Muscle Activity of the Gluteus Medius at Different Gait Speeds

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Abstract. [Purpose] The present study aimed to determine the changes in the muscle activities of the gluteus medius, latissimus dorsi, and gluteus maximus at different gait speeds, to collect basic data for the study of the gluteus medius. [Subjects and Methods] The subjects were 18 young and healthy male adults whose mean age, height, and weight were 26.4 years, 173.37 cm, and 72.5 kg, respectively. Electromyography was used to measure the maximum voluntary isometric contraction of each muscle three times and the values averaged. Then, the subjects walked on a treadmill at gait speeds of 1.5 m/s, 2.5 m/s, and 3.5 m/s and the muscle activity of each muscle was measured. [Results] The gluteus medius showed no significant difference in muscle activity among the different gait speeds. [Conclusion] For selectively strengthening the gluteus medius, to establish the external stability of the pelvis during walking, weight loading or sloped treadmills are effective interventions. However, different gait speeds exert no significant effect on the selective strengthening of the gluteus medius.

Key words: Gait, Gluteus medius, Speed

INTRODUCTION

The symmetry of gait refers to the shift and support of body weight on both sides of the lower extremities, and it requires external stability of the hip joint. External stability is the ability to control the center of mass of body weight while moving the body3). During the stance phase of gait, the posture of the hip joints is stabilized and the gluteus medius, which is the hip abductor muscle in the hip joint, plays an important role in independent gait and balance recovery2). Muscle weakness and malfunction of the gluteus medius is related to various musculoskeletal disorders, including low back pain3,4), while height differences in the hip joint can be found in persons with radiating pain around the low back and hip joints, which is accompanied by muscle weakness in the gluteus medius5). Vleeming et al.6) suggested that a posterior oblique sling links the hamstring, gluteus maximus, thoracolumbar fascia, and contralateral latissimus dorsi, in sequence. Lee et al.7) studied the changes in muscle activity of the gluteus medius in the stance phase as vertical load was applied to the lower extremities in the swing phase. They found that muscle activity increased when 0.5 kg of vertical load was applied to the lower extremities in the swing phase compared to normal gait, whereas counterintuitively the muscle activity decreased when 1 kg of vertical load was applied, compared to the 0.5 kg load. In addition, they noted that among loads of 0, 1 and 2% of body weight, the most appropriate weight for strengthening the gluteus medius was a vertical load of 1% of body weight8). Furthermore, Jung et al.9) measured the muscle activity in the gluteus medius during walking on a treadmill set at angles of 0°, 5°, and 10°, and they showed that the muscle activity was the highest at when the treadmill angle was 5°. These previous studies discussed muscle activity of the gluteus medius in relation to vertical loads and treadmill angles, which are intervention conditions whose outcomes are thought to be affected by gait speed. Therefore, the present study aimed to determine the changes in the muscle activities of the gluteus medius, latissimus dorsi, and gluteus maximus at different gait speeds, to collect basic data for the study of the gluteus medius.

SUBJECTS AND METHODS

The subjects of this study were 18 young and healthy male adults whose mean age, height, and weight were 26.4 years, 173.37 cm, and 72.5 kg, respectively. The subjects had no history of functional impairment in their musculoskeletal or nervous systems and they had no difficulty with normal gait. This study complied with the ethical principles of the Declaration of Helsinki. The subjects fully understood the experimental method before the experiment started and they participated in the experiment voluntarily. In addition, none of the processes in this study were harmful to the human body and all the subjects read and signed a written consent form. Electromyography (EMG) was used...
to measure the maximum voluntary isometric contraction (MVIC). The MVIC activities of the gluteus medius, latissimus dorsi, and gluteus maximus were measured three times and then averaged. Then, the subjects walked on a treadmill at gait speeds of 1.5 m/s, 2.5 m/s, and 3.5 m/s while the muscle activities of each muscle were measured. A MP36 (BIOPAC System Inc., USA) was employed to collect EMG data of the latissimus dorsi, the gluteus medius, and the gluteus maximus. While subjects walked at the three different gait speeds, the EMG signals were collected for 20 seconds out of 30 seconds, the first and last five seconds being discarded. For each EMG measurement, the subjects performed gait on the treadmill for one minute under the same conditions and measurements were taken during the last 30 seconds of gait. The subjects walked barefoot and they removed all the outer clothing they were wearing on the upper portion of their body, retaining only their undershirts. The electrodes were placed horizontally in the direction of the muscle fibers at 4 cm below the inferior angle of the scapula in the middle area between the outermost end of the trunk and the vertebral for the latissimus dorsi. The electrodes were placed horizontally in the direction of the muscle fibers at one third the distance between the greater trochanter of the femur and the second sacrum for the gluteus maximus, and for the gluteus medius the electrodes were placed horizontally in the direction of the muscle fibers at one third the distance between the iliac crest and the greater trochanter. One-way analysis of variance was used to examine the pelvic muscle activities during gait. As a post hoc test, the least significant difference test was used. For the data analysis, SPSS software version 18.0 was used. The significance level was chosen as 0.05.

**RESULTS**

A comparison of the results of the pelvic muscle activities at the under various gait speeds found that the latissimus dorsi showed a significant increase in muscle activity when performing a faster than normal gait, while the gluteus medius showed no significant difference in muscle activities among the different gait speeds. The gluteus maximus showed increases in muscle activity when performing gait at speeds faster than the normal gait speed (1.5 m/s) (Table 1).

**DISCUSSION**

A social and functional gait, such as crossing the road safely, requires a speed of 1.1–1.5 m/s on average. This study aimed to determine changes in muscle activity of the gluteus medius at gait speeds faster than a normal gait speed. Although a number of studies have been conducted to determine changes in the muscle activity of the gluteus medius across different intervention methods used to strengthen the gluteus medius, few studies have been conducted on the changes in muscle activity of the gluteus medius with gait speed. The gluteus medius is a muscle that prevents the pelvis from descending on the opposite side to the leg in the swing phase during walking. In previous studies, this muscle was selectively strengthened by applying weight to the legs or changing the angle of the treadmills. However, those studies did not investigate changes in gait speed. Our present study’s results show that gait speed has no effect on the selective strengthening of the gluteus medius. The study conducted by Sin et al. also noted that no change in the muscle activity of the gluteus medius was found between gait speeds changes of 3.5 and 5.5 m/s. In particular, while performing gait with weight loading on the arm, changes in the muscle activities of the latissimus dorsi and the gluteus maximus, which are the principal muscles of the Posterior Oblique Sling Theory proposed by Bermark, were found to be significant. However, no change in the muscle activity of the gluteus medius was found. In summary, at faster gait speeds, greater increases in the muscle activities of the latissimus dorsi and the gluteus maximus are seen, whereas no correlation has been found between gait speed and the muscle activity of the gluteus medius. In this study, we measured the muscle activity of the gluteus medius, at a normal gait speed, and at gait speeds faster than that normally used in ordinary daily living. Therefore, intervention methods that aim to selectively strengthen the gluteus medius in order to establish external provide stability of the pelvis during walking, using weight loading or sloped treadmills are an effective intervention methods, but changing the gait speed has no significant effect on the selective strengthening of the gluteus medius.

**ACKNOWLEDGEMENT**

This research was supported by Kyung-sung University Research Grant in 2014.

**REFERENCES**

5) Sahrmann SA: Diagnosis and treatment of movement impairment syn-

**Table 1. Comparison of the muscle activities at the different gait speeds (unit: %MVIC)**

<table>
<thead>
<tr>
<th>Muscle</th>
<th>1.5 m/s</th>
<th>2.5 m/s</th>
<th>3.5 m/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>GMed</td>
<td>11.57±3.50</td>
<td>10.88±3.56</td>
<td>9.86±3.14</td>
</tr>
<tr>
<td>LD*</td>
<td>2.74±1.16</td>
<td>3.18±1.34</td>
<td>4.25±1.77</td>
</tr>
<tr>
<td>GMax*</td>
<td>10.38±2.54</td>
<td>11.47±2.42</td>
<td>12.53±2.42</td>
</tr>
</tbody>
</table>

*p<0.05, Mean±SD

GMed: gluteus medius, LD: latissimus dorsi, GMax: gluteus maximus

†significant difference between 1.5 m/s and 3.5 m/s (p<0.05).
‡significant difference between 2.5 m/s and 3.5 m/s (p<0.05).
¥significant difference between 1.5 m/s and 3.5 m/s (p<0.05).


