Ultrasound Imaging to Evaluate Adaptive Changes of the Medial Elbow Joint Complex in College Baseball Pitchers

Kevin P. Lynch, Arie J. van Duijn, Shawn D. Felton, Mitchell L. Cordova, FACSM
Sports Medicine Research Laboratory, Department of Rehabilitation Sciences, Florida Gulf Coast University, Fort Myers, FL USA

Abstract

Musculoskeletal ultrasound imaging (MSKI) has become an increasingly studied diagnostic tool in orthopedic sports medicine. Several studies have investigated ulnar collateral ligament (UCL) integrity and morphology in throwing athletes and professional baseball players with MSKI. Research data has indicated that UCL thickness and medial joint space (MJS) width are reliable and valid measures of throwing arm injury potential. The aims of this study were to evaluate acute adaptive changes of MSKI parameters in college baseball pitchers and assess their reliability.

Methods

Subjects: All participants were recruited from an NCAA Division I baseball team. The inclusion criterion was all pitchers that were competitive in their first game of the season during the first home series. The sample in this study included 10 participants. The only exclusion criteria was any athlete that had prior history UCL reconstruction in their throwing arms. The ten pitchers included were comprised of three freshmen, four juniors, two seniors and one red-shirt junior. Eight were right-handed pitchers and two were left-handed pitchers. Only demographic data of the participants included a mean age of 20.4 ± 1.4 SD years (range, 18 to 23), mean height of 73.5 ± 1.3 SD inches (range, 72 to 76), mean weight of 185.0 ± 18.5 SD pounds (range, 154 to 238), and mean body fat percentage of 18.8 ± 3.9 SD % (range, 12.3 to 24.1).

Design: This is a non-experimental descriptive quantitative repeated measures study design. This study was performed at Florida Gulf Coast University (FGCU). Prior to participation, all subjects provided written informed consent. This study was approved by the University Institutional review board.

Procedures:

- Data collection was conducted during the first week of the season when the subjects were pitched in their first game of the season.
- Subjects were positioned supine with the throwing shoulder supported at 90 degrees of abduction and 45 degrees of lateral rotation.
- The elbow was flexed at 30 degrees of flexion as measured by a standard goniometer in order to make the anterior bundle of the UCL the major stabilizer of the elbow.
- Ultrasound images were obtained of the anterior band of the UCL and the medial articular surface of the ulna and humerus 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. One video clip was recorded both at one hour before and within 10 minutes after the subject pitched.
- 3 kg valgus stress was applied with a handheld dynamometer (Hogan Scientific microFET 2) 20 cm distal to the medial epicondyte. This fixed distance and resistance was performed to maintain 5 Nm of valgus stress throughout data collection.
- All imaging was performed by a novice student physical therapist with an hour of formal training from a faculty member prior data collection similar to that performed in Smith.
- Post collection measurements were performed on one image taken from each video clip that provided the most coherent of the following structures: through a caliper function on the GE LOGIQ E was to assess the anterior band, mid-substance thickness, anterior band trochlear attachment thickness, and MJS width.
- Mid-substance measurement was taken between the distal medial epicondyle and superficial common flexor tendon.
- Trochlear attachment measurement was taken between apex of the trochlea and the superficial common flexor tendon.
- MJS distance was measured between the distal edge of the trochlea and the proximal edge of the ulna.
- Three measurements were performed at each site using images taken before and after performance in millimeters (mm).
- The ratio of mid-substance thickness to trochlea thickness was also calculated post-collection.

![Figure 1: MSKI Image of the Medial Elbow](https://example.com/figure1)

Results

- Results of the Paired Sample t-tests compared average measured width at the mid-substance, apex of the trochlea, and MJS width during pre- and post-competition.
- A statistically significant increase in mid-substance ratio was also compared. There were no statistically significant changes in mid-substance, apex of trochlea, and mid-substance to apex ratio.

![Table 1: Tables, Standard Errors, and 95% CIs for mid-substance ratio from Pretest to Posttest](https://example.com/table1)

Table 1: Means, Standard Errors, and 95% CIs for mid-substance ratio from Pretest to Posttest

<table>
<thead>
<tr>
<th>Mid-substance</th>
<th>Mean</th>
<th>Std. Error</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-substance</td>
<td>5.722</td>
<td>10</td>
<td>70.035</td>
<td>251.147</td>
</tr>
<tr>
<td>Mid-substance</td>
<td>5.7</td>
<td>10</td>
<td>67.369</td>
<td>213.889</td>
</tr>
<tr>
<td>Apex of trochlea</td>
<td>2.674</td>
<td>10</td>
<td>653.78</td>
<td>2067.4</td>
</tr>
<tr>
<td>Apex of trochlea</td>
<td>2.614</td>
<td>10</td>
<td>607.66</td>
<td>1921.6</td>
</tr>
<tr>
<td>Apex of trochlea</td>
<td>6.337</td>
<td>10</td>
<td>145.429</td>
<td>4598.9</td>
</tr>
<tr>
<td>Apex of trochlea</td>
<td>6.584</td>
<td>10</td>
<td>154.491</td>
<td>48854.2</td>
</tr>
<tr>
<td>Apex of trochlea</td>
<td>1.0355</td>
<td>10</td>
<td>0.03512</td>
<td>0.1111</td>
</tr>
<tr>
<td>Apex of trochlea</td>
<td>1.02135</td>
<td>10</td>
<td>0.05529</td>
<td>0.1748</td>
</tr>
</tbody>
</table>

![Table 2: Results of Paired Samples t-test for mid-substance, apex of trochlea, MJS width, and mid-substance to apex ratio from Pretest to Posttest](https://example.com/table2)

Table 2: Results of Paired Samples t-test for mid-substance, apex of trochlea, MJS width, and mid-substance to apex ratio from Pretest to Posttest

<table>
<thead>
<tr>
<th>Mid-substance</th>
<th>T value</th>
<th>df</th>
<th>Sig (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-substance</td>
<td>0.222</td>
<td>362</td>
<td>0.775</td>
</tr>
<tr>
<td>Mid-substance</td>
<td>-0.60</td>
<td>1298</td>
<td>0.227</td>
</tr>
<tr>
<td>MJS width</td>
<td>-2.47</td>
<td>304</td>
<td>0.005</td>
</tr>
<tr>
<td>Mid-substance to apex of trochlea ratio</td>
<td>-0.174</td>
<td>745</td>
<td>0.476</td>
</tr>
</tbody>
</table>

Statistical Analysis

- Data analysis were performed with Version 22 of IBM SPSS software.
- Pairwise Sample t-tests were performed to compare pre to post mid-substance thickness, pre to post trochlear thickness, pre to post MJS, and the mid-substance to apex ratio of mid-substance thickness to apex of the trochlea thickness.
- The level of significance was accepted at the P ≤ 0.05 value.

Discussion

Prior to this study, there have been no studies that monitored acute changes following competition in the UCL and MJS width of collegiate pitchers following in-game performance changes. Changes in MJS may relate to increased tissue extensibility due to increased circulatory and tissue temperature, but further research of this relationship is needed. This research study provided additional insight to repeated trauma in baseball players as others have only conducted long term studies associated with prolonged competition participation. Future research to assess acute changes should include larger sample sizes and conduct data collection at varying times of the season to further explore factors that affect UCL and MJS changes and the degree to which they occur immediately following performance.

Conclusion

This study demonstrated that there is a statistically significant increase in the MJS of the throwing arms of Division I collegiate pitchers following their first competition outing of the season. More investigation may yield details on the physiological changes that may contribute to the development of UCL injuries in the baseball athlete.

References


