Kinematic Evaluation of Novel Inline Cervical Interbody Devices with Intervertebral Screw, Anchor, or Blade Fixation: A Single-Level In Vitro Study

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Introduction

Anterior cervical discectomy and fusion (ACDF) is commonly performed to alleviate neurological deficit caused by disc degeneration. Stand-alone implants with integrated screws are known to reduce retraction of paravertebral tissue. However, the relatively aggressive screw trajectory dictates size of the operative incision. Alternatively, novel intervertebral anchors or bladed devices have been introduced and provide fixation in-line with the operative disc via a curvilinear trajectory, to minimize the surgical corridor. Nevertheless, rigorous in vitro kinematic evaluation of these devices is lacking.

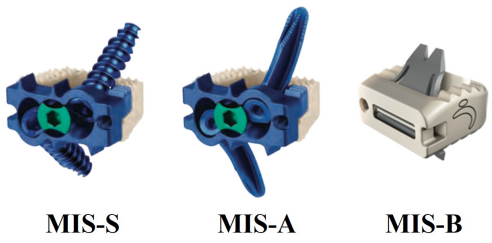

Figure 1. ACDF treatment groups

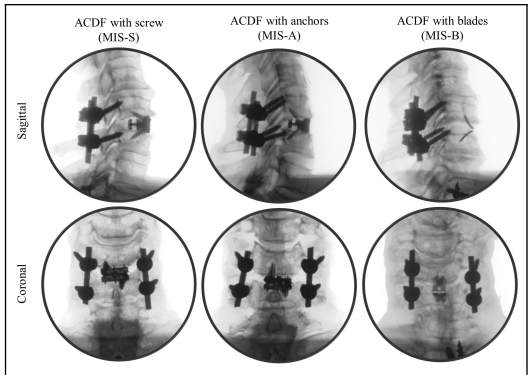

Figure 2. Sagittal and coronal radiographs

Methods

Fifteen cadaveric lumbar specimens (C2-C7) were divided in three groups: (a) traditional intervertebral body screws (MIS-S), (b) a novel anchor (MIS-A) fixation, and (c) blade fixation (MIS-B) (Fig. 1). Operative constructs (C5-C6) include: 1) intact, 2) injured, 3) spacer alone (S), 4) integrated stand-alone device (iSA), 5) iS with lateral mass screws (LMS+iS) (Fig. 2). Load control (±1.5Nm) testing was performed in flexion-extension (FE), lateral bending (LB), and axial rotation (AR). Comparisons were made between groups (significance at $p<0.05$).

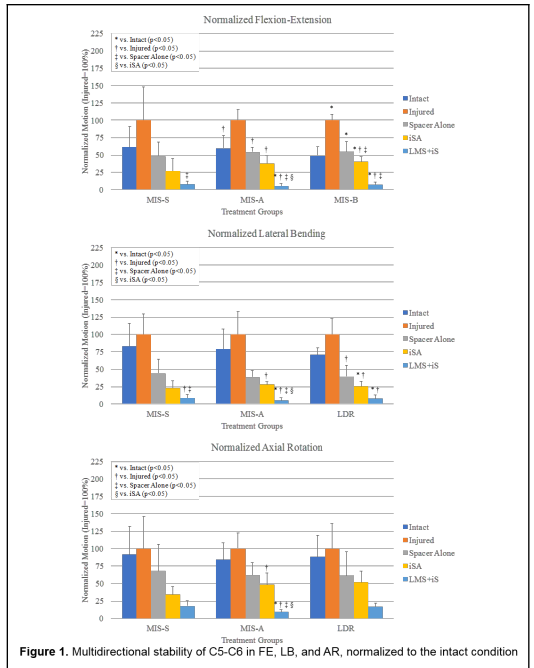

Figure 1. Multidirectional stability of C5-C6 in FE, LB, and AR, normalized to the intact condition

Figure 3. Multidirectional stability of C5-C6 in FE, LB, and AR, normalized to the intact condition

Results

Across treatment groups (MIS-S, MIS-A, MIS-B), motion in all planes followed the trend: Injured > intact > spacer alone > iSA > BPS+S. In FE, iSA reduced injured motion to 27%, 38%, and 40% (MIS-MIS-A, MIS-B, respectively). In LB, iSA reduced injured motion to 23%, 28%, and 25%. In AR, iSA reduced injured motion to 34%, 48%, and 51%. LMS reduced motion of all constructs, in all planes to 81-95%. Significant differences between constructs are included (Fig. 3). No significant differences were observed between treatment groups, in all planes of motion, for all operative constructs ($p>0.05$).

Conclusions

The present study provided the first biomechanical data of in-line minimally invasive ACDF devices. Both experimental anchor and blade fixation methods provided statistically equivalent fixation compared with traditional intervertebral screws; lateral mass screws further stabilized the operative level. Longitudinal studies are needed to establish clinical equivalency between fixation techniques.

Learning Objectives

Investigators quantified the immediate stability of single-level integrated ACDF with anchor or blade intervertebral fixation compared with integrated ACDF with traditional screw fixation.