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An Original Contribution

Quantitative Electromyography Analysis of Disc Unloader Brace

Vijay Vad, MD, and Michael Lee, MD

The purpose of this study was to determine if the Disc Unloader brace was effective in reducing intradiscal pressure. There is a strong correlation between lumbar paraspinal activity and intradiscal pressure. We used ten healthy volunteers to measure lumbar paraspinal activity at L5 using a quantitative EMG system. After doing reliability and reproducibility testing which showed margin of error of 7%, ten volunteers were measured for quantitative EMG activity at the L5 paraspinal level in full lumbar flexion without the Disc Unloader brace three times and averaged. The same quantitative EMG testing was done in full flexion with the Disc Unloader brace on at the L5 paraspinal level three times and averaged. For five of the ten patients, we performed the test first with the Disc Unloader brace on whereas for the rest of the five, the test was performed first without the brace on. There were 7 females and 3 males with average age of 39 (range 26-46). The average area under the curve score was 173 ± 27.1 microvolts at the L5 paraspinal for the ten healthy subjects without the Disc Unloader brace on. The average area under the curve score was 102 ± 19.6 microvolts at the L5 paraspinal for ten healthy subjects with the Disc Unloader brace on. There was a statistically significant ($p<0.05$) reduction in quantitative paraspinal activity of 41% with the Disc Unloader brace on. We conclude that the Disc Unloader brace is effective in reducing quantitative EMG lumbar paraspinal myoelectric activity and therefore intradiscal pressures.

Keywords: Low back pain, orthosis, quantitative EMG

Lumbosacral supports are commonly prescribed in the management of low back pain. The two main purposes of lumbosacral orthosis are to restrict mobility thus enhancing spinal stability and to reduce intradiscal pressure by supporting paraspinal musculature. Among numerous methods of directly and indirectly measuring intradiscal pressure including intra-abdominal pressure, intramuscular pressure and intervertebral disc height, myoelectric back muscle activity has been shown to have the best correlation to intradiscal pressure measured *in vivo* (1-7). Numerous lumbosacral supports are used clinically for treating low back pain without clinical trials to support their efficacy. These braces may be used to treat discogenic pain as a part of a conservative treatment protocol, post-procedurally after intradiscal electrothermal treatment or percutaneous disc decompression, or postoperatively after spinal fusion surgery (8-10). Myoelectric activity of the lumbar paraspinal muscles was measured using a quantitative electromyography (EMG) system[a] (Cadwell Laboratories, Inc, Kennewick, WA) to quantify the intradiscal pressure changes observed with application of a new lumbosacral orthotic, the Disc Unloader brace[b] (Corflex, Manchester, NH).

From Weill Medical College of Cornell University-Hospital for Special Surgery, New York, NY. Address Correspondence: Vijay Vad, MD, Department of Physiatry, Hospital for Special Surgery, 535 East 70th St, New York, NY-10021. E-mail: lutzg@hss.edu
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Methods

Ten consecutive healthy volunteers were recruited to measure lumbar paraspinal activity at the L5 level using a Cadwell Quantitative EMG system. There were 7 females and 3 males with average age of 39 (range 26-46). Measurements were taken during a 0.1 second period in maximally flexed position. Reliability and reproducibility tests showed a margin of error of 7%. The quantitative EMG activity at the L5 paraspinal level in full lumbar flexion without the Disc Unloader brace was measured three times and averaged. The same quantitative EMG testing was performed in full flexion with the Disc Unloader brace on at the L5 paraspinal level three times and averaged. For the first five of the ten patients, the quantitative EMG activity was first measured with the Disc Unloader brace on whereas for the remaining five patients, the measurements were first performed without the brace. Descriptive data are reported as mean ± standard deviation. A paired Student's t-test was performed to measure statistical significance ($p<0.05$ was considered significant).

Results

The average area under the curve score was 173 ± 27.1 microvolts at the L5 paraspinal level for the ten healthy subjects without the Disc Unloader brace on. The average area under the curve score was 102 ± 19.6 microvolts at the same level for the ten healthy subjects with the Disc Unloader brace on. There was a statistically significant ($p<0.01$) reduction of 41% in quantitative paraspinal activity with the aid of the Disc Unloader brace.

Discussion

We performed quantitative myoelectric back muscle activity measurements on 10 healthy volunteers and showed that the Disc Unloader brace was effective in reducing the intradiscal pressure by 41%. We propose that a properly made and fitted lumbosacral brace may be used as a part of a comprehensive rehabilitation program. This can be achieved either as an adjunct to control discogenic pain in those patients under going conservative treatment protocol with low back pain or as a post-procedural support for unloading the intervertebral disc after a minimally invasive interventional procedures such

as intradiscal electrothermal treatment or percutaneous disc decompression.

What effect abdominal belts and lumbosacral orthosis has on the stability of the spinal segment and intradiscal pressure is controversial (8, 11-14). There is also controversy surrounding the role of increased intra-abdominal pressure in reducing intradiscal pressure. Intra-abdominal pressure can be increased either internally, for example by a Valsalva maneuver or by holding one's breath, or externally by an orthosis such as an intra-abdominal belt. Elevated intra-abdominal pressure increases spinal stiffness and therefore spinal stability (8, 11). Increased intraspinal stiffness and stability, however, may not necessarily reduce paraspinal muscle activity and therefore intradiscal pressure. In a roentgen stereophotogrammetric analysis it was shown that while spinal orthosis prevents gross motion of the trunk but not the intervertebral mobility in the lumbar spine (15).

Paraspinal myoelectric activity is clearly correlated with intradiscal pressure measured *in vivo* and accounts for 97% of variations seen in intradiscal pressure (2-4). While increase in flexion moment clearly increases intradiscal pressure proportionately when muscle activity is eliminated, muscle activity to counteract the flexion moment significantly influences intradiscal pressure. The largest influence on increase in intradiscal pressure was m. multifidus, which accounted for approximately 50% of the pressure increase (16). While the sample size was small in this study the reduction in myoelectric activity with the brace on was easily detected. The findings of this study may not necessarily reflect what happens in symptomatic patients with spinal pathology since there is great variability in the intrinsic and maximum intradiscal pressure when healthy discs were compared to degenerated and compromised discs (17).

Conclusion

The Disc Unloader brace was effective in reducing the intradiscal pressure by 41%. We propose the brace may be used as a part of a comprehensive rehabilitation program in those patients with discogenic pain. Further studies examining the efficacy of Disc Unloader brace in reducing discogenic pain in randomized clinical outcome studies results are needed.

Author Affiliation

Vijay Vad, MD
Assistant Professor Of
Rehabilitation Medicine
Weill Medical College of Cornell University-Hospital For Special Surgery
Hospital For Special Surgery
535 East 70th St
New York, NY 10021

Michael Lee, MD
Fellow in Spine and Sports Medicine
Hospital for Special Surgery
535 East 70th St.
New York, NY 10021

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