# BIOMECHANICAL COMPARISON OF ADJACENT LEVEL SEGMENTAL MOTION IN THE CERVICAL SPINE WITH VARYING DEGREES OF LORDOTIC ALIGNMENT

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## INTRODUCTION

The anterior cervical diskectomy and fusion procedure is a well established technique with a fusion rate of approximately 95 % in non-smoking patients [1, 2]. However, approximately 25 % of these patients will suffer from degenerative disc disease at levels adjacent to the fusion within 10 years of the initial surgery [3]. It has been shown that there is a significant increase in intra-discal pressure and segmental motion at levels adjacent to a fusion during normal range of motion [4]. Graft size affects the lordotic posture of the spine which in turn affects adjacent level segmental motion. Theoretically reduction of adjacent level segmental motion should lead to a reduction of adjacent level degenerative disease. This study was designed to investigate the affect of varying configurations of cervical spine alignment on adjacent level segmental motion following a simulated cervical fusion.

## METHODS

Eight human cadaveric cervical spine specimens (aged 45 to 57 years, 4 male and 4 female) were X-rayed to ensure that no major structural abnormalities were present. C2 and C7 of each specimen were potted in customized gripping fixtures and sagittal angle markers were carefully inserted into the anterior aspects of each of the vertebral bodies C3-C6. After determination of the centers of rotation of the segments, they were tested to 0.5 Nm in extension and 0.7 Nm in flexion measuring range of motion (ROM) by image analysis using Scion Image (Beta 4.0.2, Scion Image, Frederic, MD, USA). Simulated fusion was performed by a diskectomy at C4-C5 and insertion of a 6 mm interbody graft followed by a plate and screws (Orion system, Medtronic Sofamor Danek, Memphis, TN, USA) ventrally. The biomechanical tests were repeated measuring ROM as before. A second simulated fusion was then performed using a 9 mm interbody graft followed similarly by a plate and screws, achieving greater lordotic alignment. The biomechanical tests were repeated measuring ROM as before. The ROM at each level was analyzed using an ANOVA with repeated measures to determine the difference among the values for the intact state, 6 mm interbody graft fusion and the 9 mm interbody graft fusions, with the significance level at the 0.05 level.

## RESULTS AND DISCUSSION

Two of the spines were inadvertently fractured during testing and were excluded from analysis. The mean values for the sagittal lordotic angle at C4-C5 were as follows: intact = 6.4 ± 1.3°, 6 mm spacer = 8.8 ± 1.4° (intact/6 mm graft, $p = 0.08$) and 9 mm spacer = 12.4 ± 0.9° (intact/9 mm graft, $p = 0.01$). Table 1 shows the measured ROM, compared to the intact there was no significant difference in adjacent segmental motion at C3-C4 with either the 6 or 9 mm interbody graft. Greater amount of adjacent segmental motion was seen at C5-C6 following the 6 mm interbody graft ($p \leq 0.02$), but not with the 9 mm graft. There was a significant increase in inferior adjacent ROM with the 6 mm interbody graft.

## CONCLUSION

The attainment of cervical lordosis at the time of fusion reduces the subsequent adjacent level range of motion particularly at the inferior adjacent level.

## REFERENCES

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**Table 1 – Mean segmental motion following cervical fusion with 6 mm and 9 mm grafts at C4-C5**

| ROM Measurement | Intact (degrees) | With 6 mm graft (degrees) | With 9 mm graft (degrees) |
|---|---|---|---|
| C3-C4 segmental motion in flexion | 4.5 ± 0.3 | 6.3 ± 0.6 | 4.7 ± 0.3 |
| C5-C6 segmental motion in flexion | 3.8 ± 0.4 | 5.8 ± 0.1 | 4.2 ± 0.2 |
| C3-C4 segmental motion in extension | 2.6 ± 0.2 | 3.7 ± 0.4 | 2.5 ± 0.3 |
| C5-C6 segmental motion in extension | 3.4 ± 0.4 | 4.8 ± 0.2 | 2.8 ± 0.6 |

**Note:** ROM = range of motion in degrees