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Physiotherapy and Occupational Therapy Journal **POTJ**

July - September 2019
Volume 12, Number 3

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Original Article

Physiotherapy and Occupational Therapy Journal
Volume 12 Number 3, July - September 2019
DOI: http://dx.doi.org/10.21088/potj.0974.5777.12319.1

To Study the Effect of PNF and Treadmill Training on Improving Balance, Mobility and Fatigue in Multiple Sclerosis Patients

Mohammed Aslam Ahmed[1], Rinku Yadav[2]

How to cite this article:

Mohammed Aslam Ahmed, Rinku Yadav. To Study the Effect of PNF and Treadmill Training on Improving Balance, Mobility and Fatigue in Multiple Sclerosis Patients. Physiotherapy and Occupational Therapy Journal. 2019;12(3):129-135.

Abstract

A total of 24 patients meeting the internal and external criteria were taken for the study. Mean values of their age was 38.20 ± years. And assigned into two groups, A & B, each group consisting 12 patients. In experimental study. Both groups received regular physiotherapy treatment throughout the study period other than Dynamic slow reversal PNF treadmill training. Group B (Experimental group) were treated with Dynamic slow reversal PNF technique in addition to regular physiotherapy program which they were undergoing on regular basis technique and whereas Group A (Control group) patients were treated with treadmill training in addition to regular physiotherapy program which they were undergoing on regular basis. Treadmill training consisted of supervised aerobic exercise delivered three sessions each week for 4 weeks. The mean MFIS scores was 25.75 for the Experimental Group (p<0.05) and 31.25 for the Control Group (p < 0.05). The mean BBS scores was 41.50 for the Experimental Group (p<0.05) and 34.25 for Control Group (p < 0.05). The results of this experimental study reveal that participants in the PNF group who participated in 4 week program showed significant improvements in basic mobility, balance and reducing fatigue post treatment.

Keywords: Dynamic slow reversal PNF technique; MFIS scores; BBS scores.

Introduction

Multiple sclerosis (MS) is a chronic disease of the central nervous system in which the body's own immune system attacks the myelin sheath surrounding the axons of neurons in the brain, brain stem and spinal cord.[1] MS is currently the most prevalent disabling neurologic disease of young adults in America.[2] The onset of MS usually occurs between 20 and 50 years of age, with a peak at 30 years. MS is more common in women than men by a ratio 2:1.[3] There are no large scale epidemiological studies from India on the incidence and prevalence of Multiple sclerosis. Based on hospital statistics a prevalence of approximately 1.33/100,000 was reported by Singhal *et al.* in the mid eighties from the west coast of India.[4] Although the exact etiology of the disease is unknown, it is generally accepted that MS involves an abnormal immune response within the central nervous system.[5] The variable distribution of demyelination and axonal loss throughout the central nervous system may lead to disorders of strength, sensation, co-ordination and balance, as well as visual, cognitive and affective deficits, that may lead to severe progressive limitations of functioning in daily life.[5] Common symptoms of MS include decreased walking ability and balance, as well as increased muscle weakness and fatigue. These symptoms and several others are not only detrimental to general health, but the ability to perform routine life activities, such as those mentioned above, and many other everyday motor movements.[2]

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Received on: 04.04.2019, **Accepted on** 18.09.2019

Mobility impairment is also a major consequence of MS. Declines in functional mobility are associated with loss of social connection, reduced participation and altered abilities to perform self-care, productivity and leisure occupations.[6] MS patients also experience muscle weakness as a major obstacle, contributing to poor balance, risk of falls, and limiting activities of daily living. Few past reviews concluded that physical therapy provides clear muscle strengthening benefits for people with MS regardless of the type of exercise used in treatment.[1]

One of the most common MS symptoms is generalized fatigue unrelated to physical exertion: 40% of patients in one study described fatigue as their single most disabling symptom. Several studies, including the widely-cited Petajan et al study, demonstrated that regular physical activity may alleviate MS-related fatigue while enhancing functional reserve capacity.[1] The Fatigue Management Panel of the Multiple Sclerosis Council for Clinical Practice Guidelines defines fatigue as "a subjective lack of physical or mental energy that is perceived by the individual or caregiver to interfere with usual and desired activities.[7] Fatigue among MS individual defined as "a sense of physical tiredness and lack of energy, distinct from sadness and weakness".[8] Up to 92% of the patients complains of fatigue and is one of the most common and troubling problems.[9] Over 80% who have fatigue report that it is exacerbated by heat, which appears to be different between MS fatigue and fatigue due to other chronic diseases.[8] A study done by Broach and Dattilo (2001) have found increases in performance for individuals with MS while walking up and down stairs, rotations on a stationary bike and an upper extremity ergo meter. Reversal of antagonists is a general class of techniques in which the patient first contracts the agonistic muscle then contracts their antagonists without pause or relaxation. Within that class Dynamic reversal of antagonist is an isotonic technique where the patient first move in one direction and then in the opposite direction without stopping. There is a paucity of data about the application of PNF techniques in patients with multiple sclerosis and there are limited studies examining the effect of PNF exercises in multiple sclerosis. Because limited research related to the effects of PNF exercises on mobility, balance and muscular fatigue has been found, this study was designed to study the efficacy of dynamic slow reversal technique in patients with multiple sclerosis.

Methodology

Sample: A total of 24 patients meeting the internal and external criteria were taken for the study. Mean values of their age was 38.20 ± years. And assigned into two groups, A & B, each group consisting 12 patients.

Study design: Experimental study

Inclusion Criteria

- Diagnosis of clinically or laboratory supported MS
- MS patients with mild to moderate disability (Expanded Disability Status Scale scores 1.0 to 5.5)
- Ambulatory MS Patients
- Stable disease process within last 6 weeks
- No clinical relapse for at least one month prior to study entry
- Age between 25 and 55 years
- No concomitant therapy with anti depressant, psychoactive or steroid drug, as well as with other drug that are used for the treatment of fatigue (eg. amantadine)
- No surgeries in past 6 months.

Exclusion criteria

- Patients with current relapse of multiple sclerosis
- Any major surgeries in the past 6 months
- Pregnancy
- History of cardiovascular, respiratory, orthopedics or metabolic disease as diagnosed by physician
- Any disease preventing participation in the prescribed exercise program
- Any mental illness as diagnosed by physician

Protocol

Both groups received regular physiotherapy treatment throughout the study period other than Dynamic slow reversal PNF technique and treadmill training. Group B (Experimental group) were treated with Dynamic slow reversal PNF technique in addition to regular physiotherapy program which they were undergoing on regular basis whereas Group A (Control group) patients were treated with treadmill training in addition to regular physiotherapy program which they were undergoing on regular basis. Treadmill training consisted of supervised aerobic exercise delivered three sessions each week for 4 weeks. Patients were provided rest period immediately after the treadmill training. Each treatment session per day lasted for about 45 minutes for PNF and 30 minutes for treadmill training, which included 5 minutes warm up and 5 minutes cool down period with a total of 12 treatment sessions (three times a week for 4 weeks). APMHR were calculated by following formula. Calculate predicted maximum heart rate (MHR) by subtracting age from 220.

The subject was allowed to stop the treadmill training in between if he/she felt fatigued.[1]

The measurement of both the groups was done at baseline and at 4 weeks after the study period finished.[1]

Results

Procedure

A total of 24 subjects who were previously diagnosed as casa of multiple sclerosis by a neurologist and met the inclusion criteria where included in the study prior to enrolling in to the study, met and purpose of the study were told to the participants. Informed consent were signed before study.

Group B (Experimental group)[2]

The treatment in this group consisted of dynamic slow reversal PNF technique applied to the lower extremities. The subject remained in relaxed, comfortable and supine position on the bed with the feet uncrossed. Therapist stands on either side of the lower limb of the subjects. At the start, the muscles of the dominant lower extremity were placed in the longest position.[2]

This technique involved a dynamic concentric contraction of the stronger agonist muscle group. A second dynamic concentric contraction immediately followed, this time involving the weaker antagonist muscle group.[3] The elements of PNF, such as manual contact, stretch, resistance, and verbal cuing, were incorporated into the treatment scheme. The efforts of the patient and my self were well synchronized.

The lower extremity has two diagonals (D1 and D2) named after the hip motion. Hip abduction is the leg movement from middle to the side and adduction means the contrary movement, toward the middle. At internal rotation of the hip, knee point to middle and in external rotation to the side. In each pattern of exercise the three distinct movements were combined similar to the functional human movements. The movement series was performed according to the principles of PNF in a distal to proximal direction.[4] The motion started with an initial stretch reflex and followed the movement of the subject's limb, so a continuous resistance was being given. Two minutes of rest period was given after each exercise pattern was practiced for 5 times.

D1 flexion and D1 Extension

Starting with the antagonist pattern Hip was placed into extension abduction and internal rotation, the knee into extension; planter flexion and eversion of the ankle; and toes flexion.[5]

Agonist patterns of flexion, adduction, and external rotation, and an antagonist pattern of extension, abduction, and internal rotation were used.[6]

D2 flexion and D2 Extension

Agonist patterns of flexion, abduction, and internal rotation and an antagonist pattern of extension, adduction, and external rotation were used.[7]

Description[8]

- Subject was lying on the supine position.
- Therapist stands on either side of the lower limb of the subjects.
- Myself resisted the patient's movement in one direction, usually the stronger or the better direction.
- As the end of desired range of motion approached, I reversed the grip on the distal portion of the moving segment and gave a command to prepare the change of direction.
- At the end of desired movement I gave the action command to reverse direction, without relaxation and gave resistance to knee motion starting at the distal part.
- When the patient began moving in the opposite direction, I reversed the proximal grip, so that resistance opposed the new direction.
- The reversal may be done as often as necessary.[8]

Group A (Control group)[9]

Therapist stood on the side of the treadmill.

Individuals received supervised treadmill training, three sessions each week, for 4 weeks. Walking duration was increased during the training period as tolerated by participants, up to a maximum of 30 minutes. Depending on the individuals performance and tolerance rest were incorporated during the treadmill training session. Once maximum walking duration was attained, intensity was increased by increasing walking speed. Individuals were encouraged to train at an intensity of 55–85% of age predicted maximum heart rate (APMHR) according to American College of Sports Medicine guidelines.[9]

Initially 55-60% APMHR was set to perform which was considered moderate intensity in treadmill training. After conditioning period was over vigorous intensity was set between 60-85% to be performed by participants.[10]

Subjects on motorized treadmill were trained with unrestricted garment, light weighted shoes andsupported by handrail of the treadmill. Treadmill training was given initially with short bouts of low intensity treadmill for 5 minutes followed by 20 minutes of continuous as tolerated treadmill training of intensity 55-85% of age predicted maximum heart rate (APMHR) by heart rate monitor.[10,11]

Blood pressure, heart rate and perceived exertion (CR10-RPE) were monitored manually pre and post training session. If blood pressurerose to >200 mm Hg systolic or >110 mm Hg diastolic orHR rose to >160/min, training was discontinued. After 20 minutes period 5 minutes of cool down period with short bouts was given which included low intensity of treadmill. Patients were encouraged to train at intensity of 55–85% of age predicted heart rate (APMHR). Speed was increased according to the patient's tolerance. Fan and water were available to counter the effects of heat. The intensity of exercise was reduced if aggravating symptoms arosed during treadmill training session. Exercise was stopped immediately if unusual symptoms were experienced (e.g. dizziness, nausea, or chest pain) by the subjects.[10,11]

After 4 weeks the post intervention data was collected.

Fig. 1: Starting position of D1flexion

Fig. 2: Final position of D1 Flexion

Fig. 3: Starting Position of D1 Extension

Fig. 4: Final position of D1 Extension

Fig. 5: Starting Position of D2 flexion

Fig. 6: Final position of D2 Flexion

Fig. 8: Final Position for D2 Extension

Fig. 7: Starting Position for D2 Extension

Fig. 9: Motorized treadmill

Inter group comparison of pre and post TUG score between Group-A and Group-B

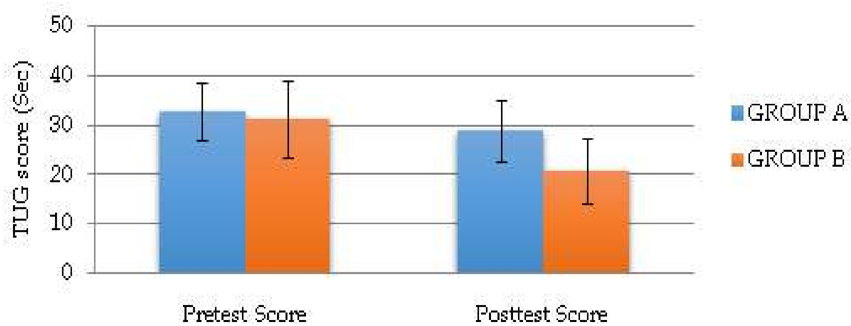

Fig. 10: Depicts improvement in mean difference of pre TUG score of subjects of Group-B as compared to subjects of Group-A

Inter group comparison of pre and post MFIS score between Group-A and Group-B

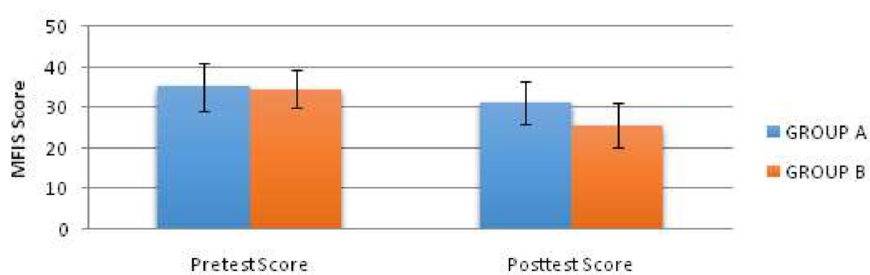

Fig. 11: Depicts improvement in mean difference of pre MFIS score of subjects of Group-B as compared to subjects of Group-A

Discussion

Physiotherapy in MS has become an essential approach in the recent years because of functional, psychological, and physical limitation of MS. Numerous studies have investigated disability and quality of life in MS. In the PNF approach, there is a large emphasis on effective motor learning strategies such as practice, repetition, visual guidance of movement, and so forth.[17] In this Experimental study Experimental group showed improvements in the post test parameter of TUG, MFIS, BBS, as compared to the pre testparameters,as shown in table 2 and figure 4 the mean post-TUG scores was 20.58 (p<0.05) and mean pre-TUG score 31.16 (p<0.05). In Table 4 and figure 5 the mean post- MFIS scores was 25.75 (p<0.05) and pre-MFIS score 34.66 (p<0.05). In Table 6 and figure 6 the mean post- BBS scores was 41.50 (p<0.05) and pre-BBS sore 30.58 (p<0.05). In this experimental study both the Control group and Experimental group showed improvements in the post test parameter of TUG, MFIS, BBS, as compared to the pre test parameters. As shown in table 2, figure 1 and figure 4 the mean TUG scores was 20.58 for Experimental Group (p<0.05) and 28.75 for Control Group (p<0.05). In Table 6, figure 3 and figure 6 the mean BBS scores was 41.50 for the Experimental Group (p<0.05) and 34.25 for Control Group (p<0.05).

The results of this experimental study reveal that participants in the PNF group who participated in 4 week program showed significant improvements in basic mobility, balance and reducing fatigue post treatment.

Limitations

1. This study was done on a small sample size.
2. This study was not checked on long term basis.
3. No follow up was done.

Conclusion

PNF exercises can be applied to patients of all ages. From this study it is clear that the dynamic slow reversal PNF technique was superior to control group in improving the balance, mobility and fatigue in patients with multiple sclerosis, hence such patients can be give dynamic slow reversal PNF technique for improving their balance, mobility and reducing fatigue.

Clinical Significance

Proprioceptive neuromuscular facilitation techniques incorporate movement in the three planes of the body. According to the International PNF Association, the PNF approach is considered to be a conceptual approach. Some authors regard it as a method. The differences in considering the terms, concept and method become clear by the description of using components of the PNF approach and the clinical reasoning in making up a treatment strategy. Whether promoting flexibility, developing functional movement, developing muscular strength and endurance, improving joint stability, or increasing neuromuscular coordination and control, PNF technique ie. dynamic slow reversal, as proven in this study ,should be incorporated into the physical therapy setting as a valuable and efficacious component of rehabilitation for patients with multiple sclerosis.[19]

Source of Funding

From Uttranchal PG College of Bio-medical scs and hospital.

Ethical Clerence

It is bonafied work done by meand I have not taken any part of thesis from any where.

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Original Article

Physiotherapy and Occupational Therapy Journal
Volume 12 Number 3, July - September 2019
DOI: http://dx.doi.org/10.21088/potj.0974.5777.12319.2

Effect of Smart Phone Usage on Neck Pain and Posture Among University Students

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How to cite this article:

Meenakshi Singh, Noresh Noor Khan. Effect of Smart Phone Usage on Neck Pain and Posture Among University Students. Physiotherapy and Occupational Therapy Journal. 2019;12(3):137-141.

Abstract

Introduction and Background: Smartphone is one of the dynamic trends in communication, in which one's mobile phone can be used for communication through email, exploring internet & using certain apps. In recent years, the usage of mobile phones has increased so much in young adults (mainly students). Many users of smart phone look sharply downwards & hold their arms in front of them to read the screens which make their head move forward & cause excessive anterior curve in the lower cervical vertebrae and excessive posterior curve in the upper thoracic vertebrae to maintain the balance which put lots of stress on the cervical spine and the neck muscles. Forward head posture is most commonly seen poor posture in sagittal plane. There is increasing incidence of the musculoskeletal problems of neck around the world due to excessive use of mobile phone and electronic devices. *Method*: Total 100 healthy students (both male and females) who use smart phones were selected by convenience sampling method from Amity university, noida, with age group of 18–25 years. General assessment of the students was performed to shortlist the students meeting the inclusion criteria, all the students who met the inclusion criteria were invited to participate in this study. A written informed consent was provided to each student prior to the study. They were asked to fill a smart phone addiction scale (SAS), neck disability index (NDI) and posture of neck was measured using ruler method. Karl pearson's coefficient of correlation was used to correlate between the SAS and NDI and SAS and TWDn-TWDc. *Results*: The karl pearson's coefficient of correlation showed a significant correlation between SAS and NDI ($r=0.68$, $p<0.05$) but no correlation between SAS and forward head posture (-0.13, $p>0.05$). *Conclusion*: The study suggested that there is a significant relation between smart phone usage and neck pain but no significant relation between smart phone usage and forward head posture. But forward head posture can develop later as degenerative process must have started which is leading to pain in the neck.

Keywords: Smart phone addiction; Neck pain; Forward head posture; Musculoskeletal disorders.

Introduction

Smartphone is one of the dynamic trends in communication, in which one's mobile phone can be used for communication through email, exploring internet and using certain apps.[1] In recent years, the usage of mobile phones has increased so much in young adults (mainly students). Many users of smart phone look sharply downwards and hold their arms in front of them to read the screens which make their head move forward and cause excessive anterior curve in the lower cervical vertebrae and excessive posterior curve in the upper thoracic vertebrae to maintain the balance which put lots of stress on the cervical spine and the neck muscles, forward head posture is most commonly seen poor posture in sagital plane.[2] There is increasing incidence of the musculoskeletal problems of neck

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Received on: 24.08.2019, **Accepted on** 18.09.2019

around the world due to excessive use of mobile phone and electronic devices.[3]

Using smartphones for longer periods of time promote repetitive and continues use of certain muscles, resulting in injury of muscle fibers, cumulative damage from acute trauma and myogenic tonus, which occurs mostly in the neck and shoulders.[4] Repetitive and cumulative trauma in the neck and shoulder causes forward head posture (a specific musculoskeletal abnormality).[5] There are number of adverse effects of long duration sitting and sedentary living on the health of the individual, in the same way people should know and understand the effect of long duration smart phone usage on their posture.[6] FHP is noticed when person is using smart phone which can lead to pain in neck.[7] When a person use smart phone for longer period of time it reduces person's social implication in real world and as a result his/her psychological well being is affected because it produces a kind of isolation, loneliness and may result in depression.[8] The heavy smart phone users meet their friends and other people very less in person.[9] According to the last few studies, the excessive user group has experienced difficulty in expressing emotions than the comparison group, and the excessive user group had suffered from very high level of anxiety which is inter personal than the comparison group.[10]

Some previous studies have reported that users of smart phone often complain that they have neck pain, muscle fatigue and ROM of cervical than the normal phone users.[11] And some studies have directly evaluated the effects of excessive usage of smart phone on pain, cervical angle and depression is commonly seen in people who are addicted to smart phone and spend most of the time using smart phones.[9]

"Text neck" is a term which was coined by Dr. dean L. fishman, who is a chiropractor. This term is used to describe repetitive stress injury or an overuse syndrome in which a person has his/her head hung or flexed in a forward position and it is bent in downward direction looking to the phone or some other electronic devices for long duration of hours, In the world to which we belong where technology has advanced so much and usage of mobile phones has increased so much there are increasing number of people who are spending their lots of time on electronic devices such as smart phones, laptops, tablets and e- readers. The result in the end is prolonged flexion of the neck when bent over these electronic devices which results in a "text neck" or "turtle neck" posture, this condition is a growing health concern and it has the potential that it affects the millions of people around the world.[12] Smart phone usage in stationary position and arm unsupported could bring an abnormal alignment of neck and shoulders, this is because small monitors of smart phones that are held downward near laps allowing users to bend their heads to look at the screens which increase the activity of the neck extensor muscles, increases muscle fatigue, decreases work capacity and affects musculoskeletal system.[5] The FHP weakens the deep cervical flexors muscles, the mid thoracic rhomboid muscle for retraction of the scapula and the middle and lower trapezius muscles. FHP also shortens the pectoralis major. And neck extension muscles. The activity of upper trapezius muscle is highly increased in forward head posture as compared to normal anatomical posture and also number of patients complain of pain due to over use of muscles.[13] Shah p. *et al.*[3], 2018, conducted a study on 100 healthy physiotherapy college students in Ahmadabad and found that musculoskeletal problems in neck and hand (thumb predominantly) can be seen in smart phone addict students which may be initially short term but later on it can become long term disability. Kim S. *et al.*[14], 2016, conducted a study to see the effect of smart phone use on neck and shoulder muscle fatigue and the investigation of pain was done in adults with forward head posture. They concluded that pain and fatigue worsened with longer use of smart phone.

In recent few years use of smart phone and electronic devices have spread widely among many communities and across all ages. Previous studies showed that musculoskeletal problems in neck can be seen in smart phone addicted people. However this study aims to see the effect of smart phone usage on neck pain and posture among university students.

Materials and Methods

Total 100 healthy students (both male and females) who use smart phones were selected by convenience sampling method from Amity University, Noida, with age group of 18–25 years. General assessment of the students was performed to shortlist the students meeting the inclusion criteria, all the students who met the inclusion criteria were invited to participate in this study. A written informed consent was provided to each student prior to the study. Only those students who agreed to fill the consent form were included in the study, others were excluded.

They were asked to fill a smart phone addiction scale (SAS), neck disability index (NDI) and posture of neck was measured by using ruler method.

Smart phone addiction scale (SAS)

The SAS is a scale to assess smart phone addiction. In SAS the total possible score in each section is 6 and least score is 1. The score range from 33 to 198. The higher the score the greater the degree of pathological use of smart phone. The SAS is a reliable and valid measurement tool for the evaluation of smart phone addiction.[15]

Neck disability index (NDI)

The NDI assessment involves 10 items, 50 point index questionnaire, of the 10 items 4 relate to subjective symptoms, 4 activities of daily living and 2 discretionary activities of daily living each item is scored on a 0 to 5 rating scale in which 0 means no pain and 5 means worst unimaginable pain, the maximum score is 50. Higher NDI score indicates greater neck disability. This index is widely used and most validated instrument for assessing self rated disability in patients with neck pain.[16]

Measurement of forward head posture

The subjects were asked to stand in a relaxed position with back and buttocks against the wall and knees straight. Instructions for relaxed posture were to stand relaxed and look straight ahead and for cued posture they were asked to look straight ahead with max. effort to stand straight and tall and touch the back of the head to the wall without tilting, The measures of forward flexed posture were as follows: occiput to wall status, tragus to wall distance and C7 to wall distance. For occiput to wall status the participants were scored as yes or no based on their ability to touch the occiput to wall. A rigid ruler was used to measure tragus to wall distance and mean of two values for the final score was taken. The distance b/w C7 to wall was measured with metal caliper and rigid rulr, the spinous process was palpated and marked with paper tag. The caliper was hold horizontally, light contact was ensured of the tips of caliper to the tag, the tips were subsequently held against ruler to measure the distance. This method is reliable and validated for measurement of forward head posture and among all the variables the most reliable was tragus to wall distance which was taken to conclude whether or not the subject has forward head posture.[17]

Based on the scores and measurement relationship between SAS, NDI and forward head posture was determined.

Fig. 1: Measurement of tragus to wall distance in normal position Measurement of tragus to wall distance in cued position

Results

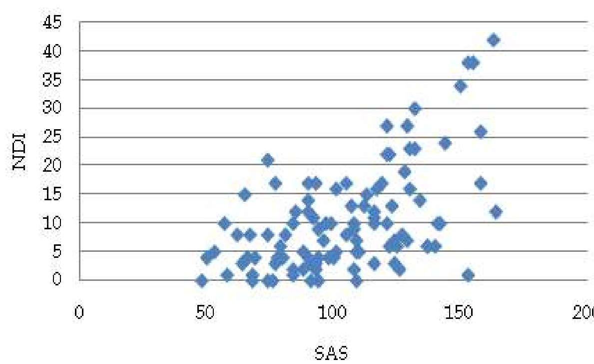
Out of total 100 subjects, 19 were males and 81 were females. Mean age of the subjects was 20.87 ± 1.17 years (Table and Graph 1-2).

Table 1: Correlation Between SAS and NDI

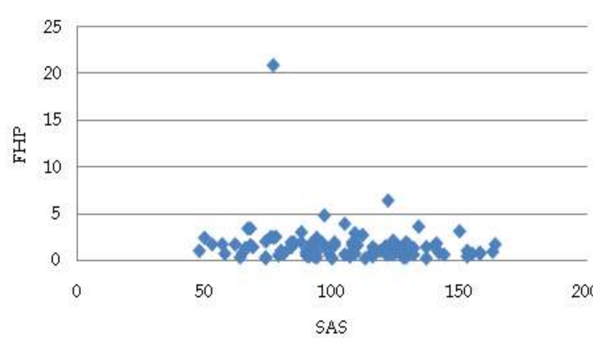
Variable	SAS	NDI
Mean ± SD	104.63 ± 27.95944	10.46 ± 9.089254
r Value	0.68* (significant at p<0.05)	

Table 2: Correlation between SAS and FHP

Variable	SAS	FHP
Mean ± SD	104.63 ± 27.95944	1.697 ± 2.2072175
r Value	-0.13533 (non significant at p<0.05)	



Graph 1: Correlation between SAS and NDI (r=0.68)



Graph 2: Correlation between SAS and FHP (r= -0.13)

Discussion

This study concerned with the effect of smart phone usage on neck pain and posture among university students. The result in present study showed that the degree of smart phone usage is significantly correlated with pain in neck among university students. There is significant positive correlation between smart phone addiction scale (SAS) and neck disability index (NDI). SAS showed a higher score indicating addiction to smart phone use and along with it the NDI scores showed significant disability.

Excessive use of smart phones may lead to repetitive movements of the head and neck, such movements are associated with high risk of chronic neck pain and may explain the strong association between SAS and NDI.[2] Similar conclusion were given by shah p. *et al.*[3] in the year 2018, their study showed that musculoskeletal problems in neck and hand can be seen in smart phone addiction students which may be short term initially but can later lead to long term disability.Also, kim S *et al.*[14] concluded that pain and fatigue worsened with longer smart phone use.

The result in the present study also showed that there is no significant correlation between smart phone addiction scale (SAS) and forward head posture the reasons could be that the study is only limited to very young and certain type of population and there are the chances that degeneration process must have started which is leading to pain but posture is not affected at present. However, follow up study of 1 to 2 year should be conducted on this type of population which will show the affect on forward head posture also.

Conclusion given by jung S. *et al.*[6] is that prolonged use of smart phones could negatively affect both posture and respiratory function but in this study there is no significant effect on forward head posture.

The reasons could be that they have also measured the rounded shoulders and scapular index of participants while in present study only tragus to wall distance is taken. Also they have not used the SAS for assessing the smart phone addiction and participants were randomly allocated to 2 groups according to duration of smart phone usage reported by each individual.

Clinical Implication of the Study

This study may help in considerations that need to be taken for the proper time management of smart phone usage, they should make effort to reduce the amount of time spent using a smart phone and also preventive measures like maintenance of correct posture while using the smart phone and taking frequent short breaks in between which can reduce the chances of development of forward head posture in future.

Limitations in the Study

- Short duration study.
- Study is limited to specific population only.
- The study is limited to a particular age group (18–25 years).

Scope for Further Study

- A follow up study of 1 to 2 years can be done to see the effect on forward head posture also.
- Above 25 years age group can also be studied.
- Other variables can also be studied like rounded shoulders.

Conclusion

The study was conducted to check any association between effect of smart phone usage on neck pain and posture among university students. Proper time management of smart phone usage and proper posture while using the smart phone can reduce the occurrence of neck pain and can reduce the chances of development of forward head posture. The study suggested that there is a significant relation between smart phone usage and neck pain but no significant relation between smart phone usage and forward head posture. But forward head posture can develop later as degenerative process must have started which is leading to pain in the neck.

Conflicts of interest: Authors report no conflict of interest and no disclosures.

Funding Source: Self funded.

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Original Article

Physiotherapy and Occupational Therapy Journal
Volume 12 Number 3, July - September 2019
DOI: http://dx.doi.org/10.21088/potj.0974.5777.12319.3

To Evaluatethe Correlation Between Trunk Length and Sitting Balance in Complete Paraplegic Patients

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How to cite this article:

Sanjai Kumar, Meenu Singh. To Evaluatethe Correlation Between Trunk Length and Sitting Balance in Complete Paraplegic Patients. Physiotherapy and Occupational Therapy Journal. 2019;12(3):143-149.

Abstract

Objectives: Spinal Cord Injury (SCI) refers the injury to the cord resulting in impairment of Neuro-muscular function below the level of lesion; motor, sensory, bladder and bowel functions are affected and the functional independence depends primarily on the level and completeness of injury, trunk length and sitting balance in complete paraplegics: a correlational study. *Methods:* A sample of 30 subjects (26 males & 4 females) from SSSMC and jai physiotherapy and dental clinic, Meerut, were included in the study. The subjects were measured for their trunk length and then asked to perform the task of sitting functional reach (both forward and lateral). The reach values (cm) and the trunk length (cm) of the subjects were documented. *Results:* The data revealed the mean scores of forward reach values of 14.87, lateral reach values of 11.90, trunk length with a mean values of 62.6 cm. A non-significant negative correlation with r value of – 0.145 (NS) was found when values of forward reach of the sample were compared with the trunk length in group 1. A significant negative correlation with r value of – 0.561* & - 0.899* was found when values of forward reach of the sample were compared with the trunk length in group 2 & group 3. A significant negative correlation with r value of – 0.561* & - 0.72* was found when values of lateral reach of the sample were compared with the trunk length in group 1 & group 2. A non-significant negative correlation with r value of –0.901* was found when values of lateral reach of the sample were compared with the trunk length in group 3. *Conclusions:* The results of this study indicates that there exists a significant negative correlation between Trunk length and Sitting Balance in Complete Paraplegics.

Keywords: Complete Paraplegics, trunk length.

Introduction

Spinal Cord Injury (SCI) refers the injury to the cord resulting in impairment of Neuro-muscular function below the level of lesion; motor, sensory, bladder and bowel functions are affected and the functional independence depends primarily on the level and completeness of injury.[1]

Due to loss of motor power in the lower limbs, the locomotion of the injured person is mostly affected. Because of the difficulties in walking and increased energy expenditure in their locomotion, 70–80% of them are dependent on wheelchair for their mobility needs. Therefore, wheelchairs have been vital for spinal cord injury patients to lead an active, independent and productive life.[2] Once the patient is on wheelchair bound, sitting becomes the most fundamental position of interaction with the environment. The challenge to convert these patients from functional dependency to

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Received on: 10.07.2019, **Accepted on** 18.09.2019

functional independency falls under the domain of physiotherapy.

Dynamic sitting balance involves the ability to maintain seated posture without falling while performing a variety of self initiated actions.[3] Reaching in sitting is a self initiated movement, which sufficiently challenges the body's postural control mechanism to control and coordinate the trunk and extremities to maintain the centre of gravity over the base of support. The system would be maximally recruited when the demand is also maximal. Any attempt beyond which will throw the centre of gravity outside the base of support and may result in a fall.

Hence any information provided by a detailed assessment of sitting position and sitting balance may play an important role in bringing a correlation between the sitting balance and functional independency of the patient which in turn will help in planning an effective rehabilitation for the patients with spinal cord injury.

Several factors such level of motor innervations, voluntary trunk control, endurance of postural muscles, spasticity and other variables such as type of sitting, pelvic tilt, are useful in predicting the sitting balance in spinal cord injury patients.[4] From mechanical perspective for a given level of injury, people of different height can have different position of centre of gravity, which in turn can affect their stability during any dynamic task.[5,6] Understanding the factors influencing sitting balance will help therapist to set appropriate goals and devise strategies for functional rehabilitation. Hence this study was planned to study the effect of trunk length, influencing dynamic sitting balance in spinal cord injured patients.

Since Modified Functional Reach Test is a well established and valid tool in assessing dynamic sitting balance, and the task of reaching used in this test is one of the most perfectly adapted activity of daily living in spinal cord injury patients, we believe that an assessment of reaching balance by using MFRT will detect the dynamic sitting balance in spinal cord injured patients.[7]

Objectives of the Study

Statement of study: Is there any correlation between trunk length and sitting balance in complete paraplegics?

Hypothesis

Alternate Hypothesis: There will be a negative significant correlation between trunk length and sitting balance in complete paraplegics.

Null Hypothesis: There will be a positive significant correlation between trunk length and sitting balance in complete paraplegics.

Operational Definitions

Sitting Balance[7]: "The ability to maintain control over upright posture in sitting during forward reaching without stabilization."

Sitting Functional Reach[7]: "The maximum distance one can reach beyond arm's length in the horizontal plane while maintaining a fixed base of support in a sitting position."

Trunk Length[5]: "Measurement from C7 spine to coccyx in sitting."

Paraplegia[8]: "The term refers to impairment or loss of motor or sensory function in the thoracic, lumbar or sacral (but not cervical) segments of the spinal cord secondary to the damage to neutral elements within the spinal canal."

Incomplete Injury[8]: "If partial preservation of motor or sensory functions is found below the neurological level and includes the lowest sacral segment, the injury is defined as incomplete."

Complete Injury[8]: "The term is used when there is an absence of motor or sensory functions in the lowest sacral segment."[12]

Limitation of Study: The movement strategy used for reaching in sitting was self selected by the individuals. No control for the strategy adopted by the subject to reach forward was predetermined which may easily influence the maximal distance reached. Sample size was small for studying this correlation with various anatomical levels of spinal cord injury patients.

Materials and Methods

Design: This study is a correlation study design which intends to find out if there is any correlation between trunk length and the sitting balance in complete paraplegics within the sample.

Sample: A sample of 30 subjects (26 males & 4 females) from SSSMC, Dehradun and jai physiotherapy and dental clinic, Meerut, were included in the study. All the subjects were assessed for inclusion and exclusion criteria of the study.

A baseline assessment of clinical and functional status was assessed before the subjects were assigned to do the task.

Following this, the subject's trunk length was measured in sitting position and were asked to perform the sitting functional reach.

Inclusion Criteria

- Volunteers between age group of 18–35 years.
- Functionally independent in wheelchair transfer (FIM Score 7).
- Complete paraplegia (ASIA A and B) ranging from T2-T12.
- Spasticity (Modified Ashworth Scale Below 1+).
- History of one or more than one year duration since SCI.

Exclusion Criteria

- An active or terminal illness that may interfere with the participation.
- Spinal deformity like kyphosis, scoliosis.
- Pressure sores.
- Any history recent pain in the shoulder.
- Contractures.
- Any other complications like hetrotrophic ossicification.

Instrumentation

1. A standardized wheelchair recommended for paraplegics.
2. One standardized 2.5 cm x 116 cm measurement scale (yard stick) mounted horizontally on the wall at the level of the acromion process of right shoulder of a subject seated in the wheelchair.
3. A standardized measuring tape.

Protocol: The subjects were introduced to the study, followed by signing of the consent form. General baseline assessment regarding their clinical history and functional independence was performed. The subjects were measured for their trunk length and then asked to perform the task of sitting functional reach (both forward and lateral). The reach values (cm) and trunk length (cm) of the subjects were documented. For the entire data collection procedure the subjects were referred to by subject number and not by name to maintain the confidentiality of the subject.

Procedure: The procedure for collection of data closely followed those described by Lieng Chen and Lynch in their study.[5,7]

Preliminary measurement was taken prior to the beginning of the reaching task included the measurement of one of the body parameters.

Trunk length: Subjects in a sitting instructed to sit as erect as possible and measurement from C7 vertebrae to coccyx by a standard inch tape was taken.

Forward reach: The subject was allowed to sit comfortably against the backrest in the standard wheelchair given to the patient. However care was taken to maintain 90 degree bent at knee and ankle joints. Feet supported on the footrest (which can be adjusted).

A clearance of 2.5 inches was maintained between the popliteal fossa and the seat edge. A yardstick was positioned horizontally on the wall at the level of acromion process of the dominant GH joint. A pointer (pencil) was attached at the ulnar styloid process.

The following instructions were given to the subjects. "Raise your arm from the shoulder to horizontal position in front, Make a fist and hold it." Care was taken not to allow trunk rotation/ shoulder protraction by keeping both the shoulders in the same horizontal plane while taking the initial and final measurement. The readings were four feet away from the anterolateral side of non-dominant limb. Initial reach was measured at the landmark of ulnar styloid process. Care was also taken here to keep wrist in neutral, elbow straight and arm in horizontal position to the trunk.

Then the patient was given the following instruction "Now reach forward along the yardstick as far as you can without losing balance or raising from the buttocks and footrest". Freedom was given regarding the strategies used to task. The subject moved parallel to the yardstick in the frontal direction.

The final position was noted as the pointer on the ulnar styloid along the yardstick on the farthest value reached. The patient is asked not to touch the wall and the ruler. No weight bearing or holding was allowed on the non-reaching upper extremity. Two practice trials were allowed followed by three measurement trials.

Lateral reach: The initial position was in an armless chair with the backrest placed against the wall. The sitting posture of the subject and the procedure remain the same as above. However the following instruction was given. "Raise your arm from the shoulder to horizontal position on the side, make a fist and hold it.” Initial reading was taken as above. Then the patient was given the following instruction “Now reach sideways along the yardstick as far as you can without loosing balance or raising from the buttocks and footrest”. Freedom was given regarding the strategies used to the task. The subject moved parallel to the yardstick in the lateral direction. The final position was noted as the pointer on the ulnar styloid along the yardstick on the farthest value reached. The patient was asked not to touch the wall and ruler. No weight or holding was allowed on the non-reaching upper extremity. Two practice trails wee allowed followed by three measurement trials.

The subjects were guarded during the reach task. Subjects were encouraged to use any reach strategy except use of non reach arm for support, raising from the buttocks or moving lower legs backward.

Variables

Modified Functional Reach (Forward)

Sitting Initial Reach (cm): Each subject sitting straight at right angle to the horizontal plane, with an upper extremity flexed forward to 90 degree. The anatomical landmark was ulnar styloid.

Sitting Final Reach (cm): The same subject on reaching forward in the horizontal plane as far as possible without loosing the balance. The final measurement was the ulnar styloid process on maximum forward reach position.

Sitting Functional Reach (cm): The average of the difference between the final and initial reach distances of the three trials.

Modified Functional Reach (Lateral)

Sitting Initial Reach (cm): Each subject sitting straight at right angle to the horizontal plane, with an upper extremity flexed sideways to 90 degree. The anatomical landmark was ulnar styloid.

Sitting Final Reach (cm): The same subject on reaching laterally as far as possible without loosing the balance. The final measurement was the ulnar styloid process on maximum lateral reach position.

Sitting Functional Reach (cm): The average of the difference between the final and initial reach distances of the three trials.

Trunk Length[5]

The length of the trunk was measured from the C7 vertebrae to the coccyx in sitting position.

Data Analysis: Data analysis was performed by using the SPSS version 10 for windows software descriptive statistics was used to analyze mean age, level of lesion and gender. Karl Pearson’s correlation test was used to find the correlation between the trunk lengths and reach values. In all cases significance was set at $p<0.05$. Appendix G gives a sample table of calculation done.

Results

A total of 30 subjects were included in the study for studding the correlation between Trunk Length and Functional Reach Values (forward and lateral both) in sitting as a measure of dynamic sitting balance in complete paraplegics. The subjects were divided into three groups with respect to the level of lesion.

Demographic Information of the subjects – thirty subjects (26 males and 4 females) in the age group of 19-32 years with the mean (standard deviation) age of 27.26 (3.39) years (Table 1). All the subjects were grade A on ASIA scale.

Table 1: Demographic details of the samples

Age (years) Mean (SD)	27.26 ± 3.39
Males	26
Females	4
Samples	30

Demographic information of the groups

Group 1 with total number of subjects 13 in the age group of 19-32 years with the mean (Standard Deviation) age of 27.38 (3.40) years (Table 2)

Group 2 with total number of subjects 9 in the age group of 22-32 years with the mean (Standard Deviation) age of 26.78 (3.80) years (Table 2)

Group 3 with total number of subjects 8 in the age group of 22-31 years with the mean (Standard Deviation) age of 27.62 (3.29) years (Table 2)

Table 2: Demographic details of the groups

Group	Cases	Mean ± SD
1	13	27.38 ± 3.40
2	9	26.78 ± 3.80
3	8	27.62 ± 3.29

Sitting Reach Values

The data revealed the mean (standard deviation) scores of forward reach values of 14.87 (4.90), (Table 2).

The data revealed the mean (standard deviation) scores of lateral reach values of 11.90 (4.86), (Table 2).

Trunk Length

The distribution of trunk length of the subjects shows the trunk length from 55–75.1 cm with the mean value (standard deviation) of 62.6 (5.89) cm, (Table 3).

Table 5.3: Mean (SD) values for Modified Functional Reach (forward and lateral) and Trunk Length

	Trunk Length	Forward Reach	Lateral Reach
Total Sample	62.66 ± 5.89	14.87 ± 4.90	11.90 ± 4.86
Group 1	62.68 ± 4.31	13.00 ± 3.27	10.21 ± 3.53
Group 2	60.63 ± 6.44	16.42 ± 3.98	12.81 ± 4.32
Group 3	64.91 ± 7.30	16.18 ± 7.18	13.60 ± 6.74

Correlation of Modified Functional Reach (Forward Reach) with Trunk Length – A significant negative correlation with r – value of -0.614** was found when values of forward reach of the sample were compared with the trunk length. (Table 4).

Correlation of Modified Functional Reach (Lateral Reach) with Trunk Length – A significant negative correlation with r – value of -0.674** was found when values of lateral reach of the sample were compared with the trunk length. (Table 4)

Correlation of Modified Functional Reach (Forward Reach) with Trunk Length in Group 1 – A non - significant negative correlation with r – value of -0.145(NS) was found when values of forward reach of the sample were compared with the trunk length. (Table 4)

Correlation of Modified Functional Reach (Forward Reach) with Trunk Length in Group 2 – A significant negative correlation with r – value of -0.561* was found when values of forward reach of the sample were compared with the trunk length. (Table 4)

Correlation of Modified Functional Reach (Forward Reach) with Trunk Length in Group 3 – A significant negative correlation with r – value of -0.899* was found when values of forward reach of the sample were compared with the trunk length. (Table 4)

Correlation of Modified Functional Reach (Lateral Reach) with Trunk Length in Group 1 – A significant negative correlation with r – value of -0.561* was found when values of lateral reach of the sample were compared with the trunk length. (Table 4)

Correlation of Modified Functional Reach (Lateral Reach) with Trunk Length in Group 2 – A significant negative correlation with r – value of -0.72* was found when values of lateral reach of the sample were compared with the trunk length. (Table 4)

Correlation of Modified Functional Reach (Lateral Reach) with Trunk Length in Group 3 – A significant negative correlation with r – value of -0.901* was found when values of lateral reach of the sample were compared with the trunk length. (Table 4)

Table 4: Correlation between Modified Functional Reach (forward and lateral) with Trunk Length.

Trunk Length	N	Sitting Forward Reach (r)	Sitting Lateral Reach (r)
Sample	30	−0.614**	−0.674**
Group 1	13	−0.145(NS)	−0.561*
Group 2	9	−0.753*	−0.720*
Group 3	8	−0.899*	−0.901*

*Significant at 0.05, ** Significant at 0.01, NS Non – significant, r Correlation Coefficient.

Discussion

The sitting problems of the neurological ill are not new. Impaired sitting stability in people with spinal cord injury seems to be related to defective motor performance. Functional Reach, a measurement of margin of stability is biomechanically analogues to centre of pressure excursion. Duncan et al who designed the test, reported that age and height are the most significant factors that influence functional reach test. The taller the subject, the greater the distance of functional reach but this is not applicable in sitting, as Dural et al reported that the COG was higher by 5% of the body length in the paraplegics then the normal subjects. This upward displacement of COG reflects a disproportional loss of body weight. Such a change in COG must lead to loss of sitting stability and may continue to change in persons limits of stability.[6] Therefore we hypothesized that a subject with long trunk length may have a higher COG and may have a lesser extent of stability limit, supported by Chiung et al in his study where he used amplitude of weight transferred as the balance measure.[5]

Our results ended up showing a negative correlation between trunk length and sitting balance as measured by modified forward reach values (forward and lateral both) in sitting. The negative correlation established was longer the trunk length poorer the dynamic balance in sitting and vice-versa. The correlation was significant for both the forward and lateral reach values in the samples.

Forward Reach

There was a significant negative correlation between trunk length and forward reach (r= -0.614, p = 0.0001),. This is consistent with the results of the previous study by Chieung et al who explained that the patient who had a longer trunk length will have a lesser forward reach values in sitting. Thus, my hypothesis was well supported with the concepts forward reach being biomechanically analogues to center of pressure excursion in sitting.

Lateral Reach

The negative correlation between lateral reach and trunk length was more significant than the forward reach (r = -0.674, p = 0.0001) in sitting. Thus may be due to the reason that the perimeter for center of pressure excursion within the base of support was comparatively smaller than the forward reach.

Outcomes Based on Level of Lesion

Further when we classified the sample with respect to various level of lesion i.e. Group 1 (T2 – T6), Group 2 (T7 – T9), and Group 3 (T10 – T12). We found the negative correlation for the Group 2, Group 3 between trunk length and reach (forward and lateral) in sitting. But the correlation was not found in Group 1 where we had higher level thorasic paraplegics. This may be due to the reason that the mean of modified forward reach values in Group 1 was comparatively lesser than the other two Groups (Group 2 and Group 3). The loss of strength in major trunk muscles in Group 1 would have been a reason in Group 1 is not bringing a correlation between trunk length and sitting balance as compared to the other two Groups. However further studies are needed to see the correlation within different groups levels (hiog and low thorasic paraplegia) with more number of sample in each group.

In normal population the centre of gravity in erect sitting passes in front of the eleventh thorasic vertebrae and through the ischial tuboricities and a person with the longer trunk length this COG is assumed to be shifted slightly higher. So, in patients like paraplegics in whom the COG is generally higher by 5% of the body length as compared to normal individuals, a longer trunk length would further shift the COG higher. Moreover these patients with complete spinal cord injury who lack muscular control will face more challenges to maintain balance during the task of reaching. Thus, this negative correlation between trunk length and sitting balance was more significant in this Group of patients leading to a better understanding of management of balance deficits. So therefore trunk length is a valuable indicator of sitting balance in patients with complete paraplegia.

Relevance to Clinical Practice

The purpose this study was to find out the correlation between the sitting balance as measured by modified functional reach test and trunk length. The sitting functional reach would act as a measure to explore the outermost limits of the stability and mobility in sitting position of the patients with spinal cord injury.

Reliable sitting assessment increases accountability in developing individualized prescription. In this study, the negative correlation showing larger the trunk length poorer the sitting balance will have a direct application in goal setting of spinal cord injury patients prior to physical rehabilitation.

There are several additional factors like injury level, base of support in sitting, motor and sensory innervations spread which play a key role in predicting patients static and dynamic sitting balance. From my study trunk length will also br added to the predictive factor, thereby helping the physiotherapists further to modify their rehabilitation protocol for the respective patients with complete spinal cord injury.

Future Research

The Co-relation between trunk length and sitting balance in complete paraplegics can be studied in an environment where the patient on the wheelchair is not at rest.

Similar studies can be repeated by using more sensitive measures of balance with a larger samples with various levels of lesion.

Conclusion

The following conclusions were drawn from the data and results obtained.

The results of my study indicates that there exists a significant negative correlation between trunk length and sitting balance in paraplegics.

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Original Article

Physiotherapy and Occupational Therapy Journal
Volume 12 Number 3, July - September 2019
DOI: http://dx.doi.org/10.21088/potj.0974.5777.12319.4

Effect of Ankle Foot Orthosis on Balance and Locomotion in Stroke Patients

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How to cite this article:

OV Akhil Kumar Sharma, Neha Gupta. Effect of Ankle Foot Orthosis on Balance and Locomotion in Stroke Patients. Physiotherapy and Occupational Therapy Journal. 2019;12(3):151-155.

Abstract

Background and Introduction: Stroke is one of the common wellbeing problems that are handicapping. The consequences can be viewed as massive disturbance in information, processing, causing and conduct issues. Despite the fact that Ankle Foot Orthosis should effectively work in regaining functional ability and provide base of support which helps in improving the efficiency of walking, there are very few studies analyzing the effect of AFO. Thus, the present study aims to evaluate the effect of AFO on locomotion and balance in stroke patients. *Subjects and Methods:* In the current experimental study 30 patients were divided into two groups 1) Experimental group (with AFO), 2) Control group (without AFO). Both the groups were provided with lower limb strengthening exercises, treadmill training, spasticity reducing exercises, reaching in standing and sitting, balance and locomotion training, stair ascent and descent. *Results:* In both groups the mode of Functional Ambulation Category (FAC) is 2. For Group A,Berg Balance Scale (BBS) the mean is 26.00 ± 3.047. For Group B, is 28.27 ± 4.431. The range of BBS in both groups is 23–37. In 6 mt walk test the meanfor Group A, is 17.20 ± 2.178. For Group B the mean is 18.27 ± 1.792. The post result values of BBS Group A, mean is 30.60 ± 3.661. The correlation is 0.935. For Group B, mean is 31.93 ± 4.877. The correlation is 0.983. For 6 mt walk test the post values for Group A, mean is 14.07 ± 1.710 and the correlation is 0.859. For Group B the post values of 6mt walk test mean is 15.87 ± 2.031, the correlation is 0.953. *Conclusion:* AFO group has shown the significant results and patients have improved the functional ability as per the results shown in the outcome measures.

Keywords: Ankle Foot Orthosis Functional Ambulation Category; Berg Balance Scale; Stroke; Balance; Locomotion.

Introduction

Prevalence rate of stroke in India is 84–262/1000, 000 in rural and 334–424/100,000 in urban areas.[1] Around 15 million individuals are getting affected each year. Stroke can be life threatening condition. It is a worldwide healthcare problem that is serious and disabling.[6] The consequences can be viewed as massive disturbance in the life of the patient and his/her family affecting physically and emotionally.[6] Stroke causes muscle weakness, spasticity, debilitated sensorimotor control along with loss of psychological capacity, communication and behavior. Restoration of locomotion is one of the main goals of stroke rehabilitation.[2,6] The ability to walk after stroke is very difficult due to the spasticity, weakness of muscles, compromised sensory-motor control and at times impaired cognitive functions.Most patients report walking as a major difficulty and priority as well.[4] The loss of Postural control further causes problems with

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Received on: 18.07.2019, **Accepted on** 18.09.2019

static and dynamic balance which increases the risk of falls and other secondary injuries. Stroke survivors with hemiparesis commonly show shorter step length, a longer stance phase along with a shorter swing phase of the affected side.[8,6,13] Spasticity is one of the major problems impairing the extremities further affecting the Quality of Life (QOL) and functional independence. The patient experiences common patterns of spasticity occurring in standing, which includes flexion of the head, leaning to the hemiplegic side and rotation.[3] Resulting in face toward the unaffected side and the upper extremities (UE) going in flexion pattern with a retracted scapula and depressed shoulder girdle.[2]

Many new approaches are being used in rehabilitation including body weight support treadmill training, functional electrical stimulation based orthosis, rhythmic auditory stimulation, robotic exoskeleton and virtual reality that are tried along with conventional rehabilitation to restore locomotion in stroke survivors.[6] There have been many questions raised regarding the clinical effect, long term safety and cost benefit of these programmes thus an alternate rehabilitation approach is desirable.[2] Research has suggested that the outcomes of many of these are inconsistent and labor intensive, at the same time a customized Ankle Foot Orthosis has the potential to offer a better transition between sitting and standing beside preventing falls.[4] Depending on the recommendations and reviews of previous research it has shown feasibility in rehabilitation following stroke as a clinical and functional advantage in rehabilitation.[10]

AFO should effectively work in regaining functional ability and provide base of support which assists in improving walking ability, if are notinsufficiently stiff. AFO's prevents plantar flexion of foot during the swing phase of gait cycle and will provide ground clearance.[6,12] They will thus, restore ankle function and should improve the balance and locomotion after stroke. The AFO provides a three point force system which is applied at the posterior side of the calf muscle, plantar surface of the foot near the metatarsal heads[5], along the dorsum of the foot, which helps the ankle maintain a better position. AFO's along with improving the biomechanics of ankle joint, also will indirectly change the hip and knee alignment.[7] This may occur by realigning the tibia to a normal position at nearly 10 degrees forward inclinations. Weight bearing on foot is redistributed to the plantar surface compared with the lateral aspect of the foot which shifts the ground reaction force (GRF) to the posterior side.[3–5] During stance phase, the GRF which is posteriorly positioned influences both the knee and hip joints. Hyperextension is prevented at the late stance phase if the GRF is closer to the knee joint. The GRF alteration position also will further change the alignment of hip joint anteriorly, which helps in reduction of abnormal flexion movement at the hip during the terminal stance. This adaptation of the GRF on both the knee and hip joints normalizes the demand on the affected limb by improving the control and stability during walking.[2,3] Keeping the above potential benefits in mind the current study aims to find the effect of AFO on balance and locomotion in post stroke patients.

Subjects and Methods

This study was conducted in Physiotherapy Centers in Noida. 62 stroke survivors attending physiotherapy OPD were screened according to the inclusion and exclusion criteria.

Inclusion Criteria:

- Stroke survivors of both genders.
- Patients who can walk 10 meters.
- Age 18–60 years.
- At least 6 months but not exceeding one year.
- Patients with intact ability to follow commands and good at comprehension.

Exclusion Criteria

- Myocardial infarction, angina in recent 6 months.
- Global aphasia.
- Brain stem lesions, cerebellar, hemispheric lesions, recurrent stroke.
- Significant visual deficit, orthopedic problem which affects the participation.

Protocol

30 subjects meeting the selection criteria participated in the study. A brief explanation about the procedure to be followed was given to patients after receiving the written inform consent form.

The baseline data was collected on first day itself, which included three scales the Berg Balance Scale (BBS), Functional Ambulation Category (FAC) and 6 meter walk test (6 mWT). The patients selected for the study have been divided into two groups A & B, in which Group A isprovided with a non-hinged thermoplastic custom made ankle foot orthosis (Fig 1) and Group B is without the AFO. The patients are treated for 10 sessions (5d/week) for two weeks. Both the groups received anactivity based therapy consisting of strengthening of lower extremity by resistive exercises, sit and stand reaching, treadmill training, balance, locomotion training, stair ascent and descent. Both the groups received the same exercise protocol, where group A performedwith the AFO and group B performed it without it.

Fig 1: Non-hinged thermoplastic custom made orthosis with the footwear

Fig 2: Non-hinged thermoplastic custom made orthosis without the footwear

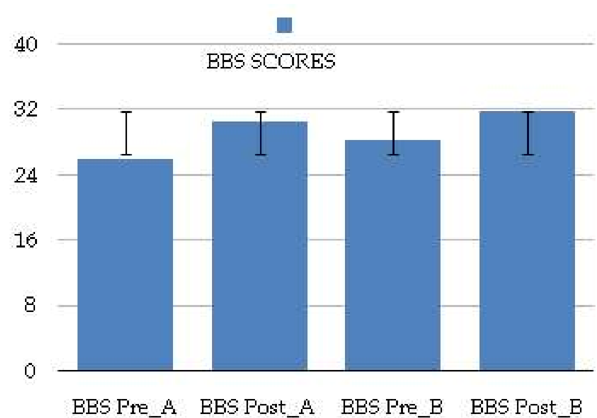
Statistical analysis

All the statistical tests are performed using the IBM SPSS software for Mac version 20.0. Paired and unpaired ***t*** tests are used to compare both intra and inter group pre and post results. A p value of ≤ 0.05 was considered as statistically significant. Descriptive analysis was done for the FAC results.

Results

Out of 30 stroke patients 4 were females and the rest 26 are males. The age of the participants ranged from 33–60 years. 3 patients were left hand dominance and 27 were right handed. Time period of onset of stroke was 24 to 37 weeks.In both groups the mode of FAC was 2 at the beginning of the session. The baseline chi-square value for both the groups was 0.839 and for BBS and 6mt walk test is shown in Table 1.

Group A showed 18.75% and group B showed 8.82% improvement in the FAC scores. Group A showed 17.69% and group B showed 12.97% improvement in the BBS scores. Group A showed 18.25% and group B showed 13.13% improvement in the 6mt walk scores. The results of paired and unpaired t-tests are shown in Table 2 and 3 and graph 1 and 2. Cadence and walking speed seemed to be significantly increased in the patients who walked with AFO. Walking speed has proved as one of the main outcome measure along with balance.



Graph 1: BBS pre and post values of both groups

Table 1: BBS and 6 mtWT

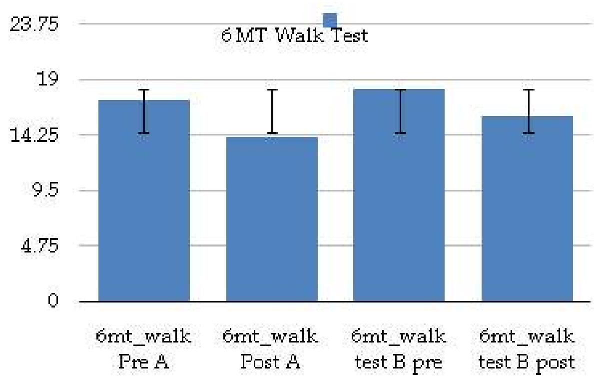
			Baseline Data on day 1		10th Day Reading	
Outcome Measure	Group	n	Mean	SE	Mean	SE
BBS	With AFO	15	26.00 ± 3.047	0.787	30.60 ± 3.661	0.945
BBS	Without AFO	15	28.27 ± 4.431	1.144	31.93 ± 4.877	1.259
6 MtWT	With AFO	15	17.20 ± 2.178	0.562	14.07 ± 1.710	0.441
6 MtWT	Without AFO	15	18.27 ± 1.792	0.463	15.87 ± 2.031	0.524

Table 2: Results of Paired t-tests within group A and B

Outcome parameter	Group	N	Mean	SD	SE	95% Confidence Interval		t	df	Sig Value
						Lower	Upper			
BBS	A	15	–4.6	1.352	0.349	–5.831	–3.851	–13.175	14	0.000
	B	15	–3.667	0.976	0.252	–4.207	–3.126	–14.552	14	0.000
6 mt WT	A	15	3.133	1.125	0.291	2.510	3.757	10.783	14	0.000
	B	15	2.4	0.632	0.163	2.050	2.750	14.697	14	0.000

Table 3: Results of Un- Paired t-tests between group A and B

Outcome parameter	Mean Difference	SE Difference	t	df	Sig Value
BBS Pre	2.267	1.389	1.632	28	0.114
BBS Post	1.333	1.574	0.847	28	0.404
6 mt WT Pre	1.067	0.728	1.465	28	0.154
6 mt WTPost	1.8	0.685	2.626	28	0.014



Graph 2: 6 mt WT pre and post for both groups

Discussion

The improvement for the locomotion and balance after stroke has been a key area of research among neurological disorders and several strategies had been devised to restore the ability of walking in stroke survivors.[10] This study focused on analyzing role and benefits of AFO in improving locomotion parameters. The result of the current study, shows that patients improved their locomotion and balance with AFO. Functional ambulation which was measured by FAC[21] was increased when the patients with stroke wear AFO and walk. As in stroke the most particular feature of stroke is decrease in locomotion and balance.[6,8]

AFO also seems to have an influence on the modification of the joint alignment of the affected side lower extremity, along with improvement in walking speed and functional ability.[11,5] The 6 mtWT has been showed an improved walking speed as the decrease in duration of walking time is noted.[16,14] It is also noted that there is improvement in balance which was measured by BBS.[9,18] In a study by Iwata *et al.*, it was shown that an inhibitory bar can be attached an AFO which can be worn by the patients suffering from hemiparesis and it was concluded that there will be increased gait velocity of nearly 13% and significant increase in cadence[2,11,14] while measured with 10 mt walk test by comparison between 2 groups wearing a chignon AFO and another group wearing a rigid AFO seemed to have the significant differences in the velocity of gait, but there were no changes in cadence.[2]

In comparisons between AFO and without AFO group, significant improvements have been observed in the locomotion, gait velocity and balance. The results are in line with previous studies which also demonstrated the functional benefits like improvement in gait, cadence and balance with AFO usage. Decrease in ankle dorsiflexion is a very commonly seen as a disturbance that occurs in stroke patients[8] during swing phase. Normally in mid swing the ankle should be at neutral position through the initial contact. Ankle in neutral position during this period of foot clearance is provided by the AFO and thus, prevents the toes from touching the ground. This study has further concluded that AFO improves dorsiflexion in swing phase and initial contact as seen in the improvements of walking speed, balance and locomotion. The functional ambulation which was measured with FAC[21] score showed the improvement. In future a follow up could be studied to see the retention effect of the AFO also an electromyography of the ankle muscles could be studied to see the effects of wearing of an AFO.

Conclusion

Ankle Foot Orthosis should be utilized to improve the balance and locomotion in post stroke patients.

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Review Article

Physiotherapy and Occupational Therapy Journal
Volume 12 Number 3, July - September 2019
DOI: http://dx.doi.org/10.21088/potj.0974.5777.12319.5

Laser Therapy for Neck Pain

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How to cite this article:

CK Senthil Kumar, Senthil P Kumar. Laser Therapy for Neck Pain. Physiotherapy and Occupational Therapy Journal. 2019;12(3): 157-159.

Abstract

Neck pain is the second common musculoskeletal complaint for a visit to a physical therapist, with huge impact on physical performance, work-related function and quality of life especially in the productive age group. Globally the healthcare burden, impact and costs for mechanical neck pain is due to specific and non-specific etiologies and high incidence of recurrence and surgery due to inadequate diagnosis and inappropriate therapeutic strategies.[1]

Keywords: Laser Therapy; Musculoskeletal; Neck pain.

Introduction

Neck pain is the second common musculoskeletal complaint for a visit to a physical therapist, with huge impact on physical performance, work-related function and quality of life especially in the productive age group. Globally the healthcare burden, impact and costs for mechanical neck pain is due to specific and non-specific etiologies and high incidence of recurrence and surgery due to inadequate diagnosis and inappropriate therapeutic strategies.[1]

Objective of the Review

The objective of this systematic review was to highlight the existing evidence for laser therapy in neck pain, through a preliminary search of PubMed (MEDLINE) database of the National Library of Medicine-National Center for BioInformatics.

Search Methods and Strategy

Two independent reviewers utilized a standardized search strategy using "cervical radiculopathy" in article title which yielded 35 articles, and when activating the filters-Abstract and English language, it was a final list of 10 included studies decided upon mutual consensus.

Main Findings

Swedish Council on Health Technology Assessment (SBU)[2] Report No. 2014–03 stated that laser therapy provided pain relief in chronic neck pain patients upto 2–6 months follow-up, many studies focused on side effects or therapeutic effects compared to placebo, very few reported on cost-effectiveness compared to other treatments especially in acute pain and its impact on function and working capacity.

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Received on: 02.09.2019, **Accepted on** 18.09.2019

Alayat *et al.*[3] utilized Multiwave locked system (MLS) laser therapy of an 808 nm continuous laser and a 905 nm pulsed laser compared versus single-wavelength low-level laser therapy (LLLT) using 830 nm laser in 75 chronic neck pain patients who were randomized into three groups- Group I received MLS laser therapy and exercises, Group II received LLLT and exercises, and Group III received placebo laser therapy plus exercises (PL + EX). Both the visual analogue scale (VAS) and neck disability index (NDI) scores reduced significantly in both groups, and MLS plus exercise was more effective therapy for CNP compared to exercise plus LLLT or exercise alone.

Alayat *et al.*[4] compared the effect of high-intensity laser therapy (HILT) in treatment of 60 male patients with chronic neck pain (CNP) on cervical range of motion (ROM), pain (visual analog scale VAS), and functional activity (neck disability index NDI). The patients were given HILT plus exercise (HILT + EX) and placebo laser plus exercise (PL + EX), respectively. HILT + EX effectively increased cervical ROM and decreased VAS and NDI scores after 6 weeks of treatment compared to PL + EX.

Chow *et al.*[5] in their systematic review of 16 randomised controlled trials totalling 820 patients and reported the efficacy of LLLT in neck pain. Two trials on acute neck pain reported a relative risk (RR) of 1.69 for pain improvement with LLLT versus placebo. Five trials of chronic neck pain reported a relative risk of 4.05 for LLLT. Overall reduction in VAS scores were 19.86 mm and the adverse events were mild and was reported similar in placebo laser. LLLT was effective for immediate pain relief in acute neck pain and upto 22 weeks in patients with chronic pain.

Chow *et al.*[6] treated 90 subjects with chronic neck pain and reported the efficacy of 300 mW, 830 nm laser (active versus sham treatment) for a course of 14 treatments over 7 weeks- 3 months. Improvements were noted in Visual Analogue Scale (VAS) scores for pain (2.7 in the treated group and worsened by 0.3 in the control group). All other measures- Short-Form 36 Quality-of-Life questionnaire (SF-36), Northwick Park Neck Pain Questionnaire (NPNQ), Neck Pain and Disability Scale (NPAD), the McGill Pain Questionnaire (MPQ) and Self-Assessed Improvement (SAI) in pain, also effectively improved in the active group compared to placebo. Low-level laser therapy (LLLT), at the parameters used in this study, was efficacious in providing pain relief for patients with chronic neck pain over a period of 3 months.

Chow and Barnsley[7] published their systematic review of LLLT in neck pain included 5/20 identified RCTs (71 patients in one study, pooled sample size was 202 from four studies) and reiterated the significant positive effects for infrared wavelengths (lambda = 780, 810-830, 904, 1,064 nm) in four trials, with substantial effect size identifiable in two studies.

Gross *et al.*[8] reported their systematic review of seven eligible RCTs (out of 17 total identified studies). Two trials provided moderate quality evidence (pooled sample size 109 participants) for improvements in pain/disability/quality of life (QoL) and global perceived effect (GPE) up to immediate term. LLLT was able to produce improvements in short-term pain/function/QoL over placebo with low quality evidence for acute neck pain. Successful pain outcome was identified in meta-regression for super-pulsed LLLT in chronic neck pain.

Kadhim-Saleh *et al.*[9] estimated the efficacy of LLLT in reducing pain scores on visual analog scale (VAS) through their systematic review of nine electronic databases. The authors included eight RCTs (pooled sample size was 443 patients) of which five trials included patients with cervical myofascial pain syndrome (CMPS), and three trials on mixed patient populations. The meta-analysis of 5 above trials yielded a mean improvement of VAS score of 10.54mm with LLLT which was statistically significant, but was well below the clinically meaningful improvement for VAS.

Konstantinovic *et al.*[10] clinically evaluated the LLLT effects in 60 patients with CR who received a course of 15 treatments over 3 weeks with active or a placebo laser. LLLT was applied to the skin projection at the anatomical site of the spinal segment involved with the following parameters: wavelength 905 nm, frequency 5,000 Hz, power density of 12 mW/cm(2), and dose of 2 J/cm(2), treatment time 120 seconds, at whole doses 12 J/cm(2). The treatment group demonstrated better improvements in arm pain and in neck extension compared to sham group.

Discussion and Conclusion

There were few clinical trials on effectiveness of high power laser for patients with neck pain. Few other authors[11] utilized sham laser in the comparative treatment group in research on patients with neck pain. There is a dearth need for more high quality RCTs as reported by authors of these included trials. The few studies on low power laser also could not evidently demonstrate long-term efficacy. Use of standardized outcome measures[12] for neck pain is also another important implication for further research. Future studies could address these issues for establishing better evidence for neurological and neurosurgical rehabilitation of these patients.

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Physiotherapy and Occupational Therapy Journal
Volume 12 Number 3, July - September 2019
DOI: http://dx.doi.org/10.21088/potj.0974.5777.12319.6

TENS for Neck Pain

CK Senthil Kumar[1], Senthil P Kumar[2]

How to cite this article:
CK Senthil Kumar, Senthil P Kumar. TENS for Neck Pain. Physiotherapy and Occupational Therapy Journal. 2019;12(3):161-162.

TENS vs PLACEBO

Maayah and Al-Jarrah[1] randomly allocated 30 people with neck pain to either TENS (n = 15) or placebo (n = 15) and administered TENS for one hour in a single session. 73% (11 subjects) in the experimental group and 43% (7 subjects) in control group demonstrated marked improvement. The study had important findings that TENS was an effective treatment for neck pain, especially in people with mild severity amidst positive effect shown by placebo TENS also.

TENS vs TRACTION

Myśliwiec *et al.*[2] studied the combined effect of Saunders traction device and transcutaneous electrical nerve stimulation (TENS) cervical spine range of motion in the sagittal, coronal and horizontal planes in 39 chronic neck pain patients. Three experimental groups were employed-first group is traction alone, second group received traction+TENS, and the third group received TENS alone, and 10 treatment sessions were given in 3 days. CROM device identified improvements in lateral flexion, extension and rotation mobility more in the combined treatment group.

Myśliwiec *et al.*[3] evaluated the combined effect of traction and TENS on painless grip and maximum strength in 45 neck pain patients of whom Saunders traction device was used in the first group, transcutaneous electrical nerve stimulation and traction were applied in the second group, while the patients in the third group received TENS only, for 10 treatment sessions in three days. Traction produced better increase in painless grip than the TENS in their study.

TENS vs no Treatment

Park *et al.*[4] administered intra-operative TENS for 100 patients with post-operative thyroidectomy-induced posterior neck pain of whom 50 patients received transcutaneous electrical nerve stimulation on the trapezius muscle and 50 patients who acted as controls. The authors assessed the postoperative posterior neck pain and anterior wound pain using an 11-point numerical rating scale at 30 min, 6h, 24h and 48h following surgery. The pain scores were significantly lower in the TENS group versus the control group at all time points. The study proved the efficacy of intra-operative TENS in this population.

Limited evidence existed for TENS and there is need for more studies in this area.

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Received on: 02.09.2019, **Accepted on** 18.09.2019

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