



Original Article

Comparison of the Efficiency of Two Taping Techniques in Reducing Thoracic Kyphosis among Girls Aged 18-30 Years

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ABSTRACT

Background: Kyphosis means an abnormal increase in the curvature of the thoracic region of the vertebral column and refers to a situation where the thoracic kyphosis range is more than forty five degrees. Vertebral column taping seems to be one of the most effective ways of treating kyphosis. The aim of this study was to investigate and compare the effect of two taping techniques in reducing the degree of kyphosis in girls aged 18-30 years.

Methods: Thirty-two volunteers were randomly assigned into two groups (n=19 per group) of V-shaped tape and I-shaped tape. Taping techniques were performed as follows by applying 50% tensile force: V-shaped tape: The tape started on both sides of the anterior of acromioclavicular joint and extended to the spinous process of T6 vertebra. I-shaped tape: The patient's body was kept in a standing and straight state and then a longitudinal tape was applied from T1 to the deepest lumbar lordosis region. The measurements were carried out before, immediately, 24, and 48 hours after taping by a flexible ruler in a similar manner. Data analysis was performed using Friedman Test, Kolmogorov-Smirnov Test, Wilcoxon Signed Rank Test and Mann Whitney Test.

Results: The results of this study showed a significant reduction in the degree of kyphosis in the case of the V-shaped tape 48 hours after taping. However, the degree of kyphosis decreased after 24 h (P=0.001) and 48 hours (P< 0001) in the I-shaped tape group. In addition, there was no significant difference between the two interventions in terms of decreasing the degree of kyphosis at any time interval except for 24 hours (P=0.043).

Conclusion: Taping reduces the degree of kyphosis by creating mechanical support, creating proprioceptive feedback, affecting the proprioception, improving the function of spinal erectors, and improving the mental image of the body with kyphosis. It appears that the I-shaped tape positioning on the alignment of spinal erectors spine makes it more effective.

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Introduction

Kyphosis or abnormal increase in the thoracic curvature refers to a situation where the thoracic kyphosis range is more than 45°. The scoliosis research society has reported the normal range of thoracic kyphosis as 20 to 45° in

adolescents [1, 2]. Kyphosis is one of the most common vertebral column deformities, with a prevalence rate of 13.2% among Iranian adolescents and 15.3% in Western articles [1]. This complication is observed for various reasons such as congenital anomalies, neuromuscular, inflammatory diseases, Scheuermann's disease, and postural causes [1, 2]. Other causes of kyphosis include improper postural habits, trauma, developmental disorders, degenerative diseases, neurofibromatosis,

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connective tissue disorders, muscular dystrophy, spina bifida, endocrine diseases, Paget's disease, poliomyelitis, and tumors [3]. Kyphosis is very dangerous in severe cases and can cause numerous complications and even death. Among such complications include forward head posture, shortness of breath, shortening of intercostal muscles, limitation of trunk rotation, nerve injury, and in severe cases, spinal cord compression, followed by injury, sensory-motor disorders, weakness of the vertebral column ligaments, causing painful points on the muscles, and a decrease in height caused by kyphosis [3]. These complications accelerate the process of degeneration and cause pain and functional impairment [1]. Also, the roundback appearance in these individuals leads to social isolation and failure to achieve their own interests. The suggested treatment strategies for kyphosis include the use of a variety of auxiliary devices such as a variety of corsets, techniques such as soft tissue mobilization, extension, stretching, exercises, and corrective exercises, and taping techniques [2]. Taping is currently one of the most useful tools for treating skeletal muscle lesions. Taping is a method of supporting injured structures, limiting individual movements, and creating painless functional activities [4], protecting ligaments, tendons and muscles, limiting unwanted joints movements [5], creating proprioceptive feedback, and increasing individuals awareness of their postural positions to prevent flexor posture [2, 6] and ultimately a non-invasive and low-cost method as compared to dangerous, costly, and time-consuming procedures such as surgery, and the use of different braces. Results of a study on the effect of scapula taping on the electromyographic activity of muscles during the performance of 8 professional violinists revealed that the scapula taping was helpful in improving the pattern of muscle activity. The use of taping also reduced the pain of the samples and increased the electromyographic activity of the upper trapezius muscle, and ultimately the person felt better support [7]. Results of another study, which investigated the effect of postural taping on the thoracic kyphosis, indicated that postural taping had a significant effect on the reduction of the thoracic kyphosis and postural taping subjects showed a more significant decrease in the degree of the thoracic kyphosis compared to the other two groups [6]. A study was conducted to determine the effect of physiotherapy program, including exercise and manual treatments (massage, mobilization, and taping) on reducing the degree of kyphosis and improving physical performance and quality of life in patients with osteoporosis and a history of vertebral fracture. There was a significant pain reduction and a clear improvement in the performance and quality of life in the intervention group as compared to the control group [8]. A study was also carried out to investigate the effect of rehabilitation on decreasing the degree of kyphosis in female elderly patients with osteoporosis. This research showed that the three-month rehab program, including manual mobilization, taping, and therapeutic exercises, reduces the degree of thoracic kyphosis in female elderly patients with osteoporosis

[9]. Results of another study that aimed to investigate the effect of kinesiology tape and stretching exercises on the forward shoulder angle in women with rounded shoulders demonstrated that the forward shoulder angle was significantly decreased in the taping + stretching exercises group [10]. Kyphosis occurs at different ages and for different causes, and different therapeutic methods are used for these patients. Previous studies have shown that the use of taping has been effective in the elderly with kyphosis [9], but few studies have examined the effect of this method on reducing the degree of kyphosis among adolescents. Previous studies have also demonstrated that the use of different taping methods, as a complementary therapy, can be effective in improving patients with kyphosis [10], but they did not specify the advantage or priority of any taping method. Considering that taping is a kind of non-invasive treatment and is well tolerated by patients, this method alone may lead to reduction in the degree of kyphosis in young people. Also, choosing a more appropriate taping method can reduce costs and improve the patient's recovery time. Therefore, the present research was conducted to determine the effect of taping techniques on decreasing the degree of kyphosis in girls aged 18-30 years.

Methods

This research was conducted on girls aged 18-30 years old as a clinical trial. Inclusion criterion included the presence of the degree of thoracic kyphosis of above forty five degrees and exclusion criteria included endocrine disorders, developmental disorders, trauma, spinal surgical procedures, and the use of medication, brace, and exercise. Individuals were selected randomly and voluntarily and the sample size was 32 individuals. After completing the consent form for participation in the project, being aware of the research procedure, and meeting the inclusion criteria, the subjects were included in the study. The data collection method included an information gathering form (including demographic characteristics and degree of kyphosis), and two taping techniques. The tape material used in this research is kinsio tape, made by a Korean Towatek company, which was stretched by applying 50% force. The tape was applied by a physiotherapist and measurements were done by another physiotherapist (double blind). The degree of kyphosis in the subjects was measured before taping using a flexible ruler. Subjects were randomly divided into two groups (n=16 per group) V-shaped tape and I-shaped tape. The two groups were evaluated after taping in three steps (immediately, 24 hours, and 48 hours after taping). The taping methods employed in the present research were as follows:

V-Shaped Tape

In this method, the tape started from the anterior part of the acromioclavicular joint and traversed the bulk of upper trapezius muscle and extended to the spinous process of T6 vertebra. This procedure was carried out on both the left and right sides (Figure 1) [6].



Figure 1: V-shaped tape



Figure 2: I-shaped tape

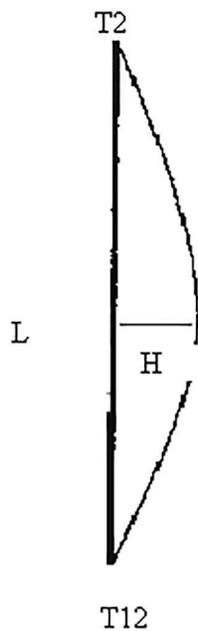


Figure 3: Curvature of kyphosis region

I-Shaped Tape

In this method, the patient was first told to keep her body in a standing and straight position. Then, a longitudinal tape was applied from the spinous process of T1 to the deepest region of the lumbar lordosis (Figure 2) [9]. Each taping technique lasted for 48 hours and the

measurement was then performed before, immediately, 24, and 48 hours after taping using a flexible ruler in a similar manner. The flexible ruler was made of special metal (60 cm in length), and covered with plastic. This device can change into different shapes and keeps its shape for a while. The validity and reliability of this device have been examined and proven in previous studies [1, 11, 12]. First, the degree of the thoracic kyphosis of the vertebral column between the spinous process of T2 to T-12 was measured using the flexible ruler. To this end, samples stood while maintaining 15 cm distance between the two (naked) feet. The hands were placed ninety degrees and perpendicular to the trunk and the person was asked to look at a point on the wall and place him/herself in a comfortable posture while distributing his/her weight evenly on two legs. The flexible ruler was then placed on the marked points and a mark was then placed on the ruler in accordance with these points. The same force was then applied along the ruler so that there is no space between the ruler and the volunteer's skin, and the ruler's shape becomes changed into the thoracic arch. The ruler was then removed from the back of the volunteer, and the resulting arc was drawn on a millimeter paper without changing its shape [13-15]. When the curvature was drawn on the paper, a line called L was formed by connecting two ends of this curvature, the maximum distance between the curvature drawn and the Line L was called the Line H. Finally, the angle Θ , which represents the angle between the T12 and T2 vertebrae is calculated using the formula $\Theta=4 \times [\text{Arc tan}(2H/L)]$ [1, 16] (Figure 3). According to previous studies, the normal angle was considered to be 20-45° and an angle greater than 45° was considered as kyphosis [17-20]. Finally, data analysis was carried out using Friedman Test, Kolmogorov-Smirnov Test, Wilcoxon Signed Rank Test and Mann Whitney Test.

Results

The mean pre-taping degree of kyphosis in the V-shaped and I-shaped tape groups was 80.69 ± 16.962 and 82.50 ± 16.876 , respectively. There was no significant difference between the two groups in terms of mean pre-taping of the degree of kyphosis ($P=0.744$). Table 1 shows the reduction in the degree of kyphosis using V-shaped tape at different times. As can be seen, there is a significant decrease in the degree of kyphosis for V-shaped tape 48 hours after taping ($P=0.03$). Table 2 shows the reduction in the degree of kyphosis using I-shaped tape at different times. There is a significant decrease in the degree of kyphosis for I-shaped tape at 24 h ($P=0.001$) and 48 hours ($P<0.0001$) after taping. Table 3 illustrates the mean degree of kyphosis in both groups at different times and compares the two taping techniques. According to this table, the degree of kyphosis showed a higher reduction in the I-shaped tape group than the V-shaped tape group at all measurement times, but this difference was only significant at 24 hours after taping ($P=0.043$).

Table 1: Demographics of participants of the project

| Variable | V-Shape (Mean±SD) | I-Shape(Mean±SD) |
|-----------------------------|-------------------|------------------|
| Age (years) | 21.37±3.9 | 21.43±1.6 |
| Weight (kg) | 62.12±3.7 | 61.50±4.4 |
| Height (m) | 1.65±3.2 | 1.64±2.7 |
| Degree of kyphosis (degree) | 80.68±16.9 | 82.50±16.8 |

Table 2: Reducing degree of kyphosis using V-shaped tape at different times

| Time comparison Angle (degree) | Average difference | Standard deviation error | P value |
|----------------------------------------------------|--------------------|--------------------------|---------|
| Before taping and immediately after taping | 2.75 | 3.376 | 1 |
| Before taping and 24 hours after taping | 2.50 | 4.583 | 1 |
| Before taping and 48 hours after taping | 12.25 | 3.371 | 0.03 |
| Immediately after taping and 24 hours after taping | -0.25 | 4.770 | 1 |
| Immediately after taping and 48 hours after taping | 2.50 | 5.199 | 0.526 |
| 24 hours after taping and 48 hours after taping | 9.75 | 3.462 | 0.078 |

Table 3: Reducing degree of kyphosis using I-shaped tape at different times

| Time comparison Angle (degree) | Average difference | Standard deviation error | P value |
|----------------------------------------------------|--------------------|--------------------------|----------|
| Before taping and immediately after taping | 11.500 | 4.463 | 0.126 |
| Before taping and 24 hours after taping | 17.125 | 3.576 | 0.001 |
| Before taping and 48 hours after taping | 22.125 | 3.555 | P<0.0001 |
| Immediately after taping and 24 hours after taping | 5.625 | 3.000 | 0.482 |
| Immediately after taping and 48 hours after taping | 10.625 | 4.018 | 0.110 |
| 24 hours after taping and 48 hours after taping | 5.000 | 2.502 | 0.385 |

Table 4: Comparison of mean kyphosis in the two groups before and after taping

| Time comparison Angle (degree) | Average difference | Standard deviation error | P value |
|-----------------------------------|--------------------|--------------------------|---------|
| Before taping | 16.962±8069 | 16.786±82.50 | 0.744 |
| Immediately after taping | 17.864±77.94 | 21.756±71 | 0.332 |
| 24 hours after taping | 13.131±78.19 | 20.142±65.38 | 0.043 |
| 48 hours after taping | 14.587±68.44 | 15.288±60.38 | 0.130 |

Discussion

The degree of kyphosis was measured before, immediately, 24, and 48 hours after applying the V-shaped tape and it was found that the degree of kyphosis decreased at all post-taping measurement times as compared to the pre-taping phase, but this reduction was significant 48 hours after taping. The results of the present research were consistent with the results of a study (2008) aimed at investigating the effect of postural taping on thoracic kyphosis of 15 women with osteoporosis and history of vertebral fracture. The tape used in this research was V-shaped, which is used in the present study. The results of this study showed that postural taping had a significant effect on the reduction of thoracic kyphosis, and the use of the above tape on the thoracic vertebrae caused rapid reduction of the degree of kyphosis in women with osteoporosis. The researcher of the above study stated that the taping leads to a reduction in the degree of thoracic kyphosis due to passive support of the tape, active support due to muscle contraction, or the combination of both. Considering that the EMG findings proved that there is no change in muscle activity, it was concluded that the extension of the thoracic region occurred passively and resulted

from the mechanical support of the tape [6]. Results of comparing the present research with the above-mentioned study reveal a significant immediate effect of taping on reducing the degree of kyphosis among female elderly, which is not observed in the present study; although the mean degree of kyphosis decreased immediately after taping. The reason for this is the high degree of kyphosis in people with osteoporosis, and thus a better result has been obtained. Another study (in 2002) investigated the effect of scapula taping on electromyographic activity of muscles during the performance of 8 professional violinists. In this study, a similar V-shaped tape was used. The result of this study indicates that scapula taping is useful in improving the pattern of muscle activity. Taping also reduces the transmission of pain feeling and increases the activity of the upper trapezius muscle, and the individual thus feels better support. The results of this study also confirmed the effect of the taping on improving the mechanical support of the subjects [7]. In a study on the effect of using both taping techniques and stretching exercises in reducing the degree of thoracic kyphosis among 20 female students, Haji Bashi et al. (2014) suggested that the taping imposes stretching on tight structures around the shoulder and lengthens the length of the pectoralis

minor muscle by placing scapula bones in its correct location, and thus corrects the individual's posture. In fact, the taping led to the improvement of the kinematic status of the scapula bone. They said that scapular bones move to the anterior tilt during the exercise and at rest due to shortness of the pectoralis minor in people with kyphosis, and taping plays an effective role in reducing the degree of kyphosis by decreasing the rate of anterior tilt in the scapula bone through placing the pectoralis minor in its normal length during the daily activities and at rest [10]. Results of examining the effect of I-shaped tape demonstrated a decrease in the degree of kyphosis in all post-taping measurement times than the pre-taping time, and this decrease was significant 24 and 48 hours after taping. A study was conducted in 2010 to investigate the effect of rehabilitation on reducing the degree of kyphosis in elderly women with osteoporosis, and 48 postmenopausal women with osteoporosis were investigated within three months. The tape used in this research was I-shaped, which was also used in the present research. The results of the study showed that a three-month rehabilitation program reduces thoracic kyphosis in older women with osteoporosis [9]. The present research compared the degree of the thoracic kyphosis changes after applying two taping techniques immediately, 24, and 48 hours after the intervention. The results showed a higher decrease in the degree of kyphosis in I-shaped tape group in all measurement times as compared to the V-shaped tape group, but this difference was significant only after 24 hours after taping ($P=0.043$). So far, few studies have compared the two types of tapes and there is limited information about the effect of this technique; however, I-shape tape positioning on the origin of the spinal erectors seems to have a greater efficiency of this type of tape compared to the V-shaped tape because the spinal erectors are among the important muscles that affect the structural shape of the vertebral column. Results of a previous study (2011) which investigated the effect of taping on the spinal erectors confirmed the above justification; that is, kinesiology tape can help to increase joints stability, increase muscle strength, reduce pain, and improve postural alignment. The kinesiology tape increases tension and activates the mechanism of pain control by inducing stimulations during active movements. The elasticity of the above tape improves spinal erectors activity and increases trunk movements by strengthening weak muscle. It can also reduce the degree of kyphosis in people by affecting the strength and activity rate of the above muscles [21]. Muscles and collagen tissues are highly adaptable and research has shown that long-term low-force stretches affect these tissues more significantly than fast and short stretches. The taping maintains the proper alignment in the member, thereby introducing a long stretch in tough tissues. Also, taping also places short and overactive muscles on their taller direction, resulting in the displacement of the length-tension diagram to the left side. Furthermore, kinesiology tape reduces the force produced by the muscle by reducing the overlap between the actin and myosin strands [10].

Previous studies have shown that taping in a person with kyphosis increases his/her awareness of his/her posture by creating proprioceptive feedback and is considered as an effective method to prevent flexor posture [6, 22]. Taping stimulates the activity of the muscles of the back area, thereby reducing the amount of kyphosis and supporting the affected organ in a functional state [5]. Taping also increases the strength of weak muscle and increases its activity [18]. Additionally, taping corrects asymmetric joints by affecting the range of motion and reduces muscle spasm [23]. According to previous studies, any increase in sensory inputs through the reflex arc stimulates muscle contraction during functional activities. If strong muscles do not function properly at the right time with sufficient force, they will not be efficient enough. Therefore, this method is used to create the proper input during taping, so that the movement is carried out in an undesirable direction. Any increase in the inputs causes increased muscle activity by inducing tension and pressure on the tape, and thus the undesirable movement is controlled [24]. Since the kinesiology tape stimulates the skin receptors, it amplifies the signals of the peripheral fibers and inputs and thus kinesiology tape can influence the modulation of muscle activity through this mechanism. The above tape also improves the transmission of information about the condition and movements of the central nervous system organs by stimulating proprioceptive receptors in the skin, hence recovery can occur by modulation of muscle activity and improvement of proprioception [25].

Conclusion

The comparison of kyphosis in the adolescent by the two techniques of V-shaped tape and I-shaped tape showed that each technique could reduce the kyphosis 48 hours after taping, and I-shaped tape had a better effect on the kyphosis.

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