The Effect of Lumbar Support Belts on Isometric Force Production During a Simulated Lift

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The use of back support belts by industrial workers has become common in recent years. The rationale for the use of these belts is based on the theory that they increase intra-abdominal pressure. Raised intra-abdominal pressure is believed to reduce compression forces on the spinal column and to assist the back extensor muscles in producing extension torque. The assistance of the belt is believed to protect the spine from injury. Thirty males and thirty females participated in this study which assessed the effect of two different back support belts (one synthetic and one leather) on isometric muscle-force production of individuals performing a static leg lift (SLL). A Latin Square double cross-over design was employed. Analysis of variance tests revealed that in males the use of the synthetic belt allowed for greater force production than a control trial, but no difference could be detected between the leather belt and either the synthetic belt or the control. In the female group, no difference in force production occurred across the three conditions. Implications and suggestions for further study are discussed.

KEY WORDS: low back pain; lifting; intra-abdominal pressure; orthoses.

INTRODUCTION

Epidemiologic studies have identified manual labor as a risk factor in the development of low back pain (1). According to Kelsey et al., one major risk factor for developing acute intervertebral disc prolapse is frequent lifting of objects weighing 25 pounds or more; this risk is greater when objects are held away from the body, or when trunk twisting occurs during lifting (2). Other investigators have also described the frequent occurrence of low back pain following an event involving manual lifting (3, 4).

Lumbar support belts are frequently used in work settings in an attempt to prevent low back injury during lifting (5). Similar belts are also used by competitive weightlifters in an attempt to prevent injury and to enhance lifting performance.

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Evidence supporting the effectiveness of these belts in preventing low back injuries is inconsistent. Walsh and Schwartz (7) determined that the use of lumbar support belts and patient education was effective in reducing low back injury in workers with previous history of low back pain. Conversely, Reddel et al. concluded that the use of lumbar support belts did not reduce the incidence of low back injury in baggage handlers (8). Barron and Feuerstein (9) recently reviewed the literature on the effectiveness of lumbar support belts in preventing back injuries. They concluded that the inconsistent findings from the aforementioned studies may be due to differences in populations and study design, including differences in the amount of lifting education and training that subjects received and different methods of belt use. One of the main rationales for using lumbar support belts is based on the fact that they are capable of increasing intra-abdominal pressure (IAP) at rest and during lifting activities (10,11). Increased IAP has been theorized to stabilize (12), and to create an extension moment on the lumbar spine (6). The proposed mechanism by which this stabilization occurs has been described in various ways. Gracovetski (13) describes the pressurized abdominal contents as a mechanical block preventing flexion of the lumbar spine when IAP is raised. Aspden has described a model for lifting in which he theorizes that the spine behaves not as a cantilever, but as an arch (12). This theoretical model postulates that increased IAP adds to stability of the spine by loading the convex side of the arch, thus reducing the tendency of the spine to collapse into flexion when loaded.

McGill et al. (6) postulate that increased intra-abdominal pressure is created by the contraction of the abdominal muscles, the pelvic floor muscles, and the diaphragm. If the diaphragm is compressing the abdominal contents, a reaction force which is equal in magnitude and opposite in direction is applied to the diaphragm. This reaction force is transmitted through the diaphragm to the ribcage and the spine, creating an extension moment on the lumbar spine (6). It is hypothesized that this extension moment reduces the extensor muscle force required to perform a given lifting activity. A reduction in the muscular force generated by the back extensor muscles results in a concomitant reduction in the lumbar spine intervertebral joint-reaction forces. The reduction in these forces may help to prevent injury to the joint itself, and to the muscles, ligaments, and intervertebral discs that oppose these joint reaction forces.

Theoretically, during a lifting activity with a given load, increased IAP results in a decreased demand on the lumbar musculature. If lumbar support belts increase IAP while a subject lifts a given load, then the back extensor muscle force required to lift that load should be reduced. Studies examining the relationship between IAP and reduced back extensor myoelectric activity during lifting have yielded conflicting results. Lander et al. (11) observed increased IAP and reduced myoelectric activity of the erector spinae muscles during a squat lifting activity. McGill et al., in a similar study, found that the use of back support belts increased IAP. This increase was accompanied by a slight, but statistically insignificant, reduction in muscle activity (6). The authors did not state whether surface electrodes were placed under the belt during the study. The placement of the electrodes between the belt and the subjects’ trunk would likely have changed the EMG readout. Conclusions regarding the relationship between IAP and myoelectric activity of the extensor muscles while