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EFFECT OF POSTURAL CORRECTION WITH DIFFERENT TAPING MATERIALS ON SCAPULAR KINEMATICS AND MYOELECTRIC ACTIVITIES OF SCAPULAR ROTATORS IN SUBACROMIAL IMPINGEMENT SYNDROME: A RANDOMIZED PLACEBO-CONTROLLED TRIAL

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ABSTRACT

Background: Rigid and kinesio tapings are commonly used in the rehabilitation of subacromial impingement syndrome (SIS). Yet; the effect of postural correction with the two taping materials in SIS has not been extensively studied. The purpose of the study is to examine the effect of postural correction with two different taping materials on scapular kinematics and electromyography of scapular upward rotators in patients with SIS.

Methods: Twenty female patients with SIS participated in this study. Their age ranged from 30-60 years. Participants were randomly assigned into: Group I (Kinesio tape, n=10) and Group II (rigid tape, n=10). Thoracic and scapular taping with posture correction was applied to both groups. Scapular upward rotation at 0˚, 60˚, 90˚ and 120˚ of shoulder elevation and the activity level of the upper fibers of trapezius (UT), lower fibers of trapezius (LT) and serratus anterior (SA) muscles were measured before and immediately after taping application.

Results: Both taping materials significantly increased scapular upward rotation at 60°, 90° and 120° angles (P =.004, .002 and .047 respectively) after the application of tape as compared to the before. In addition, significantly greater muscle activity of the LT and SA muscles (P =.027 and 0.05 respectively) were demonstrated by the kinesio-taping group as compared to rigid taping group during real taping condition.

Conclusion: Both taping materials are effective in restoring scapular kinematics. Furthermore, kinesio taping has a facilitatory effect on the LT and SA muscles. Kinesio taping may be considered an alternative to rigid taping in patients with SIS.

Keywords: electromyography, subacromial impingement syndrome, scapular kinematics, serratus anterior, taping, trapezius.

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INTRODUCTION

Shoulder impingement syndrome (SIS) is the most widespread disorder of the shoulder [1], which is more common in the population between 40 and 50 years old. Consequently, SIS has a major socioeconomic burden [2]. SIS is a phenomenon of mechanical compression of the rotator cuff against the anterior under surface of the acromion and coracoacromial ligament particularly during arm elevation [3]. It is characterized by painful arc syndrome, limitation of active range of motion and loss of shoulder function [2].

Numerous scapular three-dimensional studies using surface markers and indwelling bone pins have been done in normal individuals. Based on their findings, normal individuals demonstrated a uniform pattern of scapular upward rotation, posterior tilting, and external rotation along with clavicular elevation and retraction during scapular plane elevation of the arm [4-9]. On contrary, patients with SIS showed reduced scapular upward rotation with increased scapular internal rotation [10,11] and less posterior scapular tilting in the symptomatic shoulders [12]. Furthermore, they had decreased scapular retraction [13] and increased anterior and superior translation of the humeral head [7]. Narrowing of the subacromial space secondary to aberrant scapular motion during dynamic movements has been suggested as a cause in the development of SIS [14,15].

Abnormal activation of the scapular muscle has been detected in patients with SIS and has been directly related to aberrant scapular kinematics [16]. Ludewing and Cook, 2000 [10], Seitz et al., 2011 [15] and Cools et al., 2003 [17] observed abnormal activation of scapular rotators in patients with SIS, in which the serratus anterior (SA) and lower trapezius (LT) are inhibited and the upper trapezius (UT) is over activated. Abnormal upper body posture and associated muscular imbalance have been proposed as one of the causative factors leading to SIS [18]. In spite of the adoption of posture-directed assessment and rehabilitation by many clinicians, the support of this practice is insufficient [18]. Thus, it would be beneficial to focus on rehabilitation protocols that aim toward restoration of normal scapular behavior and correction of faulty postures in SIS.

Taping is often used in post-traumatic management of shoulder problems as an adjunct to physical rehabilitation [18,19]. Two taping materials with different changeable properties have been commonly applied in shoulder rehabilitation; they include rigid [19-27] and elastic tape techniques [28-34]. Rigid tapes are structurally supportive, extremely rigid and highly adhesive [22], and has been suggested to aid in promoting proper alignment of the scapula [19] and improving posture in patients with SIS [18,23]. However, rigid tapes can be left for only a short period of time to avoid adhesive skin reaction [22].

Contrary to rigid tapes, Kinesio tape (KT) is an elastic tape that was considered to be therapeutic and, according to its originators, yields the following results: it allows better joint function by strengthening weak muscles, relieving muscle spasm and correcting mal-aligned joints. In addition, it enhances blood and lymph circulation by removing the accumulated tissue fluid or bleeding underneath the skin through muscular movement and it lessens pain through neurological suppression [28]. The effect of taping either elastic or rigid on electromyographic activities (EMG) of scapular muscles and on scapular kinematics has been studied previously. However, the effect of elastic taping aiming for postural correction and restoration of scapular kinematics in patients with SIS has not been studied before.

Thus, this study was designed to compare the effect of mechanical scapular correction with two different taping materials; rigid tape versus kinesio tape on scapular upward rotation and myoelectrical activities of the upward rotators of the scapula in patients with SIS.

MATERIALS AND METHODS

Participants' selection:

A single-blinded, randomized placebo-controlled study was conducted in the Motion Analysis Lab at the Faculty of Physical Therapy, Cairo University; Egypt. Twenty females with SIS participated in this study based on referred diagnosis from an Orthopedist who was responsible for evaluating and diagnosing the patients. Their age ranged from 30 to 60 years, their weight ranged from 70 to 100 kg and their height ranged from 155 to 169 cm. Patients with shoulder pain for more than one month were included if they showed positive signs in two or more of the following SIS tests: (1) the Neer and Walsh test, (2) the Hawkins-Kennedy test, (3) the presence of a painful arc between 60°-120° (4) Jobe's test (the empty can test) and (5) pain when palpating the greater tuberosity of the humerus. Patients were excluded if they had a history of shoulder dislocation, shoulder surgery, reproduction of shoulder pain with cervical movement, known allergies to taping or were athletes.

Instrumentation: A SPI digital protractor (inclinometer) (13-770-3SPI Electronic Protractor, China) was used to measure scapular upward rotation during static positions. The inclinometer is designed to measure the angles from a horizontal reference with a precision of 0.1°. As described by Johnson et al [35] a modified digital protractor with a bubble level was used to measure scapular upward rotation. This modification was done to keep the body of the device perpendicular to the horizontal plane and to avoid the anterior posterior rotation of the protractor about an axis parallel to the scapular spine aiming to decrease error in digital protractor [36], as well as two extension arms (10 cm each), were used to be in contact with the landmarks placed on the spine of the scapula. Two extension arms were attached to the bottom of the instrument. Each of them had soft end. The validity and reliability of digital protractor has been found to be good in comparison to an electromagnetic tracking system [35]. Myomonitor Wireless electromyography (EMG) system (DE 2.3 EMG sensor, Delsys, Inc., USA) with an inter-electrode distance of 1 cm was used for assessing the myoelectric activities of the UT, LT, and SA muscles.

Procedures of the study:

The study procedures were explained to the patients and they were asked to sign a consent form prior to their participation in the study, which was approved by the ethical committee of the Faculty of Physical Therapy, Cairo University. Using random number generator with an allocation ratio of 1:1, participants were randomly assigned into 2 equal groups; Group I (Kinesio tape) and Group II (rigid tape).

To mark a track for scapular plane elevation, adhesive tapes were put on the floor to align the frontal plane and at a 40° from the frontal plane (scapular plane). Then, patients were instructed to stand in a relaxed position next to a tape on the wall placed along the 40° angle tape line at an arm's distance from the patient. The tape on the wall was placed to confirm proper position of the patient's arm in the scapular plane during the trials.

Prior to the assessment of scapular upward rotation, each patient was asked to remove her shirts and wear gown during the study to allow observation of posterior thorax and application of the tape. The four testing positions: arm at rest, 60^0, 90° and 120^0 of humeral elevation in the scapular plane were chosen based on former research that used the digital protractor to measure scapular upward rotation [35,37].

Using a universal goniometer, the examiner moved the patient's arm to 60^0, 90^0, 120^0 of abduction in the scapular plane. Patients were instructed to keep their hands opened pointing their thumbs up [35]. For each of the three positions, a tape was placed across the tape on the wall representing the three measured positions, as level I, level II, or level III respectively. Consistency of arm angles was confirmed by tape marks. McQuade et al [38] suggested that scapulohumeral rhythm may be affected by the used plane of humeral elevation. In the current study, humeral elevation in the scapular plane was selected since it has been proposed to simulate a functional range of the arm.

The measurements of scapula upward rotation were carreied out with the patients standing in their normal relaxed posture. The procedure was familiarized before the outcomes were measured. The protractor was placed over the spine of scapula while the shoulder joint at rest to obtain the first measurement of scapular position. Then the patient was asked to abduct the shoulder in scapular plane to 60^0, 90° and 120^0 degrees, Figure (1). The command given was "Raise your arm outward to the level I, level II, or level III marks on the wall." The reading in protractor was noted at rest, 60^0, 90° and 120^0 of humeral elevation in the scapular plane. The protractor reading for each level was repeated three times and the average of the readings were taken for data analysis. A rest interval of 2 minutes was provided after each trial.

For EMG recording, patient's skin was cleaned with alcohol to remove skin debris. Surface EMG sensors were used for EMG recordings of the UT, LT, and SA muscles on the affected side. Sites of sensors placement were determined by using marker pen, and tape measurement [39]. The EMG sensors were self secured on the skin. For the UT muscle: While the arm being rested at the side of the body, the sensor was placed on a straight horizontal line midway between the spinous process of the seventh cervical vertebra and the lateral edge of the acromion process. For the LT muscle: While the shoulder was in maximum flexion, the EMG sensor was placed obliquely approximately 5 cm lateral to the spinous process, at the level of the inferior angle of the scapula. For the SA muscle: While the arm at 90 degrees of flexion, the EMG sensor was placed just lateral to the inferior angle of the scapula and anterior to the latissimus dorsi muscle. Correct positioning of EMG sensor for each muscle was ensured through palpation and manual resistance. The reference electrode was applied over the posterior distal ulna at the wrist of the extremity not being tested which is an electrically inactive area. After placing the EMG sensors, the reference voluntary contraction (RVC) tasks were carried out. The patient was asked to hold a 2Kg weight in the hand maintaing the arm for 5s in a 125°in the scaption plane. Three RVC were repeated with at least 1-min rest between each contraction. Normalization of EMG data of the dynamic trials in the scaption plane was done using the average EMG amplitude of RVC tasks [31,40,41]. EMG measures were recorded for UT, LT, and SA muscles before and after tape application.

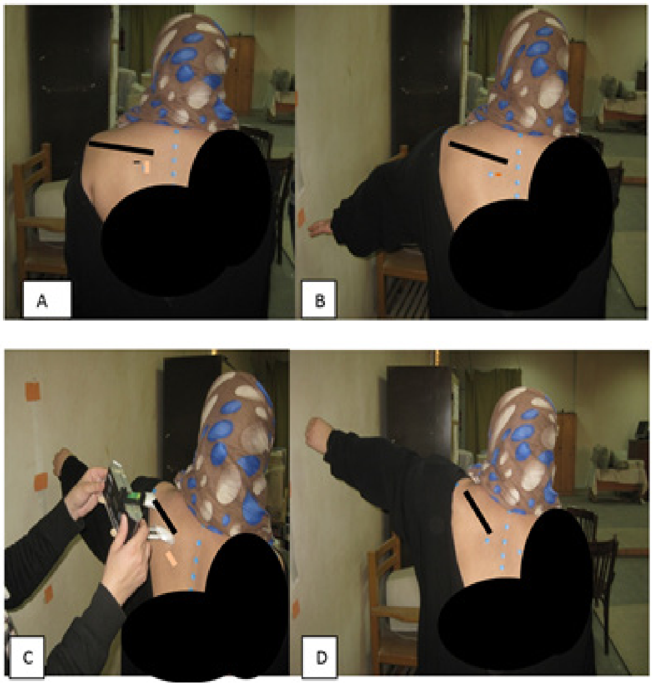


Figure 1: Measurement of scapular upward rotation with modified digital protractor: A) at rest (B) level I(60^0), (C) level II(90^0), (D) level III(120^0) of arm elevation in the scapular plane.

Based on the work done by Lewis et al [18] patients were instructed to extend their thoracic spine and fully retract and depress their scapula keeping their corrected posture. The movement was demonstrated to each patient and the patients were allowed to practice it once before the application of Kinesio Tape (5 cm in width,cotton ,porous ,adhesive and latex free elastic tape 3NSTex –Nst-05001) or Rigid Tape (Steroplast[R] Zinc Oxide adhesive Tape). 4 strips of I shaped tape were used. We applied the first and the second strips of the tape bilaterally from T1 to T12, and the third and the forth strips of the tape was applied diagonally from the center of the spine of the scapula to the T12 (Figure 2 and 3). The middle part of the KT was stretched maximally before being applied, and both ends attached to the skin without stretching of the tape.

Figure 2: Bilateral application of thoracic and scapular kinesio tape following postural correction.

Figure 3: Bilateral application of thoracic and scapular rigid tape following postural correction.

In addition to the aforementioned real tape condition, a placebo procedure was applied. It involved the application of placebo tape (Transpore[TM]1527-2M 5,0cm width) over the same locations as the real postural tape. During the application of placebo taping patients were instructed to assume their natural standing postures without trying to change posture at all [18]. The placebo taping wasn't pre-tensioned and was incorporated in the protocol to decide if the measured variables had changed due to postural correction and not due to another effect of the tape [18]. Scapular upward rotation angles at four position: arm at rest, 60°, 90° and 120° of humeral elevation in the scapular plane and EMG root mean square (RMS) of UT, LT and SA muscles of the affected side were obtaind before and after tape application (both real and placebo conditions) .

Data Analysis: Raw EMG was amplified (bandwidth = 20-450 Hz, CMRR>80 db at 60 Hz, input impedance = 10 GΩ) and collected with a sampling frequency of 1000 Hz using a 16-bit A/D card with a ±2.5 V rang. The root-mean-square (RMS) envelope of the EMG signal was calculated using a moving window with a window length of 0.125 s and window overlap of 0.0625 s.

Statistical Analysis: Data were presented as mean and standard deviation (SD) values. Data were explored for normality by checking data distribution, calculating mean and median values and finally using Kolmogorov-Smirnov and Shapiro-Wilk tests. Once data were found not to violate these assumptions, parametric analysis was conducted. SPSS (Inc, Chicago, IL) version 20 was used for statistical analysis. Rigid and Kinesio taping effects were tested for statistical significance using mixed-model 3 way MANOVA. Scapular upward rotation angles (at 0°, 60°, 90° and 120°) and RMS-EMG for scapular upward rotators (UT, LT and SA muscles) were analyzed for two taping conditions (placebo and real taping) across four time periods (within-subjects variables); with the study group introduced as between-subject variable. If a significant interaction was identified, pairwise comparisons were performed to examine differences between independent variables. The alpha level of significance was set at 0.05.

RESULTS

The unpaired t-tests revealed that there were no statistically significant differences in the mean age (*P* = 0.39), weight (*P* = .89) and height (*P* = .90) between both groups. The means (SD) of the EMG-RMS of scapular upward rotators and the upward rotation angle are shown in tables (1 and 2). Regarding the time-by-condition interaction, greater levels of mean scapular upward rotation at 60°, 90° and 120° angles (*P* =.004, .002 and .047 respectively) demonstrated after the real taping condition, compared to the placebo taping condition.

Table 1: Descriptive data of RMS-EMG of scapular upward rotators

Parameter	Time	Condition	Group	Mean± SD
UT	Pre	Placebo	v	.978 ±.22
			II	.904 ± .316
		Real	I	.960 ± .46
			II	.827 ± .46
	Post	Placebo	I	.906 ± .24
			II	.684 ± .26
		Real	I	.906 ± .20
			II	.784 ± .30
LT	Pre	Placebo	I	.95 ± .56
			II	.69 ± .21
		Real	I	.89 ± 1.06
			II	.56 ± .14
	Post	Placebo	I	1.0 ± .57
			II	.69 ± .25
		Real	I	1.05 ± .77
			II	.64 ± .13
SA	Pre	Placebo	I	.78 ± .24
			II	.80 ± .142
		Real	I	1.26 ± .77
			II	.75 ± .27
	Post	Placebo	I	.74 ± .26
			II	.78 ±.22
		Real	I	.98 ± .73
			II	.69 ± .13

UT: Upper Trapezius; LT: Lower Trapezius; SA: Serratus Anterior; SD: Standard Deviation

Table 2: Descriptive data of scapular upward rotation angles

Parameter	Time	Condition	Group	Mean± SD
0° Angle	Pre	Placebo	I	4.16 ±.66
			II	3.05±.65
		Real	I	3.2± .63
			II	3.42±.58
	Post	Placebo	I	3.7± .02
			II	3.41±.57
		Real	I	3.83±.22
			II	3.53±.39
60° Angle	Pre	Placebo	I	11.10± 2.12
			II	10.14± 1.36
		Real	I	10.93± 2.66
			II	9.64± 1.27
	Post	Placebo	I	10.9± 1.7
			II	10.08± 1.24
		Real	I	13.55± 3.27
			II	10.94± 1.95
90° Angle	Pre	Placebo	I	18.56± 3.13
			II	18.14± 4.23
		Real	I	19.13± 4.14
			II	18.09 ± 4.06
	Post	Placebo	I	18.7 ± 3.90
			II	18.14 ±.4.27
		Real	I	21.13 ± 4.17
			II	19.32 ± 3.68
120° Angle	Pre	Placebo	I	25.88 ± 3.80
			II	27.95 ± 4.619
		Real	I	24.82 ±2.34
			II	27.7 ± 3.63
	Post	Placebo	I	25.73 ± 4.33
			II	28.44 ± 4.86
		Real	I	27.44 ± 3.98
			II	28.83 ± 3.31

UT: Upper Trapezius; LT: Lower Trapezius; SA: Serratus Anterior; SD: Standard Deviation

Concerning the other tested variables, there were no statistically significant differences between the two taping conditions as shown in table (3) and graph (4). Regarding the group-by-condition interaction, greater levels of mean RMS of the LT and SA muscles (P =.027 and P=0.05 respectively) demonstrated by the KT group during real taping condition compared to RT group. With respect to RMS of the UT muscle and scapular upward rotation angles, there were no statistically significant differences between the two groups during both taping conditions, as shown in table (4) and graph (5).

Table 3: Multiple pairwise comparison between placebo and real taping conditions for the scapular upward rotation angle at 0°, 60°, 90° and 120° of shoulder elevation and EMG of UT, LT and SA muscles in the pre and post taping times.

Measure	Time	Taping Condition		Mean Difference (I-J)	P-value	95% Confidence Interval for Difference	
		I	J			Lower Bound	Upper Bound
UT	Pre	Placebo	Real	.048	.527	-.108	.203
	Post	Placebo	Real	-.049	.201	-.127	.029
LT	Pre	Placebo	Real	-.061	.624	-.320	.197
	Post	Placebo	Real	-.086	.545	-.378	.206
SA	Pre	Placebo	Real	-.215	.116	-.489	.059
	Post	Placebo	Real	-.163	.239	-.445	.118
0° Angle	Pre	Placebo	Real	.297	.155	-.124	.718
	Post	Placebo	Real	-.124	.563	-.566	.318
60° Angle	Pre	Placebo	Real	.339	.254	-.266	.944
	Post	Placebo	Real	-1.760	.004*	-2.869	-.650
90° Angle	Pre	Placebo	Real	-.258	.527	-1.096	.581
	Post	Placebo	Real	-1.850	.002*	-2.932	-.768
120° Angle	Pre	Placebo	Real	.659	.078	-.083	1.400
	Post	Placebo	Real	-1.054	.047*	-2.094	-.014

UT: Upper Trapezius; LT: Lower Trapezius; SA: Serratus Anterior

*Significant (P<0.05)

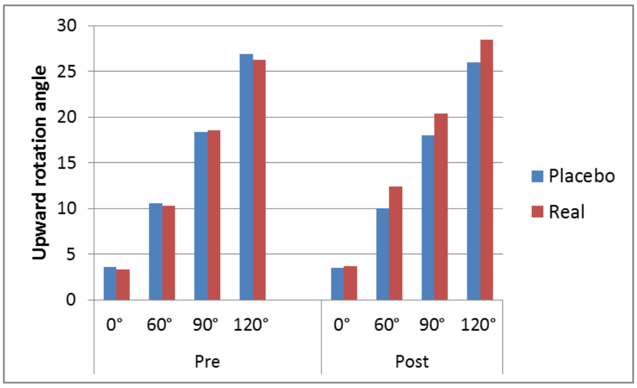
Table 4: Multiple pairwise comparison between kinesio and rigid taping groups for the scapular upward rotation angle at 0°, 60°, 90° and 120° of shoulder elevation and EMG of UT, LT and SA muscles in the placebo and real taping conditions.

Measure	Taping Condition	Group		Mean Difference (I-II)	P-value	95% Confidence Interval for Difference	
		I	II			Lower Bound	Upper Bound
UT	Placebo	KT	RT	.148	.190	-.080	.376
	Real	KT	RT	.128	..384	-.173	.429
LT	Placebo	KT	RT	.335	.077	-.040	.711
	Real	KT	RT	..671*	027*	.087	1.254
SA	Placebo	KT	RT	-.028	.761	-.217	.161
	Real	KT	RT	.494*	.05*	.01	.996
0° Angle	Placebo	KT	RT	.700	.501	-1.438	2.837
	Real	KT	RT	.032	.975	-2.120	2.185
60° Angle	Placebo	KT	RT	.887	..224	-.591	2.366
	Real	KT	RT	1.948	.064	-.127	4.023
90° Angle	Placebo	KT	RT	.540	.757	-3.073	4.152
	Real	KT	RT	1.423	.415	-2.158	5.00
120° Angle	Placebo	KT	RT	-2.392	.230	-6.431	1.648
	Real	KT	RT	-2.140	.162	-5.226	.946

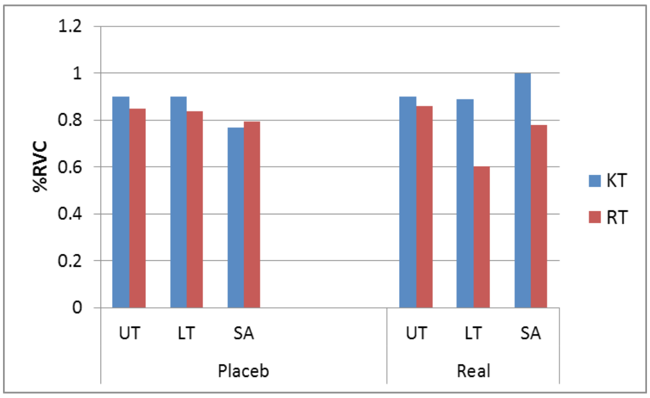
UT: Upper Trapezius; LT: Lower Trapezius; SA: Serratus Anterior

*Significant (P<0.05)

Graph 4: Time by taping condition interaction effect on scapular upward rotation angles.



Graph 5: Group by taping condition interaction effect on electrical activities of scapular rotators.



DISCUSSION

The results of the current study showed that KT group demonstrated greater EMG activity of the LT and SA muscles than those who were in the Rigid taping group following the application of real taping condition. One of the main differences between KT and traditional tapes is that it activates the region over which it is applied instead of restricting movement resulting in proprioceptive and nociceptive stimulation [42,43]. It was found that patients with SIS are clinically presented with over activation of the UT and inhibition of the LT and SA muscles [10,17]. Thus, the normalization of scapular upward rotators is crucial to improve its mechanical efficiency.

Our results are in agreement with those of Hsu et al [31], who studied the effect of KT on baseball players with SIS. Their findings revealed that KT induces facilitation on the electrical activity of the LT muscle during lowering of the arm in the scapular plane. However; they didn't find any significant effect of KT on the EMG activity of UT and SA muscles. This difference might be explained from two views: firstly: the examined sample; Hsu et al [31] studied a group of young athletes with SIS, in contrary to our sample who was sedentary female patients. Secondly: a difference related to the applied taping technique. In our study bilateral thoracic and scapular taping with posture correction was applied, while Hsu et al [31] used KT on the affected side without posture correction.

In the same context, Lin et al. [34] conducted a study on 12 healthy subjects to investigate the effects of scapular KT on the EMG activity of UT, LT, SA, anterior deltoid (AD) muscles and shoulder proprioception. Their finding related to the EMG activity of the SA muscle was in agreement with ours. However; regarding the EMG activity of the UT and LT muscles, they reported an increased activation level of the UT and a non-significant effect on the LT, which is in contrast to our findings. The difference between our findings and those reported by Lin et al [34] could be attributed to the investigated sample (patients with SIS versus healthy participants), or the applied technique. Although Lin et al [34] asked the participants to fully retract and depress their scapulae while applied the KT as in the current study, they used one strip of ''I" shaped KT applied unilaterally instead of using 4 strips of "I" shaped KT applied bilaterally aiming for both thoracic and scapular correction as was done in our study.

Our non-significant findings regarding the effect of RT on the EMG activity of the upward rotators of the scapula are in agreement with those of Cools et al. [21] who found no effect of RT application on the electrical activity of the scapular muscles in a sample of healthy participants. On the other hand, Ackermann et al [20] found increased activity of the UT muscle with declined quality of musical performance following the application of RT in professional violinists. They suggested that movement restriction and skin irritation induced by RT might explain its negative effects.

Regarding scapular kinematics, our results showed that following the application of tape, both real taping materials (KT and RT) had significantly increased scapular upward rotation at mid (60°and 90°) and final (120°) arcs of shoulder elevation as compared to placebo condition. Moreover; neither of the taping materials showed superiority when compared to each other. The improved scapular motion could be attributed to the increased activity of the LT muscle as reported before. Bagg and Forrest [44] stated that the LT muscle is ideally placed to maintain scapular position and pull along its long axis with maximum arm elevation, and it increases its contribution in rotating the scapula in the middle phase of gleno-humeral elevation. Thus, our findings suggested that both taping materials might assist in correcting the abnormal scapular movements, and accordingly allows the arm to function in a more balanced and stabilized scapula.

The findings of the current study are in accordance with those reported by Hus et al [31] who used the electromagnetic tracking system to study scapular kinematics in baseball players with SIS. They found that KT increased scapular upward rotation in the later elevation and in the lowering phase. However; in contrary to our finding, they found reduced upward rotation angle in the initial elevation. This contrary may be attributed to methodological differences.

Regarding the effect of RT, Host [19] postulated that RT aids in restoring normal kinematics by reducing scapular elevation, anterior tilting, and internal rotation. In addition, Lewis et al [18] found that RT with active postural correction had positive effects on upper body posture, and these changes were concomitant with a considerable increase in the range of shoulder flexion and abduction in the scapular plane. In the same context, RT has been found to improve scapular kinematics in healthy participants as reported by Shaheen et al [45]. They found increased scapular upward rotation, external rotation and posterior tilting during shoulder elevation in the sagittal plane. However; only scapular external rotation was increased in the scapular plane. They inferred that taping application may have beneficial effects on patient with SIS.

On the other hand, the results of this study contradict those reported by Shaheen et al [46] who stated that neither KT nor RT had an effect on scapular upward rotation in both sagittal and scapular planes. Although, they reported that both taping materials had increased scapular external rotation in sagittal and scapular planes of shoulder movements.

Methodological concerns related to the taping procedure may justify the discrepancies between the results of this study and those reported by Shaheen et al [46]. Indeed, in the latter study KT with two Y-strips were applied from the insertion to the origin of the supraspinatus and the deltoid muscles, in addition to a final I-strip was applied from the coracoid process to the posterior deltoid, without postural correction. Moreover, in our study the digital inclinometer was used to assess scapular motion, while Shaheen et al [46] used scapular tracking for the same purpose.

In closing, some limitations of the present study should be discussed. First of all, the number of the participants was relatively small, and the study was confined to females only. Therefore; a greater sample size of both genders is required to confirm our findings. Second, although the tape was placed by the same single therapist, the variation in the generated tension during tape applications might have lead to a different size of change between participants. Finally, the long term effect of taping was not considered in the current study.

CONCLUSION

Both KT and RT may have a positive effect in the restoration of scapular kinematics, which may improve the effectiveness of other therapeutic strategies directed to focus on postural corrections in the rehabilitation of SIS. KT may have additional therapeutic benefits beyond its role in scapular control, simply the ability to facilitate the LT and SA muscles activity. Thus, thoracic and scapular taping with postural correction may help scapular muscles to function in better mechanical advantage and overcome muscular imbalance during the rehabilitation program of patients with SIS.

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