Dynamic Spine Stabilizer Reduces Adjacent Intervertebral Disc Pressure during Flexion

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Introduction: Recently, the dynamic spine stabilizer has gaining its popularity for the merit of preserving the normal functional movement of spinal column, and possibly, the prevention of early disc degeneration. However, clinical reports of early disc degeneration were still reported. The efficacy of dynamic stabilizer in minimizing the risk of disc degeneration has not reached to consensus conclusion yet. Biomechanical studies have showed that the excessive intradiscal pressure (IDP) may induce the disc degeneration. The purpose of this study is to find the IDP of stabilized level and adjacent level at different level of dynamic constrains.

Methods: Specimens Preparation. Eight 4-level lumbar motion segments were dissected from 6-month old pigs. All soft tissues except the surrounding ligaments and facet capsule were carefully removed. Specimens were wrapped in saline-soaked gauze and stored in the freezer until the experiment.

Pressure Transducer. A miniature 20 G needle type pressure transducer was used to measure the IDP. The pressure transducers were inserted into the center of implant level and adjacent cranial level (Figure 1A).

[Fig 1. Schematics of Experiment Set Up]

Dynamic Stabilizer. A home-made dynamic spinal stabilizer was designed to control the range of motion (ROM) of implanted motion segment. This stabilizer is able to control the ROM of motion segment by adjusting the block and shaft for linear and rotary constraints (Figure 1B).

Experimental protocols. The ROM of total and individual level of intact and injured spinal column under 6 Nm flexion and extension pure moment were first recorded. The injury was created by damaging the mid level bilateral facet joints. After the injury, the injury level was implanted by a tradition rigid fixation device. Then, a displacement controlled rotation was applied. Then, the home-made dynamic stabilizer was implanted to tune the ROM of implant-level into these 9 intervals at the same displacement controlled rotation. The IDP of implant-level and adjacent cranial level of these 9 setting was recorded.

Results: For an intact motion segment, the IDP of mid level and adjacent level were 0.086(0.079) MPa and 0.098(0.173) MPa during 6 Nm extension, and were 0.63(0.26) MPa and 0.63(0.11) MPa during 6 Nm flexion. The injury of posterior elements increased the IDP of injury level to 0.61(0.28) MPa during 6
Nm extension, but less affected the IDP of adjacent level. The posterior injury did not affect the IDP of injury level and adjacent level during flexion. The rigid fixation reduced the IDP of implanted level and adjacent level of injured spinal column to 0.159(0.094) MPa and 0.178(0.189) MPa at the same extension deformation. However, the rigid fixation increased the IDP of implant level and adjacent level of injured spinal column to 0.822 (0.382) MPa and 1.341 (0.976) MPa at the same flexion deformation. Compared to the rigid fixation system, the dynamic spinal stabilization at all constraint level did not affect the IDP during the extension motion. However, the stabilization system did reduce the IDP of adjacent level when the constraint was set from 20% to 90% looseness during the flexion motion.

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