Clin Rheumatol (2011) 30:201–207
DOI 10.1007/s10067-010-1475-6

ORIGINAL ARTICLE

Kinesio taping compared to physical therapy modalities for the treatment of shoulder impingement syndrome

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Received: 9 March 2010 / Revised: 18 April 2010 / Accepted: 20 April 2010 / Published online: 30 April 2010

Abstract The purpose of this study was to determine and compare the efficacy of kinesio tape and physical therapy modalities in patients with shoulder impingement syndrome. Patients (n=55) were treated with kinesio tape (n=30) three times by intervals of 3 days or a daily program of local modalities (n=25) for 2 weeks. Response to treatment was evaluated with the Disability of Arm, Shoulder, and Hand scale. Patients were questioned for the night pain, daily pain, and pain with motion. Outcome measures except for the Disability of Arm, Shoulder, and Hand scale were assessed at baseline, first, and second weeks of the treatment. Disability of Arm, Shoulder, and Hand scale was evaluated only before and after the treatment. Disability of Arm, Shoulder, and Hand scale and visual analog scale scores decreased significantly in both treatment groups as compared with the baseline levels. The rest, night, and movement median pain scores of the kinesio taping (20, 40, and 50, respectively) group were statistically significantly lower (p values were 0.001, 0.01, and 0.001, respectively) at the first week examination as compared with the physical therapy group (50, 70, and 70, respectively). However, there was no significant difference in the same parameters between two groups at the second week (0.109, 0.07, and 0.218 for rest, night, and movement median pain scores, respectively). Disability of Arm, Shoulder, and Hand scale scores of the kinesio taping group were significantly lower at the second week as compared with the physical therapy group. No side effects were observed. Kinesio tape has been found to be more effective than the local modalities at the first week and was similarly effective at the second week of the treatment. Kinesio taping may be an alternative treatment option in the treatment of shoulder impingement syndrome especially when an immediate effect is needed.

Keywords Kinesio tape · Physical therapy · Rehabilitation · Shoulder · Shoulder impingement syndrome

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Introduction

Shoulder impingement has been defined as compression and mechanical abrasion of the rotator cuff structures as they pass beneath the coracoacromial arch during elevation of the arm [1, 2]. Multiple theories have been proposed to explain the primary etiology of shoulder impingement, including anatomic abnormalities of the coracoacromial arch or humeral head, "tension overload," ischemia, or degeneration of the rotator cuff tendons; and shoulder kinematic abnormalities [3]. Inflammation in the suprahumeral space, inhibition of the rotator cuff muscles, damage to the rotator cuff tendons, and altered kinematics are believed to exacerbate the condition [1, 3, 4]. Kinematic changes have been thought to be present in patients with impingement syndrome and to result in narrowing of the supraspinatus muscle outlet or suprahumeral space [3, 5, 6]. The vast majority of these cases are initially treated nonoperatively.

Fig. 1 Kinesio taping method

Conservative treatment of patients with impingement symptoms commonly includes exercise programs intended to restore "normal" kinematics or muscle activity patterns. The clinical efficacy of several different treatment regimens have been studied [7–10].

Altered function of lower trapezius and serratus anterior has been found to influence the scapular movement and associate with subsequently poor shoulder function and chronic impingement problems [11]. Cools et al. [12] and Ludewig and Cook [3] observed inhibition of the serratus anterior and lower trapezius and over activation of the upper trapezius muscle in the subjects with shoulder impingement syndrome. Most of the current rehabilitation protocols mainly emphasize the idea of the restoration of the scapular control [6, 13] and the role of various muscles among the subacromial space [14, 15].

Although the kinesio taping (KT) has been increasingly used in the rehabilitation protocols and prevention of sports injuries, there is no clear evidence regarding potential mechanisms underlying the beneficial effects of KT. One of the aims of KT techniques is to normalize the scapulohumeral rhythm by altering the scapular muscle activity and correcting abnormal scapular position. The activity of lower trapezius was found to be increased in the 60–30° arm lowering phase by KT as compared with the sham application in baseball players with shoulder impingement syndrome [16]. It has been proposed that the control of scapula and the shoulder could be provided by the constant proprioceptive feedback, alignment correction during dynamic movements with kinesio taping [13]. It has been shown that KT promotes the proximal stability of the scapula allowing free humeral movements without pain [17]. Kase described different types of taping methods like space correction or lymphatic correction which primarily aim to increase the subacromial space beside the control of the muscles stabilizing the scapula [18].

The purpose of this study was to compare the short-term effects of a therapeutic KT application on reducing pain and disability in subjects with shoulder pain (clinically diagnosed as subacromial impingement syndrome) as compared with the commonly used local modalities.

Patients and methods

After obtaining the approval of the local ethics committee and patients' written consents, patients presenting with shoulder pain indicating subacromial impingement syndrome (external impingement) between September 2006 and December 2008 were enrolled into the study. Inclusion criteria were described as: pain before 150° of active shoulder elevation in any plane, positive empty can test indicating the possible supraspinatus involvement, positive Hawkins–Kennedy test indicating possible external impingement, subjective complaint of difficulty performing activities of daily living, and age of 18-70 years. Exclusion criteria were intra-articular steroid injection, shoulder girdle fracture, glenohumeral dislocation/subluxation, acromioclavicular sprain, concomitant cervical symptoms consistent with radiculopathy, history of a shoulder surgery within the previous 12 weeks, or shoulder pain which lasted more than 6 months. Subjects were assigned

Table 1 Descriptive characteristics of the patients

	KT group		PT group	
	n	Mean±SD	*n*	Mean±SD
Age (years)	30	56.2±7.2	25	59.5±7.9
Duration of the pain (months)	30	6.3±4.3	25	7.2±4.9
DASH score (BT)	30	58.6±16.5	25	56.6±17.8
Rest pain (BT; VAS)	30	42.0±29.5	25	54.0±28.3
Night pain (BT; VAS)	30	72.0±23.8	25	74.4±28.7
Movement pain (BT; VAS)	30	83.0±17.7	25	86.0±17.6

KT kinesio taping, *PT* physical therapy, *SD* standard deviation, *BT* before the treatment, *VAS* visual analog scale, *DASH* Disability of Arm, Shoulder, and Hand scale

Table 2 DASH scores

	KT groups			PT group			
	n	Median (min–max)	IRQ	*n*	Median (min–max)	IRQ	*P* values
BT (DASH)	30	57.5 (26–99)[a]	50.3–70.3	25	56 (33–86)[a]	39.5–73.5	0.691
AT (DASH)	30	18 (10–90)[b]	17.8–32	25	31 (0–65)[b]	23–48	0.027

KT kinesio taping, *PT* physical therapy, *SD* standard deviation, *BT* before the treatment, *AT* after the treatment, *DASH* Disability of Arm, Shoulder, and Hand scale, *IRQ* interquartile range, *min* minimum, *max* maximum

$P<0.001$

[a] As compared with DASH scores after the treatment

[b] As compared with DASH scores of the other group

to two groups according to their date of admittance. The first consecutive 30 patients presenting with shoulder pain and meeting the inclusion criteria were enrolled into the physical therapy (PT) group, and the second consecutive 30 patients were enrolled into the KT group.

Kinesio taping method

The space and lymphatic correction techniques which were described by Kase were used [18]. The increased space is believed to reduce pressure by lifting the skin. By lymphatic correction technique, KT decreases the pressure under the KT strip that act as channels to direct the exudates to the nearest lymph duct. This technique also helps to maintain the scapulothoracic stability via the mechanical correction. We applied the taping to three muscles (supraspinatus, deltoideus, and teres minor). We started with the supraspinatus muscle which mainly provides scapular stability and placed the base of the strip 3 cm below the greater tubersity of the humerus with no tension. Then, the patient adducted the shoulder with lateral neck flexion to the opposite side. The rest of the strip was applied along the spinous process of the scapula with a relatively lighter tension which is described as 15–25% of the full stretch application (100%). Secondly, we applied the taping to the deltoideus muscle. The base of the Y-shaped strip was placed 3 cm below the deltoid tuberosity of the humerus without tension. Both anterior and posterior tails were applied with light (15–25%) tension. The anterior and posterior tails were placed along the outer borders of the anterior and posterior deltoid muscle, respectively, without tension. Lastly, we performed the taping of the teres minor muscle. The I-type strip was placed on the lower facet of the greater tuberosity of the humerus with no tension. Then, the patient abducted the shoulder in horizontal flexion with internal rotation. We placed the rest of the strip along the axillary border of the scapula with light (15–25%) tension [15] (Fig. 1).

Patients and treatment groups

Group 1 received a standardized intervention of therapeutic KT suggested by Kase et al. [18] in addition to the home exercise program (HEP). HEP consisted of isometric

Table 3 Pain scores [VAS] at night

	KT group			PT group			
	n	Median (min–max)	IRQ	*n*	Median (min–max)	IRQ	*P* values
BT (night pain)	30	80 (0–100)[a]	60–86.25	25	80 (0–100)[a]	60–100	0.451
1WAT (night pain)	30	40 (0–100)	17.5–50	25	70 (0–100)[b,d]	50–100[b]	0.01
2WAT (night pain)	30	20 (0–100)[c]	0–40	25	30 (0–70)[c]	0–50	0.07

KT kinesio taping, *PT* physical therapy, *BT* before the treatment, *1WAT* a week after treatment, *2WAT* 2 weeks after treatment, *IRQ* interquartile range, *min* minimum, *max* maximum

$P<0.05$

[a] As compared with the night pain 1 and 2 weeks after the treatment

[b] As compared with the night pain before the treatment and 2 weeks after the treatment

[c] As compared with the night pain before the treatment and a week after the treatment

[d] As compared with the night pain of the other group

Table 4 Pain scores [VAS] at rest

	KT group			PT group			
	n	Median (min–max)	IRQ	*n*	Median (min–max)	IRQ	*P* values
BT (rest pain)	30	42.5 (0–100)[a]	27.5–62.5	25	50 (0–100)[a]	40–80	0.108
1WAT (rest pain)	30	20 (0–70)[b]	0–50	25	50 (0–100)[b,d]	35–70	0.001
2WAT (rest pain)	30	0 (0–70)[c]	0–32.5	25	30 (0–70)[c]	0–40	0.109

KT kinesio taping, *PT* physical therapy, *SD* standard deviation, *BT* before the treatment, *1WAT* a week after the treatment, *2WAT* 2 weeks after the treatment

$P<0.001$

[a] As compared with the night pain 1 and 2 weeks after the treatment

[b] As compared with the night pain before the treatment and 2 weeks after the treatment

[c] As compared with the night pain before the treatment and a week after the treatment

[d] As compared to the movement pain of the other group

exercises, range of motion, strengthening (serratus anterior, trapezius, and external rotation) and stretching (posterior shoulder and pectoralis minor), and relaxation of the trapezius twice a day. A daily program of physical therapy modalities (ultrasound, transcutaneous electrical nerve stimulation (TENS), exercise, and hot pack) and the same HEP were used in group 2 for 2 weeks. Intermittent ultrasound of 1 MHz and 1 W/cm^2 for 5 min was used daily. TENS and hot pack were applied 20 min a day.

Outcome measures

The Disability of Arm, Shoulder, and Hand (DASH) scale [19, 20] and a 100-mm visual analog scale (VAS) was used to assess function and pain at night, rest, and with active movements including shoulder abduction, forward flexion, and internal and external rotations. The primary outcome was the DASH questionnaire. Pain scores were evaluated as secondary outcomes by means of visual analog scale. All measures were obtained at baseline, and at first (except for the DASH) and second weeks of the treatment. KT was performed by the first author, and the assessments were carried out by the first and second authors.

Statistical analysis

The minimum sample size required for 80% statistical power and 5% significance level was 22 for each group. Estimated power for 55 subjects was calculated as 90.7%. The effect size was calculated by the following formula: (mean post-intervention score−mean pre-intervention score)/standard deviation of pre-intervention score [21]. Small effects are considered greater than or equal to 0.20, moderate effects are considered greater than or equal to 0.50, and large effects are considered greater than or equal to 0.80 [21, 22]. All statistics were calculated by SPSS, Version 11.5 software (SPSS Inc, Chicago, IL, USA). Distribution-free non-parametric tests were used as there were non-normally distributed parameters. Mann–Whitney U test was used in the comparison of continuous and

Table 5 Pain scores [VAS] by movement

	KT group			PT group			
	n	Median (min–max)	IRQ	*n*	Median (min–max)	IRQ	*P* values
BT (movement pain)	30	90 (50–100)[a]	70–100	25	90 (30–100)[a]	75–100	0.445
1WAT (movement pain)	30	50 (0–100)[b]	27.50–60	25	70 (10–90)[b]	60–80	0.001
2WAT (movement pain)	30	30 (0–100)[c]	20–50	25	40 (0–80)[c]	30–55	0.218

KT kinesio taping, *PT* physical therapy, *SD* standard deviation, *BT* before the treatment, *1WAT* a week after the treatment, *2WAT* 2 weeks after the treatment, *IRQ* interquartile range, *min* minimum, *max* maximum

$P<0.001$

[a] As compared with the night pain 1 and 2 weeks after the treatment

[b] As compared with the night pain before the treatment and 2 weeks after the treatment

[c] As compared with the night pain before the treatment and a week after the treatment

ordinal data. Bonferroni-adjusted Friedman's rank test was used to compare the scores which were obtained before, after, and at the first week of the treatment. Wilcoxon signed-rank test was used to demonstrate which group differs from the others when there was significant difference with multiple group comparisons.

Results

We enrolled 60 subjects into the study. Demographic characteristics and baseline findings are shown in Table 1. There were no significant differences between two groups at baseline in terms of DASH and VAS scores which are presented in Table 1. No side effects were observed in any of the subjects during the treatment and follow-up periods.

Five subjects who did not comply with the treatment protocol were not included in the analysis. The five patients not included in the analysis were all from the PT group. On MRI, one subject had a concomitant anterior labral tear and underwent arthroscopic surgical repair. Three subjects had persistent pain which additionally needed injections for the myofascial trigger points. The fifth subject was excluded from the study as he did not participate in the program after the first week. No significant differences were found between the subjects who dropped out and the participants in terms of demographic findings and baseline data. The overall effect size was 1.69 for the DASH score, and 1.99 and 1.32 for KT and PT groups, respectively. DASH scores of the KT group were significantly lower in the control examination at the second week (Table 2). DASH and VAS scores at rest and night and by movements are demonstrated in Tables 3, 4, and 5. DASH and VAS scores decreased significantly in both treatment groups as compared with the baseline levels. The rest, night, and movement pain scores were significantly lower at the first week examination in relation to baseline. The rest, night, and movement median pain scores of the kinesio taping group were significantly lower (p values were 0.001, 0.01, and 0.001, respectively) at the first week examination as compared with the physical therapy group. However, there was no significant difference in the same parameters between two groups at the second week (Table 3, 4, and 5).

Discussion

Kinesio taping is a relatively new technique used in rehabilitation programs. Although it has been commonly used in orthopedic and sports settings, it is increasingly becoming an adjunct treatment option for the other musculoskeletal impairments. The purpose of this study was to compare the short-term efficacy of therapeutic KT application on reducing pain and disability in subjects with shoulder pain due to rotator cuff problems as compared with conventional physical therapy modalities. Various authors have previously reported improvements in function, pain, and range of motion (ROM) by KT [23–27].

Kinesio taping can improve the following musculoskeletal conditions: strengthen weakened muscles, control joint instability, assist the postural alignment, and relax the over-used muscles. KT is more elastic as compared with conventional tape forms. The primary goal of non-stretch rigid tape use is limiting unwanted joint movements or protecting and supporting the joint structure. However, Bragg et al. [28] showed that athletic tape loses its function to restrict joint motion after 15–20 min of exercise. Thelen et al. found that KT provides an immediate effect on the limitation of the active ROM, however, without any improvements in pain or disability scores among 42 subjects with rotator cuff tendonitis/impingement [29]. It was claimed that the effects of taping may be due to the sensorimotor and proprioceptive feedback mechanisms [30]. Taping provides immediate sensorimotor feedback, and patients often report symptom relief, improved comfort level, or stability of the involved joint. The elasticity of KT conforms to the body, allowing for movement.

Various taping approaches have been adapted to be used clinically for patients with shoulder problems. Taping is an adjunct treatment option during the rehabilitation program to enhance functional recovery. For the treatment of anterior shoulder impingement, taping was applied to provide proximal scapular stability. The application of the scapular taping used in conjunction with a home exercise program was shown to improve the shoulder pain and ROM [17].

Pain and disability measures, as a result of taping, were not different between groups in our study. Pain modulation via the gate control is one of the proposed theories as the tape stimulates neuromuscular pathways via increased afferent feedback [31]. Another explanation is that the improved motion due to an increased recruitment in the motor units of the supraspinatus muscle to perform the activity due to an increased proprioceptive stimulus. Frazier et al. found significant improvements in DASH scores and pain on five patients having various shoulder problems by KT and PT at the same time [23]. On the other hand, a recent study did not show any electromyographic evidence of increased muscular activity by taping [18]. Another study showed decreased upper trapezius and increased lower trapezius electromyographic activity in people with suspected shoulder impingement with scapular taping during functional overhead tasks and decreased upper trapezius activity during shoulder abduction in the scapular plane [32]. A more recent study compared the upper and lower trapezius muscles and

found altered activities with a higher ratio of upper trapezius to the lower trapezius activity in patients with symptomatic subacromial impingement syndrome as compared with healthy subjects. The taping induced a reduction in upper trapezius activity [33]. These findings are also emphasizing the role of muscle imbalance which should be implemented to the alternative treatment methods like KT as well as the exercises.

Although there was no significant difference between two groups with respect to baseline measures (p=0.108), the rest pain scores of patients in KT group before the treatment seem to be considerably lower than the PT group. We think that this may be related with the non-normal distribution of the data. Therefore, we believe that the use of non-parametric test is more reliable in these conditions.

There are some lacking points in our study. One of them is the absence of the sham application to compare with taping. Additionally, it would be better to use taping and physical therapy as a combination and compare with the other groups as well as the sham group. The lack of randomization and sequential allocation of patients are also other factors that weaken the power of this study. Another point is the possible existence of a drop out bias which may lead to over- or underestimation of our results. The assessment of possible differences in various factors like cultural, educational, and health status between the participants and subjects who dropped out was recommended [34]. Although we could not find any differences regarding demographic findings and baseline data, this is still a questionable issue.

We think that the immediate effect of KT may be considered as a very important advantage as compared with the local physical therapy modalities. This is also a favorable result which may increase the performance during exercise that is an indispensible step of the treatment process. The sudden effects may have been potentially due to KT, which reduces mechanical irritation of the involved soft tissue structures and reorients the shoulder movements through an arc of improved glenohumeral motion.

Another important practical difference of two treatment options is the duration and frequency of the application. Local modalities are usually performed daily for 2–4 weeks as we preferred in our study. However, KT is performed three times within the same period and showed similar effectiveness. Therefore, we may conclude that KT may be preferred as an alternative treatment option when an immediate effect by shorter application durations is needed. In addition, potential economic consequences between the two treatment programs due to various factors such as less frequent visits and shorter duration of therapy should also be considered. Although the second week results except for the DASH scores show no difference between groups, VAS scores of the KT are similarly lower than the PT group. However, the higher variability of the data at the second week control most likely led to these insignificant results. Therefore, it would have been more informative to evaluate the DASH scores at the first week in addition to the second week and to study on higher number of patients for longer periods of time.

Conclusion

Kinesio taping may be an alternative treatment option in the treatment of shoulder impingement syndrome especially when an immediate effect is needed.

Disclosures None

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