

# How to screen a paediatric elbow X-ray for injuries

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## Abstract

Elbow injuries are common in the paediatric population. Diagnosing these injuries relies on X-rays taken on initial presentation in the emergency department. Interpreting these radiographs can occasionally be challenging, partly because of the sequential appearance of secondary ossification centres in the paediatric elbow. We propose a methodical approach that would help a clinician identify these injuries, especially the radiographically subtle ones. Evaluating these X-rays should start with a lateral view which identifies the majority of elbow injuries. Anterior cortical disruption, fat pad sign, and the anterior humeral line can be evaluated on this view, and if present, alerts the clinician to a possible subtle fracture. On this view also, the clinician can evaluate the radio-capitellar line and then proceed to evaluate it again on the anteroposterior view. With this approach almost all fractures and dislocations around the elbow can be identified.

**Keywords:** Humeral supracondylar fractures, elbow, anterior cortical disruption, anterior humeral line, fat pad, radio-capitellar line

## Introduction

### Anatomy of the Elbow

The elbow joint is a complex pivot-hinge synovial joint that connects the arm to the forearm. It functions primarily as a lever for appropriate placement of the hand in space. In children, the appearance of secondary ossification centres of the bones around the elbow is also complex. There are six centres that develop at the distal humerus, the proximal radius, and the proximal ulna. These ossification centres start to appear in a predictable sequence.<sup>[1]</sup> It is important to take note of these centres when interpreting a paediatric elbow X-ray.

### Plain Radiographic evaluation of a paediatric elbow

Plain radiography is a very useful tool in investigating an injured paediatric elbow. Conventional anteroposterior and lateral views almost always provide satisfactory conclusions in trauma scenarios. It should be ensured that the X-rays provided represent true anteroposterior and lateral views to guarantee an accurate interpretation. In many cases, fractures and dislocations around the elbow are clearly demonstrable on these views. The following is a proposed systemic approach to evaluate an elbow trauma X-ray in a child, with proper emphasis on radiographically subtle injuries.

### Look for an anterior cortical disruption

The lateral view of an elbow radiograph usually provides an excellent image for the diagnosis of a humeral supracondylar fracture in most children. In some minimally displaced injuries, identifying the fracture line on a radiograph can be a challenge. As a first step, the clinician should inspect on a lateral view the anterior cortex of the humerus for any disruption in cortical continuity. Most humeral supracondylar fractures are diagnosed at this stage. See figure 1.

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### Look for a positive fat pad sign

There are two pads of adipose tissue located inside the elbow joint, abutting the anterior and posterior aspects of the distal humerus. The anterior fat pad is visible in normal elbow radiographs. The posterior fat pad is located deep between the humeral condyles, in the olecranon fossa, and consequently is not seen in normal lateral elbow radiographs. In the event of an elbow capsular distension, as in a case of a haemarthrosis secondary to an intra-articular fracture, both pads are displaced. The anterior fat pad appears elevated while the posterior pad is displaced from its deep-lying location into prominence posteriorly. Appearance of a posterior fat pad on lateral elbow X-rays may be the only clue to an elbow injury. Its presence should prompt the clinician to meticulously scrutinize the X-ray for a subtle fracture.<sup>[2]</sup> Figure 2.

### The anterior humeral line

In a true lateral elbow X-ray view, a line drawn along the anterior humeral cortex should pass through the middle third of the capitellum of an uninjured elbow. In children younger than 4 years this line may pass through the anterior or posterior thirds of the capitellum.<sup>[3]</sup> It should never pass anterior or posterior to the capitellum in the absence of an angular displacement typical of a humeral supracondylar fracture.<sup>[4]</sup> In an extension type humeral supracondylar fracture, the capitellum is situated posterior to this line. (Figure 3). In the relatively rare flexion type humeral supracondylar fractures, the capitellum is displaced anterior to this line.

### The Radio-capitellar line

A line drawn along the long axis of the radius should pass through the centre of the capitellum in anteroposterior, lateral, and oblique views of an elbow X-ray.<sup>[5]</sup> The radio-capitellar line deviates away from the capitellum if the radio-capitellar joint is dislocated. (Figure 4)

### Discussion and Conclusion

Evaluating a paediatric X-ray for injuries can be challenging. This is mainly due to the appearance and fusion of the different ossification centres as the child grows. A stepwise methodical approach to evaluating these X-rays would ensure that the majority of skeletal injuries around the elbow are identified. We recommend that the lateral view of an elbow X-ray should be examined first. At this stage the clinician should screen the X-ray for an anterior cortical disruption. If a fracture is not clearly demonstrated at this stage, and while still examining the lateral view, the clinician should look for a posterior fat pad sign. Appearance of a posterior fat pad sign usually signifies the presence of a humeral supracondylar fracture and should prompt the clinician to scrutinize carefully the X-rays for these injuries.



Figure 1. Anterior cortical disruption (black arrow). (Credit: Grayson DE. *The Elbow : Radiographic Imaging Pearls and Pitfalls. Semin Roentgenol. 2005;40(3):223–47. 0037-198X/05*)



Figure 2. Anterior (white arrow) and posterior (black arrow) fat pad signs in a radiographically subtle humeral supracondylar fracture. (Credit: Grayson DE. *The Elbow : Radiographic Imaging Pearls and Pitfalls. Semin Roentgenol. 2005;40(3):223–47. 0037-198X/05*)

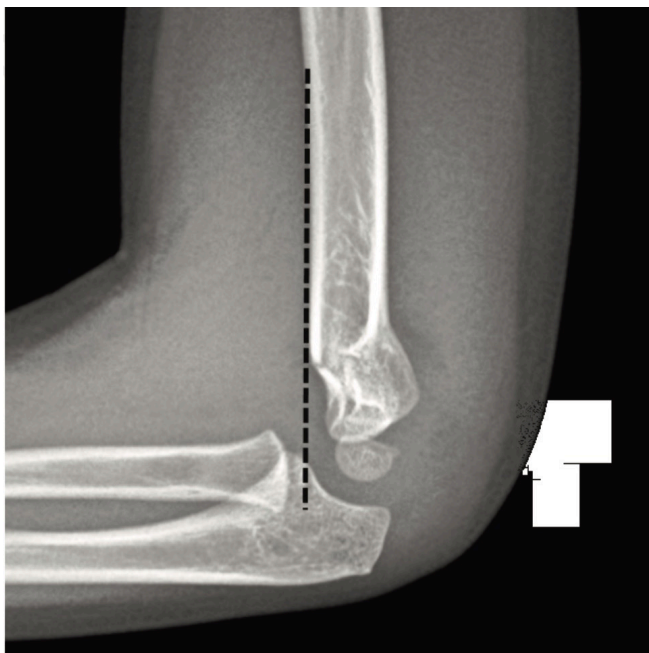


Figure 3. A lateral elbow X-ray showing the anterior humeral line in a humeral supracondylar fracture. (Credit: DeFroda S, Hansen H, Cruz JR A. Radiographic evaluation of common pediatric elbow injuries. *Orthop Rev.* 2017;9(1):7030.

While still examining the lateral X-ray radiographs, the clinician should evaluate the anterior humeral line. The radio-capitellar line could also be drawn on this view at this stage. The clinician then transitions to the anteroposterior view and again evaluates the radio-capitellar line on this view. At this point we believe that all fractures and dislocations around the paediatric elbow should be demonstrated reliably. Lastly, but not the least, if still in doubt, an X-ray of the opposite elbow would provide a comparison template to help rule out an elbow injury.

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Figure 4. An AP view of the elbow showing a disrupted radio-capitellar line in an elbow physal separation (Credit: DeFroda S, Hansen H, Cruz JR A. Radiographic evaluation of common pediatric elbow injuries. *Orthop Rev.* 2017;9(1):7030.)