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Original Research Article

EFFECT OF TAPING ON SCAPULAR POSTURE AND SHOULDER RANGE OF MOTION IN SUBACROMIAL IMPINGEMENT SYNDROME

Hemali J. Gandhi [1], Bhavna Mhatre [2], Leena Chilgar [3], Amita Mehta [4].

[*1] P.T. School and Centre, Seth G.S Medical College, K.E.M Hospital, Parel, Mumbai, India.

[2] P.T. School and Centre, Seth G.S Medical College, K.E.M Hospital, Parel, Mumbai, India.

[3] P.T. School and Centre, Seth G.S Medical College, K.E.M Hospital, Parel, Mumbai, India.

[4] P.T. School and Centre, Seth G.S Medical College, K.E.M Hospital, Parel, Mumbai, India.

ABSTRACT

Background: Alteration in upper body posture is associated with shoulder impingement due to changes in scapular orientation, increased thoracic kyphosis and concomitant imbalance of glenohumeral and scapulothoracic muscles. Mechanical correction of scaular and thoracic posture can reduce impingement. Recently use of kinesiotapes has been increasingly popular. There have been some studies reporting the effect of kinesiotapes on muscle activation and pain reduction in subacromial impingement syndrome. Kinesiotapes can also be used to correct scapular and thoracic posture in Subacromial Impingement Syndrome.

Purpose of study: To study the effect of scapula and thoracic taping using kinesiotapes in addition of conventional treatment on scapular posture and shoulder range of motion in Subacromial Impingement Syndrome.

Materials and Methods: 60 subjects with Subacromial Impingement Syndrome were randomly assigned to two groups. Experimental group received scapula and thoracic taping using kinesiotape for 24hrs along with conventional physiotherapy treatment. Control group received conventional physiotherapy. Subjects were assessed pre, immediate post intervention and 24hr post intervention for scapular posture, shoulder range of motion and pain.

Results: Experimental group showed statistical significant improvement($p<0.001$) in scapular posture, shoulder range of motion and pain (on medial rotation, and reaching the back) scores both immediately and 24hour post intervention compared to control group. Also greater improvement was seen in pain and range of motion post 24 hour as compared to immediate post intervention in experimental group.

Conclusion: Taping as an adjunct to conventional treatment is much more effective for short term improvement in scapular postures, range of motion and reduction in pain as compared to only conventional treatment in subjects with Subacromial Impingement Syndrome.

KEY WORDS: Subacromial Impingement Syndrome, Kinesiotaping, Lateral Scapular Displacement, Forward Scapular Posture, Acromion-plinth Distance, Range of Motion.

Address for correspondence: Ms. Hemali J. Gandhi, (M.P.Th.), P.T. School and Centre, Seth G.S Medical College, K.E.M Hospital, Parel, Mumbai-400012, India. **E-Mail:** drhemaligandhi@gmail.com

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INTRODUCTION

Shoulder pain and associated movement dysfunctions are amongst the most common and debilitating musculoskeletal disorders. Of these subacromial impingement accounts for 44 to 65% of shoulder complains during physicians visit[1] eventually leading to functional loss and disability [1,2].

Subacromial impingement syndrome(SIS) as described by Neer is mechanical compression and irritation of rotator cuff, biceps tendon and subacromial bursa between coracoacromial arch and upper part of humerus (subacromial space) [3]. Alteration in upper body posture is associated with impingement due to changes in scapular orientation, increased forward head posture and thoracic kyphosis and concomitant imbalance of glenohumeral and scapulothoracic muscles [4]. Increase in scapular anterior tilt, greater scapular winging and elevation, increased scapular protraction [2] results in reduction in subacromial space as compared to retracted position [2]. Sahrmann observed that patients with chronically downwardly rotated scapular posture had insufficient scapular upward rotation during arm elevation resulting in SIS & pain [5].

Potential mechanisms that can alter the alignment of shoulder girdle include pain, tightness of soft tissue, imbalance in muscle activity, muscle fatigue and cervical and thoracic curves [5].

These postural kinematics and muscle changes directly or indirectly alter the subacromial space dimension and relationship to structures within subacromial space [2].

Pain, weakness and loss of motion are the most common symptoms reported by patients with SIS [3]. Its management typically includes posture correction, neuromuscular control via specific exercises, soft tissue release, joint mobilization, passive stretches and taping.

Kinesiotape is a thin, porous elastic cotton tape mimicking human skin with roughly same thickness and inherent elastic properties of epidermis. It is 100% latex free material with acrylic adhesive which is heat activated [6].

Some proposed benefits of elastic tape includes proprioceptive facilitation, muscle activation, reduce muscle fatigue,pain inhibition and enhance tissue healing, reduce edema and improve lymphatic drainage and blood flow [6-8].

There are several mechanism of action for these proposed benefits. One of those is correction of alignment mechanical correction of joint structure without limiting range of motion, facilitating joint movement and correcting alignment of weak muscles [6,8]. Additionally tape is claimed to lift skin, increase space below it increasing blood flow. This decreases interstitial pain by decreasing pressure on nociceptors, stimulates mechanoceptors and improves overall joint propioception [6,8]. Of available research into above claims Kaya [9] showed pain reduction and better outcomes in shoulder pain with kinesiotape. An electromyographic study on SIS found scapula taping to significantly reduce upper fibre muscle activity but not alter lower fibre of trapezius or serratus anterior muscle activity(Mike Smith) [10]. In contrast, Morin[11] found taping increased middle and lower trapezius activity during isometric contraction.

Over the past decade there have been some studies reporting the effect of kinesiotaping on muscle activation & neuromuscular facilitation, pain reduction and improvement is function in SIS. But very few studies have taken into consideration the alteration of scapular and thoracic posture, & the effect of 24hours taping on correction of these postures. Hence this study aims at studying application of kinesiotaping on mechanical correction of scapular & thoracic posture & thereby its effect on pain, and range of motion in subjects with SIS.

MATERIALS AND METHODS

Approval for study was taken from Committee for Academic Research Ethics. Patients with non-traumatic shoulder pain referred to physical therapy department participated in the study after obtaining written consent.

The inclusion Criteria for the participants were unilateral shoulder pain with acromion-plinth distance >2.5cm and having 3 or more of the following positive.

1. Pain on anterolateral aspect of shoulder.
2. Neer's Impingement test [12].
3. Hawkin Kennedy test [12].
4. Impingement syndrome test [13].
5. Kinetic Medial Rotation Test [14,15].
6. Empty can test [12]

Subjects with 1. Any traumatic, infective condition, adhesive capsulitis, Acromioclavicular joint pathology, shoulder instability, 2. Cervical pathology, 3.Known allergy to taping were excluded. Subjects were assessed for pain,

shoulder range of motion and scapular posture.

Visual Analog Scale (VAS) [16] was used to record subjects pain at rest, on internal rotation(most painful movement) and on reaching the back(most painful activity. Assessment of shoulder range of motion for flexion, abduction, internal rotation and external rotation was done using a universal goniometer in supine position [17].

For assessing resting position of scapula, non allergic adhesive markers 6 mm in diameter were placed at following anatomical points. i. Posterior aspect of acromion ii. Superior angle of scapula iii. Root of spine of scapula iv. Inferior angle of scapula v. Spinous process parallel to root of spine of scapula vi. Spinous process parallel to inferior angle of spine of scapula vii.C7 spinous process viii.T12 spinous process After placing the markers, following assessments were done.

Acromion-plinth distance(APD) [18] Subjects were asked to lie supine on a standard treatment table and adopt natural relaxed posture. As described by Sahrmann, subjects placed their arms by their sides with elbows flexed resting against the lateral wall of the abdomen and hands on the abdomen. This investigation involved measuring the linear distance from the treatment table to the posterior aspect of the acromion.

Subjects were instructed to stand with head facing forward, hands by the sides,shoulder, arms and lower extremities in relaxed position [4,19].

Lateral scapular displacement(LSD) was measured using a standard non stretch measuring tape. The measurement was the length between the posterior angle of acromion and spinous process corresponding with the root of the spine of scapulan[4,19].

To measure Forward shoulder posture(FSP) angle, a lateral photograph of the cervicothoracic region was taken using a Panasonic Lumix Vario camera at a distance of 1meter between the subject and the lens. FSP angle was measured from lateral view photograph of head and shoulder posture. The angle formed between the horizontal at 7th cervical spinous process and acromion was the FSP angle .This angle was measured using the angular measurements of MB ruler software (developed by Mark Brager) [4,19].

Following baseline examination, 60 subjects were randomly allocated into 2 groups, experimental group and control group using computer generated randomized table. Experimental group received scapula and thoracic taping(along with conventional treatment) while control group received conventional treatment.

Taping Technique for experimental group: Subjects were asked to sit on a stool and straighten from their back as much as possible.(Extend the thoracic spine actively). Kinesiotapes were applied bilaterally with 75-80% stretch parallel to T1-T12 spinous process. Subjects were then asked to posteriorly tip and depress the scapula. Tape was then applied from coracoid process to T12 spinous process diagonally. Kinesio tapes were removed the next day (after 24 hrs).

Conventional treatment consisted of ultrasound (dosage as per severity and irritability) [20], muscle energy technique for pectoralis minor [21], rotator cuff activation, scapular stabilizer activation for middle trapezius [22]. lower trapezius and serratus anterior [22] and range of motion exercises for flexion, abduction and rotation.

Subjects were re-evaluated – immediately post treatment and 24hrs post treatment for Scapular Posture- (APD,LSD and FSP) , Range of Motion- (Flexion, Abduction, Internal Rotation, External Rotation) and Pain(at rest, on medial rotation and on reaching the back).

Fig. 1: Acromion-plinth Distance- the linear distance from the treatment table to the posterior aspect of the acromion.

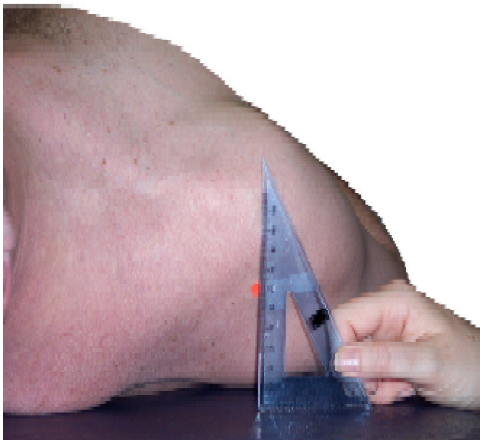

Fig. 2: Lateral Scapular Displacement- the length between the posterior angle of acromion and spinous process corresponding with the root of the spine of scapula.

Fig. 3: Forward Shoulder Posture- The angle formed between the horizontal at 7th cervical spinous process and the line joining acromion and 7th cervical spinous process.

Fig. 4: Scapular and Thoracic Tape Application- Subjects were asked to extend the thoracic spine actively and kinesiotapes were applied bilaterally with 75-80% stretch parallel to 1st to 12th thoracic spine. Subjects were then asked to posteriorly tip and depress the scapula. Tape was then applied from coracoid process to T12 spinous process diagonally.

RESULTS

Statistical Analysis: The data was collected and analysed using SPSS software version 16.0. There was no statistical difference between the groups at baseline. The data was assessed for normality using Kolmogorov-Smirnov test. Scapular posture and pain passed the normality test in both group A and B. Thus, Paired t test was used for intra-group comparison and Un-paired t test for Inter-group comparison of mean. Wilcoxon test (Intragroup comparison of median) and Mann Whitney U test (Inter-group comparison of median) was used for analysing range of motion as it did not pass the normality test. The P value less than 0.05 was statistically taken as significant.

Pain and Scapular Posture in subjects receiving and not receiving kinesiotape: Paired t test results revealed that Group A showed statistically significant improvement ($p < 0.001$) in scapular posture and pain both immediate post intervention and 24 hour post intervention. The results of paired t test in Group B showed improvement in APD and pain immediate post intervention($p<0.001$) however no significant difference 24 hour post intervention(p-0.06). Also, there was no improvement in group B immediate post intervention for LSD(p-0.62) and FSP(0.06) and 24hour post intervention for LSD (p-0.85) and FSP(0.09).

Results of unpaired t test revealed that there was statistical significant difference between the two groups with regards to scapular posture(APD, LSD and FSP) and pain(on medial rotation and reaching the back) indicating that subjects receiving kinesio taping(group A) exhibited better improvement in scapular posture and pain (except pain at rest), immediate post intervention and 24hours post intervention, compared to subjects receiving conventional treatment(group B). However no significant difference was observed in pain at rest on VAS both immediate post intervention and post 24 hour intervention in between the groups.(table1)

Range of Motion in subjects receiving and not receiving kinesiotape: Wilcoxon test results revealed that Group A showed statistically significant improvement ($p < 0.001$) in range of motion both immediate post intervention and 24 hour post intervention. The results of Wilcoxon test in Group B showed improvement in ROM immediate post intervention($p<0.001$) however there was no significant difference 24 hour post

Table 1: Statistical analysis of intergroup comparison of scapular posture, range of motion and pain.

Intergroup Comparison of Mean using Unpaired-t test							
		Pre-Immediate Post Mean			Pre-Post 24 hours Mean		
		Group A	Group B	p-value	Group A	Group B	p-value
Scapula Posture	APD	0.93	0.57	<0.0001	0.29	0.09	<0.0001
	LSD	1.25	0.44	<0.0001	1.03	0.24	<0.0001
	FSP	5.94	0.63	<0.0001	5.08	0.17	<0.0001
Pain	At rest	0.3	0.17	0.63	0.33	0.2	0.81
	On medial rotation	2.13	1.03	<0.0001	2.7	0.9	<0.0001
	On reaching back	2.37	1	<0.0001	3.17	0.93	<0.0001
Intergroup Comparision of Median using Mannwhitney test							
		Pre-Immediate Post Median			Pre-Post 24 hours Median		
		Group A	Group B	p-value	Group A	Group B	p-value
Range of Motion	Flexion	20(10,40)	10(0,20)	<0.001	30(10,40)	5(0,10)	<0.001
	Abduction	20(10,40)	5(0,10)	<0.001	25(10,40)	0(0,10)	<0.001
	Internal Rotation	10(5,15)	5(0,10)	<0.001	15(5,25)	5(0,10)	<0.001
	External Rotation	10(0,20)	10(0,10)	<0.001	5(0,10)	0(0,10)	<0.001

intervention in flexion(p-0.08), abduction (p-0.18), internal rotation(p-0.06) and external rotation(p-0.06).

There was statistical significant improvement (p<0.001) in range of motion in group A immediate post intervention and 24 hour post intervention compared to group B as per the Mannwhitney test.(table1)

DISCUSSION

Scapular and thoracic taping showed statistically significant improvement in APD, LSD and FSP which is suggestive of improvement in the scapular posture with the scapula being less anteriorly tipped and internally rotated, less abducted, and reduced downward rotation of the scapula [4,18,19]. These results accord with Jeremy Lewis who found that changing posture using scapular and thoracic taping had an effect on all the components of posture including FSP and LSD as compared to when measured with placebo taping [4].

According to Sahrmann [5], APD exceeding 2.54cm is suggestive of anterior tilting of scapula and decreases length of pectoralis minor. However Jeremy Lewis [19] provided a contradictory finding with their results indicating mean APD to be 6cm, over twice the recommended distance. The mean pre-test values of acromion-plinth distance for group A(6.25cm) and group B(6.123cm) were in accord with the findings of Jeremy Lewis.

Alteration in thoracic and scapular posture changes the orientation of glenohumeral joint with the humeral head being anteriorly and superiorly migrated, and internally rotated. All these changes result in reduction in subacromial space [1]. Taping causes correction of resting position of scapula as well as proximal stability of scapula [23]. Improvement in scapular posture due to scapular and thoracic taping is in accord to the findings seen in LSD, FSP and APD. The correction of orientation of scapula and thereby humerus increases the subacromial space and reduces pressure on subacromial structures thus reducing pain [2,4]. Also there is improved clearance of humeral head during elevation thereby improving range on motion.

Group A showed statistically significant improvement (p<0.0001) in external rotation compared to group B. During abduction, humerus must externally rotate for the greater tubercle to clear the coracoacromial arch. Thus, improvement in abduction can be associated with improved external rotation range [7]. In a study, Thelen found that at day 1 post kinesiotape intervention the score for pain-free shoulder abduction ROM in the treatment group showed a significant improvement, when compared to the sham kinesiotape group [7].

Changes in the thoracic spine, position of scapula and thus glenoid fossa alters humeral alignment with humerus being anterior migrated and internally rotated along with tightness in

posterior capsule [24]. All these changes cause restriction in medial rotation. Myers found that glenohumeral internal rotation deficit was increased in individuals with impingement when matched with healthy individuals [25]. With improvement in the orientation of glenoid fossa, due to taping, there is centering of the humeral head in the glenoid which improves medial rotation.

During arm elevation in the sagital plane, tautness in anterior capsule and ligaments along with bony configuration of posterior aspect of glenoid fossa affects medial rotation [7]. Hence, improvement in medial rotation contributes to improvement in flexion. An additional theory is that fear of movement is associated with pain intensity and so kinesiotape on application reduces fear of movement by providing sensory feedback and thus increase range of motion [8].

Alteration in scapular posture in SIS is associated with active shortening and over-activity of upper-trapezius, levator scapulae, pectoralis major and minor muscles [1]. Taping can be one way to achieve low load, prolonged duration of stretching. Besides, Kinesio-tape also strengthens the weak muscle and realigns the tissues and fascia thereby normalising muscle tension [23]. According to O'donovan 1997 there was significant inhibitory effect on upper trapezius activity in relation to lower trapezius during elevation immediately post tape application [26]. The scapular taping is done such that it crosses across upper trapezius, runs along the line of action of middle and lower trapezius thereby inserting over the thoracic spine [27] thereby improving dynamic stability of scapula. In treatment of shoulder dysfunction, taping improves scapulo-humeral rhythm and joint position via neuromuscular control and proprioceptive mechanisms [26,28].

The information from mechanoreceptors is integrated with visual and vestibular input at all levels in the central nervous system to allow perception of position sense (static), kinesthesia (dynamic) and force detection. The tension in the tape when the arm is moved gives stimulus to the patient to correct the movement pattern. Over time with enough repetition and feedback, these patterns can become learned components of the motor engrams for given movements. This is effectively cutaneously mediated proprioceptive biofeedback [26]. Jiu-jenq Lin suggested that scapular tape affects the muscle activity through proprioception feedback [28].

Better reduction in pain seen in group A (on medial rotation and on reaching the back) can be attributed to Mechanical correction of scapula and raising skin and fascia thereby removing excessive fluid and inflammatory transudate[6]. Pain modulation also occurs via Gate Control Theory – the tension created by Kinesiotape stimulates the neuromuscular pathway by increasing the afferent feedback thereby blocking nerve fibers conducting nociceptors (Thelen, 2008) [7].

Pain at rest did not show statistically significant reduction in pain. Probable reason being 83.33% of subjects had no pain at rest in both the groups with small baseline values for both the groups (Group A-0.433, Group B-0.4). Hence even though there was reduction in pain in the remaining few subjects it could not be of statistical significance.

Though group A showed greater statistical improvement, the group receiving conventional treatment also showed improvement in pain (on medial rotation and reaching the back) and range of motion. This may be attributed to the non thermal (acoustic streaming, cavitation and micro massage), thermal or placebo effects of ultrasound [20,29] and rotator cuff and scapular stabilizer muscles activation with movement training using visual, tactile and verbal cues [30]. Improvement in pain and range seen in group A can also be attributed to above mentioned effects.

Jean Sebastian Roy showed that movement training with feedback led to immediate changes during arm movements with respect to shoulder pain and upper limb kinematic. However, one training session was not enough to bring permanent improvement with changes returning back to baseline post 24 hour of intervention [30]. This supports our findings that group B receiving conventional treatment showed immediate improvement in pain and range of motion but reduced 24hours post intervention. Thus we conclude that subjects receiving kinesiotape as an adjunct to conventional

treatment was more effective in improving pain, range of motion and scapular posture than the control group.

Clinical Application: Taping should be used in treatment of patients with subacromial impingement syndrome. Spine should also be taken into consideration while treating shoulder impingement.

CONCLUSION

Taping as an adjunct to conventional treatment was more effective in improving scapular posture, improving range of motion and reducing pain as compared to conventional treatment in subjects with subacromial impingement syndrome.

ABBREVATIONS

SIS- Subacromial Impingement Syndrome
APD- Acromion Plinth Distance
LSD- Lateral Scapular Displacement
FSP- Forward Shoulder Posture
VAS- Visual Analog Scale
ROM- Range of Motion

Conflicts of interest: None

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