ISAKOS

International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine

12th Biennial ISAKOS Congress • May 12-16, 2019 • Cancun, Mexico

Paper #151

A Biomechanical Comparison of a Novel Technique for Distal Clavicle Fracture Repair Using Cortical Button Fixation and Coracoclavicular Ligament Reconstruction

David A. Porter, MD, UNITED STATES
Gautam Yagnik, MD, UNITED STATES
Paul C. Brady, MD, UNITED STATES
Joseph P. Zimmerman, MD, UNITED STATES
Charles J. Jordan, MD, UNITED STATES
Luis A. Vargas, MD, PhD, UNITED STATES

UHZ Institute
Coral Gables, FL, UNITED STATES

Summary:
Biomechanical testing of modern fixation options for distal clavicle fractures demonstrate that cortical button fixation with CC ligament reconstruction using allograft provides the highest load to failure construct.

Abstract:

Introduction

Unstable distal clavicle fractures demonstrate a high symptomatic non-union rate when treated non-operatively. A variety of surgical techniques have been described; however, many of these techniques are associated with high failure rates and hardware related complications. Newer techniques have been described to treat these fractures, which have shown promising early clinical results with fewer hardware complications; however, their biomechanical performance has not been assessed. The purpose of this study was to biomechanically compare distal-third locking plate for distal clavicle fracture repair to 3 newer techniques that incorporate coracoid fixation into the construct: (1) distal-third locking plate with a coracoid button augmentation, (2) cortical coracoclavicular button (3) cortical coracoclavicular button with coracoclavicular (CC) ligament reconstruction using semitendinosis allograft. The null hypothesis was that there would be no significant difference in overall strength and cyclic displacement between the constructs.

Methods

Thirty-six adult fresh-frozen cadaveric shoulders were randomized to 4 groups: (1) distal-third locking plate (P); (2) distal-third locking plate with a coracoid button augmentation (P+CB); (3) cortical coracoclavicular button (CB); and (4) cortical coracoclavicular button with CC ligament reconstruction using semitendinosis allograft (CB+CC). An unstable distal clavicle fracture was created by making an oblique osteotomy 15 mm medial to the AC joint and transecting the coracoclavicular ligaments. After fixation, each specimen was stressed in the coronal plane. Cyclic displacement, load at 10mm displacement and ultimate load to failure were all measured. Results were compared via a one-way ANOVA analysis.

Results

All three experimental groups biomechanically outperformed the locking plate for distal clavicle fracture fixation. For fixation strength, the mean load to failure was significantly higher in the CB (343±76N) and CB+CC (349±94N) groups

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when compared to the P (193±52N). There was also significantly less cyclic displacement in the CB (4.3 ±1.9mm) and CB+CC (4.4±1.9mm) groups when compared to the P (8.2±2.9mm). With respect to load at 10mm of displacement, which essentially measures a clinical failure, all three experimental groups P+CB (235 ±112N), CB (253±111N) and CB+CC (238±76N) significantly outperformed the P (96±29N).

Conclusion

Biomechanical testing of modern fixation options for distal clavicle fractures demonstrate that locking plate fixation alone performed significantly inferior than constructs containing CC cortical button fixation. Based on the load to failure data, the CB and CB+CC techniques demonstrated over 75% greater construct strength than the traditional locking plate alone. Coupled with greater overall construct strength and lower profile hardware, these newer techniques may result in improved clinical outcomes and less hardware related complications.