

The Pediatric Elbow – Trauma – The Radiograph Revisited

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Because the pediatric elbow has many secondary growth centers, any of which might be displaced from trauma, and because the elbow is frequently injured in childhood, secondary signs on radiographs may aid in deciding whether or not fracture or dislocation may be present. The keys to interpretation of the pediatric elbow plain radiographs are 2 fat pads (anterior and posterior, on a 90 degree flexion lateral image) and 2 lines (the radius-capitulum line (on all images) and the anterior humeral line (on lateral images of the humerus)).

A téma fontosságát aláhúzza, hogy a könyökizületben számos másodlagos növekedési centrum van, melyek traumán sérülhetnek. Gyermekeknél gyakori esemény a könyökizület traumája. A röntgenfelvételeken látható másodlagos jelek fontos segítséget nyújtanak a döntési folyamat során. Egyrészt azt kell eldönteni: van-e törés, vagy nincs. Másrészt törés esetében diszlokáció állhat fenn. A képelemzésnek ki kell terjednie az intraarticularis elülső és hátulsó zsír-testekre is. Ezek 90 fokos flexióban oldalirányú felvételeken itélhetők meg. További fontos morfológiai vonalak a radius fejecsének vonala, mely minden irányból ábrázolódik. Oldalirányú felvételen látható még az elülső humeralis vonal is.

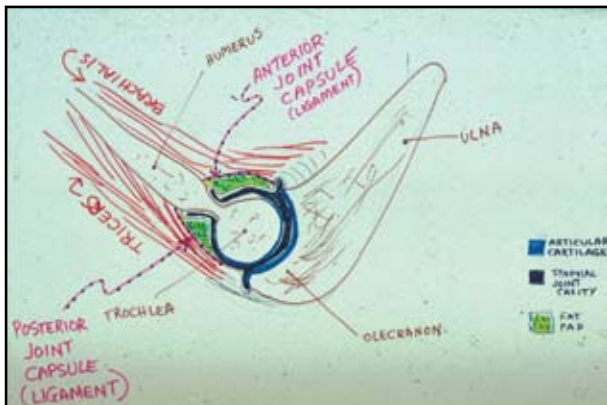


Figure 1. Diagram to demonstrate the anterior and posterior fat pads at the elbow (90 degree flexion lateral), after Cunningsham's Manual of Practical Anatomy. The posterior fossa of the distal humerus is deep, so that the fat external to the elbow joint normally remains in the fossa in this position. If the joint is swollen (from blood or infection fluid), the fat is pushed posteriorly and can be seen as a positive posterior fat pad sign, interfacing with the soft tissue density triceps. The anterior fossa is quite shallow, so the anterior fat external to the elbow is normally seen adjacent to the bone. It is pushed further from the bone when the joint is swollen, causing a positive displaced anterior fat pad sign. All three of the elbow bones are within the joint capsule, so fracture of any one or more of them results in a positive fat pad sign.



Figure 2. A. The positive posterior fat pad sign (arrowhead) after trauma suggests strongly that a fracture of at least one of the three bones is present. The anterior fat pad is also slightly displaced forward. Therefore, one should seek carefully for the fracture. In fact, the anterior tip of the coronoid process of the ulna is fractured and displaced to lie over the anterior metaphysis of the radius (arrow). B. An enlargement in slightly different position shows the olecranon tip fracture (arrow).

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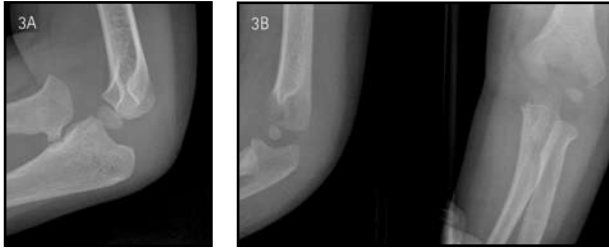


Figure 3. A. In this elbow radiograph, a positive posterior and a positive anterior fat pads are seen, but no fracture can be found. B. followup radiographs a few weeks later shows humerus metaphyseal bone destruction from osteomyelitis. Joint infection is also a cause of positive elbow fat pad signs.



Figure 5. The radius-capitulum line (midshaft of radius) should traverse the capitulum in all projections. In this patient with congenital dislocation (and radioulnar near fusion) the line passes proximal to the capitulum.



Figure 4. The anterior humeral line (shown in white) along the anterior shaft of the humerus on a lateral image should travel through the middle third of the capitulum (C). Here it traverses the anterior third of the capitulum in an elbow with a supracondylar fracture.



Figure 6. A. The radius dislocation of a Monteggia fracture may be missed if the elbow is not included on the radiograph, as in this image. B. The dislocation was detected and the elbow temporarily casted. Note the radius-capitulum line is much too anterior.



Fig. 7. In this 4 day old baby, the radius-capitulum line is directed away from the expected site of the cartilaginous capitulum, indicating a dislocation. Note also (small arrow) some avulsion of bone at the medial distal humerus.



Fig. 8. Fracture of the radius neck (arrow) is revealed on a frontal view that has the radius and ulna lying parallel to the plate; while the humerus is foreshortened, being flexed because of pain (and thus not parallel with the plate). The positive fat pads led to this additional, successful, view.



Fig. 9. Buckle fracture of the lateral radius neck (arrow) with subtle periosteal reaction from an injury over 10 days previously.



Fig. 10. Salter 2 or Salter 4 lateral condyle fracture of the humerus (arrow). Without MRI, one cannot tell if the fracture line extends through epiphyseal cartilage, which would make it Salter 4; if it does not so extend, it would be Salter 2.



Fig. 11. This lateral condyle fracture involves displacement of the capitulum (C) and a bit of adjacent metaphysis with considerable rotation in the coronal plane. Surgical correction, hopefully in timely fashion, is necessary.



Figure 12. A. A dislocation at the elbow is clearly evident, but a possible avulsed fragment is not as clearly seen. B. After reduction and casting, the avulsed fragment is seen (arrow) and is „trapped” in the elbow joint, requiring surgical correction. The postreduction images should always be done before casting, to rule out such a trap.



Figure 13. This fracture of the humerus lateral condyle is seen to traverse the medial capitulum (arrow), so that its being Salter 4 is evident on plain image.



Figure 14. „Look everywhere else!” In this 13 month old child, in addition to the lateral condyle fracture (long arrow), deformity from a prior midshaft fracture (at age 7 months) can be seen when one looks more proximally (short arrow). This is further evidence of child abuse in an infant who was returned originally to his home.



Figure 15. Fracture (arrow) of a supracondylar process in an 11 year old boy with an American football injury. The median nerve and artery lie near supracondylar processes. The process is a relatively uncommon normal variation.



Figure 16. The irregularity of the distal contour of the trochlear region (arrows) medial to the capitulum is indicative of a traumatic osteochondral lesion (in a vascular watershed area – see reference [1]).



Figure 17. Similar to the lesion of Figure 16 is a small fracture of the most medial capitulum.



Figure 18. Subtle transverse ulna fracture (arrow).

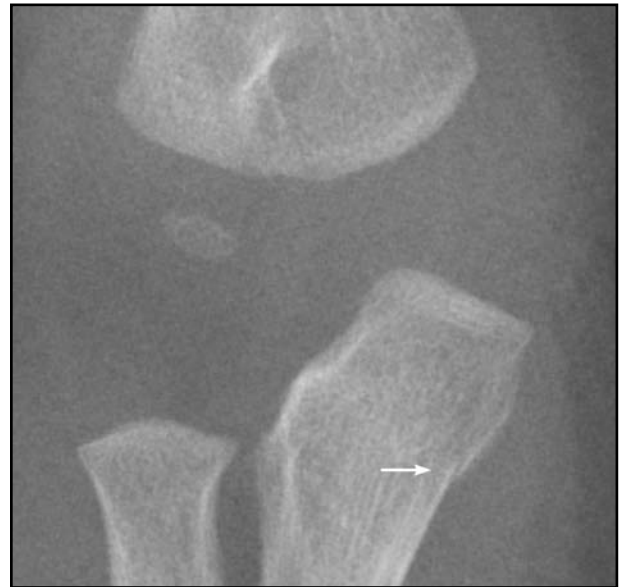


Figure 19. Subtle longitudinal ulna fracture (arrow). Attention to detail, especially if a fat pad or the anterior humeral line or the radius-capitulum line is abnormal, may assist the medical imager in locating and in diagnosing elbow fractures.

REFERENCES:

1. Marshall KW, Marshall DL, Busch MT, Williams JP. Osteochondral lesions of the humerus trochlea in the young athlete. *Skeletal Radiol* 2009; 38:479-491.
2. Oestreich AE, Crawford AH. *Atlas of Pediatric Orthopedic Radiology*. Thieme Verlag, Stuttgart and New York, 1985.