Magnetic Resonance Imaging Evaluation of the Ulnar Collateral Ligament in Young Baseball Pitchers Less Than 18 Years of Age

Laith M. Jazrawi, M.D., Matt Leibman, M.D., Mike Mechlin, M.D., Pavel Yufit, M.D., Charbel Ishak, M.D., Mark Schweitzer, M.D., and Andrew Rokito, M.D.

Abstract

Introduction: It has been shown that the asymptomatic, dominant elbow of professional baseball pitchers can demonstrate magnetic resonance (MR) imaging signal abnormalities of the ulnar collateral ligament (UCL) consistent with a strain. The purpose of this study was to determine if younger, asymptomatic, adolescent baseball pitchers exhibit similar signal abnormalities in the UCL.

Methods: Magnetic resonance images of both elbows of 14 asymptomatic, young male baseball pitchers (ranging in age from 12 to 20 years) were performed on an outpatient basis using a 1.5-T Sigma MRI unit with a dedicated extremity coil to obtain T1 and T2 coronal and axial images which were subsequently evaluated by a musculoskeletal radiologist. Chronic tears of the UCL were suspected if the signal was attenuated or absent. Magnetic resonance images of the UCL were also evaluated for high-intensity signal or thinning. Morphologic changes such as complete tears, avulsions or thickening were identified. The images were classified into 4 grades from 0 to 3 depending on the degree of signal abnormality.

Results: No discrete tears were found in any of the subjects. For the dominant pitching arm, 4 of 14 subjects had increased thickness of the ulnar collateral ligament, 3 of 14 demonstrated Grade 1 changes, and 11 of 14 demonstrated no abnormal signal within the ligament. No focal tears were present in any of the subjects. Contralateral elbows in 13 of 14 patients demonstrated Grade 0 signals with 1 patient demonstrating morphological thickening of the ligament without increased signal.

Discussion: Signal abnormalities in the throwing elbow of asymptomatic, adolescent pitchers were uncommon. These pitchers may not have experienced sufficient pitching time to develop changes in the UCL.

Magnetic resonance (MR) imaging is an important imaging modality that is often used to diagnose damage to the ulnar collateral ligament (UCL) of the elbow. The UCL is frequently injured in overhead throwing athletes such as those involved in baseball, javelin, and volleyball. The valgus forces generated during the late cocking phase of throwing can cause microtears of the UCL, with subsequent weakening and laxity of the ligament.

Mirowitz and London described the use of MR imaging to diagnose injuries to the UCL of the elbows in 11 professional baseball pitchers with medial elbow pain; five of the pitchers also presented with valgus instability. They concluded that MR imaging is useful in identifying the presence and severity of UCL injury, as well as differentiating other etiologies of elbow pain. Timmerman and colleagues used MR imaging and CT arthrography to evaluate the ulnar collateral ligaments of 25 baseball players prior to surgery. Magnetic resonance imaging had a sensitivity of 57% and a specificity of 100% in detecting tears.

Sports-related injuries commonly occur in children, and MR imaging evaluation has been found to be a useful diagnostic tool. Sugimoto and Ohsawa imaged elbows from 20 symptomatic and 8 asymptomatic athletes who were all under 18 years old (age range: 5 to 18 years) and concluded that MR imaging is useful in assessing...
UCL damage, and MR images of the developing elbow joint differ from those of an adult elbow.

Schweitzer and coworkers demonstrated that asymptomatic baseball pitchers, with clinically normal elbows, had MR imaging findings similar to patients with clinical disorders such as MCL strains. It is unknown if completely asymptomatic younger athletes can have abnormal MR images. The purpose of the study was to determine if young, asymptomatic baseball pitchers exhibit signal abnormalities in the UCL despite less pitching time than professional players.

Materials and Methods
This study was approved by the institutional review board. Magnetic resonance images of both elbows of 14 asymptomatic young male athletes (baseball pitchers) with ages between 12 to 18 years were obtained. Players were participants in a youth baseball organization (Bonnies Youth Baseball Organization, New York) and had no previous history of elbow pain, injury, or surgery. They underwent a formal physical exam prior to MR imaging and were evaluated for elbow tenderness, range of motion, and instability.

Magnetic resonance images were performed on an outpatient basis on a 1.5-T Sigma MRI unit (GE Healthcare, London, England) with the use of a dedicated extremity coil. Each MR image took approximately 20 minutes for a total of 40 minutes per subject. All MR examinations were standardized and specifically targeted for optimal imaging of the UCL: coronal, two-dimensional gradient-echo sequence (500/10 TR/TE, 30° flip angle, three excitations, 10.5 x 15cm filed of view, 3 mm slices, 0.3 mm gap, and an imaging time of 5 min 25 sec). All images were read by the same board certified radiologist who was blinded to the subjects’ data. The elbow images of the patients in this study were included among additional images from clinical patients who were being evaluated for other reasons. Right and left elbow images were separated and read at different times.

Magnetic resonance images of a normal UCL demonstrate a thin band of low intensity along the medial joint line of the elbow. Chronic tears of the UCL were suspected if the signal was attenuated or absent. The images of the UCL were also evaluated for high-intensity signal or thinning and morphologic changes such as complete tears, avulsions, or thickening. The degree of abnormality seen in the elbow images was classified as follows: Grade 0 was a normal homogeneous low signal intensity in the ligament; Grade 1-a, if a focal, linear, or diffuse intermediate signal in the ligament was present; Grade 2-a, in cases where a high signal intensity within the ligament or partial tearing at the sublime tubercle or humeral epicondyle was demonstrated; and Grade 3-a when a complete tear of the ligament was present.

Quantification of elbow tenderness was done by palpation of the medial epicondyle, lateral epicondyle, UCL, LCL, anterior compartmental capsule, and posterior compartmental capsule. Range of motion was assessed by standard goniometer measurements from full extension to flexion. Supination and pronation were also measured.

Results
Subjects had a mean age of 16.6 years (range: 15 to 18 years). The mean number of years pitching was 6.5 years per subject (range: 2 to 12 years). Eleven of the 14 players were right-handed pitchers, the remaining 3 were left-handed. On physical examination, range of motion was equal for both elbows in each subject. No player had elbow laxity or tenderness over the UCL in either elbow.

On the MR images of the dominant pitching arm, four of the fourteen subjects had increased thickness of the ulnar collateral ligament. Of these four players, three demonstrated Grade 1 changes. The remaining 11 players...
demonstrated no abnormal signal within the ligament. No discrete tears were found in any of the subjects (Fig. 1). All control elbows demonstrated Grade 0 signals except one patient who demonstrated morphological thickening of the ligament.

**Discussion**

This study found that adolescent, asymptomatic pitchers demonstrated minimal morphological changes and signal abnormalities in the MR images of their ulnar collateral ligaments. Other studies recorded in the literature have examined potential abnormalities of the UCL in asymptomatic, adult pitchers. Dynamic ultrasound examination showed increased thickness and hypoechoic foci or calcifications in asymptomatic pitchers as well as elbow valgus laxity. Both of these studies related changes in the UCL with increased pitching time.

It is possible that the duration of pitching experienced by these players, secondary to their young age, may have played a role in the prevention of any overuse-related abnormalities in the UCL. With increasing age and duration of pitching, overuse abnormalities in the UCL may begin to appear on MR images as was demonstrated by Schweitzer and colleagues. It is hoped that these players can be followed and re-evaluated at a later date, after additional years of pitching, to see if these stress-related signal abnormalities become apparent despite being initially asymptomatic. Clinically, any increased signal or abnormality in the UCL of a symptomatic young pitcher should be taken seriously in light of the results of this study.

**References**