

Adaptations of Ulnar Collateral Ligament Organization and Flexor Pronator Thickness in Professional Baseball Pitchers

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INTRODUCTION: The flexor pronator mass (FPM) helps to stabilize the ulnohumeral joint and decrease stress on the ulnar collateral ligament (UCL) during the throwing motion. While adaptations of the UCL have been studied in regards to UCL laxity and thickness, the collagen organization of the UCL has not yet been reported in baseball pitchers and adaptations of the FPM are also yet to be evaluated. Therefore, the purpose of this study was to determine the adaptations of UCL collagen organization and FPM thickness in the elbows of professional baseball pitchers, with the secondary purpose of comparing UCL organization between pitchers with vs. without a history of UCL injury.

METHODS: Asymptomatic Minor League Baseball pitchers from a single professional baseball organization underwent preseason bilateral elbow ultrasound imaging of the UCL and FPM with the elbow at 30° flexion in a standardized Telos device. FPM thickness and UCL collagen organization (0° represents optimal UCL collagen organization) were both evaluated in this position, with UCL collagen organization also assessed with 150 N of valgus stress applied. The change in collagen organization from stressed to resting was calculated as Δstress.

RESULTS: Overall, 61 professional baseball pitchers were included. Collagen organization of the dominant UCL was significantly more organized than the nondominant UCL in the stressed position (2.7° vs. 3.2°, p=0.027), while collagen organization in the resting position (3.0° vs. 3.2°, p=0.364) and Δstress (-0.2° vs. 0.2°, p=0.192) did not differ bilaterally. Flexor pronator mass thickness also did not differ bilaterally (0.8 mm vs. 0.9 mm, p=0.065). The 21 pitchers with a history of UCL injury had similar dominant arm UCL collagen organization at rest (3.0° vs. 3.0°, p=0.915), stressed (2.9° vs. 2.8°, p=0.796), and Δstress (-0.1° vs. -0.2°, p=0.888), and similar FPM thickness (0.8 mm vs. 0.8 mm, p=0.519) compared to the 40 pitchers without a history of UCL injury.

DISCUSSION AND CONCLUSION: The UCL in asymptomatic professional baseball pitchers adapts to be more organized in the throwing elbow, while the FPM thickness does not differ bilaterally. UCL organization and FPM thickness does not differ based on history of UCL injury. These findings suggest that the UCL undergoes improved collagen organization in response to the repetitive valgus stress from pitching and regardless of a history of UCL injury.



Figure 1. Assessment of ulnar collateral ligament (UCL) organization via ultrasound using custom MATLAB software. ROI = region of interest.

Table 1. Ulnar collateral ligament (UCL) organization compared bilaterally during rest and stress.

UCL Position	Dominant UCL Organization (circular SD)	Non-Dominant UCL Organization (circular SD)	P value	Effect Size
Rest	3.0° ± 1.1°	3.2° ± 1.1°	0.364	0.15 (small)
Stressed	2.7° ± 1.1°	3.2° ± 1.2°	0.027	0.40 (moderate)
ΔStress	-0.2° ± 1.3°	0.2° ± 1.4°	0.192	0.24 (small)

UCL=ulnar collateral ligament, Δ=difference between 150N valgus stress and resting positions. Significant p values are in bold, SD = standard deviation.

Table 2. Flexor pronator thickness compared bilaterally.

Variable	Dominant	Non-Dominant	P value	Effect Size
Flexor Pronator Thickness (cm)	0.8 ± 0.2	0.9 ± 0.2	0.065	0.24 (small)