INTRODUCTION:
The lumbar artificial disc replacement (ADR) has been considered to be one of the newest “joint-motion-preservation” techniques for the treatment of disc degenerative disease. Artificial disc Prodisc-L (Spine Solutions, Inc. Synthes, Switzerland), a ball-and-socket joint based design, has been publicized to be capable of reproducing the kinematics and loads transfer of a normal disc. Although motion analysis of the Prodisc-L in human cadaveric models has been widely performed, little is known about the in situ contact interaction between the prosthesis components following ADR, which may potentially have a significant impact on the lumbar spine motion, load sharing and prosthesis wear.

In this study, a 3-D finite element (FE) analysis was performed to evaluate (1) the range of motion (ROM) changes due to the implantation of the Prodisc-L; (2) load sharing by the disc and facet joint of the lumbar spine; (3) In situ contact interaction of the prosthesis components of the Prodisc-L after lumbar ADR.

METHODS:
A validated, three-dimensional, intact osteoligamentous lumbar segments L2-L4 FE model was created as the baseline case. Seven major groups of ligaments were represented by non-linear cable elements. The facet joint articulations were modeled by contact gap elements. The intact model was altered to accommodate the ADR prosthesis (Figure 2.). Prodisc-L was designated to be implanted via an anterior surgical approach into L3-L4 disc space, the anterior longitudinal ligament, superior, inferior endplates were removed, while preserving about 32% of the lateral annulus. The Prodisc-L of 6° lordosis angle then was inserted after preparation of the prosthesis components to ensure central alignments on both sagittal and frontal plane.

RESULTS:
The flexion motions across the implanted level (L3-L4) and its adjacent level (L2-L3) remain unchanged after ADR. In extension, at the implanted level, the surgical model had a 91.4% increase and at L2-L3 a decrease of 6.8%. The facet loads through L3-L4 increased by 33.2% in flexion and 36.3% in extension.

IN SITU CONTACT ANALYSIS OF THE PROSTHESIS COMPONENTS OF ARTIFICIAL DISC PRODISC-L® IN LUMBAR SPINE USING FINITE ELEMENT METHOD

*Chen, W M;*Ahn, Y H; **Lee, K Y; ***Park, C, K; +*Lee, S J
+Department of Biomedical Engineering, Inje University, Gimhae, South Korea
SJL@bme.inje.ac.kr

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