OCCULT ELBOW FRACTURES IN CHILDREN: SOME TIPS AND TRICKS TO READ RADIOGRAPHS

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ABSTRACT

Elbow traumatisms are very common in children. X-rays play important roles in the diagnosis but are sometimes difficult to read considering the quality, the normal variations of bone ossification and the type of fracture. The key to a better understanding of these fractures is first to differentiate normality from abnormality. The purpose of this report is to provide tricks and tips to help the reader when dealing with a child with an elbow traumatism.

The real problem is to miss a fracture that would need a surgical treatment. Simple geometric constructions and knowledge of the aspect of the different ossification steps of a growing elbow are sufficient. But there is no need to do comparative X-Rays. This report was focused on the X-rays but one must not forget the common sense and the clinical examination to orientate the diagnosis. Finally, in cases where the X-ray is thought to be normal, a cast immobilization and evaluation 10 days after the traumatism is necessary.

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INTRODUCTION

Elbow traumatisms are very common in children. X-rays play important roles in the diagnosis but are sometimes difficult to read considering the quality, the normal variations of bone ossification and the type of fracture. The key to a better understanding of these fractures is first to differentiate normality from abnormality. The purpose of this report is to provide tricks and tips to help the reader when dealing with a child with an elbow traumatism.

FIRST, LET US DESCRIBE THE NORMALITY [1]

From birth to skeletal maturity, X-ray changes and normal variations of bone ossification of the elbow need to be understood. At birth, only the distal humeral metaphysis is ossified **(Figure 1)**. Then the elbow ossification progressively appears: at 2 years, the capitellum is ossified **(Figure 2)**, at 4 years, it is the radial head **(Figure 3)**, at 6 years, it is the medial epicondyle **(Figure 4)**, at 8

years, it is the trochlea **(Figure 5)**, at 10 years, it is the olecranon **(Figure 6)** and finally at 12 years, it is the lateral epicondyle **(Figure 7)**.

Different lines and geometrical constructions on the X-ray may also help to detect an anomaly. The most important features are described hereafter:

- On the lateral view, the anterior flexion of the distal humerus is between 30 and 40° **(Figure 8)**.
- The Storen construction: whatever the view on the X-rays, the axis of the radial diaphysis crosses the center of the capitellum: this point is very important for the diagnostic of dislocation of the radial head **(Figure 9)**.
- On the lateral view, the line of the anterior cortex of the humeral diaphysis crosses the middle of the capitellum **(Figure 8)**.
- The angle of Baumann: on an AP view, it is the angle between the line, which passes by the middle of the humeral diaphysis, and the one that passes through the growth plate at superior part of the capitellum. The angle is normally 72° ± 5° **(Figure 10)**.
- On an AP view: the line who is in the prolongation of the medial cortex of the humerus has to almost touch the superior part of the medial epicondyle **(Figure 11)**.

With these tools we are now able to proceed to the analysis of abnormal X-Rays. Two important signs need to be sought in all cases of elbow traumatism. The first sign is hemarthrosis. When there is blood in the joint, the capsule is distended. On a lateral view the distention of the capsule induces a modification of the position of the fat density triangle at the anterior part of the joint **(Figure 12)**. The second sign is the edema. On an AP view the soft tissues close to the fracture are filled with hematoma and edema, which causes a differentiation of the soft tissues density **(Figure 13)**. These two signs are very important in cases of occult fractures.

We are now armed to describe the different types of fractures of the elbow in children. But we will only focus on difficult diagnosis.

The supracondylar fractures

Supracondylar fractures are very frequent. Many are very displaced and the diagnosis is easy. Two types of supracondylar fracture are difficult to diagnose: supracondylar fracture with anterior flexion of the distal fragment and the non or slightly displaced supracondylar fracture in extension **(Figures 14-15)**. In these two cases, the hemarthrosis sign is positive and on the tip is to use the geometrical constructions.

The medial epicondyle fracture [2]

The medial epicondyle fracture is the second most common fracture after the supracondylar fracture. It is often associated with a dislocation of the elbow and the medial epicondyle fracture may be a sign of spontaneously reduced dislocation. Conversely, in case of an elbow dislocation a medial epicondyle fracture has to be sought.

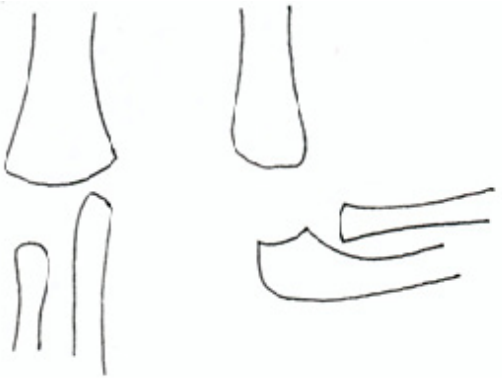

Figure 1: lateral and AP view of the elbow at birth showing that only the distal humeral metaphysis is ossified.

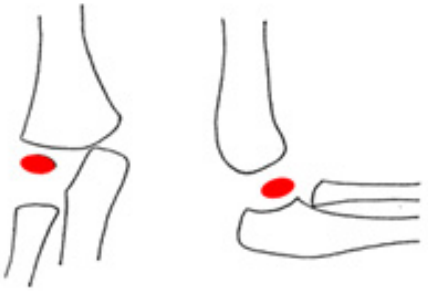

Figure 2: lateral and AP view of the elbow at 2 years showing the ossification of the capitellum.

Figure 3: lateral and AP view at 4 years showing the ossification of the radial head.

Figure 4: lateral and AP view of the elbow at 6 years showing the ossification of the medial epicondyle.

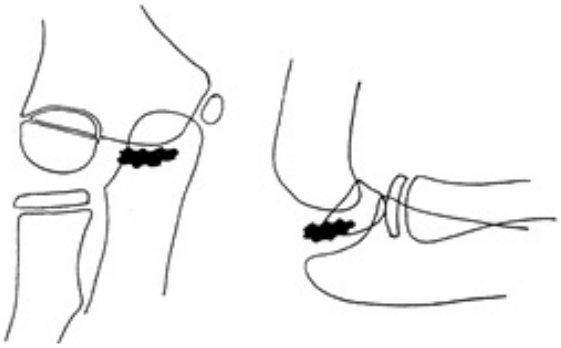

Figure 5: lateral and AP view of the elbow at 8 years showing the the ossification of the throchlea.

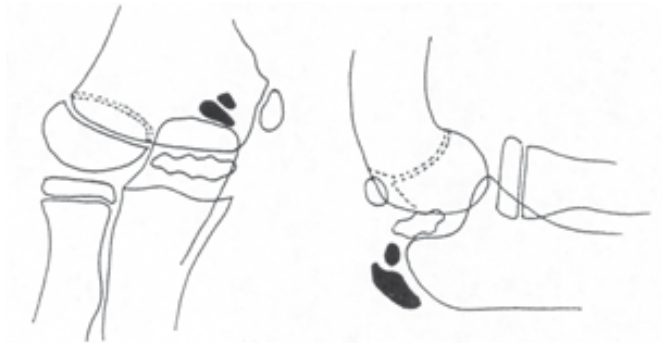

Figure 6: lateral and AP view of the elbow at 10 years showing the ossification of the olecranon.

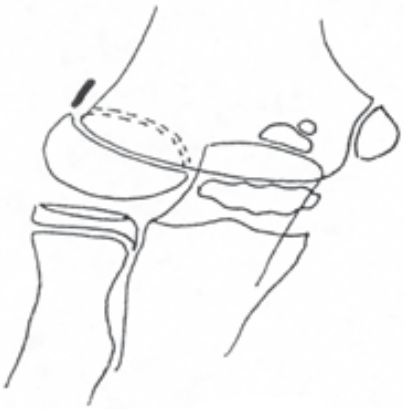

Figure 7: lateral and AP view of the elbow at 12 years showing the ossification of the lateral epicondyle.

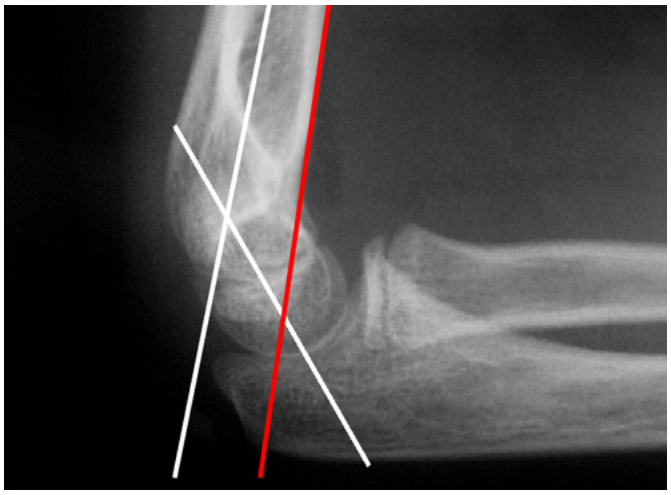

Figure 8: Lateral view of the elbow showing the anterior flexion of the distal humerus. The line of the anterior cortex of the humerus should always cross the center of the capitellum.

Figure 9: Lateral view of the elbow showing the Storen's construction.

Figure 10: AP view of the elbow showing the construction for the Baumann's angle.

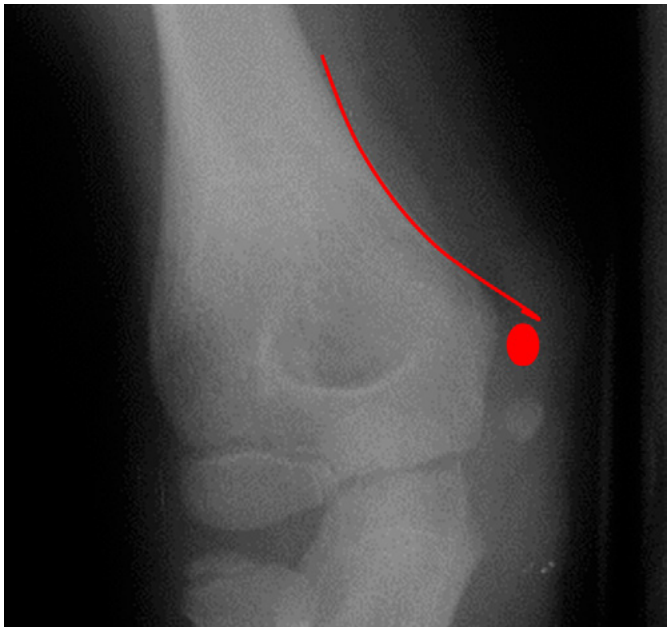

Figure 11: AP view of the elbow showing a medial epicondyle fracture. Note the edema and the constructed line of the medial cortex of the humerus. The medial epicondyle is too far under the line.

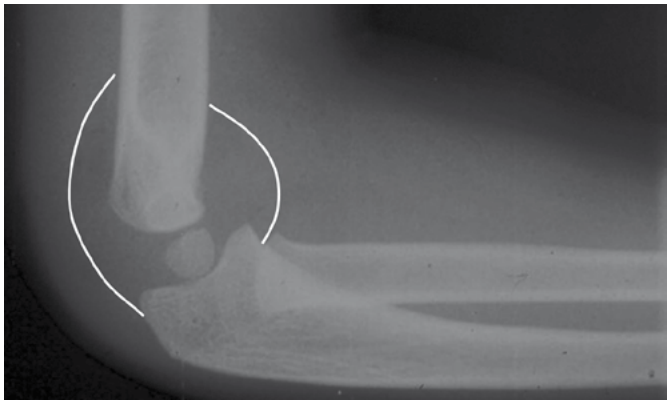

Figure 12: Lateral view of the elbow showing the anterior and posterior hemarthrosis.

Two signs may help the diagnosis of is this fracture on the AP view X-Ray: the edema and the position of the epicondyle in regard to the medial cortex of the humerus **(Figure 11)**. Before 6 years, there is no medial epicondyle ossification so the edema is the only sign of this type of fracture.

Fracture of the lateral condyle [3]

The diagnosis may be difficult and the displacement is often under estimated. It's an intra-articular fracture. The tip is to look for the edema and the hemarthrosis **(Figure 16)**.

Olecranon fracture

This fracture is less frequent that the one mentioned above. The pitfall is to confound the normal ossification of the olecranon that appears around 10 years and a real fracture. The differences are pictured in **figures 17 and 18.**

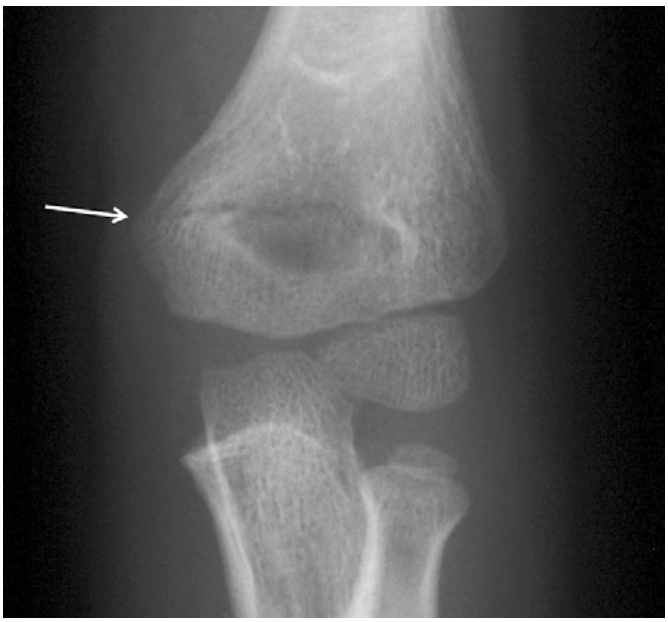

Figure 15: AP view of the elbow showing a supracondylar fracture stage 1.

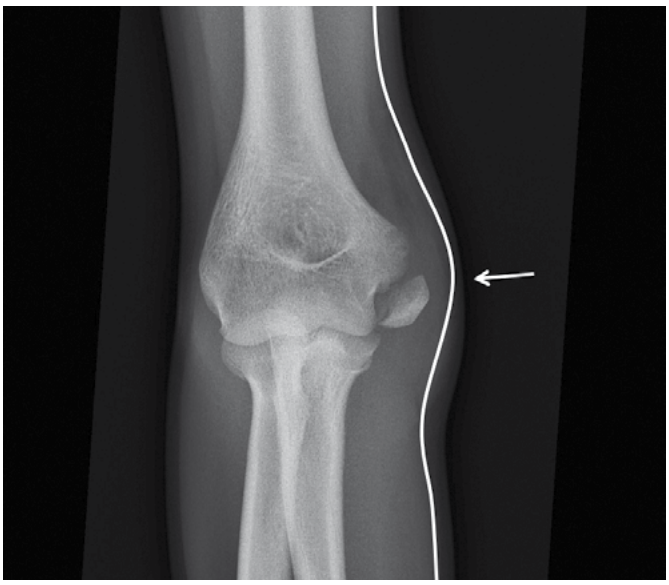

Figure 13: AP view of the elbow showing the edema at the medial side of the elbow with a fracture of the medial epicondyle.

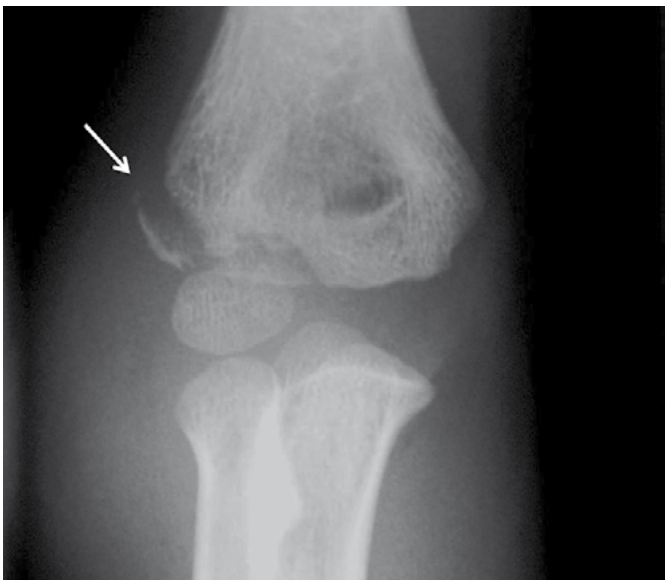

Figure 16: AP view of the elbow showing a lateral condylar fracture.

Figure 14: Lateral view of the elbow showing a supracondylar fracture stage 1. Note the hemarthrosis.

Figure 17: Lateral view of the elbow showing a fracture of the olecranon.

The Monteggia's lesion [4]

It is one of the main pitfalls in the field of elbow traumatism in children. It's an ulna's fracture associated with a dislocation of the radial head. The problem is that the ulna's fracture is not always evident. It can be a plastic deformation. Thus, it is mandatory to focus on the diaphyseal axis of radius, which always crosses the capitellum. So when there is a fracture of the ulna, it is essential to look for a radial head dislocation on the lateral and AP views **(Figure 19)**.

Elbow dislocation

Elbow dislocation is a common lesion. As mentioned above, there is a medial epicondyle fracture in almost 50% of the cases. But other associated lesions need to be sought. Sometimes small "chips" fractures may hide a coracoid lesion, a radial head fracture or any osteo-chondral lesion. In case of an associated bone lesion a CT-Scan may help making the diagnosis. But, it is often necessary to open the joint to either remove the osteochondral fragment or fix it. Before two years, the elbow dislocation does not exist: it is always a humeral supracondylar fracture.

Radial head/neck fracture

The radial head fracture is sometimes difficult to diagnose because a hemarthrosis may be absent. However, a small greenstick fracture is easily found **(Figure 20)**.

CONCLUSION

Elbow traumatisms in children are frequent. The above trick and tips may help anyone make the diagnosis. In fact, the real problem is to miss a fracture that would need a surgical treatment. But there is no need to do comparative X-Rays. Simple geometric constructions and knowledge of the aspect of the different ossification steps of a growing elbow are sufficient. This report was focused on the X-rays but one must not forget the common sense and the clinical examination to orientate the diagnosis. Finally, in cases where the X-ray is thought to be normal, a cast immobilization and evaluation 10 days after the traumatism is necessary. Sometimes, the physical examination is more accurate and the diagnosis may be performed.

Figure 18: Lateral view of the elbow showing normal ossification nucleus of the olecranon

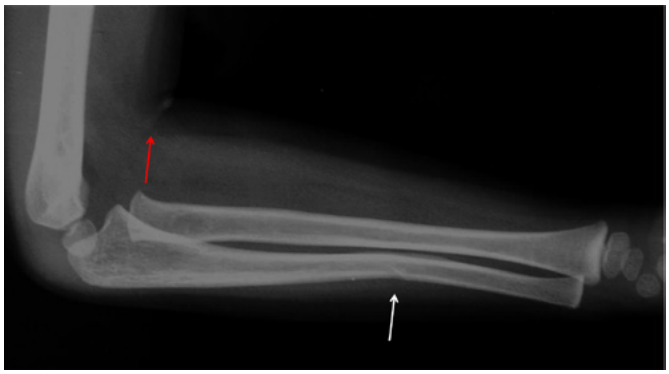

Figure 19: Lateral view of the elbow showing a Monteggia's lesion. Note that the diaphyseal axis line of the radius does not cross the capitellum.

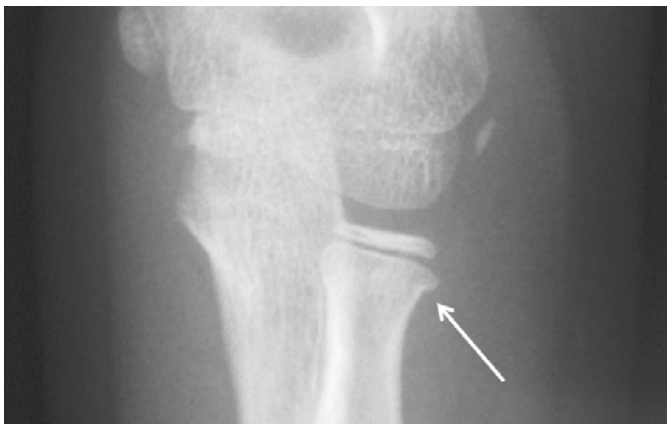

Figure 20: AP view of the elbow showing radial head fracture

REFERENCES

1. Ducou le pointe, H. Imaging of elbow trauma. Traumatologie du coude de l'enfant. Cahier d'enseignement de la SOFCOT. Paris: Expansion Scientifique Français 2000; 72:12.
2. Guillard, S. Fracture of the medial epicondyle of the elbow. Traumatologie du coude de l'enfant. Cahier d'enseignement de la SOFCOT. Paris: Expansion Scientifique Français 2000; 72:12.
3. Langlais, J. Fractures of the lateral condyle of the elbow. Traumatologie du coude de l'enfant. Cahier d'enseignement de la SOFCOT. Paris: Expansion Scientifique Français 2000; 72:65.
4. Bronfen, C. Recent Monteggia fracture. Traumatologie du coude de l'enfant. Cahier d'enseignement de la SOFCOT. Paris: Expansion Scientifique Français 2000; 72:157.