Radial head fracture: a potentially complex injury
Kaas, L.

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CASE SCENARIO

A 23 year old professional athlete (baseball pitcher) has been complaining about his right elbow for 6 months. The pain is medial sided and the onset of the symptoms was gradual. A wrong pitch 5 months ago has severely increased the pain, resulting in an inability to pitch. At physical examination there is a slight extension deficit of 10°, a positive moving valgus test and a positive milking test. This test can identify partial tears of the ulnar collateral ligament (UCL) by extending the elbow from the fully flexed position, while the examiner exerts a valgus moment by grasping the thumb and resisting extension. The patient has no neurovascular symptoms.

RELEVANT ANATOMY

Stability of the elbow is attained by dynamic and static constraints. Static or passive constraints are provided by both the bones and the soft tissues of the elbow. The role of the muscles as dynamic constraints is becoming increasingly clear and is probably larger than previously postulated. The relative role of the osseous and soft tissue restraints are shown in table I. The ulnar collateral ligament consists of an anterior and a posterior bundle, and a transverse ligament (also known as the Cooper ligament). The anterior and posterior bundles originate from a broad anteroinferior surface of the medial humeral epicondyle. The anterior bundle inserts the base of the coronoid process of the ulna and the posterior bundle inserts the medial part of the semilunar notch of the ulna. The mean length of the anterior UCL is 27.1 mm and that of posterior UCL 24.2 mm, the mean widths are about 4.7 mm and 5.3 mm respectively. The function of these ligaments is to restrain valgus stress, during extension (anterior bundle) and during flexion (posterior bundle). Studies reveal that the anterior medial collateral ligament can be subdivided into three regions or bands according to their function (see figure 1).

IMPORTANCE OF THE PROBLEM

Injury to the UCL was first recognized in 1946 in javelin throwers. The injury has since become well recognized in baseball pitchers and other overhead throwing athletes. However,

<table>
<thead>
<tr>
<th></th>
<th>Extended</th>
<th>90° elbow flexion</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCL</td>
<td>31</td>
<td>54</td>
</tr>
<tr>
<td>Soft tissue, capsule</td>
<td>38</td>
<td>10</td>
</tr>
<tr>
<td>Osseous articulation</td>
<td>31</td>
<td>33</td>
</tr>
</tbody>
</table>

*Table 1: Relative contribution to valgus stress resistance (%).*[^17]
exact numbers or incidence of this injury in athletes or in the general population are not known. The three most common causes of UCL injury are elbow dislocation, chronic attenuation in athletes or acute valgus injury. The elbow joint is the second most commonly dislocated major joint after the shoulder. In children it is the most commonly dislocated joint. The incidence of this dislocation is estimated to be 6/100,000 in the general population, usually in the posterior or posterolateral direction. Josefsson showed that elbow dislocation induced injury in the lateral as well as the medial ligamentous structures, whereas O’Driscoll demonstrated that the joint could be dislocated experimentally with preservation of the medial ligaments. During dislocation ligamentous injury occurs in a lateral to medial circle. In stage 1, the radial collateral ligament is disrupted; in stage 2, the other lateral ligamentous structures as well as the anterior and posterior capsule are disrupted. In stage 3, disruption of the UCL can be partial with disruption of the posterior bundle only (3A) or complete (3B). The UCL can therefore be disrupted after dislocation of the elbow joint. Persistent valgus instability after conservative treatment of elbow dislocation has been described in up to 50%. It is related to degenerative changes of the elbow joint after an average follow-up of 9 years.

Figure 1. The UCL complex consists of an anterior (1) and a posterior (2) bundle, and a transverse ligament. (reproduced with permission)
TOP 5 QUESTIONS

Diagnosis
1. Is UCL insufficiency a frequently encountered problem in general orthopedic practice?
2. As the clinical instability of the elbow is underestimated in most cases, what is de ‘gold standard’ for the evaluation of the UCL?

Treatment
3. Should (professional) athletes with an acute injury of the UCL always be treated surgically?
4. What are the surgical treatment options?

Prognosis
5. Does surgical reconstruction of the UCL prevent accelerated degeneration of the elbow joint?

QUESTION 1: IS UCL INSUFFICIENCY A FREQUENTLY ENCOUNTERED PROBLEM IN GENERAL ORTHOPEDIC PRACTICE?

Case clarification
The patient was treated in an upper limb unit specializing in sports medicine. In a general orthopedic practice with a small number of sports-related injuries or post-traumatic deformities of the elbow, the incidence is low. In those situations the ‘doctor’s delay’ due to unfamiliarity with UCL injury can be an issue.

Finding the evidence
- Cochrane Database: No reviews available.
- PubMed: No reports on incidence of UCL injury of the elbow in the general population or in throwing athletes.

Findings
There are no scientific reports on the incidence of UCL injury in throwing athletes or the general population. One study found an incidence of UCL lesions in 33% of 490 baseball players who underwent rehabilitation for any kind of injury of the upper extremity. As previously mentioned, persistent valgus instability after conservatively treated elbow dislocations has been described in up to 50% of the cases. In up to 54% of the patients with a radial head fracture a UCL lesion is diagnosed with MRI, although the incidence of clinical relevant UCL injuries is much lower (1-8%). Orthopedic surgeons should think
of UCL insufficiency in patients with medial sided elbow pain especially in athletes and in patients with posttraumatic conditions of the elbow as a posterolateral dislocation.

Recommendations
- UCL insufficiency of the elbow has been mainly reported in athletes and in patients with post-traumatic conditions of the elbow as a postero-lateral dislocation, although the incidence in the general (or athlete) population is unknown. [Overall quality very low]

**QUESTION 2: AS THE CLINICAL INSTABILITY OF THE ELBOW IS UNDERESTIMATED IN MOST CASES, WHAT IS THE ‘GOLD STANDARD’ FOR THE EVALUATION OF THE UCL?**

**Case clarification**
In the case described above, the history was very suggestive for UCL injury. Apparently this athlete had ruptured the UCL 5 months ago, but this injury had subsided; after a new event, the ‘chronic rupture’ of UCL became symptomatic again. Physical examination revealed a positive milking maneuver; the MRI with arthrogram (MRA) revealed a detachment of the UCL on the humeral side.

**Current opinion**
Anteroposterior, lateral and axillary views of the elbow are assessed for degenerative changes, such as joint space narrowing, ossification of the UCL and loose bodies. A small bony avulsion fragment might be identified when a UCL bony avulsion exists.

**Finding the evidence**
- Cochrane Database: No reviews available
- PubMed: 7 reports on MRA in UCL pathology. 2 reports on CTA in UCL pathology.

**Quality of the evidence**
- Level IV: 6 case series.
- Level V: 2 expert opinion.

**Findings**
Dynamic radiographs under valgus load have been described in the past as a useful diagnostic tool; however mild valgus laxity has been observed in uninjured overhead athletes and dynamic radiographs in symptomatic elbows seems to be inconsistent.16, 17 Another imaging modality is CT with arthrogram (CTA), with a sensitivity of 86% and a specificity of 91%.18 However, the preferred imaging technique for UCL injuries of the elbow is MRA.
MRI is capable of identifying full thickness tears, MRA improves the diagnosis of partial tears.\textsuperscript{17, 19-22} Another advantage of MRI/MRA is the ability to identify associated pathology, such as medial epicondylitis and chondral lesions. Sensitivity of MRA is reported to be up to 97% in detecting UCL injury, including partial undersurface UCL tears, with a specificity of up to 100%.\textsuperscript{18, 23, 24} No comparative studies between CTA and MRA are currently available.

**Recommendations**
- MRA is the preferred imaging technique for detection of UCL injuries of the elbow.
  [Overall quality very low]

**Question 3: Should (professional) athletes with an acute injury of the UCL always be treated surgically?**

**Case clarification**
Treatment of UCL of the elbow injuries is based on the patients athletic demands and the degree of UCL injury. Initial conservative treatment consists of rest, anti-inflammatory measures and physical therapy.

**Finding the evidence**
- Cochrane Database: No reviews on conservative treatment of UCL available
- PubMed: 1 report on conservative treatment of UCL injury of the elbow

**Quality of the evidence**
- Level IV: 1 case series.

**Findings**
Rettig et al.\textsuperscript{25} was the first to report on the results of conservative treatment in throwing athletes. Phase I of the conservative treatment consisted of rest and modalities to treat symptoms for 2 to 3 months. If pain free, the athlete began with phase II which consisted of muscle strengthening and throwing. Thirteen of 31 athletes (42%) returned to same level of play, with an average return of 24 weeks after injury after conservative treatment. This rehabilitation period is shorter compared to the rehabilitation period after UCL reconstruction. No history or physical examination features are predictive for athletes who will respond to no non-operative treatment.
Recommendations
- Treatment of UCL of the elbow injuries is based on the patient's athletic demands and the degree of UCL injury. [Overall quality very low]

QUESTION 4: WHAT ARE THE SURGICAL TREATMENT OPTIONS?

Current opinion
Persistent symptomatic UCL instability after initial conservative treatment is an indication for reconstruction.

Finding the evidence
- Cochrane Database: 0 reviews available on results of UCL reconstruction.
- PubMed: 17 reports available on results of UCL reconstruction.

Quality of the evidence
- Level I: 2 systematic reviews.
- Level IV: 14 case series.
- Level V: 1 expert opinion.

Findings
The first successful UCL reconstruction was performed in 1974 by Dr. Frank Jobe and colleagues. They published their initial results in throwing athletes in 1986, using the palmaris longus tendon as an autograft, with detachment of the flexor-pronator musculature, submuscular transposition of the ulnar nerve and a figure-of-eight graft fixation technique. In this fixation technique the autograft is placed through two drill holes in the ulna and three in the medial epicondyle in a figure-of-eight fashion, going through the posterior humeral cortex and suturing the graft to itself.26 Several modifications of this original technique have been introduced over the past 35 years. Muscle splitting instead of detachment and abandoning the obligatory ulnar nerve transposition, improved clinical results and decreased the complication rate.27, 28 The introduction of the docking technique by Rohrbough et al.29 allows easier graft passing, tensioning and fixation. It uses the same ulnar tunnels as in the Jobe technique, but the humeral tunnels are created with one single inferior tunnel, with two small superior and one anterior exit tunnels. The graft is positioned in the inferior tunnel, and tensioned with sutures that exit the superior tunnels. The graft is fixated by tying the sutures over a bony bridge.

Another graft fixation technique is interference screw fixation, where one or both graft endings are fixed with a bioabsorbable interference screw.23, 30 Different autografts have been described: the palmaris longus tendon, plantaris tendon, hamstrings tendon, tendon
allografts or triceps tendon can be used. Ulnar decompression or transposition can be indicated in patients with symptoms of ulnar nerve irritation, which is present in over 40% of the patients with UCL insufficiency. Additional diagnostic arthroscopy can be performed if intra-articular pathology is suspected. After surgery a long arm cast is applied for 1-2 weeks to allow wound healing. Some authors use an additional hinged brace during mobilization for 2-6 weeks. Strengthening exercises (with or without brace) are initiated after 4-6 weeks. Throwing is usually allowed after 2-5 months. Return to competition varies between ‘when ready’ to 12 months after surgery. The original report on UCL reconstruction by Jobe et al. reported excellent results in 63%. With the improvement of the surgical technique, success rates increased: 74-95% of all athletes returned to their previous level of injury or higher. Previous surgery for UCL insufficiency is associated with poorer results. The most frequent reported complication is a transient ulnar neuropathy, which occurs in 1-21% of the patients, with a mean of 6%. About 1% of the patients experience graft site complications. In this case UCL reconstruction is advised, if conservative treatment under supervision of a specialized physiotherapist for 3 months, is not successful.

Recommendations
- Symptomatic UCL insufficiency is indication for reconstruction. Reconstruction of a non-symptomatic UCL injury is not indicated. [Overall quality very low]
- The preferred surgical techniques are the docking technique or interference screw fixation. [Overall quality very low]
- Injury to the UCL of the elbow was once a career-ending-injury in overhead athletes, UCL reconstruction have made return to previous of higher level of athlete participation in sports likely to occur. [Overall quality very low]

QUESTION 5: DOES SURGICAL RECONSTRUCTION OF THE UCL PREVENT ACCELERATED DEGENERATION OF THE ELBOW JOINT?

Current opinion
Persistent valgus instability can be related to accelerated degeneration of the elbow joint. The question whether surgical reconstruction of the UCL can prevent accelerated degeneration of the elbow has not been answered yet.

Finding the evidence
- Cochrane Database: No reviews available on prevention of degeneration with UCL reconstruction.
- PubMed: No reports available on prevention of degeneration with UCL reconstruction.
Findings
Symptomatic UCL insufficiency is indication for reconstruction; a reconstruction of UCL to prevent further damage to the joint in the future is not indicated. Reconstruction of a non-symptomatic UCL injury is not indicated.\textsuperscript{10}

Recommendations
- A reconstruction of the UCL to prevent further damage to the joint in the future is not indicated. [Overall quality very low]

SUMMARY OF RECOMMENDATIONS
- UCL insufficiency of the elbow has been mainly reported in athlete’s and in patients with posttraumatic conditions of the elbow as a postero-lateral dislocation, although the incidence in the general (or athlete) population is unknown.
- The preferred imaging technique for detection of UCL injuries of the elbow is MRI with arthrography.
- Treatment of UCL of the elbow injuries is based on the patients athletic demands and the degree of UCL injury.
- Symptomatic UCL insufficiency is indication for reconstruction. Reconstruction of a non-symptomatic UCL injury is not indicated.
- The preferred surgical techniques are the docking technique or interference screw fixation.
- Injury to the UCL of the elbow was once a career-ending-injury in overhead athletes, UCL reconstruction have made return to previous of higher level of athlete participation in sports likely to occur.
- A reconstruction of the UCL to prevent further damage to the joint in the future is not indicated.

CONCLUSIONS
Research on diagnosis and treatment of UCL injury should continue to find higher levels of evidence. Prospective studies to determine preferable diagnostic technique, best graft fixation techniques and long term results of conservative and surgical treatment are in demand.
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