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Introduction: Using an in-vitro human cadaveric model, the current study served to quantify the multidirectional flexibility properties and changes in intradiscal pressure at the superior operative level and proximal adjacent intervertebral levels following reconstruction using solid and dynamic rod techniques.

Methods: Nine cadaveric lumbar spines were biomechanically evaluated under the following L1-L5 reconstruction conditions:
1) Intact,
2) Solid Rod,
3) Hybrid (flexible L1-L2 and solid rod L2-L5),
4) Dynamic Rod (flexible L1-L5),
5) Laminectomy,
6) Lami+Solid Rod,
7) Lami+Hybrid,
8) Lami+Dynamic Rod (Transition™ and Revere™ Systems).

Multi-directional flexibility testing utilized intact moments of ±10Nm for axial rotation, flexion-extension and lateral bending. Intradiscal pressure at T12-L1, L1-L2 and L5-S1 levels were quantified along with operative and adjacent level range of motion (ROM) and neutral zone (NZ) normalized to the intact spine (100%).

Results:

Lateral Bending: Solid Rod (10.24±3.99) and Hybrid (10.36±3.95), proximal adjacent level ROM (T12-L1) increased compared to the intact spine (p< 0.05). These trends were similar to post laminectomy. Distal adjacent level (L5-S1) increased in ROM for Solid Rod and Hybrid versus intact and laminectomy (p< 0.05). Proximal operative level ROM (L1-L2) for Hybrid (6.85±2.24), Lami+Hybrid (6.33±1.43), Dynamic Rod (6.03±2.22) and Lami+Dynamic Rod (5.56±1.52) were markedly higher than Solid Rod (4.48±0.78) and Lami+Solid Rod (4.46±1.15) (p<0.05). Operative level ROM (L2-L4) for Dynamic Rod (6.55±2.40) and Lami+Dynamic Rod (5.49±1.77) were significantly higher than Solid Rod (1.24±1.29) and Lami+Solid Rod (1.56±1.38) (p< 0.05) (Figure 1).

Flexion-Extension: No significant differences were observed for the proximal (T12-L1) and adjacent levels when comparing the devices (p>0.05). Distal adjacent level (L5-S1) demonstrated an increased ROM for all groups versus intact and laminectomy (p< 0.05). Operative level ROM (L2-L4) for Dynamic Rod (4.31±5.00) and Lami+Dynamic Rod (2.19±0.87) were markedly higher than Solid Rod (1.43±0.67) and Lami+Solid Rod (1.55±0.62) (p>0.05).

Axial Rotation: No significant differences were observed at any levels when comparing the devices (p>0.05). Intradiscal pressure at the proximal adjacent level (T12-L1) indicated marked decreases in flexion-extension following Hybrid (148±23 psi) and Dynamic Rod (134±34.2 psi) compared to Solid Rod (176±49 psi) (p>0.05).

Conclusions: Posterior dynamic stabilization demonstrated significantly higher ROM than solid rod in lateral bending across the L2-L4 operative levels. Trends of increased ROM in flexion-extension at the superior operative level (L1-L2) with corresponding decreases in intradiscal pressures at the proximal adjacent level (T12-L1) were also observed. The current study provides a biomechanical basis for dynamic stabilization in long lumbar spinal constructs and may serve to augment ongoing clinical investigations.