

MECHANICAL BEHAVIOR OF THE HUMAN L-SPINE WITH DEGENERATIVE CHANGE

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Introduction

Various in vitro studies of the lumbar spinal movements were performed. Recently, the movement changes with degeneration were studied [Kettler, 2011]. However, we could not find the research about the oriental populations (Asian). In this study, we performed the movement tests of Korean L-spine with flexion/extension/lateral bending and axial rotation.

Materials and Methods

Forty two Korean fresh cadavers were used. The average age of the specimens was 73 (47-94) years, and the average height was 159.10±8.75cm. We took the antero-posterior and the lateral x-ray scan for grading of degenerative change. We applied Wilke et al method for grading of degeneration [Wilke, 2006]. After x-ray scan, 82 specimens (L2/3: 40, L4/5: 42) were harvested by surgical method with the anterior/posterior longitudinal ligament, ligamenta flava, supra/inter spinous ligament

Region	Grade 0	Grade 1	Grade 2	Grade 3
L2/3	12	7	7	14
L4/5	12	13	7	10
Total	24	20	14	24

Table 1: Number of specimens with grade of degeneration

Both ends of specimens were mounted firmly by PMMA and wood screw. We used own wire-pulley system for apply pure moment to specimen [Crawford, 1995]. Universal test machine (5567, Instron, MA), six-axes load cell (MAS-333, CASS, Korea) and inclinometer (SCA-121T, VTI, Finland) were used to perform the movement test. The flexion, extension, lateral bending and axial rotation tests were performed.

Results

The results of 44 (L2/3:19, L4/5:25) normal specimens (grade 0 or 1) showed the following range of motion at 8Nm pure moment. L2/3 segment showed $-5.81\pm 2.38^\circ$ for extension, $9.99\pm 1.83^\circ$ for flexion, $7.59\pm 2.36^\circ$ for lateral

bending and $3.80\pm 1.32^\circ$ for axial rotation. L4/5 showed $-5.34\pm 2.21^\circ$ for extension, $11.25\pm 3.64^\circ$ for flexion, $7.30\pm 5.23^\circ$ for lateral bending and $3.35\pm 0.95^\circ$ for axial rotation. The range of motion of flexion was larger of L4/5 than L2/3 ($p<0.05$).

	G0 (N=24)	G1 (N=20)	G2 (N=14)	G3 (N=24)
Flexion/ extension	15.85 ±4.27	14.85 ±3.55	11.46 ±3.87	10.65 ±3.05
Lateral bending	15.73 ±4.66	13.78 ±3.04	11.51 ±3.94	10.05 ±3.32
Torsion	6.92 ±1.98	7.29 ±2.31	5.51 ±2.16	6.43 ±2.27

Table 2: Range of motion (unit: degree) with degeneration grade

Normal specimens (grade 0) showed $15.85\pm 4.27^\circ$ ROM for flexion/extension, $15.73\pm 4.66^\circ$ for lateral bending and $6.92\pm 1.98^\circ$ for axial rotation, respectively. But, severe degenerative changed specimens (grade 3) showed $10.65\pm 3.05^\circ$ for flexion/extension, $10.05\pm 3.32^\circ$ for lateral bending and $6.43\pm 2.27^\circ$ for axial rotation, respectively. We could find the statistical difference between normal and the specimens of grade 2 or 3 ($p<0.05$). But we could not find any statistical difference at axial rotational tests.

Discussion

The range of motion of this study (Korean) was larger than previous study about other populations [Kettler, 2011 and Tanaka, 2001]. The flexion, extension and lateral bending showed decreasing range of motion with increasing degree of degeneration. On the other hand, there was no increasing or decreasing with degenerative change in axial rotation.

References

- Crawford et al, Spine, 20(19):2097-2100, 1995
- Kettler et al, Eur Spine J, 20:578-584, 2011
- Tanaka et al, The Spine J., 1:47-56, 2001
- Wilke et al, Eur Spine J, 15:720-730, 2006