

63 Forearm injury

63.1 Introduction

The conservative treatment of forearm fractures of adults is difficult, because the reduction is often unstable and leads therefore to re-displacement with bad results. Fractures of the forearm are mostly the result of a direct blow. If the forearm bones are broken, the muscles attached to the fragments displace them.

- (1) Either forearm bone can fracture alone.
- (2) Both can fracture simultaneously, usually in their middle $\frac{1}{3}$.
- (3) Either bone can fracture, and the upper or lower joint between them may dislocate simultaneously.

If the radius fractures & is displaced, the lower radio-ulnar joint will sublux (Galeazzi fracture).

If the proximal $\frac{1}{3}$ of the ulna fractures & is displaced, the head of the radius will dislocate anteriorly (Monteggia fracture).

These dislocations are easy to miss, so *always include the wrist & elbow in a forearm film*, particularly if the fragments are overlapped or angulated.

EXAMINING THE FOREARM

Palpate the whole of the subcutaneous border of the ulna & the lower $\frac{2}{3}$ of the radius. Squeeze the radius and ulna together in the lower part of the forearm. If this hurts, there is probably a fracture. Examine the radial head (62.1) (Monteggia fracture and the inferior radio-ulnar joint (Galeazzi fracture) to make sure they are not dislocated.

PRONATION AND SUPINATION

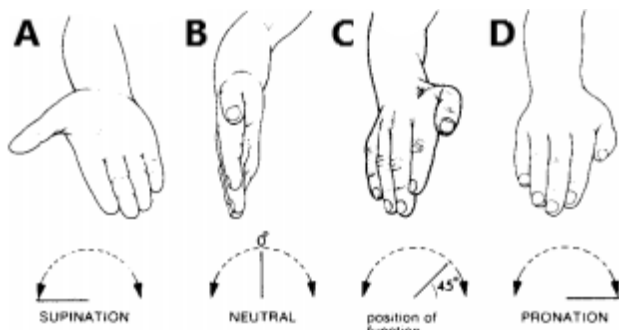


Fig. 63-1 FOREARM ROTATION. A, full supination. B, neutral position. C, position of function where the hand will be most useful if the forearm is in mid-pronation. D, full pronation. *Kindly contributed by John Stewart.*

Examine the elbow & the wrist. Test pronation & supination, as well as radial & ulnar deviation, flexion & extension. Test the circulation and sensation distally.

RADIOGRAPHS should include the wrist and a lateral view of the elbow. A line through the long axis of the radius should pass through the capitulum in both views (63-4).

X-RAY THE WRIST & THE ELBOW

It is best to treat most radial fractures and all fractures of both bones by open methods when skills and facilities are good. But if you are not a skilled surgeon, and your facilities are not perfect, closed methods are more likely to get a better functional result. External fixation is an alternative. Isolated ulnar fractures are easier to treat than radial fractures, because the muscles attached to the ulna are much less likely to displace its fragments.

LONG ARM CASTS

Use a long arm cast modified by varying the position of the wrist to suit the needs of particular fractures. If both bones are broken, gently squeeze the cast from front to back to correct the angulation of the fragments towards one another. A forearm cast is heavy, so hang it from the neck. otherwise its weight may re-displace the fragments or damage the radial nerve by pressing on it. Extend most forearm casts to above the elbow.

The 1st cast on a forearm fracture should always be a long arm cast. Apply a single layer of cotton wool to the arm, then put cotton pads over the bony points around the elbow, and in the antecubital fossa. Apply the cast from just below the shoulder to just proximal to the MCP joints. Hold the elbow at 90° and the thumb and fingers free. *The thumb must be free enough to touch the little finger.*

If the thumb is in abduction, it will be so stiff when you remove the cast as to be temporarily useless.

Apply the cast to the base of the thumb & knuckles and to the distal palmar crease. *If you apply it beyond this point, finger movement will be impossible.*

Adjust the rotation of the forearm as is best for each particular fracture (63.5). Take a narrow plaster bandage, mould a plaster eye over the centre of gravity of the cast, and tie it with a comfortable collar around the neck.

CAUTION! *Always split the cast.* Only when the swelling has gone (mostly >1wk) add a circular plaster bandage.

N.B. Instead, you can apply anterior & posterior slabs *but never overlap them!*

A LONG ARM CAST

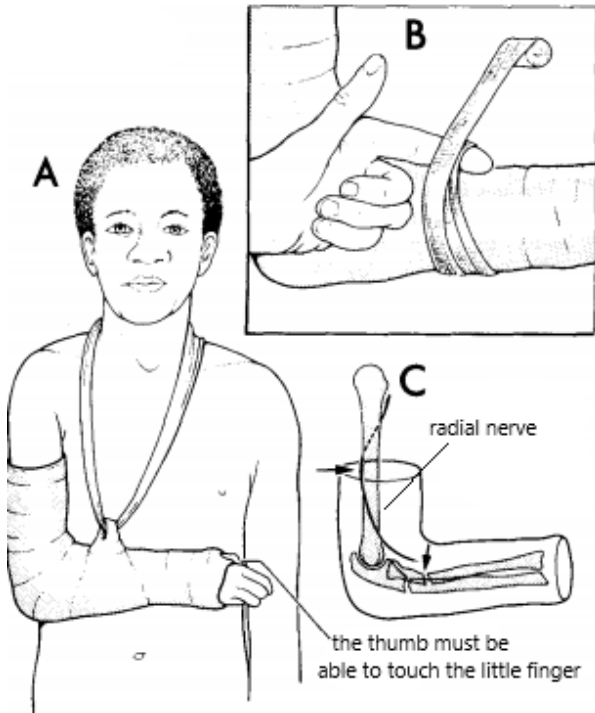


Fig. 63-2 A LONG ARM CAST. A, put a ring to suspend the cast. B, allow one finger breadth under the bandage so it is not too tight. C, avoid pressure on the radial nerve. *Make sure that the thumb is free and able to touch the little finger.* Kindly contributed by Peter Bewes.

63.2 Isolated ulnar shaft fracture

The fracture is usually complete and transverse, with minimal displacement. There may be slight angulation and bowing, but mostly there is neither shift, overlap nor rotation. The subcutaneous border of the ulna is tender and swollen over the fracture. These fractures are common and easy to miss. If tenderness over the bone persists after a few days, repeat the radiograph. Because the intact radius makes a good splint, it sometimes hinders displaced fracture healing, resulting in non-union.

TREATMENT

Make sure that the radial head is not dislocated (Monteggia fracture, 63.3) by including the elbow in a lateral radiograph.

ISOLATED ULNAR SHAFT FRACTURE

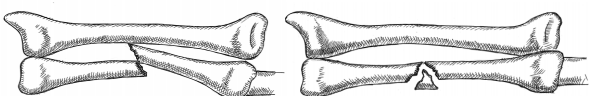


Fig. 63-4 ISOLATED ULNAR SHAFT FRACTURE. *Make sure that the head of the radius is not dislocated by including the elbow in a lateral radiograph.*

Apply a long arm cast & a sling to carry the forearm for 6wks. Then test for union by squeezing the radius and ulna together. **If there is tenderness**, the fragments have not yet united, so continue with a forearm circular plaster for another 4-6wks.

Don't use a collar & cuff as this will cause bowing of the ulna (63-3).

THE EFFECT OF A COLLAR & CUFF

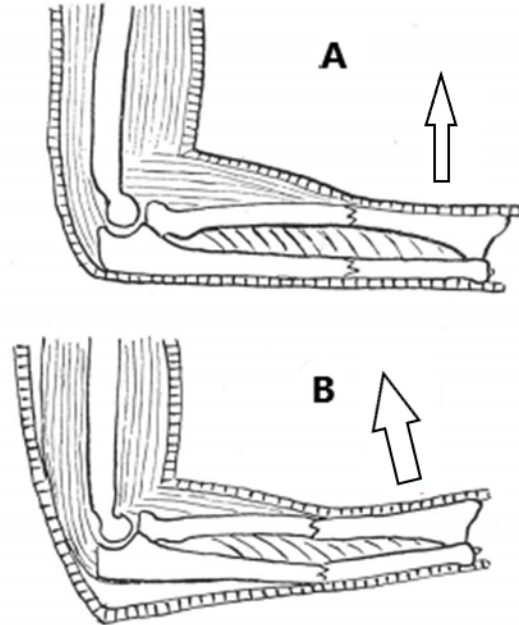


Fig. 63-3 USING A COLLAR & CUFF will cause the elbow to drop, whilst the wrist is held firmly in the cast. **Ulnar bowing will result and limit rotation.** After Charnley J, *The Closed Treatment of Common Fractures*. 3rd ed. E&S Livingstone, Edinburgh 1961

63.3 Monteggia fracture

Direct personal violence may result in this nasty adult fracture (it is otherwise a children's fracture, (73.7). The raised arm, protecting the head from a blow, receives its full force breaking the upper 1/3 of the ulna and dislocating the radial head. The important element is the latter. Rarely, the ulna does not break, or it may be overlapping (63-5).

If you suspect a dislocated radial head, take an AP & lateral view, because the dislocation may only be evident in the latter.

N.B. A line through the centre of the radius should pass through the centre of the capitulum in both views.

N.B. **If the ulnar fragments overlap**, either the radius is also fractured, or its head is dislocated.

Unless you reduce the dislocation of the radial head, the elbow will never be able to flex again. *Closed reduction is not always possible in adults.* The longer the delay, the more difficult is the reduction.

MONTEGGIA FRACTURE

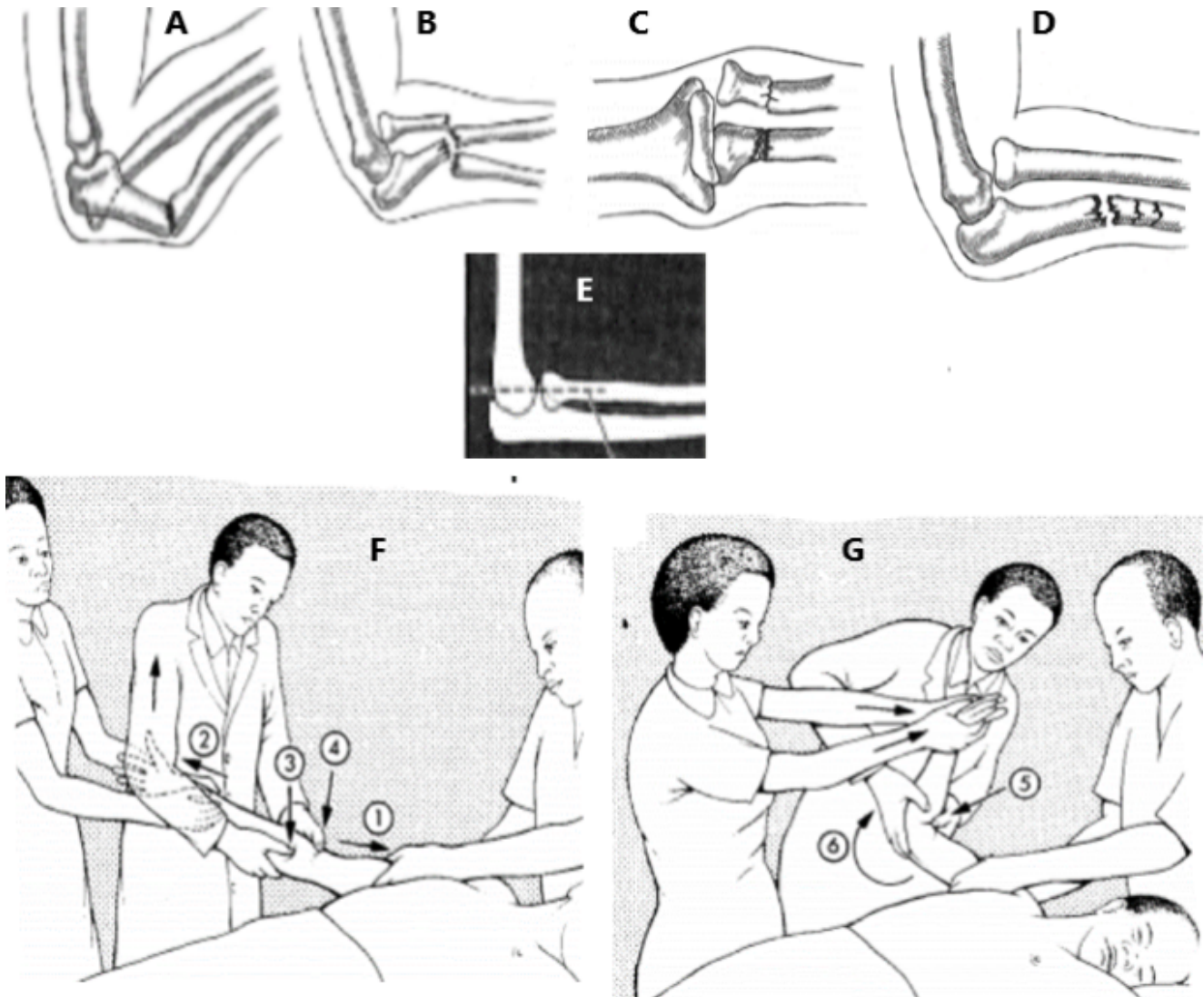


Fig. 63-5 MONTEGGIA FRACTURE. A, anterior ulnar displacement & anterior dislocation of the radial head. B, posterior ulnar displacement & posterior dislocation of the radial head. C, transverse ulnar fracture & lateral dislocation of the radial head. D, anterior displacement of ulna & radius, with anterior dislocation of the radial head. E, in a normal arm, a line through the radial head passes through the capitulum. F, while one assistant pulls on the supinated wrist (1), & another on the extended upper arm (2). Press the distal end of the proximal ulnar fragment (3), and the radial head into place (4). G, while still pressing the radial head (5), flex the supinated forearm (6). The radial head should reduce with a 'clunk' and the ulna should finally straighten completely as it does so. After de Palma AF, *Management of Fractures and Dislocations, An Atlas*, WB Saunders, 2nd ed 1970 with kind permission.

TREATMENT

Test sensation in the little finger.
Elevate the arm from a drip stand (63-10).
Under anaesthesia bend the radius back into place. This reduces the fracture and the distal radio-ulnar dislocation. *N.B. If the distal ulna is also fractured, the radial overlap will usually remain.*

Under GA, whether or not the ulna is fractured, with 2 assistants, manipulate & reduce the fracture-dislocation (63-5F).

Apply a long arm cast with the elbow at 90°, the arm in mid-supination, and the wrist in the functional position. Mould this to give a flat contour (63-9), and keep it on for 6wks

Then, remove it to test the stability of radius and distal radio-ulnar joint. If there is tenderness re-apply a cast for another 4wks.

Start finger and shoulder exercises immediately.

CAUTION! The head of the radius is unstable after this injury and can re-displace readily, so check radiographs at weekly intervals. Hang the slabs from the neck for 6wks, then remove them and start active & passive joint movement. don't *force this*, it may take months.

If reduction of the ulna or radial head fails or the presentation is late, open reduction is necessary.

If a Monteggia fracture is open, perform a careful wound toilet, and reduce the fragments into the best position you can. Apply an elbow crossing external fixator (59.5) or a backslab with a window for wound treatment. Provide skin cover by delayed primary closure or grafting.

63.4 Galeazzi fracture

These are rare, difficult fractures in adults, usually from falls onto the hand. The radius is completely fractured and the distal fragment tilts, shifts anteriorly, overlaps, and inclines towards the ulna. The distal end of the ulna dislocates from both radius and carpus and displaces dorsally to create an ugly bulge on the dorsum of the wrist. The fracture is often open, with the radius penetrating the skin on one side of the forearm. An ulnar nerve injury is common.

If reduction is not adequate, reduce the fracture with an external fixator (59.5) for 4-6wks and apply a percutaneous K-wire through the distal radio-ulnar joint to fix it.

GALEAZZI FRACTURE

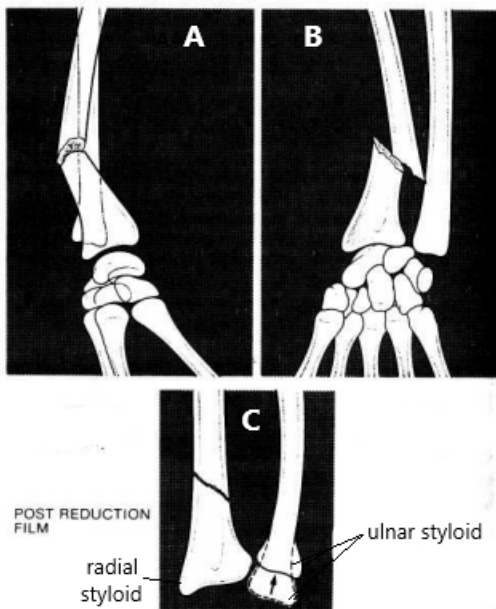


Fig. 63-6 GALEAZZI FRACTURE. A, radial fragments bow anteriorly. B, fragments overlap. C, after manipulation, if the ulnar styloid is distal to the radial styloid, reduction is inadequate.

If the fracture was missed, and both bones have united solidly, with the lower end of the ulna sticking out as a lump on the back of a stiff painful wrist, excision of the lower end of the ulna is necessary.

63.5 Isolated midshaft radial fracture

The fact that the radius rotates makes its fractures much more difficult to treat than those of the ulna. If there is no overlap, no reduction is necessary, and treatment with a long arm cast for 4wks, & another 2-4 weeks with a forearm cast is all that is needed. Mould this to give a flat contour (63-9).

ISOLATED RADIAL SHAFT FRACTURE

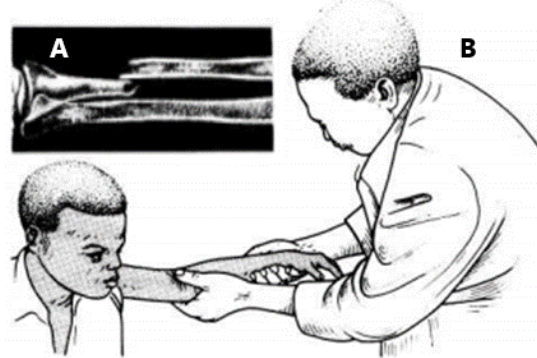


Fig. 63-7 ISOLATED RADIAL SHAFT FRACTURE. A, displaced fracture. B, technique of distraction. N.B. More than minimal angulation at the centre of the bone is unacceptable and needs fixation.

If the fragments overlap, reduction is difficult because the intact ulna prevents distraction and angulation of the broken radius, which usually breaks at its proximal 1/3. More distal fractures are even more difficult to reduce except with an external fixator.

ROTATION OF RADIAL FRAGMENTS

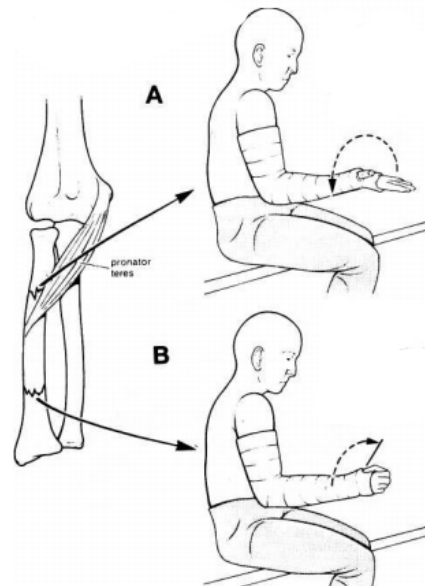


Fig. 63-8 ROTATION OF THE RADIAL FRAGMENTS. A, in fractures above the insertion of *pronator teres*, *biceps* supinates the proximal fragment, so for good alignment of the bones, supinate the distal fragment also. B, in fractures just below the insertion of *pronator teres*, this muscle, it pulls the proximal fragment into mid-pronation, so pronate the distal fragment likewise. Kindly contributed by John Stewart.

TREATMENT

Rotation of the distal fragment in more distal fractures may be variable, so it is best to obtain an AP radiograph of the proximal radius. The supinating muscles, *biceps* & *supinator* are attached to the proximal radius, and the pronating muscles, *pronator teres* & *pronator quadratus* are attached to its distal end. Use the position of the radial tuberosity as a guide to how far the proximal fragment has rotated.

Closed reduction is difficult, try elevating the arm and maintaining the position appropriately in a long arm cast. It is likely, though, you will need fixation.

JUDGING THE ROTATION OF THE PROXIMAL RADIAL FRAGMENT

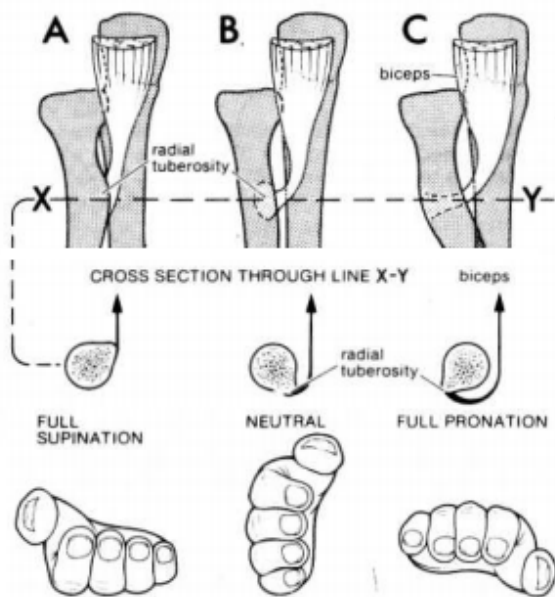


Fig. 63-9 HOW FAR HAS THE PROXIMAL FRAGMENT ROTATED? On an AP view of the proximal radius and check the position of the radial tuberosity, match it with supination/pronation positions A, B, or C, and apply the cast accordingly. *Kindly contributed by John Stewart.*

63.6 Midshaft radius & ulna fracture

These are common and difficult fractures as the fragments are difficult to align, and displace readily, and cross-union may occur, preventing rotation of the forearm. Internal fixation can be delayed up to 10 days, provided you correct overlap by applying traction meanwhile. If rotation will later be limited, make sure it is set in the position of function (63-1). Fixation in any other position is a completely unnecessary tragedy.

TREATMENT

If both bones are broken at the same level, the forearm is free to bend in the middle. You can easily correct this angulation; but you must separate the fragments of the ulna from the radius. Suspend the arm vertically (63-11) and wait till swelling subsides.

While applying a cast, gently squeeze it antero-posteriorly *while it sets*. This flattens its cross-section, compresses the muscles of the forearm, and pushes the two bones apart. However, *this is a potentially dangerous cast*, so remember to split it correctly, so as not to lose reduction. *Never use an ordinary backslab*, which is quite ineffective in complete fractures. Encourage the patient to use the fingers actively as their muscles are attached to the broken bones, and so will promote osteogenesis & union.

DISTRACTING THE FOREARM BONES

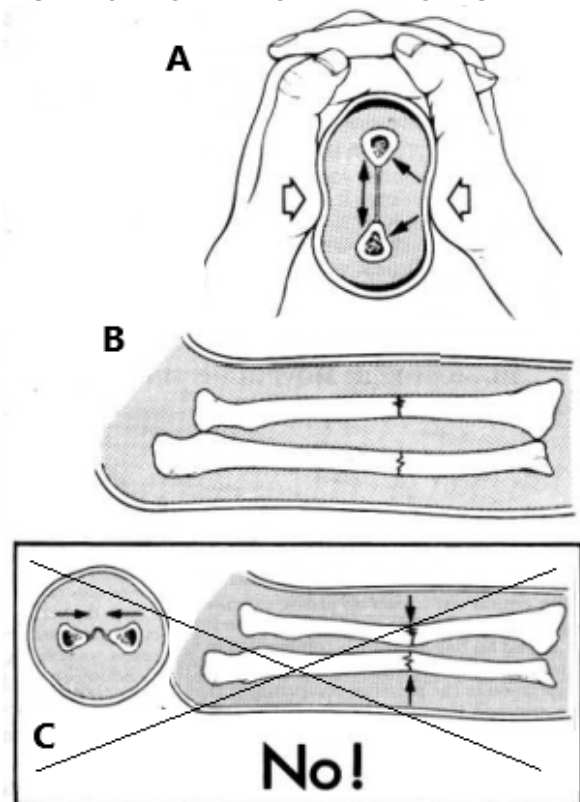


Fig. 63-10 DISTRACTING THE FOREARM BONES. A, exert gentle pressure on the forearm through a soft cast, as this will separate the radius & ulna (B) and help to prevent cross-union (C). *Kindly contributed by Peter Bewes.*

Occasionally you need to exacerbate a fracture to disengage the fragments. Be patient! When the displacement is reduced, apply the cast using cool water (so that it will not set too quickly), starting with the forearm part whilst 5Kg counterweight remains hanging from the upper arm.

ELEVATING A FOREARM FRACTURE

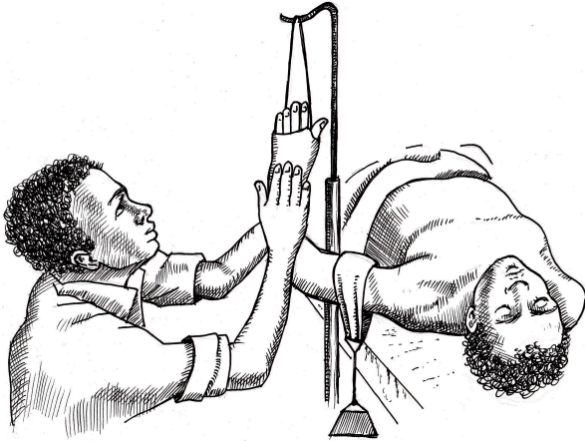


Fig. 63-11 ELEVATING A FOREARM FRACTURE. Anaesthetize the patient & elevate the forearm vertically with Chinese finger traps (63-12), so that the upper arm is horizontal, the elbow at 90°, by holding the fingers up. Apply the forearm part of the cast while 5kg counterweight applies the traction.

CHINESE FINGER TRAPS

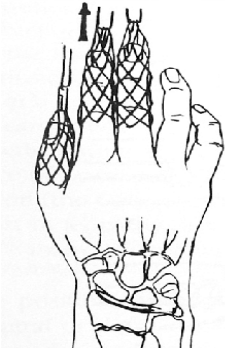


Fig. 63-12 CHINESE FINGER TRAPS. These ancient 'girl catchers' work on the principle that pulling the braid narrows the mesh, and so tightens its grip. After Lao Tzu, China 650BC.

Keep the forearm in mid-pronation. Extend the cast as far as the ip joint of the thumb & the mid-palmar crease. *The cast must allow free movements of the fingers, and the thumb should be able to touch the fingers.*

As the cast sets, squeeze it *lightly* between your hands to flatten it and separate the radius and ulna (63-9). Remove the sling and continue the cast to the upper arm.

CAUTION! Always *split the cast!* Do this while it is still soft, by making a single cut along its ulna side, from the hand to the upper arm.

Obtain a post-reduction radiograph straight away. **If reduction is unsatisfactory**, apply an external fixator (63-13).

POSTOPERATIVE CARE

Watch the circulation in the fingers carefully. The compartment syndrome (49.6) is a serious danger in this particular injury.

Check frequently whether the fingers move easily and if passive extension is painful.

Start shoulder and finger exercises immediately. Practise putting the hand as far behind the head as possible. This will also exercise the shoulder. Encourage movement of the hands.

Take radiographs at 2wks, and again at 4wks, to make sure that rotation remains in the position of function. If necessary, correct any angulation, with a new cast. *After 4wks the bones will have united and it will be too late to make any correction.*

Keep the cast intact for 6-8wks. Gently spring the forearm bones. If these angulate or are tender, reapply the cast.

If the cast needs to be changed for any reason, suspend the arm by the fingers to prevent the fracture angulating while you apply a new cast.

DIFFICULTIES WITH FOREARM FRACTURES

If pain or loss of finger movement develops, split the cast and treat as a compartment syndrome (49.6). Soft tissue swelling is much more serious than loss of position, which you can correct this later by applying another cast.

If a spike of ulna is piercing the skin, clean it & reduce the fracture. If it still protrudes, nibble it off and toilet the wound. Suspend the forearm till the wound has begun to heal, and then treat as for a closed fracture.

WATCH THE CIRCULATION IN THE HAND CAREFULLY!

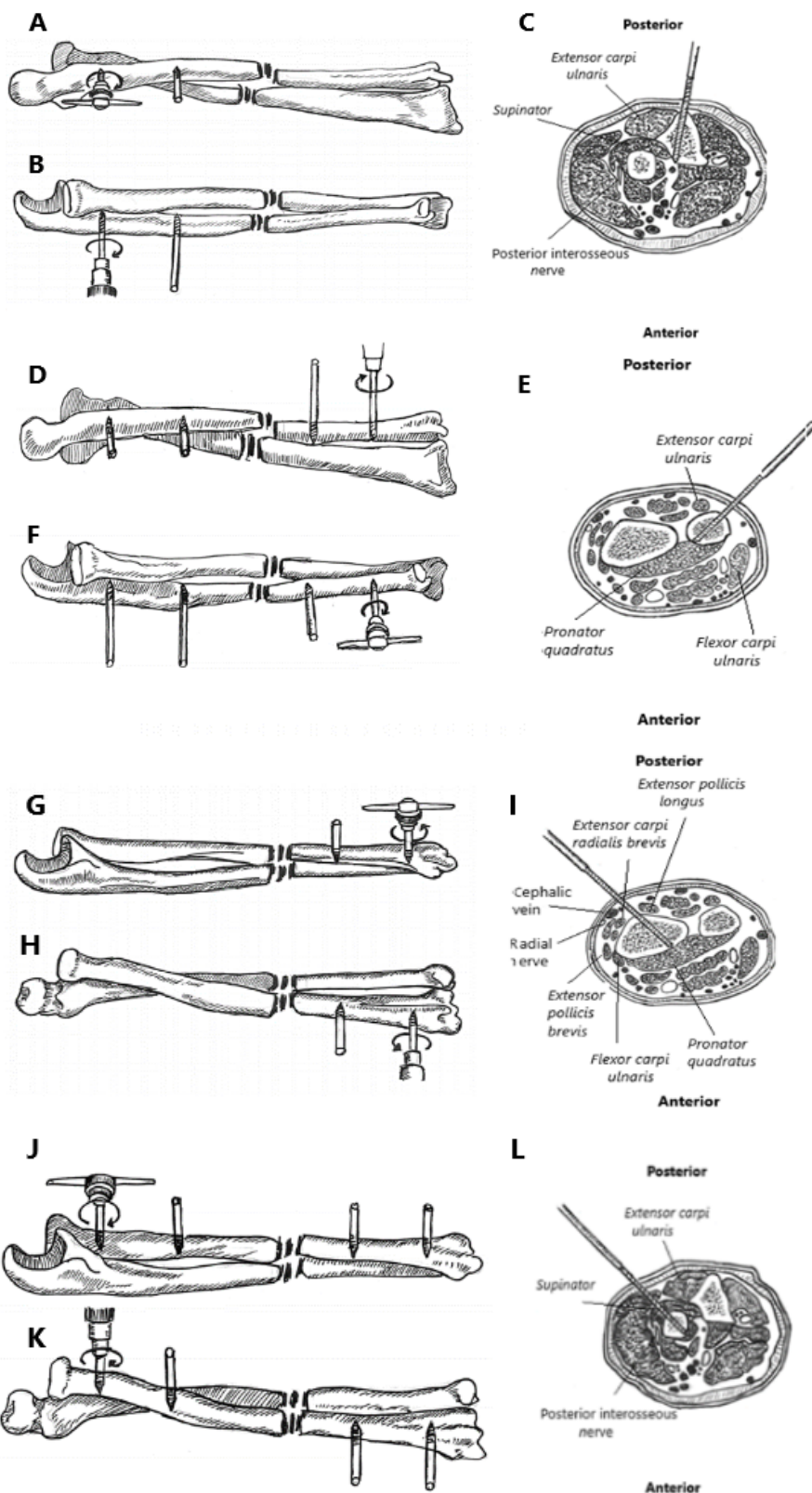
KEEP THE FINGERS MOVING!

63.7 External fixation of forearm fracture

A good alternative, especially if you cannot properly reduce & hold displaced fractures of the forearm, is external fixation (63-13). Conservative treatment often gets bad results, unless done with fine attention to detail.

EXTERNAL FOREARM FIXATION (GRADE 3.2)

Insert the proximal ulnar pins at its subcutaneous posterior border. Avoid the pin tip protruding the opposite cortex in order to avoid nerve damage (63-13A,B). Supinate the forearm fully and insert the distal ulnar pins through its posteromedial cortex. Make sure you insert the pins down to bone to avoid the superficial branch of the radial nerve (63-13D,E)



Insert the distal radial pins between the *extensor pollicis longus* & the radial wrist extensors (63-13G,H). Take great care with the proximal radial pins, which have to penetrate the *supinator* muscle through which the posterior interosseous nerve passes (63-13J,K). Make 1cm (*not stab*) incisions, so you can dissect bluntly carefully down to bone.

You must put the pins distal to the radial neck of the radius and passes between the *extensor carpi ulnaris* muscle and the mobile wad. It will penetrate the *supinator* muscle, and pass anterior to the *extensor carpi ulnaris*.

EXTERNAL FIXATION OF THE FOREARM

Fig. 63-13 EXTERNAL FIXATION OF THE FOREARM. A-C proximal ulnar pins, D-F distal radial pins, G-I proximal ulnar pins, J-L proximal radial pins. C,E,I,L cross-sections.