Effects of Patellar and Mixed Hip and Patellar Taping on Muscle Activation during the Squat Exercise

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Abstract

Objectives: The purpose of present study was to the effects of the use of mixed taping methods on muscle activation during the squat exercise. Methods/Statistical Analysis: Twenty females were recruited for this study. Subjects were required to squat under three conditions: no taping, patellar taping, and mixed hip and patellar taping. The VM: VL activity ratio and GMax activity were calculated using surface electromyography during the squat exercise. One-way repeated-measures analysis of variance was used for statistical analysis. Findings: The combination of patellar and hip taping increased VM: VL and GMax activity compared to the other conditions during the squat exercise. Improvements/Applications: We suggest that mixed taping is a useful method for enhancing VM: VL and GMax strength during the squat exercise.

Keywords: Electromyography, Mixed Taping, Patellofemoral Pain, Patella Taping, Squat

1. Introduction

Uncontrolled movement and muscle dysfunction lead to knee pathologies for instance Patellofemoral Pain (PFP)¹⁻². The occurrence of PFP is 2-3 times more frequently female compared male³. Although the etiology of PFP is unknown, some possible risk factors linked to malalignment of the lower extremity, including lower Vastus Medialis (VM)/Vastus Lateralis (VL) ratio, stiff iliotibial band, and patella tilting⁴. Therefore, the selective exercise for VM, iliotibial band stretching, and activity modification was based on physical therapy intervention for treating patients with PFP. PFP patients performing weight-bearing exercises such as the squat exercise tend to excessive hip internal rotation, which leads to knee adduction movement⁵⁻⁶. To correct this movement, many clinicians have recommended the use of corrective taping during the squat exercise such as patella taping and hip taping⁷. Patellar taping is generally practiced among physiotherapists to correct medial knee displacement⁸. Several studies have shown that patella taping helps to activity modification and decrease pain in patients with PFP⁸⁻⁹. In ⁹ found that apply to patellar taping increased VM activity and decreased VL activity in PFP patients⁹. Thus, authors emphasized that patella taping was useful for treating PFP patients. A recently study has shown that hip taping can change patellofemoral kinematics and reduce pain¹⁰. In ¹⁰ showed that femoral rotation taping changed patella movement and decreased pain compared with no taping and sham taping in patients with PFP¹⁰. Although both patellar taping and hip taping have been reported, no study has yet investigated the effects of...
mixed hip and patellar corrective taping on hip extensor and knee extensor muscle activity. Therefore, the purpose of present study was to the effects of the use of mixed taping methods on ElectroMyoGraphy (EMG) activities of the Gluteus Maximums (GMax) muscles and on the VM: VL ratio during the squat exercise. We hypothesized that mixed taping methods would increase VM: VL ratio and increase GMax EMG activity during the squat exercise.

2. Subjects and Methods

2.1 Subjects

Twenty female with no present or previous of knee pain were participated from Nambu University, Korea Table 1. In this study, female were recruited through the Craig test (with >20° medial hip rotation)\(^\text{11}\). Exclusion criteria were a history of neuromuscular disorder, absence of normal range of motion, and leg-length discrepancy\(^\text{12}\).

Table 1. Descriptive data for participants

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Mean ± SD</th>
</tr>
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<tbody>
<tr>
<td>Age(years)</td>
<td>20.3±1.3</td>
</tr>
<tr>
<td>Body mass(Kg)</td>
<td>166.3±4.3</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>53.6±7.9</td>
</tr>
</tbody>
</table>

2.2 Instrumentation

Raw EMG data were collected via surface EMG using a Laxtha EMG System (WEMG-8, LXM53008, Laxtha, Korea) Figure 1. The detected bio-signals data were stores with digitally at 2.000sample s/s, through the 20~450 [Hz] band-pass analog filters and signal amplifier, and then RMS value was converted.

2.3 Procedures

The EMG data were collected from the VM (oblique angle 2 cm medial to the superior medial border of the patella), VL (3 cm above the patella at an oblique angle just lateral to the midline), and GMax (midway between the greater trochanter and second sacral vertebra) muscles\(^\text{12}\). The electrodes were oriented in estimated direction of the muscle fiber. Each maximum isometric contraction was performed 3 trials for 5 seconds, and the average muscle activity for the middle 3 seconds of performed 3 was used for normalization\(^\text{13}\). Subjects performed the squat exercise under three conditions: no taping, patellar taping, and mixed (hip and patellar) taping. Under the no-taping condition, subjects performed the squat with no tape applied. Under the patellar-taping condition, tape was applied as follows prior to the squat, the patella was pushed toward the medial side of the leg to lead to medial attraction, and then the knee was taped using McConnell tape\(^\text{14}\). Under the mixed-taping condition, the McConnell technique with femoral rotation was applied; the femur was maximally rotated externally, and the therapist applied Kinesio tape anchored at the inferior–medial aspect of the thigh. The primary investigator described the three experimental conditions (no tape, patellar tape, and mixed tape).
and instructed the squat exercise strategy to all subjects. Subjects set up for squat exercise in a standing position while lower extremity fully extended. When squatting, subjects’ arms were folded across the chest, and the trunk was held upright to avoid flexion. The EMG data collected during 3 s while the knees were in 70° flexion.

2.4 Statistical Analysis

One-way repeated-measures Analysis Of Variance (ANOVA) and the post hoc Bonferroni test were conducted on muscle activation to compare the three conditions (no tape, patellar tape, and mixed tape). Statistical analyses were performed using SPSS version 18.0 for Windows (SPSS, Inc., Chicago, IL, USA), and significance level was set at point ≤ 0.05.

3. Results

Significant differences in VM: VL and GMax muscle activity were observed with mixed taping compared to patellar taping and no taping Tables 2 and 3.

Table 2. The EMG activity ratio of VM: VL

<table>
<thead>
<tr>
<th>Type of taping</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>0.97 ± 0.58a,c</td>
</tr>
<tr>
<td>Patella</td>
<td>1.04 ± 0.62 b</td>
</tr>
<tr>
<td>Mixed</td>
<td>1.10 ± 0.75</td>
</tr>
</tbody>
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Table 3. The EMG activity of GMax

<table>
<thead>
<tr>
<th>Type of taping</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>10.3 ± 0.95a,c</td>
</tr>
<tr>
<td>Patella</td>
<td>11.23 ± 1.0b</td>
</tr>
<tr>
<td>Mixed</td>
<td>14.63 ± 1.71</td>
</tr>
</tbody>
</table>

4. Discussion

The squat exercise is often used to train the lower extremity for spots and rehabilitation in individuals with knee injuries such as PFP with the aim of improving the function of lower-extremity muscles\(^{15-17}\). Compared to controls, PFP patients were more likely to show decreased strength of the hip external rotator and altered knee extensor muscles\(^{18,19}\). Weakness or altered these muscles related to knee valgus movement during weight-bearing exercise\(^{20,21}\). To enhance the strength of these muscles, corrective taping methods are often performed in patients with PFP. Although patellar taping and femoral rotation taping have been reported, no study has yet researched the effects of mixed hip and patellar corrective taping on muscle activities of the hip and knee extensors. The purpose of this experiment the effect of mixed taping on the activity of the VM: VL and GMax in female during squat exercise. In this study, we observed increased GMax muscle activity under mixed taping compared to patellar taping and no taping during the squat exercise. One mechanism may explain the increase in GMax under mixed taping compared to that under patellar taping and no taping. Altered gluteal muscular pattern is correlated with hip internal rotation and hip adduction movement. The present results showed that mixed taping increased the EMG activity of GMax, thereby decreasing hip internal rotation and adduction movement during squat exercise. Thus, the increase in GMax muscle activity via application of femoral rotational taping may have improved optimal knee alignment. In Present experiment, the VM: VL activity ratio was increased under mixed taping compared to patellar taping and no taping. Compare to VL, weakness of the VM results in lateral displacement of the patella; thus, facilitation of the VM muscle activity has been recommended\(^{22,23}\). An increased VM: VL ratio indicate that there is an increase in medial full on patella\(^{24}\). In the present study, the increased muscle activity of the VM under mixed taping may have resulted from the decrease in abnormal lateral displacement of the patella. These findings are consistent with those of in who found increased VM and decreased VL activity under patellar taping. Mixed taping applied to the mid patella tendon during the performance of the squat requires a reduction in hip medial rotation, which may increase the VM: VL
activity ratio. The Present study had some limitations. First, we take into explanations that apply of asymptomatic female, and further study should need hip and knee extensor muscle activity in PFP syndrome. Second, we did not assess kinematic factors such as knee valgus angle, hip internal rotation, and patella tracking; further studies are needed to examine the kinematic data.

5. Conclusions

We found a significant increase in VM: VL and GMax activity under mixed taping. A mixed taping procedure can improve both patellar alignment and femoral alignment in patients with PFP. The results may also indicate a potential benefit of the application of mixed taping to aid squat exercise in patients with PFP.

6. References

20. Levinger P, Gilleard W, Coleman C. Femoral deviation angle during a one leg squat test in individuals with patello-


