The Effects of Single Versus Double-Level Arthrodesis on Adjacent Segment Motion 1 Year Post ACDF Surgery

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Introduction

Background
- Over 150,000 anterior cervical disectomy and fusion (ACDF) surgeries are performed each year in the US with 25% of ACDF patients developing symptomatic adjacent segment disease within 10 years of the initial surgery.
- Biomechanical testing of cadaver specimens indicates single-level arthrodesis increases adjacent segment stress, and double-level arthrodesis exacerbates these effects.
- In vivo range of motion (ROM) of the adjacent levels increased after arthrodesis.
- ROM can be used to infer the effects of arthrodesis on adjacent segment loading.

Aim
- Determine if the number of fused motion segments affects the fused or adjacent segment ROM in vivo.

Hypotheses
- Adjacent segment ROM would increase from pre-surgery (PRE) to one year post surgery (1YR-POST).
- The increase in adjacent segment ROM would be greater after double-level arthrodesis.
- The motion at the operated C5/C6 segment would be greater after double-level arthrodesis compared to single-level.

Methods

Data Collection
- 23 patients who received either C5/C6 (7), C4/C5/C6 (6), or C5/C6/C7 (10) arthrodesis have provided informed consent to participate in this IRB-approved study (12 M, 11 F; average age: 50±5 years).
- Participants performed 3 full flexion/extension trials and 3 axial rotation trials while biplane radiographs were collected both PRE and 1YR-POST (Figure 1).
- CT scans (0.35x0.35x1.25mm) of the cervical spine were acquired for each participant.

Data Processing
- Bone kinematics were obtained using a previously validated volumetric model-based tracking system (Figure 1 E,F).
- Because cervical spine mechanics are level-dependent, intervertebral ROM was compared at corresponding adjacent motion segments (Figure 2).

Data Analysis
- Differences from PRE to 1YR-POST were assessed using a Wilcoxon signed-rank test with significance set at p < 0.05.
- Differences between groups in the change in adjacent and operated C5/C6 segment ROM were analyzed with Wilcoxon rank-sum test with significance set at p < 0.05.

Results

Figure 3: Adjacent level intervertebral ROM pre-surgery and 1 Year Post ACDF surgery. (A) Adjacent level axial rotation ROM. (B) Adjacent level flexion/extension ROM. Error bars are ± 1 SD.

Discussion

- We failed to find a significant change in adjacent segment ROM from pre-surgery to 1 year after surgery in either single or double-level arthrodesis groups.
- We were unable to detect a difference in the change in adjacent segment ROM between single and double-level arthrodesis groups.
- These results contradict the widely-reported increase in adjacent segment motion after arthrodesis based upon cadaveric tests, suggesting current in vitro biomechanical testing fails to replicate the in vivo condition.
- The strength of this study is that corresponding adjacent motion segments were used to compare single and double-level arthrodesis in vivo.
- Limitations include the small sample size and lack of age-matched controls to provide context for what is excessive motion at the C4/C5 and C6/C7 motion segments.

Clinical Significance
- Double-level arthrodesis does not appear to increase adjacent segment ROM more than single-level arthrodesis 1 year after ACDF.

References and Acknowledgements


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