

# Quantifying Rotation Instability in Ulnar Collateral Ligament Injuries of the Thumb: A Cadaveric Study

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## Introduction

Injuries to the ulnar collateral ligament alter the mechanics of the thumb metacarpal phalangeal (MCP) joint. In a normal thumb, there is minimal rotation about the MCP joint, but with injury of the medial ligamentous structures we have observed clinically increased rotation about the MCP joint. The purpose of our study is to substantiate our clinical finding in a cadaveric model. Our hypothesis was that sequentially disrupting the dorsal capsule, the proper ulnar collateral ligament (pUCL) and the accessory ulnar collateral ligament (aUCL) of a thumb will lead to significant progressive rotational instability.

## Methods

Twelve fresh from adult cadaveric upper extremities with intact thumbs and no prior history of thumb injury were used for this study. The mean age was 65 (range 49-76) with 4 females and 8 males specimens. The specimens were thawed to room temperature and dissected to expose the dorsal capsule, the pUCL and the aUCL. With fluoroscopic assistance two 0.45 Kirshner wires were placed through the distal metacarpal and proximal phalanx approximately 2 cm from the MCP joint. These wires were placed parallel to joint line and parallel to the horizon. The dorsal capsule, pUCL and aUCL were sequentially sectioned and the MCP joint was ranged manually in pronation and supination in the natural resting position of the hand. Digital photographs captured the extremes of motion (pronation and supination) at baseline and after each structure were sectioned. A digital goniometer was used to measure the relative pronation and supination between the proximal phalanx and the metacarpal using the k-wires to mark rotation. A student's paired t-test was used for statistical analysis with a threshold of  $p < 0.05$ .

Table 1.

	Baseline		Dorsal Capsule and pUCL		Dorsal Capsule, pUCL, and aUCL	
	Pronation	Supination	Pronation	Supination	Pronation	Supination
Mean	15.7°	12.6°	24.1°	22.1°	29.8°	30.5°
SD	4°	3.9°	8.1°	3.3°	9.1°	3°

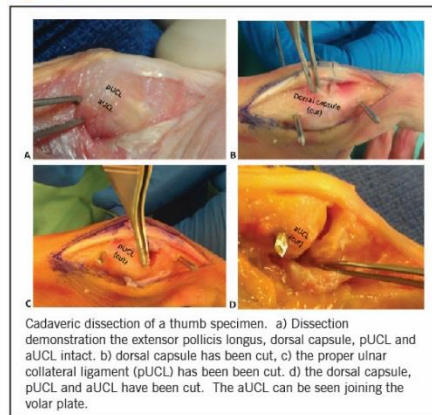
Summary of Data for Pronation and Supination of the Metacarpal Phalangeal Joint at Baseline, with the Dorsal Capsule and pUCL disrupted and with the Dorsal Capsule, pUCL and aUCL disrupted.

Table 2.

	% Increase Dorsal Capsule and pUCL		% Increase Dorsal Capsule, pUCL, and aUCL	
	Pronation	Supination	Pronation	Supination
Mean	32.5%	41.4%	45.2%	58.6%
SD	15.7%	21.2%	14.3%	12.4%

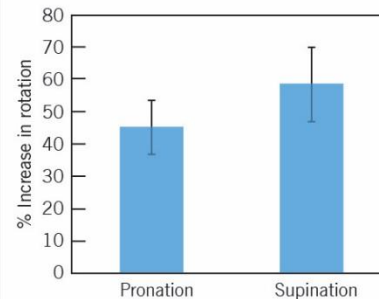
Summary of percent increase in overall pronation and supination with the dorsal capsule and pUCL disrupted and with the dorsal capsule, pUCL and aUCL disrupted.

Figure 1.



Cadaveric dissection of a thumb specimen. a) Dissection demonstration the extensor pollicis longus, dorsal capsule, pUCL and aUCL intact. b) dorsal capsule has been cut, c) the proper ulnar collateral ligament (pUCL) has been cut. d) the dorsal capsule, pUCL and aUCL have been cut. The aUCL can be seen joining the volar plate.

Figure 2.



Graphic depiction of the percent increase in mean pronation and supination with complete simulated UCL injury (dorsal capsule, pUCL and aUCL) compared to baseline control. (Standard Deviation presented as Error Bars).

## Results

Mean baseline pronation and supination were 15.7° (SD 4°) and 12.6° (SD 3.9°), respectively. After sectioning the dorsal capsule and pUCL the mean pronation and supination were 24.1° (SD 8.1°) and 22.1° (SD 3.3°), respectively and increased to 29.8° (SD 9.1°) and 30.5° (SD 3°) in pronation and supination, respectively, after sectioning the aUCL. These were both significant changes from baseline ( $p < 0.05$ ). With the dorsal capsule and pUCL sectioned, there was an increase in mean percent pronation and supination of 32.5% (SD 15.7%) and 41.1% (SD 21.2%), respectively compared to baseline. With the aUCL also sectioned, the increase in percent pronation and supination from baseline was 45.2% (SD 14.3%) and 58.6% (SD 12.4%), respectively.

## Conclusions

This cadaveric study demonstrates a significant increase in the rotational instability (pronation and supination) of the metacarpal phalangeal joint after UCL injury. The findings highlight the important contribution of rotational instability in this injury. Clinically, this increase in rotational instability can help diagnose UCL disruption and supplement traditional valgus stress testing of this injury.

## References

- Carlson MG, Warner KK, Meyers KN, Hearn KA, Kok PL. Anatomy of the thumb metacarpophalangeal ulnar and radial collateral ligaments. *The Journal of Hand Surgery*. 2012;37(10):2021-2026.
- Fraser B, Veitch J, Firoozbakhsh K. Assessment of Rotational Instability with Disruption of the Accessory Collateral Ligament of the Thumb MCP Joint: A Biomechanical Study. *HAND*. 2008;3(3):224-228.
- Malik AK, Morris T, Chou D, Sorene E, Taylor E. Clinical testing of ulnar collateral ligament injuries of the thumb. *J Hand Surg [Br]*. 2009;34(3):363-366.
- McKeon KE, Gelberman RH, Calfee RP. Ulnar collateral ligament injuries of the thumb: phalangeal translation during valgus stress in human cadavera. *J Bone Joint Surg Am*. 2013;95(10):881-887.
- Tsiouris C, Hayton MJ, Baratz M. Injury to the Ulnar Collateral Ligament of the Thumb. *HAND*. 2008;4(1):12-18.