CHAPTER NINE

THE COLLES' FRACTURE

IT is a fortunate thing that excellent functional results usually follow the common Colles' fracture, because disappointing anatomical results occasionally develop even in the most skilful hands. Though in general it is fair to class this injury as a minor fracture, this is not always the case, because the group includes a substantial number of comminuted fractures which would demand elaborate mechanical treatment if perfect anatomical restoration were to be the most important aspect of the problem.

From the student's point of view it is confusing that this common fracture is satisfactorily treated by a method which transgresses two of the basic principles of fracture treatment because, as will be shown later, the dorsal plaster slab is mechanically unsound as a method of fixation, and the position of flexion of the wrist is contrary to the general rule of splintage in the optimal position for function. Here, however, is an example of a method which is sanctioned by results and by convenience rather than theory, and these are very important practical matters in a busy clinic.

ANATOMY OF THE FRACTURE

The triple displacement of a Colles' fracture, *i.e.*, dorsal shift, dorsal tilt, and radial shift of the distal fragment, constitutes the classical 'dinner-fork' deformity known to every student. Less obvious, but more important as regards treatment, are the ruptured soft parts which accompany this displacement. The tissue which is ruptured on the volar aspect of the fracture is the periosteum, while on the dorsal surface of the fracture the periosteum and the fibrous part of the tendon sheaths remain intact and thus constitute the soft tissue 'hinge' which is the key to reduction of the displacement (Fig. 102).

In elderly patients the Colles' fracture is always comminuted, and this is responsible for the slipping of the reduction which is a rather common late feature in this injury. Comminution of the dorsal cortex invites backward tilting of the distal fragment because *it removes the strut which would otherwise be provided by the accurate reduction of an intact dorsal cortex.* When the fracture is impacted the shaft of the radius, which constitutes the proximal fragment, becomes deeply embedded in the cancellous bone of the distal fragment, and when it is disimpacted the cavity left in the distal fragment fills with nothing more substantial than blood clot (Fig. 103).

It will be seen therefore that many Colles' fractures possess little or no stability following reduction and *in theory* the tendency to collapse in this type

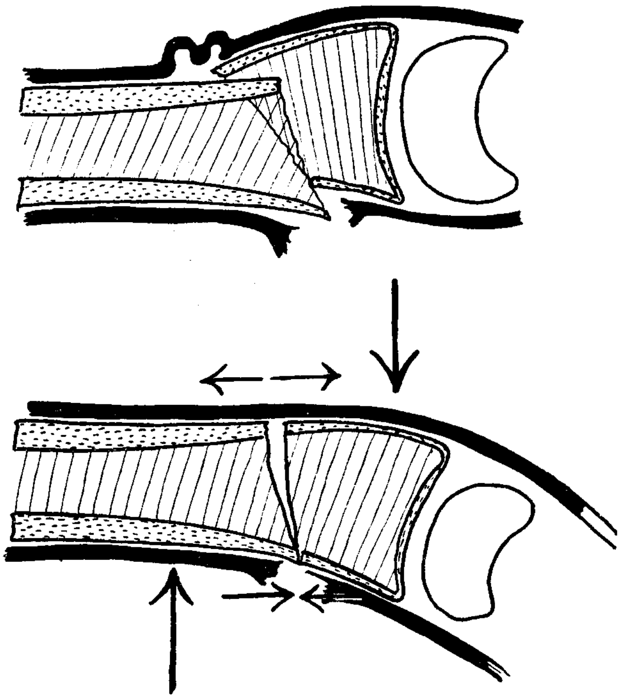

FIG. 102

Showing the soft parts involved in a Colles' fracture. The soft-tissue hinge lies on the dorsal aspect, and it is this which must be maintained under tension to produce, and to hold, the reduction.

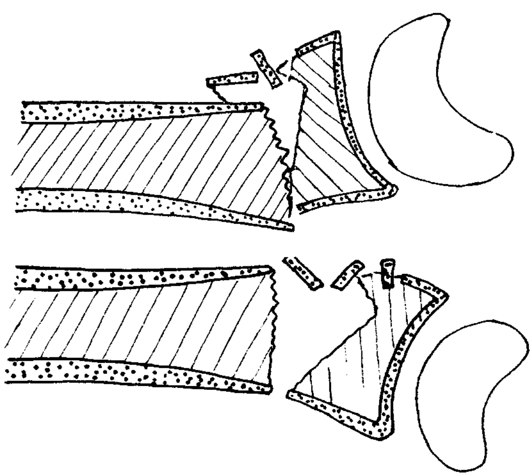

FIG. 103

Showing the cause of late collapse in the comminuted Colles' fractures so often encountered in the aged. The comminution of the dorsal cortex removes the solid strut which normally prevents redisplacement, and the cavity in the cancellous bone contains nothing more substantial than blood clot.

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of case could be prevented only by the use of traction applied to the distal fragment. Traction in this fracture would enormously complicate treatment and, because the results of a simple method are generally adequate, matters of convenience are more to be considered in this case than mechanical ideals.

Mechanical Analogy

Many stable fractures, *i.e.*, non-comminuted cases, can be reduced by the simple act of flexing the distal fragment and pressing it in a volar direction into line with the radius; reduction in these cases is demonstrated by a convincing snap. But this method will fail in an appreciable number of cases unless preceded by a well-executed movement designed to disimpact the fragments by increasing the dorsal angulation and applying traction.

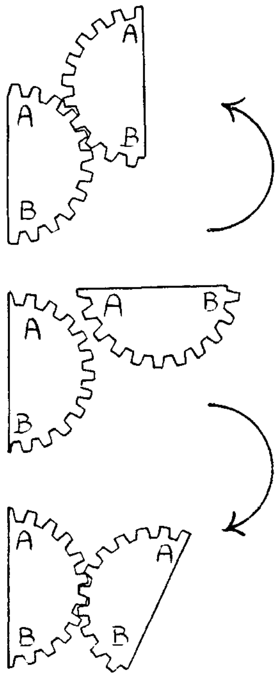

FIG. 104
Mechanical analogy in reducing a Colles' fracture.
A, Fracture in displaced position (teeth incorrectly meshed).
B, Fracture distracted and backward angulation increased in order to mesh the dorsal teeth correctly.
C, Flexion will now bring the volar cortices correctly into register.

To emphasise the *importance of preliminary disimpaction* in the treatment of a Colles' fracture, the analogy provided by the meshing of two gear-wheels is not without interest in helping to create a useful mental picture. The serrated surfaces of the fracture can be regarded as the teeth of two gear-wheels which have been erroneously meshed. Let us regard the distal wheel as being erroneously meshed by a backward rotation of two teeth in relation to the proximal. Simple pressure cannot restore the correct relation of the two wheels without shearing the teeth, and simple forward rotation will still leave the distal wheel out of alignment by the distance of two teeth (Fig. 104). It is obvious that the distal wheel will have to be separated by traction to disengage the teeth and then **by increasing the backward rotation** the 'dorsal teeth' can be correctly enmeshed; forward rotation of the distal wheel will now result in correct alignment (*i.e.*, the 'volar teeth' will now come into alignment when flexion is complete).

TECHNIQUE

It is important to have full muscular relaxation by general anæsthesia; 'smash and grab' under N_2O is useless.

In the reduction of a **left** Colles' fracture the surgeon grips the patient's

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forearm with his left hand sited on the volar aspect so that his thenar eminence is under the proximal fragment. The right hand of the surgeon is then applied to the distal fragment, the thenar eminence being sited on its dorsal surface.

Throughout the subsequent three movements which produce the reduction it will be observed that **the left hand of the surgeon remains stationary, acting as the passive hand or 'vice,' while the active part of the manipulation is executed by the right hand alone.**

Step 1. Disimpaction

An assistant takes hold of the elbow and offers counter-traction. The surgeon applies traction with the right hand, sited as just described, at the same time

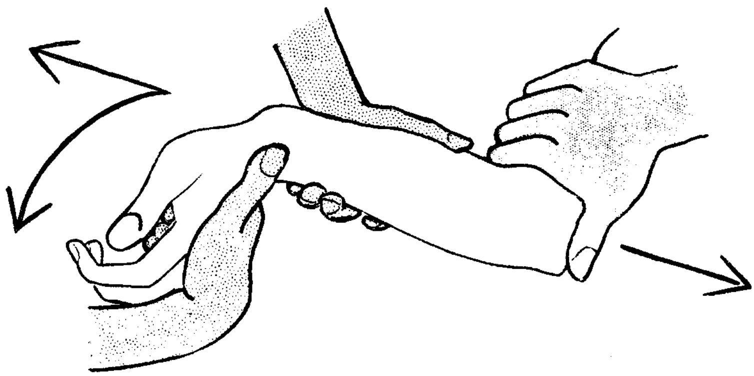

FIG. 105
Disimpaction and increasing the backward angulation. Traction maintained.

increasing the deformity by dorsiflexing the distal fragment (' re-engaging the dorsal teeth,' Fig. 105).

Step 2. Reduction

With traction still maintained, by means of the right hand the surgeon presses the distal fragment in a volar direction and then follows this with the final flexion of the wrist. The thenar eminence of the left hand applies counter-pressure against the proximal fragment during this movement (Fig. 106). *At the end of this movement the fracture is fully reduced, but it would slip if the traction force were released or if one of the two forces applying pressure and counter-pressure were removed.*

Step 3. Locking the Fracture by Pronation

The fracture is now rendered stable by the surgeon pronating his right hand, thus carrying the distal fragment into pronation and *at the same time deviating the patient's wrist towards the ulna* (Fig. 107). **If pronation is maintained the reduction will hold without traction.** This is explained by the fact that the proximal fragment in a Colles' fracture can only slip out of alignment with the distal fragment by moving in the direction of pronation, but, if the forearm is already in full pronation, it cannot therefore move any farther in order to lose alignment with the distal fragment.

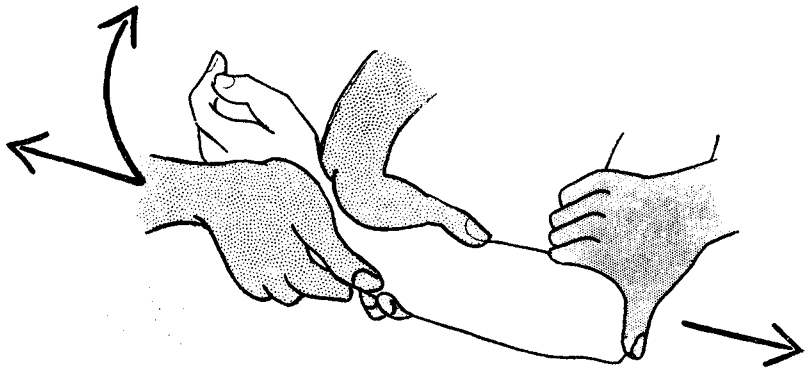

FIG. 106

Robert Jones grip applied. Pressure is applied with 'reducing' hand on distal fragment against the counter-pressure on the proximal fragment from the 'anvil' hand. Traction maintained.

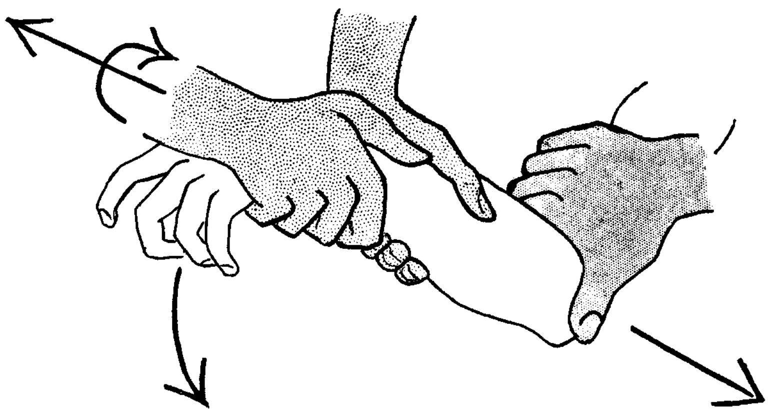

FIG. 107

Locking the reduction by pronation. The 'anvil' hand remains stationary while the pronation is done entirely by the 'reducing' hand. The wrist is forced into ulnar deviation by this same manœuvre.

Application of the Plaster

The application of plaster to a Colles' fracture is a tricky business which is personal to many surgeons and rather defies description. Faulty reductions are more often the result of clumsy plaster technique than faulty manipulation. I have found the following procedure convenient for both the surgeon and the assistant.

A quick-setting plaster slab is laid on the back of the forearm and bandaged in position with a wet gauze bandage. To facilitate the unobstructed work of the assistant who is applying the plaster the surgeon adopts the hold illustrated (Fig. 108), in which the thumb is taken in one hand and the fingers in the other;

no traction is used and the stability of the reduction depends on maintaining strong pronation. In this position ulnar deviation and slight palmar flexion is possible. To reach this holding-grip it is necessary for the surgeon to slide his hand from the position in Fig. 107 to that in Fig. 108 with some care, but if strong pronation is maintained the fracture will not slip. The only difficulty in the application of the slab in this position is that the wrist is sometimes almost upside down during the application of the plaster slab and the dorsal surface of the wrist is facing the floor.

When the plaster has been completed the surgeon resumes his hold in Step 3

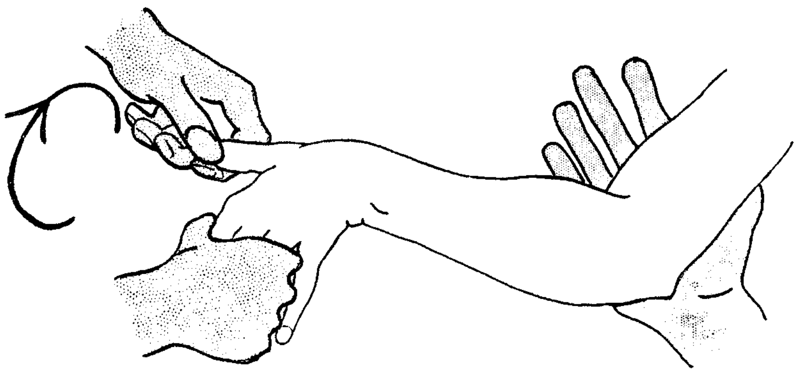

FIG. 108

Plastering position. Held in strong pronation the traction can be released without danger of the fracture slipping. Note ulnar deviation, separation of the thumb to facilitate passage of the bandage and exclusion of the fifth finger from the grip. Sometimes the pronation needed makes application of the plaster slab a little awkward as the wrist is almost upside down.

(Fig. 107) and moulds the plaster at the points of local pressure on the two fragments (see below) until the slab has hardened.

Note in Fig. 108 that the fifth finger is excluded from the grip of the surgeon's hand; this is explained in Fig. 109 as a means of preserving the normal width of the palmar arch in the completed plaster.

The Plaster Slab

For mechanical reasons the *ideal* plaster splint for this fracture would be a complete circular cast; but in Britain this is not often used because a plaster slab is more convenient in this very common fracture and the results of this method are quite adequate. The ideal cast would be moulded into a three-point system against the volar aspect of the proximal fragment and the dorsal aspect of the distal fragment (Fig. 110). To deter the fracture from slipping into radial displacement (*i.e.*, shortening of the radius) the ideal cast would have the thumb incorporated as far as the interphalangeal joint as in the case of a scaphoid plaster. From time to time various workers have suggested that the forearm should be held in full pronation by incorporating the elbow in the plaster, but this is unnecessary and delays rehabilitation. Permanent pronation of the forearm

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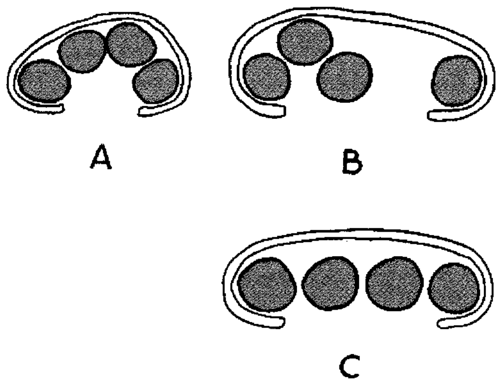

FIG. 109

Showing reason for excluding the fifth finger from the grip in Fig. 108. If all fingers are gripped together the plaster which results is that of A. When plaster is applied with the fifth finger excluded, this gives B, which allows of ample accommodation for the transverse palmar arch as at C.

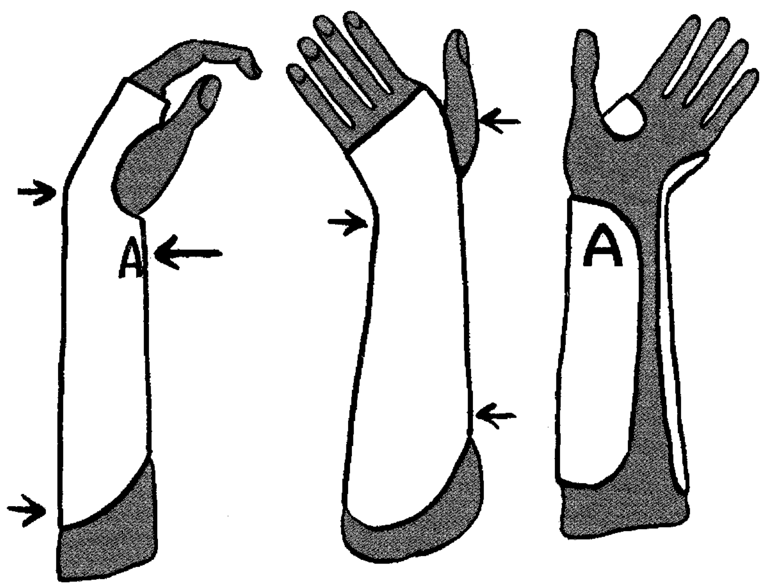

FIG. 110

The radial plaster slab. Slight palmar flexion. Considerable ulnar deviation. Thick plaster at the point marked A in order to make the plaster conform to the principles of a three-point splint.

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is unnecessary if the fragments are held in alignment by the local moulding of the plaster on the volar and dorsal aspects as part of a three-point system.

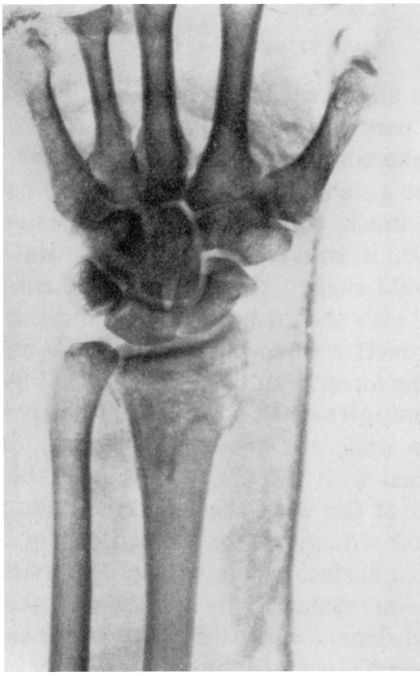
Despite the theoretical superiority of the complete cast, the plaster slab scores heavily as regards convenience; but to use a slab effectively there is one matter of such importance that it cannot be too much emphasised. **The plaster slab should never be merely a dorsal slab, it must always be a radial slab;** to emphasise the importance of this I would suggest that in the treatment of the Colles' fracture the use of the term dorsal slab should be abolished and the name radial slab insisted upon. For a slab to exert a three-point action it is essential that the slab should reach the midline of the forearm on the volar aspect (Fig. 110). **On the volar aspect it should be thick enough to take a permanent impression from the surgeon's thenar eminence** while the plaster is setting. It is a common error to find a dorsal slab applied with the edges so thin at the point where they overlap on to the volar aspect of the wrist that no three-point action could possibly be maintained. Many good reductions are allowed to slip by the slab being a dorsal strip confined to the flat surface of the back of the wrist, thus making it impossible to use a three-point system. By the same token the reappearance of radial shift after successful reduction is usually due to the use of a flat slab confined to the dorsum of the forearm; **only by having a deeply curved splint applied to the radial aspect of the wrist is there any chance of preventing late radial deviation.**

Assessing the Reduction by X-ray

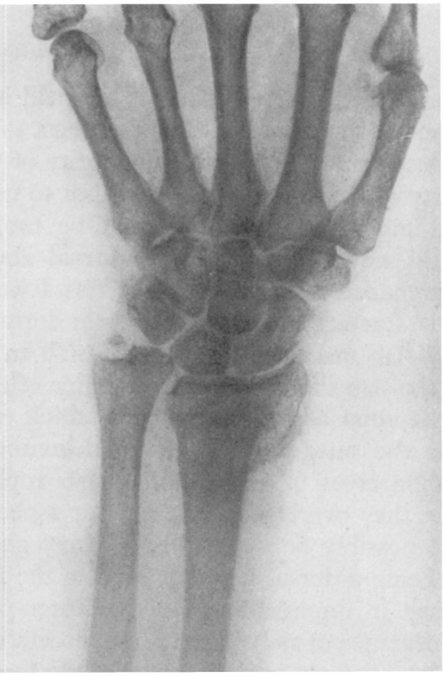
It is sometimes embarrassing to find in the end result a noticeable radial displacement of the hand which had not been previously suspected. Late radial deviation in a Colles' fracture is the only deformity which need present any serious problem; it must therefore be kept in the forefront throughout treatment. It will usually be found that careful observation of the levels of the radial and ulnar styloids will be a fairly useful guide to the presence of radial slip, but some cases will be found where quite a shapely wrist results even when the styloids are at equal levels. A useful guide to the possibility of radial deviation is in the shape of the plaster as seen in the X-ray; the shadow of the cast should always show as a straight line on the radial side but should have a concavity on the ulnar border (Fig. 111, C).

RESECTION OF THE LOWER END OF THE ULNA

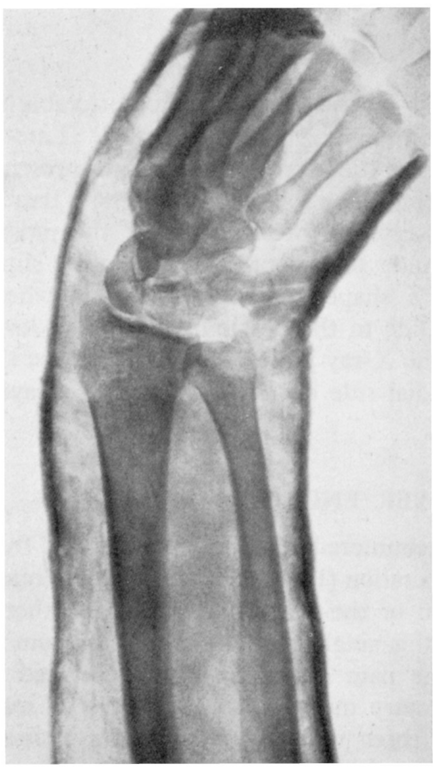
When an ugly external deformity is encountered in a mal-united Colles' fracture it can be easily corrected by Darrach's operation (Fig. 112). This simple but most effective operation concerns the resection of the head of the ulna together with about 1 inch of the adjacent shaft. By this single procedure (1) the prominence of the ulnar styloid is removed, (2) the pain arising in the subluxated distal radio-ulnar joint is abolished, and (3) rotary movement at the wrist is restored to normal. The operation entails only three weeks of post-operative disability and the benefits which accrue will reveal themselves within six weeks. **With**



A



B



C

FIG. 111

A, Showing a fair reduction of a comminuted fracture but a bad plaster in neutral position.

B, Showing the inevitable late result of radial deviation.

C, X-ray appearance of a Colles' plaster in strong ulnar deviation.

the certain knowledge that a gratifying result can be obtained after this operation, it is wiser to accept a radial deviation in a mal-united Colles' fracture rather than to attempt remanipulation. In young patients the slipping of a Colles' fracture usually results from inexpert treatment, but the slipping of a Colles' fracture in elderly patients is to be regarded almost as a natural sequel, and attempts to remanipulate are likely to fail because further absorption of comminuted bone fragments is likely to occur. Having accepted a radial

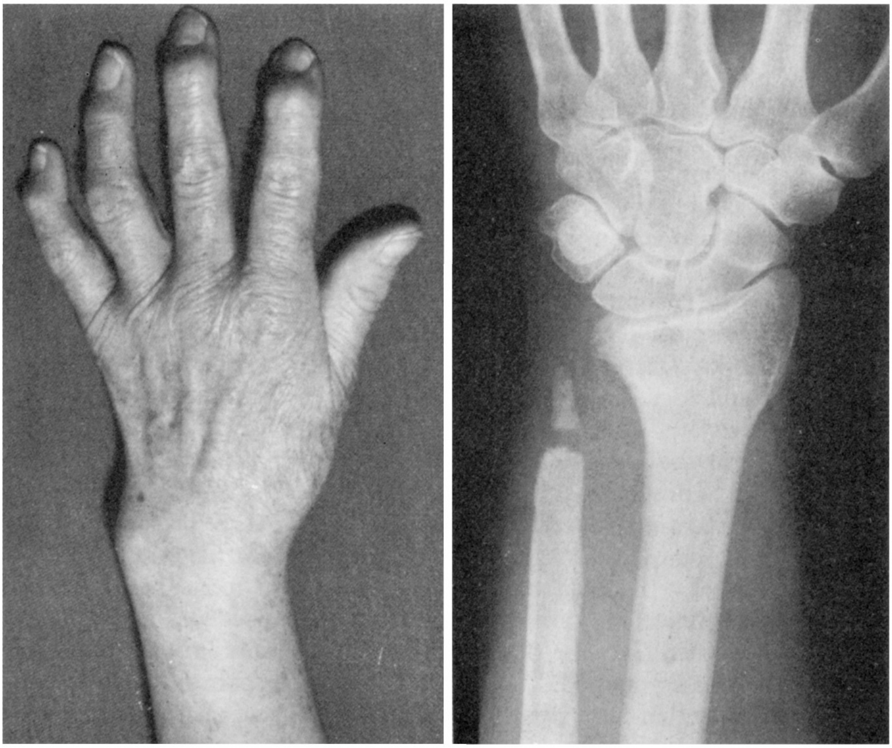


FIG. 112

Ugly deformity of radial deviation cosmetically corrected by resection of lower end of the ulna. This also restores full rotation and abolishes residual pain round the prominent head of the ulna.

deviation in an elderly patient, the splint should not be retained too long ; fixation should be abolished after three weeks, and mobilisation of the wrist should then be started. Resection of the ulnar styloid can be performed two or three months later if the patient is dissatisfied with the appearance or has persistent pain over the ulnar styloid.

The very best results of resection of the lower end of the ulna are in cases where there has been a serious block to pronation and supination. Not many patients will accept the idea of resection of the ulna if movement is reasonably good, and it is very important to realise that what causes most dissatisfaction with patients after a Colles' fracture is *pain* round the excessively prominent head of the ulna. They are not usually much bothered by slight deformity. It is important to realise that this pain will disappear spontaneously though it may last as long as one year. If they are firmly reassured about this the vast majority will be quite content.

FUTURE DEVELOPMENTS IN THE TREATMENT OF THE COLLES' FRACTURE

It has to be confessed that the conservative treatment of the Colles' fracture often leaves something to be desired in the cosmetic result, though rarely in the functional result. This is particularly so when the results of work done by young residents is considered, though even experienced operators occasionally have disappointing cosmetic results from the Colles' fracture. The perfectionist will continue to look for a method offering greater precision than the conservative method in order to eliminate the tendency to late displacement, and it is therefore the purpose of this section to examine how far mechanical elaboration of the treatment of the Colles' fracture is justifiable and in what directions future research might profitably be encouraged.

Numerous attempts have been made in the past to improve the anatomical results of the Colles' fracture by holding the wrist in full pronation throughout the early phase of splintage. This has been done by incorporating the elbow in the fully pronated plaster. This technique, though anatomically sound, is physiologically bad, because the elderly patients fail to recover supination if fixed in an extreme position of pronation for several weeks.

The Colles' fracture shortens the radius and tends therefore to subluxate the lower radio-ulnar joint, so damaging the triangular fibrocartilage at its attachment to the ulnar styloid. To hold the radial styloid down to its normal level it is obvious that, theoretically, some form of traction is needed. External skeletal fixation has been tried (*i.e.*, the Stader splint) and workers in Toronto have been enthusiastic about this method. Similar claims for comfort and for precision of holding of the reduction have been made for internal fixation using the Rush nail.

The fundamental criticism of maintaining the full length of the radius by mechanical methods is based on the biological principles of osseous union and joint movement outlined in Chapter I. The Colles' fracture is a fracture of cancellous bone, and four to six weeks after such a fracture I believe that union will be present only at the points where the cancellous fragments are in direct contact. If the radius is pulled out to its full length a cavity will be made inside the fracture which will not fill with new bone until many weeks have elapsed; it will fill only by the slow spread of osteogenesis from the points of initial contact and not by callus being 'thrown out' to fill the cavity. If the radius is pulled out to full length, initial union will be by a fragile bridge on the volar aspect with defective consolidation on the dorsal aspect and with a central cavity filled with fibrous tissue. If the apparatus maintaining length is removed after four weeks, there will be a tendency to collapse, and even if gross collapse does not occur, I believe that the threat will be manifest in a stationary, or even retrograde, phase

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in rehabilitation. *If consolidation is unsound the power of grip and the function of the wrist will be inhibited until sound osseous consolidation has been achieved.* It is during the phase of inhibited function which accompanies unsound consolidation that permanent joint stiffness develops. The Colles' fracture is therefore an excellent instance of what I believe is an axiom in the treatment of any fracture, namely, that the best way to functional recovery is by striving primarily for sound osseous union, and any factor in treatment which might delay osseous consolidation carries with it the danger of some permanent impairment of joint function.

On these biological grounds the fundamental approach to the treatment of the Colles' fracture must be to permit some collapse of the cancellous bone so as to achieve contact over a large area. The key to conservative treatment is therefore 'controlled collapse,' and provided that steps are taken to concentrate on preventing gross radial displacement the cosmetic appearance of the wrist will be acceptable. Under this regime the power of the grip will rapidly return and this in its turn may exert some beneficial compression stimulus on the cancellous bone of the fracture.

A Clinical Experiment

If traction is likely to delay consolidation by holding open a cavity in the lower end of the radius, it would seem logical to hold the radial styloid at its normal level by packing bone chips into the cavity left after reduction, and in this way the patient would theoretically compress the bone chips at each attempted movement of gripping. Claims for good results by this technique in the treatment of depressed fractures of the tibial plateau and in depressed fractures of the os calcis have been made by various workers in the past. To test this theory six Colles' fractures were operated in this way, using refrigerated bank bone.

The fracture line was exposed through a small incision at the base of the radial styloid, and while the fracture was held in the position of reduction by the assistant applying traction to the thumb, chips of bone were packed into the cavity to strut the fracture apart. In several cases a whole segment of rib was driven in as a wedge. Inspection of the size of the cavity in the distal fragment was an impressive confirmation of the instability of a Colles' fracture in the reduced position. At the conclusion of the operation the stability against shortening was gratifying, but during convalescence several of them collapsed in spite of the inserted bone (Fig. 113); this suggests that the dead bone of the graft did not take part in rapid union and was still exerting a delaying action on consolidation. However, an outstanding feature of the post-operative recovery was the absence of swelling and pain in the fingers which is such a common sequel to the Colles' fracture treated in plaster. This circulatory embarrassment is due to collapse of the fracture, rendering the wrist shorter and wider than it was at the moment when the plaster was applied with the fracture fully reduced. With this experimental operative technique a *padded* plaster could be used, because early collapse was prevented and no constriction developed. Despite this attractive and most important feature, it was felt that the operative method was unsuitable for routine use in a busy hospital and that in the hands of those on whom the reduction of

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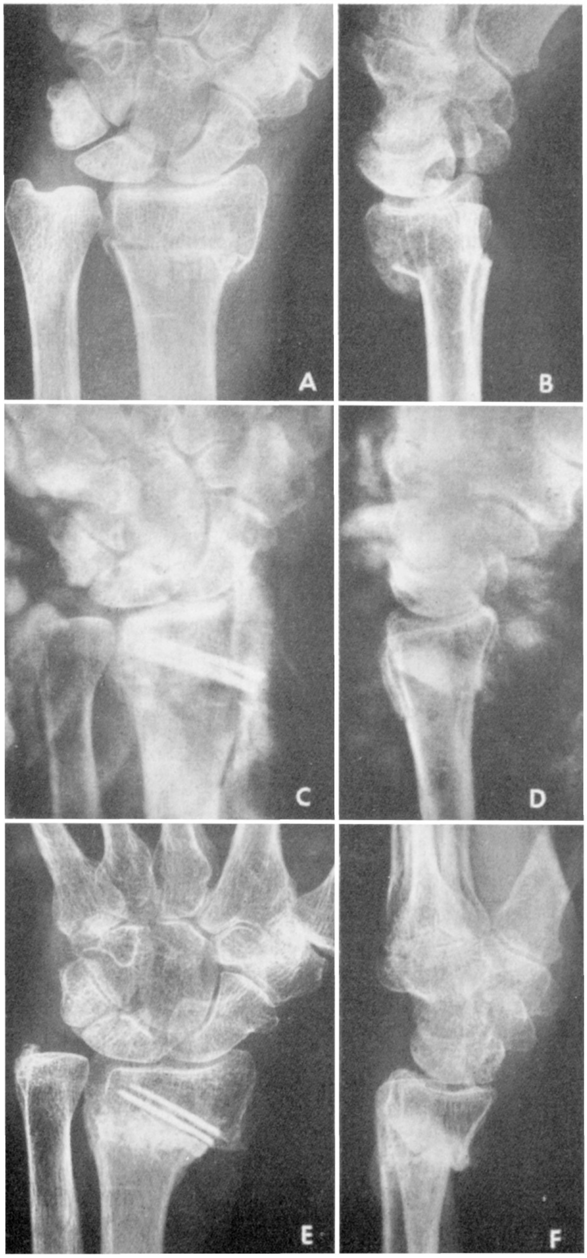

FIG. 113
See text.

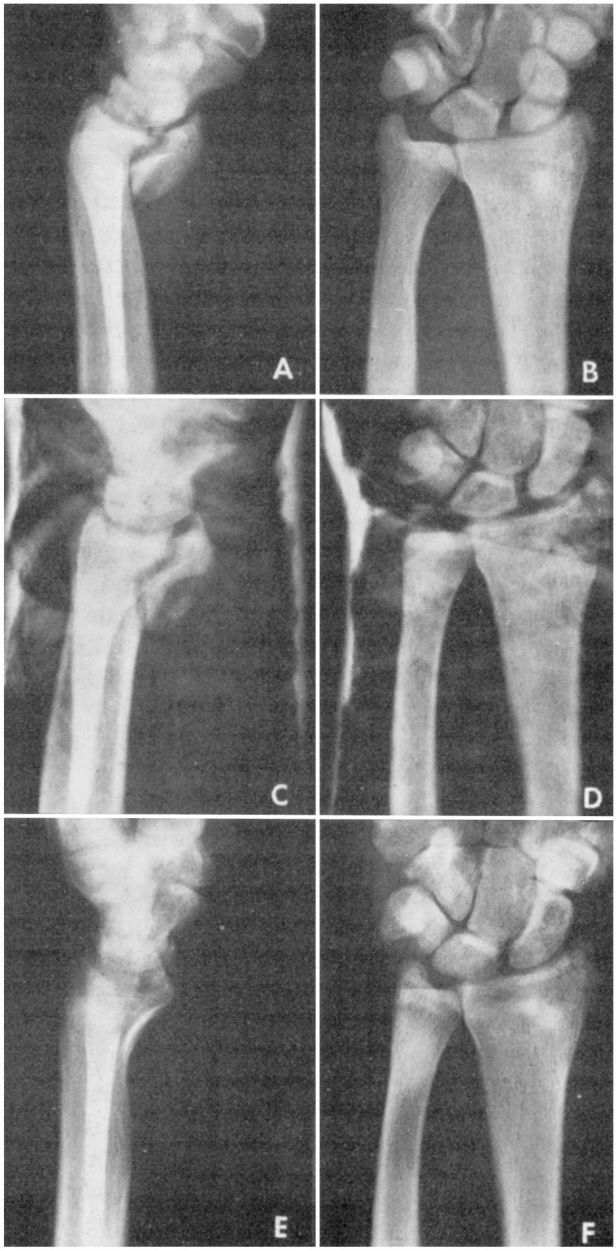

FIG. 114

Reversed Colles' fracture (Smith's fracture). Reduced, and held in plaster, in supination. The simple 'cock-up' position, logically the reverse of that used for the Colles' fracture, will not hold this reduction.

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most of these fractures devolve in British hospitals there would be complications making it unjustifiable; but the technique may well be of occasional use in selected cases and in expert hands. It is a matter of opinion whether perfect anatomical restoration with a surgical scar on the exposed radial aspect of the wrist is cosmetically superior to slight radial deviation without a surgical scar.

Delayed Reduction of the Colles' Fracture

The Colles' fracture is eminently suitable for delayed reduction and indeed I believe that whenever possible the method of choice is to permit the main swelling of the wrist to occur before attempting reduction. If the fracture is reduced and plastered immediately, or within an hour or two of having been sustained, severe swelling of the fingers is almost certain to occur, causing great pain and the necessity for splitting the plaster (and the splitting of the plaster can be a very painful procedure even if only a plaster slab has been used). Severe swelling of the fingers is all too common after a Colles' fracture and is a threat to ultimate function. A little common sense and clinical judgment must be used in recommending delayed reduction, and obviously some patients will be having pain as a result of the deformity and pressure on neurovascular structures, and delayed reduction should only be considered in patients who have little or no spontaneous resting pain. If suitable for delayed reduction a light padded cast can be applied to the recent Colles' fracture and the patient brought back at a more convenient time twenty-four to forty-eight hours later, by which time the patient will be fully prepared for anæsthesia, and much less finger swelling will be encountered after reduction.

Reversed Colles' Fracture (Smith's Fracture)

The reversed Colles' fracture, and the anterior marginal fracture of the radius, is a fracture-dislocation of the wrist in which the carpus is subluxated in a palmar direction. Though the displacement is easy to reduce by applying traction there is always a strong tendency for redisplacement in plaster when traction is removed. It is traditional to recommend that the wrist should be splinted in dorsiflexion, because the deformity is the reverse of a Colles' fracture, and pious hope is expressed in the advice of those who recommend that the shattered anterior lip of the radio-carpal joint can be moulded back into position by local pressure at the time of the reduction. It has been pointed out to me by F. Brian Thomas of Hereford that the reversed Colles' fracture can often be held in the reduced position by applying a plaster with the wrist in *full supination.* It is necessary to incorporate the elbow in plaster in order to hold the fully supinated position. In full supination the tendency for the radius to fall into pronation automatically forces the fragments into the reduced position. That this very simple technique may be the answer to this very difficult injury is indicated by the example illustrated in Fig. 114.

My objection to the treatment of the Colles' fracture in full pronation, by incorporation of the elbow in the plaster, does not apply here because the displacement of the Smith's fracture is so much more disabling than Colles' and often occurs in younger patients.