



The effects of surface condition on abdominal muscle activity during single-legged hold exercise



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ABSTRACT

To treat low-back pain, various spinal stability exercises are commonly used to improve trunk muscle function and strength. Because human movement for normal daily activity occurs in multi-dimensions, the importance of exercise in multi-dimensions or on unstable surfaces has been emphasized. Recently, a motorized rotating platform (MRP) for facilitating multi-dimensions dynamic movement was introduced for clinical use. However, the abdominal muscle activity with this device has not been reported. The purpose of this study was to compare the abdominal muscle activity (rectus abdominis, external and internal oblique muscles) during an active single-leg-hold (SLH) exercise on a floor (stable surface), foam roll, and motorized rotating platform (MRP). Thirteen healthy male subjects participated in this study. Using electromyography, the abdominal muscle activity was measured while the subjects performed SLH exercises on floor (stable surface), foam roll, and MRP. There were significant differences in the abdominal muscle activities among conditions ($P < .05$), except for left EO ($P > .05$) (Fig. 2). After the Bonferroni correction, however, no significant differences among conditions remained, except for differences in both side IO muscle activity between the floor and foam roll conditions ($p_{adj} < 0.017$). The findings suggest that performing the SLH exercises on a foam roll and MRP is more effective increased activities of both side of RA and IO, and Rt. EO compared to floor condition. However, there were no significant differences in abdominal muscles activity in the multiple comparison between conditions (mean difference were smaller than the standard deviation in the abdominal muscle activities) ($p_{adj} > 0.017$), except for differences in both side IO muscle activity between the floor (stable surface) and foam roll ($p_{adj} < 0.017$) (effect size: 0.79/0.62 (non-supporting/supporting leg) for foam-roll versus floor).

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1. Introduction

Low-back pain (LBP) is one of the most common and costly health problems in western societies, with 5–10% of all LBP patients becoming chronically disabled, accounting for 90% of the cost of this condition (Anderson, 1999). Decreased spine stability is one of the most common causes of LBP (McGill et al., 2003; Cholewicki and McGill, 1996; Norris and Matthews, 2008; Hodges and Richardson, 1996). It is suggested that improved control and stability of spine would reduce mechanical irritation and

lead to pain relief in LBP patients with spine instability (Panjabi, 1992). The spine stability is achieved by sufficient trunk muscle activation and coordination (McGill et al., 2003).

To treat LBP, various spinal stability exercises without or with therapeutic devices are used to improve the function and strength of the trunk muscles (Behm et al., 2005; Kim et al., 2011; Marshall and Murphy, 2005), which protect the lumbar segments against repetitive microtrauma that could lead to LBP (Davidson and Hubley-Kozey, 2005). In early stage, spinal stability exercise can be enhanced by facilitating a co-contraction and isolated contraction of the muscles surrounding lumbar spine (Richardson et al., 1990). For the exercise progression (dynamic spine stability), spinal stabilization exercise using an unstable surfaces, such as a gym ball or wobble board, have been used to increase the difficulty of spinal stability exercises (Vera-Garcia et al., 2000). An asymmetric load on the trunk muscles induced by a unilateral single-leg-hold (SLH) exercise on an unstable foam roll causes rotation load on lumbar spine,

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