

Diagnostic Ultrasound Imaging in Assessing Medial Elbow Joint Space in College Baseball Pitchers

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Abstract

Athletes participating in overhead throwing sports such as pitchers, volleyball players, and javelin are prone to ulnar collateral ligament (UCL) injuries of the elbow. UCL sprains typically occur when the elbow is subjected to repetitive or sudden valgus stress causing the UCL to exceed its tensile limits. Recently, the use of musculoskeletal ultrasound (MSK) during a valgus stress exam of the UCL has gained great interest. **PURPOSE:** To examine medial elbow joint space (MJS) opening changes during a constant valgus load to the UCL through MSK in collegiate baseball pitchers during 6 weeks of a competitive season. **METHODS:** Thirteen NCAA Division I college baseball pitchers with a mean age of 20.4 ± 1.45 yrs and body mass index of 24.56 ± 1.78 participated. Ultrasound images of the medial joint space on the participant's throwing arm were obtained using a GE LOGIQ E ultrasound unit. The participants were placed in a supine position with a wedge placed underneath their throwing hand to maintain their elbow angle at 30 deg. A hand-held dynamometer was used to apply a 3 kg valgus force 20 cm distal to the medial epicondyle to maintain a constant 5 Nm valgus stress to each participant. The medial joint space of the elbow was imaged at the beginning of the spring baseball season then 16 games or 6 weeks after baseline testing. Three images were taken during each session, where specific measurements from the apex of the trochlea to the apex of the ulna were taken. **RESULTS:** The MJS width increased approximately 15% from an initial baseline testing value of $.49 \text{ cm} \pm .06$ to $.56 \text{ cm} \pm .02$ after 16 games or 6 weeks ($t(12)=-5.98, P<.0001$). When controlling for total innings pitched [$F(1,11) = 0.40 P = 0.54$] or year of college participation [$F(1, 11) = 0.31 P=0.58$], MJS width did not change over time. **CONCLUSION:** The results of this investigation demonstrate that MJS width and UCL integrity can be assessed accurately using diagnostic ultrasound during a valgus stress test. Moreover, these data indicate that total innings pitched during a season and year of participation did not have an influence on the MJS width. 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.

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 patients 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. The purpose of this study was to examine medial elbow joint space (MJS) width during a constant valgus load to the UCL using MSK in collegiate baseball pitchers before and after 6 weeks of a competitive baseball season.

Methods

Subjects: Thirteen NCAA Division I college men's baseball pitchers participated with a mean age of 20.4 ± 1.45 SD and body mass index 24.56 ± 1.78 SD. 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 time with two levels (pretest and posttest). The dependent variable measured in this study was medial joint space (cm). 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.

Methods Cont.

Procedures:

- Ultrasound images were obtained of the anterior band of the UCL on the participant's throwing arm using a GE LOGIQ E ultrasound unit (GE Healthcare, Chicago, IL, USA) with a linear probe at 12 MHz.
- Participants were placed in a supine position with a wedge placed underneath their forearm to maintain their elbow position at a 30° flexion angle. A 5 Nm valgus stress was applied 20 cm distal to the medial epicondyle (see Fig. 1).
- Measurements from the apex of the trochlea to the apex of the ulna were taken (see Fig. 2) at the beginning of the competitive baseball season and then 6 weeks later. Three images were measured during each session and the average was used for analysis.

Figure 1. Musculoskeletal ultrasound evaluation of the medial elbow joint complex during a valgus load



Figure 2. Ultrasound image of medial joint space width measurement during valgus load



Statistical Analyses

- The descriptive statistics (means, standard deviations, and 95% CIs were calculated for MJS width and the control variables.
- A paired samples t-test was used to assess differences in MJS width before and after a 6 week time period during a competitive NCAA division I baseball season.
- Follow up paired samples t-tests were performed with total innings pitched during the 6 week time period and total years of intercollegiate experience were used as covariates to assess the potential influence of these control variables on MJS width.
- The level of significance was accepted at the $P \leq 0.05$ value.

Results

- The descriptive statistics for age, BMI, along with # of innings pitched and years of experience are provided in table 1.
- The Means, SEs and 95% CI for the MJS width measurements are provided in table 2.
- The study revealed that during the course of a 6 week period during a competitive NCAA division I baseball season, MJS width significantly increased 15% pretest to posttest, $49 \text{ cm} \pm .06$ to $56 \text{ cm} \pm .02$, $t(12)=-5.98, P<.0001$. When controlling for total innings pitched [$F(1,11) = 0.40 P = 0.54$] or year of intercollegiate participation [$F(1, 11) = 0.31 P=0.58$], MJS width did not change over time (table 3).

Table 1: Descriptive Statistics, Means, SD

	Mean	Std. Deviation
Age	20.4	1.78
Body Mass Index	24.56	1.78
Year of Intercollegiate Experience	2.15	1.068
Innings Pitched	10.07	10.14

Table 2: Means, Standard Errors, and 95% CIs for pretest and posttest MJS width

	Mean	Std. Error	Lower Bound	Upper Bound
MJS width pretest	.4892	.0158	.2829	.6945
MJS width posttest	.5592	.0222	.2702	.8482

Results cont.

Table 3: Results of Paired Samples t-test for MJS width from Pretest to Posttest

	Mean Difference	t value	df	Sig. (2-tailed)
MJS width Pretest to Posttest	-.070	--5.97	12	<.0001

Discussion

A primary goal of sports medicine practitioners are to determine causative factors for injury and develop a preventative program to assist in the reduction of injuries. Thus, the purpose of this study was to evaluate the effects of time and pitching on the medial elbow joint space over a 6 week period. Prior investigations of the MJS comparing dominant and non-dominant extremity revealed a joint space gap of $.456 \text{ cm} \pm .11$, and $.372 \pm .92$, respectively. Furthermore, this study indicated that over a two year period the joint space in the dominant extremity examined during the spring training pre-participation examinations increased on average $.037 \text{ cm}$. In this current investigation we found the increase to be $.07 \text{ cm}$ during a 6 week in-season period. This suggests that in-season changes to the MJS are larger than the year over year changes suggested by Ciccotti et al.² It is possible that MJS changes are partially mitigated during the rest period of the off-season.

The results of this investigation demonstrated that MJS width and UCL integrity can be assessed accurately using diagnostic ultrasound during a valgus stress test. Moreover, these data indicate that total innings pitched during a season and year of participation did not have an influence on the MJS width.

Limitations of this study include the sample size of our study, the limited number of measurements, the limited amount of time between the 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 at the shoulder and lower extremity to further determine other correlated factors affecting the increase of the MJS space.

References

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