

# The Effect of Elastic Tape on Lower Extremity Muscle Activity in Squats of Young Female Adults: A Cross-sectional Pilot Study

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## Key Words

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Kinesio tape

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**Background:** In terms of physical performance, elastic tape (ET) is known to contribute to injury prevention and performance enhancement.

**Objects:** This study aimed to compare and analyze the effect on lower extremity muscle activity of young adult women with and without ET during squats.

**Methods:** In this study, six healthy, young women were recruited as participants in a university laboratory. Participants were allocated to two groups of three after measuring muscle activity in a pre-test, and the experiment was conducted for a total of two weeks (two sessions). First, 10 half squats were taped once in the first week, and 10 half squats were performed without taping in the second week. The other group did this in reverse and measured muscle activity after the squat was over.

**Results:** As a result of this study, there was no significant difference in the quadriceps with or without ET ( $Z = -0.11$ ,  $p > 0.05$ ). Similarly, no significant difference was found in hamstring ( $Z = -0.31$ ,  $p > 0.05$ ).

**Conclusion:** No beneficial effect was found on changes in muscle activity following ET application during squats. Further studies require randomized controlled trials that increase the number of participants and the intensity of the intervention, and measure pain, function, and performance rather than muscle properties depending on the biomechanical lifting mechanism.

## INTRODUCTION

Squat is one of the most important exercises for strength and conditioning training and an essential means to strengthen the muscles and connective tissues of the lower extremities, prescribed by physiotherapists in clinical practice [1-4]. However, inadequate exercise prescription and failure to control movement during squat increase the risks of spondylolysis and patellofemoral joint pain and cartilage damage as well as knee meniscus tear [5-8]. Therefore, prevention of musculoskeletal injuries and diseases during exercise is fundamental, which can be achieved by using elastic tape (ET) among various methods [9].

ET is known to improve blood and lymph flow in injured muscles and joints [10]. It also assists in improving muscle contraction during exercise and positively affect muscle alignment and range [9,11,12]. In a previous study using surface elec-

tromyography (sEMG), ET has improved muscle activity [13]. Improvement of muscle activity is an effect explained through the biomechanical lifting mechanism (BLM) [13]. The principle by BLM is to improve the flow of blood and lymph by widening the space between tissues.

However, conflicting results have been reported among studies. Therefore, the hypothesis of this study is that muscle activation would vary depending on the presence of tape and the application site. Based on the relationship between neurofacilitation and mechanical restraint [14], this study aimed to compare the muscle activation in the lower extremities according to the presence of ET and perform sub-analyses according to different application sites.

## MATERIALS AND METHODS

### 1. Study Design

This was a prospective, open-label, cross-sectional study based on the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guidelines.

### 2. Participants

Potential participants in this study were recruited from adults in their 20s who are attending Kyungbuk College. Prior to the experiment, the research participants were selected as those who voluntarily obtained consent in accordance with the ethical principles in accordance with the Declaration of Helsinki after conducting sufficient education on the purpose of the research and the experiment before the experiment. Based on Serrão et al. [15], the eligibility criteria for study participants were those who were physically and mentally healthy, had no musculoskeletal injury experience in the past one year, and were able to faithfully participate in the study from the start date to the end date.

### 3. Interventions

The intervention in this study consisted of 20 minutes per session (5-minute warm-up, 10-minute main exercise, 5-minute cool-down) once a week for two weeks [16]. In the first session, squats were performed with ET, and in the second session, squats were performed without ET.

#### 1) Squat

Enrolled participants performed the squat after watching the squat demonstration by the researcher and then receiving verbal instructions. The distance between the feet was twice the distance between the anterior superior iliac spines, and the knees were allowed to come down over the toes without tilting medial or lateral. During the squat, the trunk was kept perpendicular to the ground, and the feet were not allowed to come off the ground [17,18]. During this exercise, two sets of five repetitions were performed for 10 minutes, and a 5-minute break was given in the middle of the set.

#### 2) Elastic tape

The ETs were attached to the quadriceps [15] and hamstrings [18]. First, the quadriceps muscle was attached from where the knee was bent at 90°, cut into two halves above the patella,

and attached along the edge at the tibia tuberosity without crossing the patella. The hamstring muscle was attached in a reverse Y shape from the ischial tuberosity to the medial condyle of femur and the lateral condyle. Taping was applied by a physical therapist with 8 years of experience.

### 4. Outcomes

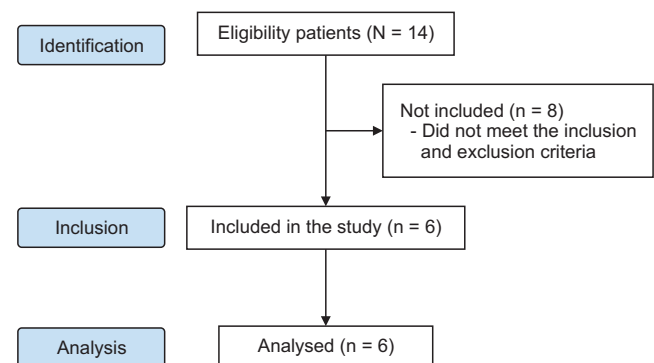
sEMG (4D-MT V2.0, Relive B.V.) device quantifies muscle contraction [19]. To attach surface electrodes (2225H, Hurev Co., Ltd.), hair was shaved, and foreign substances were removed using an alcohol pad. Electrodes were attached to rectus femoris and semitendinosus at the midpoint from the origin to insertion of the two muscles [20].

### 5. Statistical Analysis

IBM SPSS statistical software (ver. 28.0, IBM Co.) was used for all statistical analysis in this study. Descriptive statistics were conducted for general characteristics of participants. As the sample size was not normally distributed, non-parametric tests were conducted for analysis of the main effects. Wilcoxon signed-rank test was conducted for comparison of baseline and post-intervention results. In this study, all significance level ( $\alpha$ ) was set to 0.05.

## RESULTS

As shown in Figure 1, of 14 eligible participants, a total of six participants were selected and included in final analysis according to the participant selection criteria. All participants were young adult women, and the mean  $\pm$  standard deviation of age, height, and weight were  $22.66 \pm 3.61$  years,  $163.33 \pm 6.44$  cm, and  $58.16 \pm 13.92$  kg.



**Figure 1.** STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) flow diagram.

**Table 1.** Changes in lower extremity muscle activity

Variable	Baseline	Post-test	Z	F
	Mean ± SD	Mean ± SD	t	
Quadriceps femoris				
With elastic tape	3.75 ± 0.75	2.75 ± 0.75	4.69	7.48
Without elastic tape	3.50 ± 0.67	1.17 ± 1.40	6.57	
Hamstring				
With elastic tape	3.75 ± 0.75	2.75 ± 0.75	4.69	7.48
Without elastic tape	3.50 ± 0.67	1.17 ± 1.40	6.57	

Mean ± SD, mean ± standard deviation.

There was no significant difference in muscle activity between ET and non-ET groups ( $p > 0.05$ ). Similarly, there was no difference in muscle activity by ET attachment muscle ( $p > 0.05$ ) (Table 1).

## DISCUSSION

This pilot study evaluated changes in muscle activity during squats with and without ET applied to six young adult women and compared them according to the site of application.

Although no significant differences were found, quadriceps muscle activity tended to decrease while hamstring muscle activity tended to increase with ET attachment. The small number of participants evaluated in this study limits generalization of this study's findings. Similar to our results, previous studies reported changes in muscle activity by ET during exercise [9,11,12], and such effects could be partially explained by BLM.

However, a systematic review and meta-analysis study concluded that there is no substantial evidence supporting improvement of muscle strength by ET [21]. Therefore, there were no changes in muscle activity induced by ET, which are consistent with our findings. This suggests that ET has limitations in promoting muscle strength and directly changing muscle activity.

Although the nature of a pilot study presents challenges in drawing conclusions with a small number of participants, as seen in previous studies, ET seems to have limitations in increasing muscle strength and changing muscle activity during strength training. Another meta-analysis study reported contradictory findings that ET could help control delayed onset muscle soreness observed after strength exercise [22]. In agreement with this finding, other studies showed that ET was effective in controlling delayed onset muscle soreness after eccentric exercise [23], and in other studies, ET increased range

of motion [11,12,24]. Additionally, ET was effective in pain control and muscle fatigue in patients with back pain based on these findings, the mobility of body fluids between layers of tissue might have increased by BLM. This reduced accumulation of fatigue factors and pain inducing factors observed after muscle activity, improving muscle soreness and range of motion.

In this study, it was hypothesized that there would be differences in muscle activity depending on the attachment site of the ET; however, no significant differences were found. Based on the results of this preliminary study, further randomized controlled trials with a larger sample size, including both male and female participants, are required. Moreover, future studies should examine variables (e.g., pain, function, performance, etc.) related to body fluid mobility based on the underlying BLM, rather than focusing solely on changes in muscle activity, within the study procedure.

## CONCLUSIONS

In conclusion, it is difficult to expect changes in muscle activity according to the ET attachment and attachment site during squats. In further studies, it is recommended to verify the effect of the tape through variables according to BLM rather than variables that directly affect muscle properties.

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## CONFLICTS OF INTEREST

No potential conflicts of interest relevant to this article are reported.

## AUTHOR CONTRIBUTION

Conceptualization: NC, YK. Data curation: YK. Investigation: NC, YK. Resources: NC, YK. Software: NC. Supervision: NC, YK. Validation: YK. Writing - original draft: NC, YK. Writing - review & editing: YK.

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