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Changes in the Thickness of Trunk Stabilizer Muscles According to Increased Lifting Loads in Stoop Lifting

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Abstract. [Purpose] The aim of this study was to identify how the lumbar stabilizer muscles respond to increased lifting loads. Twenty-four healthy subjects (10 males, 14 females) participated in this study. [Subjects and Methods] The thicknesses of the internal oblique (IO), transverse abdominis (TrA), and lumbar multifidus (LM) muscle were measured by ultrasonography during lifting of loads 10%, 20%, and 30% of body weight. The data was analyzed measured by one-way repeated measures analysis of variance (ANOVA). [Results] There were statistically significant increases in thicknesses of the TrA and LM muscles when lifting a load of 20% of subject's body weight. The thickness of IO was not significantly different at different loads. [Conclusion] The findings of this study suggest that TrA and LM play important roles as lumbar spine stabilizers during lifting activities of less than 20% of body weight. Further study is needed to find the mechanisms of lumbar stability during stoop lifting of loads greater than 20% of body weight.

Key words: Lumbar stabilizers, Lifting load, Ultrasonography

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INTRODUCTION

Repeated lifting motions at work and in daily life are a major cause of musculoskeletal disorders such as low back pain[1)]. Lifting motions involve increases in intra-abdominal pressure achieved through simultaneous contraction of the back and abdominal muscles[2, 3)]. The abdominal muscles serve important roles in lumbar stabilization when loads are imposed on the trunk[4)].

The lumbar stabilizer muscles are divided into global and local muscles based on their dynamic roles. The global muscles include the erector spinae, the rectus abdominis, the internal oblique (IO), and external oblique (EO) abdominal muscles. They induce movement or directly deliver loads to the pelvis and the thoracic cage, and act when large external loads are imposed on the spine[5)]. The local muscles include the LM (lumbar multifidus) and the transversus abdominis (TrA). They act to maintain posture and adjust movements between the vertebrae when small loads are imposed[6)]. Effective interactions of these muscles produce effective and safe lifting movements.

The general guidelines for safe lifting state that squat lifting postures are appropriate for reducing loads on the non-contractile tissues in the lower lumbar spine[7, 8)]. However, many workers prefer stoop lifting because these postures consume less energy and facilitate balance during lifting[9)]. However, stoop lifting at work and in daily living activities raise the risk of spinal injury.

Studies of biomechanical changes in the trunk muscles related to lifting motions have been performed, including those of muscle fatigue in static and dynamic conditions[10)], symmetrical or asymmetrical working postures used in lifting[11)], global muscle activities related to the degree of load[12)], the angles of the trunk during lifting[13)], and lifting speeds[14)]. However, these studies focused on the global muscles and working postures related to lifting. Studies of the actions of the lumbar stabilizer muscles during lifting motions in relation to the degree of load are insufficient. Furthermore, unlike individual muscles in the extremities, the force necessary for the movements of the lumbar stabilizer muscles cannot be directly measured. Also, surface electromyography cannot measure the muscle activities of deep muscles. Therefore, non-invasive ultrasonography is a useful tool for measuring the changes in thicknesses of deep muscles[15, 16)].

The present study examined the changes in the muscle thicknesses of the trunk stabilizer muscles, IO, TrA, and LM, at different loads in stoop lifting postures through measurement using ultrasonography.

SUBJECTS AND METHODS

Subjects

The subjects of the present study were 24 normal adults (10 males, 14 females). All the subjects agreed to participate in the study after hearing an explanation about the experi-