

The Effect of Trunk Stabilization Exercises with a Swiss Ball on Core Muscle Activation in the Elderly

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Abstract. [Purpose] The purpose of this study was to investigate the effects of trunk stabilization exercise on the muscle EMG activations related to core stability. [Subjects and Methods] Fifteen elderly people in a geriatric hospital performed trunk stabilization exercises with a Swiss ball for 20 minutes five times per week for 8 weeks. Trunk muscle activations were measured using electromyography before and after the intervention. [Results] After the intervention, the muscle activations of the rectus abdominis, erector spinae, lateral low-back (quadratus lumborum and external oblique), and gluteus medius muscles increased significantly. [Conclusion] The trunk stabilization exercise with a Swiss ball significantly increased the muscle activities of the elderly.

Key words: Elderly, Electromyography, Core stability

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INTRODUCTION

Core stability has an important role in the dynamic balance of the elderly. However, a decrease in core stability is one of the main problems which keeps older adults from easily performing activities of daily living¹⁾. There are some factors which impair the core stability of the elderly. Many previous studies have reported that impairments of core stability are mainly caused by core muscle weakness^{2, 3)}. Core muscles are known to consist of the muscles around the abdominal and lumbar regions, such as the rectus abdominis, erector spinae, quadratus lumborum, external oblique and gluteus medius⁴⁾. These muscles play a key role in providing individuals with stability during movement of the extremities^{1, 5)}. Many therapists have conducted strengthening exercises such as trunk stabilization exercise in order to improve the core stability. However, there is a lack of scientific evidence showing the validity of trunk stabilization exercise, and the effects of trunk stabilization exercise on muscle activations are still controversial. Thus, the purpose of this study was to investigate the effects of trunk stabilization exercise on the muscle activations of the core stability muscles, to provide scientific evidence for the validity of trunk stabilization exercises.

SUBJECTS AND METHODS

The study subjects were 15 elderly people hospitalized

in a geriatric hospital (Table 1). The inclusion criteria for the subjects were as follows: at least 65 years old, no falls within the last year, and no disease that might have affected the results of this study. Those who had visual impairment, hearing damage, nervous system or vestibular organ problems, or who were unable to understand the nature of the experiment were excluded. All subjects understood the purpose of this study and provided their informed consent in writing prior to their participation in the study in accordance with the ethical principles of the Declaration of Helsinki.

The subjects carried out their ordinary activities and performed trunk stabilization exercises with a Swiss ball in the geriatric hospital for 20 minutes, five times per week for 8 weeks. Trunk stabilization exercises were carried out using the Professional Exercise Ball (Thera-Band, USA) and the diameter of the ball was individually chosen so that the subjects' feet comfortably touched on the ground when sitting on the ball. A research assistant demonstrated how to use the ball.

The subjects' trunk muscle activations were measured using a MP150 (Biopac System, USA). To focus on specific muscles, electrodes were attached to the skin over the rectus abdominis, erector spinae, lateral low-back (quadratus lumborum and external oblique), and gluteus medius muscles. All measurement results are expressed as the mean ± standard deviation.

SPSS for Windows (version 18.0) was used to analyze the data. The paired t-test was used to examine differences between pre- and post-intervention. The statistical significance level was chosen as $\alpha = 0.05$.

RESULTS

After the intervention, the muscle activations of the rectus abdominis, erector spinae, lateral low-back (quadratus

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Table 1. General characteristics of the subjects

Variables	Subjects (n=15)
Gender (M/F)	6/9
Age (years)	76.5±10.1
Height (cm)	158.9±10.9
Weight (kg)	51.1±16.0
Mean±SD	

lumborum and external oblique), and gluteus medius ($p < 0.05$). Especially, the lateral low-back and gluteus medius activities showed greater increases than the other muscles (Table 2).

DISCUSSION

This study was conducted to investigate the effects of trunk stabilization exercise on core muscle activities. The results show that there were significant increases in EMG activities of the core muscles. That is, core muscles such as rectus abdominis, erector spinae, quadratus lumborum, external oblique and gluteus medius were more activated after performing the trunk stabilization exercise program of this study.

We consider this is because the trunk stabilization exercise with a Swiss ball increased the muscle activity. Many previous studies have reported that strengthening exercises, such as trunk stabilization exercise, are effective at increasing muscle activity^{6, 7}. Stephen reported that greater motor unit recruitment and a higher rate of motor unit firing, which may be elicited by strengthening exercise, can raise the level of muscle activation⁸. Furthermore, our results are in agreement with previous studies of core stability exercises. Konin reported that the transverse abdominis muscle is the first and main contractor among the core muscles during movements, and it has also been reported that the external oblique muscle is the main factor responsible for maintaining stability, by fixation of the pelvis^{5, 9}. Paraspinal muscles assist the multifidus muscle to maintain the spine in diverse curvature alignments created by the abdominal muscles⁴. In addition, the thoracolumbar fascia which is connected to the arms and legs is believed to activate proprioception¹⁰. Through this connection, it is possible that synergic activation would occur. Besides, to maintain balance, synergistic muscles have been reported to provide agonist muscle groups with inhibitory and facilitatory inputs^{11, 12}. According to these explanations and results, the trunk stabilization exercise with a Swiss ball increased the muscle activities of the elderly.

Table 2. Comparison of muscle activations between pre- and post-test

Variables	Pre	Post
RA (%RVC)	93.3±20.8	134.0±39.7*
ES (%RVC)	78.5±20.3	112.9±23.8*
lateral low-back (%RVC)	91.5±19.6	158.4±60.9*
GM (%RVC)	107.4±31.6	167.9±62.5*

Mean±SD. * $p < 0.05$. RA, rectus abdominis; ES, erector spinae; lateral low-back, quadratus lumborum and external oblique; GM, gluteus medius

Generally, the elderly are not powerful enough to perform common resistance exercises. The results of this study not only provide evidence of the validity of trunk stabilization exercise but also suggest an alternative approach to improve the core stability of the elderly.

This study had some limitations. First, the number of subject was too small to generalize the results. Second, a follow-up test was not scheduled or conducted. Further study that addresses these limitations will be needed to support our findings and to provide more evidence.

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