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To Compare The Effectiveness Of Functional Corrective Exercises With Muscle Energy Technique And Kinesiotaping With Muscle Energy Technique Among Subjects With Thoracic Hyperkyphosis - An Interventional Study

Nivetha. R.S[1], Akash. B[1], Jasmine S Sundar[1], Valarmathi. S[1], Kalpana. S[1], Srinivas. G[1], V. S. Saravanan[2], Arul Paul. A[1]
[1](Department Of Epidemiology, The Tamilnadu Dr. Mgr Medical University, India)
[2](Mohamed Sathak A.J College Of Physiotherapy, India)

Abstract:
Background: *Thoracic hyperkyphosis, characterized by an excessive anteroposterior curvature of the thoracic spine exceeding 40°, has been linked to heightened mortality, compromised balance, and diminished well-being scores. Exercise-based interventions emphasizing postural alignment, fortification of back extensor muscles, and preservation of spinal flexibility have demonstrated relative effectiveness. In tandem with spinal orthoses, postural taping endeavors to mitigate thoracic hyperkyphosis, alleviate pain, and optimize the engagement of postural muscles for an improved spinal position. Muscle energy technique serves to elongate shortened muscles, mobilize articulations with limited mobility, fortify physiologically weakened muscles, and reduce localized edema and passive congestion. Existing research has yet to scrutinize and compare the efficacy of functional corrective exercises with muscle energy technique and kinesiotaping with muscle energy technique as interventions for thoracic hyperkyphosis. This study aims to provide valuable insights into their comparative effectiveness.*
Materials and Methods: *In this Interventional study, 40 patients of thoracic hyperkyphosis from old age homes in and around chennai belonging to age group of 45-65 years were randomly allocated into 2 groups of 20 subjects each, Group A (Functional Corrective Exercise with Muscle Energy Technique) and Group B (Kinesiotaping with Muscle Energy Technique). The kyphotic index, functional ability and balance were compared between the groups. The outcome tools were flexicurve rule, quebec pain disability scale and falls efficacy scale .*
Result: *The Comparison between the groups revealed that there were significant differences between the means of the two groups. The results interpreted significant improvement in functional ability(Mean:38.05 & Standard deviation:2.32) and balance (Mean:34.05 & Standard deviation:2.58) in Group A (Functional corrective exercise with muscle energy technique) compared to Group B (Kinesiotaping with muscle energy technique) ($p<0.01$).*
Conclusion: *From the obtained results, it is concluded that both functional corrective exercise and kinesiotaping is effective in improving kyphotic index, functional ability and balance. Whereas, on comparing the effect of both, kinesiotaping is effective in increasing kyphotic index and functional corrective exercise showed better improvement in functional ability, balance.*
Key Words: *Kyphosis, Corrective Exercise, Taping, Muscle Energy Technique, Kyphotic Index, Balance.*

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I. Introduction

Thoracic spine is the second and the largest segment of vertebral column located between two lordotic curves namely cervical and lumbar segments. It comprises of 12 vertebra and considered as least mobile portion of the spine. The thoracic spine has the normal forward curvature called kyphosis which has a normal range from 20°- 29° during childhood and also during the third decade of life[(1)]. Thoracic hyperkyphosis is defined as an excessive anteroposterior curvature of the thoracic spine ranging >40°[(2)]. Physiological thoracic kyphosis is necessary for cardiopulmonary system organs to work in harmony[(3)]. According to the cobb method, the value of the angle that the straight lines which intersect each of the parallel lines passing from superior endplate of T1 to inferior endplate of T12 gives the thoracic kyphosis angle[(4)].

One recent study reported that 38% individual aged 20 - 50 years are at a high risk of developing thoracic hyperkyphosis[5]. It is a common occurrence in patients presenting to spine outpatient department in their area and is more prevalent in cases of spinal tuberculosis and senile osteoporosis [6]. Hyperkyphosis has been associated with increased mortality, poor balance, and low well-being scores. The general deconditioning and muscle weakness, particularly of the trunk extensors, associated with aging may also contribute to postural malalignment of the spine and reduced segmental mobility[7]. Risk factors for hyperkyphosis include advanced age, low bone mass, degenerative disk disease and prevalent vertebral fractures[8]. Increased kyphosis in thoracic spine attributed to anterior displacement of centre of gravity and is associated with muscle impairments and altered gait. Women with hyperkyphotic posture demonstrate difficulty rising from a chair repeatedly without using their arms, significantly poorer balance and slower gait velocity, wider base of support with stance and gait, and decreased stair climbing speed[9].

Corrective exercise is one of the common methods for correction of postural hyperkyphosis abnormality, which is typically managed by the clinicians in patients locally based on Kendall's theory[10]. Exercise based treatments which focus on postural alignment, strengthening back extensor muscles and maintenance of spinal flexibility are relatively effective[11]. Corrective exercise was reported to be a safe and effective method in improving spinal deformities[12]. Kinesiology taping technique was developed in 1973 by Dr. Kenzo Kase[13]. Like spinal orthoses, postural taping aims to decrease thoracic hyperkyphosis, reduce pain and assist activity of the postural muscles in a more optimal spinal position[11]. Muscle energy technique lengthen a shortened muscle, mobilise an articulation with restricted mobility, strengthen a physiologically weakened muscle, reduce localised edema and passive congestion. The goal is to help restore normal muscle and joint mobility[14].

The flexible ruler, named flexicurve, has been used to measure the spine curvatures on the sagittal plane. Takahashi and Atsumi were the first to describe the flexicurve. Milne and Lauder described the first method of utilization of the flexicurve in the clinical setting for kyphosis measurement through the kyphosis index (KI) [15]. Quebec back pain disability scale (QPDS) measures the level of functional disability. This questionnaire was originally developed to monitor and compare patient progress. 20 items can be classified into 6 domains of activity affected by back pain: bed/rest (items 1-3), sitting/standing (items 4-6), ambulation (items 7-9), movement (items 10-12), bending/stooping (items 13-16), and handling of large/heavy objects (items 17-20) . For each item, a 6- point Likert scale (0-5) to indicate the level of difficulty is used, where 0 = "not difficult at all", 1 = "minimally difficult", 2 = "somewhat difficult", 3 = "fairly difficult", 4 = "very difficult", and 5 = "unable to do"[16]. There is a need for questionnaire measure that are able sensitively to discriminate between different levels of fear and assess concern about different activities. The first and most widely used scale was the 10 items Falls Efficacy Scale (FES). Falls efficacy scale, this scale has excellent reliability, is correlated with measures of balance and gait, and predicts future falls and decline on functional capacity[17].

As the existing researches have not focused on comparing the efficacy of functional corrective exercises with muscle energy technique and kinesiotaping with muscle energy technique as a treatment for thoracic hyperkyphosis, this study will give an insight on the same. Thus the samples were divided into two groups. Group A (FUNCTIONAL CORRECTIVE EXERCISES WITH MUSCLE ENERGY TECHNIQUE) and Group B (KINESIOTAPING WITH MUSCLE ENERGY TECHNIQUE).

II. Objectives of the study

1. To evaluate the effectiveness of functional corrective exercises with muscle energy technique in terms of kyphotic index, functional ability and balance in subjects with thoracic hyperkyphosis.
2. To evaluate the effectiveness of kinesiotaping with muscle energy technique in terms of kyphotic index, functional ability and balance in subjects with thoracic hyperkyphosis.
3. To compare the effectiveness of functional corrective exercises with muscle energy technique and kinesiotaping with muscle energy technique in terms of kyphotic index, functional ability and balance in subjects with thoracic hyperkyphosis.

III. Material & Methods

Study Design: An Interventional study
Study Setting: Old age homes in and around Chennai
Study Duration: The study duration is 6 weeks
Sample size: 40

- Group A=20 (Functional corrective exercise with muscle energy technique)
- Group B=20 (kinesiotaping with muscle energy technique)

Sample Technique: Consecutive sampling technique

Dependent variable:
- Kyphotic index – Flexicurve ruler
- Functional ability – Quebec pain disability scale
- Balance – Falls efficacy scale

Independent variable:
- Functional corrective exercises
- Kinesiotaping
- Muscle Energy technique

Inclusion Criteria:
- Age group between 45 to 65 years
- Both men and women are included in the study
- Thoracic extension range <1cm (OTT's sign)
- Able to walk one block without the use of an assistive device

Exclusion Criteria:
- Scoliosis
- Ankylosing spondylitis
- Previous history of spinal surgery
- Inability to move from standing to supine on a mat and return to standing independently or with the use of a nearby chair.
- Allergic to kinesiotaping material

Demographic Data:
- 22 Male & 18 Female were included in the study
- 45 to 55 years - 18 male& 12 female
- 55 to 65 years - 4 male & 6 female

Procedure:
GROUP A:

The participants in group A were provided with functional corrective exercises. The training program consisted of exercises including stretching and strengthening. The training protocol was repeated three times per week for 6 weeks, under the supervision of a physiotherapist.

1. Upper trapezius stretch
2. Foam roll pec stretch
3. Prone pec stretch
4. Seated row
5. Middle trapezius strengthening
Set: 1 – 3
Repeated: 6 – 12
Duration: 5 – 3 Sec

GROUP B:

The participants in group B received Kinesiotaping. The tape were applied at acromioclavicular joint level when the patient is in front flexion and the shoulders are protracted, the first 5 cm without stretch and then applying maximum stretch, advancing cross wise and terminating at the lower boundary of the rib, with the adhesion ends being applied zero stretch. The kinesiotape was applied at the opposite shoulder with the same technique such that a cross sign was obtained. The cross point is adjusted in a way to correspond to the lower 1/3 portion of the scapula medial border. The participants were asked to remove the tape at home 5 days after the first taping application. In order to minimize taping-related complications, taping is not applied for the next 2 days.

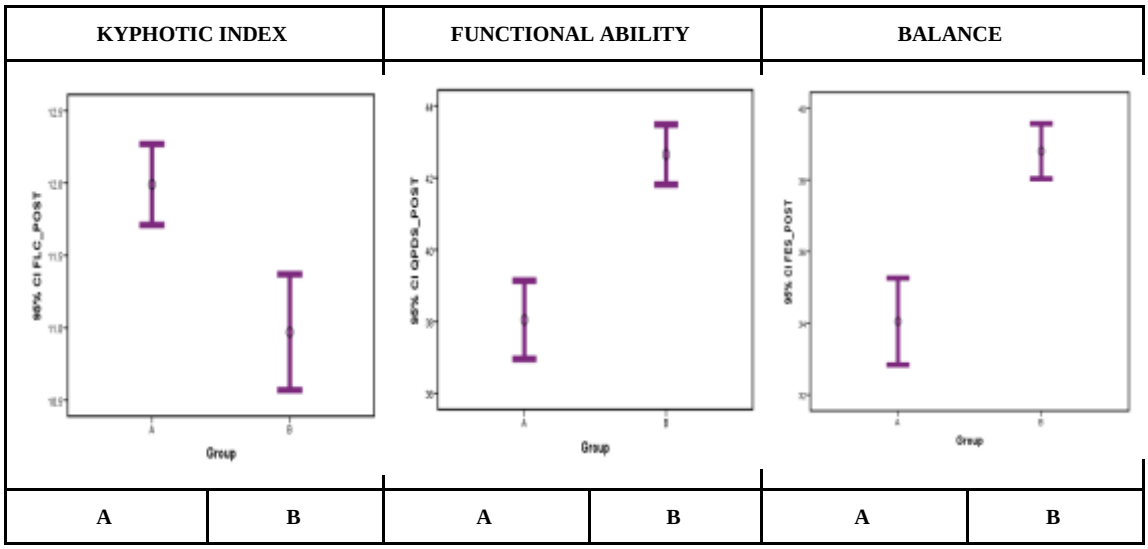
Muscle Energy Technique:

The participant's in both group A and group B received muscle energy technique. The subjects were asked to sit in a relaxed position with both hands on her neck. The participant's upper arm were supporting the therapist's arm. The therapist's other hand was placed on the spinous process of the thoracic vertebra in order to move the vertebra to the end of the extension barrier. Then, the participants were instructed to push her elbows

toward flexion no more than 25% of her maximum contraction. The therapist resisted the subject's effort for 5-7 seconds. When the participant ceases the effort, the therapist moves the vertebra further into extension. This technique was performed five times per session for 6 weeks.

IV. Result

	GROUP A		GROUP B		Mean difference	t
	Mean	Standard Deviation	Mean	Standard Deviation		
Kyphotic index	11.99	0.59	10.97	0.85	1.02	4.37
Functional Ability	38.05	2.32	42.65	1.78	4.60	7.01
Balance	34.05	2.58	38.80	1.64	4.75	6.93
P = <0.01						



The mean and standard deviation comparison between the groups in terms of kyphotic index is (Mean:11.99 & Standard deviation:0.59) in group A and (Mean:10.97 & Standard deviation:0.85) in group B, in terms of functional ability is (Mean:38.05 & Standard deviation:2.32) in group A and (Mean:42.65 & Standard deviation:1.78) in group B and in terms of balance is (Mean:34.05 & Standard deviation:2.58) in group A and (Mean:38.80 & Standard deviation:1.64) in group B. ($p<0.01$)

From statistical analysis made with the quantitative data revealed that there is statistically significant difference in one parameter between pre-test and post-test values of functional corrective exercise with muscle energy technique group and kinesiotaping with muscle energy technique group.

Descriptive statistical comparison within the groups revealed that there was a significant difference between the pre- treatment and post-treatment values in group A & group B (functional corrective exercise) for kyphotic index range (mean difference: 1.02) and functional ability (mean difference: 4.60) and balance (mean difference: 4.75).

The Comparison between the groups revealed that there were significant differences between the means of the two groups, the results interpreted significant improvement in the functional ability, balance in group A (functional corrective exercise with muscle energy technique) whereas kyphotic index showed improvement in group B (kinesiotaping with muscle energy technique).

V. Discussion

This study is aimed to compare the effectiveness of functional corrective exercise with muscle energy technique and kinesiotaping with muscle energy technique in terms of kyphotic index, functional ability and balance in thoracic hyperkyphosis. The result of this study illustrated that improvement is significantly greater

in group A who received functional corrective exercises along with muscle energy technique than group B who received kinesiotaping along with muscle energy technique.

The improvement in the corrective exercise group was previously reported in a double blinded clinical trial by Hyun Jeong Jang et al.,[7] where an intensive care program focusing on thoracic mobility, stability, posture and respiratory function for a period of 8 weeks among elder women with osteoporosis were beneficial. Other researchers emphasized the fact that strengthening the thoracic extensor and scapular retractor muscles as well as stretching pectoralis muscles through flexibility exercises can improve hyperkyphosis.

Indeed, we have also included pectoralis muscle stretching exercises in our program. Besides, it was shown that prone arm abduction and shoulder flexion can increase muscle activity of the middle and lower parts of trapezius muscle, which are weakened in subjects with hyperkyphosis. However, this present study implemented a 6-week exercise program focussing on mobility was still proven to be effective but this effect might be considered as short term due to lack of long-term follow-up.

The kinesiotape is claimed to have positive effects on muscle activation, joint repositioning, circulation of blood and lymph, and pain. Restoration of correct muscle function by supporting weakened muscles, correction of misalignment by reducing muscle spasm, removal of lymphatic fluid hemorrhage under the skin through enhanced local circulation, reduction of pain through stimulation of sensory afferents are the proposed mechanisms of action postulated by the manufacturer and some researchers. The results of the present study goes in line with the above statement and also additionally demonstrated a statistically significant effect on kyphotic index, balance and functional ability. Significant effect of the kyphotic index was demonstrated, while little effects were observed on the functional ability and balance.

Faith cavus et al.,[18] conducted 6-week kinesiotaping application with and without exercise protocol and resulted that kinesiotaping had positive results in terms of decreasing thoracic kyphosis and recommends the use of kinesiotaping with other treatment protocols in the management of increased thoracic kyphosis. In our study kinesiotaping was applied three times, each remaining for 5 days. Whereas other researchers applied kinesiotaping for 1 month. However, to clearly elucidate these positive effects, more research is needed on the duration of tape application. Manual therapy has been recommended to reduce and prevent musculoskeletal problems related to thoracic hyperkyphosis. Thoracic hyperkyphosis involves excessive thoracic flexion, with the facet joints gliding forward and upward. Therefore, posteroanterior mobilization reduces the kyphosis angle by restoring normal segment mobility. A randomized clinical trial by Fahimeh Kamali et al.,[19] compared the manual therapy and exercise therapy for postural hyperkyphosis, and concluded that both the exercise and manual therapy were effective in reducing thoracic kyphosis angle and increasing back extensor muscle strength in women with postural hyperkyphosis.

The findings of the current study reinforce the evidence that both thoracic corrective exercise and kinesiotaping may improve thoracic curve index, balance and functional ability among hyperkyphosis.

VI. Limitations

- Primary limitation of the study was the low number of participants.
- The follow up phase is not intent.

VII. Recommendations

- Designing a follow up phase with the intent of observing the incidence of recurrence of kyphosis may shed more light on the sustainability of the effects of functional corrective exercise in the management of thoracic hyperkyphosis.
- Another study could include the assessment of range of motion in the management of thoracic hyperkyphosis.
- Additional studies are required to determine the isolated effect of functional corrective exercise

VIII. Conclusion

In the present study, it is concluded that both functional corrective exercise and kinesiotaping had positive results in terms of decreasing kyphosis and increasing functional ability and balance. Whereas on comparing the both, functional corrective exercise showed definite improvement in increasing functional ability and balance.Hence we are of the opinion that it will be beneficial to incorporate functional corrective exercise along with muscle energy technique in the management of thoracic hyperkyphosis in the clinical regular practice.

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