

Braces:

Low Back Bracing for Post-operative Surgery of the Lumbar Spine

Bracing can provide significant benefits in the course of treatment post-operatively. Post-operative bracing can provide protection and pain relief.

by Saul Bernstein, MD

Today's braces are used for everything from providing support in pregnancy to correcting scoliosis. Of particular interest is the efficacy of bracing for the postoperative patient.

The spine is a multi-segmented organ consisting of approximately 24 mobile segments. The compressive strength of each vertebrae increases from the cervical to the 5th lumbar level. The strength of the cancellous bone making up the vertebrae is the same at each level; therefore, the increasing strength as one progresses caudally is due to the increasing size of the vertebrae from C3 to L5. Cortical bone carries more of the load as the individual ages. Cancellous bone resorption also occurs. Studies have shown that the posterior portion of the vertebrae, the facets, carry 18 percent of the compressive loads of the spine. The anterior and posterior longitudinal ligaments add stability to the spine but predominately are active in traction and offer very little stability in shear or compression. The ligamentum flavum between the lamina provides a compressive force across the disc and acts as a holding force in flexion. The capsule of the facets, the supraspinatus ligaments, and the inter-transverse ligaments add further stability to the spine. The iliolumbar ligaments are major stabilizers of the L4, L5 lumbar vertebrae on the sacrum.

The intervertebral disc is the most important structure between vertebrae. From L1 to S1 the discs account for 33 percent of the length of the column of the spine. The annulus fibrosus is a multifibrous structure that contains the nucleus pulposus, a remnant of the notochord. Weight is distributed across the end plate of each disc complex. With compression, the disc bulges centripetally. With flexion, however, traction and compression rotation occur, and the disc may be displaced in multiple directions. Within the intact annulus, the elastic limits of the disc cannot be exceeded without vertebral fracture. The end plate is the most susceptible; the vertebral body is second.

Muscles acting on the lumbar spine are the extensors--predominately the sacrospinalis group. The flexors, the quadratus lumborum, psoas, iliacus, and abdominal muscles act on the spine when the pelvis is fixed. Lateral bend is achieved by unilateral contracture of the quadratus lumborum muscle.

With this complex of bones, joints, and muscles acting on the lumbar spine, what is the function of postoperative bracing? What effect does a ruptured herniated disc or the excision of the disc cause? Do the facets take more pressure? Do the end plates and ligaments that act at each level have increasing forces? In the surgical patient, the operative procedure, disease, and trauma, alter the stability of the spine. Certainly, multiple changes in the dynamics of the spine occur with any injury, disease, or surgical process. These alterations can lead to pain, weakness, and dysfunction that bracing can alter.

Bracing acts in certain specific ways. The abdominal contents act in conjunction with the spine and provide stability to the trunk. The thoracic and abdominal cavities are converted into nearly rigid walls composing a cylinder of air, liquid, and semisolid material. These cylinders are capable of resisting a part of the force generated in loading the trunk and,

thereby, relieving the load on the spine itself. By increasing abdominal tone and intra-abdominal pressure, support for the spine increases. This is why the key to a strong back has always been good abdominal musculature. Increasing abdominal pressure is, therefore, one of the techniques used to support the spine. This is best achieved by a brace that increases intra-abdominal pressure.

The spine is not centered on the pelvis, but is rather posterior. Any effect that increases the lever arm from the anterior abdominal wall to the center of the rotation of the vertebrae will increase the forces required to maintain the upright position. The center of rotation of the vertebrae is at the posterior aspect of the vertebral body. This change in forces is clearly evident in pregnant women. As pregnancy proceeds and the abdominal contents increase, the distance between the anterior abdominal wall and the spine increases, leading to the increasing back pain many women experience in the final days of pregnancy. The same thing occurs in obese individuals, or those with very large protuberant abdomens. Bracing can alter the lever arm on the spine by compression. Bracing, however, is difficult for obese individuals who are most in need of this extra support postoperatively.

The spine has numerous nerves supplying the bones, joints, muscles, and fascia in the area. Prevention or reduction of movement eliminates or reduces irritability of the caudal nerve root in the postoperative patient. Spondylithetic pain, degenerative or developmental, may be a good indicator for bracing the postoperative patient. Disc disease, with its associated pain, can be improved by immobilization pre- and post-operatively.

There are varying degrees of immobilization. Simple compressive forces can be instituted with a corset with or without stays. Corsets act almost entirely by increasing abdominal tone. Semi-rigid immobilization can be achieved with a chair back brace or TLSO (thoracolumbosacral orthosis). These devices improve support to the spine by compression as well as by decreasing movement. A rigid orthosis acts to restrict motion on a three-point principle. An optimum restriction of movement is likely to be achieved about halfway along the brace segment, and decreases at each end. A rigid orthosis encompassing the hip joint acts predominantly by restricting movement and affording protection.

Bracing for protection falls into the semi-rigid and rigid orthosis categories. Post-fracture care may require immobilization to prevent forward flexion or lateral bending. Immobilization at the L5\S1 level requires reduction of motion of the hip joint, since the lumbar orthosis cannot hold the L5\S1 motion segment.

Bracing in fractures is only indicated in the minimal to moderately unstable injury. It cannot and should not be utilized by itself for unstable fractures. Internal fixation must be used in these injuries, converting an unstable situation to one of minimal instability. Postoperative bracing is used for protection and pain relief. The reduction of micro-motion postoperatively allows the patient to be mobilized quickly, which reduces complications such as deep venous thrombosis. It also reduces hospital costs by allowing for early discharge since the patient is more comfortable. Studies have noted a reduction of motion of 30 percent at each level with a canvas jacket. A body jacket such as a TLSO or a cast reduced mid-lumbar motion by 66 percent. The L4\5 to S1 level required a pantaloons type of cast or brace, which reduced motion by 92 percent.

Contraindications of bracing may be noted in select patients. Increasing intra-abdominal pressure can cause certain individuals difficulty, and individuals with pulmonary compromise may be unable to wear a restrictive device. Any associated disease that may be altered by increased abdominal pressure would be a contraindication, including diaphragmatic hernias or deep vein thrombosis.

Compliance is an issue. An orthosis must be comfortable and easily applied to allow patients to wear most of their normal clothes. In warmer climates, many patients complain of being too hot in the orthosis, and the frequent compression on the anterior thighs can make sitting in a car difficult. Basically, however, with a little bit of understanding and compassion, patients can be made quite comfortable in a brace that could significantly benefit their course of treatment.

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