in width, placed 8 feet away from patient. In a period of 5 minutes, number of balls patient successfully threw into well was taken as score

3. Throw and catch
While standing, the patient threw a ball with both hands towards wall which was 8 feet away. The ball was thrown from at or above shoulder level and the patient caught the ball with both hands as it bounced back. In a period of 5 minutes the number of times patient succeeded in catching the ball after bouncing from wall was taken as score.

4. Hit the target
While standing, the patient hit a target 15 inch height at 5 feet above the ground and 8 feet away from patient by his both hands. In a period of 5 minutes the number of times the patient succeeded in hitting the target was taken as score.

Distance between patient and target, distance of target from ground, size of target was adjusted in order to provide just right challenge to patient.

Procedure for Group B:

All activities such as working on transfers, balance, activities of daily living training also along with neurodevelopmental and neurophysiological techniques like weight bearing, bilateral activities etc were carried out. Duration of each session was 30 minutes.

Data Analysis

Mean and Standard deviation was used to determine the subject's characteristics of both control and experimental groups in terms of age, duration of CVA.

For statistical analysis, the parametric paired t test was used for determining changes after treatment within each group. The unpaired t test was used to compare the therapeutic results between the two groups.

Functional reach score taken before treatment and after treatment along with demographic data were analyzed using Statistical Package for the Social sciences (SPSS) version 16. An alpha level of $p < 0.05$ was used for all tests of significance.

Results

The individual characteristics of experimental and control groups are given in Table-1 Experimental group consisted of 15 subjects (all males). Mean age \pm standard deviation of the group was found to be 46.133 ± 9.789 years. Also the mean duration

± standard deviation since onset of stroke for the group was found to be 9.533 ± 3.292 months.

The control group consisted of 15 subjects (all males). Mean age ± standard deviation of the group was found to be 43.600 ± 10.01 years. And the mean duration since onset of stroke for the group was found to be 8.8667 ± 3.24844 months.

Changes within each group is shown in Table – 2 and was found by using paired 't' test. Both the groups exhibited within

Table 1: Patients demographics

		MEAN (SD)
Group A N=15	AGE (in years)	46.13±9.78
	DUR.(in months)	9.53±3.29
Group B N=15	AGE(in years)	43.60±10.01
	DUR.(in months)	8.86±3.24

Table 3: Between group comparison of functional reach test

	Group A Mean(SD)	Group B Mean (SD)	unpaired t-test	
			t	p
Pretest value	4.80 (0.67)	4.60 (0.50)	.917	.367
Posttest value	7.43 (0.73)	5.86 (0.69)	5.620	.000

Table 2: Within group comparison of functional reach test

	Pretest value Mean (SD)	Posttest value Mean(SD)	paired t-test	
			t	p
Group A	4.80 (0.67)	7.43 (0.73)	-18.547	.000
Group B	4.60 (0.50)	5.86 (0.69)	-7.536	.000

Discussion

The purpose of the study was to determine if similar therapeutic protocols (i.e. conventional occupational therapy) were administered, stroke patients who underwent play therapy in addition would exhibit greater improvement of functional reach than those who received the conventional occupational therapy alone.

This study was stimulated by apparent progress witnessed in different patients when play was used (Sakemiller L.M. & Nelson D.L., 1998; Beauregard R., 1998; Hoppes S., 1997; Sietsema J.M. et al, 1993). The use of meaningful activities in occupational therapy intervention assists neurologically involved patients in improving motor control (Sabari J.S., 1991).

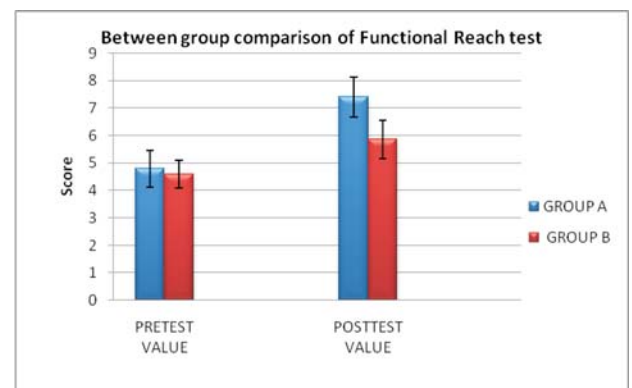
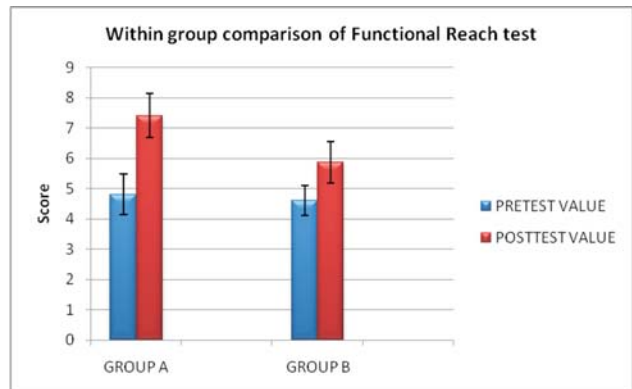
When spasticity develops, early occupational therapy intervention is essential to maintain function and promote motor relearning. A well-known characteristic of the early phase of motor skill learning is that concentration is necessary to process the information needed to perform (Fitts & Posner, 1967; Marteniuk, 1979). Therefore, a major challenge is to structure occupations that require the use of the client's involved spastic arm while invoking his or her optimum motivation.

Mosey (1986) emphasized this need for structuring occupationally embedded exercise because 'performance components are not acquired through random activity or mindless exercise; rather they are acquired through active, goal-directed interaction with the environment.

As the patients enjoyed so much the play during the therapy

group statistically significant improvement between pre and post scores in outcome measure Functional Reach Test ($p < 0.05$).

Between group changes are shown in Table-3. Comparison between the groups for changes in the score through unpaired 't' test showed that there is statistically significant difference between experimental and control groups ($p < 0.05$).



session, that whenever they succeeded they exclaimed yeah! or made a sound out of excitement. This could also have facilitated the achievement of more improvements in reach in experimental group, as is evidenced by Maitra K K et al (2006) that self-vocalization induces facilitation of reach.

Contextual effects of play activities in seated position, object affordances, task goal, and task-related training could contribute to benefits. (Wu C Y et al, 2000; 1998; 2001; Dean C M et al, 1997; Thielman G T et al, 2004).

During standing also play activities contributed to reaching enhancement as this was also observed in study by Lin K C et al (2007).

As the patients were externally focused during play activities this resulted in greater gain in reach. Same were the findings of Fasoli S E et al (2002).

This study supported the hypothesis that the occupationally embedded intervention as an adjunct to conventional occupational therapy promoted more range of functional reach than did conventional occupational therapy alone. Hitting the target and throwing ball into well provided motivating feedback to enhance performance, and the game promoted more enthusiasm and increased attention span.

Subjects required less cuing during the occupationally embedded condition and many subjects continued playing after they had completed 10 repetitions.

Limitations of the Study

- Small sample size.
- Follow up study to know retention of effects of play therapy was not done.
- Limited varieties of play were used.
- Only male subjects.

Recommendations for further Study

Further study is required to determine the carryover of effects on functional improvements.

- Group therapy session may be added to make therapy sessions more interactive, enjoyable and competitive.
- Similar studies are required for finding out improvement in hand functions.
- Similar studies are required for finding out improvement in hand functions.

Conclusion

After analyzing the result we can conclude that addition of play therapy along with conventional therapy shown greater improvement as compared to conventional therapy alone. So Play therapy can be efficiently added in clinical practice for treating stroke patients.

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Effect of Deep Transverse Friction Massage and Capsular Stretching in Idiopathic Adhesive Capsulitis

Vaishali Chauhan, Shobhit Saxena, Shalini Grover

Department of Physiotherapy, Faridabad Institute of Technology, Faridabad, Haryana

Abstract

Study Design

The study was a randomized controlled trial. This study was reviewed and approved by the research review committee at Faridabad Institute of Technology. (Faridabad).

Objective

To determine the effect of deep friction massage and capsular stretching in idiopathic adhesive capsulitis.

Background

Studies have shown the effect on deep transverse friction massage and manipulation together. This study is being done to see the effect of deep friction massage and capsular stretching together; on supraspinatus and subscapularis muscle as these two muscles are will be effective in improving the range of motion and pain with functional disability in adhesive capsulitis.

Methods and Measures

Twenty six patients with primary diagnosis of adhesive capsulitis (both men and women; mean age 40-60 years) and exhibiting a specific abduction, medial rotation and external rotation range of motion deficit will be randomised into two treatment groups.

The first group (Experimental group) will be receiving the Cyriax approach of deep friction massage on supraspinatus and the subscapularis with inferior capsular stretching, hot packs, active assisted exercises and home exercise programs for a period of two weeks. The second group (control group) will be receiving the same except Cyriax technique. The initial evaluation will be including the recording of detailed medical and physiotherapy history and assessment of range of motion using goniometer, pain using visual analogue scale with disability using shoulder pain and disability index (SPDAI).

Results

Improvement in shoulder abduction, internal and external rotation values along with functional disability and the decrease in pain were significantly better in the Experimental group after the first and second week of treatment.

Conclusion

The Cyriax method of rehabilitation provides a faster and better response than the conventional physical therapy methods in treatment of adhesive capsulitis.

Introduction

Shoulder pain is among the most common reasons for visits to a general practitioner. The point prevalence of shoulder pain is estimated to be 4-20% at any given time^{1,2}. Prospective studies

in Europe have shown that approximately 11 out of 1000 patients have shoulder pain⁵. Most people under the age of 40 with a shoulder problem have rotator cuff lesions^{3,4}. Adhesive capsulitis (frozen shoulder) is an insidious painful condition with gradual restriction of all planes of movement in shoulder. Adhesive capsulitis affects 2-3% of the general population and is the main cause of shoulder pain and dysfunction in individuals aged 40-70 years according to the data collected in 1997¹⁰.

Idiopathic adhesive capsulitis is characterized by fibrosis of capsule resulting with progressive painful loss of active & passive shoulder motion. It affects 20% of people with diabetes. Other factors associated with adhesive capsulitis include female gender, trauma, immobilization, thyroid disease, stroke, myocardial infarction, autoimmune diseases, cervical spine disorders & reflex sympathetic dystrophy^{6,11}.

Neviaser(1945) coined the term adhesive capsulitis^{8,9}. Cyriax therapy is one of the manual therapies. It includes manipulation, mobilization, traction techniques and deep friction massage for extremities. Deep transverse friction massage mainly indicated for treating muscles, tendon, joints capsule and ligaments¹³.

Cyriax (1983) proposed that tightness in a joint capsule results in a proportional pattern

of motion restriction. For the shoulder, he predicted that external rotation would be more limited than abduction, which would be more limited than internal rotation (capsular pattern)¹².

Rundquista et al findings did not support Cyriax's proposed glenohumeral capsular pattern and concluded that internal rotation was the most limited motion in 23 out of 25 (92%) involved shoulders¹⁹. Stadnick, (2005) founded that MRI showed, that the rotator interval and the axillary recess, were commonly affected by adhesive capsulitis.

The rotator interval lies between the supraspinatus muscle and tendon posterosuperiorly and the subscapularis muscle and tendon anteroinferiorly¹⁵.

Deep transverse friction causes traumatic hyperaemia, which helps to evacuate pain triggering metabolites¹. It, helps in movement of the affected structure, which prevents or destroys adhesions and optimizes the quality of the scar tissue^{15,16}. According to Cyriax, deep transverse friction massage restores mobility to the muscle in same way that mobilization frees a joint^{17,18}.

Methods

Through convenience sampling, 30 subjects (both male and females) were recruited from the patients referred to OPD of physiotherapy department of Bhagwan Mahavir Hospital, Delhi. The subjects recruited through screening, were then randomly assigned to one of the two treatment groups - Experimental group and Control group via simple randomization method.

Inclusion Criteria

(1) Primary adhesive capsulitis or idiopathic. (2) Age should be of 40 -60 years: both males and females recruited. (3) Shoulder pain and loss of range of motion more than 2 months but less than 1 year (minimum). (4) Normal findings on anterior-

posterior & axillary lateral radiographs of glenohumeral joint. (5) Absence of any rheumatoid tendinous lesions, local sepsis and skin diseases. (6) Range of motion loss of 50% or greater than the non involved shoulder (in abduction). (7) Sufficient English to complete the questionnaires.

EXclusion Criteria

(1) Presence of any medical condition like cardiac disease and diabetes mellitus. (2) Patients who had adhesive capsulitis secondary to shoulder dislocation, fractures. (3) Disorder like shoulder diseases, reflex sympathetic dystrophy, rotator cuff injuries, rheumatoid arthritis and ankylosing spondylitis. (4) Patients with bilateral involvement of shoulder (5) Presence of cervical radiculopathy (6) Patients who have prior to shoulder surgery.

Intervention

Experimental group received deep transverse friction massage of the two tendon supraspinatus and subscapularis as laid by Cyriax, followed by inferior capsular stretching, passive range of motion exercises, hot packs and home exercises program. Control group received hot packs, and home program. All patients were treated for 6 sessions (3 days a week for 2 weeks). Deep friction is given transverse to the fiber direction usually 15 per session with hourly session in hospital 3 times a week.

(a)



(b)



Supraspinatus tenoperiosteal junction transverse friction massage (b) Supraspinatus musculotendinous junction transverse friction massage (c) Capsular stretching (d) Subscapularis tenoperiosteal junction friction massage

(c)



(d)



Statistical Analysis

Total thirty subjects were recruited and were randomly assigned to 2 groups. The experimental group consisted of 6 males and 7 females whereas control group consisted of 5 males and 8 females as in Experimental group 1 and in control group 3 subjects were unable to continue the treatment. All the subjects were similar at baseline with regards to age and duration of symptoms.

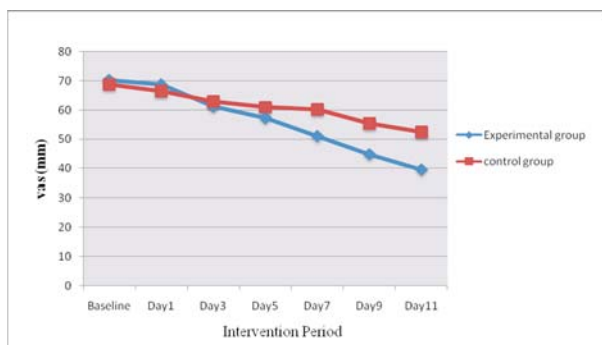
Normality of variables was checked by histograms. Parametric tests were applied for the normally distributed data. The characteristics of the data were presented through tables and graphs. Pre-treatment and post-treatment pain, disability and range of motion values were compared within each group with repeated measures ANOVA and the progression between treatment sessions were explained through paired -t test with Bonferroni correction. Independent (Unpaired) t-test was performed to analyze the intergroup difference in pain, disability and range of motion after performance of deep friction massage and capsular stretching at different sessions. The results were considered statistically significant if $p=0.05$.

Results

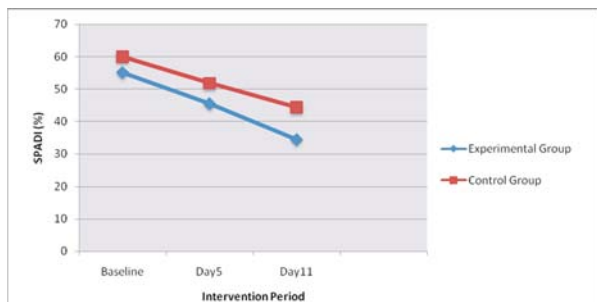
Analysis of VAS scores between experimental and control group at baseline, at the end of 1st session (day1), 2nd session (day3), 3rd session (day5), 4th session (day7), 5th session (day9) and 6th session (day11). There was no significant difference between two groups initially, however significant difference found on day7 ($p=0.047$), day9 ($p=0.035$) & day 11 ($p=0.13$).

The analysis of scores SPDAI between both the groups suggested that there was non-significant differences at the baseline ($p=0.140$) and at the end of 3rd session ($p=0.071$) but after 6th session experimental group showed significant

Graph 2.1: Comparison of pain in both the groups



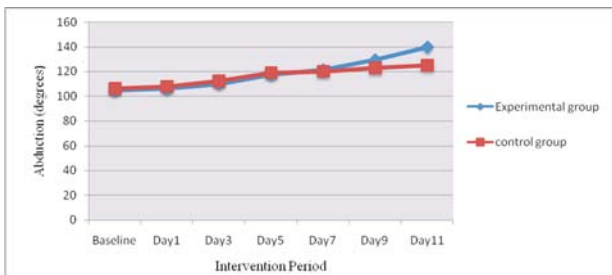
Graph 2.2: Comparison of SPADI in both the groups



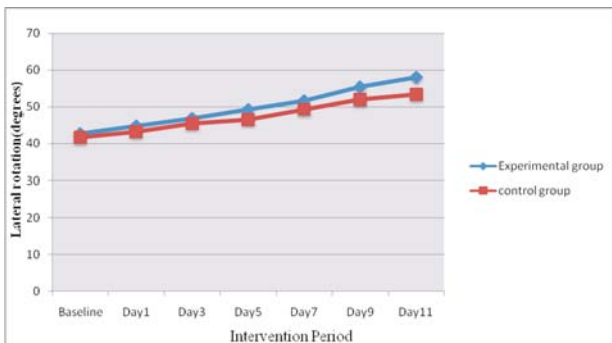
improvement than control group with a value of $p = 0.020 < 0.05$. Experimental group showed to be significant than control group having $p=0.041 < 0.05$ at the end of 6th session in abduction.

Experimental group showed improvement in lateral rotation and medial rotation after each session but the difference in frequencies did not reach statistical significance.

Graph 2.3: Comparison of abduction in both the groups



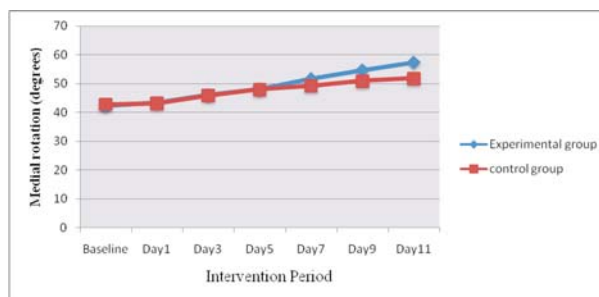
Graph 2.4: Comparison of Lateral rotation in both the groups



Discussion

The purpose of this study was to determine the effect of deep transverse friction massage and capsular stretching on pain, range of motion and functional disability in idiopathic adhesive capsulitis. In both the groups experimental and control

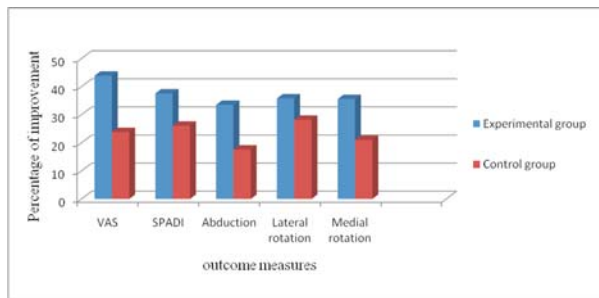
Graph 2.5: Comparison of medial rotation in both groups



Percentage of improvement for both the groups

Outcome measures	Experimental group(%)	Control group(%)
VAS	43.90	23.82
SPADI	37.60	26.10
Abduction	33.53	17.60
Lateral rotation	35.80	28.20
Medial rotation	35.60	21.00

Graph of Percentage of improvement for both the groups



group, pain, disability and range of motion were taken as the dependent variables to assess the improvement between the group and within the group. The findings of the present study suggest that the addition of deep friction massage and capsular stretching along with conventional physiotherapy reduces patient's pain more effectively than control group alone over a 2 week period. Statistically significant improvements were also found in the both dependent variables in both the groups had homogenous distribution of patients.

Abduction showed significant difference between experimental and control group. However, the inter group difference of lateral and medial rotation reached particular range of motion after the 3rd and 6th session, but the difference in the frequencies did not reach statistical significance.

With regards to pain, Experimental group improved better than control group in VAS scores at 4th 5th and the 6th session giving a statistical difference between the two groups. Both the groups showed that pain improve with deep friction massage treatment. These findings are consistent with the results Kaada B and Field, who found that mechanism through which reduction in pain may be achieved is through diffuse noxious inhibitory controls, a pain suppression mechanism that releases endogenous opiates. According to Cyriax, friction also leads to increased destruction of pain provoking metabolites, such as Lewis's substances. This metabolite, if present in too high a concentration, provokes ischaemia and pain^{1, 12}.

The introduction of deep friction massage and capsular stretching in the experimental group supports between group

comparison results. The between group VAS score comparison was found insignificant at the end of 4th session. The improvement in pain intensity was maintained in both the groups at 6th session but statistically results favored the experimental group.

It was also noted that both the groups showed significant improvement in abduction and for lateral and medial rotation ranges of motion, improvement between the both groups were shown but the difference in the frequencies did not reach statistical significance, the reason for this may be that if the study was carried for more than two weeks than it might possible to achieve significant difference for both the other range of motions, moreover this study include deep transverse friction massage on supraspinatus muscle, at two junctions namely tenoperiosteal & musculotendinous junction along with capsular stretching of inferior capsule, thus thereby resulting in significant improvement in abduction at shoulder joint within the period of the study^{13,16}. Deep friction massage are intended to produce increases in range of motion on the basis of biomechanical effect which manifests itself when forces are directed towards resistance but within the limits of a subject's tolerance. The mechanical changes may include breaking up of adhesions, realigning collagen when specific movements stress the specific parts of the capsular tissue. There was no statistically significant difference at the baseline between the two groups. The improvement was found in both the groups, a slight more towards the experimental group at the end of 3rd and 6th session. The possible reason for non-significant difference between two groups at the end of 1st and 2nd session could be a small sample size limiting statistical power and administration of treatment in both the groups. The results suggest that the experimental group has more maintained improvement than the control group. The limitation of the study would be the sample size was small and data was collected from limited places that limit the generalizability of the results. Also the study period is short and no follow up was taken. Neither the subjects nor the therapist were blinded to group assignment. Since the results of this study cannot be generalized to other subjects with secondary adhesive capsulitis as a result of diabetes, cardiac problems, stroke or trauma. So the effectiveness of deep transverse friction massage and capsular stretching techniques in these groups need to be further evaluated.

Conclusion

The analysis of the data collected showed that deep friction massage and capsular stretching to experimental group produced significant improvement in pain and disability scores at the end of 2nd week. However, deep friction massage and capsular stretching produce improvement between the both groups for rotation ranges of motion, but the difference in the frequencies did not reach statistical significance, except abduction which showed significant improvement at the end of 2nd week. These results partly accept and partly reject the experimental hypothesis suggesting that using deep friction massage and capsular stretching in experimental group will produce statistically significant difference in pain, disability and ranges of motion.

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Efficacy of Tibial Nerve Neurodynamic Mobilization for Neuropathic Pain in Type II Diabetes Mellitus- A Randomized Controlled Trial

P. Senthil Kumar¹, Prabha Adhikari², M.M. Prabhu³

¹Associate Professor in Musculoskeletal and Manual Therapy, Dept. of Physiotherapy, Kasturba Medical College, Mangalore, ²Professor and Head, Dept. of Medicine Unit-I, Kasturba Medical College, Mangalore, ³Consultant Physician and Registered Medical Officer, Shri Ramashakti Mission Charitable Trust and Hospital, Shakti Nagar, Mangalore

Abstract

To study the efficacy of tibial nerve neurodynamic mobilization as compared to control intervention on vibration thresholds, neuropathic pain severity, tibial nerve neurodynamic test range of motion and neuropathy specific quality of life (NeuroQoL) in type-II Diabetes Mellitus (DM) with neuropathic pain.

Methods

Thirty two patients of age (60.12 ± 11.41 years), both gender (13 male, 19 female) were selected on convenient sampling. Subjects were selected based on following: Physician diagnosed type-II DM of at least two years duration; complaint of neuropathic pain (screened using neuropathic pain questionnaire- NPQ) in the legs and feet; mechanical behavior of neuropathic pain (aggravated and/or relieved by movements); ability to understand and co-operate for instructions of tester. The independent blinded observer then recorded neuropathic pain intensity on NPQ, tibial nerve neurodynamic test range of motion at initial resistance R_1 , vibration thresholds by Biothesiometry and NeuroQoL. The subjects then were randomized to receive either of two interventions- control and experimental. The control group received drugs for glycemic control, analgesics for neuropathic pain, lifestyle modification and walking exercise prescription. The experimental group received in addition, tibial nerve neurodynamic mobilization consisting of nerve massage, sliders and tensioners. The treatment session was of 45 min duration on five sessions (one session per week) for total study duration of five weeks. Data was collected twice- pre and post intervention and analyzed using students' t-test.

Results

The experimental group showed significant improvements post treatment in all the four study outcomes. The between-group mean differences were NPQ (18.89 ± 2.46), neurodynamic range of motion (4.00 ± 3.85 degrees), vibration threshold (5.94 ± 1.12 volts) and NeuroQoL (15.93 ± 2.85) in favour of experimental group.

Conclusion

Tibial nerve neurodynamic mobilization comprising of nerve massage, sliders and tensioners was shown to be an effective treatment adjunct for diabetic peripheral neuropathic pain.

Key Words

Neuropathic pain, neurodynamics, diabetes mellitus.

Introduction

Neuropathic pain is defined as "pain that arises from disease or dysfunction of the nervous system" according to International Association for the Study of Pain- IASP.¹ One of the leading causes for neuropathy is diabetes and neuropathic pain forms the most common complication leading to morbidity and mortality due to diabetes mellitus.² The commonest peripheral nerve

affected due to diabetes mellitus in diabetic neuropathy is the tibial nerve.³ The neuropathic pain of diabetes mellitus is characterized by bilateral symmetrical "glove and stocking" distribution of symptoms in distal symmetric polyneuropathy⁴ subtype which can either be central or peripheral depending upon the underlying nociceptive mechanism.⁵

The peripheral neuropathic pain can rise from musculoskeletal causes due to entrapment syndromes and also from movement induced mechanosensitivity.⁶ Identification of musculoskeletal peripheral neuropathic pain is made based on mechanical behavior of symptoms which alter with postures and/or movements.⁷ Symptoms arising from peripheral nerves have been categorized into positive symptoms (dysesthetic pain such as hyperalgesia, allodynia, tingling, numbness, paresthesia and/or shooting pain) and negative symptoms (with neurological deficits such as sensory loss, motor loss and reflex loss)⁸ and appropriate management was indicated to suit individual patient presentations with shrewd clinical reasoning.⁹

Evaluation and treatment of this type of pain was proposed to be done utilizing neurodynamic testing that aims at checking neural mobility both intra and extraneural.¹⁰ Intra-neural mobility involves mobility between the nerve and its connective tissue sheaths, and extraneural mobility for between nerve and its surrounding structures.¹¹

Neurodynamic mobilization involves nerve-specific movement testing (nerve slider and tensioner) and graded mobilization, nerve massage (longitudinal and transverse) applied to the affected nerve on thorough understanding of its neuroanatomy and neurophysiology.^{7,12,13,14} Studies on neurodynamic treatment effects were done as nerve gliding exercises for carpal tunnel syndrome,^{15,16} cubital tunnel syndrome,¹⁷ radial tunnel syndrome,¹⁸ thoracic outlet syndrome,¹⁹ and as neural mobilization for cervical cord compression,²⁰ cervical radiculopathy,²¹ non radicular low back pain,²² lower extremity symptoms²³ and lumbar spine surgery.²⁴

Tibial nerve is the common nerve to get affected in type-II Diabetes mellitus and symptoms in tibial nerve distribution is characteristic of neuropathic pain in type-II Diabetes mellitus.^{3,4} Neurodynamic techniques like straight leg raise mobilization has been shown to have influence on the vibration thresholds²⁵ of the feet thus establishing evidence for neuromechanics and neurophysiology. Studies on effects of tibial nerve neurodynamic mobilization could not be retrieved from the existing literature. The purpose of our study was to observe the efficacy of tibial nerve neurodynamic mobilization as compared to control intervention on vibration thresholds, neuropathic pain severity, tibial nerve neurodynamic test range of motion and neuropathy specific quality of life (NeuroQoL) in type-II Diabetes Mellitus (DM) patients with neuropathic pain.

Material and Methods

This Observer-blinded Randomized Controlled Trial was approved by Institution Ethics committee and registered at Clinical Trials Registry- India and then conducted at Shri Rama Shakti Mission Charitable Trust and Hospital, Shakti Nagar, Mangalore in the period of four months, from August to November 2008. Thirty two patients were recruited on incidental sampling of either sex (13 male, 19 female), with mean age 60.12 ± 11.41 years, who volunteered to participate after giving

written informed consent. Subjects were deemed eligible if they were known physician- diagnosed cases of Diabetes Mellitus for atleast two years; had neuropathic symptoms in both legs and feet (in tibial nerve distribution) for atleast 6 months; had mechanical behavior of neuropathic symptoms- altered by positions and/or movements; had positive response to tibial nerve neurodynamic testing using SLR₂. Excluded subjects (21 in number) consisted of inability of subjects to understand and/or co-operate during quantitative sensory testing and/or manual nerve mobility testing and/or treatment; Progressive worsening neurological deficit, irritable pain, allodynia/ hyperalgesia, musculoskeletal problems, cognitive maladaptation syndrome.

Outcome Measurement

Vibration thresholds- Vibrotherm™ Biothesiometer (Diabetic Foot Kare India, Chennai):

The transducer probe of the biothesiometer was placed at one of the three sites in the sole of the foot (in a randomly selected order) and then instructed to report when he/she started feeling the onset of sensation of vibration.²⁶ Biothesiometer assessment of quantitative sensory testing was validated highly and studied extensively for its high reliability and responsiveness.²⁷

Tibial Nerve Neurodynamic Test- Straight Leg Raise Test (SLR) 2:

Originally proposed by Butler⁹, the test was done as follows;

The patient lay supine on the plinth, the tester stands at the tested side lower extremity. With his distal hand performed dorsiflexion and eversion of the foot while the proximal hand performed the straight leg raise fixing the knee in extension simultaneously. The leg was lifted till the tester felt the onset of first initial resistance R₁. Patient's symptom reproduction is considered to be a positive test which should again be confirmed for neural tissue involvement by structural differentiation. The tester once the symptom provocation was felt at the tibial nerve distribution, performed ankle plantarflexion or eversion and noted change in symptoms. Change in symptoms with structural differentiation is essential before considering neural tissue as the cause of the limitation of range of SLR. The range of SLR₂ was then measured using a standard universal goniometer in degrees.

Neuropathic Pain Questionnaire- NPQ²⁹

It was a 12-item self- report questionnaire which has high sensitivity and specificity and test-retest reliability for use in neuropathic pain trials. Each item has a visual analogue scale of 0 to 10 where 0 indicates no "pain" and 10 indicates "maximum or worst pain" possible for 10 different perceptions of neuropathic

Fig. 1: CONSORT Flow Chart showing the flow of participants through the study

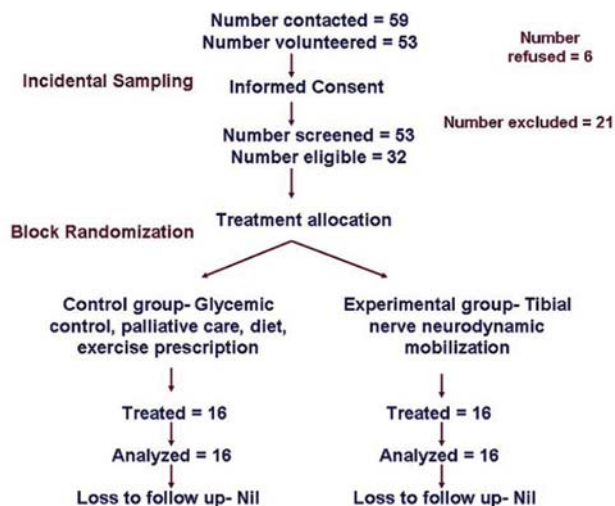


Fig. 2: Tibial nerve massage technique. (a)- Transverse ; (b)- Longitudinal

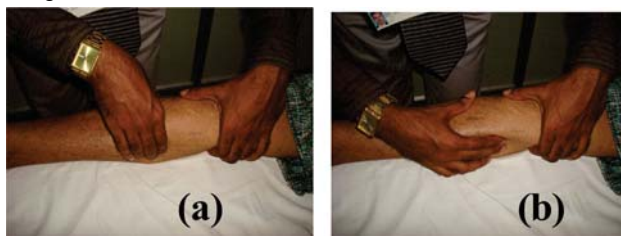


Fig. 3: Tibial nerve slider technique. (a)- Starting position; (b) End position



pain. Refer appendix-1 (reproduced with permission from authors). Score ranges from 0 to 100 where 0 denotes no neuropathic pain and 100 denotes worst neuropathic pain when scored.

Neuropathy-Specific Quality of Life- NeuroQoL³⁰:

It was a 18-item self- report questionnaire for measuring the quality of life in neuropathy subjects due to their foot problems. Each item had five responses ranging from "always" to "never". Another set of 3 responses which denote the importance of each item was also taken. Total score is thus obtained between 0 and 100 where 0 indicates poor quality of life and maximum score indicates good quality of life.

Interventions

After the outcome assessment by the blinded observer, the subjects were then randomized to receive either of the two interventions- control or experimental group by block randomization. The allocation was concealed from the primary investigator who administered the neurodynamic intervention.

Control Group

Standard care was given by physician for patients in this group comprising of glycemic control, diet advice and palliative care for neuropathic pain. Another blinded physiotherapist prescribed group exercise of gentle active movements, 25 min walking exercise prescription to be done 5 times a week, The treatment lasted for 45 min duration.

Experimental group

This group received in addition to standard care, neurodynamic intervention which consisted of, in the same order: Active movements of knee, ankle and foot 5 reps, lasting 2 mins.

Fig. 4: Tibial nerve tensioner technique. (a)- Starting position; (b)- End position.



Descriptive statistics

Comparison of patient characteristics between control and experimental groups

	Control group	Experimental group	P- Value
Number of subjects	16	16	1.000
Age (years)	57.43 ± 12.04	62.81 ± 10.43	.187
Gender Male (female)	7 (9)	6 (10)	.723
Duration of Neuropathic pain (years)	3.75 ± 2.23	3.00 ± 1.75	.299
NPQ pre	61.53 ± 12.76	59.99 ± 12.06	.729
NeuroQoL pre	64.06 ± 13.79	61.50 ± 13.51	.599
Vibration Thresholds pre (volts)	34.75 ± 2.38	34.21 ± 2.38	.533
SLR ₂ ROM pre	17.5 ± 11.83	19.37 ± 10.14	.634

All comparisons between the two groups were not statistically significant at $p < .05$. The two groups were comparable before intervention.

Inferential statistics

Mean Differences	Control group	Experimental group	Between group Difference	P- Value
NPQ (pre- post)	9.61 ± 4.69	28.5 ± 7.15	18.89 ± 2.46	.000*
NeuroQoL (pre- post)	12.7 ± 3.99	28.63 ± 6.84	15.93 ± 2.85	.000*
Vibration Thresholds (pre- post) volts	10.56 ± 2.22	16.5 ± 3.14	5.94 ± 1.12	.000*
SLR ₂ ROM (pre- post) degrees	-4.62 ± 2.94	-8.62 ± 5.79	4.00 ± 3.85	.020*

*- Statistically significant at $p < .05$

Passive stretching for knee, ankle and foot, each stretch held for 30 secs for plantar fascia, Gastrosoleus, hamstrings and rectus femoris muscles, lasting 5 mins. Tibial nerve massage- beginning with tibial nerve palpation along its course, transverse massage was given from proximal to distal. Longitudinal massage was then performed proximally and the progressing distally, lasting 3 mins. See fig 2.

Tibial nerve slider- The technique performed was two-ended slider described by Shacklock, in which the tester began from a position of ankle plantarflexion and inversion with knee in extension to ankle dorsiflexion and eversion with knee in flexion. This was given 5 reps, lasting 3 mins. See fig 3.

Tibial nerve tensioner- The tester began from a position of ankle plantarflexion and inversion with knee in flexion to an ankle dorsiflexion and eversion with knee in extension, a two-ended tensioner, as described by Shacklock. Done for 5 reps, lasting 3 mins. See fig 4.

Repeat tibial nerve sliders for 3 mins; and the session completed with active movements again for 2 mins. Total treatment duration 45 mins. All patients were seen at same time of the day, 10.00 am to 12 noon, to avoid influence from any diurnal variations on the outcome measures or on the responses to testing and interventions. The patients were then instructed to comply with home programme which was indicated by giving patient log. The independent observer collected the data twice- pre and post intervention for all the subjects.

Data Analysis

All outcomes were analysed for their pre and post differences in within-subject comparisons using students' t-test at 95% confidence interval using SPSS 11.0 for Windows.

Results

Discussion

The study had important observations;

Both the groups showed statistically significant improvements in all the four variables studied, which may be attributable to the standard care (glycemic control, palliative care, diet and exercise prescription) that subjects received might have influenced the recovery of the peripheral neuropathic pain in these subjects, as it was found in other studies^{31,32}. The experimental group however had a statistically significant large treatment effect when compared the control group which can only be attributable to the neurodynamic mobilization the subjects

received, thus rejecting the null hypothesis. TENS- Transcutaneous Electrical Nerve Stimulation was another physical therapy modality of choices which had been studied earlier^{33,34,35}, was not given in this study due to community setting, and weekly follow-up which conflicted with the prescription dosage of TENS. The study had its own limitations; the confounding effect of placebo could not be ruled out in experimental group, however, use of placebo³⁶ in neuropathic pain trials was more indicated for drug trials³⁷ than for others.

The following are the significance of this study; the first of its kind in neurodynamic mobilization and its clinical reasoning based application in so-called presumably contra-indicated in regular settings. The neurophysiological effects were studied using vibration thresholds, and adoption of quality of life measure showed it had an impact on their way of life.

The combination of nerve massage, nerve sliders and nerve tensioners was never before applied in clinical trials of neurodynamics. This opens up a new research scope for the effects of nerve sliders and tensioners in various other pathologies as well as claimed by other researchers³⁸. Clinically, the sliders were well tolerated by the subjects and they showed within- session improvements both qualitatively and quantitatively. The straight leg raise test 2 or tibial nerve neurodynamic test mobilization involved the component of SLR³⁹ added, which again might have mobilized the proximal trunks of sciatic nerve to exert an indirect influence on the tibial nerve. Future studies are warranted in other neuropathic pain syndromes, other peripheral nerves, measuring outcomes such as longitudinal nerve motion⁴⁰ using ultrasonography, nerve conduction studies.

Conclusion

Tibial nerve neurodynamic mobilization in addition to standard care was better than standard care alone in type II diabetes mellitus subjects with peripheral neuropathic pain. Tibial nerve neurodynamic mobilization should be considered as an effective treatment adjunct to standard care in treatment of neuropathic pain symptoms in type II diabetes mellitus patients.

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- Material and Methods
- Findings
- Conclusion
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Dr Archana Sharma, Editor IJPOT

Aster-06/603, Supertech Emerald Court
Sector - 93 A, Expressway, NOIDA 201 304
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