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Loading of the Total Facet Arthroplasty System™ (TFAS™) compared to a Rigid Posterior Instrumentation System

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Non-fusion stabilization of the lumbar spine is a relatively new concept that could expand the treatment options during spinal surgery. The Total Facet Arthroplasty System™ (TFAS™) is an alternative to instrumented fusion that aims to restore the intervertebral kinematics and intervertebral load-sharing, after surgery for pathology such as spondylosis or facet arthrosis. This study's objective was to characterize and compare the axial and bending loads experienced by the TFAS™ to a rigid posterior instrumentation system (UCR, SeaSpine, Riverside, CA).

Six human cadaveric lumbosacral spine specimens, L3-S1, were subjected to three-dimensional flexibility testing. A wide decompressive laminectomy of L4-L5, including bilateral facetectomy, was performed on all specimens prior to instrumentation. Three uniaxial strain gauges were applied to the cranial arms (TFAS™) and longitudinal rods (UCR) of both implants. Loading of the implants was assumed to be characterized by axial and bending loads, calculated from the strain outputs using theoretical beam-column stress-strain relationships. Following calibration, typical accuracies were approximately 5% for axial and 10% for moment loading.

The loads for both implants generally increased with increasing external moment application in all loading directions. The TFAS™ implant experienced smaller axial and bending loads under extension (20%, 41%) and lateral bending (38%, 76%) as compared to the UCR. Similar axial loads and bending moments were measured in both implants under axial torsion. The TFAS™ system experienced similar axial loads as compared to the UCR under flexion, but greater bending moments (300%).

By virtue of the TFAS™ motion-preserving design, it experienced different and generally smaller loads than the rigid UCR implant. The mechanism leading to higher TFAS™ moments under flexion loading has not as yet been established. Our results suggest that the UCR was installed with a non-zero moment present in the neutral position which may have resulted in the significant difference between the implant loads under flexion loading. In general, we expect the lower TFAS™ implant loads to be associated with reduced implant-bone interface loads. This may reduce the likelihood of implant loosening compared to rigid posterior instrumentation systems, but the different expected life spans of these devices merits further investigation on this topic.