Myoelectric Activities of Abdominal Exercise Variations for the Individual with Low Back Pain

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The purpose of this study was to compare levels of myoelectric activity in the low back muscles as well as in selected abdominal and hip flexor muscle across eight different variations of the sit-up. The sit-up variations investigated were long-lying sit-up(with 0 degree of knee flexion) and hook-lying sit-ups(with 65, 90, and 105 degrees of flexion at the knee). Twenty seven male subjects performed three repetitions of each of long-lying sit-up and three hook-lying sit-ups with and without manual support of the feet. Myoelectric activities of the four muscle sites(rectus abdominis, external oblique, rectus femoris , and the L3 level of sacrospinalis) were monitored during the whole trials. Sit-ups with lack of feet support resulted in greater iEMG values at the two abdominal sites and in less iEMG in the rectus femoris. In the sacrospinalis, the myoelectric activity was significantly greater in the unsupported feet compared to the supported feet. The greater the knee angle in the hook-lying sit-up, the greater iEMG in the external obliques and the sacrospinalis were produced. Examining the sit-up variations, the hook-lying sit-ups performed without feet support appear to be the most taxing to both the abdominal muscles and the low back muscles.

Key Words: low back pain, feet support, knee angle
Introduction

Abdominal exercises have been used as tools to measure and develop the strength and endurance of the abdominal muscles. Among those abdominal exercises sit up is most often recommended by most investigators as a preventive mean for low back pain (Alexander, 1985; Flint, 1965; Floyd, 2012). As many experts have pointed out, many individuals who have low back problems have an anteriorly tilted pelvis (Hardman & Stensel, 2009; Wirhed, 2006). Strengthening of the abdominal muscles may ameliorate this problem by tending to tilt the pelvis posteriorly, thereby reducing lumbar hyperextension and the strain on the low back.

Although various sit-up types or variations are performed, at least some sit-up variations also recruited hip flexor muscles. Among the hip flexors, the iliopsoas muscle tends to increase lordosis at lumbar vertebrae when it is overdeveloped. Because excessive lumbar lordosis is thought to bring low back pain, the recommended sit-up variation is one maximizing involvement of abdominal muscle while minimizing the participation of hip flexors. The hook-lying sit-up performed with knee flexed and the feet flat on the floor has been recommended (Cox, 2011).

The low back muscles, of course, do not serve as agonists during the sit-up performance. However, it is not uncommon that low back pain patients, for whom sit-ups are often prescribed, may have weakened low back muscles. A consideration for the low back pain patient or the individual with weak low back muscles is the extent of involvement required of the low back muscles themselves during any sort of exercise. Although appropriate strengthening exercises for the low back are usually beneficial, it would clearly be counterproductive to strain or otherwise damage the low back muscles while performing abdominal strengthening exercises for the purpose of ameliorating low back pain. This is a valid concern, since at least one clinical report indicates that the use of sit-up exercises appears to have contributed to the development of 29 cases of low back pain (Magee, Zachazewski, & Quillen, 2009; Mutoh, Mori, Nakamura, & Miyashita, 1983). The following study was consequently undertaken to evaluate the relative involvement of the low back muscles, the abdominal muscles and the hip flexors during the performances of eight commonly used variations of the sit-up exercise. Therefore, the purpose of