

PULLOUT RESISTANCE EVALUATION OF A NOVEL ANTERIOR CERVICAL PLATE

Introduction: There are several potential benefits to a single screw per vertebra plating system including reduced retraction, reduced vertebral body compromise, reduced surgical time, and the possible use of Caspar pin holes for screw placement. Despite these benefits there are concerns that one screw per vertebra will not provide a comparable amount of pullout resistance when compared to a traditional cervical plate containing two screws per vertebra. To compensate for the reduced number of screws the overall size of the UNIPLATE™ Anterior Cervical System screw has been increased in comparison to traditional cervical screws (**Figure 1**). Some screw design parameters which have been shown to affect pullout strength are major diameter, thread depth, pitch, and screw length (Chapman, et al). The UNIPLATE Anterior Cervical System screw has a major diameter of 4.6mm where traditional cervical screws have diameters ranging from 3.7mm to 4.0mm.

Figure 1: The screws used in this test included (left) the UNIPLATE Anterior Cervical System screw and (right) a competitive screw.



Methods: The UNIPLATE Anterior Cervical Plate System (DePuy Spine, Raynham, MA) and a competitive plate system were compared to determine their resistance to pullout. Sawbones® (Vashon WA) with a density of 15pcf were used as the test medium. The plate manufacturers' surgical techniques were followed to affix plates to the sawbones using 14mm screws. The UNIPLATE Anterior Cervical System was affixed with two screws and the competitive plate was affixed with four screws. After affixing plates to the sawbones an Instron® Universal Materials Testing Machine (Norwood, MA) was used to pull the plates from the bone. Two level plates were used and posts were inserted at the medial screw bores in a posterior-anterior fashion

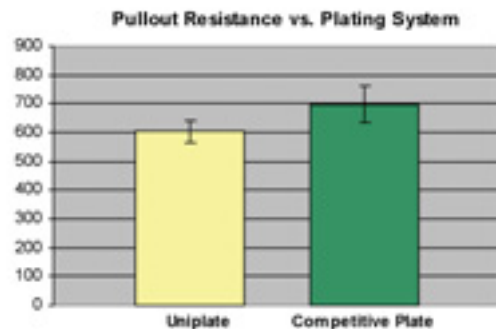
Figure 2: Pullout test depicting a UNIPLATE Anterior Cervical System as it is extracted from 15pcf sawbone.



to allow post protrusion beyond the anterior surface of the plates. The posts were then clamped by the Universal Testing Machine to allow equal loading of the inferior and superior screws. This was done to prevent pullout of the inferior or superior ends, rather than the full construct. Plates were extracted (**Figure 2**) at a rate of 5mm/min and the maximum load was recorded. Five samples of each construct were tested.

Results: The UNIPLATE Anterior Cervical System constructs, consisting of one plate and two screws, had a mean pullout force of 603N with a standard deviation of 37N. The competitive plate constructs, consisting of one plate and four screws, obtained a mean pullout force of 698N with a standard deviation of 64N (**Figure 3**). Based on these results, a UNIPLATE Anterior Cervical System construct provides 86% of the pullout resistance that is achieved by the competitive cervical plate.

Figure 3: A comparison of the pullout resistance of the UNIPLATE Anterior Cervical System construct having two screws and a competitive cervical plate having four screws.



Conclusions: As the test results demonstrate, the UNIPLATE Anterior Cervical System construct provides a comparable amount of pullout resistance when compared to a traditional cervical plate. The 4.6mm diameter screw of the UNIPLATE Anterior Cervical System provides greater thread depth and surface contact with bone, which compensates for the single screw per vertebra design. Although the UNIPLATE Anterior Cervical System does not achieve a statistically equivalent amount of pullout resistance this could be accomplished by increasing the screw length if the anatomy allows.

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Chapman, J.R., Harrington, R.M., Lee, K.M., Anderson, P.A., Tencer, A.F., Kowalski, D.
1996 "Factors Affecting the Pullout Strength of Cancellous Bone Screws"
Journal of Biomechanical Engineering, Vol. 118, No. 8, pp. 391-398.

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