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Radiography of the elbow for evaluation of patients with osteochondritis dissecans of the capitellum

Received: 3 August 2004
Revised: 6 January 2005
Accepted: 7 January 2005
Published online: 11 March 2005
© ISS 2005

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Abstract *Objective:* This study was performed to determine the ability of a routine radiographic examination of the elbow to detect osteochondritis dissecans of the capitellum and associated intra-articular loose bodies. *Design and patients:* The study group consisted of 15 patients with osteochondritis dissecans of the capitellum confirmed by surgery or magnetic resonance imaging. Seven of the 15 patients had associated intra-articular loose bodies confirmed by surgery. All 15 patients had anteroposterior and lateral radiographs and magnetic resonance imaging of their symptomatic elbow. Nine of the 15 patients had subsequent elbow surgery. We reviewed the original interpretations of the radiographic examinations of the elbow of all 15 patients to determine whether osteochondritis dissecans of the capitellum and associated intra-articular loose bodies had been identified prospectively. We also reviewed the elbow radiographs of all 15 patients to determine whether osteochondritis dissecans of the

capitellum and associated intra-articular loose bodies could be identified retrospectively. *Results:* Osteochondritis dissecans of the capitellum was detected during the initial interpretations of the radiographic examinations of the elbow in seven of 15 patients. Osteochondritis dissecans of the capitellum was detected during retrospective review of the elbow radiographs in 10 of 15 patients. Intra-articular loose bodies were detected during the initial interpretations of the radiographic examinations of the elbow in three of seven patients. Intra-articular loose bodies were detected during retrospective review of the elbow radiographs in four of seven patients. *Conclusions:* A routine radiographic examination of the elbow has limited sensitivity for detecting osteochondritis dissecans of the capitellum and associated intra-articular loose bodies.

Keywords Radiography · Osteochondritis dissecans · Elbow · Capitellum

Introduction

Osteochondritis dissecans (OCD) of the capitellum is an uncommon disorder of the elbow which primarily occurs in young individuals [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13]. The key to successful treatment of patients with capitellar OCD is early detection of the disorder [4, 14]. A radiographic examination of the elbow is the initial study of choice for the detection of OCD of the capitellum [15].

Although radiographs of the elbow are commonly used to evaluate patients with suspected capitellar OCD, there have been few studies describing the accuracy of elbow radiographs for diagnosis of this condition. This retrospective study was performed to review our experience with radiographic evaluation of patients with OCD of the capitellum.



Fig. 1 **A** A 16-year-old male with elbow pain for the past 2 years and surgically confirmed OCD of the capitellum. Anteroposterior radiograph of the elbow shows subtle lucency within the capitellum (*arrow*). **B** A 16-year-old male with elbow pain for the past 2 years and surgically confirmed OCD of the capitellum. Lateral radiograph of the elbow shows subtle flattening of the articular surface of the capitellum (*arrow*). **C** A 16-year-old male with elbow pain

for the past 2 years and surgically confirmed OCD of the capitellum. Coronal T1-weighted spin-echo MR image of the elbow shows a low signal intensity OCD lesion within the capitellum (*arrow*). **D** A 16-year-old male with elbow pain for the past 6 years and surgically confirmed OCD of the capitellum. Coronal fat-suppressed T2-weighted fast spin-echo MR image of the elbow shows a rim of high signal intensity edema around the OCD lesion (*arrow*)

Materials and methods

We selected our study group using a database of musculoskeletal magnetic resonance (MR) examinations performed at our institution from 1994 through 2003 to identify all MR studies of the elbow. By reviewing the interpretations of the 325 elbow examinations performed during this time period, we identified 15 patients in whom an OCD of the capitellum had been diagnosed by MR imaging. Approval from our Institutional Review Board was obtained prior to performing the study.

The age of the 15 patients in the study group ranged from 12 to 27 years with an average age of 16 years. There were 12 males and three females in the study group. Seven patients were baseball or softball players and four patients had a history of acute trauma to the elbow. The remaining four patients were not athletes and had no history of trauma to the elbow.

A radiographic examination of the elbow consisting of an anteroposterior view in full extension and a lateral view in 90° of flexion was performed on all 15 patients in the study group at the time of the initial orthopedic evaluation. In addition, an MR examination of the elbow was subsequently performed on all 15 patients. The time interval between the radiographic examination and the MR examination of the elbow ranged from 2 to 44 days with an average time interval of 16 days. Fellowship-trained academic musculoskeletal radiologists interpreted all radiographic and MR examinations of the elbow. Nine of the 15 patients in the study group eventually had surgery on their symptomatic elbow performed by an orthopedic surgeon who specialized in sports medicine.

All MR examinations of the elbow were performed on a General Electric 1.5 T magnet (General Electric Medical Systems, Milwaukee, Wis.) using a phased-array extremity coil. Twelve examinations consisted of coronal and sagittal T1-weighted spin-echo sequences and coronal and sagittal fat-suppressed T2-weighted fast spin-echo sequences. Four examinations consisted of coronal and sagittal T1-weighted spin-echo sequences, a coronal fat-suppressed T2-weighted fast spin-echo sequence, and a sagittal T2-weighted fast spin-echo sequence. Fat-suppression was obtained by a frequency selective chemical presaturation pulse (ChemSat; General Electric Medical Systems, Milwaukee, Wis.) to suppress signal from adipose tissue. All examinations were performed with a

field of view between 14 cm and 16 cm, a slice thickness between 3 mm and 4 mm with an interslice gap between 0.2 mm and 1 mm, a matrix of 256×192 or 256×256, and 2 excitations.

We reviewed the radiographic and MR reports of all 15 patients in the study group and the operative reports of the nine patients who had elbow surgery. We determined whether OCD of the capitellum and intra-articular loose bodies were reported on the original radiographic interpretations. We also reviewed the elbow radiographs of all 15 patients in the study group to determine whether osteochondritis dissecans of the capitellum and associated intra-articular loose bodies could be identified retrospectively. In the nine patients who eventually had elbow surgery, the surgical report was considered to be the gold standard for the presence of OCD of the capitellum. In the remaining six patients who did not have elbow surgery, the MR report was considered to be the gold standard for the presence of OCD of the capitellum. All patients with intra-articular loose bodies identified on MR imaging of the elbow had subsequent elbow surgery. For this reason, the surgical report was considered to be the gold standard for the presence of intra-articular loose bodies within the elbow joint.

Results

OCD of the capitellum was detected during the initial interpretations of the radiographic examinations of the elbow in seven of the 15 patients in the study group. Four of these patients showed subtle lucency within the capitellum on the anteroposterior view. One patient showed subtle lucency within the capitellum on the anteroposterior view and subtle flattening of the articular surface of the capitellum on the lateral view (Fig. 1). One patient showed subtle flattening of the articular surface of the capitellum on the lateral view (Fig. 2). One patient showed subtle flattening of the articular surface of the capitellum on both the anteroposterior and lateral views. OCD of the capitellum was not detected during the initial

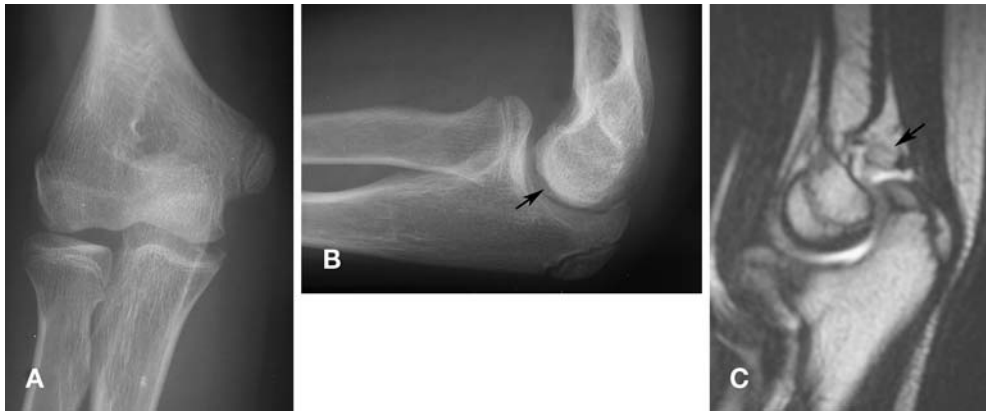


Fig. 2 **A** A 15-year-old male with elbow pain for the past 1 year and surgically confirmed OCD of the capitellum and intra-articular loose body. Anteroposterior radiograph of the elbow shows no abnormality. **B** A 15-year-old male with elbow pain for the past 1 year and surgically confirmed OCD of the capitellum and intra-articular loose body. Lateral radiograph of the elbow shows subtle

flattening of the articular surface of the capitellum (*arrow*). However, no intra-articular loose body is seen. **C** A 15-year-old male with elbow pain for the past 1 year and surgically confirmed OCD of the capitellum and intra-articular loose body. Sagittal T2-weighted fast spin-echo MR image shows an intra-articular loose body (*arrow*) within the olecranon fossa of the distal humerus



Fig. 3 **A** An 18-year-old male with chronic elbow pain for the past 6 years and surgically confirmed OCD of the capitellum. Anteroposterior radiograph of the elbow shows no abnormality. **B** An 18-year-old male with chronic elbow pain for the past 6 years and surgically confirmed OCD of the capitellum. Lateral radiograph of the elbow shows no abnormality. **C** An 18-year-old male with chronic elbow pain for the past 6 years and surgically confirmed OCD of the capitellum. Coronal T1-weighted spin-echo MR image

of the elbow shows a low signal intensity OCD lesion within the capitellum (*arrow*). **D** An 18-year-old male with chronic elbow pain for the past 6 years and surgically confirmed OCD of the capitellum. Coronal fat-suppressed T2-weighted fast spin-echo MR image of the elbow shows a tiny area of high signal intensity edema around the OCD lesion (*black arrow*) as well as slight articular surface irregularity (*white arrow*)

interpretations of the radiographic examinations of the elbow in eight of the 15 patients in the study group (Fig. 3).

Nine of the 15 patients in the study group eventually had surgery performed on their symptomatic elbow which confirmed the presence of OCD of the capitellum. Capitellar OCD was detected during the initial interpretations of the radiographic examinations of the elbow in three of nine patients with surgical follow-up. Capitellar OCD was detected during the initial interpretations of the radiographic examinations of the elbow in four of six patients without surgical follow-up.

OCD of the capitellum was detected during retrospective review of the elbow radiographs in 10 of the 15 patients in the study group. Two additional patients showed subtle lucency within the capitellum on the anteroposterior views which was not detected during the initial interpretations of the radiographic examinations. One additional patient showed subtle flattening of the articular surface of the capitellum on the lateral view which was not detected during the initial interpretation of the radiographic examination.

Seven of the 15 patients in the study group had surgically confirmed intra-articular loose bodies associated

with OCD of the capitellum. The intra-articular loose bodies were located within the olecranon fossa in five patients, within the coronoid fossa in one patient, and immediately posterior and inferior to the articular surface of the capitellum in one patient. Intra-articular loose bodies were detected during the initial interpretations of the radiographic examinations of the elbow in three of seven patients. The intra-articular loose bodies in these patients ranged in size from 9 to 11 mm with an average size of 10 mm. Intra-articular loose bodies were not detected during the initial interpretation of the radiographic examination of the elbow in four of seven patients (Fig. 2). The intra-articular loose bodies in these patients ranged in size from 3 to 10 mm with an average size of 6 mm. Intra-articular loose bodies were detected during retrospective review of the elbow radiographs in four of seven patients.

Discussion

OCD of the capitellum is an uncommon cause of elbow pain in young individuals. The exact cause of capitellar OCD is unknown. However, many authors believe that repetitive trauma to the poorly vascularized capitellum is its primary cause [1, 2, 3, 4, 5, 6, 7, 8]. Genetic factors and biomechanical differences in the articular cartilage of the capitellum and radial head may play a secondary role in the pathogenesis of the disorder [9, 10, 11, 12, 13].

OCD of the capitellum usually affects males between the ages of 12 and 15 years and occurs at a time when the capitellar epiphysis is almost completely ossified. Most individuals with capitellar OCD have a history of repetitive overuse of the elbow [2, 3, 4, 5, 6, 7]. The most common clinical presentation is pain, tenderness, and swelling over the lateral aspect of the elbow [2, 3, 4, 5, 6, 7].

OCD of the capitellum has been described in the literature as primarily occurring in adolescent male baseball players with a history of repetitive overuse of the elbow [1, 2, 3, 4, 5, 6]. Our study confirmed the male predominance of OCD of the capitellum. However, only seven of the 15 patients in our study with capitellar OCD were involved in athletic activities, such as baseball or softball, which involve repetitive overuse of the elbow.

Four of the 15 patients in our study with OCD of the capitellum had a history of acute trauma to the elbow which was not related to sports activity. The development of OCD of the capitellum following an acute episode of elbow trauma has been previously described. An association with acute trauma was noted by Brown et al. in three of 21 patients with capitellar OCD and by McNamara et al. in five of 14 patients with capitellar OCD [1, 2]. However, most of the individuals in these two studies were athletes who sustained an acute injury to the elbow while participating in sports [1, 2].

The remaining four of the 15 patients in our study with OCD of the capitellum were not athletes and had no history of trauma to the elbow. It is important to recognize that not all individuals with capitellar OCD will be athletes who present with the classic history of elbow pain following acute or repetitive trauma to the elbow.

A radiographic examination of the elbow is the initial study of choice for the detection of OCD of the capitellum. Elbow radiographs performed in the early stages of capitellar OCD may be normal or show only subtle changes within the capitellum. As the disease progresses, flattening of the contour, focal rarefaction, and nondisplaced fragmentation of the subchondral bone of the capitellum becomes apparent. In the late stages of the disease, a focal defect of the articular surface of the capitellum with an associated loose body is often seen [15].

Elbow radiographs are most commonly used as the initial screening modality in patients who are suspected of having OCD of the capitellum. However, our study has shown that a routine radiographic examination of the elbow is insensitive at detecting the presence of capitellar OCD. OCD of the capitellum was detected in only 47% of patients during the initial interpretations of the radiographic examinations and in only 66% of patients during retrospective review of the elbow radiographs.

The low sensitivity of radiographs for detecting capitellar OCD has been previously documented in two studies. Janarv and associates described the imaging findings and arthroscopic findings of 13 patients with OCD of the capitellum. Three of the 13 patients in their study had a normal radiographic examination of the elbow. The remaining 10 patients showed flattening of the articular surface of the capitellum [16]. Takahara et al. reported a case series of three patients with early OCD of the capitellum who were diagnosed with MR imaging. Two of the three patients had a radiographic examination of the elbow performed prior to the MR examination. The radiographic examinations of the elbow consisted of an anteroposterior view in full extension, an anteroposterior view in 45° of flexion, and a lateral view in 90° of flexion. The anteroposterior view of the elbow in full extension and the lateral view of the elbow in 90° of flexion showed no abnormality in either patient. However, the anteroposterior view of the elbow in 45° of flexion showed subtle flattening of the contour and subtle subchondral sclerosis of the capitellum in both patients which allowed a diagnosis of OCD to be made [17].

The most common radiographic finding of OCD of the capitellum in previous studies was flattening of the articular surface of the capitellum [15, 16, 17]. It is interesting to note that flattening of the articular surface of the capitellum was identified on elbow radiographs in only four of 15 patients with capitellar OCD in our study. The most common radiographic finding of OCD of the capitellum in our patient population was subtle subchondral

lucency within the capitellum on the anteroposterior view of the elbow.

We have no experience with the anteroposterior view of the elbow in 45° of flexion. If there is a clinical suspicion for OCD of the capitellum, it may be reasonable to include this special view as part of the radiographic examination of the elbow. However, as our study has shown, not all individuals with OCD of the capitellum will be athletes who present with elbow pain following acute or repetitive trauma to the elbow. Including this extra view in all radiographic examinations of the elbow used for patients with nonspecific elbow pain does not seem warranted.

Our study has also shown that a routine radiographic examination of the elbow is insensitive at detecting the presence of intra-articular loose bodies associated with OCD of the capitellum. Intra-articular loose bodies were detected in only 43% of patient during the initial interpretations of radiographic examinations and in only 57% of patients during retrospective review of the elbow radiographs. The vast majority of intra-articular loose bodies in our patients with capitellar OCD were located within the olecranon fossa. When evaluating elbow radiographs in young patients, it is important to closely inspect the olecranon fossa on both the anteroposterior and lateral views to avoid missing small intra-articular loose bodies associated with OCD of the capitellum.

One previous study in the literature has questioned the ability of elbow radiographs to detect the presence of intra-articular loose bodies associated with OCD of the capitellum. Bowen et al. described three patients with surgically proven intra-articular loose bodies within the elbow joint associated with OCD of the capitellum. Radiographs detected the intra-articular loose bodies in only one of the three [18]. The difficulty in identifying intra-articular loose bodies within the elbow joint has also been noted in patients with loose bodies due to other conditions. In one series, radiographs detected loose bodies

within the elbow joint in only eight of 12 patients [19]. Double-contrast CT arthrography or MR imaging of the elbow has been found useful in evaluating patients with suspected intra-articular loose bodies [20, 21]. However, MR arthrography is presently considered the study of choice for the detection of loose bodies within the elbow joint [22, 23].

One limitation of this study is that surgical confirmation was obtained in only nine of 15 patients with OCD of the capitellum. In the remaining six patients, a diagnosis of OCD was made based upon the clinical history, physical examination, and MR imaging findings. However, all six patients without surgical follow-up had the typical MR appearance of capitellar OCD with a crescentic subchondral area of signal abnormality on the anterolateral aspect of the capitellum. Exactly the same MR imaging finding was noted in the other nine patients in whom the MR diagnosis of OCD of the capitellum was confirmed at surgery. Furthermore, OCD of the capitellum was not detected during the initial interpretation of the elbow radiographs in two of six patients without surgical follow-up and in six of nine patients with surgical follow-up. The vast majority of patients in our study with OCD of the capitellum and normal-appearing radiographs had surgical confirmation of their osteochondral lesions.

In conclusion, we found that a routine radiographic examination of the elbow did not detect the presence of OCD of the capitellum and associated intra-articular loose bodies in a significant number of patients. This study raises serious questions about the ability of a routine radiographic examination of the elbow to serve as an effective screening modality in patients suspected of having OCD of the capitellum. If there is clinical suspicion for OCD of the capitellum, it may be prudent to further evaluate patients who have a normal routine elbow radiographic examination with MR imaging or, at the very least, with an anteroposterior X-ray view of the elbow in 45° of flexion.

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