Biomechanical Evaluation of Paracoccygeal Transsacral Fixation

Burak Akesen, MD, Chunhui Wu, PhD,† Amir A. Mehbod, MD,* and Ensor E. Transfeldt, MD**

Study Design: This is a biomechanical study using human cadaveric lumbar spine.

Objective: To evaluate the biomechanics of paracoccygeal transsacral rod fixation.

Summary of Background Data: Various types of transsacral fixation either by posterior and paracoccygeal approaches have been described in the literature. The biomechanical advantage of transsacral rod fixation is the preservation of supporting structures at L5-S1 level. No biomechanical data on human cadavers have been reported in the literature. The aim of this study is to evaluate the biomechanics of the transsacral rod fixation.

Methods: Six fresh human cadaveric L5-S1 motion segments (mean age 67.5 y; range 46 to 82 y) were used in the study. Unconstrained and nondestructive pure moments in axial torsion (AT), lateral bending (LB), and flexion-extension (FE) were applied to each specimen after applying transsacral rod and after additional augmentation methods, including bilateral screws, facet screws, and pedicle screw and rod system. Range of motion (ROM) was calculated for each surgical treatment. The disc space was measured with lateral plain radiographs of intact specimens and after transsacral rod insertion to evaluate the amount of distraction.

Results: The mean ROM of the intact specimens was 3.5, 6.4, and 11.0 degrees in AT, LB, and FE, respectively. Standalone transsacral rod reduced ROM more than 40% compared with the intact condition ($P = 0.002$). Bilateral screws further reduced the ROM in AT (64%) and LB (70%), but not in FE (53%). Both facet screws and pedicle screw and rod system achieved high construct stability under all loading conditions. The transsacral rod augmented with facet screws reduced ROM by 70%, 80%, and 90% compared with the intact condition. When augmented with pedicle screw and rod system, the transsacral rod reduced ROM by 73%, 87%, and 88% in AT, LB, and FE, respectively. There was no statistical difference between these 2 facet screws and pedicle screw and rod system ($P > 0.8$).

Conclusions: Transsacral rod fixation provides strong ligamentotaxis due to intact annulus. Standalone transsacral rod is able to reduce ROM significantly and achieve indirect decompression by distracting L5-S1 disc space. However, additional posterior fixation, such as facet screws or pedicle screws, is required to achieve better construct stability for successful fusion.

Key Words: transsacral fixation, biomechanics, paracoccygeal approach, minimally invasive

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From the *Twin Cities Spine Center; and †Foundation for the Advancement of Spinal Knowledge, Minneapolis, MN.

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Reprints: Chunhui Wu, PhD, Foundation for the Advancement of Spinal Knowledge, Piper Building, Suite 600, 913 E 26TH St, Minneapolis, MN 55404 (e-mail: cwu@spineknowledge.org).