Medial instability of the elbow

Findings on valgus load radiography and MRI in 16 athletes

Denise Eygendaal[1], Marinus P Heijboer[2], Willem R Obermann[3] and Piet M Rozing[1]

Departments of [1]Orthopaedics, Leiden University Medical Center, Albinusdreef 2, NL-2300 RC Leiden, [2]Orthopaedics, University Hospital Rotterdam Dijkzigt, Dr. Molewaterplein 40, NL-3013 GD Rotterdam, [3]Radiology, Leiden University Medical Center, The Netherlands. Correspondence: Dr. D. Eygendaal, Margrietstraat 40, NL-5122 HV Rijen, The Netherlands. Tel +31 161 232591. E-mail: d.eygendaal@wxs.nl
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ABSTRACT – Medial discomfort of the elbow in athletes can be due to valgus instability after acute ligament rupture or attenuation of the medial collateral ligament caused by repetitive microtrauma during overhead throwing.

We studied 16 athletes with medial instability of the elbow due to insufficiency of the medial collateral ligament. 4 patients had sensory ulnar nerve symptoms, of whom 2 had abnormalities of the ulnar nerve on electromyography. 13 showed an increase in the ulno-humeral joint space on dynamic radiography under valgus load. MRI of 10 of these 13 elbows revealed rupture of the medial collateral ligament or avulsion of the medial collateral ligament.

Dynamic radiography under valgus load seems to be of value for the diagnosis of chronic medial collateral ligament insufficiency.

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Medial discomfort in throwing athletes may have various ethiologies, such as inflammation of flexor-pronator tendon origin, sprain or rupture of the medial collateral ligament, ulnar neuritis, avulsion fractures, osteochondral bodies or traction spurs of the coronoid process and medial epicondyle.

A common denominator in all throwing sports is a basic mechanism of upper extremity motion that can be divided into 5 phases: wind-up, early and late cocking, acceleration, and follow-through. The elbow is most vulnerable during late cocking and acceleration because great valgus forces are generated along the medial side of the elbow joint (Wilson et al. 1983, Fleisig et al. 1995, Hang et al. 1997). With proper mechanics, conditioning and warm-up, most athletes can tolerate these forces. However, poor mechanics, lack of flexibility and overall condition or fatigue from overuse can have a cumulative effect that leads to muscle strain and allows further stress to be transmitted to the medial collateral ligament, the primary restraint to valgus forces of the elbow joint. Medial collateral ligament injury can be acute, due to a single traumatic event or chronic, caused by progressive attenuation of the medial collateral ligament leading to ligament insufficiency. Diagnosis is based on the history, findings on physical examination, instability on dynamic radiography under valgus load, arthrography and MRI. Rupture of the medial collateral ligament due to overhand throwing has been described extensively in American and Japanese athletes, especially in professional baseball pitchers (Indelicato et al. 1979, Kuroda and Sakamaki 1984, Jobe et al. 1986, Conway et al. 1992, Loosli et al. 1992, Andrews and Whiteside 1993, Morrey 1996). Reports of comparable injuries in European athletes are rare (Waris 1946).

We studied 16 Dutch athletes with injury of the medial collateral ligament.

Patients and methods

During 1997 we evaluated 16 (14 men) semi-professional athletes (8 javelin throwers, 6 baseball pitchers and 2 tennis players, median age 24 (19–34) years, 14 right-handed, 2 left-handed) for persistent medial-sided elbow pain. A detailed history was taken and two independent examiners per-

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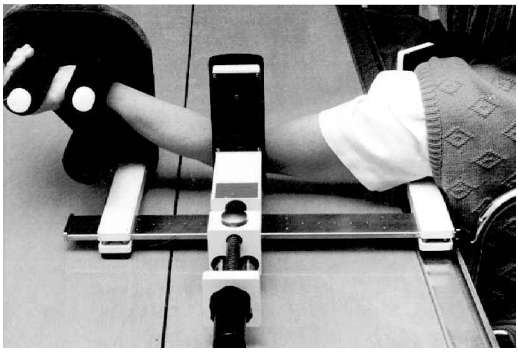

Figure 1. The valgus load device used for dynamic radiography.

formed a physical examination of both upper extremities. Valgus stability was tested bilaterally with the patient in a sitting position, the involved forearm placed between the opposite arm and body of the examiner. The examiner then applied a valgus load while palpating the ulno-humeral joint for opening. Standard radiographs of both elbow joints were take in two directions. Standardized dynamic radiographs under a 15 Nm valgus load were made of both elbows using a commercially available device (Telos GA-/IIE stress device; Austin & Associates, Fallstone, Md). The arm is fixed with the wrist in supination, secured between two rollerbars with 25° of flexion in the elbow and the upper arm, held in 65° abduction. A counterbearing supports the anterior aspect of the shoulder. A radiograph in an anteroposterior direction is taken of the elbow without resistance and with 15 N pressure applied to the lateral humeral aspect of the elbow joint using a screw-threaded shaft that permits the monitored stress to be applied gradually (Figure 1). From the radiographs, the distance (d) in mm between the most distal point on the curved contour of the medial condyle and the ulnar coronoid process was measured at zero (d0) and 15 N valgus load (d15). Medial instability was defined as (d15–d0) of the injured elbow, minus (d15–d0) of the uninjured side and graded as 'no instability' (0–0.5 mm), 'partial instability' (1–3 mm), 'unstable' (3–6 mm) or 'subluxation'(> 6 mm). This gradation was based on previous cadaver studies (Rijke et al. 1994, Eygendaal et al. 1999). In all patients, additional evaluation with MRI was performed, in 9 patients combined with 10 cc of gadopentetate dimeglumine, injected into the posterolateral side of the elbow joint. All patients were treated with immobilization of the elbow in a long arm-cast for 4 weeks, followed by a total arm-strength rehabilitation protocol under supervision of a physiotherapist in which valgus load was avoided for 3 months. The flexor carpi ulnaris, flexor digitorum superficialis and pronator teres were strengthened to provide dynamic stabilization (Glousman et al. 1992, Davidson et al. 1995).

Statistical analysis was performed with SSPS-software.

Results

9 of 16 patients mentioned a single valgus load injury in the past, suggestive of acute ligament rupture, after which the symptoms had started. None were diagnosed at the time of the injury by their doctor or physiotherapist. 7 patients could not remember a single episode, symptoms having started gradually. The median duration of symptoms was 14 (5–36) months. All baseball pitchers had localized pain around the medial aspect of the elbow during the late cocking or acceleration phases. Throwing of curved balls caused more pain than throwing of straight balls. All javelin throwers had most pain during release of the javelin. The two tennis players could not state whether one drive was more harmful than another. All patients reported relief of symptoms afterwards.

10 patients had a loss of extension of 5–10° at physical examination. 10 patients showed valgus instability at physical examination, all patients had medial pain on valgus stress and localized tenderness over the medial collateral ligament. Active resistance of wrist flexion and pronation did not induce pain. 4 patients had sensory ulnar nerve symptoms, 2 of them having abnormalities of the ulnar nerve at electromyography.

13 patients showed medial instability on dynamic radiography under valgus load, but not on the uninjured side (Figure 2). 10 patients showed an avulsion fracture of the medial collateral ligament at the humeral side or rupture of the ligament at MRI (Figure 3); 3 had an intact ligament. The avulsion fractures, seen at MRI were not visible on plain radiographs, perhaps because they were

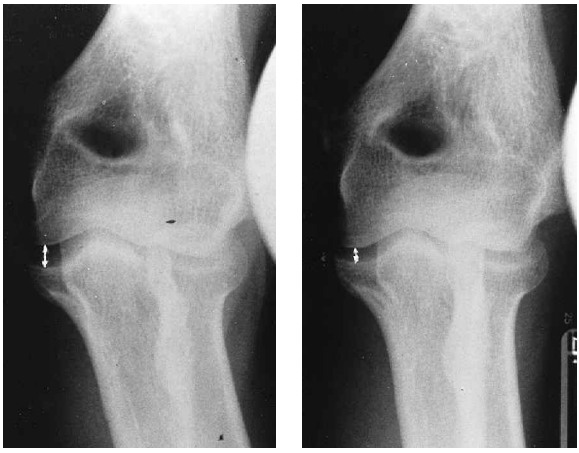

Figure 2. Dynamic radiography under 15 N valgus load. The distance in mm between the most distal point on the curved contour of the medial condyle and the ulnar coronoid process (arrow) was measured at zero (right) and under 15 N valgus load (left). This increase in distance was compared to the uninjured side.

Figure 3. T 1 weighted MRI; avulsion of the MCL at humeral side (arrow).

Findings at physical and radiological examination

No.	Sport	Acute injury	Instability at physical exam.	Grade of instability at radiography	MRI findings	Contrast	Ulna nerve symptoms
1	Baseball	+	+	+, unstable	Avulsion at humeral side of MCL	+	+
2	Baseball	–	+	+, unstable	Midsubstance rupture of MCL	+	–
3	Baseball	+	+	+, unstable	Midsubstance rupture of MCL	–	–
4	Baseball	+	+	+, unstable	Midsubstance rupture of MCL	+	–
5	Baseball	–	–	–, no instability	Normal MRI	–	–
6	Baseball	–	–	+, partial instability	Midsubstance rupture of MCL	+	–
7	Javelin	–	+	+, unstable	Midsubstance rupture of MCL	–	–
8	Javelin	+	+	+, subluxation	Avulsion at humeral side of MCL	+	+
9	Javelin	+	+	+, unstable	Avulsion at humeral side of MCL	+	–
10	Javelin	+	–	+, partial instability	Normal MRI	+	–
11	Javelin	+	–	–, stable	Normal MRI	–	–
12	Javelin	–	–	+, partial instability	Normal MRI	–	–
13	Javelin	+	+	+, unstable	Avulsion at ulnar side of MCL	+	+
14	Javelin	+	+	+, partial instability	Normal MRI	–	–
15	Tennis	–	–	–, stable	Normal MRI	–	–
16	Tennis	–	+	+, unstable	Avulsion at humeral side of MCL	+	+

too small. 3 elbows without instability on dynamic radiography showed no abnormalities on MRI. 4 patients had cartilage damage of the radio-humeral joint, 2 patients loose bodies in the joint. No signs of bone bruise were seen. In 6 patients, the MRI was normal (Table).

3 javelin throwers and 1 baseball pitcher decided to change sport activities. The others were treated as described and were satisfied at follow-up after a median 20 (14–23) months.

Discussion

In 1946 Waris was the first one to describe elbow injuries at the medial side in javelin throwers (Waris 1946). The incidence of medial elbow instability is probably much lower in Europe than in the United States and Japan where baseball is more popular and sports in general are more professionalized than in Europe. 13 of our 16 patients showed instability at dynamic radiography under valgus load. Partial ruptures have proved to give a

very slight increase in the ulno-humeral joint space, which might explain the normal dynamic radiographs and normal MRI in 3 patients (Rijke et al. 1994, Eygendaal et al. 1999).

MRI has been reported to have a sensitivity of 57% and specificity of 100% in medial collateral ligament rupture (Sonin and Fitzgerald 1996). Arthrography with plain radiography has previously been used and has shown leakage of contrast in 10 of 18 elbows of javelin throwers (Josefsson et al. 1994). Other studies indicate that magnetic resonance imaging is better for visualizing this ligament (Mirowitz and London 1992, Gaary et al. 1997). MRI with arthrography seems to improve the sensitivity to 95% in complete rupture and 86% in partial rupture (Schwartz et al. 1995, Nakanishi et al. 1996). Intra-articular contrast probably stretches the joint capsule, which improves the visibility of the ligament. 5 patients in our study had a normal MRI, without arthrography, 4 of them had medial instability on dynamic radiography. This might be explained by the low sensitivity of MRI without arthrography for small, partial ruptures or the inability to distinguish between scar tissue and a normal ligament. Damage to the cartilage of the radius and capitellum, as seen in 4 of our patients, is probably caused by compression of the radio-humeral joint, secondary to valgus instability.

Dynamic radiography seems to be the best diagnostic tool for chronic medial collateral ligament insufficiency (Andrews and Whiteside 1993, Lee et al. 1998).

However, radiography cannot detect the site of rupture in the ligament or cartilage damage, as can be done with MRI. In acute medial collateral ligament rupture, dynamic radiography may be too painful. MRI with arthrography may be more suitable for this condition.

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