Introduction: The stabilization and fixation of diseased motion segments in the cervical spine has been clinically successful with anterior cervical disectomy and fusion procedures. Cervical instrumentation as an adjunct to arthrodesis range from stand alone interbody spacers to rigid metal plating. The ability to biomechanically stabilize a functional spinal unit (FSU) may potentially be related to the load sharing capacity. These differences may affect clinical outcomes in terms of achieving arthrodesis and the rate at which the fusion is achieved. The goal of this study was to compare dynamic anterior column loading with different methods of biomechanical stabilization including a stand alone interbody spacer, a spacer with a resorbable polymer anterior cervical plate and a spacer with a rigid metal plate.

Materials and Methods: Six fresh frozen human cadaveric cervical spines were meticulously prepared for testing while preserving the osteoligamentous structures. A ±2.5Nm bending torque was applied to each specimen in flexion extension bending, lateral bending, and axial torsion. Loading protocols were cycled three times with the third cycle used for data analysis. A high capacity miniature load cell, 500N, with machined endplates was designed to mimic an interbody spacer with a similar implant interface and was used to directly measure transmitted axial load through the C4-C5 FSU in the flexion extension mode of loading. The removable endplates allowed for the appropriate size implant to be used for each FSU. The smallest height spacer with the load cell measured 6mm. The endplates were available in 1mm increments up to 10mm in height. Each spine was subjected to five treatments at C4-C5. These treatments were performed in order of least invasive to most invasive starting with the intact condition, followed by a discectomy. Each specimen was then treated with a stand alone spacer, a spacer with resorbable plate consisting of a poly lactide polymer in the composition, and a spacer with a rigid titanium plate. Kinematic data was obtained via an optoelectronic measurement system with reported submillimeter accuracy. An analysis of variance (ANOVA) was used to compare the mean loads between the different treatments. If a difference was detected, Tukey’s post hoc analysis was applied in order to determine which treatments were different with significance set at the 0.05 level.

Results: The mean load and standard deviation realized by the integrated load cell in the spacer alone treatment measured 144±28.0N. The spacer with a polymer plate on average resulted in 46.2N of the load being transmitted through the interbody space. From the results of this study, anterior column loading is statistically significantly greater with a stand alone spacer. However, no statistical difference could be detected in terms of interbody loading between a spacer with a resorbable polymer plate and a spacer with a rigid titanium plate.

Discussion: The load sharing characteristics of different anterior cervical plates have to some extent been described in the literature. Brodke et al., described the load sharing characteristics of static and dynamic plates in an idealized synthetic corpectomy model for only axial compression loading. Rapoff et al., calculated the load sharing capacity of static and dynamic plates in a cadaveric calf model. This study was the first to dynamically measure the effects of instrumentation on anterior column loading through the interbody space during flexion extension bending. Depending on the method of instrumentation, different interbody loads were transmitted through the interbody space. From the results of this study, anterior column loading is statistically significantly greater with a stand alone spacer. However, no statistical difference could be detected in terms of interbody loading between a spacer with a resorbable polymer plate and a spacer with a rigid titanium plate.

Biomechanical stabilization as measured by the ability to significantly restrict range of motion in flexion extension may have previously unanticipated effects on load sharing capacity. The axial load transmitted through the C4-C5 FSU via the spacer was altered depending on the presence of anterior cervical plating. Thus, stabilization can be achieved with different load sharing capacity and clinically, such considerations may prove useful in the design of anterior cervical fixation devices.

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