Design of a Dynamic Stabilization Device for the Correction of the Center of Rotation in the Lumbar Spine

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Technology description

Background

Despite the relatively large number of dynamic stabilization designs that have been proposed, an implant designed to manipulate the motion segment’ s center of rotation (COR) has not been developed. A successful implant must restore natural loading to the spine; however, physiologic loading will not occur unless the implanted motion of the spinal segment passes through the spine’ s natural center of rotation. An implant that imposes a non-physiologic center of rotation location produces higher tissue stresses and increases the likelihood of hardware failure. These heightened tissue stresses and non-physiologic motion patterns will also be induced on the adjacent motion segments, possibly leading to some of the long-term complications associated with current dynamic stabilization devices. For example, areas of the annulus that are normally in compression experience tensile stresses when the center of rotation moves posteriorly out of the intervertebral disc.

To combat this issue, a pedicle screw was designed using a head piece, pedicle screw, snap in lock and a cap screw. These pieces are desgined to allow simple surgical installation. Based on finite element studies, this implant does not alter the motion pattern and does not alter the natural load bearing of the lumbar spine in flexion. Further studies in cadaver spine show close relationship of rotation of the L3-L4 spine in comparison to finite element modeling.

Interspinous Spacer

In some patients, contraindications of the pedicle screw may limit certain uses. Interspinous spacers are often used to correct spinal stenosis and facet arthrosis when a pedicle screw assembly is not effective. The aim of this newly designed interspinous spacer is to: (1) increase neuroforaminal height by limiting the motion segment’ s rotation in extension, (2) preserve physiologic loading in flexion by projecting the motion segment’ s COR to its natural, undegenerated location, (3) restore overloaded facet joints to healthy levels, and (4) increase stability in the transverse and coronal planes by secure attachment to the spinous processes while limiting the stresses experienced at these interfaces.

The new interspinous spacer utilizes many of the same features found on its pedicle screw based counterpart. The system is comprised of two parts: an outer base that attaches to the inferior spinous process and an upper sliding rod that attaches to the superior spinous process.

Many features of the interspinous spacer implant make it an attractive option for the relief of spinal pathologies. The use of two moving parts rather than four means the likelihood of failure will be lower. The device will provide an alternative treatment to cases where pedicle screw systems are deemed inappropriate.

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