Evaluation of an Examination Maneuver for Ulnocarpal Instability: a Biomechanical Study

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INTRODUCTION:

Ulnar sided wrist instability is a challenging problem for hand surgeons. Stability of the ulnocarpal joint is mainly provided by the triangular fibrocartilage complex (TFCC). The TFCC provides dynamic stability of the forearm in supination and pronation, stabilizes the ulnar side of the carpus and aids in load transfer from the ulnar carpus to the ulna.[1,2] Ulnocarpal instability (UCI) can result from either trauma or compromise of all or parts of the TFCC. The clinical presentation is characterized by difficulty with carpal movements, pronation, and supination possibly warranting surgical care. Provocative tests such as the Watson and Shuck test are negative.

A clinical examination called the supination test (ST) is used to judge the stability of the DRUJ based on comparison with the contralateral hand (if unaffected) and the examiners judgement.[3,5] The ST is performed by stabilizing the DRUJ with a firm grasp while stressing the carpus in volar and dorsal translation. It has been proposed that fluoroscopic videos during the ST may be used as a diagnostic tool for UCI using image analysis to measure the length of the triquetrum while in the extreme positions of the ST and calculating the percent change. This measurement was termed the triquetral rotational index (TRI).

The aim of the current study is to validate the clinical exam, ST, by comparing the subjective grading of the examiner from ST to objective biomechanical measures of ulnocarpal volar/dorsal translation and objective measures of the TRI.

METHODS:

20 cadaver forearms, with elbow intact, were used in this study. The ST was performed on all specimens by the same investigator, from which two groups were established, stable and unstable. Measures of TRI were performed on the fluoroscopic videos with ImagePro software. The length of the triquetrum was measured while at the extreme positions recorded from the ST. TRI was calculated as the mm of length change of the projected triquetral image, (Figure 1). Mechanical testing compared the ulnocarpal motion of each specimen with the ST grade and the TRI.

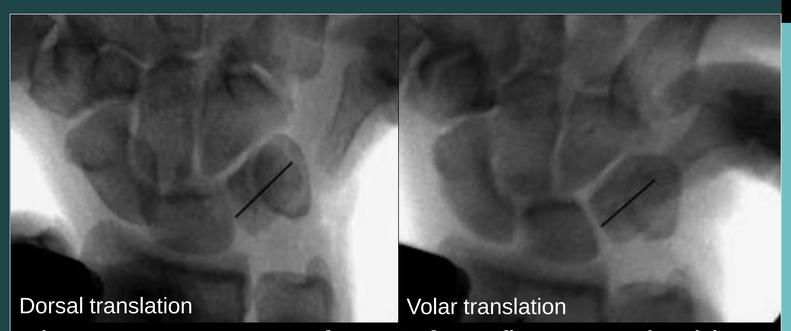


Figure 1 – measures for TRI from fluoroscopic videos

METHODS cont.:

The upper extremity specimens were fixed to a Model 858 MiniBionix II machine (MTS, Eden Prairie, MN) with the elbows and wrists placed in 90-degrees of flexion and pronation, respectively (Figure 2). A polyethylene block was positioned volarly against the pisiform to elevate the DRUJ and allow for both volar and dorsal movement. A polyaxial screw was placed in the dorsal aspect of the distal ulna and secured to the MTS actuator. A carbon fiber rod was clamped in place over the carpus holding it firmly to the MTS base. The MTS actuator, and subsequently the distal ulna, was then cycled vertically with a range that provided a clear “dorsal – volar range of motion” (DVROM) with respect to the pisiform. Resistance to ulnocarpal dorsal/volar translation was measured and the DVROM calculated.[3,4]

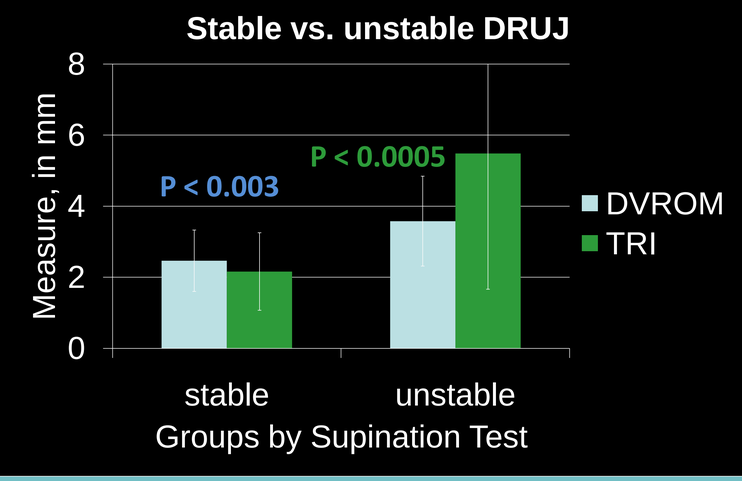
Figure 2: Testing set up with carpals locked and the distal ulna translated by the MTS through a polyaxial bone screw.

METHODS cont.:

After ST, TRI and mechanical testing, a standardized 2-3 mm lesion of the ulnar-sided peripheral TFCC was created via a single incision with a #15 scalpel blade under direct arthroscopic visualization. The location of the tear was along the ulnar-most aspect of the TFCC just as it attaches to the ulnar styloid. The ST, TRI and mechanical measures were repeated and again after surgical repair of the UCI. In total, 47 ST were conducted on cadaver arms before and after the TFCC tear and repair. After sorting the data in groups of stable vs. unstable ulnocarpal joints based on the ST, statistical comparison was made with a Student’s t-test.

RESULTS:

The examiner rated 11 supination tests as stable and 36 as unstable. Wrists judged stable with the supination test had an average DVROM length of 2.47±0.89 mm and wrists judged unstable had an average DVROM length of 3.58±1.26 mm. There was a statistically significant difference between the DVROM's of the "stable" vs. "unstable" wrists, (see graph).



SIGNIFICANCE:

Two objective measures of DRUJ instability were clearly able to distinguish the stable and unstable groups as judged by the subjective clinical ST. The correlation of DVROM measures with the TRI helps to validate the usefulness of this objective measure which can be made from the ST. While only a clinical study can truly validate the usefulness of the TRI at identifying symptomatic UCI, at least this study provides the evidence to justify a clinical trial. Since the examiner’s judgment is an important part of the accuracy of the ST, the TRI may provide a tool that can help the novice examiner to make accurate clinical assessments with ST.

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