Introduction: Total artificial disc replacement (TDR) has recently been used as an alternative solution for degenerated disc disease to prevent the degeneration of the adjacent segment while restoring the kinematics of the degenerated segment. At present most of the disc designs require anterior exposure for the placement. However, several surgeons feel that the anterior TDRs are flawed altogether. Anterior disc designs do not address pain due to facet joint; patients report post-operative facet pain. Surgeons are not comfortable with the anterior approach being unfamiliar/hazardous for placing the disc. Posterior surgeries deal with 90% of pathology vs. only 5-10% with the anterior. Thus, there is a need to develop posterior disc designs as well. In this study, we used finite element method to compare the biomechanical behavior of the lumbar spine after single level posterior disc replacement (PDR), with and without artificial facet replacement (AFPDR).

Material and Methods:
A three dimensional, ligamentous, experimentally validated L3-S1 Finite Element (FE) model of lumbar spine was modified to simulate a posterior disc and/or artificial facet concepts (implanted models, ADPDR and PDR) of lumbar spine. The rugby ball and corresponding socket type disc (material, titanium) was placed at L4/L5 level using a posterior surgical procedure which involved dissection of the entire nucleus, partial posterior annulus, posterior longitudinal ligaments (PLL) while retaining all the other ligaments, and total bilateral facetectomy. The top and bottom surfaces of the upper and lower artificial discs were tied to respective endplates of the vertebral bodies. In the second model artificial facets involving a sliding male-female concept with clearance between the two was added. The facets were attached to the pedicles using titanium pedicle screws. A compressive force of 400 N besides a bending moment of 10.6 Nm were applied to implanted and intact models to simulate physiological extension and flexion motions. Motions at various levels were computed for all the three cases.

Results: In flexion the motion in PDR model was 6.8 degrees whereas in AFPDR and intact model these were 5.5 and 4.9 degrees, respectively, Figure 2. In extension the motions of AFPDR, PDR and intact models were 2.36, 4.48 and 3.35 degrees, respectively, Figure 3.

Conclusion: Addition of an artificial facet to a segment for this posterior disc design seems essential to restore the segmental motion to normal. Additional studies for other posterior disc designs and comparative data with anterior disc designs are warranted to highlight the biomechanical advantages of using the posterior disc concept, besides the clinical needs stated in the introduction section above.

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