Effects of Different Posterior Dynamic Systems (PDS) on Graded Facetectomies

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Introduction

Spinal stenosis is a degenerative process, caused by progressive narrowing of the lumbar spinal canal and neural foramen, leading to a constriction of the nerve roots of the cauda equina. Currently, facetectomy and laminectomy combined with fusion are the standard methods of decompression for the degenerative lumbar spinal stenosis . However due to a myriad of potential degenerative complications at the fused level, and adjacent level degeneration, numerous new posterior dynamic stabilization systems have been developed. Our aim was to study the effects of graded facetectomies using three posterior dynamic stabilization devices.

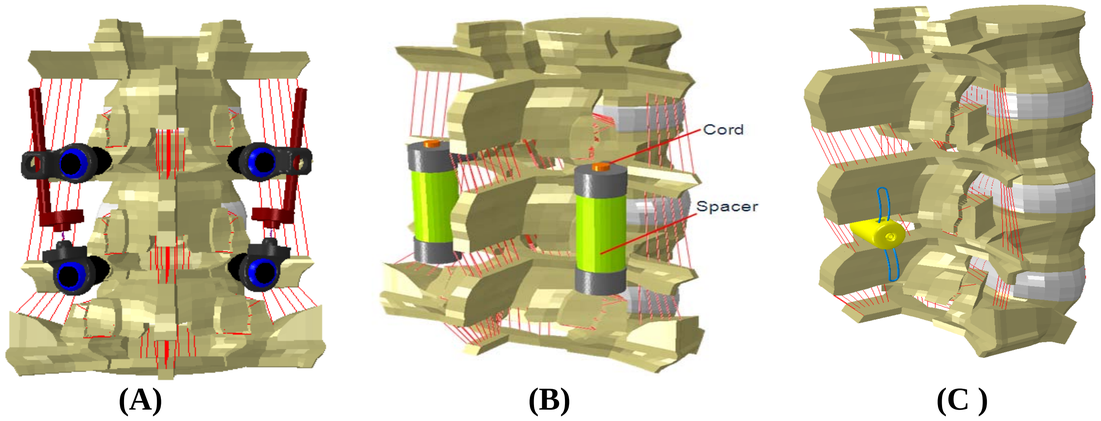

Fig 1: Posterior view of implanted Stabilimax® (A) , Dynesys® (B), and InSpace™ Spacer (C) at L4-L5 level of the finite element model**.**

Methods

An experimentally validated, 3-D ligamentous FE model of the L3-S1 segment from previous studies was used. A 400 N compressive follower load and a pure bending moment of 8 Nm were applied to the intact model. The intact model was modified to simulate 50% and 100% facetectomy at L4-L5 level. The direction of loading included Flexion (Flex), Extension (Ext), Lateral Bending (LB) and Axial Rotation (AR). Range of motion (ROM) and facet forces at the implanted level were computed for all loading modes. The total facet forces were calculated only for the left facet joint since it is a symmetrical model.

Results

With partial facetectomy, the Stabilimax decreased ROM by 53% compared to intact in Flex, 57% in Ext and 43% in LB (Fig. 2). Similarly, the Dynesys decreased ROM by 80% compared to intact in Flex, 70% in Ext and 65% in LB. Implantation of In-Space spacer led to 70% decrease in motion in Ext only. The facet force decreased at the implanted level in Ext for Stabilimax by 64%, Dynesys by 20% and 99% for the In-Space (Table 1). The facet forces for Stabilimax and Dynesys increased in all other loading modes.

Total facetectomy increased the ROM in Ext and AR (Fig. 2).

Stabilimax® is an Investigational Device, limited by Federal law to investigational use

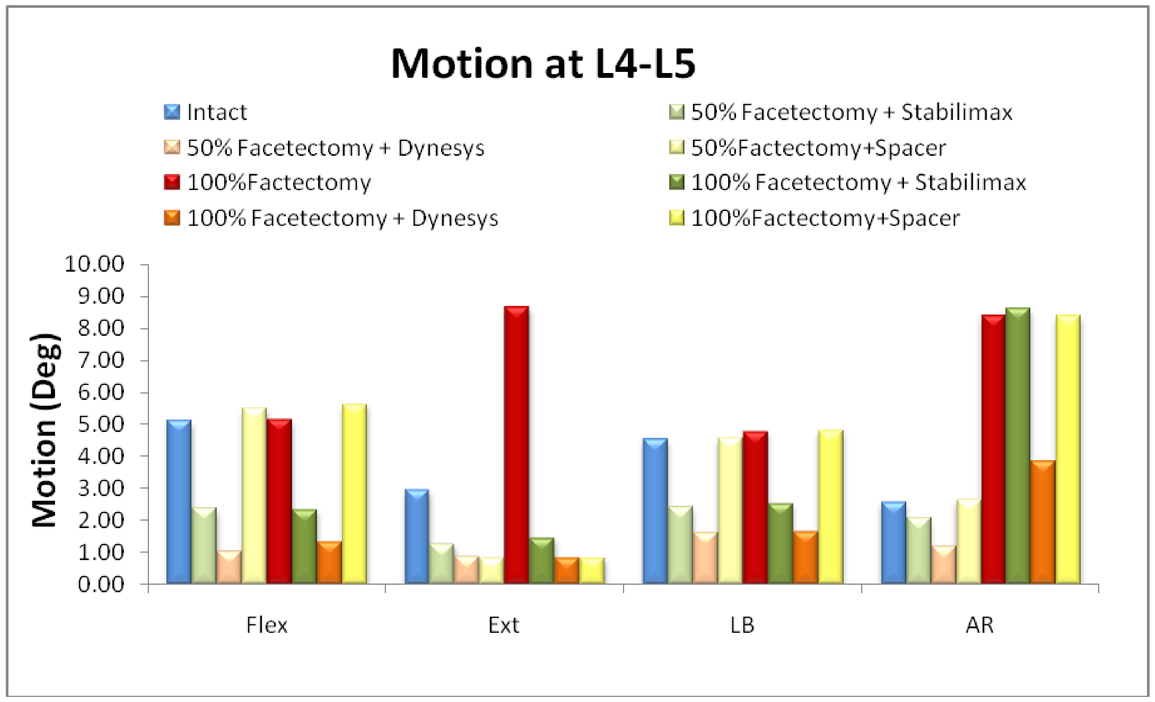

Fig 2: ROM at Implanted (L4-L5) level at 8 Nm applied bending moment

Total Facet Forces (N) on the Left Facet at Implanted Level (L4-L5)

	Flex	Ext	LB	AR
Intact	0	163.6	58.8	160.0
50% Facetectomy+Stabilimax	5.8	58.3	64.9	183.7
50% Facetectomy+Dynesys	67.2	130.7	108.5	247.3
50% Facetectomy+Spacer	0	16.1	45.1	164.5

Table 1: Total Facet Force on the Left Facet at Implanted (L4-L5) level

Discussion

Based on the above results we can conclude that after partial facetectomy, PDS provides the expected range of motion and unloads the facets in extension. With complete facetectomy, however, the PDS may not provide the necessary stability since the segment becomes highly unstable in axial rotation and extension. This may result in unexpected loads on PDS, leading to fixation overload, and ultimately implant loosening. **Therefore, in cases requiring complete facetectomy, alternative approaches, such as fusion or facet replacement systems, may be a better option.**

REFERENCES

Goel V.K., et al., *Effects of Charite artificial disc on the implanted and adjacent spinal segments mechanics using a hybrid testing protocol.* Spine, 2005. **30**(24):p. 2755-64.