Biomechanical Evaluation of a New Anterior Cervical Revision "Add-On" Plate

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INTRODUCTION

The incidence of transition syndrome at a level adjacent to a cervical fusion is well documented with an annual re-operation rate reaching 3%[1].

Currently, revision surgery requires removal of an existing anterior cervical plate (ACP) to properly address adjacent level pathology. New plating systems that would obviate this requirement may reduce required exposure, operating room time and potential complications.

The EAGLE™ Plus Micro Anterior Cervical Plate System (DePuy Spine, Raynham, MA) has a new unique triangular 3-screw design with a 30º angulation at the single screw hole that may allow fixation adjacent to a fusion without removal of an existing ACP, as shown in Figure 1.

This study evaluated the stabilizing potential of a newly developed "add-on" ACP relative to a standard four-screw cervical plate.

Figure 1: Frontal and lateral view of the EAGLE Plus Micro Anterior Cervical Plate System.

MATERIALS AND METHODS

Nine cervico-thoracic specimens extending from C2 to T3 were prepared for motion analysis. Extra care was taken to preserve the ligamentous complex and facet joint capsules.

Specimens were non-destructively loaded in three planes of motion: axial rotation (AR), flexion/extension (FE) and lateral bending (LB) using a pure moment testing apparatus (±1.5Nm).

The following configurations were tested:

1. Intact (n=3)
2. ACDF @ C5-6* + EAGLE anterior cervical plate. (n=3)
3. ACDF @ C6-C7* + EAGLE Plus Micro plate. (n=3)

During biomechanical testing of the C6-C7 level constructs, C5-C6 was additionally locked with lateral mass screw/rod fixation posteriorly to simulate a healed fusion at that level.

The full Range of Motion (ROM) data were recorded over C5-C7 segments in all three planes of motion. AR, FE and LB data are reported in either degrees of rotation or % intact ROM (following normalization).

*A spacer was used in both cases.

RESULTS

Non-destructive biomechanical testing:

Axial Rotation

Both plates (EAGLE at C5-C6 and EAGLE Plus Micro plate at C6-C7) significantly improved segmental stability in a similar way, relative to the respective pre-operative rotations, as seen in Figure 2 ($p<0.05$).

Furthermore, using existing data[2] for the EAGLE plate instrumented over C6-C7, we compared normalized ROM for the EAGLE and EAGLE Plus Micro plate when used in a revision scenario. No differences were observed in segmental stability between the two reconstructions ($p=0.106$).

Flexion/Extension

Flexion/extension testing revealed similar results to those observed during axial rotation loading.

Both types of anterior cervical plate fixations significantly reduced inter-segmental motion at C5-C6 and C6-C7 compared to the intact specimens ($p<0.05$) (Figure 3). Post-fixation ROM at the respective levels was comparable between the two constructs.

Similarly, exploring the previous EAGLE plate data obtained at C6-C7[2] that was normalized to intact[2], we did not see any differences in residual ROM at that level between the EAGLE plate and the EAGLE Plus Micro plate. (Residual motion: EAGLE Plate: 25±19% vs. EAGLE Plus Micro: 29±26%).

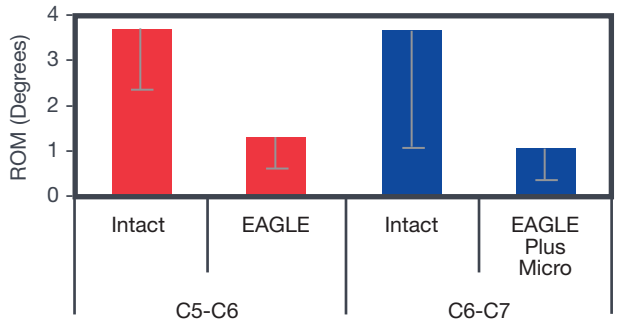

Figure 2: Axial rotation ROM.

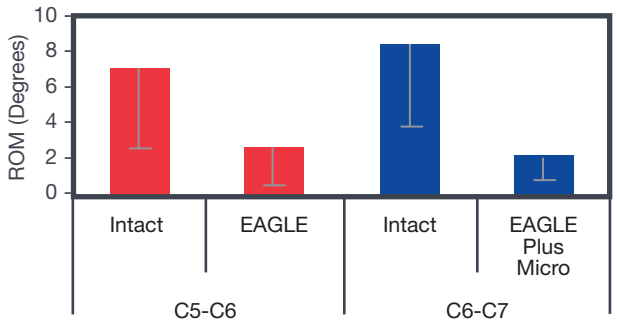

Figure 3: Flexion/Extension ROM.

Lateral Bending

Range of motion trends observed during lateral bending testing were similar to those observed in other modes. Both the EAGLE and the EAGLE Plus Micro plate significantly reduced inter-segmental rotations from intact at their respective levels ($p<0.05$) (Figure 4). Furthermore, as described above, the reduction in motion was similar for both plates, as defined by comparison of normalized values.

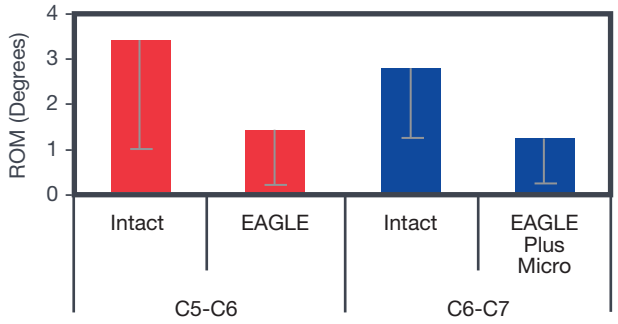

Figure 4: Lateral bending ROM.

DISCUSSION

The current study evaluated the stabilizing potential of a new EAGLE Plus Micro ACP relative to the standard EAGLE ACP in axial rotation, flexion/extension and lateral bending. The data obtained from this project indicate that both plates comparably reduced operative level ROM and afforded for similar segmental stability in a revision-type adjacent level reconstruction.

In addition, no adjacent endplate violations were observed when the EAGLE Plus Micro plate was attached to the vertebral bodies. In all cases the cephalad screw was well positioned within the C6 body.

CONCLUSION

While ACDF procedures are known for their high success rate, especially when plates are used for added stability[3], they have also been associated with significant rates of adjacent-level disease[1]. The EAGLE Plus Micro plate was shown herein to provide fixation similar to EAGLE plate and may allow revision surgeries to be performed without removal of primary instrumentation.

REFERENCES

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