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Kinematic study of total facet arthroplasty after complete laminectomy and facetectomy.

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Background: Arthroplasty of the facet joints has been proposed for the treatment of facet joint pathologies. In the United States, facet arthroplasty is initially being clinically studied as a reconstructive procedure after laminectomy-facetectomy for the treatment of spinal stenosis. We hypothesize that after a destabilizing laminectomy-facetectomy, the Total Facet Arthroplasty System™ (TFAS™) will restore stability while allowing for motion at the operated segment. Restoring motion at the operated level rather than fusing may provide a better outcome to the patient in terms of functionality and reduced incidence of complications, including adjacent level degeneration.

Methods: Nine human cadaveric lumbar spines (L1-sacrum) were tested in flexion-extension (+8 to -6 Nm), lateral bending (±6 Nm), and axial rotation (±5 Nm). Specimens were tested without preload and under 400 N of follower-load. Tests were performed in the following sequence: (1) intact, (2) total laminectomy and facetectomy at L3-4, (3), fusion, (4) TFAS (Archus) implanted at the same level. Three-dimensional segmental motion was recorded and analyzed using ANOVA and multiple comparisons with Bonferroni correction.

Results: **:** The range of motion of the intact L3-L4 segment in the initial seven specimens was 8.6º (±2.0º) in flexion-extension, 8.4º (±2.0º) in lateral bending, and 2.9º (±1.7º) in axial rotation. Removal of the facets and lamina (in the absence of an implanted device) significantly increased L3-4 motion in flexion extension ($p=0.004$), lateral bending ($p=0.02$) and axial rotation ($p=0.002$). Fusion significantly reduced L3-4 motion compared to both intact and laminectomy-facetectomy in flexion extension ($p=0.000$) and lateral bending ($p<0.01$). TFAS restored motion to intact from the laminectomy-

facetectomy condition; restoring flexion-extension to 7.9º (±2.4º) (p=0.45), lateral bending to 10.0º (±3.1º) (p=0.26) and axial rotation to 4.1º (±1.3º) (p=0.24). The pattern of load-displacement curve (quality of motion) after TFAS insertion was similar to that of the intact spine. Adjacent level kinematics was preserved after implantation of the TFAS. Discussion: This study is one of the first to report the kinematics of a facet arthroplasty device. These data suggest that after wide decompression of the neural elements, TFAS may avoid the need for fusion by virtue of its ability to restore stability while allowing motion at the operated and adjacent levels, similar to the intact spine.