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Cervical Disc Degeneration-Effects of Different Severities, and Spinal Levels of Segmental Motions, Disc Pressures and Facet Loads on Adjacent Segments

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Disclosures



- Disclosures-No Relevant Disclosures

Introduction & Background

- Cervical disc degeneration affects all of us
- DDD at C5-C7 is typically the earliest to develop and the most predominant.

Objective of Study: to determine the effects of cervical degenerative disease on ROM using FEM

Materials and Methods

Using a validated human FEM from C2-T1 with T1 vertebra fixed. Pure moment of 2 Nm was applied at superior of C2 vertebra and follower load (75N) is applied on the cable +Y for flexion, -Y for extension and -X for lateral bending and Hybrid Loading. The C5-6, C6-7, and C5-7 levels were simulated. To accommodate for the levels of severity of disc degeneration (mild, moderate and severe) the disc material properties were altered. The elastic modulus of the nucleus pulposus, annulus volume, and disc space height were altered to reflect the severity of the degeneration.

Results

Normalized ROM from degenerated disc at the index level(s) in :

Mild DDD- ROM decreased from 7.4-10.4% in flexion and 3.7-8.4% in extension

Moderate DDD- ROM decreased from 22.6-27.1% in flexion and 14.4-16.2% in extension

Severe DDD-ROM decreased from 51.1-56.8% and 29.7-41.2% in extension

Normalized ROM from degenerated disc at the cephalad level :

Mild DDD increases 3.2-3.5% in flexion, 0.4%to 5.8% in extension

Moderate DDD increases 7.8-13.9% in flexion, 3.6 -6.7% in extension

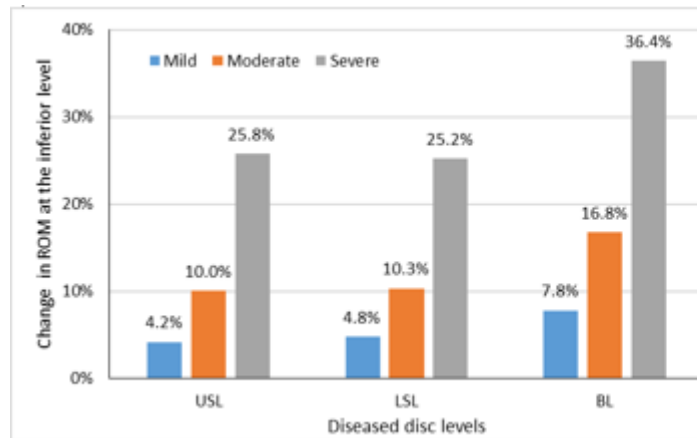
Severe DDD increases 9.9% to 33.0% in flexion, 12.9 to 17.3 % in extension

Kinematics: overall the increase in the spinal mobility (ROM) was < 10% at both adjacent levels in both flexion and extension modes. The cephalad level tends to be more involved by 1.02-1.3 times.

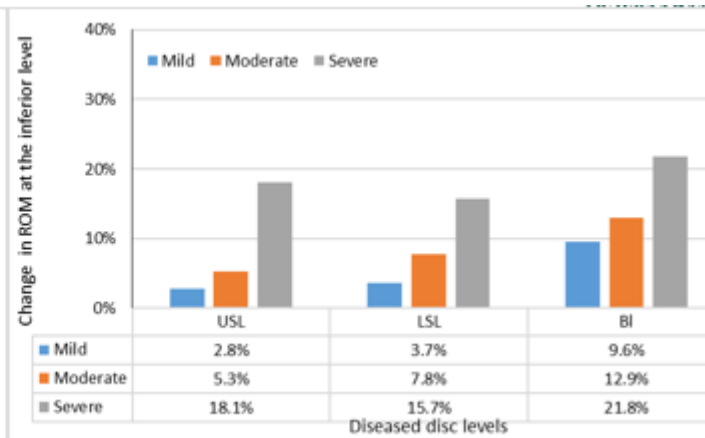
Results



Figure 1: Finite element models of the healthy spine (left), USL spine with disc disease at C5-C6 (second from right, spinal level shown in circle), LSL spine with disc disease at C6-C7 (third from right, spinal level shown in circle), and BL spine with disc diseases at C5-C7 levels (right, spinal levels circled).



Bar chart showing the normalized change in range of motion at the inferior level from the three diseased disc models under flexion. The three degrees of disc disease are shown in the legend.



Bar chart showing the normalized change in range of motion at the inferior level from the three diseased disc models under extension. The three degrees of disc disease are shown in the legend.

Conclusion/Discussion

- As cervical DDD progresses over time from dessication of NP, disintegration of annulus, decreased disc height, and osteophyte formation; the ROM and kinematics of the cervical spine change also
- Since DDD is a propagated process, the adjacent segments are also affected.
- As the degenerative affected segments decrease ROM there is a compensatory increase in motion in adjacent segments until those segments undergo a similar degenerative process.

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