Multi-Level Kinematic Assessment of Immediate and Simulated Long-Term Stabilization of Novel Inline Cervical Interbody Devices with Intervertebral Screw, Anchor, or Blade Fixation

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Introduction

Anterior cervical discectomy and fusion (ACDF) remains the gold standard for cervical spondylotic myelopathy. Multi-level stand-alone ACDF with screw fixation is widely used to reduce tissue retraction associated with anterior plating. However, the relatively aggressive screw trajectory dictates size of the incision. Alternatively, novel intervertebral anchors or bladed devices have been introduced, providing fixation in-line with the operative disc via a curvilinear trajectory to minimize the surgical corridor. Nevertheless, the immediate and long-term biomechanical efficacy of these fixation techniques are unknown.

Methods

Fifteen cadaveric lumbar specimens (C2-C7) were divided in three groups: (a) traditional intervertebral body screws (MIS-S), (b) novel anchor (MIS-A) fixation, and (c) blade fixation (MIS-B). Operative constructs (C4-C6) include: 1) intact, 2) integrated stand-alone device (iSA), 3) iS with lateral mass screws (LMS+iS), and 4) iSA following simulated fatigue. Load control (±1.5Nm) testing was performed in flexion-extension (FE), lateral bending (LB), and axial rotation (AR). Simulated in vivo fatigue of iSA devices produced maximum FE, LB, and AR motions for 1,000 cycles at 0.5 Hz. Comparisons were made between groups (significance at $p<0.05$).

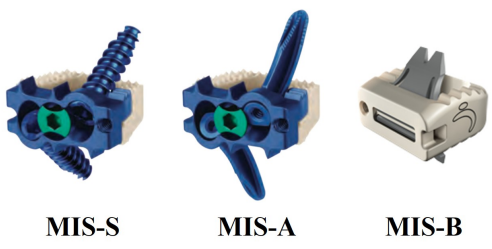

Figure 1. ACDF treatment groups

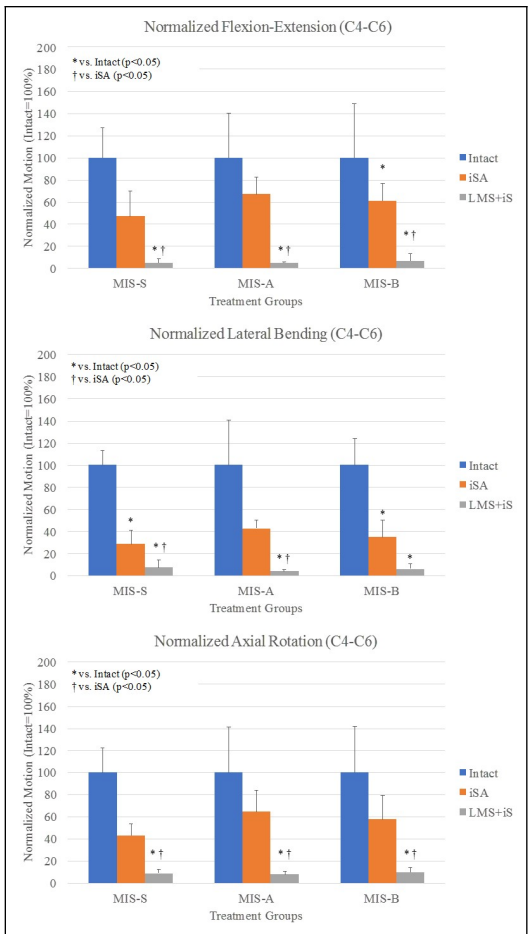

Figure 2. Multidirectional stability of C4-C6 in FE, LB, and AR, normalized to the intact condition

Conclusions

The present study provided the first biomechanical data of in-line ACDF. Both immediate and long-term stability followed the general trend: anchors > blades > screws; however, both experimental fixation methods provided statistically equivalent fixation compared to intervertebral screws.

Learning Objectives

To biomechanically quantify immediate stability and fixation following simulated in vivo fatigue of two-level integrated ACDF with anchor or blade intervertebral fixation compared with integrated ACDF with traditional screw fixation.

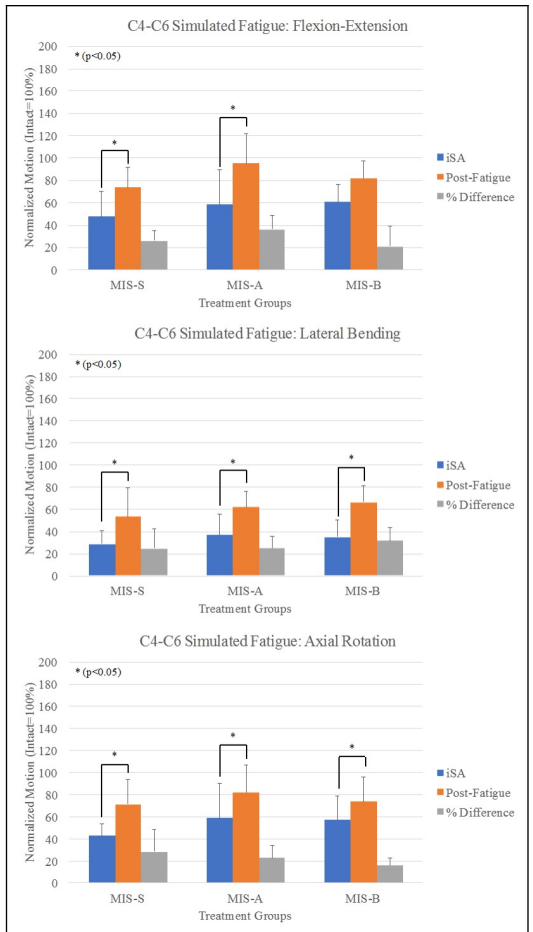

Figure 3. Multidirectional stability of C4-C6 in FE, LB, and AR, normalized to the intact condition, following simulated in vivo fatigue