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Introduction: Replacement of the nucleus with an implant often requires a large defect in the annulus, which can increase both the flexibility of a spinal segment and the extrusion risk for the implant. Implantation through a transsacral approach may preserve biomechanically important anatomical structures and prevent extrusion of the implant. The purpose of this study was to investigate the biomechanical behavior of the transsacrally implanted, in-situ cured, silicone rubber nucleus replacement (PNR™), which can be implanted after conventional microdiscectomy.

Methods: Six fresh frozen human lumbar spine specimens (L2-S1) were split in two groups: monosegmental L2-3 segments and bisegmental L4-S1 specimens. In the monosegmental group, microdiscectomy was carried out through interlaminar approach. Transsacral nucleus replacement with an in-situ cured silicone rubber implant was performed in the bisegmental group into the segment L5-S1. Both groups were exposed to cyclic loading (100-600 N) for 100,000 cycles. Segment flexibility was tested in the intact state, after microdiscectomy, transsacral nucleoectomy, implantation and 100,000 cycles of loading under pure bending moments (7.5 Nm) in the three main motion planes. After testing, all specimens were dissected and underwent macroscopic investigation.

Results: The immediate effect of implantation was a significant segmental stabilization in all planes. In the microdiscectomy group ROM in flexion/extension and lateral bending decreased significantly relative to the intact state, but not in axial rotation. In both groups, the cyclic loading caused a destabilizing effect, but was similar to non-treated segments. No expulsion of the silicon core through the posterior defect could be observed in the microdiscectomy group. Macroscopic observation revealed no visible changes of silicon core position.

Discussion: Transsacral nucleus replacement with PNR™ silicone implant provided a restoration of the biomechanical behavior of the intact segment. No implant expulsion was observed even with posterior defect in annulus fibrosus and interlaminar approach in microdiscectomy group. This transsacral approach may also serve as a possibility for the use of other nucleus implant technologies.