The Impact of Abductor and Adductor Contraction in a Bridging Exercise on Muscle Activities in of the Abdominal Region and the Lower Extremities

SANG-YEOL LEE, PT, PhD¹⁾, SU-KYOUNG LEE, PT, MS²⁾

¹⁾ Department of Physical Therapy, Kyung Sung University

²⁾ Department of Physical Therapy, Gimhae College: Sambang-Dong, Gimhae-si, Gyeongnam 621-706, Republic of Korea. TEL: +82 55-3201735, FAX: +82 55-3366222, E-mail: holeintwo@naver.com

Abstract. [Purpose] This study examined the effects of different bridging exercises on the trunk muscles, and provides preliminary data for clinical use. [Methods] Bridging exercise with hip abduction and adduction were used to examine the muscle activation of the hip abductors, which were measured by EMG. The subjects were 45 healthy young males. [Results] During adduction there were from general bridging position in all the muscle activities except for RF. The highest muscle activities were seen in TrA, EO and AM during adduction, and in RA and GM during abduction. [Conclusion] Bridging exercise with isometric abduction of the hip joint is effective at contracting RA and GM. Stabilizer exercise, it seems possible selectively strengthening of specific particular muscles by isometric adduction or abduction of the hip joint appears possible in bridging exercises for people who need lumbar stabilization exercises

Key words: Bridging exercise, Muscle activation, Trunk stabilization exercise

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INTRODUCTION

Overall coordination of the trunk muscles is more important than activation of particular muscles for the stabilization of spine¹⁾. Recently, studies have been conducted on posture and movement control, focusing on core stability^{2,3)}. Core stability exercise helps to control force when a patient's posture is unstable, and enables conscious and automatic control of movement, allowing maintenance of the spine neutral position, the best position for dealing with external loading. This exercise is receiving growing attention as a preventive measure along with therapeutic exercise⁴⁾. Among various stabilization exercises, the bridging exercise has an important influence on functions of pelvic movement, which are involved in mobilization on the bed, use of a toilet seat, relief of pressure, putting on clothes on the lower limbs and gait⁵⁾. Also, pelvic movement is important for weight-bearing on the feet and in the half kneeling position. In a sitting position, the core stability exercise increases postural control in the standing position, and strengthens the lower spine and hip extensor muscles in preparation for the stance phase of a gait⁶⁾.

Stabilization of the trunk enhances functional posture and increases spine and pelvic stability in movement. It also strengthens muscles and helps to improve control of the muscles and balance in movements⁶⁾. Among the methods that gradually increase intensity of trunk stabilization, one method increases the intensity and frequency of resistance, and another method increases exercise intensity while raising instability of the support surface using a therapeutic

ball, vestibular balance board or a foam roll⁷⁾.

Studies of muscle loading and spinal stability have reported that, when a healthy adult performs a lumbar stabilization exercise, there is high correlation with abdominal curl, side bridging exercise with right isometric side support, bridging exercise with right leg raise, bridging exercise, and the muscle activity of the rectus abdominis⁸⁾. Also, it was reported that exercise of the abdominal muscle to maintain the neutral positions for maintenance of the spine in the during external loading with trunk rotation minimizes contraction of the rectus abdominis and causes co-contraction of the transverse abdominis and the oblique muscle, and is thus suitable as a trunk stabilization exercise⁹⁾.

Activation of the abdominal muscles is critical for stabilizing the pelvic muscles against the pulling force of the hip muscles. When the pelvic muscle is stable, the forces on the trunk are transmitted efficiently to the hip joint and the lower extremities¹⁰⁾. In this study, we examined how the hip joint and the lower extremities that are stabilized in an isometric adduction, and abduction, affect the activity of the abdominal muscles in a bridging exercise.

SUBJECTS AND METHODS

The participants were forty-five healthy males in their 20s and 30s, who had sufficient muscle strength, range of motion and balance ability to perform the bridging exercise, and were mentally capable of understanding and agreeing to participation in the experiment. Those who had problems in the nervous system, cardiopulmonary system or musculo-

Table 1. Comparison of muscle activities among the different bridging exercise positions

Muscle	Neutral	Adduction	Abduction
TrA*	355.40 ± 56.63	766.31 ± 145.79 [†]	513.51 ± 79.77
RA*	166.26 ± 5.56	188.67 ± 10.00	204.35 ± 8.53 [‡]
EO*	228.84 ± 15.77	344.20 ± 38.91 [†]	320.49 ± 27.46 [‡]
AM*	171.94 ± 12.27	433.82 ± 41.78 [†]	226.82 ± 27.51 [¥]
GM*	643.55 ± 111.67	829.03 ± 184.12	1205.85 ± 166.96 [‡]
RF	329.30 ± 95.15	460.81 ± 118.86	473.23 ± 148.67

unit=%RVC. mean ± SE. TrA: Transversus Abdominis. RA: Rectus Abdominis. EO: External Obliquus. AM: Adductor Magnus. GM: Gluteus Medius. RF: Rectus Femoris. Superscripts: [†]significant difference between neutral and adduction, [‡]significant difference between neutral and abduction, [¥]significant difference between adduction and abduction

skeletal system of the trunk and the lower extremities were excluded.

When performing the bridging exercise, the participants took the same starting position as the core stabilization exercise. They spread the knees to shoulder width, aligning the feet on a line extended from the shoulder to the knee. They were asked to maintain the distance between the knee and the feet during the exercise. The head and the eyes faced the ceiling so as not to affect the posture during the exercise. The general bridging exercise was performed for the first method, and a bridging exercise with isometric hip adduction was performed for the second method, keeping an exercise ball between the knees to adduct the hip joint.

For the third method, the participants performed a bridging exercise with isometric hip joint abduction, keeping an exercise ball between the knees and a wall to abduct the hip joint. Each exercise was repeated three times, in a random order. Each posture was kept for five seconds, and the muscle activation data for the middle three seconds, excluding the first and the last seconds, were recorded and averaged for the analysis. To prevent fatigue, the participants took one-minute break after each five-second exercise.

To examine how contraction of the hip joint in isometric adduction and abduction during the bridging exercise affected the muscle activities in the abdominal region and the lower extremities, a surface EMG Biopac student Lab MP 36 (Biopac System Inc, USA) was used. Data were filtered and processed on a computer using Acknowledge software. To reduce measurement errors, skin at the electrode placement site was cleansed with alcohol, then the electrodes were attached using a sufficient amount of electrolyte. From the measured EMG signals of the muscles, RMS values were calculated. These were divided by the resting voluntary contraction (RVC) value and are presented as percentage-value (%RVC).

To measure the subjects' muscle activities of the transverse abdominis (TrA), rectus abdominis (RA), external oblique (EO), adductor magnus (AM), gluteus medius (GM), and rectus femoris (RF), surface electrodes were attached to the trunk and the low extremity of the dominant side¹¹⁾.

The experimental results were analyzed using SPSS Version 18.0 for Windows. To examine differences in muscle activities between the general bridging exercise and the bridging exercise isometric hip adduction and abduction,

repeated one-way ANOVA was used. Turkey's test was used for a post hoc test, and the significance level, α , was chosen as 0.05.

RESULTS

The general bridging exercise and bridging exercises with isometric hip adduction and abduction were performed to examine differences in muscle activities. During adduction and abduction there were significant differences ($\alpha < 0.05$) from the general bridging position in all the muscle activities except for RF. The highest muscle activities were seen in TrA, EO and AM during adduction, and in RA and GM during abduction (Table 1).

DISCUSSION

Activity of the abdominal muscles is necessary to stabilize the pelvis against the pulling forces of hip muscles. In a stabilized state, the forces of the trunk on the trunk are efficiently transmitted to the hip joint and the lower extremities¹⁰⁾. The stability of the trunk increases stability of the vertebrae and the pelvis in functional postures and movements, strengthens muscle power, and improve control and balance of the muscles and movements⁶⁾. Among various stabilization exercises, the bridging exercise has an important influence on functions of pelvic movement which are used in mobilization on the bed, use of a toilet seat, relief of pressure, putting on clothes on the lower limbs and gait⁵⁾. This study examined how the isometric adduction and abduction of the hip joint in a bridging exercise affected muscle activities the abdominal region and the lower extremity.

During adduction and abduction were significant differences ($\alpha < 0.05$) from the general bridging position in all the muscle activities except for RF. The highest muscle activities were seen in TrA, EO and AM during adduction, and in RA and GM during abduction. The contraction of the AM muscle along with active of muscle activities of TA and EO seems to indicate that the TrA and EO muscles co-contract for stable performance of the bridging exercise. This would increase the abdominal pressure, and compress the organs in the abdominal region to increase lumbar and trunk stability, and it would also increase abdominal pressure, resisting hyperlordosis. In addition, the transverse abdominis is the

most active muscle in isometric trunk extension, and it is the most consistent muscle under changing abdominal pressure to increase the vertebral stability¹²⁾.

The core principle of the bridging exercise is that it controls external force on the lumbar region, and the coordination and interaction of the muscles around the arms and legs in their movements in order to prevent disc injury, or repeated impairment of the vertebral facet or other tissues in the area. More specifically, the bridging exercise increases abdominal pressure, by efficiently performing lumbar stabilization training, and induces muscle co-contraction to reduce hyperlordosis or anterior pelvic tilt¹³⁾. In comparison, a bridging exercise with contraction and abduction of GM contributes to pelvic stability, resisting widening of the pubic due to abduction of bilateral RA. In a pelvic tilting motion, the lower rectus abdominis and lower part of the gluteus are activated, while the activity of the multifidus is reduced¹⁴⁾. Therefore, spinal stabilization exercises should include recruitment of the lower half of the rectus abdominis and lower parts of the gluteus in its actions, because correcting pelvic tilt is an important skill which is required for improving stability. The RF muscles were most active in abduction but the increase in activity was not significant. RF is a two joint muscle controlling hip flexion and knee extension, and since the bridging exercise involves opposite motions, it did not significantly affect the RF muscles.

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