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Original Article

Effect of Togu-exercise on Lumbar Back Strength of Women with Chronic Low Back Pain

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Abstract. [Purpose] The present study analyzed the effect of the Togu exercise program on the lumbar back strength of middle-aged women who did not perform regular exercise, and presents an effective exercise method for middle-aged women with chronic low back pain symptom. [Subjects] The subjects were 16 women with chronic low back pain attending N University, Chungcheong-do, Korea. [Methods] Height, weight, body fat, and body mass index (BMI) were measured using a body composition analyzer (Inbody 720, Biospace, Korea), which utilizes bioelectrical impedance analysis. Using isokinetic lumbar muscle strength measurement equipment [Isomed 2000, Back system, (Germany)], peak torque/body weight, total work and average power of flexion and extension of the lumbar region were measured. For lumbar stabilization exercises, an air cushion (Germany), jumper (Germany), and aero step (Germany) were employed. First, warm-up exercise was conducted for 10 minutes, followed by 10 sets of the 3 main exercises using the above tools with 10-second rest intervals. The main exercise was done for 40 minutes in total. [Results] The paired sample t-test showed significant in the Togu exercise group peak torque of flexion, peak torque of extension, total work of flexion, total work of extension, average power of flexion, average power of extension, after the exercise showed a significant difference in the Togu exercise group. [Conclusion] The trunk muscle actiation program for middle-aged women had a significant effect on muscle strength and low back pain. Therefore the trunk muscle activation program is effective at increasing muscular strength of middle-aged women, and the results suggest improve muscle strength is effectively stabilizaties the lumbar region.
Key words: Isokinetic, Lumbar stabilization, Togu

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INTRODUCTION

The first condition for having correct spinal posture is optimal load on the skeletal system. The skeletal system is changed structurally if unbalanced load applied to different parts of the skeletal system continues and physiological limits are exceeded for a long time[1)]. The second condition is balance between antagonistic muscle groups. Muscles in each joint facilitate balance and stability. In particular, the antagonistic muscle groups work in opposition to each other to stabilize the trunk and maintain balance. However, when functions of vmuscle groups that work in opposition to each other deteriorate, abnormal posture develops[2)], creating excessive loads on lower extremity joints, the hips, shoulders, and vertebrae[3)]. The third condition is optimal activity of internal body systems.

Haynes[4)] reported that core muscle strengthening exercise rather than simple resistance exercise biomechanically increased self-adjustment of loads applied to the vertebrae, and was effective at increasing stability, efficiently strengthening the muscles of the pelvis and lumbar spine.

The core muscles are classified into local muscles and global muscles. The representative local muscles are the intertransversarii, multifidus, transversus abdominus, quadratus lumborum, and diaphragm ; and the representative global muscles are the rectus abdominis, the external and internal oblique muscles, and the longissimus.

The core muscles are located in the abdomen and the strengthening of the core muscles such as local muscles, and the muscles of the hips and pelvis is required for overall stability of the vertebrae, and the stability of the lumbar spine and pelvis, realizing functional and therapeutic benefits fot the a human body[5)]. Furthermore, stability of the core muscles helps stability of the lumbar region and uniformly distributes forces applied to vertebrae while moving the body[6)].

For the maintenance of static balance in a correct posture, training of core muscle activity is more effective than weight training exercise[7)].

The present study analyzed the effect of the Togu exercise program on lumbar back strength of middle aged women who did not perform regular exercise, and presents an effective exercise method for middle aged women with chronic low back pain.

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SUBJECTS AND METHODS

The subjects were 16 women with chronic low back pain attending N University, Chungcheong-do, Korea. The lumbar stabilization group subjects' age (mean ± SD) was 44.80±3.64 years, their height was 163.00±6.59 cm, their weight was 62.3±8.90 kg, and their BMI was 23.4±2.85%. The Control group subjects' age (mean ± SD) was 45.60±3.88 years, their height was 159.3±3.99 cm, their weight was 58.3±4.66 kg, and their BMI was 23.4±1.82%. After explaining th experimental process, voluntary consent was obtained from those wishing to participate in the body.

Height, weight, body fat, and body mass index (BMI) were measured using a body composition analyzer (Inbody 720, Biospace, Korea), which utilizes bioelectrical impedance analysis. Using isokinetic lumbar muscle strength measurement equipment [Isomed 2000, Back system, (Germany)], peak torque/body weight, total work and average power of flexion and extension of the lumbar region were measured.

For the lumbar stabilization, exercises, an air cushion (Germany), jumper (Germany), and aero step (Germany) were employed. First, a warm-up exercise was conducted for 10 minutes, which was followed by 10 sets of the three main exercises using the above tools with 10-second rest intervals between exercises. The main exercise was done for 40 minutes in total (Table 1).

The data processing of the present study result was done using the SPSS WIN 18.0 program. The mean (M) and standard deviation (SD) of each parameter were calculated. Furthermore, two-way repeated measures ANOVA was conducted to test the mean difference of the groups and exercise times. If an interaction effect was indicated between the group and exercise time, one-way ANOVA of exercise time and the paired sample t-test were conducted. The statistical significance level was chosen as 0.05. All the subjects understood the purpose of this study and provided their written informed consent prior to their participation in the study in accordance with the ethical principles of the Declaration of Helsinki.

Table 1. Togu exercise program

	Lumbar stabilization exercise		
Warm-up	Pelvic movement local muscle activity		5–10 min
Main exercise	Body-weight squats Hip bridge Single leg hip bridge Single leg forward lunge Prone superman arm and leg Standard straight leg plank Side support plank Curl-up	3 Set 10 Rep 10's Holding	40 min
Cool-down	Stretching		5–10 min

RESULTS

For the Togu exercise group, the paired sample t-test showed a significant improvement in peak torque of flexion after the exercise ($t=-3.402$, $p<0.05$). On the other hand, the control showed no significant difference ($t=0.052$, $p>0.05$). Furthermore, a significant difference after the exercise between the groups was shown ($t=0.178$, $p<0.05$). For the Togu of extension group, the paired sample t-test showed a significant improvement in peak torque of extension after the exercise ($t=-5.399$, $p<0.01$). On the other hand, the control group showed no significant difference ($t=-0.148$, $p>0.05$). Furthermore, a significant difference after the exercise between the groups was shown ($t=2.562$, $p<0.05$). For the Togu exercise group, the paired sample t-test showed a significant improvement in total work of flexion after the exercise ($t=-5.305$, $p<0.01$). On the other hand, the control group showed no significant difference ($t=-1.344.$, $p>0.05$). Furthermore, a significant difference after the exercise between the groups was shown ($t=2.495$, $p<0.05$). For the Togu exercise group, the paired sample t-test showed a significant improvement in total work of extension the exercise ($t=-5.717$, $p<0.01$). On the other hand, the control group showed no significant difference ($t=1.201$, $p>0.05$). Furthermore, no a significant difference after the exercise was found between the groups ($t=1.590$, $p<0.05$). For the Togu exercise group, the paired sample t-test showed a significant improvement in average power of flexion the exercise ($t=-5.585$, $p<0.01$). On the other hand, the control group showed no significant difference ($t=0.568$, $p>0.05$). Furthermore, no a significant difference after the exercise was found between the groups ($t=2.033$, $p>0.05$). For the Togu exercise group, the paired sample t-test showed a significant improvement in average power of extension after the exercise ($t=-4.051$, $p<0.01$). On the other hand, the control group showed no significant difference ($t=-0.629$, $p>0.05$). Furthermore, no a significant difference after the exercise was found between the groups ($t=1.716$, $p>0.05$) (Table 2).

DISCUSSION

Strengthening the lumbar back muscle can maintain the stability of the vertebrae as well as correct spinal posture when moving statically or dynamically. The imbalance of flexion strength and extension strength due to reduced lumbar back strength can cause unstable posture.

Comerford and Mottram[8] reported that strengthening the deep stabilizer muscles and the superficial stabilizer muscle among the muscles surrounding the lumbar region can enhance muscle function and stabilize in the lumbar region. The increase of coordination between flexor and extensor muscles around the lumbar region can activate the muscles inside the abdomen thereby securing stabilization[9].

Such strengthening of lumbar back strength can result in stabilization of the core zone, which is required for balanced movement between the upper and lower body segment efficient movement by increasing interaction of contraction and relaxation of the muscles in the lumbar region[10].

Table 2. Change of back strength

		Pre-test	Post-test
Peak Torque Flexion 30° (Nm/kg)	Togu Exercise	1.87±0.44	2.44±0.39*
	Control	1.85±0.31	1.85±0.28#
Peak Torque Extension 30° (Nm/kg)	Togu Exercise	1.50±0.39	2.25±0.37**
	Control	1.71±0.42	1.69±0.47#
Total Work Flexion 30° (W)	Togu Exercise	343.12±56.87	395.88±43.78**
	Control	344.75±35.46	346.75±34.40#
Total Work Extension 30° (W)	Togu Exercise	325.00±87.36	384.25±96.36**
	Control	323.75±57.37	321.00±58.03
Average power Flexion 30° (J)	Togu Exercise	26.25±5.06	31.63±2.97**
	Control	28.63±3.02	27.75±4.49
Average power Extension 30° (J)	Togu Exercise	24.38±9.66	33.88±8.39**
	Control	27.13±6.01	27.50±6.32

* $p < 0.05$, ** $p < 0.01$: paired t-test
# $p < 0.05$: independent t-test

Therefore, stabilization exercise for the lumbar region was conducted by maintaining the neutral position for effective improvement of coordination as well as strengthening of the deep stabilizer muscle.

Both stabilization and sling exercises for the lumbar region realized significant improvements in lumbar back strength. In addition, Cosio Lima[11] reported that a stability ball training program using a ball for five weeks improved strength of lumbar flexor and extensor muscles, as well as balance capability. Kim[12] also reported that a stability exercise for the lumbar region was more effective at increasing muscle cross-sectional area tha general spine strengthening exercises.

Kim and Chung[13] also reported that a golf player diagnosed with lumbar disc herniation performed a core exercise program, and the exercise had a positive effect on the golfer's flexibility, isokinetic lumbar muscle strength, driver shot performance and pain.

Stabilization exercise for the lumbar region increases the activities of the muscles in the lumbar segments thereby enhancing the interaction of muscles' motor control between the global and local muscles in the trunk when moving the body[14]. Consequently, lumbar stabilization exercise would be effective for increasing muscle strength around the lumbar back and functional improvement of the vertebrae. Furthermore, an increase in muscle cross-sectional area in the lumbar region indicates strong muscle activation, and length of the muscles during muscle contraction from the deep stabilizer muscle thereby developing the muscle functions efficiently and bringing stabilization of lumbar back and muscle strength improvement.

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