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Taping to Improve Scapular Dyskinesis, Scapular Upward Rotation, and Pectoralis Minor Length in Overhead Athletes

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Context: Deviations in scapular motions and subsequent alterations in associated soft tissues are thought to contribute to overuse shoulder injuries in overhead athletes. Whereas rigid and Kinesio taping are recommended for preventing these injuries, high-level evidence from clinical trials is still needed.

Objective: To determine and compare the short-term effects of rigid and Kinesio taping on scapular dyskinesis, scapular upward rotation, and pectoralis minor length in asymptomatic overhead athletes.

Design: Randomized controlled trial.

Setting: Athletic training rooms.

Patients or Other Participants: Seventy-two elite asymptomatic overhead athletes (age = 17.00 ± 4.09 years, height = 1.75 ± 0.11 m, mass = 67.26 ± 15.25 kg, body mass index = 21.80 ± 3.00).

Intervention(s): We randomly assigned participants to 1 of 4 groups: rigid taping, Kinesio taping, placebo, or control (no taping). For the first 3 groups, we applied tape to the shoulder and scapular region.

Main Outcome Measure(s): We evaluated all groups for observable scapular dyskinesis using the scapular dyskinesis test, scapular upward rotation using a digital inclinometer, and pectoralis minor length using the pectoralis minor index at baseline, immediately after taping, and at 60 to 72 hours after taping.

Results: The scapular dyskinesis percentage ($P < .05$) decreased and the pectoralis minor index ($P < .001$) increased immediately and at 60 to 72 hours after taping in the rigid-taping and Kinesio-taping groups. We observed no differences among groups for the change in the pectoralis minor index ($P > .05$). Scapular upward rotation did not change after taping in any group ($P > .05$).

Conclusions: Rigid or Kinesio taping of the shoulder and scapular region improved scapular dyskinesis and pectoralis minor length but did not alter scapular upward rotation. Short-term rigid and Kinesio taping may help improve scapular dyskinesis and pectoralis minor length in overhead athletes.

Key Words: scapular taping, healthy athletes, kinematics, injury prevention

Key Points

- Short-term rigid or Kinesio taping might improve scapular dyskinesis and pectoralis minor length in asymptomatic overhead athletes.
- The taping methods used in this study did not affect scapular upward rotation.
- Long-term studies investigating taping interventions for preventing shoulder injuries in overhead athletes are needed.

Overhead upper extremity motions are performed via coordination of multiple body segments, such as the scapula, which acts as the link between the extremities and the trunk in the kinetic chain.[1,2] During the initial phases of overhead upper extremity motion (before throwing a ball), the scapula moves into progressive retraction, upward rotation, posterior tilt, and controlled internal-external rotation with elevation and external rotation of the humerus.[1,3–5] Alterations of this motion pattern are believed to lead to an increased injury risk.[1,6] Researchers have reported high rates of overuse injuries[7,8] in the dominant shoulders of overhead athletes, and Lo et al[7] observed a rate of 28.5%. Whereas many different pathologic and anatomic alterations can occur at the shoulder and contribute to an increased risk of injury, several investigators indicated that altered scapular motion may be problematic. Differences were found in the prevalence of scapular dyskinesis between nonoverhead (33%) and overhead (61%)[9] athletes along with associations between scapular dyskinesis and shoulder injury.[10] Furthermore, decreased scapular upward rotation (SUR) is believed to detrimentally affect the subacromial tissues and shoulder stability.[6]

One of the most important soft tissue changes related to scapular dyskinesis is shortening of the pectoralis minor,[2,11] which is attributed to adaptive changes in pectoralis minor muscle tension due to repetitive scapular protraction during overhead motion.[12] A relatively short pectoralis minor has been reported on the dominant side of healthy overhead athletes[12,13] and is associated with altered scapular

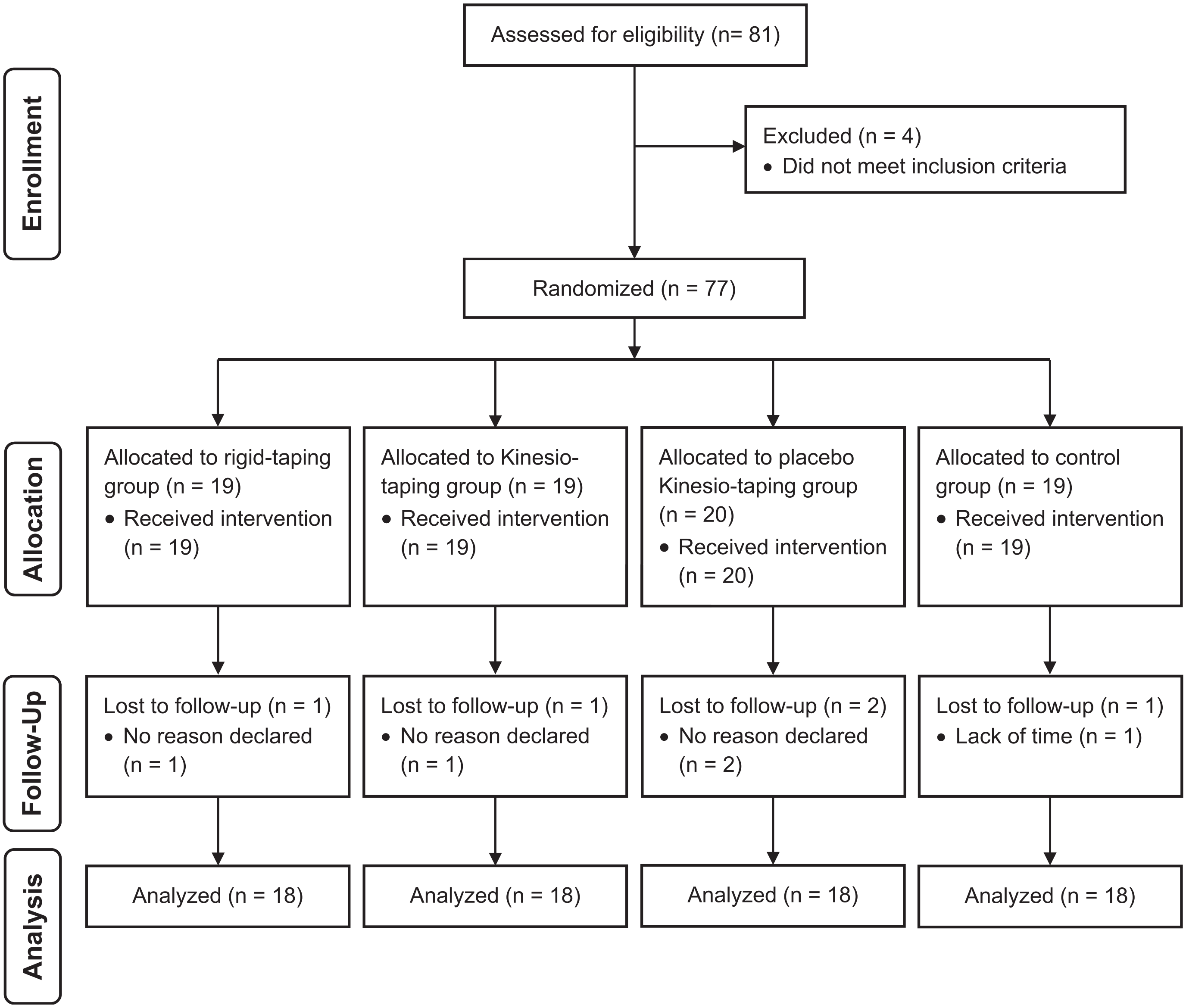

Figure 1. Participant flow diagram.

kinematics during shoulder elevation, as demonstrated in patients with subacromial impingement syndrome (SAIS).[14]

Correcting scapular dyskinesis and its associated soft tissue changes is recommended as an effective approach to injury prevention in overhead athletes,[1,9] and rigid[15,16] and Kinesio[17,18] taping are widely used for this purpose. Authors[16–19] investigating the effects of taping on scapular kinematics have mostly documented improved scapular motions in both asymptomatic and symptomatic participants. Shaheen et al[19] determined that rigid- and Kinesio-taping techniques improved scapular kinematics similarly in the sagittal plane, but elastic taping also provided improvement in the scapular plane. However, no one has evaluated the effects of taping on observable scapular dyskinesis. Contradictory data also exist concerning the effects of taping on SUR. Researchers have reported improved[16,20] or unchanged[19] SUR during shoulder elevation with taping. Furthermore, increased pectoralis minor length has been noted with rigid taping in a symptomatic patient[21] and with Kinesio taping in a nonathletic population.[22] The effectiveness of taping on pectoralis minor length is still unknown in the athletic population. Therefore, the purpose of our study was to determine and compare the short-term effects of rigid and Kinesio taping on scapular dyskinesis, SUR, and pectoralis minor length in asymptomatic overhead athletes. Based on the literature, we hypothesized that scapular dyskinesis, SUR, and pectoralis minor length would improve with both taping techniques but that Kinesio taping would result in better outcomes than rigid taping.

METHODS

Participants

Eighty-one overhead athletes from local sports clubs volunteered for this randomized controlled trial conducted between July and December 2015 (Figure 1). We investigated elite[23] overhead athletes aged 13 to 40 years who had no shoulder pain, no shoulder-complex injury in the 6 months before the study, and no limitation of active glenohumeral elevation and were able to complete the study procedures. We excluded volunteers if they had any diagnosed shoulder problems (ie, instability, rotator cuff pathologic condition), history of shoulder surgery or upper limb fracture, systemic musculoskeletal disease, pain with movement of the neck or shoulder region, chest deformity or scoliosis, pain during assessments or tape applications, skin problems in the shoulder and scapular region, or other contraindications to taping. The primary author (S.T.O.) screened participants for eligibility and assigned them to 1 of 4 groups (Figure 1) using a random-number generator (Random.org; Randomness and Integrity Services Ltd, Dublin, Ireland; https://www.random.org). We conducted sample selection and data collection in local sports clubs where players practiced their sports. All participants provided written and oral informed consent, and the study was approved by the Ethics Committee of Dokuz Eylul University.

An a priori sample-size calculation was performed using change in pectoralis minor length as the primary response variable. A 1-way analysis of variance (ANOVA) with 4 groups required 68 participants (17 participants for each group) to identify between-groups differences equal to 1 standard deviation of within-group values with an α level of .05 and power of at least 70%.[24] We used this method because we did not find a priori information on the variability of change values for this measure.

Procedures

After group assignment, the primary author (S.T.O.) measured scapular dyskinesis, SUR, and pectoralis minor length at baseline, immediately after taping, and at 60 to 72 hours after taping.[25] To ensure adhesion of the tape, she performed the immediately-after-taping measurement 30 minutes after taping. During this 30-minute time window, participants waited passively under physiotherapist supervision. After this period, they were allowed to continue their daily and sport activities. For injury prevention, measurements began with a warm-up session that included simple multiplanar shoulder movements. All measurements were obtained in a randomized order, and to avoid bias, the second author (D.K.) read and recorded the measurement results from the instruments (except for the scapular dyskinesis test). To allow observation of the scapula, men were assessed without shirts and women with sport bras.

Scapular Dyskinesis. The scapular dyskinesis test is a clinically feasible and visually based measurement method that allows valid and reliable (weighted $\kappa = 0.55–0.58$ for interrater reliability) dynamic assessment.[26] According to the recommendation of McClure et al,[26] the primary author underwent training in the standardized Web-based scapular dyskinesis test. After training and clinical practice, we determined that the intrarater κ was 0.80 (95% confidence interval [CI] = 0.55, 1.00; standard error = 0.197) in an a priori test-retest study with 10 participants. Participants used dumbbells according to their body mass: 1.4 kg for those weighing <68.1 kg and 2.3 kg for those weighing ≥68.1 kg. Each participant performed 5 repetitions of bilateral, weighted shoulder-flexion and frontal-plane abduction with the elbow in full extension and thumb pointing up. During the test, the primary author observed the test movements from the participant's posterior aspect and rated the dominant shoulder as having *normal motion*, *subtle dyskinesis*, or *obvious dyskinesis* according to the operational definitions and rating scale determined by McClure et al.[26] Given the reported strong correlation between test results of obvious dyskinesis and scapular kinematic abnormalities,[27] the test results were categorized as *dyskinesis* for those classified with *obvious dyskinesis* and *normal* for those classified with *normal* or *subtle dyskinesis*.

Scapular Upward Rotation. We measured SUR at 0°, 30°, 60°, 90°, and 120° of scapular-plane glenohumeral abduction (with the thumb pointing up) using a digital inclinometer (Baseline; Fabrication End Inc, New York, NY).[28,29] The inclinometer was modified by attaching 2 wooden dowels to the bottom of the instrument, and the Y ends of the dowels were placed along the scapular spine.[28,29] A bubble inclinometer (Baseline; Fabrication End Inc) was attached to the humerus to determine glenohumeral abduction angles.[29] We performed the measurement 3 times and calculated the average. Measurement of SUR with a modified digital inclinometer was reported as a reliable procedure, with an ICC range of 0.89 to 0.96.[29] In our a priori test-retest study with 10 participants, we determined that the intrarater reliability interclass correlation coefficients (ICCs [3,3] and 95% CIs [standard error of measurement, minimal detectable change$_{95}$]) of SUR differences at 0° to 30°, 30° to 60°, 60° to 90°, 90° to 120°, and 0° to 120° of glenohumeral abduction were 0.96 (0.84, 0.99 [0.59°, 1.64°]), 0.98 (0.93, 0.99 [1.42°, 3.94°]), 0.98 (0.92, 0.99 [1.44°, 3.99°]), 0.98 (0.93, 0.99 [1.16°, 3.22°]), and 0.99 (0.93, 1.00 [1.36°, 3.77°]), respectively.

Pectoralis Minor Length. We measured pectoralis minor length as the length between the medial-inferior angle of the coracoid process and just lateral to the sternocostal junction of the caudal edge of the fourth rib.[30] Measurements were taken using a tape measure and repeated 3 times (the average was recorded). The validity and reliability of this measurement have been established (ICC = 0.96 for in vitro analysis),[30] and our test-retest reliability ICC (3,3) was 0.96 in an a priori study of 10 participants. To normalize the height and muscle-length variability among participants, we calculated the pectoralis minor index (PMI) by dividing the resting length of the muscle by the participant's height, both in centimeters, and multiplying by 100.[14] For the PMI, our test-retest (intrarater) reliability ICC (3,3) was 0.97 (95% CI = 0.89, 0.99) in an a priori study with 10 participants, and according to Weir's[31] instructions, we calculated the standard error of measurement for PMI as 0.13 and the minimum detectable change in the 95% CI as 0.36.

Taping Procedures

All taping was done by the primary author, who is certified by Kinesio Taping Association International. We aimed to improve shoulder and scapular biomechanics using taping techniques.[32,33] Participants were instructed to remove the tape after 48 hours of use and to return for reassessment within 12 to 24 hours after the 48 hours had elapsed. This resulted in participants being examined

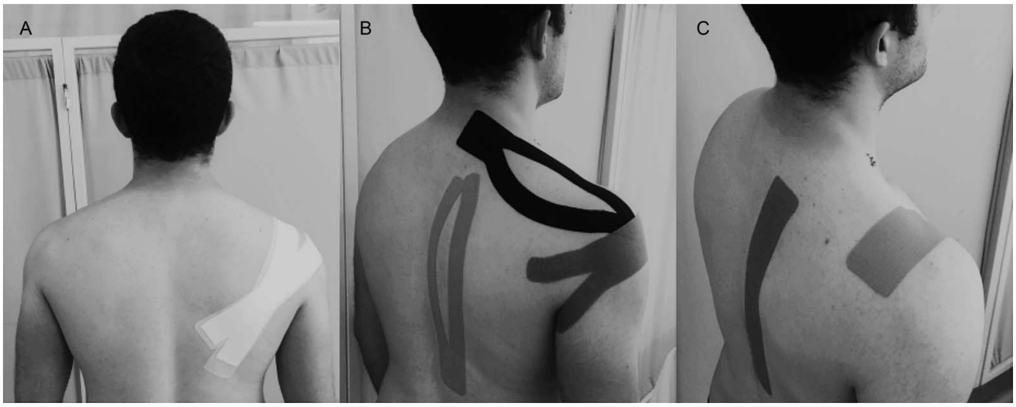

Figure 2. Tape application. A, Rigid taping (Protape; Norgesplaster AS, Vennesla, Norway). B, Kinesio (KT-X050; Kinesio Tex, Tokyo, Japan) taping. C, Placebo Kinesio taping.

between 60 and 72 hours after taping. Before taping, we tested them for any allergic reaction to the tape. If no allergies or erythema were evident, we taped participants and gave them a tape care brochure.

Rigid Taping. We applied standardized rigid taping[15,33] to the rigid-taping group (RG; Figure 2A). First, hypoallergenic tape (Hypafix; BSN Medical GmbH, Hamburg, Germany) was applied with no tension. Next, we applied the first rigid tape (Protape; Norgesplaster AS, Vennesla, Norway) from the anterior aspect of the shoulder to the T6 area with a pull into retraction and the second rigid tape from just below the coracoid in the anterior aspect of the shoulder to the T10 area with an initial pull up and then back.

Kinesio Taping. We applied standardized therapeutic Kinesio taping[32,34] to the Kinesio-taping group (KG) in accordance with the procedure described by Kase et al[32] (Figure 2B). Standard 5-cm Kinesio Tex (KT-X050; Kinesio Tex, Tokyo, Japan) was used. First, a Y-strip spanned the origin to the insertion of the supraspinatus using paper-off tension while participants reached behind their backs with their upper extremities and flexed their necks to the contralateral side. Second, we applied an I-strip from the coracoid process around the posterior deltoid using downward pressure and approximately 50% to 75% stretch. Initially, the shoulder was externally rotated with no elevation and then it was moved into slight horizontal adduction and forward elevation as the end of the tape was applied with no stretch. This I-strip had a Y shape at the end of the tape. Finally, we applied a Y-strip from the T10–T12 area to the medial border of the scapula using paper-off tension to facilitate the lower trapezius muscle. For this technique, the lateral tail of the Y-tape was applied with the shoulder horizontally adducted, and the medial tail was applied with the hands crossed over the chest.

Placebo Kinesio Taping. We applied standardized placebo taping[34] to the placebo Kinesio-taping group with standard 5-cm Kinesio Tex (Figure 2C). We applied 2 strips with no tension to the acromioclavicular joint and lower trapezius muscle separately. No participant reported being suspicious of receiving placebo taping.

Control. We gave a brochure about preventing overuse shoulder injuries to the control group. They received no taping.

Statistical Analysis

We evaluated normality using the Kolmogorov-Smirnov test and used a 1-way ANOVA to compare groups for demographic, anthropometric, and sport-related characteristics. Groups were compared for sex and sport participation using a χ^2 test. We analyzed differences in SUR at 0° to 30°, 30° to 60°, 60° to 90°, 90° to 120°, and 0° to 120° of glenohumeral abduction. A 2-way (group $\times$ time) ANOVA with repeated measures was used to determine changes in PMI and SUR. If the result of the Mauchly test of sphericity was not significant, we used an F value based on assumed sphericity; if the result of the Mauchly test of sphericity was significant, we used an F value based on the Greenhouse-Geisser test. Thereafter, we used pairwise comparisons to compare each time among the groups and to determine if the changes across time were different. Finally, we performed a McNemar test to analyze changes in groups over time for percentages of scapular dyskinesis. This test enabled us to compare the percentages of scapular dyskinesis of each group in time separately. We set the α level a priori at .05. We calculated and interpreted effect sizes according to the Cohen[35] guidelines and performed post hoc power analyses with our effect sizes using G*Power[36] (version 3.1.9.2; Heinrich-Heine-Universität, Düsseldorf, Germany). For the post hoc power analyses, we accepted a power $\geq$0.80 as sufficient.

RESULTS

A total of 77 elite overhead athletes participating in basketball, handball, or volleyball were included in the study, and data from 72 athletes (age = 17.00 $\pm$ 4.09 years, height = 1.75 $\pm$ 0.11 m, mass = 67.26 $\pm$ 15.25 kg, body mass index [calculated as kg/cm^2] = 21.80 $\pm$ 3.00) were included in the analysis (Figure 1). All groups had similar demographic, anthropometric, and sport-related characteristics (all P values $>$ .05; Table 1).

Baseline scapular dyskinesis percentages were not different among groups ($P >$ .05; Figure 3). Scapular dyskinesis percentages decreased immediately after taping in the RG (P = .002) and KG (P = .008). These improvements were maintained at 60 to 72 hours after taping.

We observed no main effect ($F_{2,136}$ values = 0.02–1.65; P $>$ .05), no time $\times$ group interaction ($F_{6,136}$ values = 0.51–1.94; $P >$ .05), and no between-groups differences ($F_{3,68}$

Table 1. Participants Characteristics

Characteristic	Rigid (n = 18)	Kinesio (n = 18)	Placebo Kinesio (n = 18)	Control (n = 18)	*P* Value	χ^2 Value
	No. (%)					
Sex						
Male	8 (44)	7 (39)	8 (44)	8 (44)	.98	0.170
Female	10 (56)	11 (61)	10 (56)	10 (56)		
Sport participation					.87	2.702
Basketball	4 (22.2)	6 (33.3)	5 (27.8)	8 (44.4)		
Handball	3 (16.7)	3 (16.7)	4 (22.2)	2 (11.1)		
Volleyball	11 (61.1)	9 (50.0)	9 (50.0)	8 (44.4)		
	Mean ± SD					
Age, y	17.39 ± 4.82	16.94 ± 3.62	17.06 ± 4.60	16.61 ± 3.48	.96	NA
Height, cm	172.72 ± 10.85	174.50 ± 10.50	175.61 ± 12.64	176.00 ± 11.98	.97	NA
Mass, kg	66.17 ± 14.90	68.67 ± 16.46	67.44 ± 15.17	66.78 ± 15.63	.83	NA
Body mass index	21.93 ± 2.85	22.29 ± 3.44	21.61 ± 2.51	21.38 ± 3.28	.82	NA
Practice duration, y	6.72 ± 4.90	6.61 ± 2.93	7.17 ± 3.78	4.89 ± 3.18	.29	NA
Practice frequency, h/wk	10.83 ± 5.28	13.06 ± 5.37	12.94 ± 4.79	12.50 ± 4.95	.54	NA
Competition frequency, h/wk	2.28 ± 0.75	2.25 ± 1.19	2.53 ± 1.40	2.39 ± 1.48	.91	NA

Taping Group: Rigid, Kinesio, Placebo Kinesio, Control.

Abbreviation: NA, not applicable.

values = 0.20–1.21; $P > .05$) in the SUR for any range of glenohumeral-abduction angles (Table 2). Effect sizes ranged from 0.15 to 0.27 (statistical power = 0.63–1.00) for the time × group interaction and from 0.01 to 0.23 (statistical power = 0.11–0.48) for the between-groups differences.

For PMI, we observed a main effect ($F_{2,136} = 55.50$, $P < .001$) and time × group interaction ($F_{6,136} = 17.78$, $P < .001$) but no differences among groups at any measurement time ($F_{3,68} = 0.15$, $P = .93$). The PMI increased immediately and at 60 to 72 hours after taping in the RG and KG ($P < .001$). Effect sizes were 0.89 (statistical power = 1.00) for the time × group interaction and 0.08 (statistical power = 0.09) for the between-groups differences. No changes were observed in the Kinesio taping, placebo, or control group over time for PMI (Table 3).

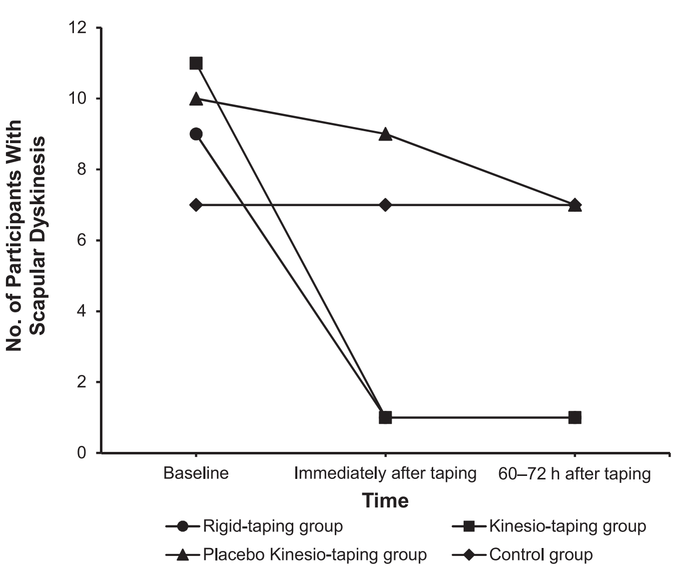

Figure 3. Change in number of participants with scapular dyskinesis by group.

DISCUSSION

The purpose of our study was to assess and compare the effects of short-term rigid and Kinesio taping of the shoulder and scapular region on scapular kinematics and pectoralis minor length in asymptomatic overhead athletes. Our results partially supported our hypothesis and suggested that both taping techniques had similar positive effects on scapular kinematics and pectoralis minor length in this population.

Most authors[16–18] have demonstrated improved scapular kinematics with rigid- and Kinesio-taping techniques. However, they evaluated only the immediate effects, and observable scapular dyskinesis was not assessed after taping. In our study, rigid and Kinesio taping immediately improved observable scapular dyskinesis evaluated with a scapular dyskinesis test, which is based on visual observation[26,27] in overhead athletes. This effect was preserved even after 60 to 72 hours. Similar to our results, Shaheen et al[19] compared rigid and Kinesio taping in patients with SAIS and reported positive effects on scapular kinematics in the sagittal plane. They also noted improved scapular kinematics in the scapular plane with Kinesio taping[19]; we did not assess scapular dyskinesis in the scapular plane.

Van Herzeele et al[17] reported increased scapular posterior tilt and SUR after Kinesio taping in asymptomatic female handball players and suggested that taping had a mechanical effect on scapular motion. In agreement with their suggestion,[17] we can speculate that mechanical correction of abnormal scapular alignment was the mechanism of the improved scapular dyskinesis in our study. In addition to the mechanical correction, enhanced neuromuscular activation in the scapular-stabilizer muscles might be another mechanism responsible for improved scapular dyskinesis with taping. Moreover, increased lower trapezius muscle activity has been seen with Kinesio taping.[18] However, assessments of scapular muscle activity after rigid taping have been inconsistent.[37,38]

In our study, rigid and Kinesio taping improved the PMI immediately and at 60 to 72 hours after taping (large time ×

Table 2. Scapular Upward Rotation Differences Among Certain Glenohumeral Abduction Angles (Mean ± SD)

Glenohumeral Abduction Angle, °	Group	Scapular Upward Rotation, °[a] Baseline	Immediately After Taping	60–72 h After Taping
0–30	Rigid taping[b]	3.10 ± 3.49	4.48 ± 2.24	3.10 ± 2.98
	Kinesio[b] taping	3.85 ± 4.14	4.17 ± 3.90	3.08 ± 2.72
	Placebo Kinesio taping	3.91 ± 3.06	2.14 ± 3.61	2.76 ± 3.04
	Control	3.17 ± 2.95	2.87 ± 3.46	2.60 ± 2.93
30–60	Rigid taping	9.60 ± 2.81	10.44 ± 2.85	8.95 ± 3.26
	Kinesio taping	9.29 ± 2.94	10.01 ± 3.38	8.63 ± 3.98
	Placebo Kinesio taping	10.10 ± 4.13	9.97 ± 4.47	9.35 ± 3.61
	Control	7.72 ± 2.32	7.99 ± 3.16	8.96 ± 3.37
60–90	Rigid taping	11.06 ± 3.07	11.07 ± 2.78	11.19 ± 3.92
	Kinesio taping	10.99 ± 2.90	11.54 ± 2.75	11.81 ± 2.44
	Placebo Kinesio taping	11.66 ± 3.70	11.19 ± 4.78	11.97 ± 5.30
	Control	11.44 ± 2.62	10.51 ± 2.10	10.89 ± 2.64
90–120	Rigid taping	12.85 ± 3.19	12.33 ± 3.87	12.99 ± 2.59
	Kinesio taping	13.47 ± 2.71	12.62 ± 3.04	12.73 ± 3.30
	Placebo Kinesio taping	12.36 ± 2.80	13.79 ± 4.23	13.67 ± 3.56
	Control	13.56 ± 3.11	13.67 ± 2.79	12.82 ± 2.29
0–120	Rigid taping	36.61 ± 6.75	38.32 ± 6.46	36.23 ± 5.25
	Kinesio taping	37.60 ± 6.79	38.40 ± 5.43	36.25 ± 5.27
	Placebo Kinesio taping	38.03 ± 8.81	37.09 ± 9.11	37.75 ± 8.79
	Control	35.89 ± 5.71	35.04 ± 5.37	35.27 ± 6.07

[a] No differences within or between groups.
[b] Rigid tape: Protape, Norgesplaster AS, Vennesla, Norway; Kinesio tape: KT-X050; Kinesio Tex, Tokyo, Japan.

group interaction effect size [0.89]), and immediate improvements (rigid taping = 0.49, Kinesio taping = 0.44) were beyond measurement error. This is consistent with the work of Han et al,[22] who showed an immediate increase in pectoralis minor length after Kinesio taping the shoulders of male workers who had rounded shoulder postures. Moreover, Host[21] determined that scapular rigid taping and exercise increased pectoralis minor length and resulted in a better scapular resting position in a patient with anterior SAIS, indicating that improved scapular alignment might provide a low-load, prolonged stretch to the tight structures around the shoulder. In agreement with Host's[21] suggestion, the improved scapular alignment in our study probably increased pectoralis minor length, providing a low-load, long-duration stretch. In support of this proposal, Yesilyaprak et al[11] described the increased likelihood of visually observable scapular dyskinesis as the PMI decreased. To our knowledge, we are the first to compare the effects of Kinesio and rigid taping on pectoralis minor length. Several reasons might explain the lack of differences between groups in the PMI changes. First, our sample size was not large enough to show a difference between groups (power = 0.09) for PMI. Second, the mean PMI of our participants (approximately 11) indicated a normal pectoralis minor length.[26]

Increased SUR with rigid or Kinesio taping or both has been shown at certain humeral elevation angles in various populations.[16,17,20] In contrast, unchanged SUR has been reported with taping during both scapular- and sagittal-plane humeral elevation.[19] We did not observe any change in SUR at any angles of scapular-plane glenohumeral elevation immediately and at 60 to 72 hours after taping. The reason for the inconsistency among studies may be their designs, including different populations and taping techniques. Hosseinimehr et al[39] reported altered SUR in the dominant shoulders of healthy male overhead athletes and suggested that some scapular asymmetry should not be considered pathologic in all athletes. This may be the

Table 3. Pectoralis Minor Index Values and Comparisons Within and Between Groups

Group	Pectoralis Minor Index, Mean ± SD[a] Baseline	Immediately After Taping	60–72 h After Taping	Comparisons Within Groups	Between Groups
Rigid taping[b]	11.50 ± 1.11	11.99 ± 1.14	11.80 ± 1.06	Baseline < immediately after taping[c] Baseline < 60–72 h after taping[c] Immediately after taping > 60–72 h after taping[c]	$P > .05$
Kinesio taping[b]	11.64 ± 1.41	12.07 ± 1.33	11.93 ± 1.30	Baseline < immediately after taping[c] Baseline < 60–72 h after taping[c] Immediately after taping > 60–72 h after taping[c]	
Placebo Kinesio taping	11.80 ± 1.36	11.83 ± 1.34	11.79 ± 1.36	Baseline = immediately after taping = 60–72 h after taping	
Control	11.63 ± 0.90	11.63 ± 0.91	11.60 ± 0.88	Baseline = immediately after taping = 60–72 h after taping	

[a] Calculated by dividing the resting length of the muscle by the participant's height (both in cm) and multiplying by 100.
[b] Rigid tape: Protape, Norgesplaster AS, Vennesla, Norway; Kinesio tape: KT-X050; Kinesio Tex, Tokyo, Japan.
[c] Different ($P < .001$).

reason that our taping techniques did not affect SUR in asymptomatic overhead athletes. Lastly, it seems that improved scapular dyskinesis after taping in our study could not be due to the change in SUR; instead, it could have been associated with increased scapular posterior tilt or external rotation. Similarly, Shaheen et al[19] showed improved external rotation and posterior tilt without concurrent alteration in SUR with rigid and Kinesio taping using 3-dimensional motion analysis. However, we did not assess scapular tilt and internal-external rotation.

The generalizability of our results is limited to overhead athletes in this age group and at this elite competition level. One of the limitations of our study was a small sample size for determining between-groups differences in the PMI. Another limitation was the lack of blinding; given the visibility of the tapes, it was not possible to blind both participants and physiotherapists.

CONCLUSIONS

Short-term rigid and Kinesio taping might improve pectoralis minor length and scapular dyskinesis in asymptomatic overhead athletes. However, these changes did not seem to be related to SUR because our taping method did not affect it. We recommend using both types of taping to improve scapular dyskinesis and pectoralis minor length in overhead athletes. Long-term studies in which researchers investigate the success of taping interventions in preventing shoulder injuries are needed.

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