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Editor's Desk

Dear Physiotherapists,

It gives me great pleasure to write from editor's desk of ***Indian Journal of Physical Therapy*** on the very first issue of volume.

Now-a-days era of evidence based practice has emerged. Whatever we give to the patient in form of treatment whether it is electrotherapy or exercise therapy, we must have evidence that that particular treatment is effective for the condition patient is suffering from.

From this journal our aim is to provide the researcher's view based on the evidences to all possible Physiotherapy professionals. For each issue, we are bound to give study materials by which one can give best to his/her patient. We also take care that in each issue, we provide different subject related evidence based knowledge.

A lot of research work is going on at present in our country in the field of Physiotherapy including various research institutes, Physiotherapy colleges and as a part of various post graduate and Ph D thesis programs. However, a platform for compilation and publication of this hard work of everyone is yet somewhat limited. ***Indian Journal of Physical Therapy*** is a small effort to provide platform for this hard work to bring into notice of all interested Physiotherapists and clinicians and to create a database that will be of great help to all the professionals.

On behalf of all staff members of IJPT, I request all Directors, Deans, Principals, Academic Staffs, Clinical Practitioners, Interns and Students to send us articles for publications and write us for any suggestions, queries or inquiries on our website.

Waiting eagerly for your positive response for this journal.

Thank You.

Dr Dinesh M Sorani
Editor
Indian Journal of Physical Therapy

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Arthrogryposis Multiplex Congenita (AMC): A Case Report

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Introduction

Arthrogryposis multiplex congenita (AMC) is a rare congenital disorder that is characterized by multiple joint contractures and can include muscle weakness and fibrosis. It is a non-progressive disease. The disease derives its name from Greek; literally meaning curved or hooked joints.

In some cases, few joints may be affected and may have a nearly full range of motion. In the most common type of arthrogryposis, called amyoplasia, hands, wrists, elbows, shoulders, hips, feet and knees are affected. In the most severe types, nearly every joint is involved, including the jaw and back. Frequently, the contractures are accompanied by muscle weakness, which further limits movement. AMC is typically symmetrical and involves all four extremities with some variation seen. [1, 2, 3]

Case report

Here reported case is of 7 years old male child born with blood group A +ve and suffering from AMC. At the time of birth patient had bilateral Congenital Dislocation of Knee (CDK) and bilateral Congenital Talipes Equino Varus (CTEV). Child was not able to stand or walk due to deformities. Patient has been operated for the same seven times with serial plaster casts in his 7 years of life.

At the age of 5 years on examination patient had CTEV and bilateral CDK with 40^0 Fixed Flexion Deformity (FFD) of Right knee, recurvatum with 20^0 valgus of Left knee and bilateral radial head dislocation with restricted supination. Patient was operated for Left quadriceps-plasty, reduction of knee joint, bilateral Tendo Achilles (TA) Tenotomy, Plantar fasciotomy and Tibialis Posterior release. After surgery patient was advised for strict limb elevation and active toes movements followed by physiotherapy.

At the age of 6 years on examination patient had recurred CTEV and ended up in fixed deformity including varus, adduction, cavus and equines and patient was operated for bilateral dorsal wedge resection of foot & k-wire fixation, TA tenotomy & posterior capsulotomy of ankle and subtalar joints bilaterally. Four months after surgery, on clinical examination residual knee FFD of 10^0 of right knee and resistant left foot deformity for correction to neutral position.

At the time of presentation to physiotherapy clinic after last surgery for physiotherapy patient had reduced muscle power on both lower limbs. By manual muscle test described by Daniel muscle power was reduced in all muscles of lower limbs, but in majority of muscles power was found > 3 out of 5.[4] On girth measurement, wasting of was found on left side as compared to right side. Amount of wasting found was 0.5 cm and 1 cm respectively in thigh and leg. Limb length shortening was found on right side as compared to left side. Amount of shortening found was 6 cm and 2 cm in above knee and below knee measurement.[5]

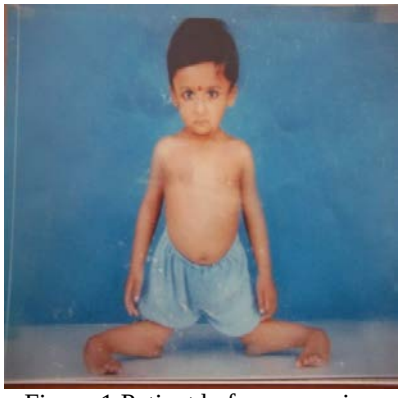

Figure 1 Patient before surgeries

Figure 2 Patient after surgery (Supine)

Figure 3 Patient after surgery
(Walking with rollator)

Physiotherapy treatment was directed towards maintenance of range of motion in all joints of bilateral lower limbs, strengthening of weak muscles of bilateral lower limbs as well as gait training with bilateral ankle foot orthosis and knee extension brace and with rollator. Bilateral upper limbs were only given home exercises and patient had become habitual with the use of both upper limbs even with restricted supination range of motion. Along with this physical treatment, psychological counseling of patient's father about regular follow-up to orthopedic surgeon and consistency in visit of physiotherapy department without fail was done.

Discussion

The patient selected for the study was not able to walk before surgery as the above mentioned muscles were very short and not allowing movement in full range of motion. Due to short muscles since birth there was also development of above mentioned deformities. If child would have been untreated, he might not have been able to stand on his own. Preoperative physiotherapy, surgeries with serial plaster casts and postoperative physiotherapy made the child walking with the help of assistive devices like splints and mobility aids like rollator. There are very few researches available for role of physiotherapy in arthrogryposis multiple congenita and other related congenital abnormalities. So more numbers of researches are needed to be done with long term duration. This can also help for creating awareness about changing common belief that for this type of child, only maintenance of condition and preventing complication is not sufficient. This type of patient can be given improved quality of life even though the condition itself is not curable.

Conclusion

Arthrogryposis multiple congenita is rare congenital disorder. It is not curable but by multiple corrective surgeries and physiotherapy treatment, child can be made independent as much as possible. Before surgery, patient should be assessed for manual muscle testing to decide the possible outcomes of surgery as muscle power reduces after surgery. After surgery, if physiotherapy treatment given properly, child can live with better quality of life later on.

Funding

The above study is not funded by any institute or person.

Conflicts of Interest

There was no personal conflict of interest.

Consent of Patient:

The author was not able to acquire consent letter for this study.

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Effect of Pulmonary Rehabilitation on Quality of Life of T.B. Patients

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Abstract

Objective -*to see the effectiveness of pulmonary rehabilitation on quality of life of TB patients.*

Study design - *Cohort study.*

Sample size - *40 patients.*

Methodology- 40 patients *were selected irrespective of the gender with sputum negative TB infection were selected for the study and divided into 2 groups: Group A - 20 patients who received pulmonary rehabilitation Group B - 20 patients who received breathing rehabilitation. Outcome was measured by 6 min walk test (6 MWT) and Saint George respiratory questionnaire (SGRQ). Data were analyzed by paired and unpaired"t" test.*

Conclusion:- *According to statistical analysis, pulmonary rehabilitation group shows improvement in quality of life of TB patients.*

Introduction

Tuberculosis (TB) is an infectious disease caused by 'Mycobacterium Tuberculosis 'and rarely by the other organism of the Tuberculosis complex.

Tuberculosis is most commonly transmitted by inhalation of infected droplet nuclei which are discharged in the air when patients with untreated sputum positive TB coughs or sneezes. If the bacillus succeeds in infecting a person and only 5-10% of such infection develops active disease. In the remaining 90-95%, initial infection goes unnoticed. Tuberculin sensitivity appears within a few weeks of infection and initial lesions commonly heal leaving no residual changes except occasional pulmonary or tranche bronchial lymph node calcification (primary complex). Infection occurs exclusively through respiratory route.

Post primary TB (Active) arises from the latent foci which dormant since initial infection. Post primary TB in 85% affects lungs and then through blood stream, lymph it may spread towards lymph nodes, pleura, bones and joints, genitor-urinary tract, the nervous system, intestine etc. So pulmonary TB should receive topmost priority for treatment.

In pulmonary TB, fibroblastic reactions causes fibrosis and chest wall retraction compromising pulmonary expansion. This leads to long disability, restrictive lung movement and many daily living activities are hampered because of that.

One third of the global population so estimated to be infected with TB bacillus. It is estimated that 1.8 million people die from TB each year. TB remains a major public health problem in India. Annual risk of Tuberculosis infection (ARTI) study done for the four zones of the country from 2008 to 2010. India accounts for one fifth of global incidence of TB.

In India every day more than 5000 developed TB and more than 1000 people die from it. According to WHO (Estimate made in 2006) more than 170 million people work days are lost. Nearly 3,00,000 school children dropout from the schools More than 1,00,000 women rejected by their families. Tuberculosis causes physical, economical and social dependency on family. It is a biggest barrier to socio-economical development and because of stigma of TB, person cannot get socialized easily.

In India Tuberculosis is major cause of death. To control TB the national tuberculosis program of India (NTP) was initiated in 1962. A full-fledged program was started in 1997 which is known as Revised National Tuberculosis Control Program (RNTCP). This program works on DOTS i.e. Directly Observed Treatment, short course. In this program health worker watches as patient swallow all medication. This helps in ensuring cure. Along with DOTS other treatment methods are also helpful as supportive therapy to restore the functional capacity. Pulmonary rehabilitation techniques shows good result on pulmonary condition to restore the lung capacity.

Pulmonary rehabilitation is non-pharmacological treatment in pulmonary condition. Application of pulmonary rehabilitation improves physical condition and restores quality of life & social integration.

This study aims to see the effectiveness of the pulmonary rehabilitation on quality of life of TB patients.

Materials and Methodology

60 patients were enrolled in treatment program initially, then according to inclusion and exclusion criteria 40 patients were selected and written consent was taken from them.

Out of 40 pulmonary T.B. patients, 20 were randomly allocated for pulmonary rehabilitation (PR) & 20 were given conventional breathing exercises (BE) along with airway clearance technique.

PR program was explained to them. Basic CVS, RS and musculoskeletal examination was done. SGRQ and 6 min walk test was evaluated and target HR was decided on the basis of heart rate maximum by Karvonen's formula.

Both groups received protocol treatments for 6 weeks. Pulmonary rehabilitation group received protocol given by King's college, (Lambeth & Southwark pulmonary rehabilitation program). The protocol included warm up exercise session followed by aerobic as well as strengthening exercises followed by cool down exercises including stretching

exercises. Breathing exercises group was daily treated with conventional breathing exercises like diaphragmatic and segmental breathing, thoracic expansion exercises, incentive spirometry and chest clearance techniques.

Then again 6 min walk test and SGRQ questionnaire was evaluated after 6 weeks.

Pre and post rehabilitation data were analyzed using paired and unpaired Student's t test.

Results

Table 1: Average parameters of 6 minute walk test RPE, distance covered during 6 minute walk test and quality of life (SRGQ) score in both groups before and after intervention

	PR			BE		
	Before	After	p	Before	After	p
RPE	5.56	2.7	< 0.05	5.35	3.65	< 0.05
DISTANCE COVERED	178	202.25	< 0.05	170	181.5	< 0.05
QUALITY OF LIFE	82.95	35.73	< 0.05	82.39	52.24	< 0.05

Table 2: Comparison of parameters between groups

	Mean difference		
	PR	BE	p
RPE	2.95	1.7	< 0.05
DISTANCE COVERED	24.25	10	< 0.05
QUALITY OF LIFE	47.18	30.13	< 0.05

Discussion

The aim of this study is "To see the effectiveness of pulmonary rehabilitation on quality of life of TB patients". For this study 40 patients were selected with DOT treatment and divided into two groups. Group A received pulmonary rehabilitation and group B received breathing exercises. Distance covered, RPE and questionnaire were taken into consideration. Before pulmonary rehabilitation (PR) and after PR as well as before breathing exercises (BE) and after BE values were compared by paired t test. Both groups showed improvement in quality of life. Mean differences of both groups were then compared by unpaired t test.

Distance covered in pulmonary rehab group before treatment was 178m and after treatment was 202.25 m. t value for this group is 7.07. In breathing group, distance covered before treatment was 170 m and after treatment was 181.5m. t value for this group is 3.37.both the group shows improvement. The reason behind this is because of exercise lung capacity increase and it helps to increases the endurance.

RPE values in pulmonary rehab group, before treatment was 5.35 and after treatment was 3.65. And in breathing group before treatment it was 5.56 and after treatment was 2.7. t value for pulmonary group is 6.89 and for breathing group it was 4.25. This result shows significant improvement in both groups. The RPE values decreases after treatment because regular exercise helps to increase the endurance and reduce the breathlessness.

In case of SGRQ, in pulmonary group before treatment value is 82.95 and after treatment value is 35.73 and in breathing group before treatment value is 82.39 and after treatment value is 52.24. t value for pulmonary group is 9.99 and for breathing group 4.93.Both group shows significant improvement. The reason behind improving quality of life is decrease in breathlessness and increase in functional capacity. Overall endurance is also increased.

When after treatment results were compared by unpaired t test following results were seen. When distance covered was compared between both the groups, pulmonary group shows more improvement (t = 3.35). When RPE was compared then also pulmonary group shows more improvement. (t = 2.37). When SGRQ were compared then also pulmonary group shows more improvement. (t = 2.28).

Thus, it is concluded that both groups shows improvement in the quality of life but pulmonary rehabilitation group shows more significant improvement as pulmonary rehabilitation program shows effect on every system of the body and helps to restore functional capacity.

Limitation

The sample size is too small to arrive at a concrete conclusion and the study is recommended on more subjects. Questionnaire had to be translated in local language to explain to the subject.

Conclusion

Pulmonary rehabilitation is effective treatment method which helps to improve quality of life in TB patients.

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Effect of pain and fatigue on functioning in subjects with post polio syndrome

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Abstract

Introduction - *In the past few years, many polio survivors have experienced late-onset neuromuscular symptoms and decreased functional abilities. Post-polio syndrome (PPS) refers to a clinical disorder affecting polio survivors with sequel years after the initial polio attack. These patients report new musculoskeletal symptoms like fatigue, pain, new and unusual muscular deficits, on healthy as well as deficient muscles initially affected by the Poliovirus. Although pain and fatigue have been identified as common problems in these individuals, less research has examined the role that these symptoms might play in their physical or psychological function. In this study, effect of pain and fatigue on function in subjects with PPS was seen.*

Methodology - *A co-relational study was conducted on a convenient sample of 50 subjects with the diagnosis of PPS according to Halstead criteria (1985), above 18 years of age, in the community of Gujarat. Subjects unwilling, with cognitive impairment were excluded.*

Procedure - *Subjects with PPS were approached and those willing to participate were assessed for pain, fatigue and function. Pain and Fatigue intensity were examined using Numeric Rating Scale (P-NRS and F-NRS respectively). Physical and psychological functioning were examined using PROMIS (Patient Reported Outcomes Measurement Information System) and PHQ-9 (Patient Health Questionnaire-9) questionnaires.*

Results - *Pearson's test for co-relation was applied. A negative linear co-relation was found between Pain intensity and functioning; indicating that pain affects physical function in subjects with PPS and a positive linear co-relation between pain and psychological function was found; indicating higher levels of depression in those with higher levels of pain. Correlation between fatigue and functioning was insignificant; indicating that fatigue did not affect function.*

Conclusion - *Pain affects the physical and psychological function of subjects with PPS, highlighting the need for effective and accessible pain relieving treatment options.*

Keywords: Post polio syndrome, Pain, Fatigue, Functioning, PROMIS, and PHQ-9

Introduction

In the past few years, many polio survivors have experienced late-onset neuromuscular symptoms and decreased functional abilities.[1] After many years of stable functioning, these patients report new musculoskeletal symptoms like fatigue, pain, new and unusual muscular deficits, in healthy muscles as well as deficient muscles initially affected by the poliovirus. These symptoms have been termed Post Poliomyelitis Syndrome (PPS).[2]

PPS is an exclusion diagnosis. There is no diagnostic test for PPS, and the diagnosis is based on a proper clinical workup where all other possible explanations for the new symptoms are ruled out. The existence of PPS has been questioned, but the late effect of poliomyelitis, or PPS, is generally accepted as a defined clinical entity. The term post-polio syndrome was introduced by Halstead in 1985 to cover medical, orthopedic and psychological problems possibly or indirectly related to the long-term disability occurring many years after the acute episode. The criteria for PPS3 were as following:

1. Confirmed history of polio.
2. Partial or fairly complete neurological and functional recovery after the acute episode.
3. Period of at least 15 years with neurological and functional stability
4. Two or more of the following health problems occurring after the stable period: extensive fatigue, muscle and/or joint pain, new weakness in muscles previously affected or unaffected, new muscle atrophy, functional loss, cold intolerance.
5. No other medical explanation found.

Halstead revised these criteria in 1991 and added gradual or abrupt onset of new neurogenic weakness as a necessary criterion for PPS, with or without other co-existing symptoms.[4] Dalakas redefined and narrowed the use of PPS in 1995 with an additional criterion of neurological examination on EMG and/or MRI.[5]

The prevalence of PPS has been reported to be between 20% and 85% of people who have had poliomyelitis.[6] This disparity is most probably caused by the use of different clinical diagnostic criteria. In this context, it is important to remember that people who have sequelae of poliomyelitis but who do not fulfill diagnostic criteria for PPS might still have substantial loss of motor function and be in need of therapeutic interventions.

Pain and fatigue are common in individuals with PPS and have been recognized as the key symptoms. PPS subjects are more prone to fatigue and have more physical mobility problems than non-PPS subjects.[7] The main functional problems in these subjects are related to physical activities such as walking, climbing stairs, and mobility-related activities of daily life. Measures of pain and fatigue have been shown to be associated with various measures of dysfunction in PPS populations. Hildegunn et al found that self-reported muscle strength, disability, and pain intensity were all associated significantly with measures of fatigue and activity level in a sample of 32 patients with PPS.[8] Ostlund et al found pain intensity to be significantly associated with lower levels of physical and psychological functioning in a sample of 143

individuals with PPS. In another survey study, measures of fatigue demonstrated significant associations with both physical and psychological dysfunction.[9]

Interest in PPS has increased over the past two to three decades worldwide, with research varying in focus from molecular to clinical aspects, and health-related quality of life. India had traditionally been considered one of the toughest places in the world to eradicate polio. Considering the large number of polio survivors in our country and looking at the prevalence of pain and fatigue in polio survivors, it becomes important to identify the problems faced by PPS subjects as a rehabilitative perspective. The purpose of the current study was to better understand the importance of pain and fatigue in relation to functioning. The study was aimed To find the correlation between pain and fatigue intensity; using Numeric Rating Scale with Physical and Psychological Functioning using PROMIS and PHQ-9 Questionnaires respectively.

Methodology

A convenient sample of 50 subjects, both males and females above 18 years of age, with PPS according to Halstead Criteria (1985) was selected from the community of Gujarat. The study design was co-relational. Those with cognitive impairment or unwilling to participate were excluded. All subjects provided informed consent for participation in the study. Subjects were assessed for Pain intensity, Fatigue intensity using Numeric Rating Scale (P-NRS and F-NRS respectively). Physical and psychological functioning were examined using PROMIS and PHQ-9 questionnaires. Subjects were asked for their age at onset of polio and about the usage of assistive devices in daily life.

NRSs are frequently used to assess symptom severity, including the severity of both pain and fatigue, and research supports their validity for this purpose.[10] Participants were asked to rate the severity of these symptoms over the past week on scales from 0 to 10 (0 being none; 10 being very severe).

Table 1: PHQ-9 Interpretation

Total score	Depression severity
1-4	Minimal
5-9	Mild
10-14	Moderate
15-19	Moderately severe
20-27	Severe

PROMIS11 Physical Functioning item bank assesses an individual's ability to perform a range of physical activities. Average performance in ability to engage in various tasks over the past week is measured on 5-point scales that range from "without any difficulty" to "unable to do". Higher the Raw score of PROMIS, better the physical function. PHQ-911 is a 9-item measure which asks respondents to rate the frequency that they experienced 9 symptoms of depression in the past 2 weeks by using a 4-point scale, where 0 is "not at all," and 3 is "nearly every day." The PHQ-9 total score can range from 0 to 27, and a higher score represents higher levels of depressive symptoms. The PHQ-9 has been widely used to assess depression severity and has a great deal of support for its validity in populations with physical disabilities. Level of significance was kept at 5%.

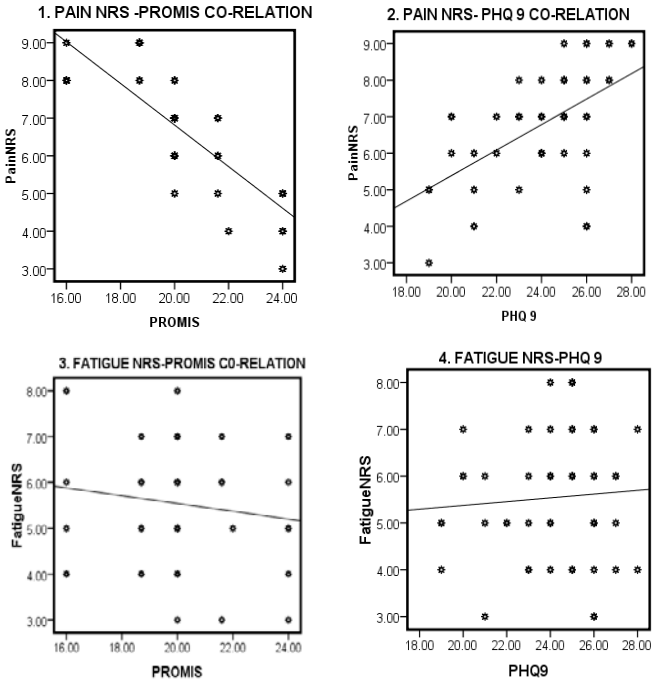
Results

Statistical analysis was done using SPSS 16.0. Variables were evaluated to ensure that they were normally distributed using one sample Kolmogorov- Smirnov test. Pearson's test of co-relation was applied, co-efficient r was determined and the p value was noted. Descriptive statistics of age, pain, fatigue, physical and psychological functioning are listed in Table 2.

Table 2: Descriptive Statistics

Variable	Mean ±SD
Age	32.58±7.65
P-NRS	6.82 ±1.48
F-NRS	6.54 ±1.34
PROMIS	19.99 ±2.13
PHQ-9	24.10 ±2.39

Pain intensity had a strong linear co-relation with physical functioning (r=-0.794; p =0.01) which was statistically significant, indicating that the physical functioning of subjects with PPS was affected if they had pain. Pain had a moderate linear co-relation with psychological functioning (r= 0.564; p=0.01), indicating that pain had an effect on the psychological functioning of subjects with PPS. Fatigue intensity had a weak



linear co-relation with physical functioning (r= -0.135, p = 0.351) and psychological functioning (r= 0.072; p=0.620) which was statistically insignificant.

Figures 1-4 show the graphs of co-relation between the outcome measures. Components most affected on the physical function scale were "being unable to bend down and pick up clothing from floor", "being unable to push a heavy door", "unable to do eight hours of physical labor" and "unable to reach and get down an object from above the head". On psychological function scale, the components most affected were "feeling tired or having less energy", "Moving or speaking so slowly that other people could have noticed- or the opposite, being so fidgety or restless that you have been moving around a lot more than usual".

Discussion

The findings from this study suggest a statistically significant co-relation between the severity of pain and lower levels of physical functioning and higher levels of depression in individuals with PPS whereas severity of fatigue did not have a statistically significant co-relation. Also, the severity of pain showed a stronger co-relation with physical functioning than with psychological functioning. These findings have important implications in understanding the role of pain on functioning in PPS subjects.

Jenson MP et al (2008) studied the independent effect of pain and fatigue on function in subjects with PPS and concluded that pain and fatigue both made independent contributions to the prediction of functioning.[11] They found that relationship between pain and fatigue and both physical and psychological functioning was similar across all age cohorts suggesting that complaints of pain or fatigue in patients with PPS who are older or elderly should not be attributed merely to the process of aging. In contrast, the present study did not show a co-relation with psychological function. The reason could be the recruitment of younger participants in the present study.

Hidegunn L et al (2007) studied the perceived disability, fatigue, pain and measured isometric muscle strength in patients with post-polio symptoms.[8] They found significant correlation of self-reported general muscle strength, pain intensity and pain distribution with patients' perceived fatigue and function at the activity level. This is much in line with the results of our study.

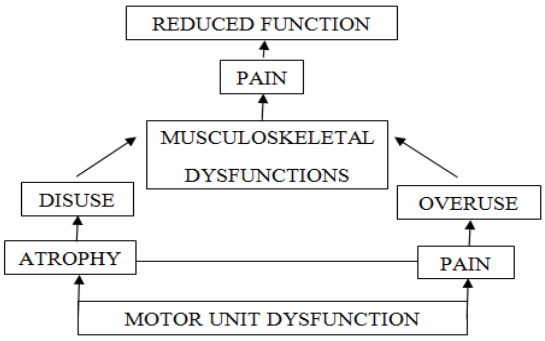
In a cross sectional case control study, On AY et al (2006) assessed the impact of post-polio related fatigue on Quality of Life (QoL).[13] The presence and severity of fatigue was measured using Fatigue Severity Scale (FSS), QoL by Nottingham Health Profile (NHP) and the impact of fatigue on QoL using Fatigue Impact Scale (FIS). Fatigue (FSS score> 4) was significantly higher (p value <0.05) in the PPS group (76.9%) than both the non-PPS (30%) and the control group (23.3%). Also, NHP scores were significantly higher in the PPS group than in the control group (p value <0.05) with the dimensions of physical mobility, energy, pain and emotional reaction particularly affected. These findings are much consistent with our study in that the fatigue intensity (6.54 +1.34) was moderate.

In a similar study by Trojan DA et al (2009), different variables were found to be associated with general, physical, and mental fatigue.[14] Correlates of general fatigue included disease-related and psychosocial factors whereas correlates of physical fatigue were disease-related and behavioral factors, and correlate for mental fatigue was a psychosocial factor. The components most affected on physical and psychological function scales in our study are similar to the findings of this study.

Stoelb BL et al studied the frequency, intensity and impact of pain in persons with PPS.[15] Pain interfered most with sleep and with activities requiring a high level of musculoskeletal involvement. Respondents also reported pain problems that were more severe than those of the general population and than those of a sample of people with multiple sclerosis. Participants with pain in our study reported a moderate level of pain intensity (P-NRS= 6.82+1.48) which was higher than the above mentioned study.

Earlier, Nollet F et al did a study to compare perceived health problems and disability in former polio subjects with PPS and non-PPS subjects, and to evaluate perceived health problems, disability, physical performance, and muscle strength.[16] Health problems mainly concerned with physical mobility, energy and pain on NHP were higher in PPS subjects as compared to non-PPS subjects and most disabilities in PPS subjects were concerned with physical and social functioning.

Figure 5: Flow chart of overuse and disuse leading to pain and hence, reduced function.



Consistent with previous findings, participants in the present study reported pain problems that were significantly affecting their functioning. Figure 5 explains the flow chart of overuse and disuse leading to pain.

A co-relation between pain and reduced function is believed to be either a measure of overuse or disuse that falls into a vicious cycle. Motor unit dysfunction leads to atrophy and cramping muscle pain, both of which lead to a combination of overuse and disuse in muscles. When musculoskeletal overuse occurs, pain develops. Rest and immobilization can relieve this pain, but this leads to decreased use of certain muscles, with development of disuse atrophy and further weakness. After this,

relatively normal use of the muscle leads to pain and further disuse. Musculoskeletal dysfunction resulting in pain occurs as a consequence. And this pain restricts an individual's level of physical function and as a result to some extent, psychological function as well. Fatigue did not have a significant effect on function, indicating that affection in function was mainly due to pain and not fatigue. Possible reasons for which could be self pacing of daily activities, inacceptance or denial of having fatigue

Limitations

The sample size was small. Various studies done on PPS suggest younger subjects experience more pain and fatigue than the older subjects because of the nature of PPS[17]. Hence, study is likely to be biased based on the age included (32.78 + 7.65).

Future Recommendations

The use of assistive devices plays an important role in health related problems. Hence, an elaborated study with effects of these biomechanical devices on pain and fatigue should be done. Future prevalence study can focus on the frequency of pain, and also examine rates of pain in normals compared to presenting rates of pain specific to PPS. A study to assess potential predictors of these outcomes may be valuable. The current study also highlights the need of helpful and accessible treatment options for pain relief.

Conclusion

This study suggests that pain and fatigue are common problems in subjects with PPS and pain intensity significantly affects the physical and psychological function highlighting the need for effective and accessible treatment options.

Clinical Application

Acute polio is no longer a constant threat to people in the polio-free areas of the world but there are still thousands of polio survivors who are at risk of developing late manifestations of the disease. These findings highlight the importance of carefully screening all patients with PPS for the presence of pain and fatigue, so that a variety of interventional strategies to reduce their problems are implemented promptly.

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A study to evaluate activation of the lower trapezius muscle during varied forms of Kendall exercises

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Abstract

Background - *The trapezius muscle, a dynamic structure plays a crucial role in maintaining proper shoulder mechanics and is often considered a source of weakness and dysfunction in patients.*

Objectives - *To evaluate the activation pattern of lower trapezius muscle during varied forms of kendall exercises, so that it can help clinicians to design an efficient shoulder rehabilitation program.*

Design - *A Cross Sectional Observational Study*

Method - *The muscle activation pattern of lower trapezius muscle of 50 individuals, aged 20 to 30 years was measured using surface EMG for maximum voluntary isometric contraction against manual resistance during which EMG activity of lower trapezius muscle was assessed in shoulder at 75^o, 90^o, 125^o, and 160^o of abduction with arm externally rotated and manual resistance was applied at the distal forearm.A repeated measure ANOVA was then performed.*

Results - *Means of lower trapezius showed highest muscle fiber activation at 160^o abduction. Then ANOVA was applied and calculated using Graphpad Version 3.10, Obtained values: p = 0.5139, F = 0.7675.*

Conclusion - *There was no significant difference in activation of lower trapezius muscle at any angle of arm abduction.*

Keywords - Electromyography; Kendall exercises; Arm Abduction, Shoulder Rehabilitation

Introduction

The shoulder moves in a complicated manner during elevation, involving all of the joints at the shoulder complex, to facilitate optimal placement of the hand for function.[1] During elevation, glenohumeral motion occurs around the stable base of the scapula, with that stability provided by the scapulothoracic muscles. In addition these muscles also dynamically position the scapula for efficient glenohumeral motion (Paine and Voight, 1993).

The trapezius muscle plays a crucial role in maintaining proper shoulder mechanics and is often considered a source of weakness and dysfunction in patients. The trapezius muscle is a dynamic structure, which is called upon to play multiple roles in maintaining glenohumeral joint stability and functional outcomes.[2] As the humerus is abducted, the three portions of the trapezius (upper, middle, and lower) act along with the serratus anterior to concentrically control upward rotation of scapula.[3] A dysfunction or weakness in this muscle may lead to muscle imbalance, decreased muscle endurance and altered scapulohumeral rhythm, which in turn might lead to shoulder impingement, muscle fatigue, instability of the glenohumeral joint and postural changes (Fuglevand et.al., 1993; Lehman et.al., 2004).

Past research has used electromyography (EMG) to investigate the muscle activation patterns and muscle fatigue of the shoulder musculature in functional activities. Lower trapezius muscle is often targeted in shoulder rehabilitation due to its contribution in maintaining proper shoulder kinematics and stabilization.1 Studies have shown that therapeutic exercises aimed at strengthening of separate portions of the trapezius can ultimately improve scapulohumeral rhythm. Several authors recommend different positions for the lower trapezius muscle strengthening; thereby it is very important to know which position will have the maximum activation of the muscle. Moseley et.al. (1992) indicated that rows, horizontal abduction, scaption, and shoulder flexion being the optimal exercises for lower trapezius. Ekstrom studied 10 different exercises at high intensity (85-90% of one repetition maximum) and identified overhead arm raise in standing and shoulder external rotation at 90^0 of abduction were optimal exercises for lower trapezius.[4] Interestingly, one exercise examined was a 90^0 horizontal abduction exercise based on Kendall's position. Activation was not highest among the exercises, but was substantial. The intensity of exercise makes any generalization to the rehabilitation population difficult and examining a single Kendall position limits the knowledge of its effectiveness.

The purpose of this study was to investigate the muscle activation patterns of the lower trapezius during four specific therapeutic exercises using positions described by Florence Kendall (Kendall et.al. 1980).5 By identifying the most effective positioning criteria in targeting the lower trapezius muscle, clinicians will be better able to design a more efficient and centered rehabilitation program. The purpose of the study was to evaluate the activation pattern of lower trapezius muscle during four specific therapeutic exercises using positions described by Florence Kendall.

Methodology

Cross senctional observational study was performed on 50 healthy individuals at Shri K. K. Sheth Physiotherapy College. The subjects were selected by simple random sampling. Inclusion criteria were (1) Normal Individuals (BMI 18 to 24.9 kg/m2) (2) Between ages of 20 to 30 years (3) Both Gender – Males and Females. Subjects were excluded (1) Those who had participated in consistent resistive weight training within the

past 6 months. (2) Those with History of previous Neck, Back, or Shoulder Pain and/or Trauma. (3) Those with any associated Musculoskeletal or Neurological disorder affecting the Study.

Prior to the commencement of the study, consent had been taken from all the subjects. Muscle activation pattern of lower trapezius muscle was measured using surface EMG during Maximum Voluntary Isometric Contraction (MVIC) at four different angles of arm abduction. Subject lie prone with arm abducted and externally rotated such that thumb is pointing towards ceiling. Each subjects was shown and practiced the four testing positions, i.e. 75^o, 90^o, 125^o, and 160^o of shoulder abduction wherein they were suppose to perform Maximum Voluntary Isometric Contraction.

Active Electrode was placed perpendicular to vertebral column at the level of inferior angle of scapula, 3-4 cm (2 fingers breath) lateral to the spinous process of 7th dorsal vertebrae. Reference Electrode was placed 3cm distal to it.[6]

With the subject prone on the plinth, goniometer was used to move the arm into one of the four positions of arm abduction; 0o was defined as the subject having the arm completely adducted against the thigh. The glenohumeral joint was used as base for the goniometer. Electromyography activity of MVIC of lower trapezius muscle was assessed at each of the four positions against the manual resistance being applied at the distal forearm and the subject was asked to raise their arm against it. Three trials at each position were taken with the MVIC for 5 seconds and 5 seconds rest between each repetition.

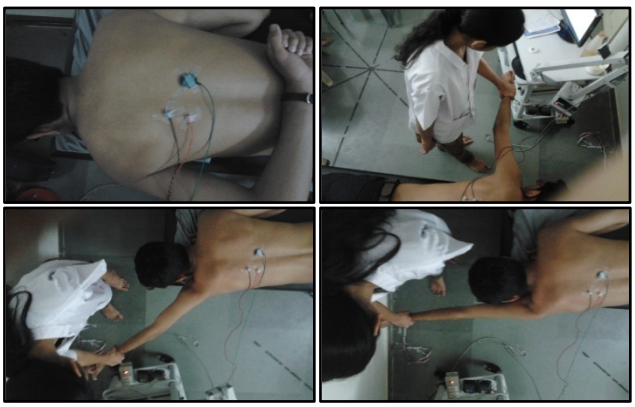
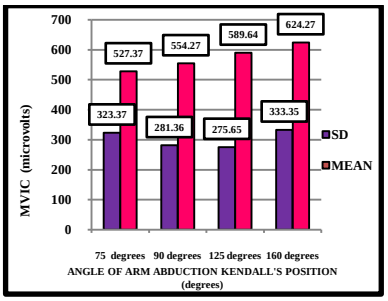


Figure 1 Method of recording MVIC of lower trapezius muscle at varied Kendalls positions

Data Analysis

Mean of the highest measure obtained at each position was taken and then standard deviation was calculated. A single factor repeated ANOVA was performed for each aspect of trapezius studied.

Graph 1: lower trapezius activation at various angles



Results

Out of 50 subjects tested, 18 were males and 32 were females. ANOVA was applied and calculations done using Graphpad Version 3.10, Obtained values of $p = 0.5139$ and $F = 0.7675$ is considered non significant and thus the variation obtained among column means is by chance.

Discussion

The results of the study showed that lower trapezius muscle demonstrated no significant level of difference of activation at any of angle of arm abduction. These findings are congruent with that advocated by Paula et al., that patterns of increasing and decreasing activity were nearly equally present in individuals, consequently resulting in no significant increase in the group mean value between 90^o and 140^o.

While lower trapezius demonstrated the greatest activation at 160^0, this position was not significantly greater than the other three positions; 75^0, 90^0 and 125^0 of arm abduction. Activation at 125^0 was lower than all other angles for the lower trapezius muscle. This findings are contrary to Elissa Kinney et.al., (2007) who suggested greatest amount of lower trapezius activation is during 90^0 and 125^0 of arm abduction. However Kendall (1980) advocated 160^o angle of arm abduction will target the lower trapezius muscle maximally, since the overhead arm position will target lower fibers optimally. Ekstrom (2003) showed that lower trapezius showed maximal activation at 125^o as the muscle fibers have been estimated to run at that angle. Moseley et. al., conducted a fine wire EMG study of trapezius muscle and found optimal position for lower trapezius activation was horizontal arm abduction (90^o).

Data from this investigation provides baseline information regarding muscle activation of the lower trapezius during horizontal abduction. The variability in patterns of EMG activity reported in this study may explain the apparent contradiction in reports of lower trapezius activity among preceding investigations. Previous authors report increasing activity of the lower trapezius at increased humeral elevation angles,[7] decreasing activity after 90^0,[8] or activity changes being dependent on the plane of elevation.[9] In the present study, patterns of increasing and decreasing activity were nearly equally present in individuals, consequently resulting in no

significance. Thus the probable reason being that as the angle of elevation increases the contribution from the serratus anterior and upper trapezius muscle increases, thus there is combine role of these muscles in the upward rotation of scapula as the arm elevation increases, causing no significant increase in the lower trapezius muscle firing with arm elevation.[10]

These findings can be generalized to strengthening in the clinical setting. When clinicians are formulating rehabilitation programs for patients with shoulder, neck and back problems. It may provide some insight into the rehabilitation of patients with shoulder pathology in clinical setting, causing clinicians to question the effectiveness of exercises that have been considered the standards of practice for quite some time by many.

The limitations of the study were small sample size, temperature could not be controlled and only one muscle lower trapezius was analyzed. The study can be in future conducted by involving the simultaneous EMG recording of Maximum Voluntary Isometric Contraction of all three, upper trapezius, lower trapezius, and serratus anterior muscle in Kendall's positions.

Conclusion

The investigation suggests that for shoulder rehabilitation program, lower trapezius muscle strengthening at any angle of shoulder abduction (750, 900, 1250, or 1600) would lead to equal amount of lower trapezius muscle activation.

Clinical implication

As there is no significant difference in activation pattern of Lower Trapezius between any of the angle of arm abduction, thus any of the four positions can be used for an efficient rehabilitation program.

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A comparison between single task versus dual task condition balance training in older adults with balance impairment

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Abstract

Background and Purpose - *Traditionally, rehabilitation programs emphasize training under single-task conditions to improve balance and reduce for falls. The purpose of the study was to compare the efficiency of three different balance training strategies in an effort to understand the mechanisms underlying training-related changes in dual task balance performance of older adults with balance impairment.*

Methods - *45 older adults with balance impairment were recruited and randomly assigned to three groups. Group one received single task balance training, group two received dual task training balance training under fixed priority, group three received dual task balance training under variable priority. Subjects received one hour individualized training sessions, five times in a week for two weeks. Berg balance scale, time up and go test and dynamic gait index were the outcome measure and their scores for all groups were taken prior and after the training.*

Results - *One way analysis of variance was used to analyse the difference among the balance improvement in Group one, two and three. And the results revealed that post intervention scores were highly significant (p□ 0.05) in group two and group three performed better than group one.*

Conclusion - *In conclusion, dual task training is effective in improving balance under dual task context in older adults with balance impairment, and single task training may not generalize to balance performance under dual task conditions.*

Keywords - Balance, Fall, Berg balance scale, Time up and go test, Dynamic index gait, Dual task.

Introduction

Falling is one of the most serious problems associated with ageing.[1] Falls are the most frequent cause of injury- related morbidity and mortality among the elderly. The risk of falling exceeds 20% per year among persons aged 65 and older and living in the community and reaches 35% per year among those 75 and older.[2,3]

Falls are costly and have potentially devastating physical, psychological and social consequences. Several studies have been performed among both home living and institutionalized populations to define risk factors associated with falls.[11-15]

These risk factors have included both- intrinsic or personal factors (example- Balance impairment, neurological disorders, postural hypotension, and medication use)[1,8,10,16-18] and extrinsic or environmental factors (example- Ill fitting footwear, poor lighting, slippery surface and inappropriate furniture.[1,8-10,18-20]

There are multifactorial intervention have been introduced which included eliminate environmental hazards, improve home support, provide opportunities for socialization and encouragement, modify medication, provide balance training, involve family and provide follow up.[9,21,22]

Keeping this in mind, this study is designed with the purpose of identifying the most appropriate balance training program under single and dual task condition in older adults with balance impairment because no research have examined the effects of training balance under single task versus dual task (fixed priority versus variable priority) conditions in older adults.

Single task training involves practicing functional task requiring balance (example Standing, walking, transfer) in isolation. In previous researches, the therapist may vary the condition to increase the challenge to balance during performance under which the subject practices for example – changing the availability of sensory cues (reduce visual cues by asking the participants to close your eyes), or support surface conditions (example- Walking on a flat surface versus an inclined surface. [23-24]

Dual task method, which requires participants to perform multiple tasks simultaneously, has been used to investigate the effect of cognitive tasks on postural control and vice-versa. It has been shown that the ability to maintain postural stability is reduced when performing two or more tasks concurrently & these deficits are increased in elderly people with balance impairment.[25-28]

Some studies compared the effectiveness of whole/dual-task training under various set of instructions (fixed priority versus variable priority). In fixed priority condition, participants were asked to place the same amount of attention on both tasks at all times, whereas in variable priority condition, attention was switched between tasks.

Kramer et al[31] compared dual task training under two instructional sets; fixed priority and variable priority instructional sets. In their study included a monitoring task in conjunction with an alphabet-arithmetic task. Results showed that the variable priority group improved (increased accuracy and decreased response time) significantly more than fixed priority group and dual task processing skills learned during variable priority training transferred to novel tasks. In this study, the effect of instructional set on dual task balance training in elders is not known. In light of research indicating that inability to perform concurrent tasks is a contributing factor to instability and falls in many older adults, it has been suggested that training under both single and dual –task condition is necessary to optimize functional independence and reduce falls in elderly people. So my purpose of study is to compare the effects of training balance under single task versus dual task (fixed

priority versus variable priority) in older adults with balance impairment.

Three balance scales are used to assess the outcomes of both interventions. They are Time Up and Go Test, Berg Balance Scale and Dynamic Gait Index. These scales have good reliability and validity. These scales have been selected for study because

1. They are very simple to administer
2. They are quick and practical.
3. They are easy to be conducted in Indian clinical setting
4. The contents of these scales closely mimic the day to day activities and are easy for the patients to understand.

Methods

Selection and description of participants

A sample of convenience of 45 older adults with balance impairment took part in this study. Subjects were gathered through a Free Physiotherapy Camp organized at Sarvodaya Hospital and community center at Ghaziabad and ISIC, Hospital, New Delhi. Subjects who fulfilled the inclusion criteria and were ready to attend exercise program regularly were selected.

To participate subjects had to meet the inclusion criteria: (i) Subjects with age of 65 of years or above. (ii) Subjects with history of one fall within the previous year.(iii) Independent ambulators with ability to walk 9 meter without any assistance.(iv)Subjects who were independent in their activities of daily living. (v) Subjects who scored greater than 24 on mini mental status examination score.[39]

Exclusion Criteria for the subjects were: (i) History of any other severe neurological, musculoskeletal and cardiovascular condition that affected balance. (ii) Any history of dizziness, depression. (iii) Any uncorrected severe hearing & visual impairment which will affect the balance in elderly. (iv) Receipt of physical therapy or enrollment in any other formal exercise program at the same time.

Technical information

A pre-post experimental design was used. The subjects were invited to participate in the study and were divided accordingly into three groups. A detailed explanation of the procedure was given to the patients after which they signed informed consent. Then the subjects were assessed on 3 balance scales included in our study: Berg balance scale, time up and go test, dynamic gait index. Balance training sessions followed Gentile's taxonomy of movement tasks, a theoretical framework for retraining motor control.

Group 1 received Single task condition training which included balance activities such as standing with reduced base of support, tandem standing, standing with eyes closed.

Group 2 received Dual task condition training under fixed priority which included same set of balance tasks as group 1 while simultaneously performing auditory and visual discrimination tasks as well as cognitive tasks such as substraction and subjects were directed to maintain attention on both postural and secondary tasks at all times.

Group 3 received Dual task condition training under variable priority which included half training was done with a focus on postural task performance, and half had a focus on secondary task performance such as semi tandem with eyes closed and arm alteration was postural task and spell word backward is secondary task and attention was switched between the task.

Subjects were then assessed on three balance scales- Berg Balance Scale, Time Up and Go Test, Dynamic Gait Index

Statistics

The data was managed on excel spread sheet and was analyzed using SPSS (Statistical Package for social sciences for windows) software, version 12. A One way analysis of variance was used to analyze the difference among the balance improvement in Group 1, 2, 3. Post hoc analysis of significant F ratio ($p \leq 0.05$) was conducted using Duncan mean test. Student t- test (paired) used to analyze the difference between the balance improvements within the group. A significance level of $p \leq 0.05$ was fixed.

Results

The group 1 receiving single task condition balance training program consisting of 12 males and 3 female with a mean age of 68.47 years. Group 2 receiving dual task condition with fixed priority balance training program consisting of 12 males and 3 females with a mean age of 68.20years. Group 3 receiving dual task condition balance training with variable priority balance training program consisting of 12 males and 3 females with a mean age of 68.07 years. All three groups were matched in terms of age, height, weight (table 1.1. and figure 1.1). One way analysis of variance was used to compare the performance of subjects of group 1, 2, 3 on Berg balance scale, Time up and go test, Dynamic gait index.

Graph 1.1. Comparison of age among the group 1, 2, 3
Group 1 = Single task condition balance training
Group 2 = Dual task condition balance training
Group 3 = Dual task condition balance training

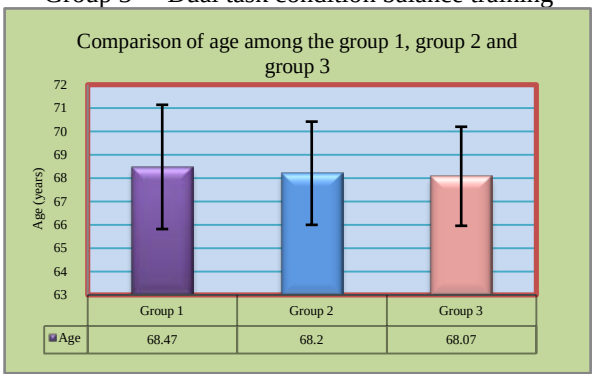


Table 1.1. Demographic Data: Comparison among Group 1, Group 2, Group3 (One way ANOVA)

Variables	Gp 1 (n = 15) Mean (SD)	Gp 2 (n = 15) Mean (SD)	Gp 3 (n =15) Mean (SD)	F value	p value
Age (year)	68.47 (2.66)	68.20 (2.21)	68.07 (2.12)	0.113 NS	0.893
Height (cm)	165.93 (11.61)	164.93 (10.35)	164.33 (10.37)	0.084 NS	0.9195
Weight (kg)	61.66 (6.04)	60.93 6.06)	60.80 (5.88)	0.0907 NS	0.9134
Gender	Male = 12 Female = 3	Male = 12 Female = 3	Male = 12 Female = 3		

NS = Not significant at p≤ 0.05 level
n = number of subjects
Gp = Group
Group 1 = Single task condition balance training
Group 2 = Dual task condition with fixed priority balance training
Group 3 = Dual task condition with variable priority balance training

Pre-intervention scores of Berg balance scale (Graph 1.2)

All the groups did not showed significant difference (F= 0.8543, p≤ 0.05) indicating that all three groups were matched in terms of Berg balance scale. Group 1 (mean= 49.55, SD=1.88), Group 2 (mean= 50.33, SD= 1.75), Group 3 (mean= 50.20,SD= 1.74).

Pre-intervention scores of Time up and go test for balance (Graph 1.3)

All the groups did not showed significant difference (F= 0.5513, p≤ 0.05) indicating that all three groups were matched in terms of Time Up and Go Test. Group1 (mean= 11.14, SD= 1.24), Group2 (mean= 11.33, SD= 1.03), Group3 (mean= 11.57, SD=1.06).

Pre- intervention scores of Dynamic gait index for balance (Graph 1.4)

All the groups did not showed significant difference (F= 0.7434, p≤0.05) indicating that all three groups were matched in terms of Dynamic Gait Test. Group 1 (mean= 20.40, SD= 1.05), Group 2 (mean= 20.40, SD= 1.18), Group 3 (mean= 20.00, SD= 0.84)

Post- intervention scores of Berg balance scale (figure 1.2)

Results revealed significant difference in group 1 versus group 2 and group 1 versus group 3 with F value= 9.1953, p≤ 0.05. Group 1 (mean=54.33, SD=1.63), Group 2 (mean= 55.66, SD= 0.48), Group 3 (mean= 55.80, SD= 0.56)

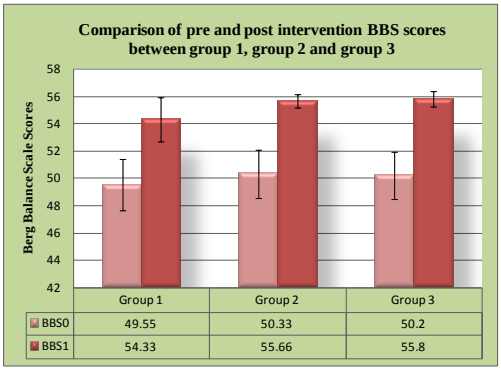
Post- intervention scores of Timed up and go test (figure1.3)

Results revealed significant difference in group 1 versus group 2 and group 1 versus group 3 with F= 6.68451, p≤0.05. Group 1 (mean =9.70, SD= 0.80), Group 2 (mean = 8.80, SD= 0.84), Group 3 (mean = 8.72, SD= 0.75)

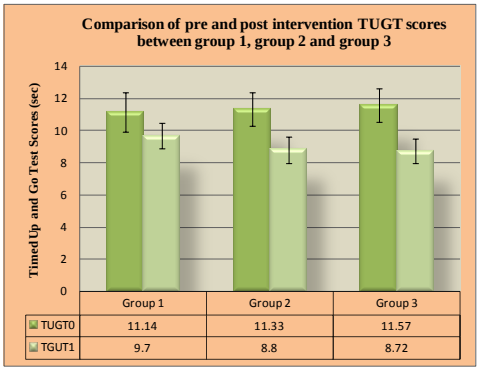
Post- intervention scores of Dynamic gait scale (table 1.3 and figure 1.4)

Results revealed no significant difference in among all three groups with F= 1.4135, p ≤0.05. Group 1 (mean=23.53, SD =0.74), Group 2 (mean = 23.80, SD= 0.41), Group 3 (mean = 23.86, SD=0.51).

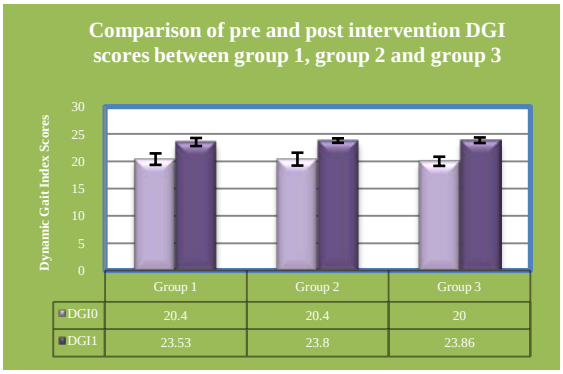
Graph 1.2. Comparison of pre and post intervention of berg balance scale scores among group 1, 2, 3
BBS0 = Pre-intervention scores of Berg balance scale
BBS1 = Post-intervention score of Berg balance scale



Graph 1.3. Comparison of pre and post intervention of time up and go test scores among group 1, 2, 3.
TUGT0 = Pre-intervention scores of Time Up and Go Test
TUGT1 = Post-intervention score of Time Up and Go test



Graph 1.4. Comparison of pre and post intervention scores of dynamic gait index among group 1, group 2 , group 3
DGI = Dynamic Gait Index
DGI0 = Pre-intervention scores of Dynamic gait index
DGI1 = Post –intervention scores of Dyanmic gait index



Discussion

The results of study have revealed that subjects in group 1 (single task condition balance training), group 2 (dual task condition balance training with fixed priority), group 3 (dual task condition balance training with variable priority) benefited from balance training intervention with a significant improvement in post- intervention balance scores on Berg balance scale, Time up and go, but results did not show the significant improvement on Dynamic gait index. Although Dynamic gait index have shown improvement with in all three groups.

Secondarily, post intervention scores were highly significant in among the groups but group 2 and group 3 performed better than group 1. So dual task condition balance training program was found to be more effective in improving balance in older adults with balance impairment.

One factor that might have contributed to improved scores in group 2 and group 3 could be based on task coordination and management theory proposed by Kramer et al. According to this theory practicing two tasks together (not a single task practice) allows participants to develop task coordination skills. Thus, a possible explanation of this outcome is that the efficient integration and coordination between the two tasks acquired during dual task training is crucial for improving dual task performance. Alternatively, according to Task Automatization hypothesis, practicing only one task at a time (single task training) allows participants to automatize the performance of individual tasks. As a result, the processing demand required to perform the tasks is decreased, leading to more rapid development of skills.[33-36]

Another factor that might have contribute to improved scores in group 2 and group 3 was that they had instructional set in dual task training. Research by Kramer et al suggests that who receive dual task training with variable priority instructions have advantage over those who receive training with fixed priority instructions. These researchers found that participants in dual task training groups with either fixed priority or variable priority instructions could learn to coordinate the two tasks. However, after training, the processing demand required to perform the tasks was less when their attention was shifted between the two tasks, as was required in dual task training with variable priority instructions group. This could explain why the participants in our dual task training with variable instructions group were able to learn faster. Although in our results we could not found a significant difference between fixed priority and variable priority instruction but the subjects who received variable priority have done less number of miss steps and less errors in verbal response during the intervention period as compare to fixed priority instructional sets.[32-34]

After two weeks intervention program, subjects in all training groups significantly improved performance on Berg balance score and Time up and go. But results did not show the significant improvement on Dynamic gait index. Although Dynamic gait index have shown improvement with in all three groups. No research studies have examined that support the dynamic gait index is improved in dual task condition balance training. Might be the rate of learning and retention phase was not appropriate. Thus, the outcomes suggest that dual task condition balance training is more effective than single task and the importance of instructional set during balance training.

Conclusion

The result of the present study clearly states that dual task training is effective in improving balance under dual task context in older adults with balance impairment, and single task training may not generalize to balance performance under dual task conditions. The instructional set was an important in dual task performance. The variable priority instructional set offered advantages over the fixed priority instructional set in terms of the rate of learning and ability to maintain the skill level achieved during training. Although in our results we could not found a significant difference between fixed priority and variable priority instruction but the subjects who received variable priority have done less number of miss steps and less errors in verbal response during the intervention period as compare to fixed priority instructional sets.

Thus, the alternate hypothesis stated in the beginning of the study, that is, Dual task condition balance training acts as better technique from single task balance training in older adults with balance impairment, have been proved.

Clinical Implication

This study found that it was feasible to implement individual dual task training, combining traditional intervention with a variety of cognitive tasks, in community-dwelling older adults with balance impairment. We also found that older adults could in fact adhere to instructional sets regarding attentional forces. They successfully allocated their attention to task in which they were instructed. Thus, results

may generalize to similar older adults with balance impairment, excepting those with a significant neurological or musculoskeletal diagnosis.

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The effect of lower limb progressive resistance exercise on balance in subacute and chronic stroke patients

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Abstract
Background and Objective - *Balance problems are thought to be common after stroke and they have been implicated in poor recovery of activity of daily living and mobility and an increase risk of falls. A positive correlation exists between balance impairments and decreased lower-limb strength. So the aim of the study was to find out effect of lower limb progressive resisted training on balance.*
Methodology - *An experimental longitudinal study was conducted with 30 subacute and chronic stroke patients. The experimental group (N=15) were given progressive resistance training with 70% 0f 1 RM, 3sets of 8-10 repetition, 6 days/week for 4 weeks. Exercises were given to HF, HE, HAB, HAD, KF, KE and ADF. Progression was checked every week and accordingly increase in resistance was given. The control group (N=15) were given conventional physiotherapy for same duration. Pre and post evaluation of strength and balance was taken by 1 RM and BBS respectively.*
Result - *The paired –t test for intra group comparison of pre and post treatment 1RM shows significant improvement in strength in both groups. The unpaired- t test inter group comparison of post treatment 1RM shows significant improvement in experimental group compare to control group HF (t=5.42, p<0.001) HE (t=8.46, p<0.001) HAB (t=5.40, p<0.001) HAD (t=6.14, p<0.001) KF (t=7.03, p<0.001) KE (t=5.08, p<0.001) ADF (t=6.74, p<0,001). The Wilcoxon Signed Rank test for intra group comparison of pre and post treatment BBS score shows significant improvement in balance in both groups (z=3.414, p<0.001 for experimental group, z=3.495, p<0.00 for control group). The Mann Whitney U test for inter group comparison of post BBS score shows significant improvement in balance in experimental group as compared to control group (z=2.725, p<0.006).*
Conclusion - *There was significant improvement in muscle strength of lower extremity and balance after progressive resistance training in experimental group as compared to control group.*
Key words - Stroke, BBS, 1RM, Progressive resistance exercise

Introduction

The traditional definition of stroke, devised by the World Health organization in the 1970s, is a "neurological deficit of cerebrovascular cause that persists beyond 24 hours or is interrupted by death within 24 hours". Stroke or Cerebral Vascular Accident (CVA) was the 3rd largest cause of death after heart disease and cancer worldwide[1] and the most important single cause of severe disability in people.[2]

Hemiplegia is registered in 70–85% of first case stroke, and reduced muscle strength is considered a major cause of motor disability.[3] Balance problems are thought to be common after stroke, and they have been implicated in the poor recovery of activities of daily living and mobility and an increased risk of falls. More than 80% of subjects who had first-time stroke, have limited sitting balance, standing balance and stepping balance in acute phase.[4] Balance is a pre-requirement for all functional activities and an essential part of sitting, sit to stand, and walking activities, depends on integrity of the CNS.

The functionally significant components of balance are maintenance of a posture, postural adjustments in anticipation of and during a self initiated movement, and postural adjustments made in response to an external disturbance. Balance emerges from a complex interaction of the sensory and musculoskeletal system integrated and modified within the central nervous system (CNS) in response to changing internal and external environment conditions.[5]

Decreased muscle strength, range of movement, abnormal muscle tone, motor coordination, sensory organization, cognition, and multisensory integration can contribute to balance disturbances at different levels.[6] Studies of balance impairments consistently have shown that people with stroke have greater postural sway than age-matched volunteers who are healthy. They also have altered weight distribution patterns; so that less weight is taken through the weak leg, and they have smaller excursions when moving their weight around the base of support, especially in the direction of the weaker leg appear to take longer to reach the same level of functional gain.[7]

In the literature, post stroke weakness has been described not only as impaired force magnitude but also as a more broadly defined phenomenon, including slowness to produce force, a rapid onset of fatigue, an excessive sense of effort, and difficulty with producing force effectively within the context of a taskictions.[8]

A positive correlation exists between balance impairments and decreased lower-limb strength.[4,6] In hemiparetic patients, weakness and impaired muscle control of the affected lower limb, decreased range of motion, and pain can lead to changes in the base of support (BOS) control.[6] Abnormal motor control, with a decrease in rate and frequency of motor neuron activation and poor timing and co-ordination of muscle contraction (i.e. loss of muscle strength and co-ordination) which cause problems of force and timing lead to an inability to maintain a relatively stable posture against gravity.

According to Carr & Shepherd it is lower extremity muscles that control the movements of trunk over the base of support.[9] The strength of multiple muscle groups of the paretic lower limbs has been shown to correlate with independence in the stand-pivot-sit transfer. The decreased trunk movements seen as a person post-stroke reaches out in sitting, reflects a reluctance to move the body mass too far towards the periphery of the base of support because of insecurity that results from difficulty stabilizing the lower extremity.[9] So it is important to

improve muscle strength in stroke patients on affected side to maintain good balance. So the aim of the study was to find out effect of lower limb resisted training on balance.

Methodology

The study design was experimental. 30 subjects with subacute and chronic stroke were selected from various physiotherapy centers in Rajkot. The patients were divided into group A (experimental) and B (control) by random sampling. Inclusion criteria was (1)Single episode of unilateral stroke, (2) Less than one year post stroke (sub-acute to chronic stage), (3) Both male and female, (4) Age group 40-65 and (5) Brunnstrom`s recovery grade more than 3. Patients were excluded if they had (1) More than one instance of cerebrovascular event, (2) Visual and auditory deficits, (3) Aphasia, (4) Inability to follow simple commands, (5) Uncontrolled hypertension or (6) Any other orthopedic, neurological or cardiovascular problems affecting muscle strength or balance.

1RM of major muscle groups of lower limb (hip flexors, extensors, adductors, abductors knee flexors, extensors and ankle dorsi-flexors) and BBS of all patients were taken. Group A were given progressive resistance exercise with conventional treatment. Group B were given only conventional treatment.

GROUP A: The progressive resisted exercise was given with 70% of 1RM. Resistance was given with free weights. 3 sets of 8-10 repetition at 70% of 1 RM. Exercise were given 6 days/week for 4week.10 Exercise were given to hip flexors, extensors, abductors, adductors knee flexors and extensors, and ankle dorsi-flexors. Progression was checked every week with 1 RM and according to increase in weight, progression in 70% of 1RM was given.

GROUP B: Conventional treatment was included stretching for hamsring and calf muscles and wrist flexors, normalizing tone activity, mat exercises, sit to stand activity, Proprioceptive neuromuscular facilitation for lower limb and trunk, task specific activities for upper limb. Exercises were given 6 days/week for 4 weeks.

Post exercise 1RM and BBS were assessed for both the group.

Results

Table 1 shows the value of Paired t-test for 1 RM on comparing pre and post training in the Group A and B. The result shows that there was significant improvement in muscle strength post strength training. HF ($t=6.56$, $p<0.001$) HE ($t=8.87$, $p<0.001$) HAB ($t=6.45$, $p<0.001$) HAD ($t=7.12$, $p<0.001$) KF ($t=9.29$, $p<0.001$) KE ($t=5.46$, $p<0.001$) ADF ($t=7.35$, $p<0.001$) in group A. In the Group B the result shows that there was significant improvement in muscle strength post conventional training. HF ($t=10.45$, $p<0.001$) HE ($t=3.22$, $p<0.006$) HAB ($t=3.84$, $p<0.002$) HAD ($t=4.51$, $p<0.001$) KF ($t=4.93$, $p<0.001$) KE ($t=2.77$, $p< 0.01$) ADF ($t=2.25$, $p<0.02$)

Table 2 shows the value of unpaired t-test for strength on comparing pre and post training between the Group A and Group B. The result shows that there was significant improvement in muscle strength post training in Group A compare to Group B. HF ($t=5.42$, $p<0.001$) HE ($t=8.46$, $p<0.001$) HAB ($t=5.40$, $p<0.001$) HAD ($t=6.14$, $p<0.001$) KF ($t=7.03$, $p<0.001$) KE ($t=5.08$, $p<0.001$) ADF ($t=6.74$, $p<0,001$)

Table 1: Comparison of pre and post treatment measurement of 1RM mean and results of paired t – test (In Group A and B)

MUSCLE GROUP	GROUP A		GROUP B	
	Mean (SD) (gms)	p	Mean (SD) gms	p
Pre HF	2300 (1221.82)	< 0.001	1300 (649.17)	< 0.001
Post HF	3286.66 (1704.14)		1466.66 (673.65)	
Pre HE	933.33 (593.61)	< 0.001	580 (439.48)	< 0.006
Post HE	1666.66 (748.01)		633.33 (468.53)	
Pre HAB	1800 (996.42)	< 0.001	766.66 (409.99)	< 0.002
Post HAB	2500 (1309.3)		866.66 (361.87)	
Pre HAD	1700 (1014.18)	< 0.001	886.66 (561.71)	< 0.001
Post HAD	2466.66 (1288.22)		973.33 (592.17)	
Pre KF	1125.46 (1125.46)	< 0.001	913.33 (669.61)	< 0.001
Post KF	2513.33 (1277.19)		1033.33 (679.98)	
Pre KE	1586.66 (977.5)	< 0.001	1020 (583.34)	< 0.01
Post KE	2433.33 (1374.07)		1073.33 (572.54)	
Pre ADF	466.66 (381.1)	< 0.001	180 (101.41)	< 0.02
Post ADF	886.66 (582.93)		206.66 (103.27)	

Table 2: Comparison of post treatment measurement of 1RM mean and results of unpaired t – test (Between Group A and B)

MUSCLE GROUP	MEAN (SD) gms	p
Pre HF	986.66 (581.7)	< 0.001
Post HF	166.66 (61.72)	
Pre HE	766.66 (319.97)	< 0.001
Post HE	53.33 (63.99)	
Pre HAB	700 (414.03)	< 0.001
Post HAB	106.66 (96.11)	
Pre HAD	766.66 (416.9)	< 0.001
Post HAD	93.33 (79.88)	
Pre KF	646.66 (269.56)	< 0.001
Post KF	126.66 (96.11)	
Pre KE	846.66 (599.84)	< 0.001
Post KE	53.33 (74.32)	
Pre ADF	420 (221.03)	< 0.001
Post ADF	26.66 (45.77)	

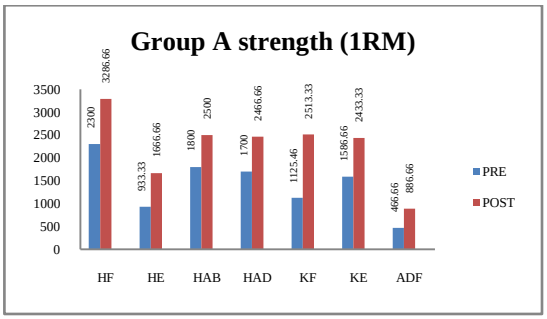
Table 3: Comparison of means of BBS score measured pre and post treatment for Group A & B and Wilcoxon Signed Rank test for inter group comparison

		Mean (SD)	z	p
Group A	Pre treatment	31.2 (5.1)	3.414	< 0.001
	Post treatment	41.06 (5.3)		
Group B	Pre treatment	42.6 (5.67)	3.495	< 0.001
	Post treatment	32.53 (5.73)		

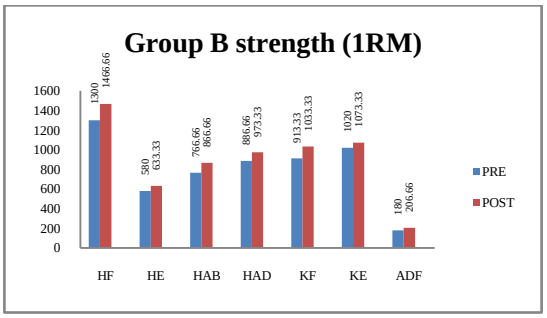
Table 4: Comparison of means of BBS score measured post treatment between Group A and B and results of Mann-Whitney U test for inter group comparison

	MEAN	SD	z	p
Group A	42.6	5.73	2.725	0.006
Group B	32.53	5.26		

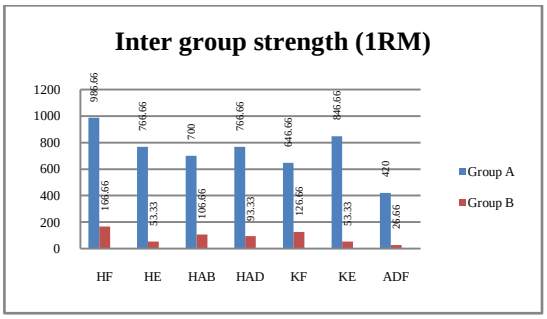
Graph 1: Comparison of means of 1RM measured pre and post strength training for different muscle group in the Group A



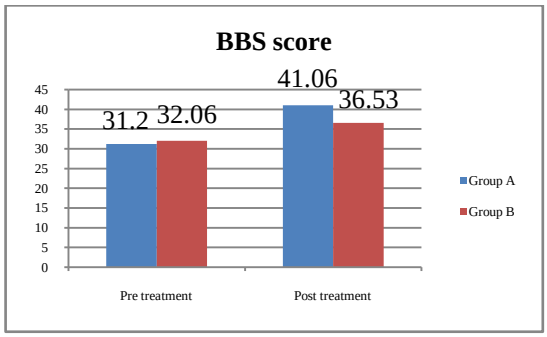
Graph 2: Comparison means of 1RM measured pre and post strength training for different muscle group in the Group B



Graph 3: Comparison of means of 1RM measured post strength training for different muscle group between the Group A and Group B



Graph 4: Comparison of means of BBS score measured pre and post treatment in Group A & B



Discussion

The result of the present study are in line with findings in literature and support the conclusion that by application of progressive resistive exercises lower limb muscle strength and balance are improved. Many researchers like Patricia Kluding et al., (2009)[11], Stephen J page et al, (2008)[12], Weiss et al., (2000) [13], Richard W. Bohannon et al., (1991)[14] have documented that lower limb strength was associated with gain in balance (BBS). Dean CM et al., (2000)[14] demonstrated significant improvement in walking speed and endurance, force production through affected leg during sit-to stand and the number of repetition of the step test by application of muscle strengthening exercise in affected lower limb.

The possible mechanism for improvement in balance explained by supporting studies was, strength training can result in increased motor unit activity, there by potentially increasing strength after stroke. Progressive resistance training includes higher level of neuromuscular activation than functional activity.[15] It also produce physiological changes in the muscle (hypertrophy) and mechanical effect such as increased joint stability[16].

Changes in the pattern of motor unit recruitment and increase in the neural drive may be inclusive factors after strength training. Thus, based on the principles of neuroplasticity, strength or resistance training plays an important role in improving motor unit recruitment, because the capacity to produce muscular force is primarily a neural phenomenon with task specific regulation of neural activity. All previous study found the improvement in functional balance, sit-to-stand activity, stair climbing and walking speed. All these activities represent good static as well as dynamic balance. So ultimately it represents increase in balance.[16]

These results contrast with those of Indr Kligyte ea al., (2003)[9], Mead et al., (2007)[17], Yang et al., (2006)[18], Shart et al., (1997).[19] They found lower limb muscle strength has a poor influence on dynamic balance problem[17] and no significant improvement was seen in dynamic balance after endurance resistance training program.[17,18]

Weak correlation between the Functional Reach test and lower extremity muscle strength was obtained in above

study because no measure were taken to control the subject`s strategy of reaching forward. One other reason was that the assessment of the strength of isolated muscle group was taken instead of assessing synergistic muscle group.[17] But in present study balance measure used was BBS, which includes static as well as dynamic balance component. And all major muscle group strength was taken in to consideration. Progressive load applied to patient after checking strength improvement every week in present study, was not given in above studies.

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Energy expenditure during wheelchair propulsion in different levels of paraplegics

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Abstract
Background - *Wheelchair is considered as an efficient means of locomotion with optimal independence for a non – ambulatory person with dysfunctioning lower limbs. A linear relationship between oxygen consumption (VO_2) and heart rate at submaximal levels has been repeatedly proven in able-bodied subjects, handicapped children, and paraplegics during arm cranking at different power levels. Therefore heart rate is used an indicator of energy expenditure. This study is aimed to evaluate the energy expenditure during standard wheelchair propulsion in different levels of paraplegics using Physiological Cost Index (PCI).*
Materials & Methodology - *Male paraplegics (n=50,) age = 31.52 ± 5.20 (Mean ± Standard Deviation) years between T7 to T12 spinal level using wheelchair were included in the study. Patients were given 5 minutes time at the starting line in order to attain a steady resting heart rate which was measured by palpation of radial pulse. Subjects were instructed to propel the wheelchair at their normal propulsion speed on a standard level corridor (walkway of 25 meters) for a minimum duration of 5 minutes to attain a steady physiological heart rate. At the end of 5 minutes, they were instructed to stop and steady propulsion heart rate was measured. Energy expenditure (PCI) was calculated by: PCI (beats/meter) = Steady propulsion heart rate – Resting heart rate (beats per minute / propulsion speed (meter/minute)*
Results - *Descriptive statistics using mean and standard deviation and Pearson correlation was used. There was a strong correlation between PCI and duration since wheelchair used.*
Conclusion - *There is strong correlation between PCI and duration since wheelchair used, but there is no correlation between PCI and different level of thoracic injury, American Spinal Injury Association (ASIA) score and speed of propulsion.*

Introduction

Spinal cord injury (SCI) is an insult to the spinal cord resulting in change, either temporary or permanent, in its normal motor, sensory or autonomic function.[1]

Spinal cord injury (SCI) is catastrophic condition that, depending on its severity may cause dramatic changes in person's life.[2] The degree & type of forces that are exerted on the spine at the time of injury determine the location & severity of the damage that occurs.[3] The incidence of multiple traumas in the client with a traumatic spinal cord injury is 55.2%.[4]

Spinal cord injuries are the named according to the level of neurological injury and are classified as complete or incomplete. The neurological level of injury is defined as the most caudal level of the spinal cord that exhibits intact sensory and motor functioning.[5] A person is said to have a complete spinal cord injury if there is total and permanent functional disruption of the cord. No sensory or motor function is present in areas innervated below the neurological level of injury. A lesion is classified as incomplete if any sensation or voluntary motor function exists more than 3 segments below the neurological level of injury.[5]

The wheelchair should enable individuals with paraplegic to perform the activities of daily living (ADL) that are important for them, with minimal to no assistance and with the least amount of energy expenditure. Types of activities include transfers, personal needs (e.g. bathing and toileting), working, preparing meals, cleaning and shopping.[6]

Energy is defined as the "capacity of a physical system to perform work". Energy exists in several forms such as heat, kinetic or mechanical energy, light, potential energy, electrical, or other forms. The SI unit of energy is the joule (J) or Newton-meter (Nm).[7]

Energy expenditure is an important parameter in the assessment of orthotic treatment or during wheelchair prescription in paraplegics. Estimation of energy cost of ambulation provides functional efficiency of the user, loco motor efficiency of the wheelchair and potential benefits of the propulsion system.[9]

In able body subjects, heart rate and oxygen uptake have linear relation upto submaximal workloads. This has enabled the clinician and the researcher to monitor the energy cost of a variety of physical activities by monitoring the heart rate alone. In high thoracic paraplegics monitoring heart rate was considered to be unreliable because of suspicion of injury to the sympathetic contribution of the cardiac plexus, Bar-on and Nene found that, in paraplegics below the lesion level of T3 spinal level injury, heart rate shows linear relation to oxygen uptake.[8]

Both speed and heart rate have been used as indicator of efficiency and energy cost of locomotion but their combined use was first reported by Mac Gregor in 1979, who highlighted the problems of factor other than work load which may cause heart rate variability. He introduced a new method of finding the energy expenditure and it was termed as Physiological Cost index (PCI). PCI (beats/meter) = Steady propulsion heart rate – Resting heart rate (beats per minute / propulsion speed (meter/minute)

Aim and Objectives

AIM: To determine the energy expenditure during wheelchair propulsion in different level of paraplegics.
OBJECTIVES: (1) To correlate the physiological cost index during wheel chair propulsion and different levels of thoracic injury. (2) To correlate the physiological cost index during

wheel chair propulsion and the duration since wheel chair use in different levels of thoracic injury.

Methodology

STUDY DESIGN: Cross-sectional observational study
STUDY SETTING: Government Physiotherapy College, Civil Hospital, Ahmedabad.
STUDY DURATION: The study was performed only in a single session.
SAMPLE SIZE: Fifty
7 subjects with T7 spinal cord injury.
9 subjects with T8 spinal cord injury.
9 subjects with T9 spinal cord injury.
7 subjects with T10 spinal cord injury.
8 subjects with T11 spinal cord injury.
10 subjects with T12 spinal cord injury.
STUDY POPULATION: Subjects diagnosed with spinal cord injury
SAMPLING DESIGN: Simple random sampling
AGE GROUP: 20 – 40 years, mean age 31.52±5.20 years
INCLUSION CRITERIAS:

1 Patients who were willing to participate.
2 Only male subjects were selected.
3 Spinal cord injury patients between T7–T12 levels.
4 Medically stable patients.
5 Height of patient varying from 5 feet 4 inches to 6 feet 2 inches.
6 Patients who were already trained for wheelchair propulsion for at least 3 weeks.

EXCLUSION CRITERIAS:

1 Any cardio–respiratory abnormality.
2 Any musculoskeletal abnormal abnormality preventing appropriate seating or propulsion of wheel chair.
3 Any neurological problems (e.g. tumors, cerebro-vascular accident)
4 Pain in upper limb.
5 Patients with bed sore.

PROCEDURE: A written consent form was taken from patients who fulfilled the inclusion and exclusion criteria. The procedure was explained to them. A thorough neurological examination was done. ASIA scale was used to differentiate between the complete or incomplete spinal cord injuries and also to know the level of impairment.

A standard wheelchair was used on which the patient was seated with a cloth belt tied at the level of anterior superior iliac spine to prevent him from sliding from seat. Another cloth belt was tied horizontally just above the foot rest to prevent the legs from slipping from the rest during wheel chair propulsion.

Figure 1: Paraplegic patient sitting on wheel chair

Patients were given 5 minutes time at the starting line to sit quietly in order to attain a steady resting heart rate which was measured by palpation of radial pulse. Subjects were instructed to propel the wheel chair at their normal speed on a standard leveled corridor (which had a walkway of 25 meters) for a minimum duration of 5 minutes to attain a steady physiological heart rate. At the end of 5 minutes, they were instructed to stop and immediately the steady propulsion heart rate was measured by the palpation of radial pulse. The distance travelled by the patient was measured by calculating the number of rounds covered by the patient multiplied by 25 meters (walk way distance) and the extra distance was measured using an inch tape. Wheel chair propulsion energy expenditure using PCI was calculated.

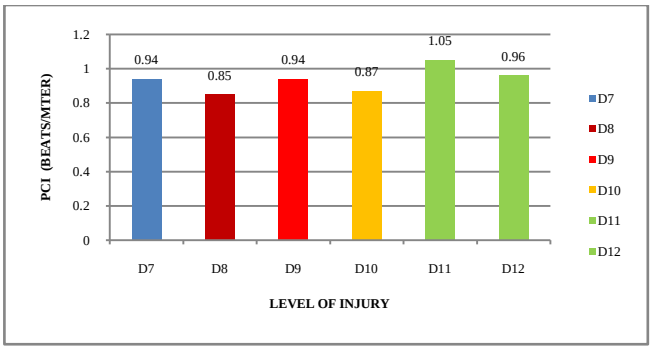
Results

Table 1: Mean age and DSWU in patients with spinal cord injury (T7–T12)

	MEAN (SD)
AGE	31.52(5.2)
DSWU	24.54(13.42)

Table 2: Mean values of ASIA, RHR (Beats/Minute), PEHR (Beats/Minute) and Distance (Meter).

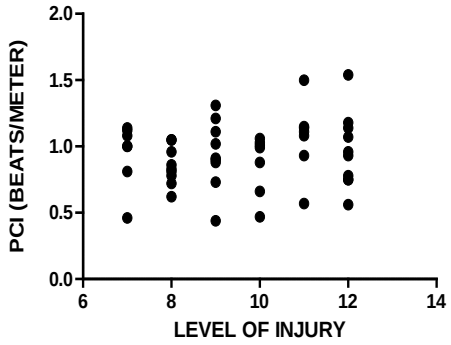
	MEAN (SD)
ASIA	134.1(17.53)
RHR (beats/minute)	87.9(15.9)
PEHR (beats/min)	113.3(19.55)
DISTANCE (meter)	130.6(47.59)



Graph 1: Mean values of PCI (Beats/Meter) in different levels of spinal cord injury

Table 3: Correlation between different levels of paraplegics and PCI. (Pearson Product moment correlation coefficient)

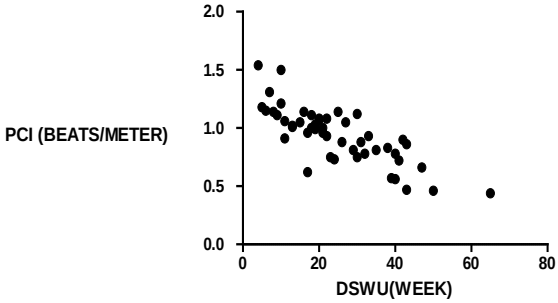
Variables	Mean (SD)	Pearson correlation coefficient R	P
PCI (beats/meter)	0.94(0.23)	0.1410	0.3338
Thoracic level injury	9.5(1.8)		



Graph 2: Correlation between different levels of paraplegics and PCI

Table 4: Correlation between duration since wheelchair used (DSWU) and PCI. (Pearson Product – moment correlation coefficient)

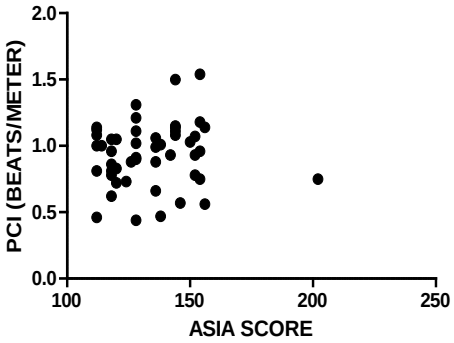
	Mean (SD)	Pearson correlation coefficient R	P
PCI (beats/meter)	0.94 (0.23)	- 0.7971	<0.0001
DSWU (week)	27 (14.26)		



Graph 3: Correlation between duration since wheelchair used (DSWU) and PCI

Table 5: Correlation between PCI and ASIA score in different levels of thoracic injury (T7 – T12). (Pearson Product – moment correlation coefficient)

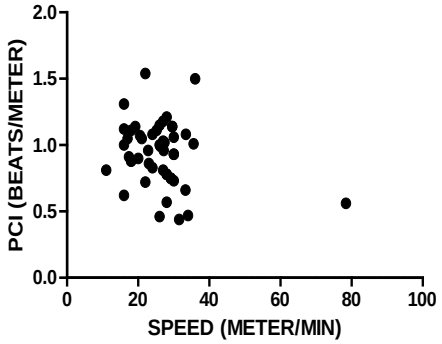
	Mean (SD)	Pearson correlation coefficient R	P
PCI (Beats/meter)	0.94 (0.23)	0.0772	0.5976
ASIA score	134.1 (17.53)		



Graph 4: Correlation between PCI and ASIA score in different levels of thoracic injury (T7 – T12)

Table 6: Correlation between PCI and speed of propulsion in different level of thoracic injury (T7 – T12). (Pearson Product – moment correlation coefficient)

	Mean (SD)	Pearson correlation coefficient R	P
PCI (beats/meter)	0.94 (0.23)	- 0.2516	0.0812
Speed of propulsion (meter/min)	26.12 (9.52)		



Graph 5: Correlation between PCI and speed of propulsion in different level of thoracic injury (T7 – T12). (Pearson Product – moment correlation coefficient)

Discussion

This study consisted of only male paraplegics to avoid any gender influences in energy expenditure. All the subjects were below the level of T6 as patients above this lesion have no control over their sympathetic system which leads to loss of control in heart rate and blood pressure which may affect the heart rate index.[8]

The average speed of propulsion was 26.11 meter/minute. There was a significant negative correlation between speed of propulsion and PCI suggesting that increasing in speed had resulted in less energy expenditure.

There was no significant correlation between different levels of spinal cord injury and PCI. This may be because the muscles used during propulsion may not have highly differed between various levels of spinal cord injury. Mulroy SJ et al studied the muscular activity and found that the shoulder girdle muscles contribute to a greater extent for the propulsion of wheelchair. They identified functional synergy : push (anterior deltoid , pectoralis major, supraspinatus , infraspinatus , subscapularis , serratus anterior , biceps) and recovery (middle and posterior deltoid , supraspinatus , subscapularis , middle trapezius , triceps). [10] In our study all the patients had these shoulder girdle muscles preserved.

Similarly there was no correlation between the ASIA and PCI due to lack of homogeneity among the subjects in the same level of thoracic injury. Also the ASIA scores reports only about the sensory scores and not about the motor scores at the thoracic level. So the correlation could not be established.

There was a very strong correlation between duration since wheelchair used to PCI. Longer the duration since use of wheelchair lesser was the energy expenditure. This may be because of the improved cardiovascular efficiency with longer usage, increased muscular power in the propelling muscles and due only about the effect of motor learning as less muscle activity is required with improved learning. This suggests that with longer usage, wheelchair propulsion may become a more energy efficient form of ambulation in paraplegics.

Limitations of the study

1 Small sample size.
2 Propulsion technique was not controlled.
3 Body Mass Index was not noted.

Suggestions for Future Study

1 Patients with similar duration of wheelchair training should be included for homogeneity.
2 Patients should be instructed to propel the wheelchair in higher velocity to analyze the effect of trunk muscle activity on energy expenditure (PCI).

Conclusions

There is strong correlation between the duration since wheelchair and the energy expenditure where longer the duration lesser the energy expenditure but there is no correlation between different levels of spinal cord injury level and the energy expenditure during wheelchair propulsion, no correlation between ASIA scores and PCI in different levels of thoracic injury, no correlation between the speed of propulsion and PCI in different levels of injury.

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Immediate effectiveness of diathermy, positional release therapy and taping on acute wry neck in a post-partum woman: single case report

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ABSTRACT

Objectives - *To find out the immediate effectiveness of diathermy, taping and positional release in the treatment of acute wry neck in a post-partum woman.*

Design - *Single case study design.*

Setting - *Tertiary care center.*

Participants - *A single individual with acute wry neck participated in this study.*

Interventions - *Interventions used in this study included continuous short wave diathermy, positional release therapy and taping.*

Main outcome measures: Pain relief in terms of visual analogue scale and active cervical side flexion to opposite side in centimeters.

Results - *Pain was reduced by 6.8cm on VAS scale and active cervical side flexion was increased by 3.2cm immediately after the interventions.*

Conclusions - *Diathermy, taping and positional release therapy can be used for immediate relief of acute wry neck pain and restricted movements.*

Keywords - neck pain; physiotherapy; taping; positional release technique; continuous short wave diathermy; positional release.

Background and Purpose

Neck pain is a common condition, with an annual incidence estimated at about 15%[1]. Patients with neck pain frequently are treated without surgery by primary care and physical therapy providers[1]. It has been estimated that as many as 70% of individuals report experiencing neck pain at some point in their lifetimes, and at 5 year follow-up, 78% of men and 85% of women report full recovery.[2,3] The economic burden associated with neck pain is immense, and nearly one-third of people who experience first-time onset of neck pain will continue to report healthcare utilization for their neck pain at a 5-year follow-up.[4] Acute neck pain is usually the result of injury or accident, most often road vehicle accidents associated with whiplash. Some prognostic studies have suggested that chronic neck pain is related to repetitive working conditions[5]. However, there is also an association between depression, chronic neck pain and low back pain. Patients with neck pain often presents with acute wry neck, neck pain with scapular pain and neck pain with root pain depending on their underlying pathology. Despite the prevalence of neck pain, there is a lack of evidence at present regarding whether to include or exclude the use of thermotherapy, therapeutic massage, EMG biofeedback, mechanical traction, therapeutic ultrasound, TENS, electrical stimulation, and combined rehabilitation interventions in the daily practice of physical rehabilitation of patients with acute and chronic neck pain.[6] In spite of the neck pain being so common, there are hardly any study that has evaluated the combined immediate effectiveness of interventions like Diathermy, Taping and Positional release therapy in relieving acute neck pain and improving disability in patients with non specific neck pain. Hence, in this study an attempt is made to determine the immediate effectiveness of these interventions in relatively unusual case of acute wry neck in a post partum woman.

Case Description

The patient (Mrs. DK) was a 27 year old software engineer. She was referred for acute wry neck by gynecologist after discussing the case with orthopedician. The case was attended by Physiotherapist and enrolled on daily treatment basis.

Patient history: Mrs. DK complained neck pain for three days. She delivered a female baby and when recovered out of general anesthesia, she noted that there was severe neck pain on her right side. She rated her pain as 8.6 on a 0–10 centimeter visual analogue scale and described it as severe at the time of examination. She noted that almost all the neck movement were painful especially more pain was perceived on active right rotation and left side flexion of cervical spine. She recalled no specific injury to her neck or history of similar problem in the past. Further, she reported that there were no temporal variations but sleeping with neck support could alleviate her symptoms.

Physical Examination

Physical examination was performed on the third day of symptoms. On physical examination it was found this patient had forward head posture, elevated right shoulder, spasm of upper trapezius and scalenii muscles, tender C_5 and C_6 spinous process of cervical vertebrae, painful & limited active and passive neck movements 20^0 left side flexion and 15^0 right rotation. Cervical compression test was positive and x-ray was normal.

Treatment Methods

The patient was treated with continuous short wave diathermy for 10 minutes in supine position with pad electrodes placed on either side of neck with a pillow support.7, 8 For

positional release9 the pressure was applied at tender point located at the middle portion of the right upper trapezius by pinching the muscle between the thumb and the fingers. The patient's head was side-flexed laterally toward the tender point side. The therapist grasped the patient's forearm and abducted the shoulder to approximately 90^0 and added slight flexion or extension to fine tune. This position was held for 90 second and the procedure was repeated three times. After positional release therapy, taping was applied with elastoplast in X shaped manner over both nape and upper thoracic region so as to keep both the scapulae in retracted position that minimized her discomfort. She was treated for additional three days and her case follow up was done six months. The primary outcome measure was a horizontal 10 cm VAS for pain (graded from zero, representing no pain, to 10, the worst imaginable pain).[10, 11]

Results

Immediately after the completion of treatment procedure, patient was re-evaluated for pain relief. It was found that her visual analogue scale score got reduced to 3.1 and her active range of motion of side flexion at left side was 40^0 and right rot was 55^0. She expressed it as dramatic relief of her symptoms.

Discussion

The results of this study showed that a single session of diathermy, postural release therapy and taping is useful in the treatment of acute wry neck. This could be due to muscle relaxation, relief of pain, placebo effect, removal of stretch from spasmodic muscles, reduction in nocisecptive stimuli and improved circulation. However, exact cause and effect relationship could not be studied.

Since there is hardly any study with similar study design and interventions, the results could not be interpreted with preceding literature. The obvious limitation of this study is generalization to other individuals or situations is difficult. Also, single subject participation in this study limits the conclusion of study for specific person.

Conclusion

The results of this study suggest that short wave diathermy, positional release therapy and taping may be an effective management strategy for a patient with acute wry neck in a post partum woman. Further studies are needed to determine the clinical utility of this treatment approach in a larger population.

Funding

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Conflicts of Interest

As per knowledge and study of authors, the presented case study report is having no personal or institutional conflicts of interest.

Consent of Patient:

The author was not able to acquire consent letter for this study hence, all the personal details and information was omitted from present case study paper.

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A comparative study to analyze the risk factors in elderly with and without fear of fall

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Abstract

Older people make up a large and increasing percentage of the population. As people grow older they are increasingly at risk of falling and consequent injuries. . The prevention of falls is of major importance because they engender considerable mortality, morbidity. The exact cause of falling, though unclear, some authors agree on the multi factorial etiology like fear of fall, dizziness, loss of muscle power and proprioception, visual impairment, problems in gait and balance. This study analyzes the risk factors, their contribution for fall in elderly who experience fear of falling and in those who do not experience fear of falling. In the present study seventy normal elderly individuals of age 60 years and above, who were physically independent were recruited and among them , individuals who experience fear of fall were grouped together and those who did not experience fear of fall were in the other group and the above mentioned risk factors were assessed and concluded that all the risk factors were present in both the groups but with greater proportion in the individuals who experience fear of fall, with greater deficits in proprioception, vestibular function and depression leading to fall.

Key words:Aging, elderly, fear of fall, fall, risk factors.

Introduction

Aging is a dynamic, progressive, and physiological process accompanied by morphological, functional, biochemical and psychological changes, which cause a reduction in the functional reserve of organs and systems.[1]The rate and magnitude of change in each system, may differ from person to person, but total body decline is an inevitable part of life for everyone.

Falls and fall-related injuries among older people are major issues for health and social care providers in India and indeed the world, because of the rapid increase in life expectancy observed during the twentieth century.[2] Falls among older adults are recurrent and may occur due to many factors[3,4] therefore examining an individual at risk of falling by considering only the physical risk factors is in a sense to neglect other important aspects that cause falls, such as the fear of falling. Falls and fear of falling are interrelated problems; each is a risk factor for the other.[5,6] Both of these can substantially reduce quality of life and independence and almost 33% of the older population experience functional decline after a fall.[7]

Risk factors associated with fear of fall are dizziness,[8,9] depression,[10,11] visual impairment,[12] decline in muscle strength,[13] decline in lower extremity proprioception, problems with gait and balance.[5,11]

The present study analyzes the risk factors and their contribution for fall in the elderly individuals who experience fear of falling and in those who do not experience fear of falling and also it identifies which group of population has more number of risk factors.

Methodology

Study design: Observational analysis**.**

Ethics: This study has been approved by Ethics committee for student's proposals (CSP/11/AUG/18/55), Sri Ramachandra University.

Seventy physically independent elderly individuals of age sixty years and above were recruited. The subjects were screened for eligibility to participate in the study, and are counseled regarding the study and asked to sign the informed consent.

Inclusion criteria

1. Subjects (both males and females) aged between 60 years and above, who had experienced at least some fear of fall and without fear of fall.
2. Medically stable.
3. Ambulatory.
4. Able to understand simple commands.

Exclusion criteria

1. Acute medical illness.
2. Orthopedic disorders.
3. Preexisting Neurological disorders.
4. Cognitive dysfunction

Instrumentation:

Mini mental state examination.
Fall Efficacy Scale,
Depression Anxiety Stress Scale,
Electronic goniometer,
Hand held dynamometer,
Romberg Test.

Procedure

The subjects were initially screened by Mini Mental State Examination. The total score of the examination ranged from 0-30. Subjects with scores greater than 24 were considered for the study.

The subject's level of confidence was measured using Tinetti's Fall Efficacy Scale for a specific activity of daily living. This Scale consists of 10 components with a total score of 100. Subjects who had a score of greater than 70 were

considered to have Fear of falling and with a score of lesser than 70 were considered to have no Fear of fall.

The subject's depression, anxiety, stress was quantified by Depression Anxiety Stress Scale 21. This scale consists of 21 items. Each item is scored on a 4-point scale (starts from '0'= did not apply to me at all, and ends with '3' = Applied to me very much or most of the time). Scores from each subscale are summed and multiplied by two. Subscale score range from 0 to 42. Higher scores indicate greater levels of distress.

The subject's isometric force of lower limb musculature especially knee flexors, extensors, ankle dorsiflexors was measured by Hand-held dynamometer. This digital dynamometer displays force measurements to the nearest 0.1 kg to a maximum of 100kg.

The isometric force of knee extensors was tested with the subjects sitting upright, hip and knee flexed 90deg, hands resting in lap. Dynamometer placement is just proximal to malleoli. For knee flexors subjects were positioned in prone lying, dynamometer placement is just proximal to ankle joint (posterior). For ankle dorsiflexors, subjects were positioned supine with knee maintained in full extension, leg supported with foot off the table. Dynamometer placement is just proximal to metatarsophalangeal joints.

Subjects then performed the action actively until they were able to perform correctly. Isometric "make" tests were used as the subjects were asked to build their force gradually to a maximum voluntary effort over a self-determined 2-second period. They then maintained maximum effort for 5additional seconds. The dynamometer was programmed so that each trial lasted 7 seconds, during which the tester held the dynamometer stationary against the limb segment. Peak force values were recorded from the digital readout on the dynamometer.

The proprioception of knee and ankle joint is measured by joint reposition method using electronic Goniometer. The subjects were instructed to slowly straighten their knee or ankle and told to stop at a random angle. This 'test angle' is measured by goniometer. Then the subject was asked to reproduce the test angle in the contra lateral limb and is measured. The procedure was performed for 10 test angles chosen randomly throughout knee flexion, extension, ankle dorsiflexion and plantar flexion. The mean error between 10 test and reproduced angles was calculated.

Visual dysfunction is screened by using pocket – size Snellen chart, A score of 20/200 may signal that vision is contributing to the patient's instability and vestibular dysfunction is screened by Romberg test, in which subject is asked to stand with the heels together, first with eyes open, then with eyes closed and any excessive postural sway is noted.

The subjects were categorized into 2 groups according to their level of confidence in activities of daily living. Both groups were administered the above mentioned instruments, questionnaires. Values tabulated and results analyzed.

Results

The data has been analyzed by the **SPSS 15th version** software. The variables tested were vision, vestibular function, proprioceptive deficit, muscle torque, depression, and anxiety and stress scores.

The data was found to be normally distributed and independent 't' test was used to analyze these variables. The mean and standard deviation for each variable was calculated and chi-square test was used and found that there was linear association between fear of fall, proprioception, vestibular dysfunction, depression and to some extent to muscle torque.

Table 1: group statistics

	Group	N	Mean (SD)	T	P
AGE	Without Fear of Fall	60	63.03 (1.868)	-1.048	.299
	With Fear of Fall	10	63.70 (1.829)		
FES	Without Fear of Fall	60	11.17 (2.817)		
	With Fear of Fall	10	88.00 (2.582)		
MMSE	Without Fear of Fall	60	30.00 (0.00) [a]		
	With Fear of Fall	10	30.00 (0.00) [a]		
vision score	Without Fear of Fall	60	1.00 (0.00) [a]		
	With Fear of Fall	10	1.00 (0.00) [a]		
vestibular score	Without Fear of Fall	60	1.00 (0.00)		
	With Fear of Fall	10	1.80 (0.422)		
proprioception score	Without Fear of Fall	60	1.48 (0.504)		
	With Fear of Fall	10	1.80 (0.422)		
muscle torque score	Without Fear of Fall	60	1.00 (0.00) [a]		
	With Fear of Fall	10	1.00 (0.00) [a]		
Dep_score	Without Fear of Fall	60	9.93 (4.599)		
	With Fear of Fall	10	14.20 (6.763)		
Anx_Score	Without Fear of Fall	60	6.27 (1.894)		
	With Fear of Fall	10	6.40 (2.066)		
Sress_Score	Without Fear of Fall	60	11.83 (4.603)		
	With Fear of Fall	10	12.80 (4.131)		

a. t cannot be computed because the standard deviations of both groups are 0.

Table 2: chi-square tests for depression

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.678[a]	2	.008
Likelihood Ratio	10.540	2	.005
Linear-by-Linear Association	9.532	1	.002
N of Valid Cases	70		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is .86.

Table 3: Chi-Square Tests for anxiety:

	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)
Pearson Chi-Square	.239[a]	1	.625	
Continuity Correction[b]	.021	1	.883	
Likelihood Ratio	.241	1	.624	
Fisher's Exact Test				.739
Linear-by-Linear Association	.235	1	.628	
N of Valid Cases[b]	70			

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.71.

b. Computed only for a 2x2 table

Table 4 : Chi-Square Tests for stress

	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.154[a]	1	.695		
Continuity Correction[b]	.002	1	.961		
Likelihood Ratio	.155	1	.694		
Fisher's Exact Test				.745	.484
Linear-by-Linear Association	.151	1	.697		
N of Valid Cases[b]	70				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.57.
b. Computed only for a 2x2 table

Table 5: group statistics of muscle torque

Group	Group	Mean (SD)	T	P
Rt knee extension	0 1	12.10 (1.03) 10.22 (.12)	5.745	0.000
Lt knee extension	0 1	12.29(1.00) 10.27 (.11)	6.271	0.000
Rt knee flexion	0 1	11.93 (1.00) 10.16 (.093)	5.557	0.000
Lt knee flexion	0 1	12.08 (.99) 10.19 (.10)	5.992	0.000
Rt ankle dorsiflexion	0 1	9.07 (.58) 8.72 (.049)	1.911	0.060
Rt ankle planterflexion	0 1	9.23 (.57) 8.69 (.14)	2.903	0.005

Table 6: Chi-Square Test for Vestibular component

	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	54.194[a]	1	.000		
Continuity Correction[b]	46.578	1	.000		
Likelihood Ratio	39.746	1	.000		.
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	53.419	1	.000		
N of Valid Cases[b]	70				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.14.
b. Computed only for a 2x2 table

Table 7: Chi-Square Tests for proprioception

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.345[a]	2	.002
Likelihood Ratio	9.205	2	.010
Linear-by-Linear Association	8.663	1	.003
N of Valid Cases	70		

a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is 1.00.

Discussion

Aging is a fundamental process that affects all of our systems and tissues. Population aging is a worldwide trend. Studies involving community dwelling older adults (76.3±6.6 years) show that approximately 20 to 60% of this population have already experienced the fear of falling, with a higher frequency in women, particularly those who have a sedentary lifestyle.[14]

In the past, studies have analyzed either one or two above said risk factors among individuals who experienced fear of fall. Unfortunately, there has been no study which analyzed risk factors among elderly individuals who experienced fear of fall and in those who did not experience fear of fall and hence the need was felt for such a study. In the present study risk factors like vision, vestibular function, Muscle torque, proprioception, depression, anxiety, and stress were analyzed in both the groups.

The fear of falling has negative consequences for older adults' physical and functional well-being, degree of independence, ability to perform activities of daily living (ADLs) and restriction on physical activity, which explains the high prevalence of sedentary lifestyle in this age group. A sedentary lifestyle leads to reduced mobility and balance and, consequently, higher risk of falls and heightened fear that they might occur. [15,16,17]

Fear of falling has been compared to a vicious circle that includes the risk of falls, deficit of balance (muscle strength and proprioception) and mobility, fear and functional decline resulting in more fear.[17] Due to the relevance of this issue among older adults, the aim of the present study was to analyze the risk factors in elderly individuals who experienced fear of falling and those who did not experience fear of falling.

Muscle weakness and reduced physical fitness, particularly to the lower body, are one of the most common intrinsic risk factor, increasing risk of fall by four to five times.[18] A reduction in muscle strength is common with ageing, this reduced function is due to the loss in strength results from an age-related decrease in muscle mass.

In the present study, in comparison with both the groups, muscle torque in individuals who had experienced fear of falling was slightly reduced but it was not statistically significant.

Depression, anxiety also appeared to be a risk factor in four studies.[19,20] Anxiety and/or fear of falling need to be considered for everyone experiencing a fall —an important consideration given that fear of falling does not necessarily need to result from an actual fall. It may be appropriate to consider in older people with new onset anxiety or depression and changes in activity. [5,21]

Falls, fear of falling and subjective dizziness were strongly associated with anxiety and depression. Individuals who experience fear of falling had high anxiety and depression scores. This may be an indication of the psychological impact of falls. .Fear of falling and depression were significantly associated with falling.[22]

Knee proprioception deficits are exacerbated in the elderly, and this is believed to be a factor contributing to the risk of falls in this population. There is an existence of an age-related change in proprioception and static joint position sensation in women than in men.[23] Proprioception is an important component of balance. Interestingly, it was seen that proprioception and flexibility did not correlated with quality of life and risk of falling in elderly individuals.[24] The present study is in accordance with this.

Impaired vision has been linked to risk of falls; however, the impact of deficits in specific components of vision on the risk of falls is not well known. But Visual field loss is the primary vision component that increases the risk of falls.

Fear of falling and subjective dizziness was strongly associated with each other.[25] Dizziness was mentioned as one of the risk factor for fear of falling in three studies.[5,10,20,26] showed that 25% of older adults diagnosed with vestibulopathy fell when submitted to computerized dynamic posturography.

In the present study, elderly individuals who experienced fear of falling had vestibular dysfunction when compared to the other group. This risk factor showed significance statistically (p value <0.05).

Limitation

The study could be carried out with a larger sample size.

Conclusion

The study identified that, decreased muscle torque, proprioceptive deficit; vestibular dysfunction and depression are the contributing factors among the elderly for fall and are associated with fear of fall.

It was also found that risk factors were present among the elderly group who had experienced fear of fall in more proportion than in the other group.

Clinical application

By knowing these risk factors we can give geriatric rehabilitation to every elderly and make their life more independent and improve quality of life.

Acknowledgement

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Immediate effectiveness of positional release therapy in acute ankle sprain

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Abstract

Ankle sprain is often seen and treated by sports and orthopedic physiotherapists working in different setups. The real challenge in treating ankle sprain is immediate relief of pain so that the individual can continue the physical activity in the chosen filed within the limits of the injury. Few studies have reported the immediate effectiveness of positional release therapy an orthopedic manual therapy technique in various musculoskeletal conditions. However, there is limited evidence for the same in acute ankle sprain. Hence, this pilot study was undertaken to find out the immediate effectiveness of positional release therapy in alleviation of pain associated with acute ankle sprain, pressure pain threshold and active ankle inversion. Eight participants with acute ankle sprain were treated with positional release therapy and their pre and post pain intensity, pressure pain threshold and active range of ankle inversion was measured. Results showed significant differences ($p<0.01$) in these outcome measures immediately after the three sessions of this intervention in acute ankle sprain.

Keywords: Positional release therapy, acute ankle sprain, physiotherapy

Introduction

Ankle injuries are one of the most commonly occurring musculoskeletal injuries and it is estimated that 75% of all ankle injuries are ankle sprains with 85% of those ankle sprains caused by inversion trauma.[1, 2] It is estimated that per 10,000 people, one ankle sprain will occur per day .Ankle sprain injuries are most common in sports, activities of daily living and occur usually in young physically active individuals.[3] Ankle sprain has been shown to be 20 times more common in the dominance leg and to have a high (73.5%) prevalence of recurrence.[4]

Most common causes of sprained ankle is fall, a sudden twist or blow that leads to mechanical forces exceeding the tensile limits of ankle joint capsule and supportive ligaments.[5] There are several predisposing (intrinsic and extrinsic) factors that lead to ankle sprain which like history of previous ankle sprain, increased body mass index, limb dominance, increased foot width, weak or lax ankle joint ligament, weak muscles especially peroneal muscle and hind foot varus deformity, walking or running on uneven surfaces, inappropriate shoes, tight heel cord and lack of warm up or stretching before exercise.[6, 7, 8]

The most common mechanism of injury in ankle sprain is combination of inversion and adduction of plantarflexed foot which often leads to a predictable sequence of lateral ligamentous complex tear which includes anterior talo-fibular ligament (ATFL) that is torn first, followed by the calcaneo-fibular ligament (CFL), and lastly the posterior talo-fibular ligament (PTFL). [9, 10] In this type of injury lateral ligaments are stretched followed by pain, tenderness, swelling, limited range of ankle motion, functional and mechanical instability.[11] Specifically the ATFL is reported to be weakest ligament and hence is most commonly injured.[12]

Primary aim of treatment in acute ankle sprain is to manage pain, control inflammation and protect joint. Treatment varies according to grades and duration of injury. The immediate treatment of any soft tissue injury consists of the RICER protocol i.e. rest, ice, compression, elevation and referral which is advocated for pain and swelling. No HARM treatment protocol should be applied- no heat, no alcohol, no running and no massage. All theses will lead to increased bleeding and swelling in injured area. Studies have proved that use of non-steroidal anti-inflammatory drug improves healing and speeds recovery. Functional treatment (early mobilization with external support) involves semi-rigid or rigid brace, taping and elastic bandage which facilitates early weight bearing. There are various physiotherapy treatment approaches for treating acute ankle sprain which includes electro physical agents, orthopaedic manual therapy, proprioception training, strengthening exercises and soft tissue therapies.[13-17]

Positional release therapy (PRT) or positional release technique or strain counter strain technique was 1st developed by Dr.Lawerence Jones in 1955. PRT is an osteopathic indirect manual therapy for tissue resistance, which places the affected part of the body into position of greatest perceived comfort (ease) through passive motion using the tender point to relieve the associated dysfunction. Holding the position of comfort (ease) as 90 seconds evokes therapeutically significant physiological response in tissue i .e neurological and circulatory which alleviate pain, enhanced mobility and resolution of actual dysfunction.[18-21]

Positional release therapy (PRT) is one such technique which has been studied earlier by various authors. The aim of this study was to evaluate the immediate effects of PRT on acute ankle sprain. The treatment effect in pain, pain pressure threshold and active inversion range of motion was measured before and immediately after technique was performed.

Materials and methods

Participants and study design

A pilot quasi-experimental design was conducted in Department of orthopaedic Physiotherapy, Pravara Rural Hospital (tertiary hospital).The study received approval from Institutional Ethical Committee (IEC) of Pravara Institute of

Medical Sciences, Loni, India. The purpose of the study was explained to the participants with acute ankle sprain and written informed consent was obtained for their active participation. Participants who consented were screened for inclusion and exclusion criteria. Between period of April and May 2012 participants were recruited for inclusion in our study in the college of physiotherapy, PIMS, Loni, India. They were referred to the orthopedic physiotherapy OPD with clinical diagnosis of acute ankle sprain. Both male and females whose age between 15-35 years, who were diagnosed with acute ankle inversion grade I ankle sprain, symptom less than 6 week, with unilateral inversion ankle sprain and tenderness at anterior talofibular ligament isolation were included in study.[22-25] Exclusion criteria were those, previous history of ankle sprain, presence of severe pheripheral vascular disease in lower limb, lower extremity surgery and hard tissue injury.[24, 26.]

Measurements

Participants were evaluated and assessed on visual analogue scale (VAS), pressure pain threshold (PPT) and active ankle inversion range of motion initially and immediately treatment session.

Visual Analogue Scale (VAS): Visual analogue scale was used to measure the intensity of pain before and after the intervention. The pain was recorded with 10 cm horizontal visual analogue scale (VAS), the participants were asked to mark their intensity of pain on a 10 cm long line in the data collection sheet with no pain and most severe pain on either end of the scale. The reliability of VAS has been reported to be 0.88.[27]

Pressure pain threshold (PPT): Quantitative measures of pain were measure via pressure pain threshold. Pressure algometry was used to measure PPT. The head of the algometer (hard rubber tip, surface area 1 cm^2) was applied at right angle to ATFL and pressure was increased steadily at rate of approximately 1 kg/cm^2. The range of values of the pressure algometer is 0 to 30 kg, with 0.3-kg divisions. The participants were instructed to say stop as soon as the sensation of pressure became discomfort or turned into pain. PPT measurements were taken 3 times with 30 seconds rest interval between each measurement. The mean of these 3 trials was used for data analysis[28, 29]. The reliability of PPT has been reported to be 0.9 to 0.95.[30]

Active inversion ROM: Active ankle inversion range was measured by using universal goniometer. The reliability of universal goniometer has been reported to be 0.91.[31]

Procedure

Eight participants (5 females and 3 males) were treated with PRT. For this purpose supine with complete relaxation was preferred as starting position and therapist stood by the foot end of treatment plinth. The tender point was palpated at ATFL and continuous pressure was applied by thumb until maximum pain was experienced by participant. While monitoring the tender point with thumb, the participant's foot was then dorsiflexed and everted till tender point sensitivity was reduced by 70% and slight either internal or external rotation was used to fine tune position. Once tender point sensitivity was reduced by 70%, position of comfort was held for 90 seconds. After 90 seconds pressure was released, the participant's foot was placed back to the normal position and again reassessment of participant's severity of pain was done. This was repeated thrice so as to give the intervention for a total period of 270 seconds.[18, 20,21,32]

Statistical analysis

The results were analyzed with GraphPad Instat software 3.03. Data was presented as mean, standard deviation (SD). Differences in baseline outcome measures prior to the interventions and immediately after the interventions were tested using paired t test.

Results

The baseline characteristics of all eight participants are shown in Table I.

Table 1

Total no. of participants	8
Age (years)	22.87±2.41
Height (cms)	159±5.14
Weight (kg)	58±8.26
BMI (kg/m^2)	21.96±2.06

Descriptive statistics show participant's VAS (Table II and Figure1), PPT (Table III and Figure 2) and active ankle inversion ROM (Table IV and Figure 3) which illustrates the improvement in all variables after immediate post intervention.

The pre- interventional average VAS score was 7.05±1.19 and after immediate intervention the average VAS score of these participants was 4.22±0.91. The average difference in pre and post intensity of pain in terms of VAS score was 2.82±0.90.Significant difference was found between pre and post mean score of VAS and p value ($p<0.01$) was highly significant.(Table II and Figure 2).

Table 2 Comparison of VAS mean score between pre and immediate post treatment Figure 1 VAS Score pre and post test

Pre treatment	Post treatment	Mean difference ±SD	'p' value	't' value	Result
7.05±1.19	4.22±0.91	2.82±0.90	<0.001	8.797	Highly Significant

Figure 1 VAS Score pre and post test

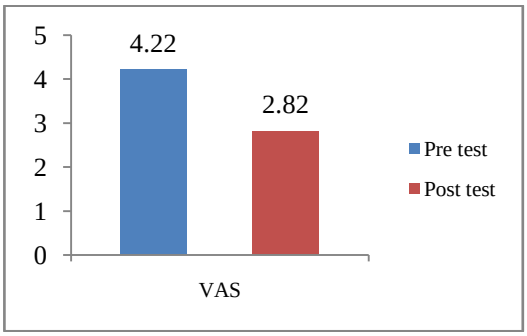
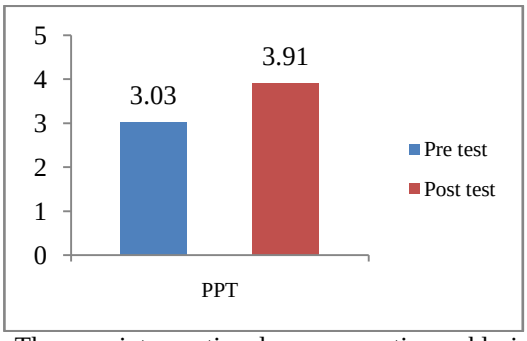


Table III and Figure 2 showed results of PPT of participants. At beginning of treatment the overall mean PPT scores was 3.03±0.03 and after immediate treatment it increased to 3.91±0.33.The average difference in pre and post PPT mean score was 0.878±0.31. Significant improvement was noted in terms of PPT among participants. The mean values of pre and post treatment in PPT were highly significant (p<0.01).

Table 3 Comparison of PPT mean score between pre and immediate post treatment

Pre treatment	Post treatment	Mean difference ±SD	'p' value	't' value	Result
3.03±0.03	3.91±0.33	0.878±0.31	<0.001	7.77	Highly Significant

Figure 2 PPT score pre and post

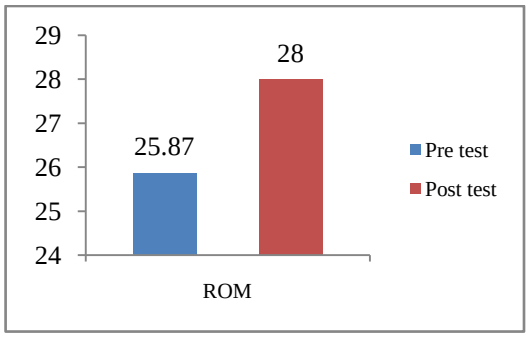


The pre- interventional average active ankle inversion range was 25.87±1.95 and after immediate intervention the average active inversion range of these participants was 28.0±2.13. The average difference in pre and post range of ankle inversion was 2.12±0.64. There was statistically significant difference in average active range of ankle inversion and p value (p<0.01) was highly significant. (Table IV and Figure 3).

Table IV. Comparison of active ankle inversion ROM mean between pre and immediate post treatment

Post treatment	Post treatment	Mean difference ±SD	'p' value	't ' value	Result
25.87±1.95	28±2.13	2.12±0.64	<0.001	9.379	Highly Significant

Figure 3 Active inversion pre and post ROM



Discussion

The results of the present study showed that positional release therapy (PRT) may be an immediate effective technique for patients with acute ankle sprain. It showed significant decrease in pain, increase in PPT and improvement in active ankle inversion range in patients with acute ankle sprain. According to 'Lawrence Jone' (1981) a combination of the position of ease for 90 seconds (comfort) while simultaneously applying pressure on tender point showed dramatic improvement in severe and painful conditions as well as it evoke a therapeutically significant physiological responses i.e. reduction in tension, nociceptive sensitivity, minimizes the stimulation of the affected proprioceptors and circulatory enhancement which helps to resolve musculoskeletal dysfunction[18, 33]. Bailey and Dick (1992) proposed a nociceptive hypothesis that tissue damage can be reduced by PRT mechanism. Relaxation of the damaged tissue may be achieved by placing patient in position of ease and consequent improvement in vascular and interstitial movement in distressed tissue (i.e blood and lymph). This can have an indirect effect on removal of inflammatory chemical mediators[18, 19.] Travell and Simons stated that the pain is produced due to the localized ischemia and lack of oxygen in stressed soft tissue. Jacobson and colleague (1989) suggested that in PRT unopposed arterial filling occur in tissue during 90 second hold in position of ease. It helps to wash away the toxic products thus providing relief of pain and restoring range of motion[18].

The result of present study showed that there was increased PPT immediately after PRT which might be due to capacity of PRT to relief tissue tenderness. Previous literature postulated that PRT decreased irritability of tissue tenderness by position of comfort, altering nociceptive activity as well as maintaining inhibitory pressure on tender point which induced a degree of local and reflex inhibition of neural activity[18]. This is in accordance with the study of Baldry who (1993) stated that after application of pressure analgesic endorphin was released in local soft tissue which was important mediator in pain relief[34].

It has already been observed that individual with ankle sprain often present reduced active inversion ankle range of motion. Because of pain, patient is less likely to attempt mobilization. Also, tissue swelling increases the likelihood of adhesions that can delay healing and decrease ROM[35]. In this study PRT showed significant improvement in active inversion range of motion. This may be due to significant reduction of pain and swelling. Minimization of pain allowed movement to greater improvement. This is an accordance with studies Eisenhart et al (2003)[35] and Collins (2007)[36] which has documented effect of PRT to increase ankle range of motion.

Limitation of present study

Various limitations of the present study includes:-

- Small sample size
- This study was focused only on patients with acute grade 1 ankle sprain.
- No control group.

Suggestion for further research

Since there are very few studies and limited literature regarding the use of PRT on acute ankle sprain, so further research is suggested to find out effectiveness of this technique with larger sample size, longer duration and follow up. Future studies should be carried out to find the effects of PRT with other intervention in the treatment of acute ankle sprain.

Conclusion

On basis of present study, it was concluded that PRT may be used for immediate pain relief, increasing pressure pain threshold and improving active ankle inversion ROM in treatment of acute ankle sprain

Clinical implications:

PRT is a non-invasive, safe and not time consuming technique.
PRT provides immediate relief in pain, increasing PPT and active ankle ROM.

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