

Differences of Muscle Activities of Various Bridge Postures Using Thera-band on the Stable Surface

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Abstract

Background/Objectives: This study was conducted to compare and analyze the muscle activity of vastus lateralis, muscle vastus medialis, spinal erector muscles and gluteus maximus muscle using the EMG measuring device and suggest effective results of the bridge exercise when conducting the bridge exercise with various bridge postures using resistance of Thera-band on the stable support surface.

Method/Statistical Analysis: In order to examine the difference in the muscle activity of vastus lateralis, vastus medialis, erector spinae and gluteus maximus, a total of 3 exercises were conducted by each different posture; the normal bridge posture, the hip adduction bridge posture using the resistance of Thera-band and the hip abduction bridge posture using the resistance of Thera-band. The measured results of the experiment was analyzed by repeated measure analysis of variance

Findings: The results showed that muscle activity was all higher when conducting the bridge exercise using the resistance of Thera-band for vastus lateralis, vastus medialis, erector spinae and gluteus maximus, In the hip adduction bridge posture, vastus lateralis and vastus medialis showed significant difference, and in the hip abduction posture, gluteus maximus showed significant difference compared to the normal bridge posture.

Improvements/Applications: It is considered that the hip abduction bridge exercise and the hip adduction bridge exercise using the resistance of Thera-band can help stabilize the body.

Keywords: Bridge exercise, Thera-Band, Hip Adduction, Hip Abduction, Muscle activity.

Introduction

More than 50% of the modern people are often experiencing low back pain in their lifetime. The strength of the body stabilization muscle is weakened by the decrease of physical activity. And there is a lot of time for the modern people sitting in abnormal posture for a long time and having excessive tension, which also weakens gluteus maximus muscle, the one of the strong hip joint extensor^[1,2,3]. According to Sahrman and Van

Wingerden, the weakening of gluteus maximus muscle, declines and function cause instability and dysfunction of the hip joint and excessive activity of spinal erector muscles^[4,5,6]. Therefore, exercise for the body stabilization muscle has been applied for the lumbar region and the back pain. It has been recognized as an effective exercise therapy for the low back pain and prevention^[7,8]. The muscles related to the body stabilization maintain the center of body and stabilize the back when body is moving^[9]. Previous studied that exercise for the body stabilization restores muscle and moving control ability, especially stabilizes erector normal muscle and gluteus maximus muscle are strengthened and more effective for balance. In particular, gluteus maximus muscle is the most strong muscle among the muscles related to the body stabilization exercise and improves stabilization of joints and delivers power to pelvis from

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lower body at initial contact because direction of fibers is vertical on sacroiliac joint and it plays an important role in daily lives^[7,8,10]. O. Sullivan and Moon reported that the body stabilization exercise protects the spine from repetitive damage, increases stability, reduces pain relief, dysfunction and improves muscle strength to restore balance and exercise control capacity. It is more effective than preservation treatment^[11,12,13]. In recent days, bridge exercise is recommended interventions for the low back pain among various exercise treatments^[9]. The bridge movement is a closed chain exercise that increases strength by strengthening of the vastus lateralis muscle, vastus medialis muscle, erector spinae and gluteus maximus muscle. It also increases the stability of the body including the spine and lumbosacral region. Everyone can easily learn and practice therefore it is used often. As it activates local muscle fatigue and global muscle, it helps muscular cooperation^[7,9,14]. Some studies reported that resistance exercise of the closed chain exercise which strengthens the lower body with Thera-band is very effective and resistance exercise using the Thera-band is the most effective way to improve the balance of activities of daily living^[14,15]. As Thera-band has elasticity, it can avoid the risk of excessive exercise and easily used by anyone to do exercises. It has advantages of stability and practical and effective results in improving muscle strength^[16,17]. Likewise, there are many studies on the effect of the bridge exercise to reduce the back pain but studies on various bridge postures on the stable support surface using thera-band is insufficient. The purpose of this study is to compare the changes of muscle activity such as vastus lateralis, vastus medialis, erector spinae and gluteus maximus muscle depending on various bridge posture.

Table 1. Study subjects general characteristic (n=17)

Division	Mean Value
Gender (M/F)	8/9
Age	21.4±1.12
Height	167.5±6.19
Weight	63.2±13.39

Method

The subjects of this study were healthy men and women. As a total of 17 subjects had no medical history of knee, ankle, hip joint and spine (8 men, 9 women). Before they participate in this study, the subjects were

fully explained the content and purpose of the study and received the consent to participate in the experiment. The normal characteristics of the study subjects are as follows [Table 1]. Before the exercise, bridge exercise was conducted in a lying position after attaching the electromyogram pad to the regions of vastus lateralis, vastus medialis, erector spinae and gluteus maximus muscle for the experiment measurement. Exercise was divided into three types and normal bridge exercise on the stable support surface, bridge exercise in the hip joint posture, and bridge exercise in the hip open posture were conducted for 10 seconds for each exercise. When the bridge exercise was conducted, both arms of the subject were placed 30 degrees far from each body. Both toes were facing forward, and the width of both feet was between 15cm. The angle of the knee was bent at 90 degrees and scapula, lumbar, pelvis, hip knee and ankle were made straight. The bridge exercise is to lift the hips and lumbar with bending the knee at 90 degrees when lying down and facing ceiling. It promotes the stability of the body including the spine and lumbosacral range. They were guided to make a smooth slope and keep lifting foot from the ground when lifting waist and hip and they kept making their scapula, lumbar, pelvis, hip, knee and ankle straight. First, the width of the feet was fixed to about 15cm before the exercise on the stable surface and both of arms angle was at 30 degrees, the normal bridge posture without Thera-band was measured. Secondly, the bridge posture of the hip adduction was measured by giving resistance using Thera-band under the same conditions. Thirdly, the bridge posture of the hip abduction was measured by giving resistance using Thera-band under the same conditions. In this study, we used OQUS100 (Zero WIRE EMG, Noraxon) to measure the muscle activity of vastus lateralis, vastus medialis, erector normal and gluteus maximus muscle. The sampling rate was 1,024 Hz when measuring the surface EMG. In order to remove the noise, 60Hz band stop filter and 10 to 500Hz band pass filter were used. The EMG signal was amplified by 1785 times. Signals of the collected muscle activity were recorded by full wave rectification and root mean square (RMS). For data analysis, SPSS 20.0 version program was used. And one way repeated measured test and Bonferroni was used to examine the difference between individual interventions according to muscle activity during various bridge exercises using Thera-band on the stable support. Statistical significance level was set to $p < .05$.

Table 2. Differences muscle activities of various bridge postures using Thera-band on the stable surface

	NBE	HDBT	HABT	F
VLO	10.31±3.92	15.06±6.00	12.05±5.53	8.98*
VMO	12.89±4.42	19.84±8.81	12.53±4.09	8.05*
ES	84.52±53.66	83.77±50.93	100.18±52.72	0.81
GM	41.05±24.02	43.35±33.53	91.02±59.30	6.24*

*p<.05, average±standard deviation, VLO : Vastus lateral Oblique, VMO : Vastus medialis Oblique, ES : Erector Spinae, GM : Gluteus Maximus, NBE: Normal Bridge exercise, HDBT: Hip Adduction Bridge exercise using Thera-Band, HABT : Hip Abduction Bridge exercise using Thera-Band

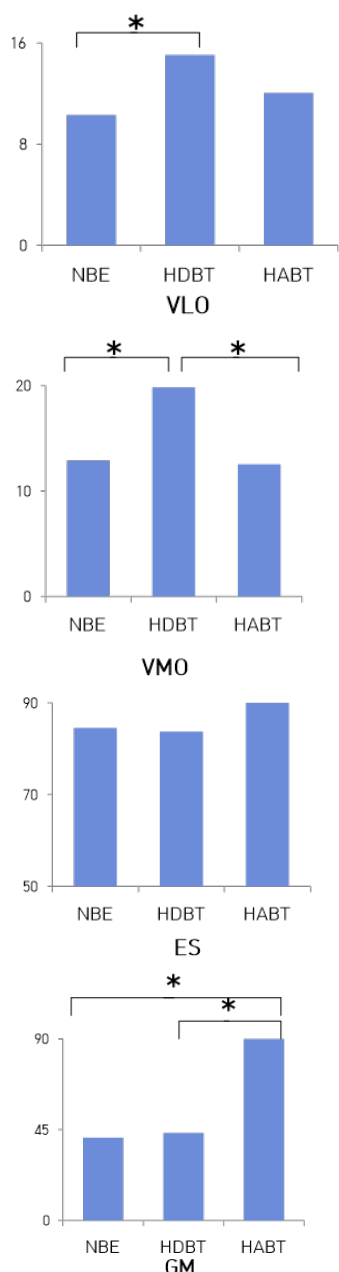


Fig. 1. Different of muscle activity among the positions

Result

There was statistically significant difference between NBE and HABT (p<.05) but there was no statistically significant difference between NBE, HABT, HDBT and HABT (p>.05)[Table 2][Figure 1]. Difference of activity level of vastus lateralis depending on various bridge postures using Thera-band. There was statistically significant difference between NBE and HDBT, HDBT and HABT (p<.05), but there was no statistically significant difference between NBE and HABT (p>.05) [Table 2] [Figure 1]. There was no statistically significant difference between NBE and HDBT, HDBT and HABT, NBE and HABT (p>.05)[Table 2] [Figure 1]. There was statistically significant difference between NBE and HABT, HDBT and HABT (p<.05) but there was no statistically significant difference between NBE and HDBT (p>.05) [Table 2] [Figure 1].

Discussion

In this study, the muscle activity of vastus lateralis, vastus medialis, erector spinae and gluteus maximus was measured and analyzed using resistance of Thera-band on the stable support.. As a result of the bridge exercise using Thera-band, there was a significant difference between NBE and HDBT in vastus lateralis. However, Vastus medialis, there was significant difference between NBE, HDBT and HDBT and HABT. There was no significant difference between NBE, HDBT, and HABT in erector spinae. And there was a significant difference between NBE, HABT and HDBT, HABT in gluteus maximus muscle. Therefore this study recorded about high muscle activity when conducting HDBT and HABT. The vastus lateralis and vastus medialis related to knee extension among quadriceps femoris is the strongest muscle. In the study, the bridge exercise in HDBT showed higher muscle activity than the bridge exercise in NBE or HABT. The bridge exercise in HDBT showed more activation rather than the bridge exercise in NBE and HABT because it tightens hip and hip adduction. Therefore it is considered that the muscle activity of vastus lateralis and vastus medialis is increased. Quadriceps femoris that is related to the bridge exercise conducted by many precedent researches is the main muscle that maintains the normal posture of the knee joint and stabilizes the hip joint, as it contracts the hip joint adductor muscles when exercising, it increases vastus lateralis muscle and vastus medialis muscle. It is reported that it is more effective to increase muscle activity when exercising the hip joint adductor muscle and

abduction activity^[9,15,18,19]. The erector spinae stretches the body and acts against gravity when conducting the bridge exercise, therefore the muscle activity of each muscle is not different from other muscles. And it is considered that the muscle activity of gluteus maximus muscle was increased and the muscle activity of erector spinae was decreased. Both of them had interaction for each other. The bridge exercise is useful for increasing the lower part of spine, lumbar vertebrae, abdominal muscle, pelvis, hip joint extensor strength and motor control ability, the activation of abdominal muscle acts an effective element to stabilize the pelvis toward the pulling force of hip joint muscles and the power of the body goes to the lower part and hip joint muscles when pelvis is stabilized^[20]. As gluteus maximus stretches the body like the erector spinae and acts a role of the hip joint extension and external rotation, muscle action was stronger when conducting HABT rather than NBE and HDBT. This was consistent with the results of previous studies which suggested that muscle pulling direction can increase the amplitude of muscle activity because it is to be optimized when in horizontal line with the muscle fibers. It also helps prevent damage of the local muscles such as spine, joints, and ligaments. This exercise is a basic exercise for the body stabilization exercise practicing on a normal mat by drawing up a knee at 90 degrees. It is an important exercise to make a posture of drawing up knee with loading weights on both feet. As it develops the control of sitting and standing, it is widely used as a useful exercise for improving muscle strength^[13]. However, there was no significant difference when all muscles exercise were conducted in various bridge postures using the resistance of theraband. This is because there can be difference in muscle activity depending on the existence and nonexistence of the resistance of theraband when exercising with Thera-band. When conducting exercise in NBE on the stable support, it maintains a more normal posture because of no resistance. However, HDBT and HABT use more strength against resistance and have difficulty in maintaining posture and balance. Therefore, It is believed that muscle activity of vastus lateralis, vastus medialis, erector spinae and gluteus maximus was more increased. In addition, when conducting exercise in NBE without resistance of theraband on the stable support, it uses less strength rather than the muscle activity of vastus lateralis, vastus medialis, erector spinae and gluteus maximus when conducting exercise in HDBT and HABT. This study suggests some limitations. First, the noise of the signal may be generated according to

the muscle movement or the fine movement due to the characteristics of the surface EMG measurement when having the bridge exercise. Second, in this study did not focus on one gender of the subjects, therefore there can be difference of muscle activity depending on gender. It is expected to have a study on differences of muscle activity for the same gender in future studies.

Conclusion

This study was carried out to investigate the changes of muscle activity on various bridge postures using the resistance of Thera-band on the stable support during the bridge exercise. The results showed that VLO and VMO when conducting exercise in HDBT increased muscle activity. And GM when conducting exercise in HABT increased muscle activity than NBE. Therefore, it is expected that it will be a more effective bridge exercise method if use necessary intervention method for each posture to increase activity of certain muscle.

Ethical Clearance: This study was approved by the Institutional Review Board (IRB) of Sunmoon University. (SM-201804-026-1).

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Conflict of Interest: Nil

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