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Biomechanical Comparison of Facet Spacer and Facet Screw for Lumbar Posterior Stability

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Extended Abstract

Facet stabilization is gaining popularity for lumbar posterior stability. The strategy behind this technique is to fuse the facet joints with intra-articular spacer or fix the superior and inferior facets with perforating screws [1,2]. This study compared the mechanical performance of lumbar facet spacer and facet screws using an *in vitro* porcine model [3].

Twelve functional spinal units (FSUs) of porcine lumbar spine were enrolled. For each FSU, the surrounding musculature was removed, leaving all ligamentous structures intact. Each FSU was embedded in customized fixtures with acrylic (AcriliMet). The upper and lower vertebrae were embedded into the acrylic to their midbodies. The disc and facet joints were free of embedding material and accessible for the application of instrumentation. Each FSU was instrumented with either a facet spacer (Group I, n=6), or a facet screw (Group II, n=6). In Group I (facet spacer), two facet spacers were inserted into the joint spaces of bilateral superior and inferior facets. In Group II (facet screw), two perforating screws were used to trans-fix the bilateral superior and inferior facets. All 12 of the FSUs were initially tested un-instrumentedly using MTS testing machine. After un-instrumented testing, six FSUs were instrumented randomly with facet spacer, and the remaining six were instrumented with facet screw. Each FSU was nondestructively tested in four sequential modes: flexion, extension, lateral bending and torsion. For all four loading modes, a pure moment up to 6,000 N-mm was applied to achieve the flexion, extension, lateral bending and rotational motions. Global stiffness of the vertebral constructs were calculated based on moment vs. displacement curves. Additionally, for flexion and extension, the intervertebral displacement between upper and lower vertebrae was measured using an extensometer (MTS Corp., US). The difference of foramen area of FSU with and without facet spacer implantation was examined using X-ray photographs. Foramen area was then calculated using image analysis software (Image-pro plus, Media Cybernetics, Inc., Silver Spring, Maryland.)

In un-instrumented experiments, the stiffness of flexion, extension, bending and rotation was 584.47 N-mm/mm, 732.25 N-mm/mm, 979.10 N-mm/mm and 3366.28 N-mm/deg, respectively. After instrumentation, in Group I (facet spacer), the stiffness of flexion, extension, bending and rotation was 1237.54 N-mm/mm, 1915.42 N-mm/mm, 1007.95 N-mm/mm and 3653.78 N-mm/deg, respectively; in Group II (facet screw), the stiffness of flexion, extension, bending and rotation was 1467.76 N-mm/mm, 1667.50 N-mm/mm, 1413.24 N-mm/mm and 4821.02 N-mm/deg, respectively. Significant reduction ($p<0.05$) of intervertebral displacement was found for FSUs with facet spacer implantation or facet screw fixation as compared to un-instrumented. This implies that the implantation of facet spacer or facet screw would significant improves the postoperative stability of FSU. An average increase of 3% in foramen area was observed for FSU with facet spacer implantation, which may be beneficial for spinal decompression surgery.

In conclusion, either facet spacer implantation or facet screw fixation improved the stability of a single lumbar motion unit. Facet screw fixation provided better stabilization in flexion, rotation and lateral bending, while facet spacer implantation provided better stabilization in extension.

References

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