ISSN: 2349-7300
ISO 9001:2008 Certified
International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences (IJIRMPS)
Volume 1, Issue 1, October 2013

Immediate Effect On Balance After Correcting Postural Hyperkyphosis Of Thoracic Spine in Elderly Population Using Therapeutic Tape

Pallavi Prabhu, S. Nandakumar

Abstract: ***Changes in the alignment of posture is commonly noticed with ageing. One of the common postural changes is flexed posture or thoracic hyperkyphosis(prevalence is approximately 20-40% among community dwelling subjects aged ≥60 years[2]).The precise etiology of flexed posture is still unknown, but it can be associated with musculoskeletal or neuromuscular impairments with or without low mineral density and degenerative alterations of the intervertebral discs. Increased thoracic kyphosis displaces the centre of mass (COM) anteriorly towards the limits of stability. This increases the chance of loss of balance (Horak et al, 1989).Loss of balance and body sway are the important risk factors for falls in the elderly. Alison M Greig et al, 2006 proved that postural taping is effective in correcting the hyperkyphosis of thoracic spine in osteoporotic women. However, there is lack of evidence of the effect of correction of hyperkyphosis of thoracic spine on balance using therapeutic tape, in elderly population. Hence, the following study is been undertaken to know the immediate effect of correction of hyperkyphosis of thoracic spine on balance in elderly population using therapeutic tape.***

I. INTRODUCTION

In elderly, as a part of ageing process there will be degenerative changes in almost all the systems of the body including the neuromuscular system which is the major system involved in maintaining balance. The ability to maintain and control balance is a complex motor task. Balance and co-ordination is directed by the brain but is affected by changes in the muscles and joints. Factors related to balance include age, etiology, mobility, the need to concentrate while walking, limitations in activities of daily living(ADL) and fear of falling.[2] Reduced mobility in old age due to various reasons leads to joint stiffness, muscle weakness and thereby cause pain,disability,falls,loss of independence, frailty etc. Thus loss of balance can be major risk factor for falls in elderly. Version and associates tested non-institutional men and women between 60-90 years of age on two types of balance tests that involved one legged stance, found that balance time and torque production reduced significantly with age.[3]

Statistics on injuries and accidents indicate that falls are seventh leading cause of death in people over 75 years of age (Ochs et al.,).In addition, fall rates in persons 65 years of age and older are at least 33% per year in community-dwelling older adults, with women at higher risk than men(Campbell et al., 1981;Nevitt et al.,1989).[2] It is estimated that nearly 1.5 to 2 million persons are injured and 1 million succumb to death every year in India. Gururaj (2002) has found out that falls contribute to 20-25% of total death in India every year.[4]

Postural control involves controlling the body's position in space for the dual purposes of stability and orientation.[1] In standing position it controls the body's orientation in space, maintain the body's Centre Of Mass(COM) over the Base Of Support(BOS) and stabilize the head with regard to the vertical so that the eye gaze is appropriately oriented. Maintenance of control of posture depends upon the integrity of the Central Nervous System (CNS), vestibular system and musculoskeletal system. A normal functioning CNS selects appropriate combination of muscles to complete the task on the basis of an analysis of sensory inputs. A second level of input includes cues from the vestibular system and proprioceptive input from all body segments.[5]

Changes in the alignment of posture are commonly noticed with ageing as the skeletal muscle mass starts to deteriorate. Most people see the biggest changes between their 40s and 50s. Muscles provide the force and strength to move the body. Changes in the muscles, joints, and bones affect the posture and gait, and lead to weakness, slowed movement and ultimately to falls and morbidity. Spinal flexibility shows the greatest decline with age, compared to any other joints in the body and spinal extension shows the greatest restriction (Einkauf et al.,1987) Decreased range of motion and loss of spinal flexibility in many older adults leads to a characteristic stooped posture/flexed posture with thoracic hyperkyphosis(prevalence is approximately 20-40% among community

ISSN: 2349-7300
ISO 9001:2008 Certified
International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences (IJIRMPS)
Volume 1, Issue 1, October 2013

dwelling subjects aged ≥60 years[6]). Flexed posture is referred to as excessive kyphosis or anterior concave curvature of thoracic region of spine resulting in protuberance of the upper back.

The precise etiology of flexed posture is still unknown. But it can be associated with musculoskeletal/neuromuscular impairments with or without low mineral density and degenerative alterations of the intervertebral discs. The curvatures of the vertebral column increases its resistance to axial compression forces.[6] Thoracic spine which is basically kyphotic in structure has a curvature ranging from 20^0 to 50^0 when assessed by Cobb's radiographic method. According to Kendall and Mc.creary, the Line Of Gravity (LOG) passes through the bodies of lumbar and the cervical vertebrae and anterior to the thoracic vertebrae in optimal posture. The stress on supporting structures would be greatest in thoracic area, where the LOG would pass at a greatest distance from the vertebrae.[3] Increased thoracic kyphosis is associated with increased compression loading through the spine, which results in greater vertebral and intervertebral disc loads (keller et al.,2003) and in such spine there will be displacement of COM anteriorly towards the limits of stability. This increases the chance of loss of balance Number of studies have been conducted on apparently healthy elderly to correct the stooped posture. Anne Shumway Cook[8] developed special regimen and M.Sinaki et al., [9] developed a special orthosis called weighted kyphotic orthosis (WKO) to improve balance in osteoporotic women. Ivan Bautmans et al., [10] conducted a study to explore the feasibility and effects of rehabilitation using manual mobilization of the thoracic spine in elderly female patients with osteoporosis. A study was done by Maria Grazia Benedetti[11] on effects of an adapted physical activity program in a group of elderly subjects with flexed posture. In one of the studies conducted by M.Greig et al., [12] on kyphotic women with osteoporosis using postural taping to correct thoracic hyperkyphosis, found that the application of postural taping brings in immediate reduction in the angle of thoracic kyphosis. All of these studies were conducted with an objective of bringing in change in posture over a period of time and most of them did not look for effect of posture correction on balance. Since the spinal extension shows the greatest decline with age, many researchers studied the muscle activity of spinal extensors during quite standing and dynamic activity. Most of the EMG studies have shown that the longissimus dorsi, rotators and neck extensor muscles exhibit intermittent activity during normal standing. This evidence suggests that ligament us structures and passive muscle tension are unable to provide enough force to oppose all external gravitational moments acting around the joint axis of the upper vertebral column.[4] Therefore, to overcome the gravitational force during any activity strong antigravity force is very essential.

II. LITERATURE SURVEY

Kado DM et al studied the prevelance of flexed posture among community dwelling subjects and estimated the prevelance in the range of app. 20-40% in aged ≥ 60 years[1].Dr. B. Krishnaswamy and Dr. G. Usha studied the statistics and epidemiology of falls in elderly in india and concluded that Falls and fracture are common in older women and men with a mortality rate of 20-25% every year.[2] Walter S. Bartynski et al., conducted a study on Severe Thoracic Kyphosis in Older Patient in the Absence of Vertebral Fracture. The purpose of this study was to determine the statistical distribution of the thoracic kyphotic angle (TKA) measurement in older patients without vertebral body abnormalities when compared with a young population. The TKA was measured by Cobb angle on digital lateral chest radiographs in 90 patients >65 years of age. Patients with vertebral compression, vertebral body angulation, congenital anomaly, or significant scoliosis were excluded. Extreme thoracic kyphosis therefore occurs independently in a large subset of people, in the absence of vertebral wedge compression. The development of extreme thoracic kyphosis might contribute to excess biomechanical stress in the spine and may identify a population at risk for future vertebral compression fracture in particular at the thoracolumbar junction. GT Fon et al., measured Thoracic kyphosis on chest radiographs of 316 "normal" subjects by means of the Cobb technique. A total of 159 males and 157 female subjects 2-77 years old were studied. These results were used to determine the expected ranges of kyphosis for a "normal" patient of a given age and gender. The range was between 20-40 degrees. They also found out that the degree of kyphosis increased with age and the rate of increase was higher in females than in males. Mehrsheed Sinaki studied Balance disorder and increased risk of falls in osteoporosis and kyphosis: significance of kyphotic posture and muscle strength. Twelve community-dwelling women with O-K (Cobb angle, 50–65° measured from spine radiographs) and 13 healthy women serving as controls were enrolled. Quantitative isometric strength data were collected. Gait was monitored during unobstructed level walking and during stepping over an obstacle of four different heights randomly assigned (2.5%, 5%, 10%, and 15% of the subject's height). Balance was objectively assessed with computerized dynamic posturography consisting of the

ISSN: 2349-7300
ISO 9001:2008 Certified
International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences (IJIRMPS)
Volume 1, Issue 1, October 2013

sensory organization test. Data showed that thoracic hyperkyphosis on a background of reduced muscle strength plays an important role in increasing body sway, gait unsteadiness, and risk of falls in osteoporosis.

III. MATERIAL AND METHODS

Study design:
Experimental study

Subjects:
Subjects between the age group of 55-75 years with postural thoracic hyperkyphosis were taken from different old age homes and from the community in the city of Bangalore.

Sample design:
Convenience sampling

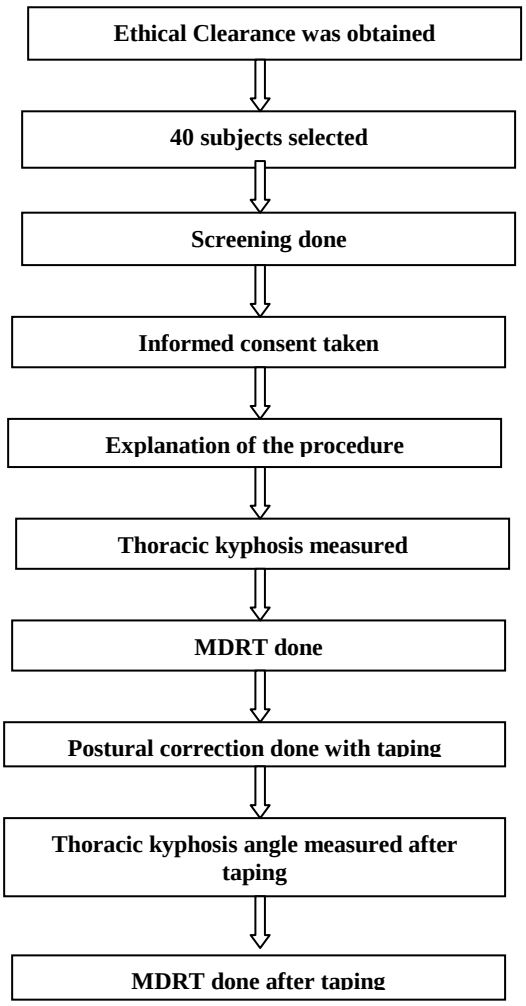
Sample size:
40 subjects

Inclusion criteria:
→ Males and females between the age group of 55-75 years.
→ Males and females with postural hyperkyphosis of thoracic spine(≥40°)

Exclusion criteria:
→ Wheel chair or bedridden subjects.
→ Subjects with structural hyperkyphosis of thoracic spine.
→ Subjects with other neurological problems like Stroke, parkinsonism etc., which affects balance.
→ Severe back pain affecting activities of daily living, recent fractures of vertebra and lower limb, scoliosis.

Materials:
→ Flexicurve.
→ Kinesiotape.
→ Measuring tape attached to a stand.

IV. PROCEDURE



ISSN: 2349-7300
ISO 9001:2008 Certified
International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences (IJIRMPS)
Volume 1, Issue 1, October 2013

V. RESULT ANALYSIS

Table 1- Description of Sample

SAMPLE	FREQUENCY	PERCENTAGE (%)	MEAN AGE IN YEARS	MEAN ANGLE IN DEGREES
MALES	7	82.5	62.67	62.94
FEMALES	33	17.5	61.1	60.74
TOTAL	40	100	61.68	61.13

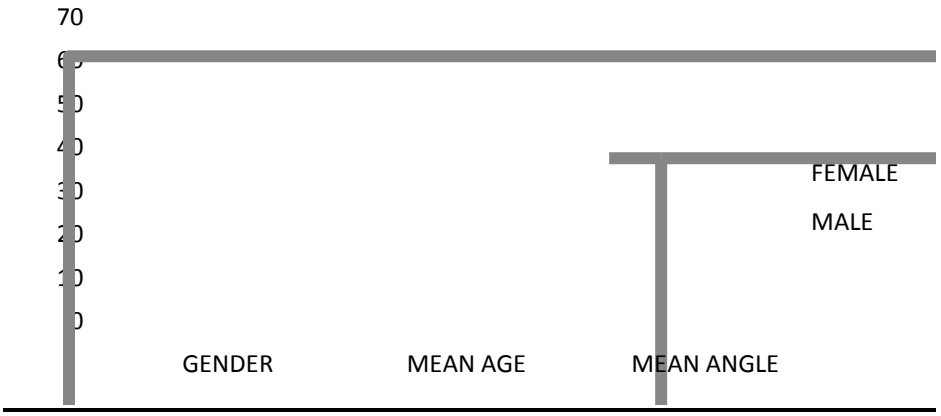


Fig 1.Sample Description

Table 2- Descriptive Statistics of Change in Angle Pre and Post

MDRT VARIABLES N=40	MEAN (in DEGREES)	SD (in CMS)	't' VALUE	'P' VALUE
ANGLE PRE	61.13	11.28	12.0	<0.05
ANGLE POST	38.67	13.22		

The above table shows that the mean change in the angle before (61.13±11.28) and after (38.67±13.22) treatment was statistically significant ($p<0.05$).

ISSN: 2349-7300
ISO 9001:2008 Certified
International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences (IJIRMPS)
Volume 1, Issue 1, October 2013

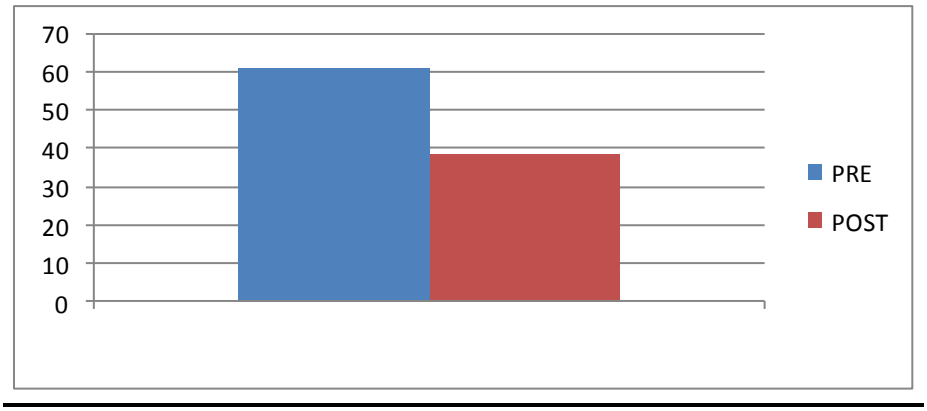


Fig 2. Change in the angle PRE and POST intervention

The above graph shows the mean change in the angle before treatment was 61.13 degrees and after treatment was 38.67 degrees.

Table 3- Descriptive statistics of MDRT values pre and post intervention

MDRT VARIABLES N=40	MEAN (in CMS)	SD (in CMS)	't' VALUE	'P' VALUE
FRT PRE	**19.29**	**8.56**	**-10.52**	**<0.05**
FRT POST	**28.37**	**8.81**		
BRT PRE	**8.87**	**4.72**	**-11.42**	**<0.05**
BRT POST	**13.04**	**4.54**		
LRT PRE	**7.89**	**1.23**	**-10.98**	**<0.05**
LRT POST	**11.48**	**1.83**		
RRT PRE	**7.89**	**1.29**	**-14.01**	**<0.05**
RRT POST	**11.52**	**1.52**		

The above table for the comparison of MDRT values before and after treatment shows that the mean change in the MDRT values were statistically significant ($p<0.05$).

ISSN: 2349-7300
ISO 9001:2008 Certified
International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences (IJIRMPS)
Volume 1, Issue 1, October 2013

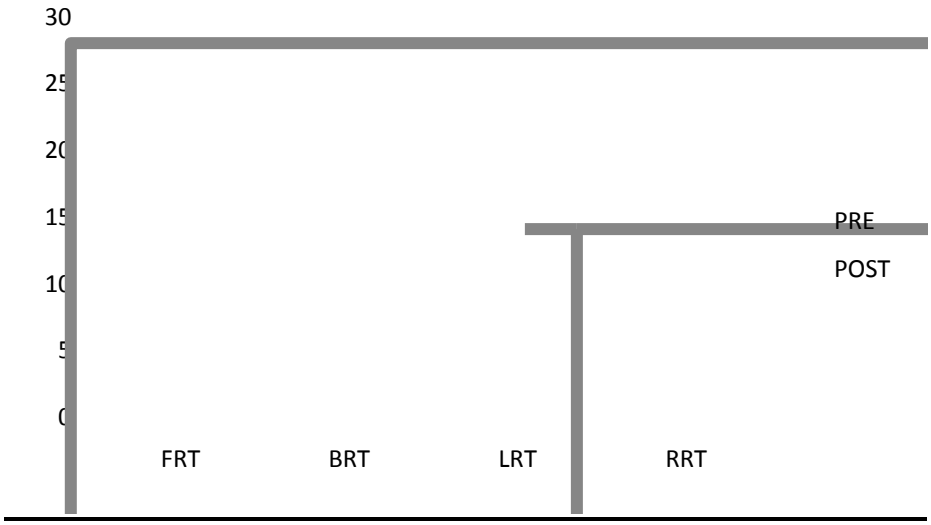


Fig 3. Difference in the MDRT values pre and post

The above graph obtained by the comparison between the MDRT values Pre and Post intervention shows that there is significant improvement in balance after the intervention.

Table 4- Correlation between change in angle and Variables of MDRT

		CHANGE IN ANGLE	MEAN FRT	MEAN BRT	MEAN LRT	MEAN RRT
CHANGE IN ANGLE	PEARSON CORRELATION	1	-0.46	-0.36	-0.49	-0.32
	SIG.(2-TAILED)		0.003	0.024	0.01	0.045
	N	40	40	40	40	40

VI. CONCLUSION

In the present study it was seen that correction of posture in elderly people with postural thoracic hyperkyphosis will not have an immediate clinically significant improvement in dynamic balance. Reduced mobility in old age due to various reasons leads to joint stiffness, muscle weakness and thereby cause pain, disability, falls, loss of independence, frailty etc. Changes in the alignment of posture are commonly noticed with ageing. Hyperkyphosis is referred to as excessive kyphosis or anterior concave curvature of thoracic region of spine resulting in protuberance of the upper back[3] due to which the COM shifts anteriorly to the limits of stability. It was hypothesized that a change in postural thoracic kyphosis may shift COM posteriorly within the BOS and also restoration of correct muscle function by supporting weakened muscle with the mechanical external support from the kinesio tape, would thus improve the dynamic balance. An experimental study was undertaken on 40 elderly subjects both males and females having postural hyperkyphosis of thoracic spine fulfilling the criteria's for the study. The angle of thoracic spine was measured using the flexi curve. Next, the balance was assessed using "Multidirectional reach test" and the best of three readings shall be recorded. Kinesio tape was applied on the back and correction in the thoracic hyperkyphosis was measured using flexi curve. If the thoracic kyphosis was corrected then those subjects underwent the balance assessment using "multidirectional reach test". Three readings were taken and the average of three was recorded for analysis.

The results of the study showed that there was a significant increase in the balance in elderly population with thoracic hyperkyphosis after postural correction using the kinesio tape ($p<0.05$). There was a low (0.48) correlation between change in angle of kyphosis and the balance. Hence, it was concluded that immediate effect of correction of posture in elderly people with postural thoracic hyperkyphosis will not have clinically significant improvement in dynamic balance

ISSN: 2349-7300
ISO 9001:2008 Certified
International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences (IJIRMPS)
Volume 1, Issue 1, October 2013

REFERENCES

[1] Roberta A. Newton, Validity of the Multi-Directional Reach Test: A Practical Measure for Limits of Stability in Older Adults; 2001, Journal of Gerontology: Medical sciences, Vol. 56A, No. 4, M248–M252.

[2] Deborah M. Kado et al, Narrative Review: Hyperkyphosis in Older Persons, 2007, Annals of internal medicine, vol 147, no 5,330-338.

[3] Milne, JS, Lauder, IJ. Age effects in kyphosis and lordosis in adults. Ann Hum Biol 1974; 1:327.

[4] M Senaki et al,Balance disorders and increased risk of falls in osteoporosis and kyphosis: significance of kyphotic posture and muscle strength ,2005, Osteoporosis international,vol 12,1004-10.

[5] Greig AM, Postural taping decreases thoracic kyphosis but does not influence trunk muscle electromyographic activity in women with osteoporosis, Manual Therapy:an international journal of musculoskeletal therapy. 2008 Jun; 13(3):249-57.

[6] Teixeira FA and Carvalho GA, reliability and validity of thoracic kyphosis measurements using the flexi curve method, Rev. bras. fisioter. São Carlos, 2007, v. 11, n. 3, p. 173-177.

[7] Martha R. Hinman, Interrater reliability of flexi curve postural measures among novice users, Rehabilitation, Volume, 33-3.