

Utilizing Ultrasound Imaging to Evaluate Acute Doppler Flow Adaptions of the Medial Elbow

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Abstract

The use of musculoskeletal ultrasound imaging (MSKUI) has been rapidly gaining use and application in the orthopedic clinical setting. An emerging feature of MSKUI is power Doppler imaging quantification (PDQI) that can be used to quantify circulation in MSK tissues and provide a measure of tissue perfusion and/or inflammation. **PURPOSE:** To examine the use of PDQI for evaluation of tissue perfusion of the ulnar collateral ligament (UCL) following an in-game performance in collegiate pitchers. **METHODS:** Ten Division I collegiate baseball pitchers (mean age 20.4 ± 1.4 yrs and mean body fat percentage 18.6 ± 3.9%), with no history of significant upper extremity injuries participated. MSKUI imaging was obtained with a GE LOGIQe ultrasound unit for each athlete prior to and immediately following (< 15 minutes) the pitching performance during his first game of the season. Post-imaging PDQI ratios were calculated to assess the maximum level of tissue perfusion of the UCL in the throwing arm. **RESULTS:** Differences in maximum UCL PDQI ratios pre and post the first pitching outing of the season were analyzed through paired sample t-tests. There was no significant difference (t(9) = -1.37, p>0.5) between the PDQI ratios before (mean max ratio .082 ± .06) and after pitching (mean max ratio: .22 ± .29). Assessment of the following control variables: pitch count (F1,7 = 0.73, p=.42) and innings pitched (F1,7 = 0.37, p=.56) indicated no significant effect on the PDQI ratios. **CONCLUSIONS:** No statistically significant difference in perfusion of the UCL, as expressed by PDQI ratios was found after a single pitching outing. However, a numerical increase in the mean PDQI ratio post pitching was seen. Upon further exploration of the data, it was noted that there was significant variability in ratio changes among the subjects, which may be improved upon by increasing the sample size and number of pitching outings. Further research is needed to evaluate the clinical significance of immediate perfusion changes during throwing.

Introduction

The use of ultrasound imaging has been in medical practice since the 1950s and recently since the 1980s.¹ The use of ultrasound imaging has been used more regularly to assist the accuracy of the clinical examination in the musculoskeletal orthopedic setting.² The enhanced use has been attributed to the safe, portable and less expensive alternative to the MRI.³ Furthermore ultrasound imagery is an excellent compliment or alternative to other forms of radiography imaging since all patients can undergo sonography the use of sonography is more patient friendly especially those patents that experience claustrophobia and is non-invasive free of radiation.^{3,4} The use of sonography to evaluate medial elbow pain has been increasing in popularity. To date the use of sonography has been investigated in several ways to enhance the clinical accuracy of the elbow exam. Ciccotti et al² indicated that the use of stress US can detect changes to the UCL in asymptomatic professional baseball pitchers. More recently Roedle et al⁵ concluded that that conventional US is as accurate as MR arthrography in diagnosing UCL tears. An emerging feature of MSKUI is Power Doppler imaging quantification (PDIQ) that can be used to quantify circulation in MSK tissues and provide a measure of tissue perfusion and/or inflammation.

Purpose

The purpose of this study was to examine the use of PDQI for evaluation of tissue perfusion of the ulnar collateral ligament (UCL) following an in-game performance in collegiate pitchers.

Methods

Subjects: Ten NCAA Division I college men's baseball pitchers participated with a mean age of 20.4 ± 1.45 SD and a mean body fat percentage of 18.6 ± 3.9 SD, with no history of significant upper extremity injuries. Subjects gave written informed consent before participating, and the protocol was approved by Florida Gulf Coast University's Institutional Review Board.

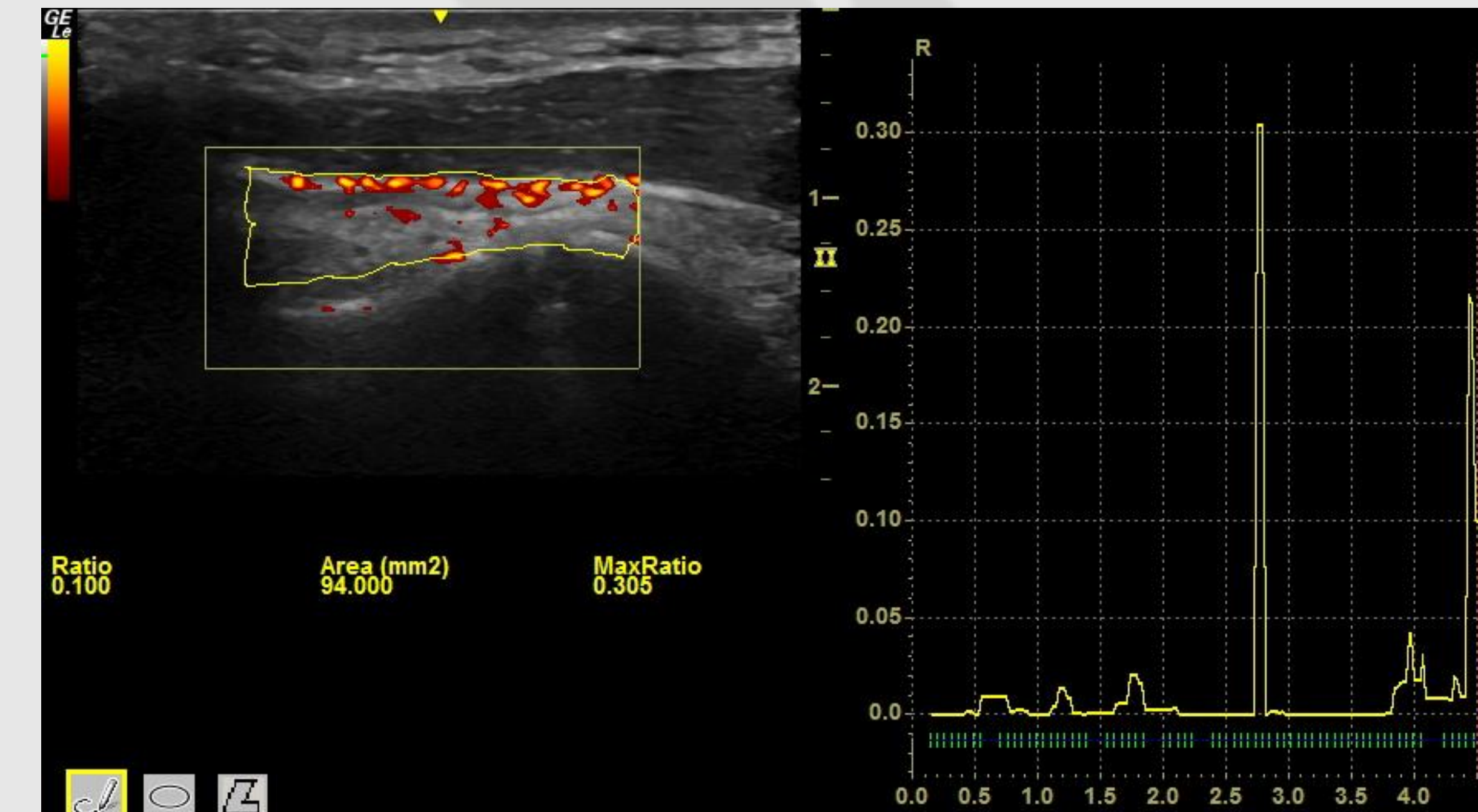
Design: A repeated measures, non-randomized 1 x 2 experimental design guided this study. The single independent variable was a single pitching outing with two levels (pretest and posttest). The dependent variable measured in this study was the PDQI Ratio. The number of innings pitched and years of intercollegiate pitching were used as control variables to assess the potential influence of these variables on the dependent measure over the time course of this investigation.

MSKUI imaging was obtained with a GE LOGIQ e ultrasound unit for each athlete prior to and immediately following (< 15 minutes) the pitching performance during his first game of the season. Post-imaging PDQI ratios were calculated to assess the maximum level of tissue perfusion of the UCL in the throwing arm.

Figure 1. Musculoskeletal ultrasound evaluation of the medial elbow joint complex



Figure 2. Ultrasound image of UCL PDQI Measurement



Statistical Analyses

Differences in maximum UCL PDQI ratios pre and post the first pitching outing of the season were analyzed through paired sample t-test. Since the PDQI measurement requires the definition of the measurement area for each image, differences in size between the pre and post measurement areas were evaluated by a paired sample t-test to account for any differences between the two measurements. The control variables were assessed by repeated-measures ANOVA.

Results

Differences in maximum UCL PDQI ratios pre and post the first pitching outing of the season were analyzed through paired sample t-tests. There was no significant difference (t(9) = -1.37, p>0.5) between the PDQI ratios before (mean max ratio .082 ± .06) and after pitching (mean max ratio: .22 ± .29). Assessment of the following control variables: pitch count (F1,7 = 0.73, p=.42) and innings pitched (F1,7 = 0.37, p=.56) indicated no significant effect on the PDQI ratios. Results of the Paired-Samples t-tests are presented in the table below:

Table 1. Paired T-Tests

	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval		t	df	Sig. (2 tailed)
				Lower	Upper			
Pair 1 Pre & Post-performance Doppler Area	-1.800	5.453	1.724	-5.701	2.101	-1.044	9	.324
Pair 2 Pre & Post-performance Max Ratio	-.141	.324	.103	-.374	.0918	-1.370	9	.204

Discussion

There was no statistically significant change in perfusion of the UCL, as expressed by PDQI ratios after a single pitching outing. However, a numerical increase in the mean PDQI ratio post pitching was found. Upon further exploration of the data, it was noted that there was significant variability in ratio changes among the subjects, which may be improved upon by increasing the sample size and number of pitching outings. Potential differences in defining the PDQI measurement area for each image may also lead to increased measurement error, though no statistically significant differences in pre and post measurement areas were found in this study. A standard method of further defining the measurement area may minimize this potential measurement error. Further research is also needed to evaluate the clinical significance of immediate perfusion changes during throwing.

Limitations of this study include the sample size of our study, the limited number of measurements, and the lack of control for the number of pitches thrown by the participants.

Conclusion

Further research is recommended to perform multiple imaging testing throughout the entire year (Fall and Spring seasons) to determine specific time points at which MJS width changes in collegiate baseball pitchers. Furthermore, future research should focus on the effects of varying ROM throughout the entire year (Fall and Spring seasons) at the shoulder and lower extremity to further determine other correlated factors affecting the increase of the MJS space.

References

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