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The morphologic change of the ulnar collateral ligament of elbow in high school baseball pitchers, with and without symptoms, by sonography

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Background: Few reports in the literature relate morphologic changes of the ulnar collateral ligament (UCL) to prior elbow symptoms. This study used ultrasonography (US) to assess the ulnohumeral joint space width, with and without stress, and elucidate morphologic changes of the UCL of the elbow in high school pitchers with and without a history of elbow symptoms.
Methods: Each of 122 high school baseball pitchers who underwent US of the medial aspect of both elbows completed a self-administered questionnaire related to the self-satisfaction score (0-100) for pitching performance and throwing-related elbow joint pain sustained during the prior 3 years. We conducted gravity stress US elbow examination with 30° of flexion with and without valgus stress. Comparisons of the UCL thickness and ulnohumeral joint space width, with and without valgus stress, were made among the 122 high school pitchers with and without a history of elbow symptoms.
Results: Pitchers with an elbow symptom history exhibited a greater difference between the UCL thickness on the throwing side than those with no elbow symptom history ($P = .0013$). A negative significant association was found between UCL thickness on the pitching side and the self-evaluation score for pitching performance ($r = -0.20$, $P = .04$).
Conclusions: US assessment demonstrated that the UCL in the dominant side with elbow symptom history was thicker than that with no elbow symptom history. The UCL thickness might reflect the prior pitching condition of high school baseball pitchers.
Level of evidence: Level III; Diagnostic Study

Keywords: Elbow; baseball; pitcher; ulnar collateral ligament (UCL); injury; ultrasonography

The ulnar collateral ligament (UCL) is the major stabilizer of elbow joint valgus stress.[14] Repetitive valgus stress to the elbow often injures the UCL, especially during the late cocking and acceleration phases of throwing.[1] Werner et al[22] stated that the UCL provided inherent varus resistance to high

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valgus elbow torques experienced during the late cocking phase and that it might be injured at this point. Acute, chronic, and traumatic UCL injury has been evaluated for diagnosis in combination with symptom history and physical examination, along with stress radiography imaging, magnetic resonance imaging (MRI), and ultrasonography.[4,5,13,18,20,23] Stress radiography has been advocated as a means of accurately detecting elbow medial joint laxity, but it does not directly visualize the UCL tear.[18] MRI provides material information related to edema and tears of the UCL.[13,20] Apparently, MRI is not an expedient examination; moreover, it is expensive.

Ultrasound (US) imaging with dynamic stress assessment has some usefulness to detect UCL injury. Recent development of US technology has enabled clearer visualization of soft tissues, with conveniently obtained and reproducible images. US has actually become an important imaging tool for assessing pathologic conditions in elbows, showing capabilities not only for conspicuous spatial resolution but also for dynamic assessment of joint instability.[11]

Earlier reports have described that the UCL tears of baseball pitchers can be diagnosed using stress US.[5,23] Furthermore, the stress US technique has shown UCL laxity and elbow joint instability of the throwing side in asymptomatic baseball players.[15,19] Earlier studies have revealed a significantly wider medial joint space of the throwing side than of the nonthrowing side. Their results demonstrated that the anterior band of the UCL is significantly thicker on the throwing side than on the nonthrowing side in asymptomatic baseball players.[15,19]

However, no report in the relevant literature has described a study of whether prior subjective elbow symptoms are reflected in US images of the morphologic changes of the UCL and elbow joint instability with valgus stress. This study evaluated the relation between prior subjective elbow symptoms and morphologic changes of the UCL and elbow joint instability of the throwing side by US examination. This study also elucidated the correlation between US images of the UCL and elbow joint instability of the throwing side and the self-satisfaction scores of pitching performance in high school pitchers.

Materials and methods

This retrospective case-control study was designed to use US to elucidate UCL instability and morphologic changes of the UCL of the elbow in high school pitchers with and without a history of elbow symptoms. To assess their physical condition during the winter training season (off season), 135 local high school baseball pitchers were recruited for this study. All participants and their parents gave informed consent to participate in this study.

The participants underwent physical examinations of both elbows and completed a self-administered questionnaire with items related to the throwing side, years of playing baseball, and history of throwing-related elbow joint pain sustained during the prior 3 years. They marked their self-satisfaction scores for throwing themselves. This score reflects their ball control, ball speed, and throwing condition. Elbow joint pain was defined for this study as a condition caused directly by throwing that resulted in participation loss.

Exclusion criteria included any prior elbow surgery or acute elbow injury, such as UCL injury and fracture, and elbow pain on the medical check. Of the 135 pitchers, the study excluded 13: 4 had prior elbow surgery, and 9 showed elbow pain at the time of a medical examination. The remaining 122 high school baseball pitchers who participated were a mean age of 16.5 years (range, 15-17 years). Participants had played baseball for an average of 8.18 years (range, 2-12 years). Of those, 91 pitchers (74.6%) were right-handed, and 31 (25.4%) were left-handed.

Elbow measurements were recorded during winter training medical check-ups (in preseason). The elbow range of motion (ROM) was measured while the participant was seated. The shoulder was elevated 90° with the elbow in full extension and flexion and wrist in full supination. The fulcrum of the goniometer was placed over the lateral epicondyle of the humerus. We positioned 1 arm of the device in the center of the humerus to the tip of the acromion process and the other arm in the center of the radius to the radial styloid process.[10]

A pilot test was conducted in a prior study to evaluate the intratester reliability of passive ROM measurements of the elbow. After measuring 10 healthy men for passive ROM of elbow extension and flexion, the same examiner remeasured them 5 days later. The intraclass correlation coefficients were 0.88 for shoulder external rotation, 0.84 for shoulder internal rotation, 0.97 for elbow extension, and 0.98 for elbow flexion.

US of the elbow was performed with participants supine. We scanned the elbow at 30° of flexion. Gravity stress was applied to the forearm, straining the UCL. We obtained images of UCLs with and without gravity stress on the bilateral side for each time. US imaging was conducted using a multifrequency 12-MHz linear-array transducer (LOGIQe; GE Healthcare, Waukesha, WI, USA).[21] Earlier reports have described application of 30°, 70°, or 90° of elbow flexion for US evaluation of the anterior band of the UCL.[2,5,6,9,12,14,15,19,22] We used conventional 30° elbow flexion for US evaluation of the anterior band of the UCL to evaluate the relation between its thickness and elbow valgus instability and the self-satisfaction assessment for throwing.

Harada et al[8] assessed the validity of gravity stress radiography compared with Telos stress device radiography in 57 patients with medial elbow pain. They reported a positive significant correlation between the Telos and gravity radiography measurements in the medial elbow joint space on the affected side ($r = 0.798$, $P < .0001$) and the nonaffected side ($r = 0.870$, $P < .0001$). We used the easy and verifiable gravity valgus stress method. The method was used by an orthopedic surgeon (T.T.) with 15 years of experience in musculoskeletal US, who was blinded to other items in the evaluation.

Electronic calipers were used to measure the ulnohumeral joint width at the level of the anterior band and the thickness of anterior band of the UCL at its midportion without gravity valgus stress on the bilateral side (Fig. 1). We defined the ulnohumeral joint space as the distance from the midportion of the trochlea of the humerus to the edge of the coronoid process of the ulna. The difference between the width of the ulnohumeral joint, with and without valgus stress on the bilateral side, was calculated.

The primary investigator in the preliminary study evaluated the intratester reliability of the width of ulnohumeral joint. The ulnohumeral joint widths of 10 healthy elbows were measured 3 separate times during the same testing period. The intraclass correlation coefficient was 0.81. The prior test–retest reliability of the