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Anwar Abdelgayed Ebid

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Key words: Posterior Tibial Nerve; Electrical stimulation; Overactive bladder; Urgency.

INTRODUCTION

Urinary incontinence and overactive bladder are common conditions in adult population, with impact on physical, psychological, and social well-being, and represent an important burden to the economy of health services [1].

Overactive bladder symptoms include urgency, frequency, nocturia and urge incontinence and are frequent complaints of patients attending urology and gynecology clinics. In many patients, the cause is idiopathic with no obvious underlying neurological abnormality. Patients with overactive bladder also suffer from sleep disturbance, psychological distress from embarrassment due to incontinence and disruption to social and work life. Quality of life scores (QOL) are consistently reduced in this group of patients [2].

Neuromodulation has been reported to be effective for the treatment of stress and urgency urinary incontinence. The cure and improvement rates of pelvic floor neuroodulation in urinary incontinence are 30–50% and 60–90% respectively pelvic floor exercise with adjunctive neuromodulation is the mainstay of conservative management for the treatment of stress incontinence. For urgency and mixed stress plus urgency incontinence, neuromodulation may, therefore, be the treatment of choice as an alternative

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to drug therapy it can offer improvement in patient quality of life [3]. Electrical stimulation therapy can be considered a passive physiotherapy there is a twofold action of electrical stimulation when applied to the pelvic floor: contraction of pelvic floor muscles and relaxation with inhibition of bladder overactivity[4].

Stimulation of the tibial nerve was first described as a neuromodulatory treatment option by McGuire *et a*l [5] by stimulating the tibial nerve near the medial malleolus. The tibial nerve contains fibres originating from the spinal roots L4–S3; from this site also arises the somatic and autonomic nervous supply of the pelvic floor. It is believed that through this crossover tibial nerve stimulation works. Transcutaneous stimulation progressed to percutaneous stimulation is known as posterior tibial nerve stimulation (PTNS) and was initially known as Stoller afferent nerve stimulation.Posterior tibial nerve stimulation appears to be an easy and less expensive way to reach satisfactory results[6].

PTNS is a minimally invasive neuromodulation system designed to deliver retrograde electrical stimulation to the sacral nerve plexus through percutaneous electrical stimulation of the posterior tibial nerve. The posterior tibial nerve contains mixed sensory and motor nerve fibers that originate from L4 through S3, which modulate the innervation to the bladder, urinary sphincter, and pelvic floor. The specific mechanism of action of neuromodulation is unclear. Theories include improved blood flow and change in neurochemical balance along the neurons. Neuromodulation may have a direct effect on the detrusor or a central effect on the micturition centers of the brain [7] .

Urodynamic detrusor overactivity (UDO) is currently defined by the International Continence Society (ICS) as a condition in which the bladder is shown to contract either spontaneously or with provocation to contraction during filling while the subject is attempting to inhibit micturition, Urodynamic investigations are a functional assessment of the lower urinary tract, the purpose being to try to reproduce the symptoms and obtain an objective explanation for the dysfunction.

MATERIALS AND METHODS

Sixty patients of both gender were included in this study. They had overactive bladder (urge incontinence) and were randomly selected from the department of urodynamics of the The National Institute of Urology and Nephrology between years 2008-2010. Their ages ranged from 20 to 70 years (mean age 52.96 ±15.18). Weight ranged between 60-93 kg with a mean of 74.4 ± 9.41 kg in Group A, while it ranged between 60-90 kg with a mean of 76.36 ± 7.7 kg in Group B.Height ranged between 156-179 cm with a mean of 166.68 ± 5.9 cm in group (A), while it ranged between 155-176 cm with a mean of 166.2 ± 6.15 cm in group (B).Comparison of age, weight, and height revealed no statistically significant differences (P>0.05) between the two studied groups.

Patient Criteria

Inclusion Criteria: Patient age was > 19 years old; patient had ≥ six month history of documented overactive bladder; patient had failed other conventional therapy; patient was free of mechanical urethral obstruction as documented by cystoscopy or pressure flow criteria; patient demonstrated an understanding of neuromodulation therapy, its benefits, and its potential risks; patient had normal functioning of the upper urinary tract, urgency/frequency syndrome; a tem-day washout period prior to treatment had be completed.

Exclusion Criteria: Pregnant patients or those intendings to become pregnant during the course of the study. Patients becoming pregnant during the course of the study were to be immediately terminated from the study. Patient having an active urinary tract infection, patient having abnormal cystoscopy, which is concerning for or indicative of malignancy, patient having a urinary fistula, patient had a bladder stone, patient had ankle injury or surgery causing inability to stimulate the tibial nerve or discomfort in using the foot cradle, patient having metal implant from surgery or a metallic foreign body in either leg below (distal to) the knee, patient had cochlear implants, patient having a hyperreflexic neurogenic bladder or urodynamically proven instability secondary to a known neurourologic cause (i.e. stroke, parkinson's, multiple sclerosis), patient had uncontrolled diabetes, patient having diagnosed peripheral neuropathy such as diabetes with peripheral nerve involvement.

Complete physical examination and history was taken for all patients, including previous urological symptoms like frequency, urgency, nocturia, or incontinence. The physical examination included neurological assessment of perianal sensation, anal sphincter tone, and a brief screening for any neurological factors such as, Parkinson's disease, multiple sclerosis, stroke, or previous operations (mainly pelvic surgeries). Detailed analysis of the present overactive bladder symptoms was done. Medical history including current drugs especially diuretics, and anti-diabetic drugs was done. Urologic examination done by the staff of urology department of the National Institute of Urology and Nephrology, excluded genitourinary infection that might cause urinary incontinence. Laboratory investigations, mainly fasting and postprandial blood glucose, complete urine analysis were carried out to exclude diabetes mellitus, urinary tract infection as well as renal infection. Urodynamic studies had been by the staff of urodynamic unit, confirmed the diagnosis of overactive bladder and urgency.

The patients were randomly divided into two equal groups. Group A included thirty patients with overactive bladder (urge incontinence). They received posterior tibial nerve electrical stimulation of faradic type, biphasic continuous rectangular, with frequency of 0-10 Hz, pulse width 200 μHz, 15 minutes daily, three days/week, with maximum tolerable intensity, for 12 weeks, plus the routine pelvic floor exercise. Group B included thirty patients who received the routine physical therapy program of pelvic floor muscle through pelvic floor exercises 15 min three times a week for 12 weeks.

Electrical stimulation was delivered to the posterior tibial nerve via a combination of electrode and generator components, including a small 34-gauge needle electrode, surface electrode, lead wires, and hand held electrical generator. The low-voltage stimulator had adjustable pulse intensity according to patient tolerance, a fixed pulse width of 200 microseconds and a frequency of 10Hz. The device produces an adjustable electrical impulse that travels to the sacral nerve plexus via the tibial nerve.

Urodynamic investigation system was used to perform the urodynamic investigations, as voiding cystometry . It comprises of a trolley-mounted unit with integral printer and monitor, a mobile patient unit with built in H_2O and CO_2 pumps, a stand-mounted urofloobeen subjected to multichannel cystometry before starting the study and at the end of the study (after 12 weeks).

Measurement was done by urodynamic Evaluation System This procedure was performed by using the

DANTIC UD5000/500 urodynamic investigation system. The urodynamic studies are valid and reliable, by testing the multichannel cystometry.

The variables measured. (a) Initial desire to void which reveals bladder sensation, **(b)** Bladder stability (number of uninhibited detrusor contractility), and **(c)** Maximum flow rate.

RESULTS

The result of this study includes (1st) Results of 1st desire to void in both groups and between Groups, (2nd) Results of Stability in both groups and between groups and (3rd) Results of Maximum flow rate in both groups and between groups: The collected data presented as before (pre) and after 12 weeks of treatment application (post), that to determine role of PTNS in patients with overactive bladder (urgency).

(a) Results of Initial desire to void:

There was no statisticaly significant difference (P>0.05) in initial desire to void for both groups A and B, after 12 weeks (post) when compared with the corresponding mean value before initiation of treatment (pre), with a percentage of improvement of 8.64% and 0.88% for Group A and B respectively.

Comparative analysis of testing initial desire to void between groups. Un-paired t-test of initial desire to void at pre treatment for Group A and group B revealed no statistical by significant differences (p>0.05) of mean value of initial desire to void among both groups at the beginning of the study.

Comparative Analysis of initial desire to void at end of the study (Post-treatment): Un-paired t-test of initial desire to void after application of treatment (post) for both Groups A and group B, revealed no statistical by significant differences (p>0.05) of mean value of initial desire to void among both groups after application of treatment.

(b) Results of stability

For Group A: The statistical analysis of the mean differences of stability by Wilcoxon matched pairs signed ranks test at pre and post treatment of electrical stimulation group revealed that there was a highly statistical by significant difference (<0.05) in stability post of treatment of PTN electrical stimulation group when compared with the corresponding mean value before initiation of treatment, with a percentage of improvement of 48.69% post treatment of electrical stimulation group.

For Group B: The statistical analysis of the mean differences of stability by Wilcoxon matched pairs signed ranks test at pre and post treatment of exercise group revealed the following results: There was no statistical by significant difference (P>0.05) in stability, post treatment of exercise group when compared with the corresponding mean value before initiation of treatment, with a percentage of improvement of 4.25% post treatment of exercise group.

Comparative analysis of testing stability between groups Pre and Post treatment

Pre-treatment: Mann-Whitney test of stability at pre treatment for PTN electrical stimulation group (Group A) and exercise group (Group B) revealed no statistical by significant differences (p>0.05) of mean value of stability among both groups at entry of the study.

Post-treatment: the statistical analysis of the mean differences of stability by Wilcoxon matched pairs signed ranks test at pre-treatment and after application of treatment (Post) of exercise group revealed the following results: There was no statistical significant difference (P>0.05) in stability, after application of treatment (Post) of exercise group when compared with the corresponding mean value before initiation of treatment (Pre). with a percentage of improvement of 4.25% after application of treatment (Post) of exercise group.

Table 1. Comparative analysis of the mean value of stability among Electrical stimulation group (Group A) and Exercise group (Group B) after application of treatment (Post)

Statistics	Stability after application of treatment	
	Electrical stimulation group (A)	Exercise group (B)
Mean	1.933	1.633
Standard Deviation	0.254	0.49
Mann-Whitney U-value	315	
Probability value	0.0411	

Table 2. The statistical analysis of mean differences of maximum flow rate before initiation of treatment (Pre) and after application of treatment (Post) of Electrical stimulation group (Group A)

Statistics	Maximum flow rate	
	Pre	Post
Mean	12.51	15.663
Standard Deviation	6.263	3.861
Mean Difference	3.153	
Paired t-value	3.277	
Probability value	0.0027	
Significance	Significant	
Percent of Change	25.2 %	

Table 3. Comparative analysis of the mean value of maximum flow rate among Electrical stimulation group (Group A) and Exercise group (Group B) after application of treatment (Post)

Statistics	Maximum flow rate after application of treatment	
	Electrical stimulation group (A)	Exercise group (B)
Mean	15.663	12.807
Standard Deviation	3.861	4.693
Un-Paired t-value	2.575	
Probability value	0.0126	
Significance	Significant	

(c) Results of Maximum flow rate

1-Results of maximum flow rate for group (A): As observed in Table 2. There was statistical significant difference (<0.05) in maximum flow rate, post

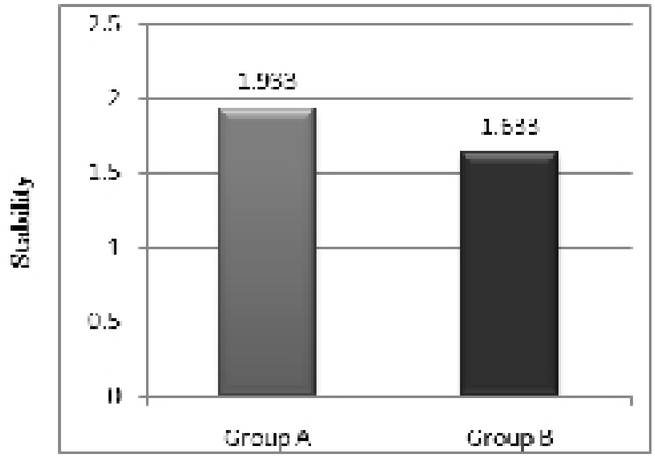

Figure (1): The mean values of stability after treatment (Post) for PTN Electrical stimulation group and Exercise group.

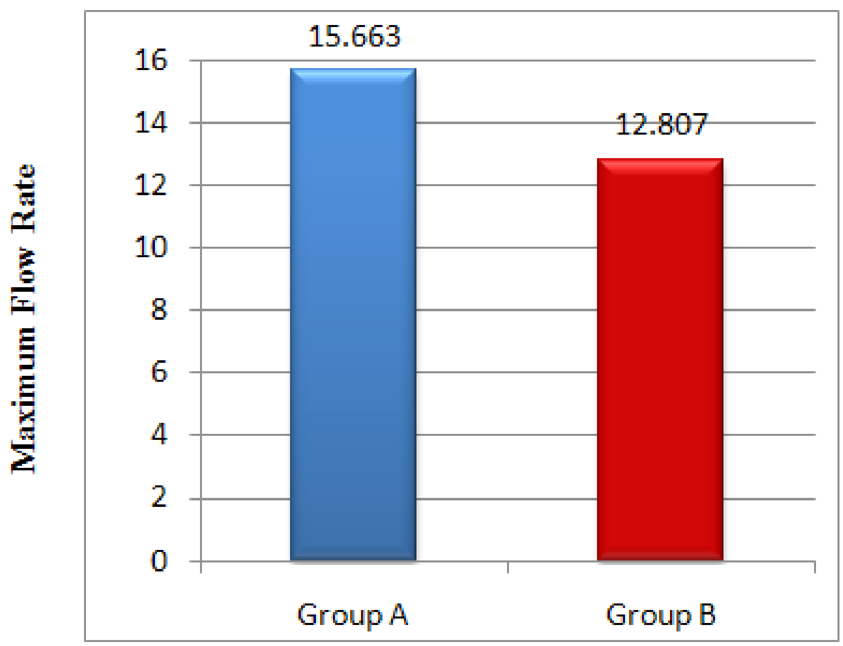

Figure (2): The mean values of maximum flow rate after treatment (Post) for Electrical stimulation group and Exercise group.

treatment of electrical stimulation group when compared with the corresponding mean value before initiation of treatment (pre), with a percentage of improvement of 25.2% post treatment of electrical stimulation group.

For Group B: There was statistical by significant difference (<0.05) in maximum flow rate, post treatment of exercise group when compared with the corresponding mean value before initiation of treatment (pre), with a percentage of improvement of 12.37% post treatment of exercise group.

Comparative analysis of testing maximum flow rate between groups pre and post treatment:

Pre-treatment: Un-paired t-test of maximum flow rate at pre treatment for electrical stimulation group (Group A) and exercise group (Group B) revealed no statistical by significant differences (p>0.05) of mean value of maximum flow rate among both groups at entry of the study.

Post-treatment: As observed in table 3 and figure 2, un-paired t-test of maximum flow rate post treatment for electrical stimulation group (Group A) and exercise group (Group B) revealed statisticaly significant differences (p<0.05) of mean value of maximum flow rate among both groups post treatment.

DISCUSSION

Electrical stimulation of the posterior tibial nerve with needle electrodes demonstrates suppression of detrusor contraction in patients with overactive bladder. Posterior tibial nerve electrical stimulation was chosen as the physiotherapeutic method because it is an interesting alternative for the treatment of overactive bladder, which is effective and without sideffects, despite the fact that pharmacological treatment is currently the first option for the treatment of patients with clinical symptoms of overactive bladder, but adherence to treatment is low, especially due to side effects which lead to discontinuation in 60% of cases. Posterior tibial nerve electrical stimulation is considered to be a simpler, less invasive, and easy to apply form of peripheral sacral stimulation that is well tolerated by patients and more affordable [8].

Posterior tibial nerve stimulation (PTNS) is a technique of electrical neuromodulation for the treatment of voiding dysfunction in patients who have failed behavioral and/or pharmacologic therapies. Voiding dysfunction includes urinary frequency, urgency, incontinence, and nonobstructive retention. Altering the function of the posterior tibial nerve with PTNS is believed to improve voiding function and control. While the posterior tibial nerve is located near the ankle, it is derived from the lumbar-sacral nerves (L4-S3) which control the bladder detrusor and perineal floor [9].

PTNS offers a nondestructive alternative for patients with urge incontinence caused by over active bladder that is refractory to conservative treatment modalities. Detrusor overactivity inhibition is achieved by acute electrical stimulation of afferent somatic sacral nerve fibers by PTNS; the rational of treatment is based on the existence of spinal inhibitory systems that are capable of interrupting detrusor contraction [7]. The aim of this treatment modality is to achieve detrusor inhibition by electrical stimulation of somatic nerve fibers by means of PTNS.

One study used peripheral tibial nerve stimulation on urodynamic findings in patients with Parkinson's disease. The study group had storage issues, overactive bladder, and involuntary detrusor contraction. The results showed significant improvement in patient's symptoms [10]. In a prospective observational study, the efficacy of a tibial nerve stimulation device in patients with overactive bladder unresponsive to pharmacotherapy, fielded initial success rate was 54%, with improvements seen in voiding diary parameters, urodynamic parameters and quality of life scores [11].

In groups of 90 patients with overactive bladder, the result revealed that PTNS delayed onset of detrusor instability [DI] but could not abolish it [12]. Additional studies assessed patients treated with PTNS and concluded that PTNS is an effective, minimally invasive procedure to treat urge incontinence and idiopathic voiding dysfunction [13, 14, 15].

A study compared outcomes between patients treated with the percutaneous Stoller Afferent Nerve Stimulator (SANS) alone and patients that received both SANS plus a low dose of antichoinergic medication. All patients underwent 60 minutes of SANS treatment once a week for a total of eight weeks. The treatment response rate was 61.6% in the SANS group and 83.2% in the SANS plus medication group. The researchers noted that the best symptomatic improvements were seen in patients with urge incontinence [16].There is little difference in outcomes in incontinent patients randomly assigned to PTNS weekly Group 1 versus three times per week Group 2. The result showed 63% and 45% were completely cured after treatment for Group 1 and 2 respectively [17]. In our study we use 1-10 Hz pulse rate which did not lead to fatigue contraction of the leg muscles.

Our results were supported by the following: the beneficial effect of acupuncture on symptoms such as urgency, frequency, and dysuria has been proved by different studies which compare the action on the S6 (posterior border of the tibia, 5cm above the tibial medial malleolus). It is traditionally known for its effectiveness in treatment of lower urinary tract dysfunction. With use of the technique in other parts of the body no symptoms relief has been obtained [18].

PTNS produce improvement in bladder instability, voiding frequency and bladder capacity by urodynamics evidence [19]. PTNS in patients with over active bladder symptoms (urgency ,frequency) had a good results and urodynamics parameters were improved after treatment and showed statistically significant decrease in leakage episodes ,frequency and nocturea [5, 20, 21, 22] .

Objective results based on frequency volume charts, voiding volume, number of leakage episodes, incontinence severity, number of pads used, and quality of life was reported after application of PTNS [23, 24, 25, 19, 26].

PTNS has proving to be effective and well tolerated in adults and produced modification in urodynamic pattern in patients with non-neurogenic bladder dysfunction [27,28].There was an objective effect of PTNS on urodynamic parameters (significant improvement in maximum cyctometric capacity and involuntary detrusor contraction, and this improved bladder overactivity is an encouraging argument favouring PTNS as a non invasive treatment in clinical practice [29] .

The results of a single case study concluded that PTNS increased cyctometric capacity in spinal cord injury patients but detrusal overactivity was not found to recur immediately after stimulation was stopped. In another study of 37 patients there was significant increase in bladder volume at first involuntary detrusor contraction together with bladder maximum cyctometric capacity [30].

Peripheral nerve stimulation produces a statisticaly significant improvement in lower urinary tract symptomse specially day time and night time voiding frequency and volume,leakage episodes [31,21]. A study that include 23 children suffering from un responsive lower urinary tract symptoms revealed that PTNS produced improvement of overactivity symptoms and normalized the bladder cyctometric capacity, detrusor pressure at maximum flow rate and maximum flow rate [32] .

PTNS is a minimally invasive technique that is effective to suppress detrusor overactivity, and improve bladder cyctometric capacity [7]. PTNS has a subjective efficacy of 63–64% and an objective efficacy of 46–54% in a non-neurogenic patient with overactive bladder [6].

Percutaneous tibial nerve stimulation is reliable and effective for non-neurogenic, refractory lower urinary tract dysfunction in children. Efficacy seems better in dysfunctional voiding than in overactive bladder cases. There is evidence that percutaneous tibial nerve stimulation should be part of the pediatric urology when treating functional incontinence [33].

Our results were not supported by the following: In patients with interstitial cystitis PTNS had no significant clinical effect; it may give some response but lesser than through sacral root itself [34] .

PTNS had no effect or failed to suppress detrusor contraction in neurological detrusal overactivity patients, but the bladder volume during the first contraction and cyctometric bladder capacity was increased [35] .

Author study included ten women and five men (mean age, 60 years) with chronic pelvic pain and urinary symptoms who had failed other therapies. After 12 weekly PTNS treatments, mean of visual analogue scale score for urgency changed from 4.5 ± 1.0 at baseline to 2.7 ± 0.7 ($P < 0.05$).Mean visual analogue score for pain decreased from 8.1± 0.2 at baseline to 4.1 ± 0.6 after 12 weeks of treatment($P < 0.01$). They found no statistically significant changes in the number of voids or bladder volume from baseline after treatment [36].

CONCLUSION

This study has demonstrated that PTNS, which is a minimally invasive technique, is effective to suppress detrusor overactivity. Also, demonstrated objective effect of PTNS especially bladder stability, maximum flow rate, improved urodynamic parameters with PTNS, which is observed in this study, is an encouraging finding that further supports its use as an effective treatment modality in the clinical practice of detrusor overactivity. No serious adverse events or sideffects were observed during or after treatments, so posterior tibial nerve electrical stimulation is a new trend in the treatment of overactive bladder and urgency.

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Effects of muscle energy techniques and its comparison to self stretch of bilateral ankle plantarflexors on performance of balance scores in healthy elderly subjects

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ABSTRACT

Purpose of the study: is to investigate whether the application of muscle energy technique on bilateral ankle plantarflexors influence the balance scores of the elderly subjects. Secondary aim is to determine the effect of practice of muscle energy technique on bilateral ankle plantarflexors compared to self stretching for performance on balance tests in elderly subjects.**Materials and Method** : A sample of convenience of 60 healthy elderly subjects were taken. All the subjects (N=60) who were fullfilling the inclusion and exclusion criteria were recruited for the study and randomly assigned into two groups. **Results** From the result t-test and its significance in the pre and post intervention collected from the subjects the following has been inferred In group-1 (MET group): The TUG was significantly decreased by 7.4%. FRT scores were significantly increased by 9.5% along with 31% increase in ankle passive range of dorsiflexion after the intervention. In group-2 (self stretching): The TUG was significantly decreased by 5.4%, FRT scores were significantly increased by 7.9% along with 15% increase in ankle passive range of dorsiflexion after the intervention The average mean increase in the group-1 was greater then group-2 but the difference was not statistically significant. **Conclusion** This appears to be a positive effect of MET which in the first place is considered to be and is applied as a method for improving flexibility and range of motion as well as precarious balance or stability of the elderly, but a less significant change was also found by self stretching but further comparative investigation was done to determine the performance by MET and self stretching maneuver was found not to be significant.

Keywords: Muscle energy technique; Plantar flexors.

INTRODUCTION

Falls present a substantial health problem among the elderly population. Research shows that altered balance is the greatest collaborator towards falls in the elderly, with a high correlation between balance deficit and incidence of falls [1]. The musculoskeletal system plays a great role in the maintenance of balance [2]. As postural control mechanism deteriorate with age and disease, balance becomes increasingly tenous resulting in susceptibility to falls often resulting in fractures and other injuries [3]. Health surveys have indicated that there is a loss of flexibility and range of motion (ROM) in elderly people[4]. There is definite decrease in ankle ROM and is considered as a risk factor associated with decrease in balance thus limiting functional activities such as ambulation [5]. A decrease length of the calf muscle tendon unit (MTU) defined as the decrease in dorsiflexion range of motion with the knee extended is also associated with normal aging in both men and women [6]. Therefore we have studied the ankle joint complex because of its significant role in gait, standing posture, maintenance of balance, shock absorption and adaptation to non level surfaces. A

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muscle must be long enough to permit normal mobility of the joints and be short enough to contribute effectively to joint stability.

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Stretching increases muscle flexibility, maintains and augments the range of joint motion and increases the elasticity and length of the musculotendinous unit. These results can be expected to improve balance[7]. Muscle Energy Techniques (MET) is a manual technique developed by osteopaths that is claimed to be effective for variety of purposes including lengthening a shortened or contractured muscle, strengthening muscles, as a lymphatic or venous pump to aid the drainage of fluid or blood and increasing the range of motion of a restricted joint[8]. It not only restores joint mobility, but also normal function and physiology of muscles[9]. Sandra Yale extols METs potential in even fragile and severely ill patients, older patients with restricted motion from arthritis or brittle osteoporotic bones[10].

Many studies show that increase in ankle ROM increases balance but there is limited amount of information comparing these different stretching techniques, the purpose of this study was a comparison of effect of MET and self stretch on the performance of balance scores of healthy elderly subjects having restricted ankle joint dorsiflexion. Ballantyne F, Fryer G et al conducted a study on the effect of muscle energy technique on hamstrings extensibility and concluded that just a single application of MET produced significant increase in range of motion at the knee joint. Denise K Burns et al conducted a study that showed, the muscle energy technique produced a significant increase in overall regional cervical range of motion. Similar results were given by KL Lenehan, G Fryer, P McLaughlin who conducted a study over the effect of muscle energy technique on gross trunk range of motion. Geiringer et al indicates that muscle demonstrate decreased length can cause joint malalignment and alter the normal available range[11]. Knott and Voss have hypothesised that muscle which surround an abnormal joint undergo length-tension changes according to altered position and restricted range of motion. MET may be valuable for correcting faulty joint positions and hypomobile joints by restoring the original length-tension relationship.

Movements and stabilizing forces about the ankle joint contribute to normal gait patterns and postural control.During the swing phase of the gait approximately 10 degrees of dorsiflexion are necessary for toe clearance, strong ankle plantarflexion during the stance phase is needed for a rapid propulsion of the body forward. An adequate range of motion at the ankle joint complex is an important prerequisite to the precise, efficient gait execution required for just enough elevation to ensure toe clearance during the swing phase. Adequate ankle movements are also necessary for muscular response used to maintain perturbations to balance (McIlroy & Maki, 1996) since locomotion is an integral component of many daily activities, mobility at the ankle joint complex is a constant demand of these tasks.

It is generally thought that the muscles of the lower limbs play a key role in standing, with the calf muscles specially shortening and lengthening to control sway. So this notion leads to an association of calf muscle strength to postural stability. Hence, we hypothesised that aging deteriorates these muscle-tendon characteristics, which in turn are associated with and may partly explain the variance in postural balance performance, especially in more demanding postural tasks[12].

Impairment of this mobility poses a threat to physical safety and can lead to fear for one's safety with imposed restrictions on activity[13]. Hence the high prevalence of falls and dysmobility in older individuals require that geriatric assessment included a reliable, easily administered measure of balance. Functional reach is a new clinical measurement intended to assess dynamic balance of healthy elderly. Diminished reach distance has been associated with an increased risk of fall and fraility in older adults[14]. Hence Functional reach posses both concurrent and predictive validity and continues to be a strong predictor of falls risk when we control the age[15]. The Timed up and go test (TUG): is another test of basic functional mobility.

MATERIAL AND METHODS

A sample of convenience of 60 healthy adults fulfilling inclusion criterion were taken for the study. Subjects were selected from the elderly camp organised by a private physiotherapy clinic and were randomly assigned in two groups.

Inclusion Criteria

Asymptomatic healthy and independent elderly, age 60-80 yrs[16].

- Ankle dorsiflexion passive range of motion of less than 10 degrees
- Independent in activities of daily living
- Good cognitive function (Mini-Mental State Examination score of > 23)[17].

Exclusion Criteria[5,8,14]

- A FRT score of less than 7 and a TUG score of more than 30 seconds
- Any recent injury, surgery, pain or deformity around the ankle.
- Presence of any disorder that can account for problem in balance or unexplained fall.
- Shoulder flexion less than 90 degrees.
- Elbow flexion contracture
- Muscle tightness as hamstrings, quadriceps.
- Absent proprioception and / or abnormal tone.
- Had any previous neuromuscular or vestibular disorder.
- Malignancies of lower extremities
- Diabetes with neuropathy in lower extremities.
- Any systemic pathologies:Rheumatoid arthritis, Ankylosing Spondilitis, etc.

- Persons undergoing mobilization exercises for lower limb , especially ankle and / or balance training.

Procedure

The study was a Pre-test Post–test Control Experimental Design to measure balance scores before and after a stretching intervention. The independent variable was the application of MET and self stretching. The dependent variable was the performance in the balance score of the elderly.

The variables like height, weight, ankle dorsiflexion in lying (active and passive), plantar flexion in lying (active and passive) were measured.

The correlation of functional reach values and timed up and go test scores with ranges of motion were analyzed after applying different stretching techniques.

Total number of subjects was divided into two groups:

*Experimental group 1 (group 1): 30 subjects

*Control group (group 2): 30 subjects

Group 1- Application of superficial heat for 10 minutes, followed by muscle energy technique for 10 seconds for 3 times once a day for each leg (plantarflexors) alternately.10

Group 2- Application of superficial heat for 10 minutes, followed by 10 repetitions in each in a single daily session. Each stretch was held for 30seconds with upto a 30-second rest period between repetitions. Subjects who were unable to hold a stretch for 30 seconds were instructed to hold each stretch as long as possible with the goal being 30 seconds [guidelines of American College of Sports Medicine (ACSM) [18].

The balance scores were measured before and after stretching intervention soon after the completion of intervention on the same day.

Protocol

The purpose of the study was explained to the subject. Verbal description of all the procedure was given. Testing was performed only after informed consent was taken from the subject. Each subject who agreed to participate in the study was asked to complete a MMSI questionnaire which is a neurological examination test done in elderly[17].

A goniometer was used to measure joint range of motion of ankle joint. Three measurements were made for each movement and the average value was taken.19

Measurement of Balance Scores

Functional Reach Test 8

The initial position was standing by the side of the wall mounted with the yardstick. The yardstick was positioned horizontally on the wall at the level of the acromion of the dominant glenohumeral joint. A pointer (pencil) was attached at the head of third metacarpal of the subject. the subject was asked to Raise arm from the shoulder from the horizontal plane in front. Make a fist and hold it. Care was taken not to allow trunk rotation / shoulder protraction by emphasizing the subject to keep both the shoulders in the same horizontal plane, to maintain wrist in neutral, elbows extended and arm in horizontal position to the trunk while taking the initial measurement. The measurement at the yardstick that corresponds to the third metacarpal level was marked. This was taken as the initial reach. Then the subject was asked to reach forward along the yardstick as far as possible without losing balance or taking a step. The subject is asked not to touch the wall or the ruler. The position of the third metacarpal is noted and taken as the final reach. The difference between these two values has given the functional reach value. Two practice trials were allowed followed by three measurement trials. The researcher guarded all the subjects during the test.

Timed Up and Go Test20

The timed up and go test measures the time it takes a subject to stand up from an arm chair, walk a distance of 3 meters, turn, walk back to the chair and sit down. A chair of 46 cm of height was used for the study. A 3 meter distance was marked on the floor in front of the chair. The test began with each subject sitting, back against the chair, arms resting on the lap and feet supported on the ground. The subject was instructed that on the word "GO", one should stand up, walk comfortably and safely to the mark on the floor, turn around, come back and sit on the chair. The subject was informed that the trial would be timed. Timing began at the word "GO" and ended when the subject's back rested against the chair upon returning. A practice trial was performed for all subjects before the recorded trial. This was to make the subject familiar with the procedure.

Data Acquisition

For all the dependent variables (functional reach value and timed up and go test scores), objective evaluation was done during the procedure. Three readings were taken.

Placement of Strain gauge[21]

Measurement of maximum voluntary contraction (MVC) of ankle plantarflexors.

The patient is positioned supine with hip and knee at full extension with heel raised by placing cushion below the calf. The strap is placed around the metatarsals with the therapist stabilizing around the ankle and knee. The strain gauge is mounted to a wall. The foot is moved into plantar flexion for measuring MVC and the reading is recorded.

Assessment of Tight Plantarflexors[10]

The patient is supine with feet extending over the edge of the table. For right leg examination the therapist left grasps the Achilles tendon just above the heel, avoiding the pressure on the tendons. The heel lies in the palm of the hand, fingers curving around it. The practitioner's right hand is placed so that the fingers are placed on the dorsum of the foot (these are not active and do not apply any pulling stretch), with the thumb on the sole, lying along the medial margin.

Stretch is introduced by the means of a pull on the heel with left hand, taking out the slack of the muscle, while at the same time the right hand maintains the cephalad pressure via the thumb (along its entire length).

A range of movement should be achieved which takes the sole of the foot to a 90degrees angle to the leg without any force being applied. If this is not possible(i.e. force is required to achieve the 90degrees angle between the sole of the foot and the leg), there is shortness in the plantar flexors.

It is possible to use the (left) hand which has removed slack from the muscles via traction to palpate for a sense of bind, as the foot is dorsiflexed. The leg must remain resting on the table all the while and the right hand holding/palpating the muscle insertion and the heel should be placed so that it is an extension of the leg, not allowing an upward (towards the ceiling) pull when stretch is introduced.

MET Treatment of Shortened Plantar flexors10

The exact same position is adopted for treatment as for testing. Starting from the appropriate position, at the restriction barrier or just short of it, based on the degree of acuteness or chronicity, the patient is asked to exert a small effort (no more than 20% of available strength) towards plantarflexion, against unyielding resistance, with appropriate breathing.

This effort isometrically contracts gastrocnemius and soleus. This contraction is held for 10seconds together with held breadth.

On slow release, on an exhalation, the foot/ankle is dorsiflexed to its new restriction barrier if acute, or slightly and painlessly beyond the new barrier if chronic, with the patient's assistance.

If chronic, the tissues should be held in slight stretch for atleast 10 seconds to allow a slow lengthening of tissues.

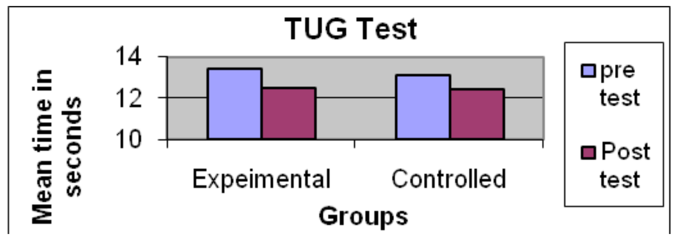
This pattern is repeated for further gains for 3more times (backing off to mid-range for the next contraction, if chronic, and commencing the next contraction from the new resistance barrier if acute)

Self stretching protoco[122]

Patient is in long sitting position with a towel wrapped around foot and held in the both hands to provide resistance during isometric phase each stretch will be held for 30 seconds with up to a 30 seconds rest period between each repetition, stretching were done for 10 repetition in a single session (guidelines of the American College of Sports Medicine [ACSM]

Data Analysis

All data was collected and analysed using SPSS for windows version15. The data collected consisted of subjects score on the Timed up and go test, Functional reach test, Range of motion at ankle joint. The scores on timed up and go test was determined by taking mean of two readings awarded by each member of the group and mean for a subject over 3 trials was taken as the score of the elderly on functional reach test. The test –retest reliability of the performance of the patient on the balance score was determined using mean, standard deviation, the paired t-test at 95% confidence intervals, the pearson's coefficient were used to determine whether a true linear relationship existed between muscle energy technique and balance score of elderly. Also for comparison between the experimental group and control groups, the magnitude of difference in the values between pre treatment and post treatment were tested. Pre and post intervention were analysed for both the control and experimental groups using independent t test and significance was set at 95% confidence



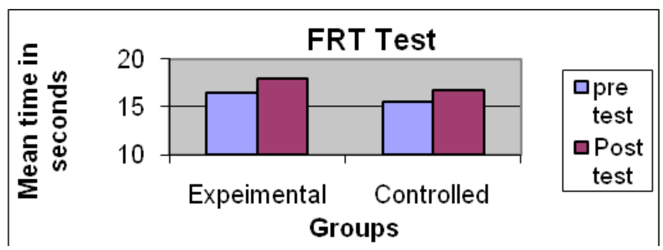
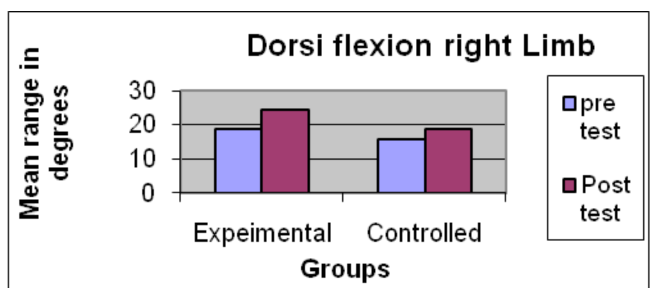


Fig 1.1. Comparison for Timed up and go scores



for experimental and control group

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RESULTS

Sixty subjects of both sexes with mean age of 65.08 ± 5.29 were agreed to participate in the study.

Fig 1.2. Individual scores of subjects in timed up and go test in experimental group

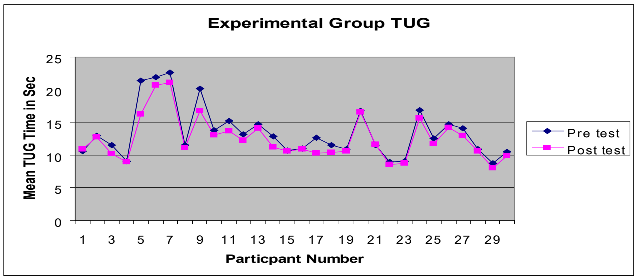
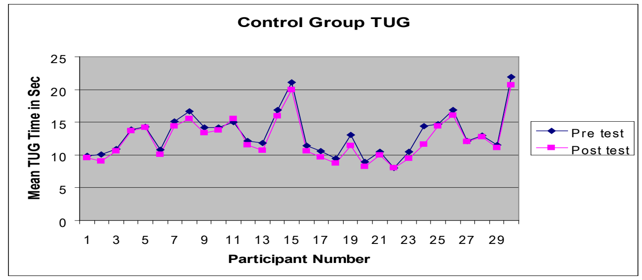


Fig 1.3 Individual scores of subjects in Timed up and go test in Control Group



Thirty subjects were randomly selected and placed in the treatment group and received muscle energy technique along with hot pack application and remaining thirty subjects were placed in the control group and underwent self stretching along with hot pack application. All values are expressed as mean ± standard error. Independent t-test is used to find the significance between the experimental group and the control group. Dependent t-test or paired t-test was also used to find the significance within the group to see the effect of treatment.

Differences in pre and post data

Paired t-test was performed to test the significance of the differences observed in the pre and post values of the various parameters in the data of the subjects in experimental and control group and independent t-test is applied to check which significance between two groups.Timed up and go test (TUG):

Experimental Group: the result was found to be insignificant because the $p \geq .05$.(Refer Fig 1.2)

Dependent t-test is also applied to find that is there any effect of muscle energy technique on

timed up and go test and the result is found to very significant

Control group: the result was found to be insignificant because the $p \geq .05$.

Dependent t-test is also applied to find that is there any effect of self stretching on timed up and go test and the result is found to very significant because $p \leq .05$.(Refer Fig 1.3)

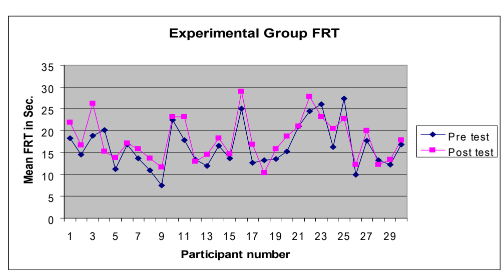
Functional reach test (FRT)

Experimental Group: Independent t-test was applied to find the significance between both the groups but the result was found to be insignificant sependent t-test is also applied to find that is there any effect of muscle energy technique on functional reach test and the result is found to very significant (Refer Fig 1.4).

Control group: Independent t-test was applied to find the significance between both the groups but the result was found to be insignificant

Dependent t-test is also applied to find that is

Fig 1.4. Individual scores of subjects in functional reach test in experimental group



there any effect of Self stretching on functional reach test and the result is found to very significant

Range of motion

On right and left side: Dorsiflexion

Experimental Group: Independent t-test was applied to find the significance between both the groups the result was found to be highly significant Dependent t-test is also applied to find that is there any effect of muscle energy technique in increase the dorsiflexion at ankle joint and the result is found to very significant.

Control group: Independent t-test was applied to find the significance between both the groups the result was found to be highly significant. Dependent t-test is also applied to find that is there any effect of self stretching in increase the dorsiflexion at ankle joint and the result is found to very significant.

From the result t-test and its significance in the pre and post intervention collected from the subjects the following has been inferred

In group-1 (MET group): The TUG was significantly decreased by 7.4%. FRT scores were significantly increased by 9.5% along with 31% increase in ankle passive range of dorsiflexion after the intervention.

In group-2 (self stretching): The TUG was significantly decreased by 5.4%, FRT scores were significantly increased by 7.9% along with 15% increase in ankle passive range of dorsiflexion after the intervention.

The average mean increase in the group-1 was greater then group-2 but the difference was not statistically significant.

DISCUSSION

An individual with limited ankle joint mobility may be a risk for tripping and fall, an event which sometimes leads to serious injury and dependence2 On basis of various studies done, it established that a minimum of 10 degrees of dorsiflexion range of

Table 1.1 Experimental Group Paired T-test/Dependent

	Mean	Standard Deviation	T-Value	Deg of Freedom	P-Value
TUG1-TUG2	.9557	1.10	4.72	29	0.000
FRT1-FRT2	-1.57	2.76	-3.11	29	0.004
DFR1-DFR2	-5.77	3.04	-10.40	29	0.000
DFL1-DFL2	-5.20	2.62	-10.87	29	0.000

Table 1.2 Control Group Paired T-test/Dependent T-

	Mean	Standard Deviation	T-value	Degree of Freedom	P-value	
TUG1-TUG2	.71	.58	6.60	29	0.000	
FRT1-FRT2	-1.23	3.36	-2.01	29	0.054	
DFR1-DFR2	-3.13	1.63	-10.50	29	0.000	

motion is needed during stance (Murray et al; 1966, Stauffer et al; 1977) and swing phase (Patla, Frank and Winter, 1990) of normal gait. There is a correlation between ankle range of motion and balance in community dwelling elderly5 andthe literature reports that stretching significantly benefits flexibility imbalances may be associated with balance impairment and falls.7

The data demonstrates that in group I where MET was applied to the bilateral ankle plantarflexor muscles there was significant increase in the balance scores of functional reach test (- 1.57 ± 2.76; P= .004), TUG (.95 ± 1.10; P= .000) and passive range of ankle dorsiflexion for both right and left sides respectively (Right side =-5.77 ± 3.04; P= .000), (Left Side =-5.20 ± 2.62; P= .000). For the control group in which self stretching was applied at the ankle joint the increase in functional reach test (- 1.23 ± 3.36; P= .054), TUG (0.71 ± 0.58; P= .000) and passive range of ankle dorsiflexion for both right and left sides respectively (Right side =-3.13 ± 1.63; P= .000), (Left Side =-2.57 ± 1.36; P= .000). However, the research provides us with the evidence that muscle energy technique is a valuable and good tool which can benefit the joints and muscles simultaneously.23 The mechanism underline improved muscle flexibility may be a result of biomechanical or neurophysiological changes or an increase tolerance to stretching.3 The joint is mobilized by the isometric muscle contraction and it is believed that golgi tendon reflex is activated which is claimed to produce a stretch on the golgi tendon organs and a reflex relaxation of the muscle.3

The another aim of study was to compare the two techniques for balance scores and the result shows undoubtedly the average mean increase in balance scores in group I where MET was applied was better then the group II where traditional self stretching technique was used. Subsequently, the two groups were not statistically significant.

The study reveals that MET is a physiologically adequate technique which utilizes the patient own muscle contraction to alter restriction of motion. MET provides safety for the patient as the intensity of contraction is lesser (20%-30% MVC) and the activating force is intrinsic and the patient can easily control the dosage with lesser effort which is easier for the elderly.24After the sustained but light contraction a momentary pause should occur before the therapist stretches the shortened and contracted muscle to a new resting length. Also it is an appropriate technique to correct postural balance and gait by treating group of muscles that influence joints to withstand gravitational strain. 25Furthermore, it should be noted that the MET applied throughout this study aimed to increase gross range of motion at ankle joint which is a significant and independent predictor of balance, which it succeeded in doing.

In comparison, self stretching is a traditional and widely practiced intervention which leads to improvement but the effect is not maintained for long and even have some negative effects as revealed by the various studies done.

Kirsch et al also examined the effect of a maintained stretch on ankle ROM in healthy subjects and reported small and transient increases in ROM with 60 seconds of sustained stretching.26

As the study conducted by Scott G. Spernoga et al; 2001 reported that a single session of stretching does not deform tissues enough to produce a permanent change i.e a plastic deformation in musculotendinous unit. Therefore, the temporary improvement in hamstrings flexibility may be attributed to changes in elastic region caused by a single session of stretching.27

In addition, the results of the following study seem to produce improvement in the balance scores with regards to ankle ROM which is a important factor in balance affection and hence provide therapist with a valuable tool to monitor and regulate falls status for the aged in the community.

The outcome of this study might contribute to the development of adequate exercise programs aiming at preventing or slowing down the age related decline of physical functioning and maintained optimal independence and quality of life without unduly restricting activities.

CONCLUSION

In summary, the findings of the present study demonstrates that a moderate bout of MET (three repetitions for each individual) held to the point of discomfort/barrier can affect performance on test of balance as well as the passive range of motion (for dorsiflexion and plantarflexion). The technique used for stretching should be preferred as patient is actively participating in the treatment which is psychologically healthier for him and because likelihood of damage to the muscle and its supporting connective tissue is less.

This appears to be a positive effect of MET which in the first place is considered to be and is applied as a method for improving flexibility and range of motion as well as precarious balance or stability of the elderly, but a less significant change was also found by self stretching but further comparative investigation was done to determine the performance by MET and self stretching maneuver was found not to be significant.

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A differential Electromyographic analysis of Rectus Abdominis muscle segments during performance of different test movements: A randomized within participants experimental study

Swati C. Meshram

ABSTRACT

Objective: To compare surface EMG activity of upper & lower portion of Rectus Abdominis activity during 4 test movements viz, trunk curl up(TCU), Leg Lowering, Abdominal Muscle Lift (AML) , Leg Raise .To provide the biomechanical basis for rationalized clinical testing & training of abdominals. To find out an activity producing optimal & maximal activation of abdominals. **Methods:** Study design & setting: Randomized, repeated measure within subject, experimental study .All measurements were performed in hospital EMG laboratory. **Study population:** 20 normal healthy female chosen randomly who were capable to perform all test movements comfortably. **Procedure**: EMG data was collected from Upper &Lower portion of Rectus Abdominis muscle during performance of 4 tests movements by the subjects. **Outcome measures:** Peak EMG amplitude during maximum recruitment of muscle. **Results:** Study showed differences in the activation of rectus abdominis during 4 tasks. Amongst all the exercises Abdominal muscle lift (95% CI=82.5-93.8, 89.7-98.2) showed greater activation followed by Trunk curl up (95% CI=80.4-97.3, 74.8-93.3), Leg raise (95% CI=57.2-74.09, 63.3-79.4) & leg lowering (95% CI=53.8-70.4, 52.9-71.7). **Conclusion:** No significant differences in the activation of two portions. Rectus Abdominis activity is maximum during abdominal muscle lift.

Key words: Rectus Abdominis; EMG activity; Abdominal muscle testing; Abdominal muscle lift.

INTRODUCTION

Rectus abdominis is broad & long muscular strap descending throughout the abdominal wall. It acts to support the viscera, helps in respiration [1]. It is most active in crook lying curl up [2].

Apart from its action as the flexor of torso [1] it has recently been defined as movement synergist & global stabilizer of the spine [3, 4]. Muscle also bears great share of load of pregnant uterus & undergoes great amount stretching & widening [5].

Strengthening of this muscle has been given prime importance not only in the rehabilitation of low back pain population but also in fitness testing & training in sportsperson. Its testing & training involves curling of trunk & leg exercises for upper & lower portion of muscle resp [6,7].

Various studies have been conducted to quantify the activation level of upper & lower portion of RA during various exercises. One such study Showed that curl type exercises activates upper rectus while pelvic tilting type of exercises activates lower rectus to the greater extent [8]. Another study examined upper, medium, lower rectus abdominis during seven abdominal exercise tasks [9]. Significant differences in activation of the different portion

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were observed. While other evidences suggest no such differences between its portions, significant difference was present amongst the exercises with regard to activation of RA muscle as a whole [10]. In another study, little differences (20%) were found which were attributed to geometric & postural changes rather than preferential activation of upper & lower portion [11].

Present study, attempts to examine the extent of activation of upper & lower portion of rectus abdominis during performance of 4 different task. These include basic exercises used to test the muscle in its upper & lower portion differently. Such a trial have neither been attempted before nor does any subtle evidences exist to support the view that this exercise preferential activate portions of RA differently.

Present study was an attempt to analyze normalized Electromyographic activity of upper & lower segments of rectus abdominis muscle. Spinal curvature & torso geometry was maintained constant. This was done to obtained constant force output making data comparable.

METHODS

Study design: Structured, randomized, Prospective, Comparative, study [12].

Sampling techniques: Simple random sampling.

Study population: 20 healthy female resident volunteer, undergraduate students of physiotherapy. (Age=19.45+ 0.4, BMI=16.75+1.3)

Study set up : EMG lab, Shree Swaminarayan College of physiotherapy, Kadodara, Surat. Local ethical committee of college approved the study.

Inclusion criteria

Healthy females with their informed consent to participate in study. Only female subjects were studied because the variation in the amount and distribution of subcutaneous tissue between the sexes could have confounded the results.

Exclusion criteria

Subjects having BMI > 24.9.Subjects giving H/O recent injury, any kind of musculoskeletal impairment (structural & functional), recurrent backaches, abdominal colic of any origin etc. Subject who did not give informed consent to participate in study.

Subject selection: 20 subjects satisfying above criteria.

PROCEDURE

Assessment:

Participants were subjected to strength testing of the RA.

For this purpose basic test movement (TM) were used [7].

TM 1: Trunks curl up test as follows:

Subjects were positioned in crook lying position with knees flexed to 90 degree. They were asked to perform following movements.

Grade 1: Lifting of head in an attempt to look towards the toes hold it for 6 sec.

Grade 2: Lifting of head & curling of shoulders off the plinth & hold it for 6 sec.

Grade 3: Hands towards knees lifting of head &curling of shoulders with rib cage off the plinth until lower angle of scapulae clears plinth & hold it for 6 sec.

Grade 4: Hand across the chest lifting of head & curling of shoulders with rib cage off the plinth until lower angle of scapulae clears plinth & hold it for 6 sec.

Grade 5: Hands behind head curling of shoulders with rib cage off the plinth till lower angle of scapulae clears plinth & hold it for 6 sec.

Maximum possible grade that subjects were able to perform was noted.

TM 2: Bilateral leg lowering test

Position of subjects: Crook lying position with hip flexed to 70-degree position. BP cuff placed below lumber spine. Subjects were asked to perform posterior pelvic tilting action. Mercury level was noted. Subjects were asked to maintain pelvic tilt so that mercury level at any time does not fall below the noted reading + 10 mm of Hg while lowering the legs [15].

Maximum grade was noted as follows:

Grade1: hip flexed to 90 degree.

Grade 2: hip flexed to 60 degree.

Grade 3: hip flexed to 45 degree.

Grade 4: hip flexed to 20 degree.

Break of 4 min was given between each grade. [7].

Subjects were kept in their predetermined test position (max grade possible on TCU & leg lowering test).Skin was prepared for the application electodes. Cathod was placed appx. 3 cm lateral & 5 cm superior& inferior to umbilicus for upper & lower portion of rectus abdominis resp on rt. side[8,13].

Instrumentation

Surface EMG (double channel , Neuroperfect Medicaid System) was used to record the muscle activity of upper & lower portion of rectus abdominis at simultaneously while execution of task. Filter settings were adjusted to 20 Hz to 2Kz with sensitivity at 500 UV. Electrode movement was avoided by keeping posture constant & collecting data during isometric hold.

Data Collection

Subjects were passively kept in their predetermined test position for TCU & Leg Lowering Activity. Raw EMG data was collected from URA & LRA when subjects exerting actively to hold the

TM 1: Trunk curl up test (TCU)

TM 2: Bilateral Leg Lowering Test

TM 3**:** Abdominal Muscle Lift test.

position in predetermined grades. Similarly, Data was also collected for abdominal muscle lift & leg raise activity. During leg raise Pelvic tilting was monitored same as in leg lowering activity. Subjects were trained for both the activities just prior to data collection.

TM 4: Leg Raise

Abdominal muscle lift is the activity similar to trunk curl up .Only difference is that the neck lies in line with trunk .Subject attempts to lift the trunk off the plinth. Starting position remains similar to the TCU activity [13].

Leg raise is activity where subject has to bilaterally raise the legs without curling of the back, which was monitored through the pressure cuff [7].

Outcome parameters: Raw EMG data was collected over 2 sec for each of 4-test activities. Data of each subject for URA & LRA separately was then normalized to max EMG activity noted during any of four tasks. Same procedure was followed for all 20 subjects. Thus, actual data used for comparison was the % of max EMG activity of upper & lower

Table1: Showing demographic data of subjects included in study

	weight	height	TCU	LL	BMI
Mean	43.45	161.25	4.15	1.7	16.72
Lower95% CI	42.16	158.95	3.8	1.35	16.09
Upper 95% CI	44.73	163.54	4.49	2.04	17.4
S.D	2.74	4.89	0.74	0.73	1.39
S. E	0.61	1.09	0.16	0.16	0.31

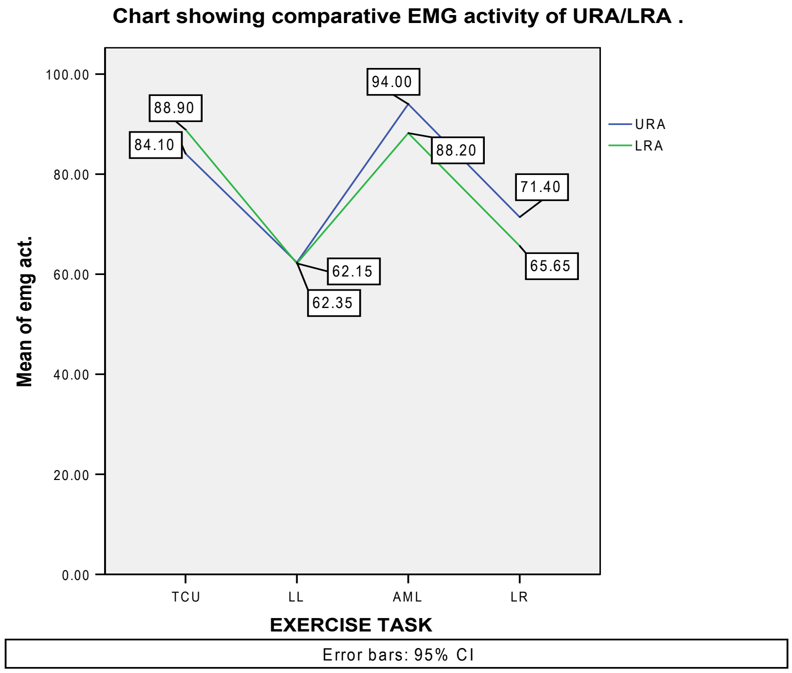
Table 2: Descriptive analysis of URA for all test movements

	N	Mean	S.D	S.E.	95% C.I.
TCU	20	84.1	19.76	4.42	74.84-93.35
LL	20	62.35	20	4.47	52.98-71.71
AML	20	94	8.98	2	89.79-98.2
LR	20	71.4	17.15	3.83	63.37-79.42
Total	80	77.9	20.68	2.31	73.36-82.56

Table 3: Descriptive analysis of LRA for all test movements

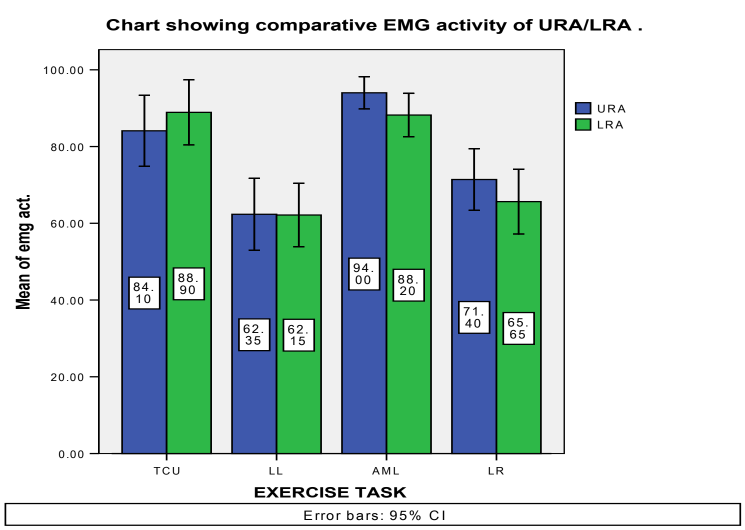
	N	Mean	S.D	S.E.	95% C I
TCU	20	88.90	18.13	4.05	80.41-97.38
LL	20	62.15	17.66	3.94	53.88-70.41
AML	20	88.20	12.06	2.69	82.55-93.84
LR	20	65.65	18.03	4.03	57.20-74.09
Total	80	76.22	20.56	2.29	71.64-80.80

portion. This enabled us to rectify the individual differences of strength as well as making the data comparable [8, 11, 13].



Paired Samples Test

Test Mov.	Mean diff	S.D	95% C I	t	Sig. (2-tailed)
TCU	-4.80	22.04	-15.11-5.51	-0.97	0.34
LL	.20	17.90	-8.17-8.57	0.04	0.96
ABM	5.80	12.71	-0.15-11.75	2.04	0.05
LR	5.75	23.02	-5.02-16.52	1.11	0.27



DATA ANALYSIS

Normalized EMG data was analyzed to compare the activity of upper & lower portion of RA during an exercise task .Also all 4 activities were compared for the extent of activation of rectus abdominis.

Comparison of URA amongst all 4 activity through ANOVA: F=13.30, P=0.000.CI =73.36-82.56. Comparison of LRA amongst all 4 activity through ANOVA: F=14.7, P=0.000.CI =71.64-80.80.Bonferroni Post hoc test suggest that TCU activates muscle to the similar extent as abdominal muscle lift task for LRA (P=1.000, CI=-13.58-14.9) & URA (P=0.4, CI=-24.5-4.7).Leg lowering activates muscle to the similar extent as leg raise task for LRA (P=1.000,CI=-17.7-10.78)& URA (P=0.58,CI=-5.57-23.67).

Chart:1

Table 4: Comparison of activation between upper & lower portion of RA during performance 4 exercise task.

DISCUSSION

Descriptive analysis suggests no significant differences between upper & lower portion of rectus abdominis activity (table4) (chart2), although the differences exist in the level of its recruitment amongst the tested exercise task. (Table 2, 3).One of the study showed similar findings in which Rectus Abdominis did not show any differences concerning its upper & lower portion recruitment during curl up exercise. However, extent of its recruitment amongst 4-exercise task showed differences. On the other hand, same study showed reduced EMG activity during reverse curl up, leg lowering, & rolls out task [10].

In present study, attempt is made to compare basic test movements i.e. TCU & leg lowering with abdominal muscle lift, which haven't been tried before. Amongst the 4 tested exercise task; abdominal muscle lift showed overall greater activation of upper &lower part of rectus abdominis followed by trunk curl up as compared to leg lowering & leg raise activities .(Table3,4). Differences are statistically significant. The exercise tasks selected for the present study are the activities used to test the upper & lower portion of Rectus Abdominis muscle differently [7, 14].

However, findings of present study suggest that the lifting of upper torso type of activity activates the rectus abdominis in the better way as compared to leg lowering & leg raising task. One of the study supports this finding in which significant differences were observed between upper & lower portion of rectus abdominis muscle during performance of certain exercise task [13].

Results also suggest that abdominal muscle lift was the activity has a tendency to recruit rectus abdominis to maximum extent consistently followed by trunk curl up. (Table 3, 4)

Findings presented by sarti et al, showed the preferential recruitment of lower rectus abdominis during posterior pelvic tilting exercises in highly trained individuals. While upper portion of rectus recruited more during trunk curl, type of exercises. [8]. In his study , author had assigned the subject to a group of highly trained correct performers, so it is highly doubtful that to which extent the above findings can be made generalized to the population where fitness characteristics are varied & non uniformity exist amongst the demographic characteristics of the subjects. In our study, we selected the physiotherapy female students of average built, who were not under any training programme. (Table1)

Our main concern was to study the activity of lower portion of rectus abdominis recruitment during trunk curl up & abdominal muscle lift.

It was noted that lower portion was activated to similar extent as the upper portion of rectus in fact its recruitment was greater during this two activities as compared to leg raise &leg lowering activity, which was significant statistically (table3). The result does not support the belief that leg raise & lowering are necessary conditions to activate the lower portion of rectus abdominis. That the strength & endurance adaptation occurring at one section should occur in other section too [13]. During leg raise & leg lowering activity overall Rectus Abdominis activation was although the lesser than as compared to other two task; both the upper & lower portion were activated the similar extent. (Table 4) Thus, even the upper part of rectus can be stimulated through the leg raise & leg lowering exercises. Thus, we can say that as lower portion gets activated to the similar extent as upper portion through AML & TCU, upper portion gets activated to the similar extent as lower one in leg raise & leg lowering. Further selection then depends on whether eccentric muscle work or concentric muscle work is required & determine by the effects of specificity of training. Thus, lower portion of rectus testing & training can be achieved satisfactorily through trunk curl up & abdominal muscle lift exercise.

It was shown that curl up activity at least activates 20-50% of MVC of rectus abdominis, which is sufficient to stimulate force production (strength) & endurance. In same study 20% differences in differential recruitment of upper & lower portion of rectus abdominis were observed. This was attributed to geometric & postural changes [11].

Thus, to bring about an activity whether it is to curl up the torso or lift & lower the leg, both the portions of rectus are recruited to almost similar extent in general population of average strength. (Table 4).The scope for its clinical application in certain situation should be searched out .e.g. diastasis of recti where rectus testing & training cannot be undertaken thought trunk curl up exercise .In this situation leg lowering or its lowest sub grades can be used to test & train the muscle.If any portion becomes preferentially weak as occurs in the diastasis of lower portion of recti 2 possibility exists. First, not only leg raise but trunk curl will also be weak. Second, strong portion must be compensated for the weak part to bring an activity creating undue overloading of the respective part of thoracolumber spine. Amongst 4 exercises, all the activities tested muscle concentrically except leg lowering task where muscle works eccentrically. Trunk curl up & abdominal muscles' lift checks muscle ability to raise the torso while leg raise & leg lowering checks its ability to stabilize the pelvis ability to against the moving limb.(static action). Hence, each of the exercise bears unique biomechanical characteristics. This should be a deciding factor while undertaking the testing & training procedure for the rectus abdominis. This possibilities advocates further research & needs to be tested clinically.

CONCLUSION

Traditional exercises employed for the differential testing of rectus abdominis recruits both portions to similar extent. In such situation, purpose of testing, training, & biomechanical characteristics of an exercise should be a consideration. Given priority to theses aspects, one should use realistic testing procedures in certain special situations.

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Comparison of Energy Expenditure in Community Ambulating Spastic Diplegic Children with and without Walker: A Cross-sectional Study

Jaya Shanker Tedla, Kavitha Raja

ABSTRACT

Purpose: To compare energy expenditure of ambulation with and with out walker on outdoor uneven surface and indoor even surface in children with spastic diplegia. **Methods:** Twenty five children (13boys, 12 girls) with spastic diplegia, between 5-17 years walked for 50 meters on an indoor even surface and outdoor uneven surface with and with out walker. Their energy expenditure was measured by Physiological Cost Index (PCI). **Results:** Independent t-test and paired t-test were used for analysis. There was a statistically significant difference between children who walked either with hand support or independently and with walker. Indoor performance was better than outdoor performance under both conditions. Children walking independently or using hand support consumed less energy than children who used walker on both surfaces ($p < 0.05$). **Conclusions:** Children with spastic diplegia require more energy when ambulating with walker than when ambulating with hand holding assistance or independently.

Key words: spastic diplegia, walker, energy expenditure, physiological cost index.

INTRODUCTION

Increased energy expenditure during walking is one of the hall marks of spastic diplegia [1]. Assessment of energy expenditure during walking is an important parameter, which can be used to determine clinical and functional improvement in children with spastic diplegia. Energy expenditure has traditionally been calculated by measuring oxygen consumption, but this method involves the use of expensive and cumbersome equipment. Such apparatus may adversely affect the measurement it self and it is particularly unsuitable to use for children and the disabled [2, 3].

Studies have shown that heart rate is linearly related to oxygen consumption at submaximal levels[4, 5, 6]. Speed of walking can also be a useful indicator. In normal subjects, speed increases from childhood to young adulthood, then declines with age. With each age group, the relationship has been found to be linear in normal children and adults up to a speed of 100 meters per minute [7]. This relation ship is also seen in children with cerebral palsy [8, 9].

Both speed and heart rate have been used as indicators of efficiency and energy cost of locomotion [10]. Mac Gregor first reported their combined use in 1979. He suggested that the effect of an activity was better represented by the net heart rate (working heart rate -resting heart rate) divided by speed of walking, thus yielding a physiological cost index (PCI) in net beats per meter. He demonstrated that for a variety of normal and handicapped subjects, PCI was minimal at self-selected or preferred speeds of walking and that the relation was reproducible [11].

PCI can be used either to measure changes in

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locomotor efficiency over time, or changes as a result of the use of different Orthotic and prosthetic devices, or as an indicator of handicap when compared with the matched normative data.3, 9, 12 In general, whatever the cause of disability, a pathological gait yields a higher value for PCI.

Duffy CM et al looked for differences in the energy expenditure patterns of ambulant children with cerebral palsy and spina bifida compared with normal healthy children. The rate of oxygen consumption (ml/kg/min) was significantly higher in the children with diplegia than in those with hemiplegia , spina bifida or healthy children. This suggests that energy expenditure in children with cerebral palsy is more than normal [12].

Earlier studies have shown the efficacy of assisted device like AFO to improve energy expenditure in ambulant children with cerebral palsy [13, 14]. Many children with cerebral palsy have difficulty in walking. Assistive devices like walkers are frequently prescribed to these children to provide the additional stability required for ambulation.

The thrust towards ambulation is greater in our country due to socio cultural reasons. Walkers are the most common assistive devices prescribed to children with spastic diplegia who are capable of ambulation with assistance at the time of discharge from hospital. Walkers also help in improving gait pattern of spastic diplegics [15]

One of the common observations noticed in children with spastic diplegia at the time of review in the hospital is that they do not use the walker

Figure-2; Spastic diplegia children who walked independently

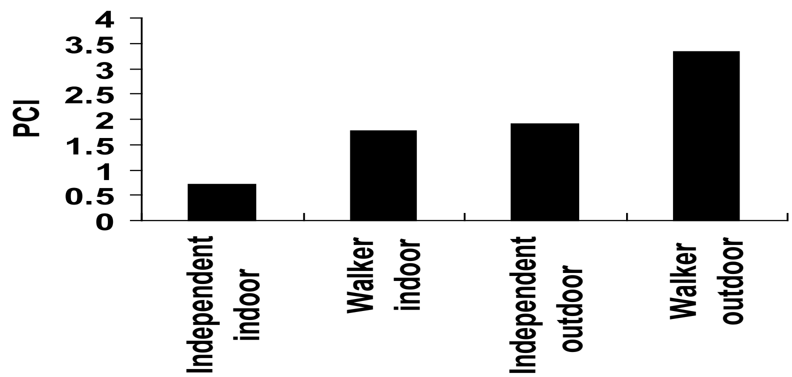
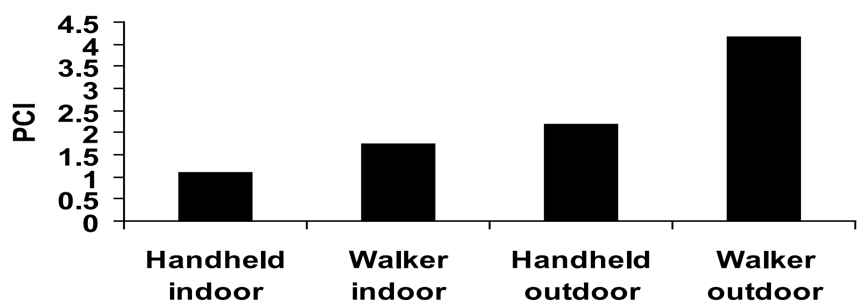


Figure-1; Spastic diplegia children who walked with hand support



prescribed to them effectively in community ambulation reasons given for not using walker are unsubstantiated [16]. The clinical decision-making has increasingly become difficult, as there is lack of literature for children with spastic diplegia to measure the energy expenditure using walker on different surfaces.

PURPOSE OF THE STUDY

Objective of this study was to compare the variation of energy expenditure with and without walker on outdoor uneven surface and indoor even

(Figure-3)

surface in children with spastic diplegia.

METHOD

Children were selected by convenience sampling from four special schools in our locality, consent form was obtained from the parents/ guardian. Children with diagnosis of cerebral palsy of spastic diplegic type, Age 5 to 17 (mean 12y±1.5y) years, who are able to walk fifty meters independently or with one hand held for the past six months with and with out walker in outdoor were included in the study.

(Figure-4)

Children who are unable to follow simple commands, with severe behavioral problem, with severe visual and perceptual problems, with uncontrolled seizure disorder and with diagnosed cardiovascular problem were excluded from the study.

Energy expenditure was tested with the use of physiological cost index in these 25 children with spastic diplegia of age between 5-17 years (mean 12y±1.5y) .out of 25 children 13 were boys and 12 were girls.

Outcome measures used was Physiological Cost Index (PCI) and Instruments used are a Seat, Stop watch, Two twenty five meter walk ways – one in indoor and other on outdoor.

The Procedure was explained to the parents/ guardian. The therapist then completed a screening checklist to ensure that all inclusion and exclusion criteria were met. The subject was made to sit quietly for five minutes on a seat. Resting heart rate was measured as the average heart rate taken over a two-minute period after five minutes rest. Then subject was made to walk at his/her own pace on fifty-meter indoor level surface and the time taken was measured [17]. The subject made to sit after the walk and the heart rate was measured for first fifteen seconds manually and calculated for minute. The same procedure was repeated and average of two trials was measured to determine PCI.

Test one: PCI was determined with above procedure on indoor even surface without using a walker(Figure-3)

Test two: PCI was determined on indoor even surface with a walker that he/she was being trained with.

Test three: PCI was determined on outdoor uneven surface with out a walker

Test four: PCI was determined on outdoor uneven surface with a walker that he/she was being trained with.

In all these procedures subject was made to walk with their preferred speed using their own assistive devices like AFO, splints, or any orthosis and the therapist accompanied the subject. Sufficient rest period to gain the resting heart rate was given between the trials. If the subject required hand support this assistance was given when they were not using walker by parents/guardian (Figure-4). These children were analyzed as a separate cohort from the children who walked independently.

Data analysis

Subjects were grouped as those walked independently and those who required hand support for analysis. Data analyzed using the statistical package SPSS (version10). PCI of same group of subjects with and without walker was compared by using paired t test. PCI of both groups of patients was compared by using independent t test. Results were expressed in terms of mean, standard deviation. A 'p' value less than 0.05 were considered significant.

RESULTS

There was no significant difference in the PCI values of subjects who required hand holding assistance and those who walked independently. This was true for both surfaces indicating that the groups were homogenous at baseline. Hence the whole group was analyzed as a single cohort.

Paired t test mean values of children with spastic diplegia with and without walker, indoor versus outdoor are showed in Table 1. This indicates that there is a statistically significant difference between children who walked either with hand support or independently and with walker indoor or outdoor. In all the children indoor performance is better than outdoor.

PCI mean values of spastic diplegic children are graphically expressed in Figure 1 and 2. Both the figures show a linear improvement in PCI .

DISCUSSION

This study was designed to determine the energy

Table 1. PCI values of ambulation with and with out walker indoor versus outdoor

Mode of ambulation	Number of children	PCI Mean (SD)	p value
Hand held indoor Walker indoor	16 16	1.08±1.10 1.75±1.36	0.020
Hand held outdoor Walker outdoor	16 16	2.19± 1.19 4.16± 1.76	0.000
Hand held indoor Hand held outdoor	16 16	1.08± 1.10 2.18±1.19	0.000
Walker indoor Walker outdoor	16 16	1.75±1.36 4.16±1.76	0.000
Independent indoor Walker indoor	9 9	0.72±0.16 1.76±1.03	0,010
Independent outdoor Walker outdoor	9 9	1.89±1.13 3.34±1.90	0.006
Independent indoor Independent outdoor	9 9	0.72±0.16 1.89±1.13	0.013
Walker indoor Walker outdoor	9 9	1.76±1.03 3.34±1.90	0.020

expenditure of children with spastic diplegia with and without walker, indoor and outdoor. To minimize the study bias, the subjects involved in this study were restricted to those children with spastic diplegia as per clinical criteria. All the children were familiar with the walkers because they were using the walker.

Children with cerebral palsy show higher heart rates and low walking speeds when walking with walker. This means that a higher physiological workload was sustained during ambulation by these children.13 This study also show similar findings .PCI values of children when ambulating without walker was better than with walker either indoor or outdoor. To encourage walker use for longer duration, reduced energy expenditure is desirable; therefore energy conservation is a major issue when choosing an assistive device.

Using walker consumes more energy in children with spastic diplegia. These children have impaired postural control, abnormal muscle tone and pathological muscle coordination which make them difficult to control their own body along with the walker. When they walk independently they use their upper limbs for balance. But when assistive device is used for gaining balance extra energy may be expended in using the device.

When normal children are compared with indoor and outdoor they do not have any significant differences in PCI. In this study children with spastic diplegia who walked independently or with hand support showed significant differences in PCI on indoor and outdoor surfaces. Even with walker outdoor values of PCI are significantly differ from indoor values. This may be due to their physical condition or due to environmental barriers or because of lack of regular practice.

So before prescribing assistive device like walker energy expenditure values should be considered in indoor and outdoor environments according to patient requirements. Also practicing with walker outdoors regularly may decrease energy consumption.

Severity of involvement in the patients being dissimilar may have affected the results. Not using the walker out side regularly can also be a reason for significant differences. Walkers, which were not custom fitted, may have interfered with efficient ambulation. The following are suggestions for future study. PCI should be evaluated in children with various types of cerebral palsy with various types of available assistive devices and also with custom fitted supportive devices.

CONCLUSION

Children with spastic diplegia require more energy when ambulating with assistive device than self selected mode of ambulation, indoors and outdoors. Clinical significance of this study is that prescription of walker should take in to consideration not only gait pattern but also efficiency as this may dictate patient compliance.

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Effect of Long Term Physical Exercise Training on Auditory and Visual Reaction Time

Shashi Kant Verma

ABSTRACT

The present work was planned to determine long term physical exercise has any beneficial effect on central neural processing, by studying its effect on reaction time. In present study 20 male and 20 female, young medical students practiced exercise (15 min sessions) for 3 months on alternate day basis. Outcome assessments of auditory reaction time (ART) and visual reaction time (VRT) were performed at baseline and after the 3 month of exercise training. In both male & female, there was a statistically significant (P<.001) decrease in ART and VRT. Also ART and VRT values were more in females than in males both before and after physical exercise training. This probably attributed to the differences in processing strategy in males and females. This decrease in ART and VRT after exercise practices may be due to physiologically relaxed state but increased mental alertness, improved concentration, and/or increased CRH & cortisol secretion in response to a challenge. . This is of applied value in situations requiring faster reactivity regarding serious safety concern such as in day today driving to avoid road traffic accidents, in sports for recommendation of safety limits, machine operations and in specialized surgery. So we suggest that the physical exercise is a lifestyle factor that might lead to increased physical and mental health and performance that can be used as an effective means of training people involving such tasks.

Key words: Physical exercise, Reaction time, Central neural processing

INTRODUCTION

Simple reaction time is defined as "the interval between the onset of the stimulus and the response under the condition that the subject has been instructed to respond as rapidly as possible"[1].

Reaction time (RT) is an indirect index of the processing ability of central nervous system and a simple means of determining sensory motor association and performance [2]. RT involves central neural mechanisms and its study is of considerable physiological interest. In 1983 Spirduso proposed RT as a measure of the overall integrity of central nervous system [3]. Also there is evidence that cardiovascular fitness exerts a positive influence in the psychomotor domain. RT has been used as primary index of psychomotor performance.4 RT is sensitive and reproducible test and its measurement can be done with simple apparatus and set up. It has also been suggested that RT can be used as a simple and objective method to determine the cognitive and motor performance effects of various exercise trainings [4].

Over the past several decades there has been an increasing interest in the influence of exercise on motor performance. A number of studies have reported improvement in performance in terms of reaction time (RT) with physical training5-7 while some research showed no effect on RT.8-10 So, we planned to see the effect of long term exercise training on reaction time. Additionally, we try to make a hypothesis on neurophysiological mechanism be-

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hind the changes in RT after long term exercise.

MATERIALS AND METHODS

The present study was conducted in Department of Physiology, RMCH, Bareilly on forty (40), 1st year MBBS students. Detailed information was collected on pre-designed proforma. Complete general, anthropometric and systemic examinations were carried out. Subjects with previous regular athletic activity or yogic training/ meditation were excluded from study. After briefing about the study protocol, consent was obtained. These two groups of male (n=20) and female (n=20) students performed physical exercise on bicycle ergometer till target heart rate between 100-150 beats/minute (moderate exercise) was obtained. This exercise was done for 3 months on alternate day basis in peaceful, lighted and well - ventilated hall between 7.00 AM to 8.00 AM at room temperature. Clothing was minimal and very loose. The ART and VRT were recorded initially at the onset of the study (Baseline reading) and again after 3 months of physical exercise training.

An electronic instrument (Fig. 1 and Fig. 2) was used to measure reaction time both auditory and visual, whose sensitivity was to take readings from 0

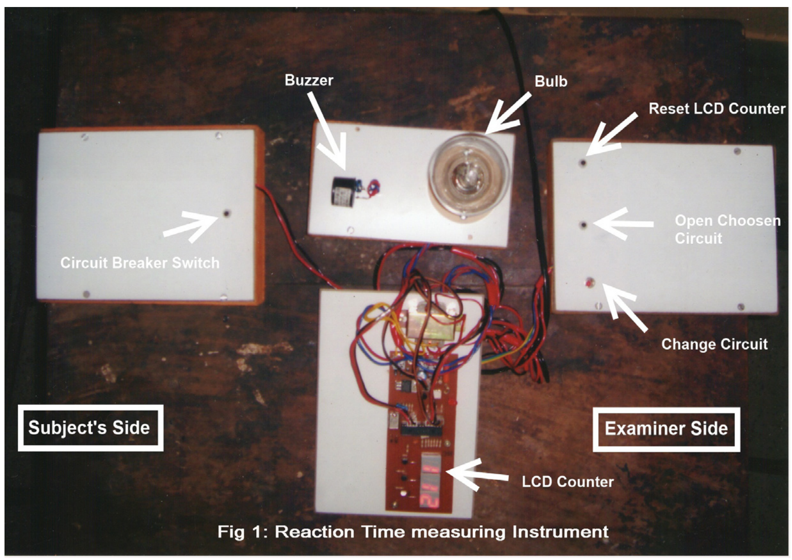

Fig. 1. Reaction time measuring instrument

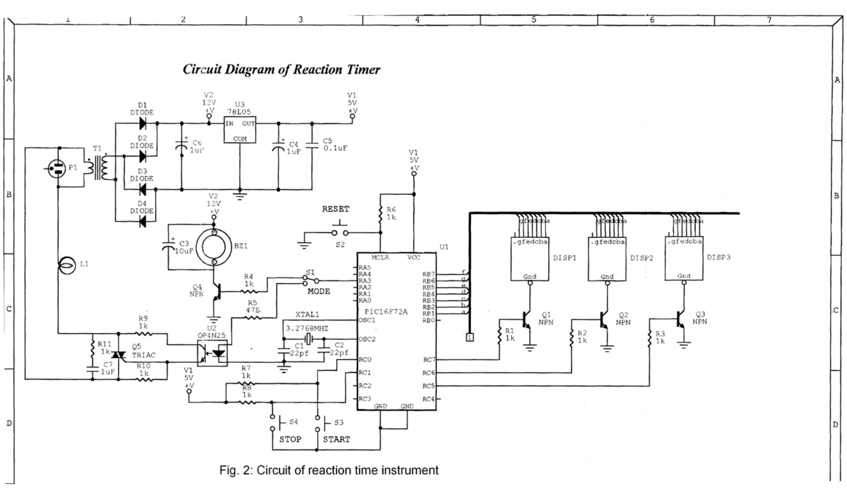

Fig. 2. Circuit of reaction time instrument

to 999 milliseconds (ms). This instrument consisted of 4 boards. One board was on the examiner's side (which subjects cannot see) in which there were 3 switches: first switch was to change the circuit between auditory or visual signal productions, second switch was to open the circuit as opted by first switch and third switch was to reset the LCD counter. Second board had the LCD for counting the reaction time (0 to 999 ms).The third board had a buzzer and a bulb. The second and third boards were placed in between the subject and the examiner. The fourth board on the subject's side had a switch to break the circuit after receiving the stimulus either auditory or visual. All the switches used in instrument were micro-switches that were very sensitive to touch.

No warning signal was given and to avoid the effect of lateralized stimulus, visual and auditory signals were given from the front of the subjects who were instructed to use their dominant hand while responding to signal.

Recording of Auditory Reaction Time

Subjects were blindfolded and instructed to cut off the circuit by pressing the switch as soon as they hear the buzzer. The observer selects the auditory circuit by the switch provided and switches on this circuit at varying time intervals to avoid guess work by subject. As soon as subject hears the sound, he cut off the circuit by pressing the switch. The subsequent time taken was recorded as auditory reaction time (ART) of that particular subject. Three such readings of each subject were taken and the mean was calculated.

Recording of visual reaction time

The above procedure was repeated by choosing the visual circuit instead of auditory circuit, where the subject is instructed to use ear plug and responds by pressing the switch as soon as he visualizes the lighted bulb (40 watt). The subsequent time taken is the visual reaction time (VRT) of that particular subject. Three such readings of each subject were taken and the mean was calculated.

Table 1. Anthropometric data of the volunteers

	Male (Mean ± SD)	**Female (Mean ± SD)**
Age (Yrs)	22.9 ± 1.141	21.5 ± 1.732
Height (cm)	179.0 ± 5.254	156.05 ± 2.999
Weight (kg)	58.6 ± 3.720	48.55 ± 3.649

SD = Standard Deviation, Yrs = Years, cm = Centimeter and kg = Kilogram.

Data collection and analysis

The baseline readings were taken at start of the study and then compared with that of final readings at the end of 3 month training in both male and female groups. The paired t-test was used for statistical analysis, a P-value of <0.05 was considered statistically significant. RT analysis excluded erroneous key presses.

Table 2. Comparison of auditory reaction time in males and females before and after the 3 months of exercise practice

	Before Ex practice (ms)	After 3 months of Ex practice (ms)	Significance
Male (Mean ± SD) (n=20)	148.10 ± 25.538	122.90 ± 13.799	HS
Female (Mean ± SD) (n=20)	160.25 ± 28.325	134.30 ± 17.391	HS

SD = Standard Deviation, Ex = Exercise, ms = millisecond and HS = Highly significant (P<.001).

RESULTS

All the students were unmarried and Hindu. 60% (24) students were vegetarian, and the remaining 40% (16) gave history of taking non-vegetarian diet occasionally. Anthropometric data of subjects are summarized in Table 1.

None of the subject gave any history of yogic training or physical exercise of any kind. Also no history of any addiction (alcohol, guthka or cigarette smoking) is found.

Paired 't' test was used to analyze the data. For statistical analysis, the software SPSS version 17.0 was used. The confidence interval of 95% was set for all comparisons and a P valve of less than 0.05 was accepted as indicating significant difference between the compared values. Data are expressed by using mean and standard deviation.

Before Exercise training, in males ART was 148.10 ± 25.538 ms and after performing three months training, ART decreased to 122.90 ± 13.799 ms, the decrease being statistically highly significant (P<0.001). (Table 2)

Table 3. Comparison of visual reaction time in males and females before and after the 3 months of Exercise practice

	Before Ex practice (ms)	After 3 months of Ex practice (ms)	Significance
Male (Mean ± SD) (n=20)	167.55 ± 26.916	137.00 ± 18.186	HS
Female (Mean ± SD) (n=20)	177.95 ± 24.831	149.80 ± 14.898	HS

SD = Standard Deviation, Ex = Exercise, ms = millisecond and HS = Highly significant (P<.001).

Before Exercise training, in females ART was 160.25 ± 28.325 ms and after performing three months training, ART decreased to 134.30 ± 17.391 ms, the decrease being statistically highly significant (P<0.001). (Table 2)

Before Exercise training, in males VRT was 167.55 ± 26.916 ms and after performing three months training, VRT decreased to 137.00 ± 18.186 ms, the decrease being statistically highly significant (P<0.001). (Table 3)

Before Exercise training, in females VRT was 177.95 ± 24.831 ms and after performing three months training, VRT decreased to 149.80 ± 14.898 ms, the decrease being statistically highly significant (P<0.001). (Table 3)

DISCUSSION

Effect of exercise on processing ability of central nervous system in terms of reaction time is debatable as some studies shown no effect8-10 while other reported a decrease5-7 in it.

The finding of our study revealed that RT for auditory & visual reaction stimuli was found to be faster in subjects having exercise training as compared to pre-training RT status.

In our study we have also found that ART and VRT was more in females than in males, which is in conformity with previous studies11-13. This probably attributed to the differences in processing strategy in males and females [14]. Also the auditory reaction time was faster than the visual reaction time both in males and females that is in line with previous studies [13].

This faster RT in aerobic exercises is due to improved concentration, alertness, better muscular coordination and improved performance in the speed and accuracy task [15, 16[. These factors leads to reduce tension and develops alertness and better coordination of mind with body, which seems to be responsible for better performance of the individual [15, 17]. Aerobic exercise training affects various organ systems including Cardiovascular, respiratory, CNS & skeletal muscles etc. These trainings leads to an increase in cardiac stroke output associated with more complete emptying of heart during systole. There is also a reduction in the ventilation minute volume at high rates of work, on account of an improved muscle blood flow and an increase in intracellular enzymes[15]. There is increased vagal tone in athletes, with greater muscle tension and behavioral features which distinguish the trained from the untrained and favours establishment of new motor performance[16, 17].

Exercise training bring out an increase in stores of creatine phosphate as well as glycogen. Creatine kinase activity is increased and so is the activity of mitochondrial enzymes leading to enhanced respiratory capacity of skeletal muscles18. This causes sparing of glycogen and increased capacity to oxidise fatty acid, thus improved work time, delayed fatigue, increasing oxidation of ketones and increased removal[15, 19]. Thus, these beneficial effects in aerobic exercisers are responsible for their faster reaction time performance.

Some studies had shown no significant change in reaction time after long term aerobic and resistance training[8, 9, 10, 20, 21]. However this inconsistency may due to differing in subject selection, mode of exercise (strength/ endurance), the timing of RT measurement (Immediate after exercise or during exercise) or sensitivity of RT instrument.

A decrease in RT is known to improve the sensorimotor performances. Thus RT could be used either for screening the large population for physical fitness [22], in sports physiology [23, 24], as a therapeutic intervention in certain type of medical conditions like depression [25], cardiovascular diseases and diabetes [26], to train mentally retarded children and older sports persons who have prolonged RT [27], as an index of cortical arousal [28] or to assess cognitive impairment after an accident [29].

Exercise training leads to increased CRH (corticotropin releasing hormone) [30] and cortisol secretion in response to a challenge as compared to the control subjects [31] but the baseline levels during rest are reduced [32]. So when a challenge is presented in form of pressing the key as soon as possible in response to light or buzzer there is increased CRH and cortisol secretion. While testing RT, the individual being tested is in a state of stress/ challenge as he has to press the key in the shortest possible time in response to an auditory /visual signal. To do so the nerve impulse has to be processed faster in the auditory/visual neuronal pathways and its association fibers to frontal cortex. The reaction time also depends on the quick activity of skeletal muscle. Both these factors depend on the blood flow to the particular organ i.e. central nervous system and skeletal muscle. Exercise has been shown to increase cerebral [33, 34] and skeletal muscle blood flow18 by increasing cortisol level in blood during stress [31].

So we want to hypothesize that this dual action of exercise both on CNS as well as skeletal muscle are the possible mechanisms that lead to markedly decrease reaction time as compared to control subjects. Further studies are required to substantiate this.

CONCLUSIONS

This shortening of RT after regular exercise training is of applied value in situations requiring faster reactivity regarding serious safety concern such as in day today driving to avoid road traffic accidents, sports, for recommendation of safety limits, machine operations and in specialized surgery. So we suggest that regular physical activity should be promoted and access to sports facilities should be facilitated especially in people involving such tasks.

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Standard journal article

[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. J Oral Pathol Med 2006;35:540-7.

[2] Twetman S, Axelsson S, Dahlgren H, Holm AK, Källestål C, Lagerlöf F, et al. Caries-preventive effect of fluoride toothpaste: A systematic review. Acta Odontol Scand 2003;61:347-55.

Article in supplement or special issue

[3] Fleischer W, Reimer K. Povidone iodine antisepsis. State of the art. Dermatology 1997;195 Suppl 2:3-9.

Corporate (collective) author

[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. J Periodontol 2000;71:1792-801.

Unpublished article

[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. Dent Mater 2006.

Personal author(s)

[6] Hosmer D, Lemeshow S. Applied logistic regression, 2nd edn. New York: Wiley-Interscience; 2000.

Chapter in book

[7] Nauntofte B, Tenovuo J, Lagerlöf F. Secretion and composition of saliva. In: Fejerskov O, Kidd EAM, editors. Dental caries: The disease and its clinical management. Oxford: Blackwell Munksgaard; 2003. p. 7-27.

No author given

[8] World Health Organization. Oral health surveys - basic methods, 4th edn. Geneva: World Health Organization; 1997.

Reference from electronic media

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ 20.pdf (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

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