J. Phys. Ther. Sci. 28: 1582–1583, 2016

The Journal of Physical Therapy Science

Original Article

Effects of bridging plus exercises with heel lift on lower extremity muscles

Won-gyu Yoo[1)]

[1)] *Department of Physical Therapy, College of Biomedical Science and Engineering, Inje University: 607 Obangdong, Gimhae, Gyeongsangnam-do 621-749, Republic of Korea*

Abstract. [Purpose] This study investigated the effects of the bridging plus exercise with heel lift on lower extremity muscles. [Subjects and Methods] Nine healthy males participated. The subjects performed bridging exercises under two conditions. Surface electromyography was used to measure the electrical activities of the medial hamstring (MH) and the gluteus maximus (GM) muscles. [Results] Activation of the MH muscle during bridging with heel lift decreased, and activation of the GM muscle during bridging with heel lift increased compared to those with the bridging exercise. [Conclusion] This result showed that bridging plus exercises with heel lift could be an effective exercise for patients with compensatory mechanisms during bridging exercises, such as weak GM with hamstring tightness.

Key words: Bridging exercise, Heel off, Plus-up exercise

(This article was submitted Jan. 12, 2015, and was accepted Feb. 2, 2016)

INTRODUCTION

Bridging exercises are one of the most commonly used exercises for lumbopelvic stabilization in the rehabilitation of individuals with low back pain[1)]. The trunk repositioning accuracy of low back pain patients is significantly lower than that of healthy subjects[2)]. Patients performing these exercises often have excessive spine movements, inducing unwanted anterior pelvic tilt, and lumbar and thoracic hyperextension. Decreased activity of gluteus maximus (GM) is one cause of low back pain, resulting in sacroiliac joint instability and dysfunction[3)]. Hamstring tightness is commonly observed as a compensatory mechanism for weak GM during bridging exercises[4)]. Rehabilitation professionals recommend supine bridging exercises with a neutral spine to target the gluteus maximus. This study investigated the effects of the bridging exercise combined with a heel lift on lower extremity muscles.

SUBJECTS AND METHODS

Our study subjects were 9 males aged 23.2 ± 2.1 years (mean ± SD) with a mean height and weight of 169.8 ± 2.5 cm and 65.5 ± 5.3 kg, respectively. Subjects with conditions that might affect trunk mobility, such as injury or neurologic deficits of the hip and lower extremities during the previous year, were excluded from the study. The subjects received an explanation about the purpose and methods of the study prior to their participation and provided their informed consent according to the ethical principles of the Declaration of Helsinki. Electromyographic (EMG) data were collected using Biopac MP100WSW (Biopac Systems, Inc., Goleta, CA, USA). We measured the medial hamstring (MH) and the GM during the bridging exercise and bridging with heel lift exercise. Bridging exercises were performed in the supine position. The knees were flexed at 90°, with the feet hip-width apart while resting on the floor, and the toes facing forward. The arms were crossed over the chest to minimize arm support. The subject was instructed to lift his pelvis comfortably at a self-selected speed until the trunk, pelvis, and thigh were aligned in a straight line (hip extension 0°). The subject was asked to hold the bridging position for 5 seconds

Corresponding author. Won-gyu Yoo (E-mail: won7y@inje.ac.kr)

with the pelvis and thigh aligned in a straight line. The bridging exercise with heel lift included the addition of lifting the heel off the ground in the final stage of the bridging exercise. Data were analyzed using SPSS 18.0. The paired t-test was used to test differences between the different bridging conditions, with a significance level of $\alpha=0.05$.

RESULTS

The EMG activity of the MH muscle during the bridging with heel lift exercise was significantly (26.9 ± 5.2%) less than in the bridging exercise (31.3 ± 6.9%) ($p<0.05$). The EMG activity of the GM muscle during the bridging with heel lift exercise (25.6 ± 7.2%) was significantly more than in the bridging exercise (20.3 ± 5.6%) ($p<0.05$).

DISCUSSION

These results showed that the EMG activity of the MH muscle during the bridging with heel lift exercise was significantly lower than in the bridging exercise ($p<0.05$). The bridging exercise is a closed chain exercise[5)]. The isometric exercise for knee flexion to 90° in the supine position requires co-activation between the calf muscle and the hamstring muscle[5)]. The bridging exercise combined with heel lift increases the activation of the calf muscle, so the activation of the hamstring is decreased. This result showed that the EMG activity of the GM muscle during the bridging with heel lift exercise was significantly greater than during the bridging exercise ($p<0.05$). Bridging exercise combined with heel lift also decreases the base surface, providing a more unstable condition. GM has a function in maintaining the stability of the pelvis, so by decreasing the stability of the position, the heel lift condition might result in increased activation of the GM[5)]. The heel lift motion could easily increase the exercise difficulty without additional tools or devices. Lehman et al also demonstrated that push-up exercises with elevated feet activated the serratus anterior to a greater extent than did the position with the feet on the ground[6)]. Overall, these results show that the bridging plus exercise with heel lift could be an effective exercise for patients with compensatory mechanisms, such as hamstring tightness resulting from weak GM, during bridging exercises.

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