



Intervention To Improve Thoracic Kyphosis

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ABSTRACT: Excessive or reduced thoracic kyphosis can contribute to back pain, muscle fatigue, limited mobility, impaired balance, and postural dysfunction. This study explores innovative physiotherapeutic approaches aimed at improving the thoracic kyphotic angle. The study included 15 patients aged 19-30 years who had experienced back pain for at least 12 weeks and were not receiving treatment for this condition during the study period. Those whose symptoms were related to systemic diseases, significant motor impairments that would affect participation were excluded. Subjects completed a Gyrotonic exercise program focused on thoracic mobility, trunk stability, and postural control. The intervention lasted 12 weeks and consisted of three sessions per week. Each session lasted 50-60 minutes and was supervised by a certified physiotherapist. Thoracic kyphosis was assessed pre- and post-intervention using the 4D DIERS non-invasive three-dimensional surface topography for metric system. After the 12-week Gyrotonic exercise program, participants approached the pre-specified ICT-ITL reference range of 44°–54°. The mean distance from decreased from 7.12° (SD = 2.68°) before the intervention to 1.31° (SD = 1.41°) after. The decrease was statistically significant (Wilcoxon signed-rank test, $W = 0.00$, $p < .001$), and 15 participants (41.2%) reached the reference range after treatment. Through controlled multidirectional movements, spinal extension, and coordinated breathing, the method can promote and improve postural stability. Gyrotonic exercises may be a valuable component of rehabilitation for postural deviations. Studies should include larger samples, control groups, and longer periods are recommended to confirm the stability and clinical relevance of the results.

KEYWORDS: thoracic kyphosis, Gyrotonic, postural control, physiotherapy

I. INTRODUCTION

The increasing prevalence of sedentary behaviour, prolonged sitting, and reduced physical activity associated with modern lifestyles has been linked to postural changes and a greater incidence of spinal discomfort [1]. A key structural component of the sagittal alignment of the spine is thoracic kyphosis, the natural posterior curvature of the thoracic spine. This curvature contributes to the distribution of mechanical loads throughout the vertebral column, supports upright posture, and helps maintain the body's centre of gravity within the base of support.

Thoracic kyphosis is a normal anatomical feature, an excessive curvature, commonly referred to as thoracic hyper kyphosis, can alter sagittal alignment and negatively affect movement and physical function. The degree of thoracic kyphosis varies depending on age, sex, spine morphology, body composition, habitual posture, physical activity, and the method used for measurement. Back pain is a common musculoskeletal condition that can significantly limit mobility, occupational performance, and daily functioning [2]. Thoracic kyphosis is the physiological posterior curvature of the thoracic spine in the sagittal plane. It contributes to spinal load distribution, control of upright posture, and the mechanical relationship between the thoracic spine, rib cage, cervical and lumbar regions, shoulder girdle, and pelvis.

Hyper kyphosis can result from structural changes, such as vertebral compression fractures, Scheuermann's disease, osteoporotic vertebral fractures, and degenerative changes, or from modifiable postural and neuromuscular factors. These may include reduced thoracic mobility, impaired postural control, weakness or reduced stability of the spinal extensor muscles, and prolonged flexed postures. It is important to note that pronounced hyper kyphosis does not always result from vertebral compression fractures, indicating that muscular, degenerative, and postural factors may also contribute to its development [3, 4].



Thoracic hyper kyphosis should be understood as more than an isolated change in vertebral curvature. It may involve interactions between spinal mobility, muscle performance, scapular positioning, respiratory mechanics, and habitual postural behaviour. In older populations, greater hyper kyphosis has been associated with reduced physical performance and limitations in activities of daily living [3]. Since the thoracic vertebrae articulates with the ribs, changes in thoracic posture may also affect rib cage mobility and respiratory mechanics. A pronounced or rigid kyphotic posture may limit thoracic expansion and reduce the mechanical efficiency of respiration.

Systematic reviews and meta-analyses indicate that structured exercise can reduce thoracic kyphosis, although the certainty of the evidence varies due to differences in participant characteristics, intervention duration, exercise content, measurement methods, and methodological quality [5]. A more recent review of exercise interventions in adolescents similarly reported improvements in thoracic kyphosis but highlighted considerable heterogeneity between the programs included [6]. Corrective interventions generally seek to improve thoracic extension mobility, spinal extensor performance, scapular control, and sagittal alignment awareness. Targeted spinal strengthening and postural training have been shown to improve outcomes related to kyphosis in controlled studies, although most of the evidence identified relates to conventional corrective exercise programs rather than the Gyrotonic method specifically [7].

The Gyrotonic method is a movement-based exercise approach that incorporates spinal extension, coordinated breathing, trunk stabilization, and multiplanar movement patterns. Sessions may include controlled flexion, extension, lateral flexion, rotation, and circular or spiral movements of the spine and shoulder girdle. These characteristics provide a reliable therapeutic basis for addressing factors associated with postural hyper kyphosis, particularly limited thoracic mobility, reduced postural control, and impaired trunk and shoulder girdle coordination. However, direct evidence regarding the effect of Gyrotonic® exercise on thoracic kyphosis remains limited.

Thoracic kyphosis can be assessed using radiographic and non-radiographic methods. Our study aimed to determine whether a 12-week Gyrotonic® exercise program shifted altered ICT-ITL angles toward the pre-specified reference range of 42°–55°. It was hypothesized that the distance from this range would decrease after the intervention.

II. METHODS

This pre–post intervention study evaluated the effects of a four-week Gyrotonic® exercise program on thoracic kyphosis. The primary objective was to determine whether the program moved the DIERS For metric 4D ICT–ITL angle toward the prespecified reference range.

Participants

The study included 15 participants aged 19–30 years with an altered thoracic kyphotic angle. Participants were recruited mostly as students University of Barleti and the treatment was done right there in the school clinics and fitness centres. The inclusion criteria were:

- No spinal surgery or acute spinal injury during the previous six months
 - No participation in another structured postural or spinal rehabilitation program during the study.
- Participants with structural scoliosis, symptomatic disc herniation, vertebral fractures, serious neurological conditions, or systemic musculoskeletal disorders were excluded.

Exercise intervention

Participants completed a four-week GYROTONIC® exercise program. The sessions were conducted three times per week, for a total of 12 sessions. Each session lasted approximately 50–60 minutes and was supervised by a certified GYROTONIC® practitioner. The program focused on improving thoracic mobility, strengthening the back and shoulder-girdle muscles, stretching shortened chest muscles, and increasing awareness of upright posture.

Session structure

1. Warm-up: 10 minutes: The warm-up prepared the spine and shoulder girdle for the main exercises and included:

- Controlled breathing exercises;
- Gentle shoulder movements;
- Scapular retraction and depression;
- Gentle thoracic rotation;
- Thoracic extension and spinal elongation; and
- Slow arch-and-curl movements.

2. Main exercise phase: 25–30 minutes: The main part of each session included;

- Arch-and-curl exercises to improve controlled movement of the thoracic spine;
- Thoracic extension exercises to encourage a more upright posture;
- Spinal-elongation exercises to reduce compression and improve postural alignment;

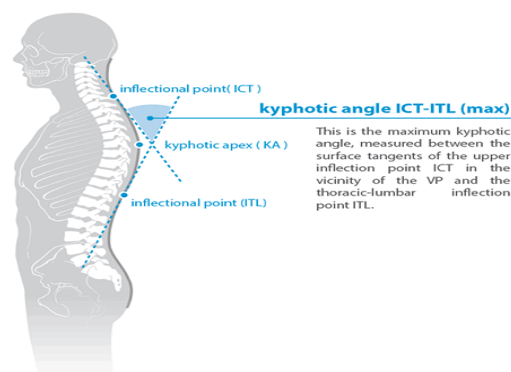


Circular and spiral spinal movements to improve thoracic mobility;
Scapular-retraction exercises to strengthen the muscles between the shoulder blades;
Shoulder-opening exercises to reduce rounded shoulder posture;
Chest and pectoral stretching to lengthen shortened anterior muscles;
Back-extensor strengthening exercises to improve the ability to maintain an upright trunk position;
Trunk-stabilization exercises to support spinal control; and
Breath-coordinated movements to improve rib-cage mobility and movement control.
3. Cool-down: approximately 5 minutes: The cool-down included;
Slow, controlled breathing;
Gentle stretching of the chest and shoulders;
Gentle thoracic mobility exercises;
Relaxed spinal elongation; and
Practice of an upright and comfortable standing posture.

The difficulty of the exercises gradually increased according to each participant's mobility, postural control, and tolerance. All exercises were performed slowly and within a comfortable, pain-free range.

Outcome measurement

The primary outcome was the thoracic kyphotic angle ICT–ITL, measured in degrees using the DIERS For metric 4D system. The DIERS For metric 4D is a non-invasive and radiation-free surface-topography system. It projects parallel light lines onto the participant's back and uses their deformation to create a three-dimensional representation of the trunk and estimate spinal alignment [8,9]. The ICT–ITL angle represents the thoracic curvature between the cervicothoracic transition point and the thoracolumbar transition point. It is a surface-topography measurement and is different from the Cobb angle measured using radiography.



Data collection

Measurements were performed twice:

- Before the first exercise session, at week 0; and
- After completion of the program, week 12.

The same DIERS equipment, measurement procedure, and examiner were used during both assessments to improve consistency.

Data analysis

The participants' ICT–ITL angles before and after the intervention were compared. Descriptive statistics were used to summarize the measurements, and a paired statistical test was used to evaluate the change following the intervention. Statistical significance was set at $p < .05$.

Because some participants initially had a reduced kyphotic angle and others had an increased angle, improvement was defined as movement of the ICT–ITL angle toward the study's prespecified reference range of 41° – 44° , rather than only as a reduction in the angle.

III. RESULTS AND DISCUSSION

All participants showed improvement, defined as movement of the ICT–ITL angle toward the prespecified reference range of 41° – 44° . Before treatment, 10 participants had angles below the reference range and seven had angles above it; none were within the reference range. After treatment, 5 participants (43.3%) were within the reference range, 14 remained slightly below it, and only one remained above it. The mean distance from the reference range decreased from 8.10° ($SD = 2.89^{\circ}$) before treatment to 1.33° ($SD = 1.45^{\circ}$) after treatment. This reduction was statistically significant using the paired Wilcoxon signed-rank test ($p < .001$). The average



improvement toward the reference range was 6.77° (SD = 1.74°).

The findings demonstrate a consistent normalization of thoracic kyphosis following the intervention. Although not every participant reached the 41° – 44° reference range, all participants moved closer to it, and almost half achieved values within the range. The reduction in variability after treatment also indicates that participants' measurements became more concentrated around the reference values.

Table 1. Descriptive statistics for ICT–ITL angles

Measure	N	Mean	SD	Med	Min	Max
Before	15	39.53°	12.07°	34.00°	28°	65°
After	15	44.40°	6.62°	41.00°	37°	59°

The mean ICT–ITL angle increased from 39.53° before treatment to 44.40° after treatment. The standard deviation decreased from 12.07° to 6.62° , indicating that the post-treatment measurements were less dispersed and more concentrated around the prespecified reference range. However, the change in the raw means should be interpreted cautiously because the sample included participants with both reduced and increased initial angles.

Table 2. Distribution of ICT–ITL angles relative to the prespecified reference range

ICT–ITL classification	Before treatment, n (%)	After treatment, n (%)
Below 42°	23 (76.7%)	16 (53.3%)
Within 42° – 55°	0 (0.0%)	13 (43.3%)
Above 55°	7 (23.3%)	1 (3.3%)
Total	30 (100%)	30 (100%)

Table 3 Paired comparison of distance from the reference range

Comparison	Statistical test	Test statistic	p-value
Before vs. after treatment	Wilcoxon signed-rank test	$W = 0.00$	$< .001$

The Wilcoxon signed-rank test showed a statistically significant reduction in distance from the prespecified reference range ($W = 0.00$, $p < .001$). All participants improved according to this criterion; no participant was unchanged or moved farther from the range.

IV. CONCLUSION

These findings suggest that supervised Gyrotonic® exercise may be a useful short-term approach for improving thoracic alignment in individuals with either reduced or increased ICT–ITL angles. The program's emphasis on multidirectional spinal mobility, elongation, trunk stabilization, scapular control, and coordinated breathing provides a plausible basis for the observed change. This study examined the short-term effect of a four-week, 12-session Gyrotonic® exercise program on thoracic curvature in 15 adults aged 19–30 years with altered DIERS ICT–ITL angles. Following the intervention, every participant moved closer to the prespecified 41° – 44° reference range. The mean distance from the range decreased from 8.10° to 1.33° , representing an average improvement of 6.77° . Thirteen participants (43.3%) reached the reference range, and the paired analysis confirmed that the reduction in distance was statistically significant ($W = 0.00$, $p < .001$).

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