MECHANICAL TESTING OF DISTAL RADIOULNAR INSTABILITY REPAIR: LIGAMENT RECONSTRUCTION VS. CAPSULORRAPHY

Dy, Christopher J[1]; Ouellette, Anne[1]; Makowski, Anna-Lena[1];Mohnani, Dena[2,3]; Malik, Ali[2,3];Latta, LL[1,2,3]
1. Department of Orthopaedics and Rehabilitation, University of Miami, Miami, FL
2. Max Biedermann Institute for Biomechanics, Mount Sinai Medical Center, Miami Beach, FL;
3. University of Miami, Miami & Coral Gables Campuses, FL

INTRODUCTION:

Pathology of the distal radioulnar joint (DRUJ) can cause instability of both the radioulnar and ulnocarpal joints. Although the pathologic DRUJ is increasingly repaired via anatomic radioulnar ligament reconstruction, an alternative capsulorraphy procedure, the Herbert Sling, has been proposed and used by the investigative team with clinical and biomechanical success. The current study is a biomechanical comparison of the ability of these two techniques to restore radioulnar and ulnocarpal stability after iatrogenic creation of a tear in the triangular fibrocartilage complex.

METHODS:

Six matched pairs of cadaveric upper extremity specimens were prepared with the proximal humerus stripped of soft tissue.

Non-Destructive Testing

The physical properties of each specimen were thoroughly evaluated with a series of non-destructive testing, including clinical examination with simultaneous fluoroscopy, arthroscopic evaluation, and tissue stiffness testing. The sequence of testing is seen below:

Pre-injury testing	TFCC tear	Post-tear testing	Surgical repair	Post-repair testing

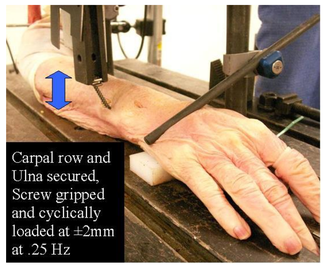
For tissue stiffness testing, the upper extremity specimens were fixed to a Model 858 MiniBionix II machine (MTS, Eden Prarie, MN) with the elbows and wrists placed in 90-degrees of flexion and pronation, respectively (Figure 1a). The MTS actuator was then cycled vertically in displacement control and the displacement envelope increased until a recognizable neutral zone was displayed (approximately +/- 1.0mm). Load-displacement curves for each examination were evaluated and neutral-zone analysis of the load-displacement curve, as initially described by Panjabi, was used as a measure of laxity prior to support from the soft tissues to better assess the TFCC's contribution to ulnocarpal and radioulnar stability (Figure 1b).

TFCC Lesion Creation

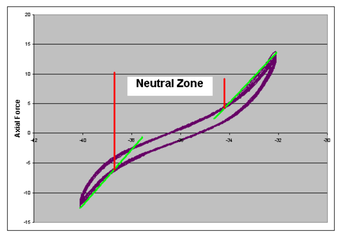
Following the completion of non-destructive testing, a standardized 2-3mm lesion of the ulnar-sided peripheral TFCC was created, to emulate the injury pattern similar to that for which an Adams ligament reconstruction is indicated. Following the creation of the tear, the series of non-destructive tests was repeated for each specimen.

Surgical Repair

One specimen in each pair was assigned for repair with the Herbert Sling and the other specimen in the pair assigned for repair with anatomic ligament reconstruction (Figure 2). The series of non-destructive tests was repeated following surgical repair.

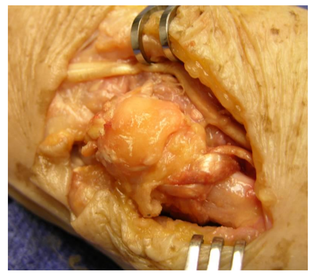


1a. DRUJ Stiffness Testing

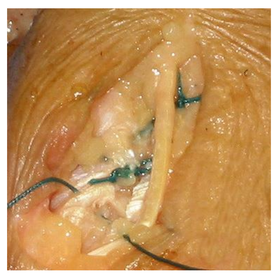


1b. Neutral Zone Analysis

FIGURE 1 - Non-destructive testing



2a. Anatomic radioulnar ligament reconstruction



2b. Herbert Sling

FIGURE 2 - Surgical repair techniques

RESULTS:

Radioulnar and ulnocarpal laxity increased following the creation of the TFCC tear, and decreased following either type of surgical repair. The Adams ligament reconstruction provided a better restoration of radioulnar stability than the Herbert sling, but this difference was not statistically significant (p=0.06). However, there was a significant difference in ulnocarpal stability between the two repair techniques (p=0.038), with the ulnocarpal joints in the Adams specimens significantly more lax than the Herbert specimens (Figure 3).

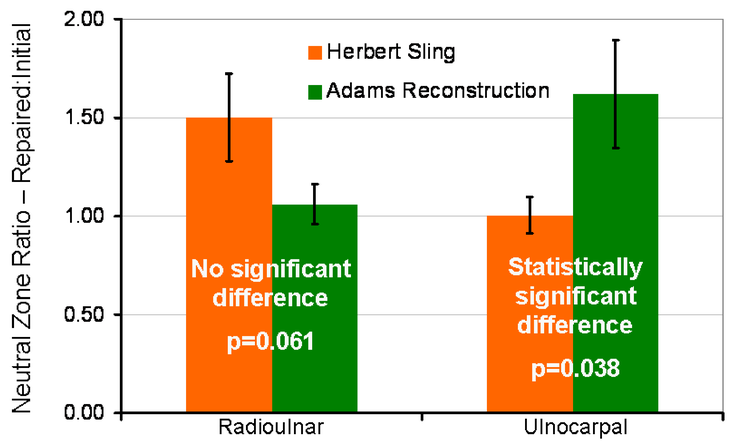
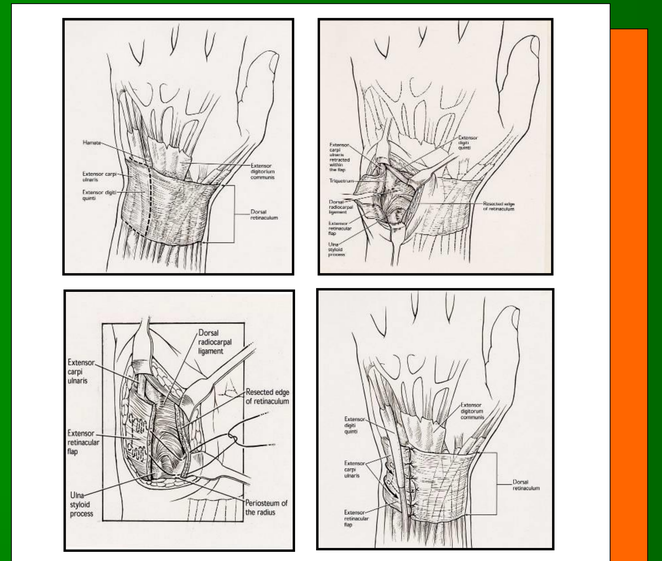


FIGURE 3 – Neutral Zone Ratios: lower ratios indicate better restoration of joint stability



DISCUSSION:

The results of the current study show the ability of the Herbert Sling to provide significantly more ulnocarpal stability when compared to the Adams anatomic ligament reconstruction. The current study's finding that the Herbert sling provides significantly greater ulnocarpal stability than the Adams reconstruction is not surprising, as ulnocarpal stability is not specifically addressed in the anatomic ligament reconstruction. Aside from its biomechanical advantages, the Herbert Sling provides pragmatic benefits, such as less operative time, a less intrusive approach, and less equipment needed, in the interest of both the surgeon and the patient. The findings of the current study suggest that radioulnar and ulnocarpal stability of the distal radioulnar joint can be achieved using the Herbert Sling, a relatively simple and less time consuming procedure, with biomechanical results equivalent to those following a more invasive and complex surgical reconstructive procedure.

ACKNOWLEGEMENTS:

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