# Fat Pad Signs in Elbow Trauma

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The elbow is frequently involved in trauma and is 1 of the most commonly radiographed joints in emergency departments.[1] Often, the trauma results from a fall on an outstretched hand and the outcome is a radial head fracture. Consequently, radial head fractures are a common elbow injury seen in the adult patient.[2,3] Unfortunately, not all radial head fractures are easily visualized on radiographs. Often they are occult, meaning not radiographically apparent; likewise, the radial head is often obscured by the ulna. This presents a positioning challenge for the radiographer and requires additional scrutiny by the dictating radiologist.

To cope with these difficulties, radiologists often use the "fat pad sign" when assessing injuries to the elbow. This is done by evaluating several small masses of fat that can be seen on a properly positioned lateral radiograph of the elbow. The anterior and posterior fat pads are small masses of fat in close proximity to the radial, coronoid and olecranon fossae. Their presence and positions may necessitate further investigation of the joint. Additionally, the supinator fat pad is located on the proximal forearm, but will not be discussed in this article.

### *Anterior Fat Pad*

Radiographically, the anterior fat pad is a superimposition of the radial and coronoid fat pads when viewing a lateral radiograph. Their location is anterior to the coronoid and radial fossae located on the distal anterior humerus. These fat pads are slightly more radiolucent than the adjacent muscle tissues, making them visible on a properly positioned 90° lateral radiograph of the elbow. They appear as a single radiolucent density. (See Fig. 1-A1.) The anterior fat pad can be elevated in a patient with an occult fracture. This is known as the "sail sign" due to the triangular sail-like appearance of the anterior fat pad.[4] (See Fig. 1-B1.)

### *Posterior Fat Pad*

In contrast, the posterior fat pad is located deep within the concavity of the olecranon fossa and is not normally visualized on a properly positioned lateral radiograph. (See Fig. 1-A2.) It is important that the radiographer understand that a fat pad sign may demonstrate a false positive if the lateral has been improperly positioned. Proper positioning requires 90° flexion of the elbow joint. Other angles may tempt the posterior fat pad to emerge from the olecranon fossa, mimicking the fat pad sign. Therefore, in a noninjured, correctly positioned lateral elbow, the posterior fat pad should not be visible because it is hidden within the olecranon fossa. If the fat pad is evident, further study may be warranted to investigate injury. (See Fig. 1-B2.) Technique is of paramount importance to evaluate the soft tissue adjacent to these areas.

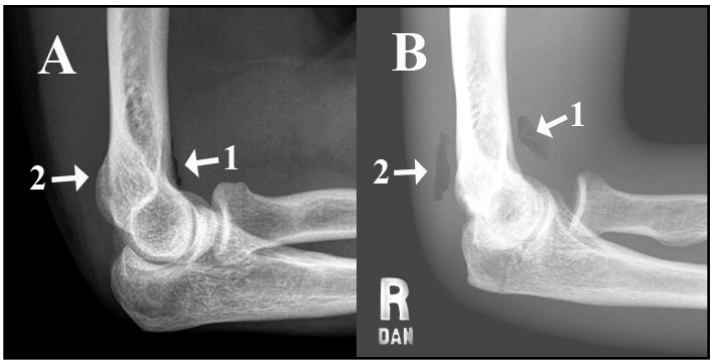


**Fig. 1.** *A. Normal fat pad signs. 1. Anterior fat pad sign. 2. Location of posterior fat pad, not visible on a correctly positioned lateral elbow. B. Abnormal fat pad signs demonstrating digitally enhanced fat pads. 1. Anterior fat pad "sail sign." 2. Posterior fat pad sign.*


**Fig. 2.** *Sitting 45° axial lateromedial projection, patient positioning and resulting image.*

*Nontraditional Methods*

Some authors suggest that a positive fat pad sign could be indicative of an occult fracture and that nonroutine methods are needed to demonstrate fractures.[5,6] A subtle radial head fracture is 1 such example. This type of fracture can be hard to demonstrate because of the overlapping nature of the radial head and ulna on an anteriorposterior projection. This is further complicated for a patient who cannot extend the elbow joint. Obtaining the traditional external oblique can prove frustrating and difficult for the radiographer to position. As a result, axial lateral projections are beneficial in this type of scenario.

Furthermore, a review of the literature suggests several alternate methods of obtaining radiographs of the radial head.[5,7-11] This article describes 3 such nontraditional projections. The advantages of these axial lateral projections are:

- They do not require complete extension of the elbow joint.
- They can be performed with the patient in a sitting or recumbent position.
- They can be performed in the emergency department with a portable x-ray machine.

The benefit is that each demonstrates the radial head without superimposition of the ulna.

## Methods

*Sitting Axial Lateromedial Projection (Coyle Method[7,8])*

The patient should be seated on a chair at the end of the examination table on which the imaging receptor (IR) is placed. If possible, the elbow is flexed 90°. Exact 90° flexion is not necessary. Also, the palmar surface of the hand is in contact with the imaging receptor and table top. The x-ray tube is angled 45° in a lateromedial projection with the central ray (CR) directed to the mid-elbow joint. (See Fig. 2.) The resulting radiograph separates the radius from the ulna, displaying the radial head without superimposition. The radial head is slightly distorted due to the angle of the CR with respect to the joint and the IR.

*Recumbent Axial Lateromedial Projection (Coyle Method[7])*

This is the same position as the previous projection,


**Fig. 3.** *Recumbent 45° axial lateromedial projection, patient positioning and resulting image.*

but with the patient recumbent instead of erect. If possible, the elbow is flexed 90°. Again, exact 90° flexion is not necessary. The palmar surface of the hand faces the IR. The x-ray tube is angled 45° in a lateromedial projection with the CR directed to the mid-elbow joint. The resulting radiograph separates the radius and ulna, displaying the radial head without superimposition. (See Fig. 3.) Once more, the radial head is slightly distorted due to the angle of the CR with respect to the joint and the IR.

*Sitting Axial Mediolateral Projection*

The patient should be seated on a chair at the end of the examination table on which the IR is placed. The arm is brought slightly forward so that the elbow is at an angle of greater than 90°. The dorsal side of the forearm is placed against the IR, and the CR is directed at a 45° mediolateral projection centered to the mid-elbow joint. (See Fig. 4.) The radial head is free from superimposition with the ulna. The capitellum and trochlea are distorted due to the angle of the CR.

## Discussion

Conventional radiography of the traumatized elbow does not always succeed in demonstrating subtle fractures of the radial head. A positive fat pad sign may warrant further evaluation. Because it is often difficult to perform traditional oblique projections in patients who have limited mobility, the nontraditional projections presented in this article may be valuable in some instances. The erect and recumbent axial lateral projections are uncomplicated to perform and require minimal movement by the patient. Additionally, the radial head is sufficiently demonstrated without superimposition of the ulna. These positions are of value for patients that cannot move the arm sufficiently for traditional radial head capitellum views.

The sitting axial mediolateral projection is interesting in that it can be performed without the need to extend the arm fully. Tomás described this position for evaluation of the coranoid process with the opposite CR angle.[10] The radial head modification demonstrated in this article is an adaptation of this projection.


**Fig. 4.** *Sitting 45° axial mediolateral projection, patient positioning and resulting image.*

Realistically, it can be performed on a patient with an arm sling, yet who is able to abduct the elbow from the body enough to assume the position. The advantage of this position over the previous positions is that both the radial head and coronoid process can be visualized by taking 2 projections angled 45° contralaterally; 1 mediolateral projection is taken for the radial head and 1 lateromedial projection for the coronoid process.

The positions described in this article may be useful to radiographers performing examinations of the traumatized elbow. Realistically, occult fractures will most likely be referred to magnetic resonance imaging or nuclear medicine departments. Regardless, these positions are atypical and add to the repertoire of a seasoned radiographer. ◆

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