

# Effect of Kinesio Tape Applied to Supraspinatus Muscle on Shoulder Scaption Strength and Upper Extremity Stability in Healthy Women Aged 20 to 30 Years: A Double Blind Randomized Controlled Trial

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## SUMMARY

**Objective.** To investigate the effect of kinesio tape applied to the supraspinatus muscle on shoulder scaption muscle strength and upper extremity stability in healthy women.

**Methods.** 26 healthy female volunteers aged 20-30 years were included in the study. Individuals were randomized into two groups, kinesio taping (n = 13) and sham taping (n = 13). In the kinesio taping group a Y-shaped tape was applied to the supraspinatus muscle in the direction of facilitation while in the sham group an I tape was applied on the scapula. Before taping and 20 minutes after taping the shoulder scaption strength was measured with a dynamometer and functional evaluations were performed by the closed kinetic chain upper extremity stability test.

**Results.** In the kinesio tape group, median scaption strength decreased after taping (p = 0.016). The median contact, normalized, and power scores increased significantly (respectively, p = 0.001, p = 0.001, and p = 0.001). In the sham group there was no significant difference in the median scaption strength after taping; the median contact, normalized and power scores increased significantly (p = 0.004, p = 0.004, and p = 0.006, respectively). There was no significant difference in scaption strength and upper extremity stability test scores between groups. After taping the changes were categorized as “no change”, “increase” and “decrease” according to the minimal clinically significant difference value, the number of individuals with increased scaption strength was higher in the kinesio tape group compared to the sham group, although not statistically significant.

**Conclusions.** The significance of kinesio taping applied to healthy women was not observed compared to sham taping on shoulder scaption muscle strength and upper extremity stability.

## KEY WORDS

*Muscle strength; kinesio taping; shoulder; stability; supraspinatus.*

## INTRODUCTION

Glenohumeral joint is the most mobile joint in the human body. Its stability is provided mainly by muscles, which can be divided into movers and stabilizers. The stabilizing muscles are defined as the rotator cuff muscles and they maintain glenohumeral joint alignment which is essential in daily activities. Supraspinatus muscle, one of the rotator cuff muscles functions both as a mover and as a stabilizer during arm abduction (1). Shoulder complaints are frequently encountered (2) and the supraspinatus muscle is a common source of pain (3). Understanding the mechanical effects of the supraspinatus muscle on strength and stability will help in the prevention and management of shoulder injuries and complaints. Guidelines recommend therapeutic exercises during the rehabilitation of rotator cuff tears (4). In daily life, especially during overhead activities, both the rotator cuff and periscapular musculature provide shoulder stability and painless mobility. Scaption is shoulder elevation in the scapular plane and is defined parallel to the scapular plane, and 30° anterior to the coronal plane. There are studies showing that scaption strength is beneficial for preventing injury, reducing pain, and promoting good posture (5). It has been shown that scaption strengthening exercises form the core of the shoulder muscle strengthening program (6). Kinesio taping is widely used in the treatment of many musculoskeletal problems, especially sports injuries (7-10). The tape used is similar to the structural feature and flexibility of human skin. It does not limit joint range of motion but allows movement. Kinesio taping is supposed to have several effects such as supporting muscle and fascia, improving muscle strength (11), function (12), and proprioception (13), reducing pain (14), and improving lymphatic circulation (15).

Studies show conflicting results regarding the effects of kinesio taping in healthy individuals: kinesio taping increased quadriceps muscle strength in one study (16), while it had no effect on hand grip strength in another study (17). Inconsistencies between studies may be due to the differences in methodology such as study design, sample size, or outcome measures used. Similar conflicting results are seen in shoulder kinesio taping studies. Studies investigating the effect of kinesio taping applied to the muscles around the shoulder such as infraspinatus and pectoralis major muscles demonstrated strength improvement in healthy individuals (18). On the other hand, another study reported that kinesio taping of infraspinatus and teres minor muscles did not make a significant difference in shoulder external rotation peak torque in healthy individuals (19). To our knowledge, there is no study regarding kinesio taping applied solely to the supraspinatus muscle in healthy individuals.

The aim of this study is to investigate the effect of kinesio taping applied to the supraspinatus muscle with the facilitation technique on strength and stability in healthy individuals. The hypothesis of the study is that kinesiotaping will increase strength and improve function compared to sham application.

## METHODS

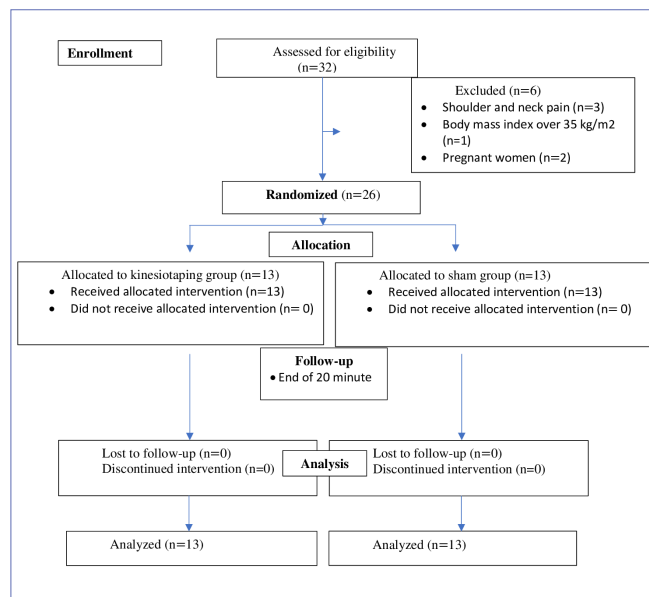
Permission and approval number 2021.431.IRB1.123 was received for this study by the Koç University Hospital Clinical Research Ethics Committee on November 24, 2021. This study was written according to the Consolidated Standards of Reporting Trials “CONSORT” statements.

### Participants

Twenty-six healthy volunteers were included in this study. Inclusion criteria were being 20-30 years old, female, and having a body mass index below 35 kg/m<sup>2</sup>. Those with shoulder and neck pain, body mass index over 35 kg/m<sup>2</sup>, professional athletes, pregnant women, and individuals with chronic muscle and/or neurological diseases were excluded from the study.

### Study design

This is a randomized controlled and double-blind study. Individuals were randomized 1:1 into two groups; kinesio taping (n = 13) and sham (n = 13) using a computer program (<https://www.randomizer.org/>). The flow chart diagram of the study design is shown in **figure 1**.



**Figure 1.** CONSORT Flow diagram of the study.

## Blinding

Kinesio taping was applied by the Physical Medicine and Rehabilitation Physician who did not participate in the assessment of the patients. Taping was applied to all of the individuals who did not know which application was made to them. After kinesio tape application, the participants were asked to wear t-shirts in a way that would prevent the tapes from being seen by the assessor. The assessor performed muscle strength and stability tests without knowing which band was applied to the patients.

## Interventions

KinesioTex Gold (Kinesio Holding Corporation, 2017, Albuquerque, NM – GKT15024) with a single color was used in this study. The dominant extremity of the individuals was determined by asking which hand they wrote with. Taping was applied to the dominant extremity of the individuals. Applications were made on hairless, clean skin. After the individuals were asked to take off their clothes, the application was made while sitting comfortably. All taping procedures were performed by the same investigator, based on methods used in previous research, with the technique to stimulate the supraspinatus muscle by facilitation from the origin to the insertion of the muscle group (20). The distance from the supraspinous fossa to the tuberculum major of the humerus was measured with a tape measure (approximately 20 centimeter) and a Y band of this length was prepared. While the individual was in the resting position, the anchor part of the tape was adhered to the end point of the muscle without tension. Then the individual was placed in the position where the supraspinatus muscle was in its longest size with the shoulder in protraction and internal rotation. By applying 50% tension to the area except the first and last 5 centimeters of the tape, the tape was adhered so that the ends were at the origin and the anchor part was at the insertion point of the muscle. Thence the supraspinatus muscle was kept between the arms of the Y band (20-22) (**figure 2**). In the sham group, the kinesio taping was applied vertically over the scapula not coinciding with the supraspinatus muscle. A single 8 centimeters I tape was adhered to the scapula without stretching, in a way that it would not cross any joint and would not cause activation or inhibition, similar to a previous study (14, 23-25) (**figure 3**).

## Outcome measurements

Demographic information of individuals was recorded before the evaluation. Before and 20 minutes after taping, individuals were evaluated with a dynamometer (Mecmesin Myometer Test, UK) and closed kinetic chain upper extremity stability test. A-20-minute interval was left for the activation of tape (20).

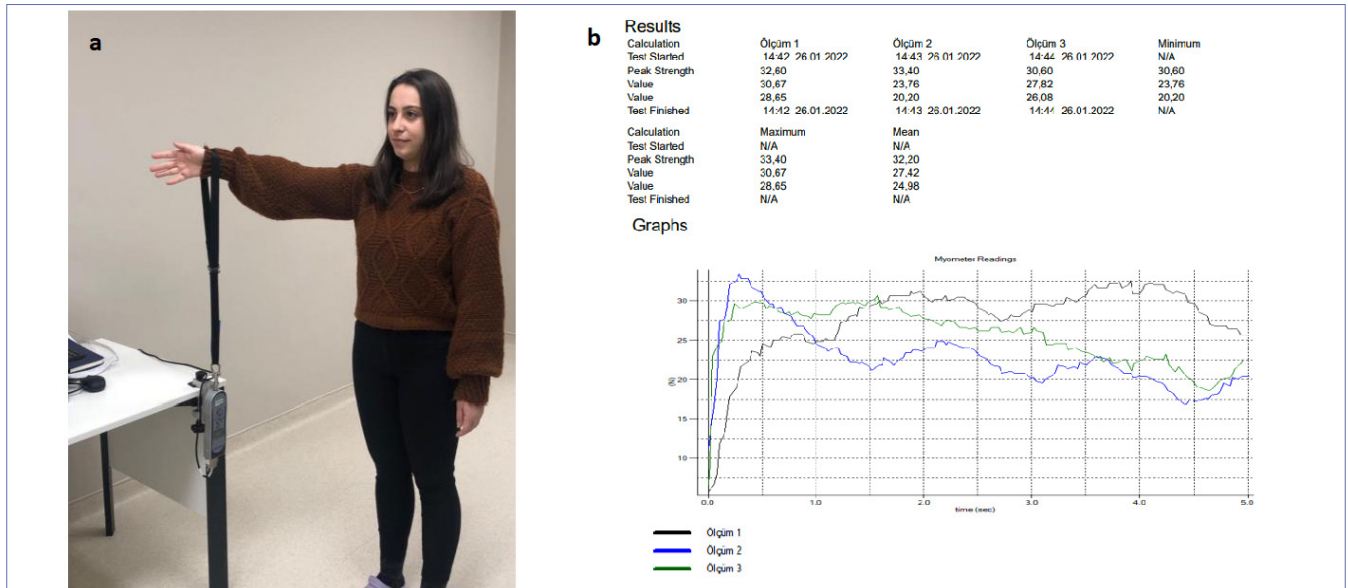


**Figure 2.** Kinesio taping applied to the supraspinatus muscle by facilitation method.



**Figure 3.** Vertically applied sham tape at the level of the scapula.

Scaption muscle strength was measured with a dynamometer (Mecmesin Myometer Test, UK) and upper extremity stability was evaluated with a closed kinetic chain upper extremity stability test. The Mecmesin Myometer Test is an adjustable belt electronic dynamometer designed to measure shoulder muscle strength. Assessing shoulder strength with a hand-held dynamometer has been shown to be more reliable and objective than manual muscle testing (26, 27). Measurements were recorded on a computer connected to the dynamometer. Visual feedback was provided to the individual as a graphic output on the computer screen (28). While the individual was standing, the arm was positioned in 90 degrees scapular abduction, the elbow in extension and the forearm in neutral (29, 30) (**figure 4a**). Three measurements were performed with one-minute break. During the measurements, standard verbal instructions (ready 5, 4, 3, 2, 1, push, push, push) were given to the individuals. Each



**Figure 4.** (a) Measuring position with dynamometer; (b) Measurement report with dynamometer.

measurement lasted approximately 5 seconds, the average value at the 2<sup>nd</sup> and 3<sup>rd</sup> seconds of the measurements was taken into account and analyzed (31) (**figure 4b**). The minimal clinically significant difference was accepted as 3 Newtons for the scaption muscle strength (28, 32).

The closed kinetic chain upper extremity stability test was used to assess shoulder stability (33, 34). The participant was placed in the push-up position with their knees touching the ground (**figure 5**). The distance between the two hands was set to 90 cm (35). Three different scores were recorded in this test:

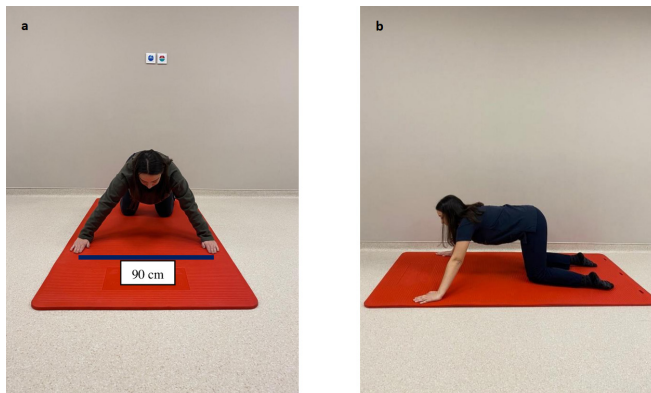
1. Contact Score: for 15 seconds the participant was asked to touch her right hand with her left hand and touch

her left hand with her right hand consecutively. Number of hand contacts were counted. This test was repeated three times. Between trials, the individual was rested for 45 seconds. The average score of 3 repetitions was used for the test score (35, 36).

2. Normalized Score: it was calculated by dividing the contact score of the individual by her body height.
  3. Power Score: it was calculated by multiplying 68% of the individuals contact score and dividing her weight by 15.
- The minimal clinically significant difference was accepted as 3.43 units for the contact score, 0.05 units for the normalized score and 18.30 units for the power score (36, 37).

### Statistical analysis

A pilot study was conducted by the authors on 10 women before this study. Considering the scaption strength difference values obtained from the pilot study, sample size was calculated as 26 women with 0.05 type 1 error and 0.80 study power. Data were analyzed using SPSS 26.0 for Windows (IBM Corp., Armonk, NY, USA). Data were presented using, median, interquartile range (IQR), minimum and maximum values. 95% confidence intervals were provided. Mann Whitney U test was used to compare two independent continuous variables. Wilcoxon Signed Rank test was used to compare two dependent continuous variables. Chi-square test was used to compare the categorical variables of the groups. The significance level was determined as 0.05 in all analyzes.



**Figure 5.** (a) Front stability test position; (b) Side stability test position.

## RESULTS

Twenty-six healthy women volunteered to participate in the study. There was no statistically significant difference between the age, height, body weight and dominant extremities of the individuals in the kinesio taping and sham groups (**table I**). In the kinesio tape group, the median scaption strength decreased after taping, whereas there was no signifi-

cant difference in the median scaption strength after sham taping. The median contact, normalized and power scores increased significantly in both groups (**table II**). There was no statistically significant difference in terms of scaption strength or upper extremity stability test scores between kinesio tape and sham groups (**table II**).

**Table I.** Age, height, weight, body mass index and dominant extremity of participants.

	Kinesiotape Group Median (IQR)	Sham Group Median (IQR)	P-value
Age, year	25.0 (4.5)	25.0 (7.0)	1.000
Height, m	1.68 (0.06)	1.65 (0.08)	0.695
Weight, kg	58.0 (6.5)	65.0 (22.5)	0.695
BMI, kg/m <sup>2</sup>	21.05 (1.44)	22.72 (5.06)	0.434
Dominant extremity, right, %	92	69	0.322

IQR: interquartile range (75%-25%); BMI: body mass index.

**Table II.** Kinesiotape and sham groups pre-taping and post-taping strength measurements and upper extremity stability test scores.

	Kinesiotape Group Median (IQR)	Sham Group Median (IQR)	95%CI*	P-value*
<b>Scaption Strength</b>				
Pre-	37.5 (22.8)	41.6 (17.9)		1.000
Post-	36.8 (24.0)	42.1 (13.5)		1.000
Difference	4.1 (9.0)	0.5 (5.1)	2.80-4.97	0.115
P-value**	<b>0.016</b>	0.507		
95%CI**	0.2-10.7	-2.5 to 4.3		
<b>Contact Score</b>				
Pre-	17.3 (4.8)	16.7 (4.0)		1.000
Post-	20.7 (3.3)	18.3 (4.8)		0.434
Difference	3.0 (2.5)	1.7 (2.9)	0.34-1.66	0.115
P-value**	<b>0.001</b>	<b>0.004</b>		
95%CI**	1.3-4.3	0.3-4.3		
<b>Normalized Score</b>				
Pre-	10.2 (3.2)	9.8 (2.7)		1.000
Post-	12.7 (2.3)	10.7 (2.1)		1.000
Difference	1.9 (1.4)	1.0 (1.8)	0.35-0.96	0.115
P-value**	<b>0.001</b>	<b>0.004</b>		
95%CI**	0.8-2.6	0.2-2.6		
<b>Power Score</b>				
Pre-	44.7 (8.3)	51.0 (15.8)		1.000
Post-	54.3 (2.7)	52.0 (21.4)		0.434
Difference	7.6 (7.0)	5.4 (7.5)	1.19-3.85	1.000
P-value**	<b>0.001</b>	<b>0.006</b>		
95%CI**	3.7-12.2	1.1-9.8		

IQR: interquartile range (75%-25%); CI: confidence interval; \*Mann-Whitney U test, \*\*Wilcoxon signed rank test.

**Table III.** Comparison of the number of individuals who did no change, increase or decrease according to the minimum clinical significant difference value of the scaption strength and upper extremity stability test scores after taping.

	Number of individuals with increased value		Number of individuals with decreased value		Number of individuals with no change		P-value
	Kinesiotape	Sham	Kinesiotape	Sham	Kinesiotape	Sham	
Scaption Strength Change	8	3	1	2	4	8	0.055
Contact Score Change	5	3	0	0	8	10	0.336
Normalized Score Change	13	11	0	1	0	1	0.240
Power Score Change	2	1	0	0	11	12	0.500

When the differences in the measurements before and after taping were categorized as “no change”, “increase” and “decrease” according to the minimal clinically significant difference value, the number of individuals with increased scaption strength was higher in the kinesio tape group compared to the sham group, however it did not reach to the level of statistical significance ( $p = 0.055$ ). The number of individuals with an increase in upper extremity stability test scores was found to be similar between the two groups (**table III**).

## DISCUSSION

This study demonstrated that the number of individuals who observed an increase greater than the minimum clinically significant difference in muscle strength and upper extremity stability test scores with kinesio taping was higher, however it was not statistically significant when compared with the sham group. There are many studies examining the effects of kinesio taping. Significant improvements were obtained in some of these studies (16, 38-40), whereas statistically significant changes were not observed in others (17, 41, 42). There are not sufficient data to explain the reasons for these discrepancies.

In 20 healthy students, taping the deltoid muscle (a Y tape and an I tape perpendicular to it at the coracoid process level) had no significant effect on shoulder stability or functional performance (42). In another study, the immediate effect of kinesio taping applied with the facilitation technique to the infraspinatus and teres minor muscles in the form of two I tapes demonstrated no significant difference regarding peak torque of the shoulder external rotators and shoulder internal-external range of motion in 39 healthy individuals compared to the placebo taping (19). Similarly, in male athletes with rounded shoulders, rotational kinesio tape application did not have immediate effect on shoulder dynamic balance and proprioception, compared to group

without tape (43). The abovementioned studies performed the assessments immediately after taping, as in our study. The short time interval might prevent the possible potential beneficial effects of taping on the muscle functions.

Hand grip strength measurements performed immediately after kinesio taping applied to the dominant forearm extensor muscles were higher than that of inelastic taping in healthy adults (39). In another study consisting of 150 people, kinesio taping group had greater hand grip strength than that of control group, whereas similar to the group of the soft tissue mobilization with graston (44). Regular users of kinesio tape to the forearm extensor muscles demonstrated a significant increase in hand grip strength compared to those who were not regular users. However, electromyographic activity and self-perceived performance did not differ between the two groups (45).

In studies investigating the long-term effects of kinesio tape, 2 weeks of kinesio tape applied to the dominant forearm in combination to exercise of both extremities, a significant increase was observed in the hand grip strength of the dominant extremity compared to the non-dominant extremity in 32 healthy individuals (46). In another study, taping to the forearm extensor muscles increased maximum hand grip strength significantly as time progressed in the measurements performed at the 30<sup>th</sup>, 60<sup>th</sup>, 90<sup>th</sup> and 120<sup>th</sup> minutes in 40 healthy individuals (47). Considering the results of these studies, it can be interpreted that the effects of kinesio tape on muscle strength become more evident as the duration of stay of kinesio tape in the body in healthy individuals is extended.

Regarding the direction of kinesio tape application either in a facilitatory or inhibitory direction, studies did not support one's superiority over another in improving muscle function. Hand grip strength, electromyographic activity or self-perceived performance did not differ when kinesio taping applied to the forearm extensor muscles either in the facilitatory or inhibitory direction in healthy subjects (43). Kine-

sio taping applied to the biceps brachii muscle from proximal to distal or distal to proximal in healthy individuals did not differ, however the application of two horizontal stripes provided the highest peak force (48). Although studies did not suggest any relationship between the direction of kinesio taping and its effect as it was thought, we preferred to apply kinesio taping in the direction of facilitation in our study.

The results of kinesio tape applications on the lower extremities were conflicting. Electromyographic activation and torque value increased 24 hours after the application of kinesio tape to the vastus medialis muscle in healthy subjects and the increase lasted 72 hours after the removal of tape (40). In another study, both concentric and eccentric torque of the muscle increased after taping applied to the quadriceps muscle together with isokinetic exercise in healthy women (16). Kinesio tape application to quadriceps muscle improved strength and functional performance greater than that of kinesio taping in combination with brace or only brace in healthy individuals (38). Immediate effect of kinesio taping applied to the quadriceps muscle did not differ regarding bioelectrical activity in electromyography, postural balance or lower extremity functions compared to inelastic adhesive tape in 60 healthy women (49).

In studies investigating athletes, kinesio taping applied to the forearm muscles was not superior to the placebo in the immediately measured hand grip strength (17). With Y-shaped kinesio tape applied to the quadriceps muscle of the athletes; no significant difference was observed in muscle strength measurements performed immediately or 12 hours after taping (41). It can be concluded that the high fitness level of the healthy athletes and their regular training would reduce the possibility of the additional effect of kinesio taping.

In 39 patients with partial rotator cuff tendinopathy, 4 weeks of kinesio tape applied over 3 regions (the supraspinatus and infraspinatus, deltoid muscle belly and an I-shaped tape anchoring the others from the coracoid process towards the scapular spine) found that kinesio taping increased muscle strength of flexors and internal rotators while kinesio taping and exercise increased muscle strength in all directions (50). In our study, kinesio taping was applied only to healthy people and in direction of facilitation, whereas Martins de Silva *et al.* applied it with the muscle inhibition method. Facilitation of muscle activity due to pain inhibition may have played a role in the increase in muscle strength they found. In our study, we may not have seen an increase in strength because the people were already healthy.

The effect of kinesio tape application on shoulder joint position sense, strength, function and return to sports can be investigated in new studies to be planned in athletes such as swimmers, where shoulder pathologies such as scapular dyskinesia are common (51), and overhead athletes following arthroscopic rotator cuff repair (52).

### Limitations of the study

Absence of long-term follow up is a limitation of our study, we only investigated the acute effects of kinesio taping on muscle strength and upper extremity stability. The results of our study cannot be generalized to individuals and athletes with musculoskeletal problems, since only healthy individuals were included.

Sham tape application may be another limitation of the study. Although sham was applied to the posterior surface of the scapula not aligned with the direction of muscle fibers and without tension, we cannot be completely sure that it had no effect on the infraspinatus or trapezius muscle.

## CONCLUSIONS

Kinesio taping applied to healthy women was not superior to sham taping on shoulder scaption muscle strength and upper extremity stability. In order to better understand the effects of kinesio taping in future studies, it is recommended to make measurements at different times after the application and to plan studies that will examine the effects on athletes and patients.

## FUNDINGS

None.

## DATA AVAILABILITY

Data are available under reasonable request to the corresponding author.

## CONTRIBUTIONS

DK, HA, OOT: data collection, data analysis and interpretation, writing - original draft, writing - review & editing. All authors: study design.

## CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

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