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Avulsion Fracture of the Ulnar Sublime Tubercle in Overhead Throwing Athletes

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ABSTRACT

Background: Injuries to the ulnar collateral ligament are relatively common in throwing athletes and result from either acute traumatic or repeated valgus stress to the elbow. Avulsion fracture of the sublime tubercle of the ulna is a rarely reported site of ulnar collateral ligament injury.

Purpose: We retrospectively reviewed our cases of ulnar collateral ligament injuries to study avulsion fractures of the sublime tubercle of the ulna.

Study Design: Case series.

Methods: Data, including radiographs and magnetic resonance imaging scans, were obtained by review of hospital and office records and by follow-up examination. Of 33 consecutive patients treated for ulnar collateral ligament injuries, 8 had avulsion fractures of the sublime tubercle of the ulna. All eight were male baseball players with dominant arm involvement, an average age of 16.9 years, and an average follow-up of 23.6 months.

Results: Six of eight patients had failure of nonoperative treatment and required surgical repair. Two of the six underwent ulnar collateral ligament reconstruction and four had direct repair of the sublime tubercle avulsion with bioabsorbable suture anchors. At last follow-up, all eight had returned to their preinjury level of activity. No patient had residual medial elbow pain or laxity.

Conclusions: Diagnosis of sublime tubercle avulsion fracture is made with history, physical examination, and radiographic studies. Magnetic resonance imaging can help identify an avulsion fracture not visible radiographically and can help determine whether direct repair or reconstruction is needed.

Injuries to the ulnar collateral ligament of the elbow are relatively common in throwing athletes or those involved in sports requiring overhead arm positions.[4,5,8,9,14,16] The ulnar collateral ligament is the elbow's primary soft tissue constraint to valgus stress[4,6,8,12–14,16,19] and consists of three parts: the anterior and posterior bundles and the transverse band (ligament).[4,6,8] The anterior bundle is the primary stabilizing structure to valgus stress.[4,6,8] The anterior bundle originates from the anteroinferior surface of the medial epicondyle of the humerus posterior to the axis of rotation and inserts on the sublime tubercle of the ulna (Fig. 1).[6,8]

Injuries to the ulnar collateral ligament result from either acute traumatic or repeated valgus stress to the elbow. Valgus overload is common in throwing athletes and those involved in overhead sports (baseball and tennis players, javelin throwers). The repeated valgus stress involved in such overload can cause attenuation or rupture of the ulnar collateral ligament and result in functional medial elbow pain and instability.[1,3–5,8–10,14,16]

The anatomic area of injury to the ulnar collateral ligament has been documented.[1,3,5,10] Conway et al.[5] reported the results of 70 patients treated with either repair or reconstruction of the ulnar collateral ligament. They reported 7 patients with soft tissue avulsion of the ulnar attachment, 2 with soft tissue avulsion of the epicondylar attachment, and 61 with midsubstance tears. Avulsion fracture of the sublime tubercle of the ulna is a rarely reported site for ulnar collateral ligament injury.[7,15] To the best of our knowledge, there is only one case report in the English orthopaedic literature regarding this entity.[2] We report the treatment and results of eight patients who had medial elbow pain while throwing and were found to have avulsion fractures of the sublime tubercle of the ulna.

MATERIALS AND METHODS

We retrospectively reviewed our cases of patients with ulnar collateral ligament injuries. Data were obtained by review of hospital and office records, which included fol-

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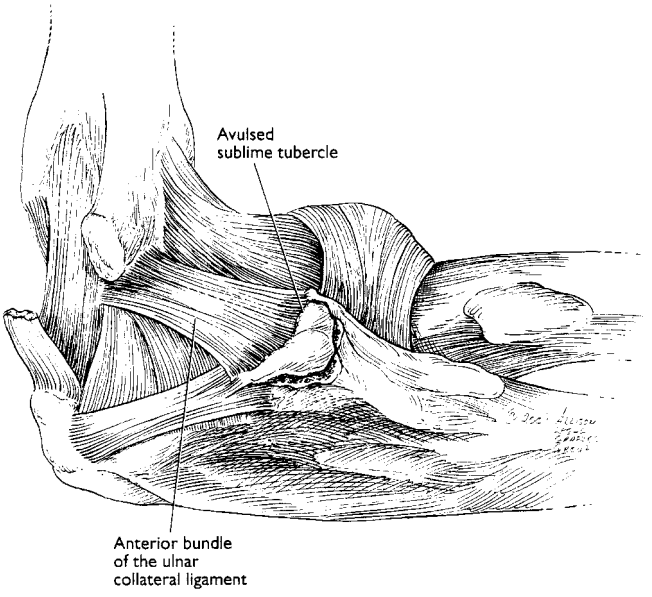

Figure 1. Medial view of the elbow showing the anterior bundle of the ulnar collateral ligament.

low-up examination. Thirty-three patients were treated for an injury to the ulnar collateral ligament between March 1994 and May 1999. Eight of the 33 had avulsion fractures of the sublime tubercle. All eight patients were competitive baseball players (seven pitchers, one catcher). Five were high school level players, two were college level, and one was professional (minor league). Their average age was 16.9 years (range, 15 to 19), and the average length of follow-up was 23.6 months (range, 13 to 56). Clinical history, physical examination, and correlation with radiographic studies confirmed the diagnosis. Preoperative radiographs and MRI scans were obtained in all patients.

All patients with sublime tubercle fractures were treated nonoperatively with immobilization in a range of motion brace locked at 90° for 7 to 10 days until the acute inflammation resolved. For the next 6 weeks the elbow brace was worn continuously (except for bathing) in an unlocked position to allow for active and passive range of motion exercises.

After this period of nonoperative treatment, radiographs were taken and showed varying degrees of ossification across the avulsion fracture, even in patients whose initial radiographs appeared normal (Fig. 2). Clinically, all patients also had resolution of their pain with applied valgus stress. On the basis of these two findings, our assumption was that the fracture was healed. The brace was removed and strengthening exercises were initiated. A throwing program was started at 8 weeks. Throwing at full velocity was allowed at 12 weeks. During the throwing program, nonsteroidal antiinflammatory medication was administered as required by symptoms. Six patients had failure of nonoperative treatment and developed medial elbow pain while throwing, resulting in a limited performance level.

Figure 2. A, radiographic evidence of avulsion fracture (arrow). B, healed avulsion fracture in the same patient 2 months later, after nonoperative treatment.

Patients who did not respond to nonoperative treatment (Fig. 3) were treated with surgical repair (four) or reconstruction (two). All operative procedures were performed with a minimally invasive, muscle-splitting technique described by Smith et al.[18] and modified by Hechtman et al.[8] A 6-cm incision was made beginning just distal to the level of the medial epicondyle and brought slightly volar. The one to two branches of the medial antebrachial cutaneous nerve were identified and protected. A split was made in the posterior third of the fascia and careful blunt dissection was performed with two freer elevators splitting the muscle in line with its fibers. Once the split was made, the underlying joint capsule and the ulnar collateral ligament were identified.

Figure 3. Radiograph (A) and MRI scan (B) of patient in whom avulsion fracture (arrows) was diagnosed. Radiograph (C) and MRI scan (D) of nonunion after 6 months of nonoperative treatment (arrows).

During repair, the fibrous tissue from each side of the sublime tubercle was removed. The surfaces were rasped if necessary to ensure proper approximation of the fragment to the bony bed (Fig. 4). One or two bioabsorbable anchors were placed in the ulnar side (Fig. 5). Holes in the avulsed fragment were predrilled with a K-wire to avoid splitting the fragment when both limbs of the suture anchors were placed through the avulsed bone. Once the sutures were tied, the stability of the repair was checked. If fixation was inadequate, a reconstruction was performed.

The reconstructions were performed with autologous tissue (palmaris longus or plantaris tendon) and secured with bioabsorbable suture anchors in the medial epicondyle and bone tunnels in the ulna. The surgical approach is a muscle-splitting approach that does not involve transposition of the ulnar nerve and avoids detachment of the flexor muscle origin.[11]

Patients who underwent primary surgical repair had their elbow immobilized in 90° of flexion in a posterior splint for 7 to 10 days. The arm was then placed in a range of motion brace locked at 90° for 3 weeks. At 3 weeks, the

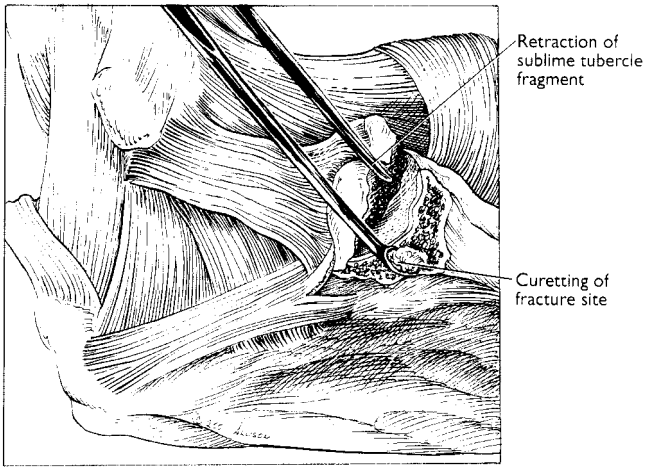

Figure 4. Medial view of the elbow during surgical repair.

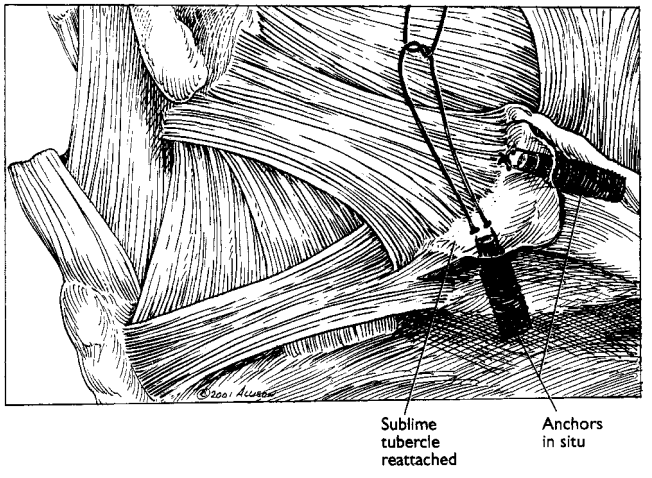

Figure 5. Medial view of the elbow with two bioabsorbable anchors placed in the ulna during surgical repair.

brace was unlocked to allow active and passive range of motion exercises. Once bony union was achieved, strengthening exercises were initiated (Fig. 6). A throwing program was started at 12 weeks and patients were back to throwing at full velocity by 4 to 6 months.

All patients who underwent formal reconstruction had their elbow immobilized in 90° of flexion in a posterior splint for 7 to 10 days. The arm was then placed in a range of motion brace locked at 90° for 3 weeks, during which time the brace could be removed to allow daily range of motion exercises. At 3 weeks, the brace was unlocked to allow full range of motion exercises. At 6 weeks the brace was discontinued and strengthening exercises were initiated. A throwing program was started by 6 months and patients were allowed to gradually increase to full throwing velocity by 9 to 12 months.

RESULTS

In all eight cases, the patient's dominant arm was involved. All eight patients had medial elbow pain with

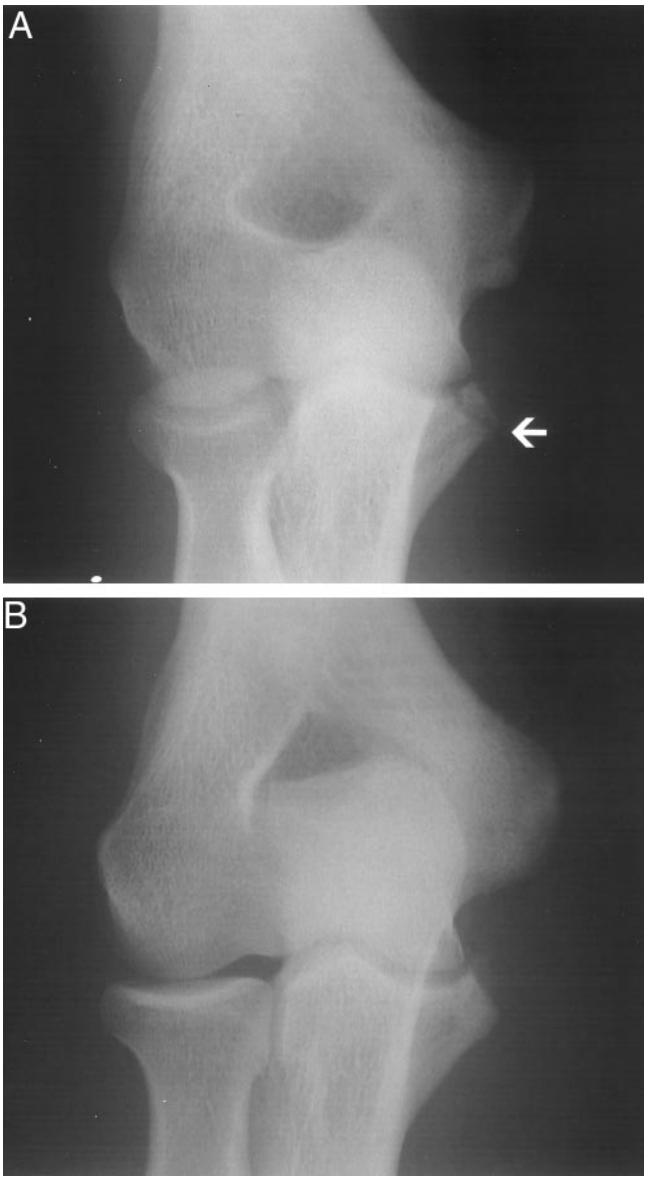

Figure 6. A, postoperative radiograph showing appearance of bony fragment and radiolucent bone anchors (arrow) (same patient as in Fig. 3). B, radiograph in the same patient with healed avulsion fracture.

throwing that began with an acute episode. Three patients had a history of elbow pain that had resolved with rest. When initially seen in our office, seven patients (88%) had pain on valgus stress and only one patient (12%) displayed clinical laxity on valgus stress testing.

Radiographic and MRI studies were obtained of all patients. Radiographs demonstrated the avulsion fracture in six of the eight patients (75%). Magnetic resonance imaging scans revealed the avulsion fracture in all eight patients. Magnetic resonance imaging scans with a gradient echo sequence allowed the best visualization of the avulsion fracture and the ligament substance. In the two patients who required reconstruction of the ulnar collateral

ligament, the MRI scan with gradient echo sequence demonstrated changes consistent with midsubstance injury in the ligament proximal to the avulsion fracture. In patients who underwent direct repair, MRI with gradient echo sequence showed no evidence of midsubstance ligament injury.

Six patients (75%) had failure of nonoperative treatment and went on to have their ulnar collateral ligament repaired or reconstructed. Four of the six (67%) underwent primary repair of the sublime tubercle avulsion fracture with bioabsorbable suture anchors. Two patients (33%) had evidence of injury to the ulnar collateral ligament proximal to the sublime tubercle avulsion fracture and therefore required reconstruction rather than direct repair. At the last follow-up office examination record, no patient displayed pain or laxity with valgus stress. All eight patients had a painless, full range of motion. No patient had ulnar nerve symptoms. All eight patients had returned to their previous level of activity. There were no fixation or graft complications and no patient had experienced recurrence of medial elbow pain.

DISCUSSION

Evaluation of the athlete with medial elbow pain must include a detailed history, physical examination, and appropriate imaging studies. A history of repetitive throwing or overhead throwing activities with medial elbow pain during the late cocking or early acceleration phases of throwing is consistent with ulnar collateral ligament injury.[4] Frequently there is an associated complaint of loss of velocity or control, especially in pitchers. Patients may also have a history of low-grade medial elbow pain followed by a single episode of giving way that represents the final injury to the ligament complex. On examination, the patient will have medial elbow tenderness that is worsened by valgus stress. Valgus instability can be detected by applying valgus stress to the elbow at 20° to 30° of flexion to unlock the olecranon from its fossa.[4] During the application of valgus stress, the forearm is kept in pronation and the wrist in flexion to relax the flexor pronator muscle.

Imaging studies include standard radiographs, valgus stress views, and MRI. Radiographs may demonstrate traction osteophytes, loose bodies, or calcification in the ligament. Magnetic resonance imaging scans may show soft tissue edema, ligament avulsion, partial tears, or full-thickness tears.[4] Arthrograms have been used by some authors for diagnosis of ulnar collateral ligament injury[17]; however, by using a volumetric gradient echo sequence with 1.3 mm thickness MRI cuts, we have found the arthrogram unnecessary. We found MRI to be the most effective diagnostic tool for confirming the avulsion fracture; 25% of these fractures were missed on radiographs in our series. Magnetic resonance imaging with a gradient echo sequence also allows the best visualization of the ligament substance and can aid the surgeon in determining the necessary type of fixation (repair versus reconstruction).

In addition to the clinical examination and radiographs, an MRI scan or possibly a CT scan can be ordered to confirm the presence or absence of bony union. The high degree of failure with nonoperative treatment may be related to inadequate healing time or simply to the poor healing response of this type of injury. Regardless of the cause, it is very difficult to restrict a throwing athlete for longer than the initial length of time involved in nonoperative treatment. This is especially true when considering that results of nonoperative treatment vary and surgical intervention is highly successful.

Injury to the ulnar collateral ligament of the elbow in the throwing athlete is a well-recognized entity. However, avulsion fracture of the sublime tubercle of the ulna is not a common site of ligament failure. It has been documented in two reports in the radiology literature, but in neither report did the authors describe treatment or outcome.[7,15] There has been one case report in the orthopaedic literature.[2] In one other study, Conway et al.[5] reported the results of 70 patients treated with either repair or reconstruction of the ulnar collateral ligament. They reported 7 patients with soft tissue avulsion of the ulnar attachment, 2 with soft tissue avulsion of the epicondylar attachment, and 61 with midsubstance tears. There was no specific mention of sublime tubercle avulsion fracture.

Avulsion fracture of the sublime tubercle of the ulna is an underreported entity in throwing athletes with functional medial elbow pain. With our small patient population, it is difficult to reach definitive conclusions regarding patients with sublime tubercle avulsion fractures and functional medial elbow instability. Nonoperative treatment usually does not provide enough relief of symptoms to allow return to the preinjury level of activity. Our findings indicate that the majority of patients with sublime tubercle avulsions require surgical treatment, especially competitive throwing athletes. However, with early recognition of this specific entity and appropriate initial treatment, patients may avoid surgical intervention. Operative repair or reconstruction is successful in patients in whom nonoperative measures have failed and allows them to return to their preinjury level of activity in a timely fashion.

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