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Effect of kinesiotaping as an adjunct to conventional exercises on shoulder pain, range of motion and disability in patients with subaromial impingement syndrome

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Abstract
Subacromial impingement syndrome is one of the most common form of shoulder pathology representing 44-65% of all shoulder problems which if left untreated could progress to stage III where tear of rotator cuff muscles occur. Conventional exercises and kinesiotaping individually are found to be effective in treatment of SAIS. But, the combined effect has not being studied much to see the effect on shoulder pain, range of motion and disability, thus giving inconsistent results.
Methodology: Ethical clearance was obtained. Informed consent was taken. 24 patients were randomly allocated using chit method into 2 groups-experimental and control (12 subjects in each group) according to inclusion and exclusion criteria. All subjects were assessed for shoulder range of motion using universal goniometer, shoulder disability using Disability of Arm, Shoulder and Hand (DASH) and pain using Visual Analogue Scale (VAS) on 1st day, at the end of 2nd week and at the end of 4th week. Experimental group received kinesiotaping and conventional exercises and control group received conventional exercises only.
Result: Parametric tests such as t test, Repeated Measures ANOVA Test was applied for the data which was normally distributed. Non parametric tests like Freidman and Mann Whitney U Test was applied for the data which was not normally distributed. There was a statistically significant improvement($p<0.001$) concluding that the experimental group was better than the control group in improving the active and passive shoulder ROM of flexion, abduction and internal rotation. Both the groups were effective in improving the active and passive shoulder external rotation ROM, VAS and DASH scores.
Conclusion: The study concluded that kinesiotaping as an adjunct to conventional exercises and conventional exercises alone, both are effective in reducing pain, improving the range of motion and decreasing disability at the end of 2nd week and 4th week. On comparing both the groups, statistically significant improvements were seen in the active and passive ROM of shoulder flexion, abduction and internal rotation in the experimental group and a carryover effect was seen at the end of 4th week. For VAS, DASH and active and passive ROM of external rotation, it was not statistically significant but clinically experimental group was more effective than the control group at the end of 4th week.

Keywords: impingement, shoulder pain, kinesiotaping, disability, range of motion

1. Introduction
Impingement syndrome is originally described by Neer as mechanical impingement of supraspinatus and long head of biceps tendon under the acromial arch [1]. It is characterized by pain which is aggravated with arm abduction (painful arc) and overhead activities, reduced active range of motion, functional loss and disability [2]. Lifetime prevalence of shoulder pain ranges from 7% to 36% of population [3]. Subacromial impingement syndrome is one of the most common form of shoulder pathology representing 44% to 65% of all shoulder problems [2, 4, 5, 6, 7].
Physiotherapy for subacromial impingement syndrome include strengthening exercises for rotator cuff and scapular stabilizers, stretching the posterior joint capsule, manipulative treatment, electrotherapeutic modalities like ultrasound therapy, laser therapy, extracorporeal shock wave therapy and taping [2, 8, 9]. Conventional exercises help improve the stability and mobility at the shoulder joint, reduce pain and disability and also improve the altered scapulo-humeral rhythm [8]. They also help in restoring the normal kinematics or muscle activity patterns [10].
Kinesiotaping now-a-days is also used in the treatment of subacromial impingement syndrome. Kinesiotaping was introduced by KenzoKase in 1980. It is an elastic, latex free, quick drying tape and is designed to resemble the properties of human skin [2, 11, 12]. The adhesive of kinesiotape is 100% acrylicand heat activated. It allows for evaporation and quick drying due to the presence of 100% cotton fibers, so it can be worn in the shower or pool without having to be reapplied. The prescribed wear time for one application is usually 3 to 4 days [13]. Taping has been used in patients with shoulder problems to control or support the movement [7, 11]. Kinesiotaping is considered to be effective in reducing pain, improving muscle function and joint proprioception and improving postural alignment by inducing proprioceptive feedback and modulating various physiological processes [3, 7, 11, 12, 14].
There are studies done to see the effect of conventional exercises on shoulder pain and range of motion in subacromial impingement syndrome. A few other authors have studied the effect of kinesiotaping on shoulder pain and disability. But, the combined effect of conventional exercises and kinesiotaping has not been studied much to see the effect on shoulder pain, range of motion and disability, thus giving inconsistent results. Thus, there is a need to investigate a combined effect in subacromial impingement syndrome and to see if there is an effect on shoulder pain, range of motionand disability at the 2nd week

and also if there is a carryover effect after 4weeks.

2. Materials and Methods

2.1 Materials

- Paper
- Pen
- Goniometer
- Treatment Table (Plinth)
- Kinesiotape
- Scissor

2.2 Methods

- Type of study design: Experimental
- Setting (location of study): Urban area; OPD setting
- Sample Size: 24 [Taking a standard deviation of 17.35 in one group and 17.87 in the other group to detect a difference of 21.96 at a significant level of 5% and power of 80%, the sample size required is 24. Statistical package used to calculate sample size was WinPepi (Version 11.38)].
- Sampling Technique: Purposive
- Duration of study: 1 year

2.3 Inclusion Criteria

- Stage II subacromial impingement (subacute) according to Neer's classification [1]
- Males and females in the age group of 20-40 years [1]
- Positive Neer's impingement test [11, 14, 15]
- Positive Hawkin's Kennedy test [11, 14, 15]
- Painful arc between 60-120 degrees [1, 4, 11]
- Subjects with forward shoulder posture [4]

2.4 Exclusion Criteria

- Recent fractures at or around shoulder (in the past 6 months) [14]
- Malunion, any deformity at or around the shoulder joint
- Congenital differences in the acromion eg hooked acromion
- History of shoulder dislocation [14]
- History of any shoulder surgeries [11, 14]
- Reproduction of shoulder pain with cervical movement [14]
- Traumatic rupture of rotator cuff muscles [11]
- Allergy to taping [12]
- Any Neurological involvement [14]

2.5 Procedure

In this experimental study, the purpose of the study and the procedure was submitted to the institutional ethical committee and university postgraduate academic committee and the permission was granted from the above-mentioned committees to commence this study. Subjects were assessed according to the inclusion and exclusion criteria, explained about the nature, purpose and procedure of the study and written consent was taken from the subjects who fulfilled the inclusion criteria. 24 patients gave consent. They were randomly allocated in two groups: Experimental Group and Control Group. All subjects were assessed for shoulder range of motion using Universal Goniometer, Shoulder disability was assessed using Disability of Arm, shoulder and Hand (DASH) Scale and pain was assessed on VAS. The assessed parameters were taken on 1st day, at the end of 2nd week and at the end of 4th week. Experimental group received kinesiotaping for supraspinatus, deltoid and a mechanical correction technique along with conventional exercises and Control Group received only conventional exercises. Treatment was given 3 days a week for a period of 2 weeks and home exercise protocol from 2nd to 4th week. Data was collected by single investigator using standardized proforma. Reassessment of shoulder pain, range of motion and disability was done after 2nd week and 4th week.

Intervention: Kinesiotaping [12]

Kinesiotape was applied for supraspinatus and deltoid muscle and mechanical correction technique was done.

1st strip: Was applied to supraspinatus muscle from insertion to origin. Base of Y strip was placed 2 inches below the greater tuberosity of humerus with no tension. Patient then was asked to move into shoulder adduction behind the back with lateral neck flexion to opposite side. Light tension (15-25% of available) or paper off tension was applied to the kinesio Y strip Superior tail of 1st strip was applied superior to spinous process of scapula, between upper and middle trapezius muscles and was ended at supraspinous fossa on superior medial border of scapula. The distal 1-2 inches of the tape was applied with no tension.

2nd strip: Was applied for deltoid muscle from insertion to origin. Base of the Y strip was placed 2 inches below deltoid tuberosity on the humerus with no tension. Both anterior and posterior tails were applied with light tension (1525% of available) or paper off tension. Shoulder was then be moved into abduction to 90 degrees, external rotation and horizontal extension. Anterior tail was applied along outer border of anterior deltoid to approximatelty AC joint. The last 2 inches of tape were applied without tension. The shoulder was then moved into horizontal flexion with internal rotation while maintaining abduction and posterior tail was applied along outer border of posterior deltoid to approximately AC joint. The last 2 inches of tape were applied without tension.

3rd strip: Was applied for mechanical correction with tension on base of the tape. Base of Y strip was placed on anterior aspect of shoulder in the area of coracoid process with no tension. Moderate to severe tension (50-75% of available) with inward pressure over approximately half of kinesio Y strip wasapplied. The patient was then moved into shoulder flexion with horizontal flexion. The tails of Y strip were applied in a splayed-out pattern to dissipate created force without tension. The tape was replaced after every 3 days for a period of 2 weeks

Conventional exercises

Sr No	Exercise	No.of reps	Progression	Frequency/week
1.	Posterior capsule stretch	30 sec hold, 3 reps	30 sec hold, 3 reps	3
2.	Closed chain stabilization exercises of glenohumeral joint i) Wall press (shoulder isometrics) - Flexion, extension, abduction, internal and	5 sec hold, 10 reps	10 sec hold, 15 reps	3

	external rotation			
3.	Open chain stabilization exercises of glenohumeral joint i) Shoulder flexion ii) Shoulder extension iii)Shoulder abduction iv) Shoulder medial and lateral rotation	10 reps	15 reps	3
4.	Scapular closed chain stabilization exercises i) Push up against wall ii) Seated dips iii) Protraction, retraction, elevation and depression against wall	10 reps	15 reps	3
5.	Scapular open chain exercises i) Lower trapezius ii) Rhomboids iii) Middle trapezius iv) Scapular retraction	10 reps	15 reps	3
6.	Active exercises i) Full can exercise ii) Shoulder lateral rotation iii) Shoulder medial rotation iv) Punching exercise	10 reps	10 sec hold, 15 reps	3

3. Results

Data analysis shows that experimental group has shown significant improvement in the active and passive ROM of flexion, abduction and internal rotation. Both, experimental and control groups were effective in improving active and passive ROM of shoulder external rotation, VAS and DASH scores.

Table 1: Change in score at 2 weeks and 4 weeks of Visual Analogue Scale (VAS)

	Group A	**Group B**
	Mean ± SD	Mean ± SD
Change in score at 2 weeks	44.16 ± 11.05	25.41 ± 5.17
Change in sore at 4 weeks	65.50 ± 10.18	47.00 ± 9.25
P value	p = 0.204	

Inference

In both the groups, the mean values increased at 2 weeks and 4 weeks. However, this change across time within the group was not statistically significant (p = 0.779). Also, when comparing the change between 2 groups, it was not statistically significant (p = 0.204). Although not statistically significant, but clinically, the experimental group showed better improvement than the control group at 2nd week and 4th week.

Table 2: Change in score at 2 weeks and 4 weeks of active and passive shoulder flexion, abduction and internal rotation range of motion (ROM)

	AROM shoulder flexion		**AROM shoulder IR**		**PROM shoulder flexion**			**AROM shoulder abduction**			**PROM shoulder abduction**			**PROM shoulder IR**		
	Group A	Group B	Group A	Group B	Group A	Group B		Group A	Group B		Group A	Group B		Group A	Group B	
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	P val	Mean ± SD	Mean ± SD	P val	Mean ± SD	Mean ± SD	P val	Mean ± SD	Mean ± SD	P val
Change in score at 2 weeks	42.50 ± 11.82	26.66 ± 10.48	14.66 ± 5.24	7.41 ± 5.83	42.16 ± 11.16	26.66 ± 10.20	0.00	44.25 ± 22.36	32.83 ± 7.66	0.065	45.16 ± 22.65	33.08 ± 7.63	0.065	14.66 ± 6.37	7.75 ± 5.75	0.015
Change in score at 4 weeks	71.16 ± 10.80	55.66 ± 15.37	23.33 ± 12.47	12.08 ± 8.41	71.00 ± 10.45	56.16 ± 15.18	0.014	77.83 ± 20.53	59.41 ± 12.92	0.009	77.08 ± 21.76	59.50 ± 12.21	0.015	23.08 ± 12.90	12.25 ± 8.23	0.040
P value	p = 0.010		p = 0.017													

Inference

The mean values of active and passive shoulder flexion, abduction, internal and external rotation ROM increased at 2 weeks and 4 weeks in both the groups. There was a statistically significant difference (p < 0.001) within the group for all the above-mentioned parameters within the group. When both the groups were compared, there was a statistically significant difference found for active ROM of shoulder flexion (p=0.010) and internal rotation (p= 0.017), passive ROM of shoulder flexion and IR at the end of 2 weeks (p= 0.006, p=0.015) and 4 weeks (p=0.014, p= 0.040) and active and passive ROM of shoulder abduction at the end of 4 weeks (p= 0.009, p=0.015). Active and passive shoulder external rotation ROM was statistically not significant between the groups but it showed clinical improvements at the end of 2nd and 4th week which suggests that both groups were effective.

Table 3: Change in score at 2 weeks and 4 weeks of Disability of arm, shoulder and hand (DASH) of experimental and control groups

	Group A	Group B
	Mean ± SD	Mean ± SD
Change in score at 2 weeks	25.55 ± 5.41	24.73 ± 8.38
Change in sore at 4 weeks	43.47 ± 11.04	38.96 ± 11.69
P value	p = 0.439	

Inference

The mean values of DASH increased at 2 weeks and 4 weeks in both the groups.. The improvement seen over time in both the groups was statistically significant ($p < 0.001$). When both the groups were compared, p= 0.439 which is considered as statistically not significant.

4. Discussion

The present study was carried out to see the effects of kinesiotaping as an adjunct to conventional exercises on shoulder pain, Range of motion (ROM) and disability. Pain was assessed using a 100 mm Visual Analogue Scale (VAS), Range of motion (ROM) was assessed using Universal Goniometer and Disability was assessed using Disability of Arm, Shoulder and Hand (DASH) questionnaire. In Subacromial Impingement Syndrome (SAIS), there is pain, reduced range of motion (ROM) and difficulty in performing functional activities.

Hassan Shakeri et al did a randomized clinical trial on therapeutic effect of kinesiotaping on Disability of Arm, Shoulder and Hand in patients with subacromial impingement syndrome. He found that there was a difference in the mean scores of DASH in both the experimental and control groups at the end of 1 week and it was statistically significant in the experimental group as compared to the control group. Thus, in our study we evaluated the patients at 2nd week to see if there was an effect of kinesiotape and conventional exercises and 4th week to see if there was a carryover effect [11].

According to Table 1, in the present study, pain relief which is obtained has been the result of additional benefit from kinesiotaping along with conventional exercises which works on the same principle that the body has healing mechanism. Kinesiotaping has expanding and contracting properties which provides sensory stimulation to various types of sensory receptors in the skin during movement [16, 17].

Mark Thelan et al in his study found that kinesiotaping activates skin receptors as well as proprioception in skin during movement which further activates the spinal inhibitory system through stimulation of touch receptors and activates descending inhibitory system to decrease pain via gate control theory which was proposed by Melzack and Wall and thus helps to reduce pain. As proposed by one of the Gate Control Theory, there is modulation of pain because the tape stimulates the neuromuscular pathways via the increased afferent feedback [13, 16].

Erkan Kaya et al applied kinesiotape over supraspinatus, teres minor and deltoid muscles using insertion to origin technique, in addition to a home exercise program in subacromial impingement syndrome. He found similar results in his study. The Visual Analogue Scale scores decreased in both the experimental and control groups but were not statistically significant between the two groups [10].

Cryotherapy when given acts like a vasoconstrictor and reduces the metabolic activity which helps in reducing inflammation. Cryotherapy also helps in increasing the pain threshold and thus allows for reduced pain which is associated with an acute injury and thus allows the shoulder joint to function normally throughout the range of movement of shoulder [18].

According to a study done by Erkan Kaya et al, where he compared the efficacy of kinesiotaping and physical therapy modalities in patients with subacromial impingement syndrome, he found similar results that DASH scores decreased significantly in both the groups as compared to baseline values. But, he did not find a significant difference between the groups at the end of 2nd week. He stated that the effects of taping were seen due to the immediate sensorimotor feedback mechanism which it provides and also due to the proprioceptive feedback mechanism. Also, kinesiotaping helps in controlling the joint instability, which helps in assisting the postural alignment and relaxing the overused muscles which further helps in improving function of the upper extremity [10].

In subacromial impingement syndrome (SAIS), there is reduction in the range of motion of the shoulder causing difficulty in carrying out activities of daily living. Table 2 to Table 13 illustrates the mean values of active and passive shoulder range of motion of flexion, abduction, internal and external rotation. Capsular stretching stimulates the synovial glands to produce liquid lubricant which facilitates the sliding movement of articular joints. It helps to reduce intra-articular pressure and facilitates the separation of adhered articular surfaces which helps to increase the range of motion of the shoulder joint [19].

The scapular stabilization exercises correct the abnormal scapular location and functional movement disorder and provides stability to the entire scapula [20]. Sean Williams et al conducted a meta-analysis in which he mentioned regarding the improvement in the range of motion after application of kinesiotape. There is a physiological increase in blood circulation in the region which is taped and this leads to an increase in the range of motion. Also, when kinesiotape is applied, it reduces the fear of movement (kinesiophobia) and thus helps in improving the range of motion. The author stated that kinesiotape has a small, immediate effect on pain free shoulder abduction range of motion but does not seem to have a beneficial long-term effect. Thus, between group no significant results have been found for active and passive shoulder external rotation ROM [21]. V. Rajalaxmi et al in his study found that the shoulder active range of motion score showed significant improvement in the post means but the experimental group was more effective than the control group which was consistent with our findings [3].

DrAjit Dabholkar et al did a study to find the effect of scapular strengthening on shoulder function and disability in shoulder impingement syndrome and found that there was a significant improvement in Visual Analogue Scale (VAS), Quick DASH and Patient Specific Functional Scale (PSFS). The scapular muscle strengthening helps in improving the disability and function by improving the stability at the scapulothoracic joint and dynamically positioning the glenoid so that efficient glenohumeral movements can occur.[22]

Thus, it was observed that kinesiotaping as an adjunct to conventional exercises and conventional exercises alone, both were effective in the treatment of subacromial impingement syndrome but better improvement was seen in the patients with kinesiotaping and conventional exercises (experimental) group clinically. Thus, by inhibiting the muscle over activation, kinesiotaping helps in relieving pain, improving the range of motion by increasing the tissue extensibility and thus leads to improved functional disability.

5. Conclusion

In the present study, we conclude that kinesiotaping as an adjunct to conventional exercises and conventional exercises alone, both are effective in reducing pain, improving the range of motion and decreasing disability at the end of 2nd week and 4th week.

On comparing both the groups, statistically significant improvements were seen in the active and passive ROM of shoulder flexion, abduction and internal rotation in the experimental group and a carryover effect was seen at the end of 4th week. For VAS, DASH and active and passive ROM of external rotation, it was not statistically significant but clinically experimental group was more effective than the control group at the end of 4th week.

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