

SHORT TERM EFFECT OF CONVENTIONAL TLSO ON BALANCE AND GAIT IN INDIVIDUAL WITH OSTEOPOROSIS OF SPINE

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ABSTRACT

Osteoporosis is a widespread chronic bone disease leading to an increased risk of bone fractures. The most common clinical consequences are back pain, hyperkyphosis, limitations of physical functioning and activities of daily living as well as reducing quality of life. Osteoporosis is associated with decreased strength and deficits of gait and balance, all together resulting in an increased risk of falls and a subsequent aggravation of fracture risk. Besides pharmaceutical and exercise therapy, back orthosis are increasing being used in the therapy of osteoporosis and rehabilitation after vertebral fractures due to osteoporosis.

Previous studies have evaluated the efficacy of specific device for Orthotic management of spinal problems due to osteoporosis. Therefore the purpose of the present study was to assess the Short Term effect of Conventional Thoraco Lumbar Sacral Orthosis (TLSO) on dynamic balance and gait in individual with osteoporotic spine.

Key words: Osteoporosis, Orthosis, Vertebral fracture, Balance and Gait.

INTRODUCTION

Osteoporosis is a major health problem of aging community. Osteoporosis and associated fractures increases markedly with age and are major cause of mortality and morbidity - and thus of medical expenses throughout the world. According to World Health Organization, Osteoporosis is a diseases characterized by Low bone mass and micro architectural deterioration of bone tissue, leading to enhanced bone fragility and a consequent increases in fracture risk. It causes bones to become fragile and brittle and affects both men and women. A decrease in bone mass normally begins in the fourth decade and continuous throughout life. In general, osteoporosis can be classified with inherited disorder or acquired pathologies. Primary osteoporosis has two subcategories as Type I or Type II. Type I affect women and is associated with estrogen deficiency occurring 5 to 10 years after

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menopause. Type II osteoporosis affect both males and females and is associated with ageing, calcium and Vitamin D deficiency.

Osteoporosis is also associated with decreased strength and deficits of gait and balance, all together resulting in an increased risk of falls and subsequent aggravation of fractures. Osteoporosis of the spine is marked by diminished trunk muscle strength and reduced bone mass. Both fractures increases the risk of vertebral fractures. The vertebral fracture caused by osteoporosis results in loss of height and increased kyphosis³. Kyphotic posture is the most disfiguring and psychologically damaging effect of osteoporosis and can contribute to an increment in the risk of falling.

In most countries the incidence of osteoporosis is about 2 to 4 times higher in females than males. It may be because of estrogen deficiency post menopausal¹. According to site, the fractures most commonly occur in the vertebral bodies, hip and forearm.

The most common clinical consequences are back pain, hyperkyphosis, limitations of physical functioning and activities of daily living as well as reduced quality of life. It has been estimated that the number of women over the age of 65 years has increases from 188 million in 1990 to 325 million in 2015. According to International Osteoporosis Foundation, 1 out of 8 males and 1 out of 3 females in India suffers from osteoporosis, making India one of the largest affected country in the world⁵. The incidence of hip fracture is 1 woman to 1 man in India⁶. In most Western countries, while the peak incidence of osteoporosis occurs at about 70-80 years of age, in India it may afflict those 10-20 years younger, i.e. at age of 50-60⁷ years.

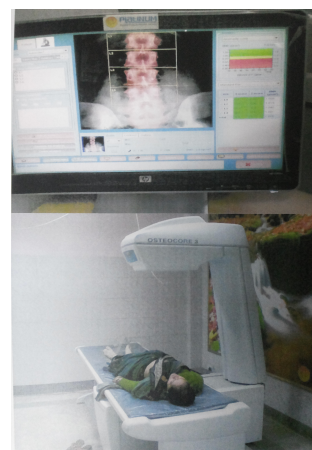
The orthotic treatment modality in the management of osteoporotic spine remains subjective because to our knowledge no objective data is available in India on the effectiveness of conventional TLSO on dynamic balance and gait in individuals with osteoporotic spine. Previous studies have evaluated the efficacy of specific device for Orthotic management of spinal problems due to osteoporosis. Therefore the purpose of the present study was to assess the Short term effect of Conventional Thoraco Lumbar Sacral Orthosis (TLSO) on dynamic balance and gait in individuals with osteoporotic spine.

METHODS

A sample of 30 subjects with osteoporotic spine took part in the study. The subjects of this study were the patients of Safdarjang Hospital, VMMC and Indian Spinal Injuries centre. Subjects who fulfilled the inclusion criteria; age between 50-70 years, both male and female diagnosed with osteoporotic spine with symptoms having lasted less than 6 months, hyperkyphosis angle less than 60 degrees, ability to walk for at least 3 minutes at a comfortable walking speed, dual energy X-ray absorptiometry score < 2.5, and were willing to participate in the study were selected.

Study Design

Pretest- Posttest experimental design was used in this study to measure the short term effect of Conventional TLSO on balance and gait of individual with osteoporotic spine on POMA scale. The primary end point of the study was improvement in balance and gait characteristics of the individuals included in the study. At the study entry assessment of the subject's medical history including circumstances and date of diagnosis were documented. Physical examination of the subject's spine and whole body was undertaken to exclude secondary osteoporosis. Conventional TLSO: a conventional TLSO was fabricated on the basis of biomechanical principles.



PROTOCOL

A sample of convenience 30 number of elderly individuals with osteoporosis took part in the study. Demographic data of the subjects was collected which included the sex, age, height and weight. Following this the subjects were assessed on the Performance Oriented Mobility Assessment (POMA) (Total) scale after assessing the initial balance and gait scores, the conventional Thoraco Lumbar Sacral Orthosis was fitted to each patient for a period of one week for adaptation. Subjects were instructed to wear the orthosis throughout the day at least 5 to 7 hours per day. A chart (orthosis wear recording form) monitoring the actual duration of orthosis were also given to the patients and were asked to fill it up on a daily basis. After one week, the same subjects were assessed on the POMA scale with conventional Thoraco Lumbar Sacral Orthosis. Other treatment methods such as pharmaceutical and therapeutic modalities remained unchanged.

The subjects with osteoporotic spine were invited to participate in the study through Out Patient Department (OPD) of S.J. Hospital, VMMC and ISIC. The subjects as per the inclusion and exclusion criteria were selected for the study. Detailed procedure was explained to the subjects and consent was obtained. Demographic data of subjects was collected. Following this the subjects were assessed for pre-test balance and gait score on the POMA scale.



After initial assessment, a conventional TLSO was fabricated for each patient after taking proper measurement. The orthosis was prepared from iron or aluminium strips, leather, cross link polymer, canvas cloth etc. The orthosis was fitted to the subject and was asked to wear the brace for 5-7 hours per day. A time period of 7 days was given to the subject for adaptation. Then after 1 week, the same subject was again assessed for balance and gait on POMA scale with the conventional TLSO.

The Performance Oriented Mobility Assessment (POMA) scale was developed by Tinetti and first published in 1986. It is a widely used tool for assessing mobility and fall risk in older people. It is easily applied in clinical setting; other than a standard chair and stop watch was required. The total (POMA-T) consist of a balance scale (POMA-B) and a gait scale (POMA-G). POMA-B carries the subject through positions and change in position, reflecting stability tasks that are related to daily activities. In POMA-G several qualitative aspects of the locomotion pattern are examined. Each item is scored on a 2 or 3 point scale, resulting in a maximum score of 28 on the POMA-T and maximum score of 16 and 12 on the POMA-B and the POMA-G respectively. In general, a score below 19 is a high risk for falls.

DATA ANALYSIS

Data was managed on an Excel spreadsheet, SPSS statistical software was used for data analysis. A pair t- test was used to analyze the balance and gait improvement in pre and post condition. Hypothesis was tested at significance level of $p \leq 0.05$.

RESULTS

The sample consist of 30 individuals with osteoporotic spine as 6 males with mean age of 66.83 ± 8.18 years and 24 females with mean age of 64.75 ± 5.33 . The mean height (cm) of male was 168.16 ± 3.12 and of female was 150.25 ± 7.1 weight of male subjects range from 65.66 ± 2.87 and female lies between 56.79 ± 8.54 . (table `1). Statistical analysis was done by using paired t-test to compare the difference in pre- intervention without orthosis and post-intervention with conventional TLSO by POMA- B score. The mean balance score of subject on POMA- B without orthosis was 8.43 ± 2.2 and post balance score with conventional TLSO after one week was recorded 12.6 ± 1.2 . The result shows that there is significant difference between pre and post intervention. (t value = 15.1, p value = 0.000) indicating that conventional TLSO is effective in improving balance in short term use.(Table 2)

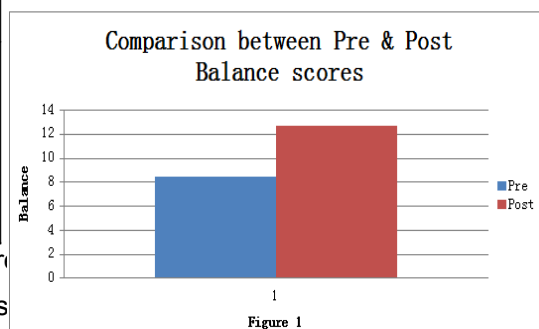
Profile	Sex	N	Mean	SD
AGE	Female	24	64.75	5.33
Table 1: Demographic data of Age, Height and Weight (N = 30)				
	Total	30	65.167	5.901
HEIGHT	Female	24	150.25	7.1
	Male	6	168.16	3.12
	Total	30	153.833	9.738
WEIGHT	Female	24	56.79	8.54
	Male	6	65.66	2.87
	Total	30	58.567	8.504

The mean gait score of subject on POMA –G without orthosis was 7.067 ± 1.8 and post gait score with conventional TLSO after one week, was recorded 9.6 ± 1.1 . The result shows that

there is a significant difference between pre and post intervention. (t value =11.3 , p value = 0.000) indicating that conventional TLSO is effective in improving gait in short term use. (Table 3).

Table 2 : Comparison between Pre and Post Balance scores of POMA

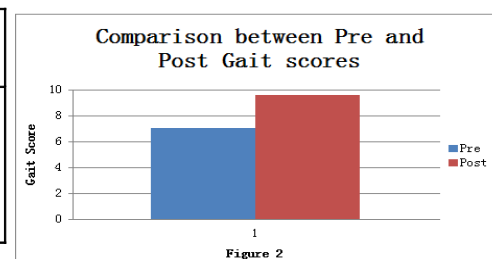
Balance	Mean	SD	t- value	p- value
Pre	8.43	2.2	15.1	0.000
Post	12.6	1.2		



The comparison of mean difference between pre and post intervention on POMA- T without orthosis was 15.5 ± 3.7 s. Post balance and gait score with conventional TLSO after one week, was recorded 22.2 ± 2.107 . The result shows that there is significant difference between pre and post intervention (t value = 18.48 , p value = 0,00) indicating that conventional TLSO is effective in improving balance and gait in short term use.(Table 4)

Table 3 : Comparison between Pre and Post gait Scores of POMA

Gait	Mean	SD	t- value	p-value
Pre	7.067	1.8	11.33*	0.000
Post	9.6	1.1		



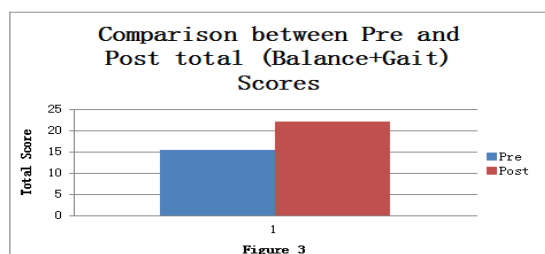
DISCUSSION

Osteoporosis is a disease characterized by low bone mass and micro architectural deterioration of bone tissue, leading to enhanced bone fragility and a consequent increase in fracture risk¹. It causes bones to become fragile and brittle and affects both men and women. Furthermore, osteoporosis is associated with decreased strength and deficits of gait and balance, all together resulting in an increased risk of falls and a subsequent aggravation of fracture risk². Osteoporotic subjects have weaker back extensor muscles and lower extremity muscle strength than the normal subjects. It was found that antero-posterior and medio-lateral displacement of centre of mass in the osteoporotic subject was greater than the normal subjects. Thorso Lumbar Sacral orthosis, soft and rigid Lumbo Sacral orthosis are recommended for osteoporotic spine. These orthoses aim to reduction of axial loading, reduction of muscle strain and/or improvement of standing balance by moving the position of centre of gravity posterior restoration of heel to toe gait pattern, improve posture and

decrease risk of fall¹⁷. Earlier studies have shown that wearing a specific spinal orthosis results in reduction of pain as well as improvements of posture and back extensor strength.

Table 4 : Comparison between Pre and Post Balance and gait scores of POMA

Balanc e+ Gait	Mean	SD	t-value	p-value
Pre	15.5	3.7	18.48**	0.000
Post	22.2	2.107		



individuals with osteoporotic spine. The result obtained from the analysis in this study revealed that subjects are benefited with conventional TLSO intervention with a significant improvement in post intervention balance and gait score on POMA.

The mean balance score of subject on POMA- B without orthosis was 8.43 ± 2.2 and post balance score with conventional TLSO after one week was recorded 12.6 ± 1.2 . The result shows that there is significant difference between pre and post intervention (t value = 15.1 , p value = 0.000) (Table 5.2) indicating that conventional TLSO is effective in improving balance in short term use. This may be due to decrease the sway COM displacement by conventional TLSO²⁵. It also supported by L.Vogt et.al (2005) study that found 3 hour wearing of orthosis provides a clinically significant erection of trunk signifying an improvement of posture²³.

The mean gait score of subject on POMA- G without orthosis was 7.067 ± 1.8 and post gait score with conventional TLSO after one week, was recorded 9.6 ± 1.1 . The result shows that there is significant difference between pre and post intervention (t value = 11.3 , p value = 0.000) (Table 5.3) indicating that conventional TLSO is effective in improving gait in short term use. It is supported by earlier study conducted by Schmidt K et al., which suggests that wearing a spinal orthosis introduced a reduction in double support time associated with a beneficial impact on gait stability².

The mean balance and gait score of subjects on POMA –T without orthosis was 15.5 ± 3.7 showing that patients were in high risk of fall. Post balance and gait score with conventional TLSO after one week, was recorded 22.2 ± 2.107 . The result shows that there is significant difference between pre and post intervention. (t value = 18.48 , p value = 0.00) (Table 5.4) indicating that conventional TLSO is effective in improving balance and gait in short term use. This intervention is supported by conclusion of Mei- Yun Liaw et al.2009 where in their study Knight - Taylor brace efficiently enables the subject to maintain static and dynamic motor balance²⁵.

CLINICAL IMPLICATIONS

The evaluated data suggests that conventional TLSO is effective in improving balance and gait in population with osteoporotic spine. This helps us to have a considerable rationale for conventional TLSO prescription for osteoporotic spine patients to improve their balance and gait.

FUTURE RESEARCH

This research was conducted for short period only. Future research can involve longer duration by extending the time of follow up to months and large sample of subjects.

CONCLUSION:

The experimental hypothesis that conventional TLSO improve balance and gait in individual with osteoporotic spine is supported by this study. Conventional TLSO shows significant improvement on balance and gait outcome scale and thus it can be concluded that conventional TLSO is a good prescription for osteoporotic spine patients who are under risk of fall due to impaired balance.

REFERENCES

1. Waters DL, Hale L, Grant AM, Herbison P, Goulding A Osteoporosis and gait and balance disturbances in older sarcopenic obese New Zealanders. *Osteoporos Int*.2010 Feb;21(2):351-7. Epub 2009 May13.
2. Susan G. Lynn, MA, Westerlind, PhD "Balance Characteristics of Persons with Osteoporosis" *Arch Phys Med Rehabil* 1997;78:273-7
3. Schmidt K, Hubscher M, Vogt L, Klinkmuller U, Hildebrandt HD, Fink M, Banzer W "Influence of spinal orthosis on gait and physical functioning in women with postmenopausal osteoporosis". PMID: 22139393 (Pub Med) *Orthopade*. 2011 Dec
4. Mosekilde L. Normal vertebral body size and compressive strength: relation of age and to vertebral and iliac trabecular bone compressive strength. *Bone* 1986;7:207
5. Randell A, Sambrook PN, Nguyen TV, et al. (1995) Direct clinical and welfare costs of osteoporotic fractures in elderly men and women. *Osteoporos Int* 5:427.
6. Matthias Finkl, Banu Kalpakcioglu², Matthias Karst³ and Michael Bernateck³ "Efficacy of A Flexible orthotic Device in Patients with Osteoporosis on Pain and activity os daily living" *J Rehabil Med* 2007;39:77-80
7. Pfeifer M, Bgerow B, Minne HW: Effect of new spinal orthosis on posture, trunk strength and quality of life in women with postmenopausal osteoporosis: a randomized trial. *Am J Phys Med Rehabil* 2004;83:177-186
8. Riggs BL and Melton LJ, 1995, *Bone* 17 (5); 505; American Heart Association, heart and Stoke Facts 1996; American Cancer Society, Cancer Facts and Figures, 1996
9. Cooper C, Campion G and Melton LJ, 3rd (1992) Hip fracture in the elderly: a worldwide projection. *Osteoporos Int*2:285.
10. McGinty SM, Masters LD, Till DB. Inter-tester reliability using the Tinetti gait and balance assessment scale. *Issues on Aging*.1999;22:3-5
11. Cipriany- Dacko LM, Innerst D, Johannsen J, Rude V. Inter-rater reliability of the Tinetti balance scores in novice and experienced physical therapy clinicians. *Arch Phys Med Rehabil*.1997; 78:1160-1164.
12. Verghese J, Buschke H, Viola L et al. Validity of divided attention tasks in predicting falls in older individuals: a preliminary study. *J Am Geriatr Soc*. 2002; 50:1572-1576.
13. Mecagni C, Smith JP, Roberts KE, O'Sullivan SB. Balance and ankle range of motion in community- dwelling women aged 64 to 87 years: a correlational study. *Phys Ther*. 2000; 80:1004-1011.
14. Kaplan RS, Sinaki M.Hameister; Effect of back supports on back strength in patients with osteoporosis: a pilot study, *Mayo Clin Proc* 71:235-241,1996
15. Mehrsheed Sinaki, Md; Robert H. Brey, Phd; Christine A. Hughes, Bs; Dirk R. Larson, Ms And Kenton R. Kaufman, Phd, Significant Reduction in Risk of falls and Back Pain in Osteoporotic- Kyphotic Women Through a Spinal Proprioceptive Extension Exercises Dynamic (SPEED) Program *Mayo Clin Proc*. July 2005;80(7):849-85.
16. Mei-Yun Liaw¹, Chia- Ling Chen² · Jung- Fu Chen³, Fuk-Tan Tang², Alice May-Kuen wong², Huei- Huang Ho⁴ Effects of Knight_Taylor brace on balance performance in osteoporotic patients with vertebral compression fracture 2009; 22, Number2: 75-81.