

ACCIDENT & EMERGENCY RADIOLOGY

A SURVIVAL GUIDE

SECOND EDITION

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5 ELBOW

BASIC RADIOGRAPHS

- AP in full extension
- Lateral with 90° of flexion
- **Optional** – but routine in some departments – the radial head–capitellum view.¹ This view projects the proximal radius away from the other bones. It is an excellent view for evaluating the radial head. **Technique:** the patient is positioned as for the lateral view but the tube is angled 45° to the joint.

ANATOMY

ANTEROPOSTERIOR PROJECTION

- The olecranon is obscured by the humerus (Fig. 5.1)
- The capitellum is lateral and articulates with the radial head
- The trochlea is medial and articulates with the ulna
- **Note:** the internal epicondyle in children can be normal but seemingly widely separate from the humerus. However, when normal, its lateral border is always parallel to the cortex of the adjacent humeral metaphysis.



Figure 5.1 Normal AP and lateral radiographs. The normally positioned anterior fat pad (arrows) is slightly darker than the surrounding muscle.

LATERAL PROJECTION – THE BONES

- The capitellum and trochlea are superimposed
- The radiocapitellar line (Figs 5.2, 5.3) passes through the capitellum
- The anterior humeral line (Fig. 5.4) should have at least one third of the capitellum anterior to it.

LATERAL PROJECTION – THE SOFT TISSUES

- **Elbow fat pads.** There are two pads of fat related to the distal humerus – anterior and posterior. They are extrasynovial but intracapsular. The fat is in contact with the joint capsule.
 - Fat is seen as a darker streak in the surrounding grey soft tissues
 - The anterior fat pad will be seen in most (but not all) normal elbows and is characteristically closely applied to the humerus (Figs 5.1, 5.5)
 - The posterior fat pad is not visible in the normal elbow
- **Supinator fat stripe.** A linear strip of fat overlies the supinator muscle and is positioned anterior to the radial head and neck. It is often claimed that, if this stripe is displaced or obliterated, then there is haemorrhage in the deep soft tissues. A definite association with an occult fracture remains unproven.

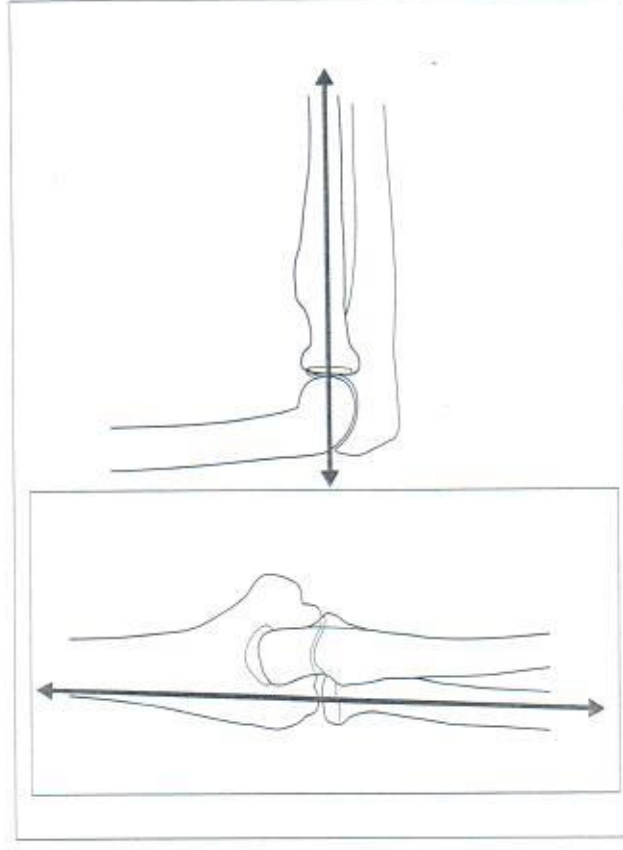


Figure 5.2 Normal radiocapitellar line on the AP and lateral projections.

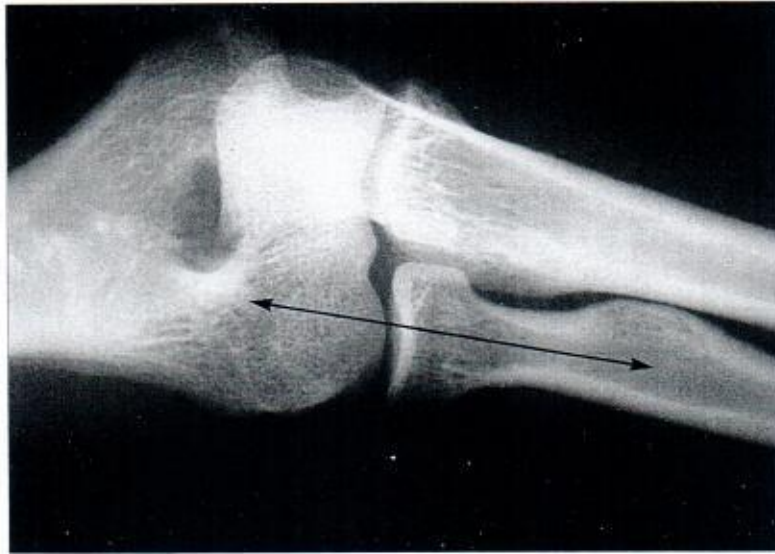


Figure 5.3 The normal radiocapitellar line. Note: on the AP view the line is drawn along the centre of the proximal portion of the radius.

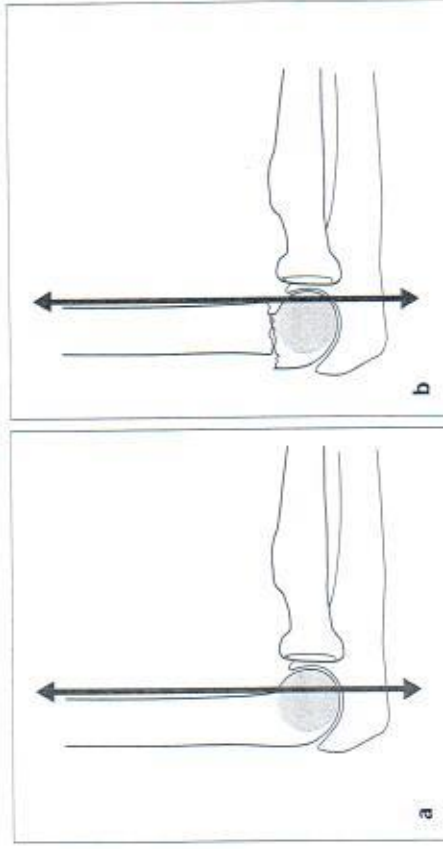


Figure 5.4 The anterior humeral line. (a) In most normal patients approximately one third of the capitellum (shaded) lies anterior to this line. (b) A supracondylar fracture often results in the distal fragment being displaced posteriorly, as a consequence less than one third of the capitellum may lie anterior to the line.

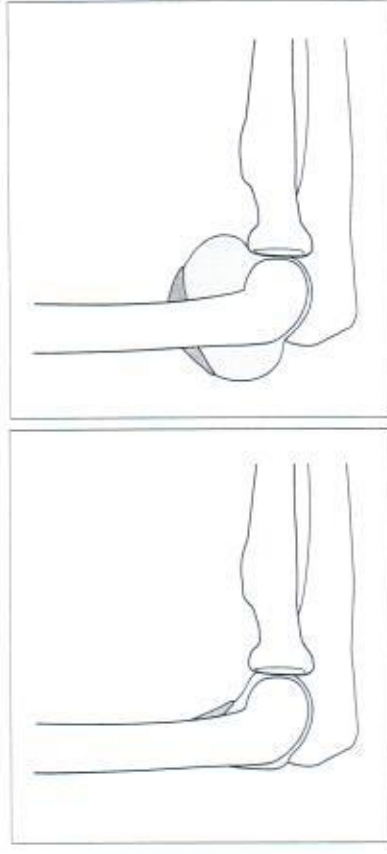


Figure 5.5 Position of the normal anterior fat pad (left). A large effusion displaces both the anterior and posterior fat pads away from the humerus (right).

INJURIES

- Fractures, dislocations and apophyseal avulsions can be subtle and will be overlooked unless a step-by-step approach is taken when assessing the radiographs.
- Pulled (or nursemaid's) elbow in a child. The history is typical – the extended forearm is pulled suddenly.
 - The injury is usually described as being caused by stretching of the annular ligament, which slips proximally on the radial head. Ultrasound² demonstrates that the injury is actually due to subluxation of the radial head on to the superior rim of a shallow depression in the adjacent ulna (Fig. 5.6). The conventional explanation that the proximal radius subluxes distally through a stretched annular ligament is mistaken. When treated by rapidly pronating and supinating the forearm the head of the radius relocates into the shallow depression on the lateral cortex of the ulna.
 - There are no radiographic abnormalities with a nursemaid's elbow. The diagnosis is clinical. Radiography is not indicated.

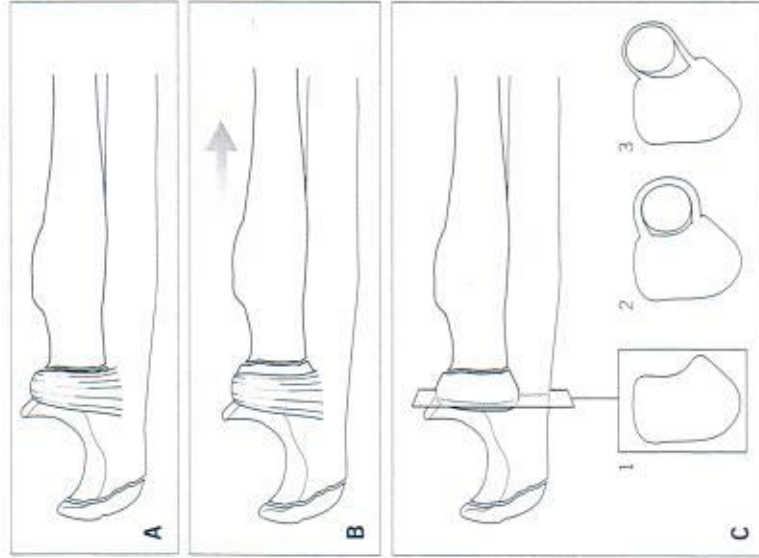


Figure 5.6 Pulled elbow / Nursemaid's Elbow. The usual theory is that the head of the radius subluxes distally under the annular ligament [A] and [B]. An ultrasound study² provides a different explanation [C]. A cross section at the level of the annular ligament demonstrates a shallow depression on the lateral margin of the ulna (1). The normal anatomy is shown in (2). A pulled elbow injury causes the head of the radius to perch on the anterior rim of the ulnar depression [3]. This ventral subluxation explains why a successful reduction is often preceded by a snap or a click which can be felt over the head of the radius; the click is caused by the head dropping back into its natural position alongside the ulnar groove.

STEP BY STEP ASSESSMENT OF THE RADIOGRAPHS

Most fractures around the elbow are readily identified (Fig. 5.7). The most common elbow fractures in adults involve the radial head or neck. The most common elbow fracture in children is a supracondylar fracture. Also, in children, fractures of the lateral condyle comprise approximately 20% of elbow fractures. If initial scrutiny does not show an obvious abnormality then the radiographs need to be re-examined using a precise and systematic approach.

- In adults – three questions to ask
- In children – ask a fourth question.



Figure 5.7 Fracture of the radial head. A common injury usually easy to detect.

QUESTION 1

Are the fat pads normal?

FAT PADS

- When a joint effusion is present it distends the capsule and displaces the fat pads away from the bone (Figs 5.5, 5.8)
- A visible anterior fat pad is normal but if displaced anteriorly (the SAIL sign) it is abnormal
- A visible posterior fat pad is always abnormal (Fig. 5.8). It denotes a large effusion
- Not all joint effusions are associated with a fracture.³ Nevertheless, in the context of trauma an effusion indicates that a significant injury has occurred even if a fracture is not seen
- If there is displacement of either of these fat pads then the arm needs to be placed in a collar and cuff until an orthopaedic assessment occurs a few days later. This cautious approach recognises the fact that some of these patients will have an undisplaced fracture.^{3,5}



Figure 5.8 A large effusion displaces the anterior and posterior fat pads.

Pitfall: Absence of a visible fat pad does not exclude a fracture. There are two possible explanations for this. The radial neck is usually extracapsular and thus a fracture of the neck may not produce a haemarthrosis and the fat pads will not be displaced. Alternatively, the joint capsule may rupture and the blood (haemarthrosis) drains from the joint.

■ QUESTION 2

Is the radiocapitellar line normal?

- The rule:** a line drawn along the longitudinal axis of the radial head and neck should pass through the capitellum (Figs 5.2, 5.3, 5.9–5.11).
- If this line does not pass through the capitellum then a dislocation of the radial head is probable
 - This rule is **always** valid on a true lateral film
 - Whenever there is a fracture of the shaft of the ulna the radiocapitellar line must be evaluated. There may be an associated dislocation of the radial head (Monteggia fracture dislocation). This Monteggia injury is particularly likely when there is angulation or displacement of the ulnar fracture (Fig. 5.11).

Pitfall: The radiocapitellar line can be affected by radiographic positioning. In children the rule is not always valid on the AP view because of eccentric ossification of the radial head or of the capitellar epiphysis. The radiocapitellar rule is best applied to a true lateral projection only.⁶

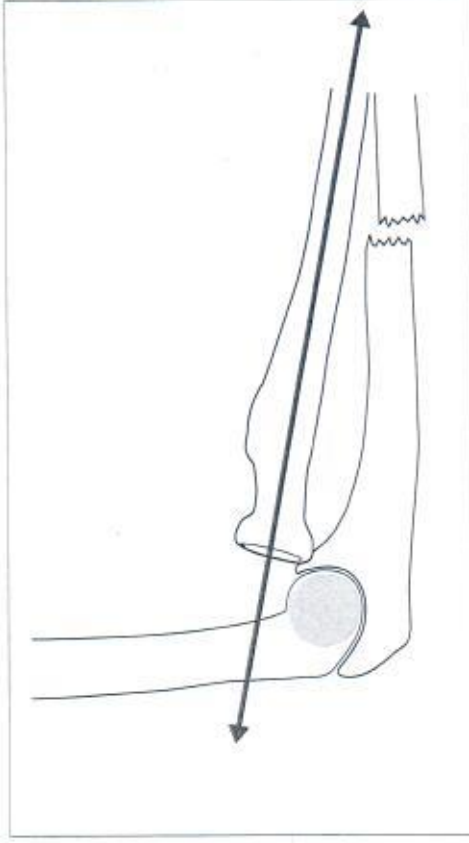


Figure 5.9 Abnormal radiocapitellar line. On the lateral view the line does not pass through the capitellum (shaded); this indicates that the head of the radius is dislocated.



Figure 5.10 The radiocapitellar line does not pass through the capitellum. This indicates that the radial head is dislocated. Note: in this patient the abnormal alignment is the result of a dislocation of the entire elbow joint.



Figure 5.11 Fracture of the shaft of the ulna with over-riding of the fragments. The radiocapitellar line indicates that there is a dislocation of the radial head. This injury is known as a Monteggia fracture dislocation.

QUESTION 3

Is the anterior humeral line normal?

The rule: in most patients a line traced along the anterior cortex of the humerus will have at least one-third of the capitellum anterior to it (Fig. 5.4).

- If less than one-third of the capitellum lies anterior to this line then there is the strong probability of a supracondylar fracture with the distal fragment (including the capitellum) displaced posteriorly (Figs 5.4, 5.12)
- A supracondylar fracture is the commonest elbow fracture in children aged 4–8 years. It is a serious injury. Vascular damage, nerve injury, malunion or elbow deformity are potential complications. Evaluation of the anterior humeral line will prevent some of these difficult-to-see fractures from being overlooked.

Pitfall: This rule is not always reliable in very young children when there is only partial ossification of the capitellum. Nevertheless, if the anterior humeral line appears abnormal and a supracondylar fracture is not identified then the opinion of an experienced observer should be sought.



Figure 5.12 Anterior humeral line. The AP view is normal. When the lateral view was assessed it was noted that the anterior humeral line did not have a third of the capitellum (arrow) in front of it. This led to further evaluation of both the AP and lateral films and the supracondylar fracture (arrowhead) was identified. Note the displaced posterior fat pad.

QUESTION 4: to be asked in all children

Are the ossification centres normal?

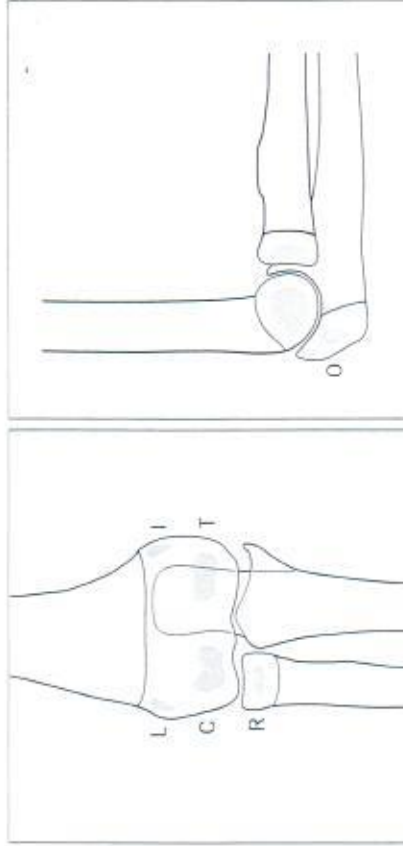


Figure 5.13 The normal ossification centres (dark shading) situated within the cartilaginous ends of the long bones. C = Capitellum; R = Head of radius; I = Internal epicondyle; T = Trochlea; O = Olecranon; L = Lateral epicondyle.

- At birth, the ends of the radius, ulna and humerus are present as lumps of cartilage that are not visible on a radiograph. The large empty gap between the distal humerus and the radius and ulna is normal
- During childhood, six separate ossification centres (Fig. 5.13) appear at various intervals (6 months to 12 years). Four of these centres belong to the humerus, one to the radius and one to the ulna (Fig. 5.14). The four humeral centres gradually ossify, enlarge, coalesce and eventually fuse to the shaft
 - The age at which each ossification centre appears is not important
 - The order (Fig. 5.14) in which the centres ossify is important
 - The acronym CRITOL gives the usual sequence in which the centres appear on the radiograph.

Table 5.1 Elbow ossification centres

Approximate age at appearance	Most common sequence
Birth	C apitellum
 12 years	R adial head
	I nternal (medial) epicondyle
	T rochlea
	O lecranon
	L ateral (external) epicondyle

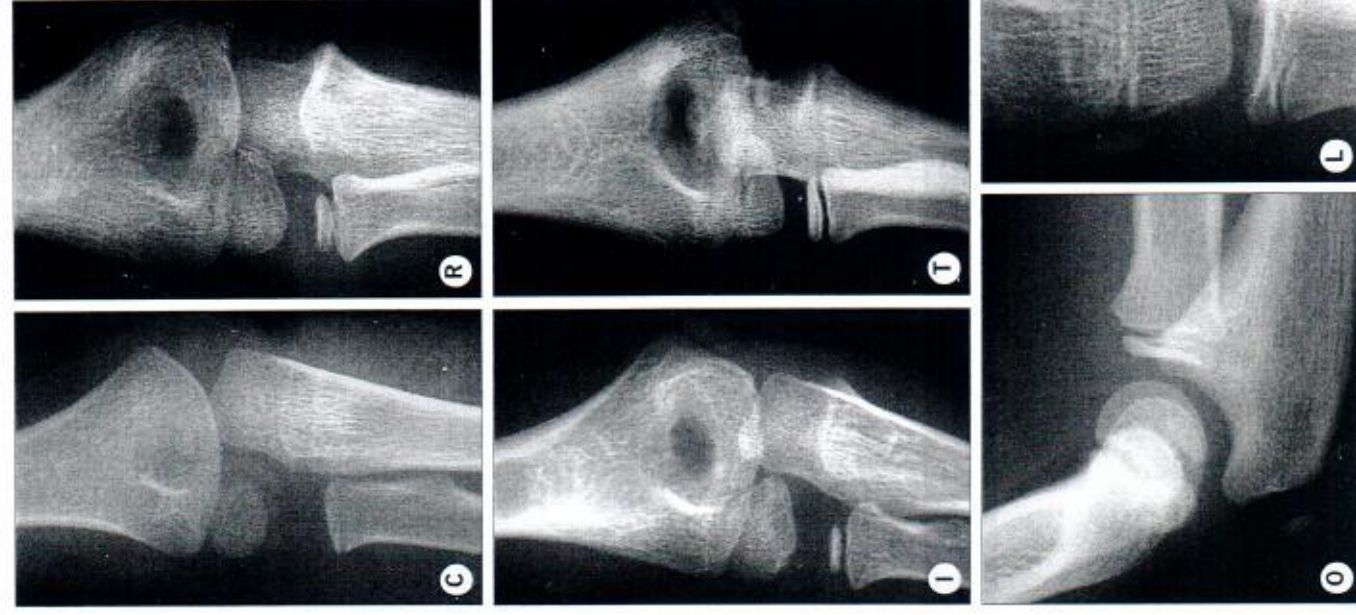


Figure 5.14

The sequence (**CRITOL**) in which the ossification centres usually appear on the radiograph.