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Effects of Lumbar Stabilization Exercise on Lower Extremity Strength

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Abstract

Purpose: this study was conducted on female university students in supine position and preformed the 2 bridge positions exercises, which are the bridge position exercise and the bridge exercise preformed with form rollers attached between their knees, in order to research the effects lumbar stabilization exercise has on lower extremity muscular strength. **Method:** In order for the participants to fully understand the topic and procedures of the experiment, they were given a 20 minutes of briefing and practice before the experiment. **Result:** Bridge exercise group and foam roller group were improved the knee flexion and extension strength. **Conclusion:** This research studied the difference of each lumbar stabilization positions and the effects they have on the fortification of the leg's flexion extension muscular strength, and by comparing which different exercise methods increase muscular strength the most works to plan a more optimal exercise method for lumbar stabilization.

Key words : bridge exercise, strength, stabilization

Ⅰ. Introduction

The torso which provides the basics or the driving force to all movements of the arms and legs are very crucial to the human body (Sharma, Geovinson, and Singh, 2012). Lumbar stabilization exercise which improves one's torso control ability is a favored treatment between physical therapists (Vasseljen, 2012). Lumbar stabilization exercise is an exercise that controls the external force applied to the torso by maintaining a neutral posture of the body which is achieved by proper constriction of the abdominal muscle, and stands for the human ability to consciously or unconsciously regulate his or her own joint movement. Recently, lumbar stabilization exercises are one of the most common prescription for rehabilitation from injuries, to prevent injuries, and to fortify the muscles of the torso (Chang, Lin, and Lai, 2015).

Many types of lumbar stabilization exercises are being implemented for the general public to prevent damages in daily living such as public health, and falls (Barr, 2005). Lumbar stabilization exercise from crawling and bridge position improves the coordinated constriction of the

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psoas muscle and the activity of the core muscles. (Chei Hyui-su, 2005; Venzina and Hubley-kozey, 2000).

The fortification of the core muscle increases the flexion-extension muscle strength of the leg by defusing the muscle contraction of the week leg muscles (Hwang Byung-jun and Kim Jong-wu, 2011), and improves the functional stability of the body, elevating the proprioceptive sense and muscle ability of the leg as a result, preventing falls in the process (Akuthota and Nadler, 2004).

Doing bridging exercises which is a lumbar stabilization exercise, has been shown to activate the Gluteus maximus muscle and hip extensor muscles 14 percent more than the erector spinae muscles (Konard, 2001), and showed that in bridging or crawling exercises which are a closed chain exercises, induced isometric contraction to the leg muscles fortifying leg muscle strength as a result (Hwang Byung-jun and Kim Jong-wu, 2011).

Also, when a ball was inserted between the knees during abdominal crunch, the overall activation of the abdominal muscles increased compared to if there was no ball (Gyu-Wan Lee et al., 2014).

Isokinetic exercise is a superior method to fortify muscular strength than isometric or isotonic exercises (Kacin and Strazar, 2011). Isokinetic exercise assessment allows for an objective assessment of muscular strength, endurance, and joint range of motion, making it a great exercise therapy for rehabilitation of musculoskeletal system injuries by, allowing for maximum muscular constriction at all times through the full range of motion, which sees wide use in the field and makes it a crucial factor in many studies (Urzica et al., 2007; Pang and Mak, 2009). Ever since the concept of isokinetic exercise was introduced as a branch of progressive resistive exercise, instruments based on isokinetic exercises assessment have performed the task of making muscular strength assessment more precise (Hall et al., 2017). Muscular assessment preformed with isokinetic exercises have been reported to have high effectiveness and reliability (Smith et al., 2017).

Therefore, this study was conducted for female university students which have the effects of lumbar stabilization exercise on lower extremity muscular strength.

Ⅱ. Methods

1. Subjects

This research was conducted based on 15 female university students who attend G-university, and the participants were selected from volunteers. The exercise groups were selected as 5 participants who preform bridge exercises, 5 who preform bridge exercises with form roller, and 5 as control group. The general qualities of the participants are as follows in Table 1.

2. Assessment instruments and methods

1) Isokinetic muscular strength assessment

In order to measure the flexion extension muscle strength of the leg muscles before and after the experiment, the isokinetic exercise equipment Biodex Medical, Inc, USA was used, with an angular speed of 60 degree/sec with an average of 5 times, with the highest results used to calculate the maximum torque. As a list of measurements, the knee joint's extension and flexion muscular strength was assessed (Table 2).

Assessment of the flexion extension muscular strength of the knee joint was conducted with the participant positioned on a Biodex dynamometer with a chair angle of 85 degree, and joints except for the knee joint were strapped in such as chest, abdomen, thigh, and feet ankle with adjustable straps during repeated assessment. The dynamometer was set at 90 degrees, the head tilt angle at 0 degree with knee strips attached. The axis of rotation of the dynamometer was fixed in place with the partic-

ipant's knee, and a lever arm was attached to 1cm above the lateral ankle bone of the feet which happens to be the effort point, restricting the exercise movement angle of the knee joint's flexion and extension movement from 0 degrees to 70 degrees, using the Hold and Resume key with the dynamometer's rotating axis as the focal point. Furthermore, participants were adapted to the isokinetic exercise by preforming them 3 times beforehand. In order to prevent muscular exertion due to continuous assessment, 10 minutes of rest were given between each assessment. In order to compare results, assessments were made before and after.

3. Experiment procedure

In order to strengthen the lumbar stabilization muscle of the participants of this study, participants were asked to preform bridge exercises with foam rollers attached between both knees, and the flexion extension muscle strength before and after the exercise was compared. In order for the participants to fully understand the topic and procedures of the experiment, they were given a 20 minutes of briefing and practice before the experiment. The experiment consists of comparing the flexion extension muscular strength prior experiment and post experiment in accordance to the exercise position. All participants of the experiments were prohibited to learn of the experiment results or the meaning of such results. 3 sets of bridge exercises were performed, with 10 minutes of rest between prior exercise and post exercise to prevent muscular exertion. Bridge exercises with a foam roller between the legs were also performed in the same manner.

4. Exercise method

In this research, as the exercise method, the bridge exercise was performed holding a position where the participant is in a straight prone position, knees bent at a 60 degree angle, and by raising the pelvic till the hip bone, knee, and 2nd toe all come into alignment making the-angle infront of the pelvic 0 degree.

For the experiment group preforming bridge exercise with foam roller between both knees was done in by the same position as the bridge exercise group as they raise their hip with a foam roller squeezed between the knees, maintaining a 0 degree angle in front of the pelvis.

Both the experiment group preforming only bridge exercise and the group that performs them with foam roller between their knees, consisted of three sets of exercise with each set consisting of three, maintaining 10 seconds of bridge position and 5 seconds of rest.

5. Processing Data

The data accumulated from this experiment was processed using a statistical program "PASW Ver.18 for window". For each result, the average and standard deviation was calculated, in order to analyze the pre and post results of the leg flexion extension muscle strength, matching sample was used for T-testing, One way ANOVA was conducted to understand the most efficient exercise method, and lastly Duncan was performed as a post-havoc comparison in order to discover the difference between factors.

Ⅲ. Results

1. The comparison of pre and post exercise muscular strength in extension

In the comparison of before and after the experiment during extension, the average result for pre experiment muscular strength of the bridge exercise group was 110.24 Nm, post experiment average results of 117.34 Nm stating that the extension muscular strength after the

experiment increased, showing statistically significant results. The bridge exercise group with foam rollers showed pre experiment average of 127.34 Nm, and a post experiment average of 152.22 Nm, showing increases in extension muscular strength which were also statistically significant.

After further assessment, the post experiment extension muscular strength of the bridge exercise group with foam rollers between their knees showed the highest and statistically significant results of 152.22 Nm ($p<.05$). There wasn't any noticeable difference between the bridge exercise group and the control group.

2. The comparison of pre and post exercise muscular strength in flexion

In the comparison of before and after the experiment during flexion, the average result for pre experiment muscular strength of the bridge exercise group was 55.7 Nm, post experiment average results of 59.66 Nm, and the bridge exercise group with foam rollers to their knees have shown pre experiment results of 71.36 Nm and post experiment results of 77.72 Nm, showing post experiment muscular strength in flexion has increased but showed no statistical significance.

After further assessment, the post experiment flexion muscular strength of the bridge exercise group with foam rollers between their knees showed results of 77.72 Nm showing the highest results compared to the bridge exercise group and was statistically significant.

Ⅳ. Discussion

This research, in order to study the effects lumbar stabilization exercise have on the muscular strength of the lower extremity, compared the bridge exercise which is a widely known lumbar stabilization exercise and compared the 2 applications of the exercises.

The big stimulation of the center of the body effects toward the further side and in order for one part to work efficiently, another part must act as a fixed point (Carroll et al., 2006).

The muscular function of the leg can be increased via specific training to parts of the leg. However, in physical activity, the waist serves as a starting point to generate force followed by the arms and legs assisting the generated center force, furthering the importance of the waist as a Power zone (Hall et al., 2017). Therefore, based on recent researches made on the subject, lumbar stabilization showed aptitude toward affecting the muscular strength of the lower extremity.

The fortification of the extremis muscles preforms an efficient activity toward the waist, and the fortification of the lumbar muscles preform an efficient activity toward the extremis (Hoppes et al., 2016), as a result of preforming lumbar stabilization exercises on female university students, showed significant increases to their leg muscular strength.

Unlike former research that state lumbar stabilization exercises fortify flexion and extension muscular strength, this research only showed results that lumbar stabilization exercises fortify extension muscular strength. In both the bridge exercise group and the foam roller group showed increases to their flexion muscular strength yet statistically insignificant which is hypothesized to be the result of experiment participants or the experiment methods.

This muscular fortification looks to be the result of isometric contractions to the leg muscles that took place due to the bridge exercise which is a lumbar stabilization exercise.

When researching the effect of the different types of lumbar stabilization exercise have on the extremis muscles, a method that can objectively assess the muscle functionality during semi exercise state is required, therefore making the isometric assessment methods very useful in these situations (Won Gi Kim and Man Jung Kim,

2006).

For patients who suffer from a stroke, the fortification of the leg muscle does support the walking potential of the patient, but the lumbar muscle which associates with balance is also important (Karatas et al., 2004). The trunk of the body is a crucial center figure in posture reflex and control, making the ability to control the trunk in daily mobility without the loss of balance very important (Granacher et al,, 2013). Therefore the muscular strength and stamina of the lumbar muscle is crucial, the back muscle and the psoas muscle has association to the stabilization of the lower waist, and is important to the trunk mobility and positioning (Hodgesetal et al., 2002).

For the group with foam rollers to their knees, when they performed the bridge exercises, showed overall better improvements to their pre, post, leg extension and flexion muscle strength. This is due to the fact performing the bridge exercise with foam rollers between their knees helps with the energization of the hip adductor muscles via the internal rotation and contraction of the hip joint, and furthermore simultaneously contracts the pelvic center muscles.

Therefore, in this research, alongside previous research, we were able to conclude that lumbar stabilization exercises statistically fortify the muscular strength of the leg's extension and flexion.

Ⅴ. Conclusions

This research studied the difference of each lumbar stabilization positions and the effects they have on the fortification of the leg's flexion extension muscular strength, and by comparing which different exercise methods increase muscular strength the most works to plan a more optimal exercise method for lumbar stabilization.

The results are as follows.

First, in the bridge exercise group, showed increase in pre and post flexion extension muscular strength and the extension muscular strength showed statistical significance.

Second, in the bridge exercise group with foam rollers on their knees, showed increase in pre and post flexion extension muscular strength and the extension muscular strength showed statistical significance.

Third, in the comparison between the exercise methods, the exercise group with the foam rollers on their knees shows higher results then both the normal bridge exercise group and the control group and was statistically significant.

With this research, it can be concluded that based on female university students in their 20s, while they preform lumbar stabilization exercises, when they put and squeeze foam rollers with their knees while exercising to raising their pelvis, it can fortify the leg muscular strength that associates with lumbar stabilization. Therefore, it is necessary to choose the correct lumbar exercise in order to fortify leg muscular strength.

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Appendix 1. Table

Table 1. General quality of the participants

	Bridge exercise group (n=5)	Form roller group (n=5)	Control group (n=5)	p
Age (year)	23 ± 0.0	23.2 ± 0.2	22.8 ± 0.2	0.061
Height (cm)	164.4 ± 1.29	161.2 ± 2.22	164.6 ± 1.36	0.333
Weight (kg)	53 ± 2.53	61 ± 4.89	56.4 ± 4.84	0.408

*p<.05

Table 2. General quality of the participants (Nm)

		Bridge exercise group	Foam roller group	Control group	F	p
Extension	Pre	110.24 ± 14.17	127.34 ± 10.26	118.78 ± 22.34	1.362	.293
	Post	117.08 ± 16.36	152.22 ± 17.88	106.76 ± 20.91	8.314	.005*
	t	−2.924	−3.748	2.080		
	p	.043*	.020*	.106		
Flexion	Pre	55.7 ± 10.31	71.36 ± 7.32	61.96 ± 10.54	3.438	.066
	Post	59.66 ± 11.98	77.72 ± 9.65	56.4 ± 9.78	5.958	.016*
	t	−2.097	−1.983	2.743		
	p	.104	.118	.052		

*p<.05