

Signs in Imaging

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The Fat Pad Sign¹

APPEARANCE

Normally, on a lateral radiograph of the elbow held in 90° of flexion, lucency that represents fat is present along the anterior surface of the distal humerus, and no lucency is visualized along its posterior surface. An elevated anterior lucency and/or a visible posterior lucency on a true lateral radiograph of an elbow flexed at 90° is described as a positive fat pad sign (Fig 1).

EXPLANATION

The elbow, a hinge joint, consists of complex articulations that involve the distal humerus and the proximal radius and ulna. The joint is held together by a fibrous capsule that attaches firmly to the bone. The synovial membrane of the elbow lines the deep surface of the fibrous capsule. Three small masses of fat rest in the radial, coronoid, and olecranon fossae and are enveloped by the fibers of the joint capsule, which separate the fat pads from the synovial lining, making the fat pads intracapsular and extrasynovial in location. This anatomic arrangement is the basis for understanding the fat pad sign (1).

The anterior fat pad is a summation of radial and coronoid fat pads, which are normally pressed into the shallow radial and coronoid fossae by the brachialis muscle. On a lateral radiograph of the elbow with 90° of flexion, the anterior fat pad is normally seen as a faint line that is more radiolucent than adjacent muscle and is parallel to the anterior distal humerus. The posterior fat pad is normally pressed into the deep olecranon fossa by the triceps tendon and anconeus muscle and is invisible on a true lateral radiograph of the normal elbow with 90° of flexion.

Distention of a structurally intact joint capsule causes displacement of the fat pads (Fig 2). When there is joint distention, the anterior fat pad is displaced further anteriorly and superiorly, and the posterior fat pad is displaced posteriorly and superiorly. The previously invisible posterior fat pad becomes visible on the lateral radiograph of the elbow held in 90° of flexion. Hemarthrosis or joint effusion due to trauma, infection, inflammation,



Figure 1. Lateral radiograph shows a positive fat pad sign in a patient with a nondisplaced fracture of the radial head. The anterior lucency (arrow) represents the elevated anterior fat pad, and the posterior lucency (arrowhead) represents the elevated posterior fat pad.

or neoplasm can distend the joint capsule and displace the fat pads.

DISCUSSION

The elbow is frequently involved in trauma and is one of the most frequently radiographed joints in emergency departments. Although commonly emphasized as a sign of trauma, the fat pad sign frequently occurs in nontraumatic elbow disease. Fat pad displacement is a response to distention of the joint capsule and occurs irrespective of the cause. It has been described in a variety of disorders, such as hemophilia, rheumatoid arthritis, gout, osteoarthritis, and acute pyarthrosis, and can be expected to occur whenever there is distention of the joint capsule (2,3). It may be the manifestation of an occult fracture as a result of trauma, or it may herald the onset of an inflammatory or other synovial process that occurs in a clinical setting.

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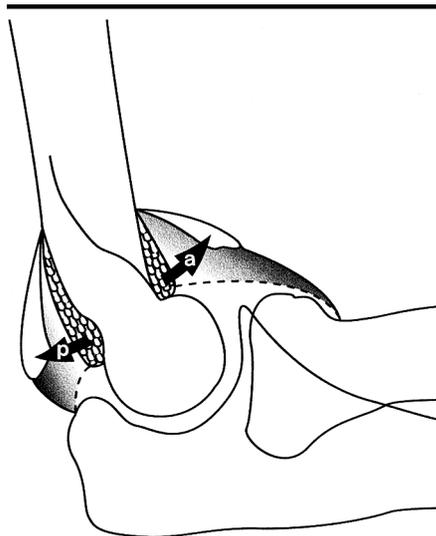


Figure 2. Illustration demonstrates how distention of the joint capsule elevates both anterior (arrow, *a*) and posterior (arrow, *p*) fat pads. Shaded gray area represents the potential joint space, which, when distended, elevates the fat pads (clear or white areas).

Radiographic examination of elbow fat pads is best performed with a true lateral view with the elbow in 90° of flexion, as any obliquity may obscure visualization. A false-negative fat pad sign may occur if there is poor positioning, extracapsular abnormality, or capsular rupture. The posterior fat pad may usually be visualized with the elbow in extension (3). With the triceps relaxed, the posterior capsule is lax, and the olecranon process displaces the fat pad from the olecranon fossa. Normal displacement of the posterior fat pad with the elbow in extension should not be mistaken for a sign of joint disease (Fig 3).

Rarely, properly performed conventional radiography may fail to demonstrate the fat pad sign in patients with joint effusion or capsular rupture (due to severe trauma) or when there is massive soft-tissue swelling around the joint. Ultrasonographic examination may be useful when conventional radiographs fail to show the fat pads or when spurious elevation of the fat pads is suspected (4).

The value of the fat pad sign is greatest as a predictor of an intraarticular disease process at the elbow in the absence of any radiographically visible bone abnormality. Fat pad displacement is independent of fracture displacement and comminution. This applies in particular to elbow examination in children, who often have very slight structural changes at presentation. Supracondylar fractures account for 60% of all elbow fractures in children, followed by fracture of the lateral epicondyle (15%) and separation of the medial epicondylar ossification center (10%) (5). In adults, fracture of the radial head or neck accounts for just under 50% of all fractures at the elbow, followed by fracture of the olecranon (20%) and dislocations and fracture dislocation (15%) (5).

An awareness of the most common sites of injury aids in the search for fractures. Additional radiographic views, such as the radial head–capitellum view, may be added when clinical suspicion remains high or when displaced fat pads are seen on routine projections (6). The reported prevalence of fracture in elbows with an elevated fat pad and no other radiographic evidence of fracture ranges from 6% to 76% in different studies (7,8). Limitations of prior studies include a limited number of patients and limited follow-up. Nevertheless, there is wide support for the practice of treating patients with displaced fat pads as if they have nondisplaced fractures around the elbow (5,7).



Figure 3. Lateral radiograph of a normal extended elbow joint in a child. Both anterior (arrow) and posterior (arrowhead) fat pads can usually be visualized with the elbow in extension. This should not be mistaken as a sign of joint disease.

In properly performed radiography of the elbow, the fat pad sign is a highly sensitive indicator of disease processes involving the elbow joint. When present, the sign is easily demonstrable on conventional radiographs, which are often the first images obtained to study the elbow. Most important, being aware of the limitations of this sign and remembering that the sign is not specific to trauma alone will help provide more effective treatment of patients suspected of having involvement of the elbow joint.

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