THE INFLUENCE OF PARTIAL PARS INTERARTICULARIS FENESTRATION ON STRESS-FRACTURE FOLLOWING DECOMPRESSION IN THE LUMBAR REGION

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INTRODUCTION:
Lumbar spinal stenosis, especially foraminal stenosis, is the most important cause of failed back surgery syndrome (2, 3, and 4). One of the proposed approaches to decompress nerve root is the fenestration of pars interarticularis (5, 7). While this approach allows complete decompression and visualization of the nerve root but it can lead to iatrogenic spondylolysis, especially if the fenestration is too excessive (6). However, there is no information in the literature about correlation between extent of removing pars interarticularis and decrease in spine stability. Thus, the purpose of this study is to investigate stresses and motion of lumbar spine after the pars interarticularis fenestration surgery using the finite element (FE) analysis.

MATERIAL:
Finite Element Model:
An experimentally validated 3-dimensional non-linear FE model (FEM) of the intact L3-S1 segment was used. This model has been previously used to investigate a number of clinically relevant issues (1). The unilateral partial medial L5 pars interarticularis fenestration involving 25% (L5med25), and 50% cutting of medial pars interarticularis (L5med50); were simulated by removing appropriate elements of the intact model, Figure 1. The unilateral partial lateral L5 pars interarticularis fenestration involving 25% (L5lat25), 50% cutting of lateral region of pars interarticularis (L5lat50) models were also prepared.

ANALYSIS:
The range of motion (ROM) across L5-S1 and maximum Von Mises stresses in the interarticularis region of L5 were analyzed in flexion, extension, lateral bending and axial rotation in response to 10.6 Nm moment with 400 (N) axial compression. The data were compared with the corresponding intact lumbar spine.

RESULTS:

![Figure 1. Posterior view of intact spine model with simulation of pars interarticularis fenestrations of L5 lamina (medial and lateral).](image)

The stresses in the remaining pars interarticularis L5 after L5med25, L5med50, and L5lat25 were close to intact spine stresses. On the other hand, the stress values after L5lat50 in extension and left rotation were 86 and 71.78 (MPa), and it was 43% and 37% higher than the value in the intact model, respectively (Figure 3).

CONCLUSION:
This result indicates that removing of 25%, 50% of medial and 25% lateral part of interarticularis region does not alter the biomechanical behavior and thus does not require additional stabilization. The 50% removal of lateral part increases the possibility of stress-fracture, although the motion still remains close to normal. In order to reduce the chances of stress fracture in this case, additional stabilization may be indicated.

REFERENCES: