CHAPTER EIGHT

FRACTURES OF THE RADIUS AND ULNA

IN this chapter we are only concerned with the treatment of fractures of the shafts of the radius and ulna in their middle thirds. There are many difficulties in treating the radius and ulna by closed manipulation; closed methods can give excellent results, but the element of luck is rather prominent, and for this reason I am in favour of operative treatment. Some of the difficulties which damp enthusiasm for closed reduction are illustrated in the following sequence of catastrophes:

1. An excellent reduction may be secured by skilful manipulation.
2. The patient may suffer severe pain, with swollen fingers, because a close-fitting plaster is obviously necessary; this causes the surgeon considerable anxiety, and may necessitate splitting of the plaster, thus causing further suffering to the patient unless a second anæsthetic is used.
3. When the swelling subsides there is a strong possibility of the initial reduction collapsing.
4. A second manipulation (sometimes the third anæsthetic) may therefore be necessary after fourteen to twenty-one days.
5. This may be followed by further pain and further swelling of the fingers.
6. An excellent reduction obtained initially is rarely ever retrieved by the second manipulation.
7. Delayed union of one or other bone may occur.
8. Limited pronation and supination may result after four to six months of plaster fixation.
9. External deformity may be so great as to be visible even to the patient.
10. Finally, bone grafting may be necessary in a forearm which is not fully mobile after six months of fixation. The operation may present considerable technical difficulty owing to mal-alignment of the fragments. The total disability following the grafting operation, after a further four months in plaster, will be about twelve months, the greater part of which time having been spent in plaster.

This unhappy sequence is certainly an extreme example of all the disasters which can follow the conservative treatment of this difficult fracture, but it illustrates the fact that by closed methods the results are not entirely under the surgeon's control. After operative treatment, on the other hand, there is practically no possibility of late deformity spoiling the result; early movement is possible, and **if delayed union should result a bone graft can be substituted for the**

plate with the minimum trouble and in a forearm already fully mobile at the time of grafting.

Against the operative treatment of forearm fractures in women, we must not ignore important cosmetic factors. A longitudinal scar on the radial aspect of the forearm is permanent and very disfiguring, because it always has a tendency to heal through a keloid phase. On the other hand, complete overriding of the forearm bones produces no external blemish if alignment is preserved. There is here scope for clinical judgment in which the patient's occupation will be considered. The case of a boy of eight years of age, illustrated in Fig. 90, gives food for thought ; this boy had a transverse fracture of the lower end of the radius with overriding of the fragments which defied two attempts to reduce by closed

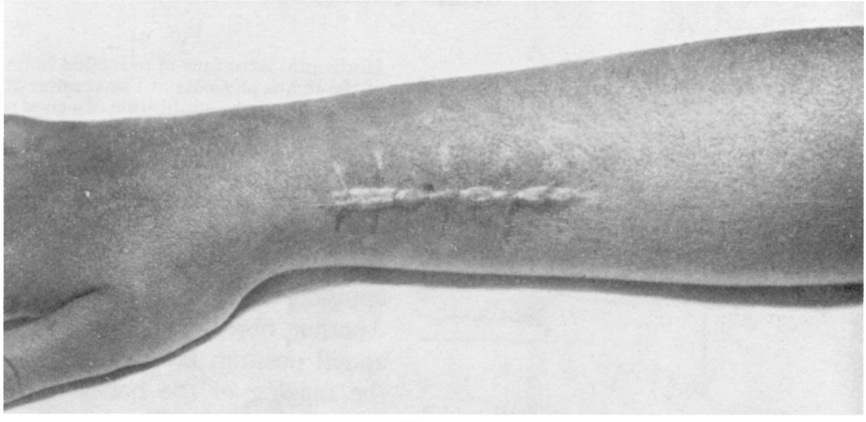


FIG. 90

Illustrating the cosmetic argument against the operative treatment of fractures of the forearm in young patients.

manipulation and eventually the ends were got into contact by directly exposing them. Had this small patient been a girl I would have advised strongly against operation because the overriding fracture would remodel completely in the course of three or four years. Blount [1] has published illustrations showing how completely the normal anatomy can be restored by remodelling in children's forearm fractures with overriding of the fragments.

The use of intramedullary nails in the forearm bones theoretically would avoid the unsightly scars inevitable if these fractures are plated. I have not been happy with my own attempts to insert intramedullary nails in the forearm, and for this reason I use plates whenever operative treatment is indicated.

TECHNIQUE OF CLOSED REDUCTION

Despite the disadvantages of the closed method it is important that the best method of performing it should be known, for there are many cases where operation is contraindicated.

[1] BLOUNT, WALTER P. (1954). *Fractures in Children.* Baltimore : Williams & Wilkins Co.

Disadvantages of Horizontal Technique

Perhaps the commonest method of attempting the closed reduction of this forearm fracture follows the technique described by Böhler in which traction is applied to the fingers, while counter-traction is applied at the elbow by a webbing sling attached to a hook on the wall.

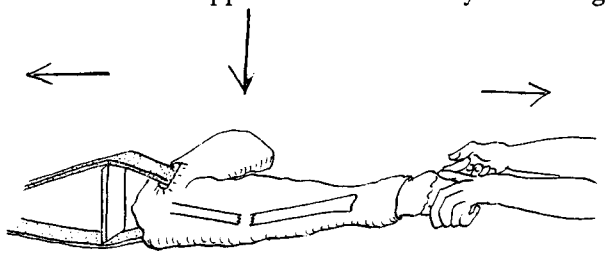


FIG. 91

Horizontal technique of reduction in fractures of the radius and ulna. The counter-traction sling prevents the application of a good plaster. Gravity tends to encourage sagging at the fracture site.

The main objection to this method is that the counter-traction sling makes it impossible to apply a full-arm plaster except by applying it in two separate stages. Another objection is that the horizontal position favours deformity by the sagging of the bones under the action of gravity (Fig. 91).

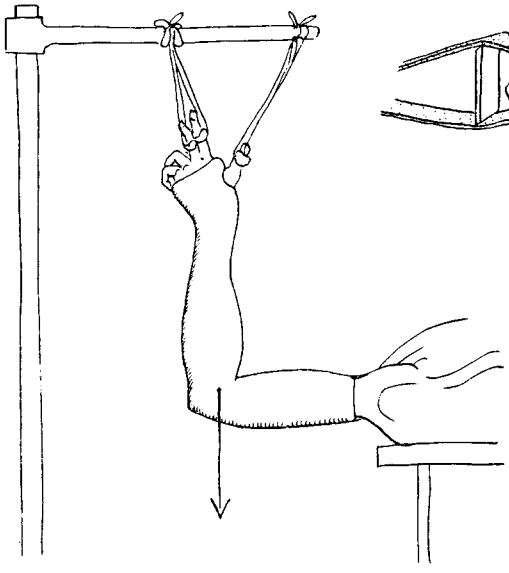


FIG. 92

Vertical position for reducing and plastering a fracture of the forearm. Counter-traction by gravity. Note position of digits to allow easy application of plaster through the first cleft. Gravity helps in alignment.

By holding the forearm vertically, suspended from the thumb and index finger, the weight of the arm and proximal part of the forearm will apply its own traction and a full plaster can be applied in one stage. In the vertical position of the forearm there is no tendency for the fragments to sag and parallel alignment is favoured (Fig. 92).

The Vertical Technique

The following technique includes several points which, though apparently trivial, contribute materially to ultimate success.

The patient is fully anæsthetised to secure relaxation. The forearm is suspended vertically by attaching 'monkey puzzles' or clove hitch knots to the thumb, index and middle fingers, and these are suspended from any convenient overhead frame (an intravenous drip-stand is very convenient because it allows the height to be varied). The thumb is suspended separately from the index and middle fingers to facilitate the passage of the plaster bandage round the palm (Fig. 92). The patient lies horizontally on the table and the height of the

suspension is adjusted so that the arm is horizontal and, therefore, with the forearm vertical, the elbow is exactly at 90 degrees. A slight increase in traction to assist reduction can be applied by an assistant exerting downward pressure on the arm, or by gripping the epicondyles and pulling downwards.

The fracture is now manipulated by applied pressure at the level of the fracture, the surgeon squeezing the forearm between his hands with the ' squeezing ' grip shown in Fig. 93. During this procedure the forearm is best held in supination so that the squeeze separates the forearm bones from one another ; thereafter the forearm can be allowed to fall into the natural position of mid-pronation. An X-ray film should be taken at this stage to check the reduction.

FIG. 93
The ' squeezing ' grip for reduction and for moulding the cast into an oval cross-section.

If an X-ray shows that one or both of the bones are still overriding, it is obvious that the swelling of the forearm or the fibrous elements in the forearm are offering a mechanical barrier to elongation. It is useless in this case to repeat the same manipulation ; my own experience has been that the use of longitudinal traction continuously for several minutes, as recommended by Böhler, rarely succeeds, though when using local anæsthesia it might well be important. If, therefore, length is not secured in the first attempt, the second attempt should be made by the manœuvre of increasing the deformity followed by straightening the limb when apposition has been secured ; after this manipulation the forearm should again be suspended by the digits for the application of the plaster.

It is advisable to apply a single layer of wool before applying the plaster ; a skin-tight plaster provides no better mechanical fixation than a padded plaster skilfully applied, and the removal or splitting of a skin-tight plaster may necessitate an anæsthetic or otherwise inflict great discomfort on the patient.

The application of *adhesive felt pads to the head of the ulna, and particularly to the medial epicondyle at the elbow*, is a trivial detail but one strongly to be recommended ; these are often sources of great discomfort and may prevent the patient rehabilitating in the cast because of pain.

The plaster is applied from the knuckles to the lower part of the axilla with the forearm in mid-position. During the application of the plaster an assistant must hold the elbow by the epicondyles to prevent it swaying from side to side as the turns of the plaster are applied.

Two points in the application of this plaster deserve special emphasis :

1. THE THUMB

It is a common practice to cut away the plaster from the base of the thumb so as to expose the whole of the thenar eminence with the object of leaving the first

metacarpal free to perform a complete circumduction at the carpo-metacarpal joint. This well-intended notion brings in its train an unfortunate sequel: the tendency for the radius to shorten by collapse of the distal fragment towards the ulna can logically be prevented only by some form of traction applied to the thumb; but cutting away the plaster from the thumb *invites* collapse of the radius by removing purchase on the thumb; the radius then collapses and the base of the thumb is drawn back against the margin of the plaster and a pressure sore develops at the base of the thumb (Fig. 94, A). To relieve this point of pressure futile attempts are often made to pack lint between the skin and the plaster; to cut the plaster farther back merely results in another pressure sore and further collapse of the radial fragment. For this reason I am convinced that **the thumb should always be enclosed up to the interphalangeal joint just as in the treatment of a scaphoid fracture.** This introduces a slight traction element to resist shortening and certainly makes the patient comfortable. If the thumb is brought round to oppose the fingers (as it should be in the treatment of a scaphoid fracture) there is no danger of stiffness even if the thumb is so fixed for twelve weeks (Fig. 95).

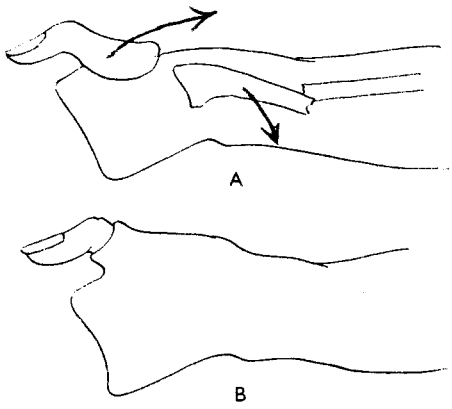


FIG. 94

A, If the thenar eminence is liberated from the plaster with the object of encouraging movement in the thumb, a pressure sore often results at the proximal part of the aperture. This is inevitable if the radius collapses towards the ulna.

B, By incorporating the whole thumb, as in the scaphoid plaster, a pressure sore at the base of the thumb is avoided.

2. THE OVAL CROSS-SECTION OF THE CAST

During the setting of the plaster it is important to apply the 'squeezing' grip at the level of the fracture so as to mould the plaster into an oval cross-section (Fig. 93). This is a most important step; **if the cross-section of the plaster at the mid-forearm is circular the constricting action of the plaster tends to drive the forearm bones together; if the cross-section is oval this is avoided.** The padded plaster, compressed into an oval cross-section, can be regarded as exerting high pressure across the forearm in the narrow diameter, and low pressure in the long diameter (Fig. 96); the radius and ulna thus tend to float away from each other in the direction of low pressure. A more exaggerated exploitation of this principle was used by Böhler who incorporated two short lengths of wood in the plaster in an attempt to exert pressure between the fragments and open out the interosseous space; though experience has shown this to be a *dangerous* procedure I have no doubt that the principle is effective, for when pressure is applied by the finger tips between the bones of the forearm it is quite possible to feel the forearm bones separate from each other with a widening of the interosseous space.

General Remarks

1. Patrick (1947) has shown *the danger of using a collar and cuff* to take the weight of the plaster; he believes this to be the cause of the late angulation of

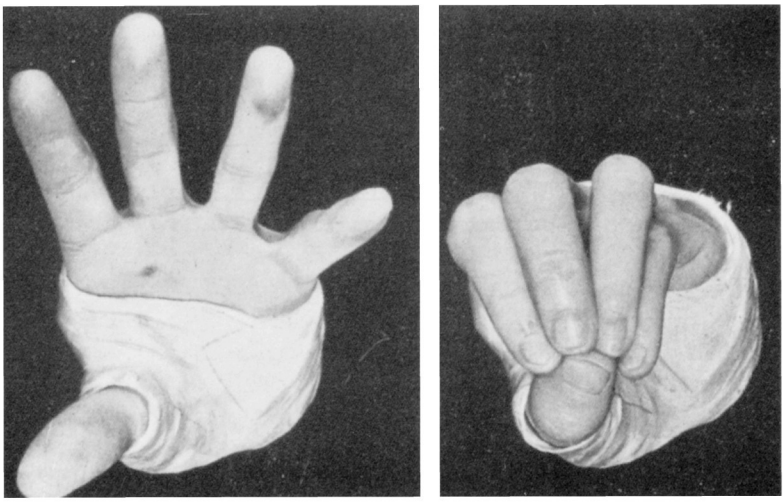


Fig. 95

Showing the ideal shape of the cast for function of the hand. Full opposition of the thumb is imperative.

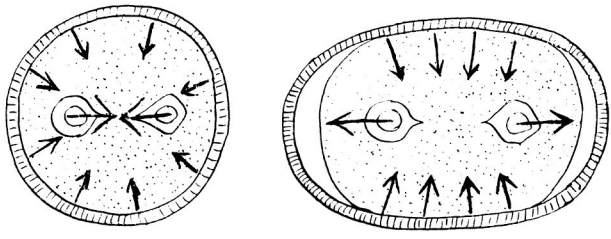


Fig. 96

A, A circular cross-section of the forearm part of the cast is to be condemned in a fracture of the forearm; this encourages falling-in of the bones.

B, If the cast is compressed with an oval cross-section by the squeezing grip (Fig. 80) there is a tendency for the bones to float apart towards the zones of low pressure as the radial and ulnar borders of the cast.

both bones of the forearm, convex towards the ulnar border, which is such a common late development. This deformity results from the plaster maintaining a close grip on the distal half of the forearm, where the bones are practically subcutaneous, whereas the proximal half of the forearm is only loosely gripped by the plaster, being enclosed in large muscular bellies which rapidly shrink and

waste. The dropping of the plaster at the elbow which is encouraged by the collar and cuff thus produces angulation. *If the elbow is supported by a sling and the*

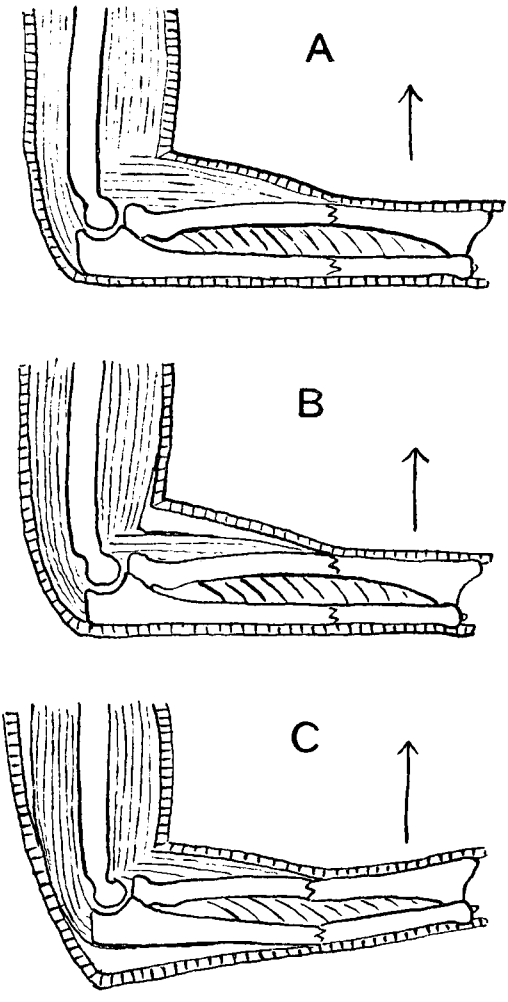


FIG. 97

Showing how a collar and cuff, applied to a forearm cast, can induce ulnar bowing (after Patrick). If held by a collar and cuff the plaster cast drops at the elbow when the forearm muscles waste; this produces ulnar bowing because the wrist is still held firmly by the cast. A sling is therefore to be preferred as it prevents dropping of the cast at the elbow.

plaster prevented from dropping at the elbow there is less tendency for this late deformity (Fig. 97).

2. The plaster should be retained continuously for twelve weeks before the

limb is examined for clinical union and therefore the plaster should be a good one from the start.

3. Should the plaster need changing for looseness or any other reason, the limb should be suspended by the digits to prevent angulation during this procedure.

4. Finger exercises are obviously of great importance, but of equal importance, though sometimes forgotten, is the need to maintain full movement in the shoulder; by insisting that the patient touches the back of the neck and the small of the back he secures full abduction, full internal rotation and full external rotation in two simple movements.

5. *Greenstick fractures of the forearm in children should never be treated in skin-tight plaster casts.* Because the greenstick fracture presents only an angular deformity it is ideally suited to fixation in a three-point splint. If the angular deformity is straightened, all that is needed is a padded plaster applied for three to four weeks and a perfect result will be obtained. It is horrifying to see the unnecessary suffering to these little patients which the application of a skin-tight plaster can often cause. Manipulation of a greenstick fracture often results in it becoming complete, and indeed it is advisable that the fracture should be deliberately completed to remove the 'spring action' of the intact bridge which may induce the return of the original deformity (Fig. 51, p. 54). In a skin-tight plaster further swelling of the forearm will result in blue and swollen fingers. The subsequent splitting of the plaster may be so painful, unless an anæsthetic is given, that a permanent psychological resentment may develop against the idea of a hospital. Numerous cases of Volkmann's ischæmic contracture have been *caused by bad treatment* of this utterly trivial fracture.

6. The greenstick fracture of the forearm in children illustrates very clearly the dictum that to get a straight limb one must use a curved plaster (p. 51). The concavity of the plaster must be in the opposite sense from that of the original deformity which is usually concave dorsally (Fig. 98).

Late Angulation in Greenstick Fractures of the Radius

There are certain greenstick fractures of the radius which tend to develop a most disfiguring late deformity after an initially perfect reduction. Unless the surgeon knows this he will have the unpleasant experience of removing a plaster from a case which, till then, he has thought offered no difficulty, and finding to his chagrin the initial deformity of dorsal concavity of the radius (Fig. 99). Not only is this an ugly deformity, and one which causes the parents of the child great alarm, but if allowed to persist it may permanently limit pronation of the wrist. The fracture which is most susceptible to this late deformity is that involving the radius *when the ulna is intact.* Fractures of both the radius and the ulna seem to be less prone to this late deformity. The deformity is one of angulation, concave on the dorsal surface.

Whatever may be the actual mechanism of late dorsal angulation of the radius, one thing is certain, that *it defies all attempts at correction by the application of local force over the convexity.* Attempts to remanipulate the fracture while

the callus is still soft appear to be frustrated by the presence of the intact ulna which shields the fracture from the full effect of any local corrective force.

If the callus is still soft the deformity can be corrected easily by forcible pronation of the distal fragment. The reason for this is that the proximal fragment reaches the end of its range of pronation while the distal fragment is still in some supination as a result of the angular deformity. By forcing the wrist into full pronation the proximal fragment reaches full pronation before the distal and cannot pronate any farther, so the soft callus at the fracture

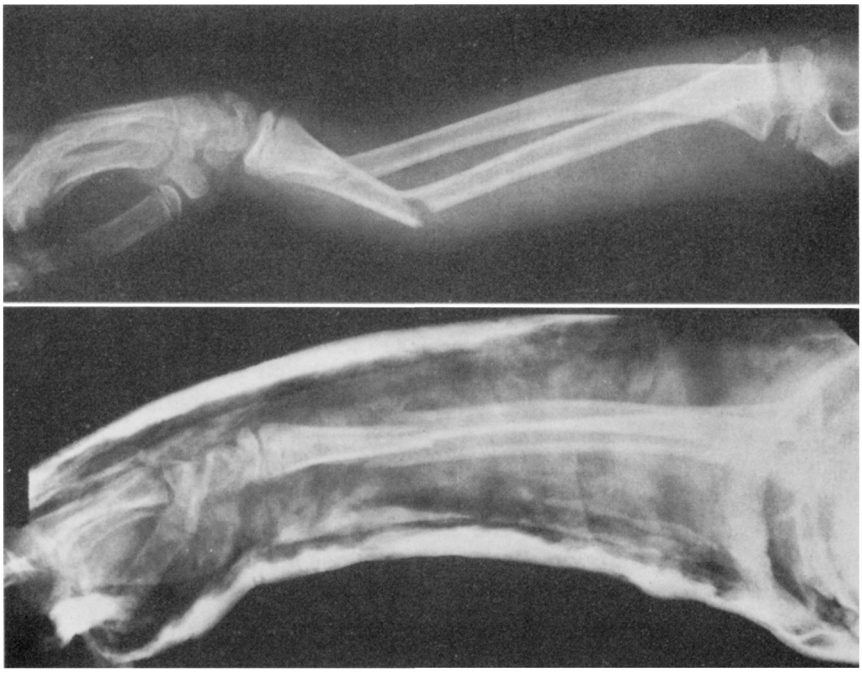


FIG. 98

Three-point plaster in action. A straight limb is produced by a curved plaster. Compare Fig. 48, A, page 51. Curvature of plaster is opposite to original deformity.

line must yield and allow the distal fragment to align itself with the proximal (Fig. 100). To hold this reduction it is necessary to apply the plaster with the wrist in practically full pronation; to hold the pronated position, it will be necessary to incorporate the elbow.

A similar mechanism occurs in the treatment of the Colles' fracture in the adult (p. 131). In the Colles' fracture the deformity of 'dorsal tilt' is prevented by locking the wrist in strong pronation.

Delayed Correction of Deformities in Children

The unsuspected recurrence of angular deformity in greenstick fractures of the forearm, while concealed in plaster, is an annoying event if it takes the

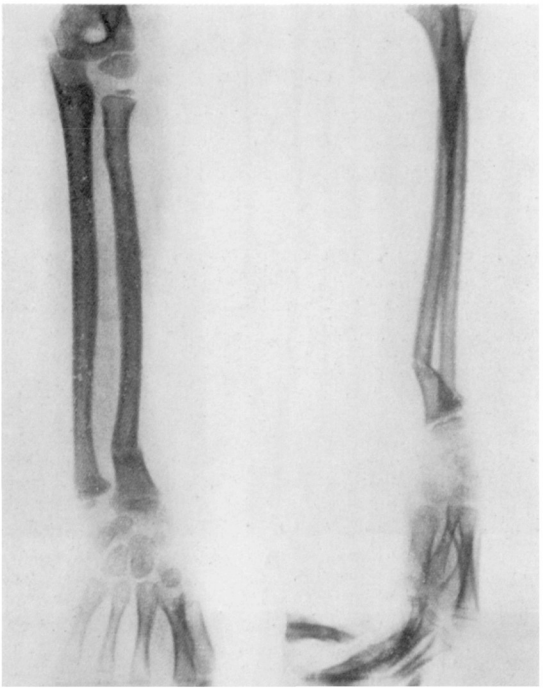


FIG. 99

Late dorsal tilt of greenstick fracture of radius occurring spontaneously inside the plaster. This can be prevented only by fixing in pronation, and is especially important if the ulna is intact.

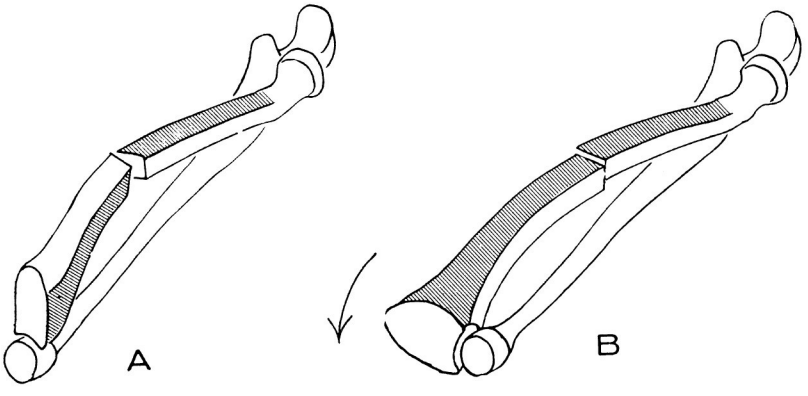
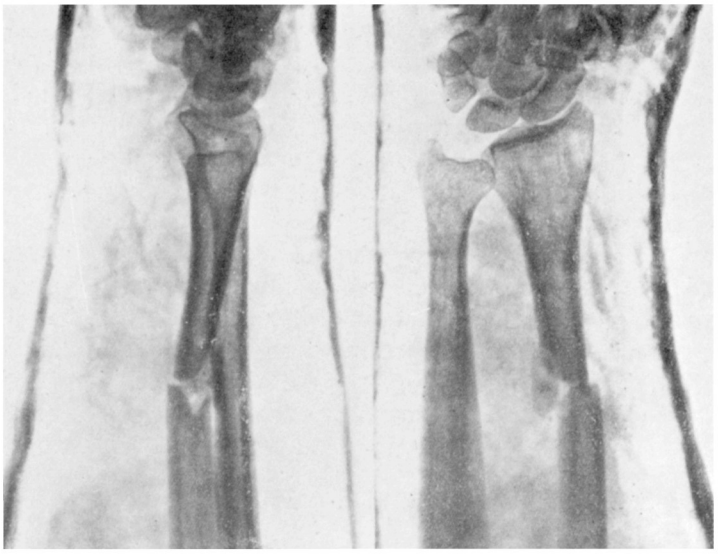
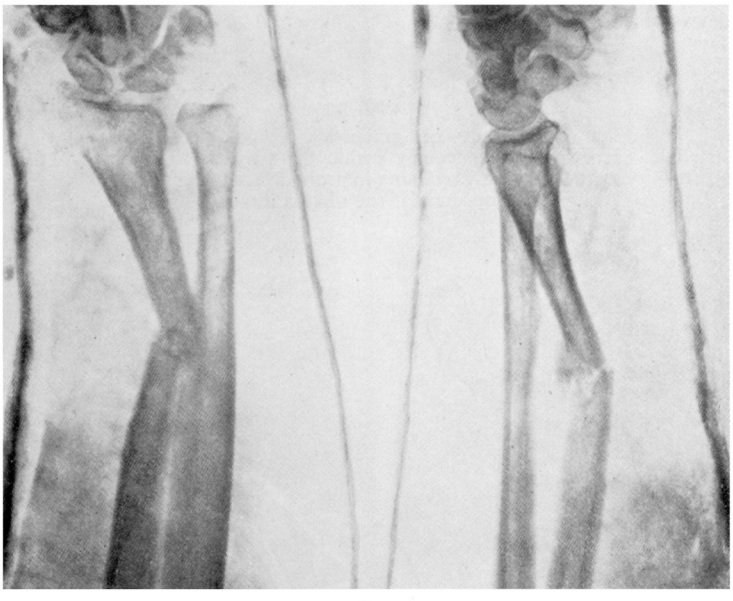


FIG. 100

Illustrating how a deformity of the radius which appears to be one of angulation, concave dorsally, in the presence of an intact ulna, has in fact an important element of supination in the distal fragment.



A



B

FIG. 101

A, Fracture through middle and lower thirds of the radius in good positions in plaster.

B, Typical late collapse of the reduced position. This type of case should always be treated by internal fixation.

surgeon by surprise and is not discovered until the plaster is removed. Parents, quite understandably, may be more annoyed about this happening to their children than if it had happened to themselves, and do not easily forgive the surgeon. This complication is very prone to happen if a greenstick fracture is not ' completed ' during manipulation, and is due to the elasticity of the bone or the tension of intact fascial structures on the concave side of the deformity.

However, if the surgeon specifically looks for the recurrence of the initial deformity at an early stage (*i.e.*, at four weeks) by taking an X-ray through the plaster, it can very easily be corrected while the callus is soft. When the fracture is ensheathed in callus the fragments can be moulded precisely into the desired position without fear of further recurrence. There is much to be said in favour of this as a planned ' two-stage ' procedure, especially if the original fracture is very mobile, and it is wise to mention it to the parents immediately after the first reduction ; if late ' moulding ' is not needed no harm is done, but if later it is needed the parents know the surgeon has the matter under control.

Fractures of the Lower Third of the Radius

A common fracture of the adult radius occurs at the junction of its lower and middle thirds, without fracture of the ulna ; the radius collapses towards the ulna and results in subluxation of the lower radio-ulnar joint (Fig. 101, A, B). The deformity in this fracture is particularly prone to recurrence even if manipulative reduction has been complete, but **if manipulative reduction has been only partially successful one can guarantee with absolute certainty that complete relapse of the initial deformity will take place in the plaster.** In this fracture operative treatment with internal metallic fixation is *always* advisable except in the aged.