CHAPTER FOUR

THE TREATMENT OF FRACTURES WITHOUT PLASTER OF PARIS

HOW often we see plaster of Paris applied merely because X-ray examination has revealed a small crack or undisplaced fracture! On many such occasions the surgeon would probably have treated a case without plaster had he used his clinical sense alone; he would then have been treating the injury according to his estimate of the damage inflicted on the soft parts. It is a platitude to say that soft-part injuries can be more serious than mere cracks in bone. One of the commonest instances in which the clinical assessment of an injury by soft-part damage is more important than the radiological is seen in severe ankle sprains where simple X-ray reveals 'no bone injury.' If an ankle presents very gross swelling, with extensive ecchymosis and solid induration due to the tension of the swelling, it is highly likely that there has been a rupture of the tibiofibular syndesmosis or of the external lateral ligament, and late displacement of the talus or recurrent subluxation of the ankle will occur if too early function without plaster is permitted. On the other hand, patients are frequently prevented from returning to work by plasters which are not essential but which are forced on them by surgeons who think only in terms of routine procedures and do not adjust their method to the demands of the individual problem.

It frequently happens that a surgeon is obliged to X-ray limbs for the medico-legal implication of an injury; but the result of this examination need not make him change his clinical judgment too lightly (p. 85, Fractures of the Scaphoid). The penalty of using plaster of Paris unnecessarily when compensation is being claimed is just as serious as the danger of using too little plaster. To put an unnecessary plaster splint on a patient who has a strong compensation neurosis, or worse still, one who is wilfully exaggerating his case, is to play into the hands of a litigious patient.

A popular impulse to apply plaster to practically anything in which the X-ray shows a fracture would seem to spring from an unvoiced belief that plaster is some sort of dressing which, when applied to the skin, accelerates the healing of the underlying bone. It is as well to remember that the human species has survived in the struggle for existence by making a fair attempt to unite its own fractures during the millions of years which preceded the discovery of plaster of Paris. A critical mechanical inquiry into the motive for applying a cast will often show that the aim of 'immobilisation,' by which plaster is fondly supposed to act, often results in nothing of the kind. It is true that the liberal application

of plaster to all and sundry of the minor fractures encountered in a casualty department can do no serious harm to any, and may do good to some; but there is, however, a deeper motive for criticising the too liberal use of plaster. The healing of bone and the recovery of flexibility in soft tissues are phenomena which are basic to the work of the orthopædic surgeon. To understand the materials of his trade the surgeon must observe the behaviour of these materials just as much in the untreated as in the treated case. The casualty surgeon must snatch at any opportunity which presents itself for observing how quickly the untreated Colles' fracture becomes painless and how quickly the full power of the grip returns. It is, moreover, from the behaviour of healing fractures that the basic operations or arthrodesis and bone grafting derive and from these the greater part of modern orthopædic surgery is built. It is by observing the behaviour of the 'minor' fracture that the orthopædic surgeon learns to think in terms of healing bone; if this period of his training is circumscribed by dogma and devoted purely to the execution of routines (*i.e.*, Colles', four weeks in plaster; tibias, twelve; scaphoids, six; etc.), his apprenticeship has been wasted.

PRINCIPLES IN THE TREATMENT OF FRACTURES WITHOUT FIXATION

The treatment of fractures without rigid external fixation is no new idea; the method was advocated many years ago by the French surgeon Lucas-Championnière who described in elaborate detail a system of massage for each fracture and dislocation. Many of the reasons why the method could never be popular are economic: thus it would require an enormous personnel to administer it to an industrial region and a large number of hospital beds would be required, whereas plaster fixation renders domiciliary treatment possible. At the present time the treatment of minor fractures without splintage tends to receive insufficient publicity (though most surgeons instinctively practise it when the occasion arises), and interest is aroused only when major fractures, such as those of the os calcis or the spine, are treated by early movement. Yet it is in the common, minor fracture that the advantages of abandoning external fixation are most apparent.

In the following paragraphs an attempt is made to indicate what type of fracture can be treated without plaster fixation and what general principles might guide the surgeon in choosing this treatment, but before this can be done it is first necessary to expose certain **popular misconceptions regarding plaster fixation**:

1. That the fragments of a fresh fracture are always mobile unless fixed by artificial means.
2. That a plaster cast will prevent such mobility.
3. That displacement will increase if the limb is not splinted.
4. That plaster fixation accelerates fracture healing.
5. That the quality of the end result will be better after treatment with plaster than without.

That the Fragments are Mobile if not Splinted

In the mechanics of fixation the fractured shafts of the long bones differ considerably from the short bones. Errors in the treatment of fractures of the short bones often have their origin in the application of principles which are only indicated for fractures of the long bones. When we attempt actively to elevate, without splintage, an extremity which contains a fractured long bone, movement at the fracture is produced by the weight of the distal limb acting through the leverage offered by the long fragments. In fractures involving the short bones, the length of the levers and the weight of the distal limb are both small and, unless muscular contractions generate an indirect force, there is practically no strain imposed on such fractures during gentle and restricted movements of the associated joints. Relative to their length, the short bones are of large diameter, which renders them mechanically stable when fractured, whereas the long bones, being narrow in comparison with their length, are exceedingly unstable when fractured.

In fractures through cancellous bone, impaction is common and this offers one obvious explanation of the absence of movement at a fracture when the whole limb is moved. In the long bones impaction is impossible because both fragments are of ivory bone (a fact which students often seem to overlook), but impaction of an ivory shaft can take place into the cancellous extremity of a long bone, as is commonly seen in the Colles' fracture and less commonly in necks of the femur and humerus.

In the miniature long bone—the metacarpals and metatarsals—isolated fractures are splinted by the adjacent bones through the strong interosseous ligaments which bind them together.

Fractures of cancellous and cortical bone differ considerably in their rate of healing. Whereas a fracture in the shaft of a long bone may be mobile for six weeks (because of the great leverage on the fracture site and scanty callus), a fracture in cancellous bone may be clinically firm in this time though it would of course be unfit to bear weight until true consolidation had occurred.

In recent fractures it seems reasonable to interpret pain on the movement of adjacent joints as a sign that the fracture is being disturbed. That the pain in a recent fracture does in fact come from the fracture itself is shown by the absence of pain when local anæsthesia is introduced into a fracture hæmatoma. Therefore it can be considered as an axiom that, in a recent fracture, as long as a range of movement is possible in neighbouring joints without evoking pain in a healing fracture, no significant movement is taking place at the fracture site; **significant movement at a fresh fracture is threatened only when the painless range is exceeded.**

That a Plaster of Paris Splint prevents Movement in a Fracture

Perkins has attempted to rationalise the teaching of fracture treatment by dividing the functions of splints into two types; these serve the functions respectively of 'simple splintage' and 'immobilisation.' The *simple splint* is

capable only of controlling gross external deformity of the limb as a whole; that is to say, it will hold the fragments in alignment while healing is taking place, and will result in the restoration of the normal external shape to the body. The function of *immobilisation*, on the other hand, implies the absolute abolition of microscopic movement between the bone ends during the process of healing. It is obvious that there is no method of external splintage which could fulfil this definition of immobilisation, and therefore some form of internal fixation by a metal splint or bone graft is the only perfect means of enforcing it. Even in fractures of the carpal scaphoid it is doubtful whether the most skilfully applied plaster splint can immobilise the fragments, because of the movement which is possible between the skin and bones. Similar reflection will show how futile it is to expect a walking plaster to immobilise a fracture in the tarsus or metatarsus; at every step of the foot the soft cushion of tissues in the sole of the foot is compressed and the arches of the foot deflect under the body weight and spring back again when the weight is relieved (Fig. 66). A walking plaster for such fractures is actually no more effective than a leather boot. In recent fractures of the forefoot treated in a walking plaster the patient invariably walks with weight on his heel during the first week or two; only when healing is moderately advanced does he permit the forefoot to exert any pressure on the sole of the plaster. In Fig. 67 is seen a fracture of the first metatarsal treated by this method; the patient was walking in a boot and without pain by the fourth week and was back at work in six weeks.

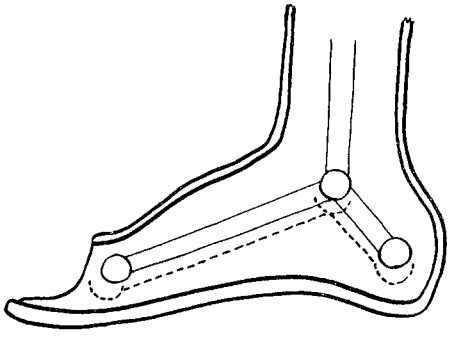

FIG. 66

Diagram illustrating futility of the idea that a walking plaster can immobilise the tarsus. Under body weight the arches of the foot deflect and the soft tissues in the sole of the foot are compressed whether the limb is in plaster or not.

That the Displacement will Increase if not Splinted

On viewing the X-ray of a recent fracture there is often a subconscious fear that the deformity will increase unless a plaster is applied. A spontaneous increase in deformity is inevitable if fractures of the shafts of the long bones are left without artificial support, because the leverage of long fragments alters the displacement at every change in the patient's posture by reason of the heavy weight of the distal limb. But this is not true of many of the smaller fractures; **in fractures of the short bones the displacement is limited by the extent to which the tough fibrous elements in the vicinity have been torn.** It is thus unlikely that a displaced fracture of a short bone will move beyond the initial position of displacement unless further violence is used to rupture more fibrous tissue.

There is one important exception to this statement, mentioned on page 32. There is always the possibility that what may be diagnosed as an 'undisplaced' fracture, judged by the initial radiograph, may have been grossly displaced at the moment of the injury and in the process of first-aid splintage may have been reduced into almost perfect position. Subsequent displacement, as a result of ligaments and soft parts being torn, may later take the surgeon by surprise. This accident is a trap for the unwary in the case of the ankle fractures. It is very unlikely that a bi-malleolar fracture could have been sustained without considerable tearing of soft parts, so beware the diagnosis of 'undisplaced' fractures if bi-malleolar, because if early weight-bearing in plaster is permitted (which is a reasonable thing to do in an undisplaced fracture) it is probable that the original

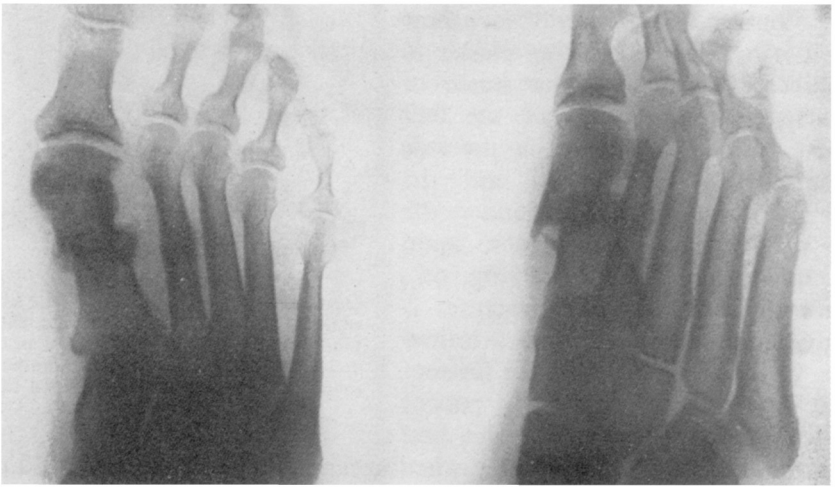

FIG. 67

Fractures of the shaft of the first and second metatarsals treated without plaster of Paris. By walking on his heel this patient was able to keep on his feet and was back at light work in six weeks.

deformity will develop. This accident is especially likely to catch the unwary surgeon because one does not usually insist on repeated radiographic checks of the position when the original diagnosis is an undisplaced fracture, and thus the first intimation of displacement may be when the plaster is finally removed.

When a fracture has been reduced by manipulation it will always be necessary to apply a splint to prevent recurrence of the initial displacement; but **if an attempt at reduction fails and the position is thereby not improved, splintage is no longer essential** and treatment by early movement may then offer certain advantages.

That Plaster Fixation will Speed Healing

Prompting the application of many plasters is the fear that a fracture may fail to unite unless it is splinted. The fear of pseudarthrosis is often quite unfounded

and often arises by loose inference from isolated cases which are erroneously regarded as instances of a general principle. In fractures of the long bones some form of external fixation is absolutely essential in order to restrict gross movement, but these factors are absent in the short and the miniature long bones and therefore in these it is to be expected that healing might proceed without external fixation. There are two notable exceptions to this statement, namely: fractures of the carpal scaphoid and of the neck of the femur. The specific nature of these two examples is shown by the fact that they should be further particularised into fractures of the *waist* and *proximal pole* of the scaphoid, and of the *midcervical* and *subcapital* region of the femoral neck. The common factor which isolates this small group from fractures of the rest of the skeleton is the complication of *ischæmic necrosis*. It cannot be too strongly insisted that ischæmic necrosis is a *complication* of fracture repair and that the study of fracture healing must not include such instances in the healing of 'normal' fractures. The disaster of pseudarthrosis which follows the treatment of a fracture of the carpal scaphoid by early mobilisation is so well known that it is not surprising it should influence the treatment of other injuries. There is, however, no logical reason why fractures of the cuneiform, os magnum, or tubercle of the scaphoid should be treated by rigid external fixation. It is possible that further study may show that ischæmia is a factor in all fractures where slow union is common, but for practical purposes the condition of ischæmic necrosis is to be regarded as a complication only encountered in a few well-known sites, such as the talus, the medial malleolus, dislocations of the semilunar, dislocation of the hip, and sometimes in the distal thirds of the shaft of the tibia and of the ulna.

As regards the effect of plaster fixation on the speed of fracture healing, it hardly needs to be pointed out that plaster cannot *accelerate* healing; plaster merely ensures that the limb will be in good alignment when healing has taken place. The rate of healing is a function of the activity of the osteoblast and in all probability healing takes place, under normal conditions, according to certain time phases related to various chemical and physical changes. But though these processes cannot be accelerated they can easily be inhibited by unfavourable external conditions; the final stages of ossification can be delayed by faulty blood supply or by gross and continuous movement. **The aim of fracture treatment is to eliminate all deleterious influences rather than to accelerate union.**

That the Quality of the Result is Better after Plaster Treatment than Without

This belief arose from the teaching of Böhler who taught that by applying plaster to enable the splinted limb to be used, static muscular contractions would maintain the blood supply and thereby accelerate union. Böhler believed that by preventing 'intercellular œdema' the stiffening of joint capsules as the cause of permanent stiffness would be eliminated. Though containing much truth the result of this dogma has not supported his claims; delayed union of the tibia still remains a common occurrence, joint stiffness occurs as often as after any other method, and late œdema is a frequent complication following removal of the plaster splint.

But apart from theoretical matters one must face a practical question. Can any significant saving of time be effected in treating fractures without plaster? In the upper extremity there is no doubt that some saving of time is possible by treating suitable fractures without plaster, and that the patient, particularly if a professional man, may find the convalescence more tolerable without plaster (*i.e.*, facilities for washing and being normally clothed, etc.). In the lower extremity, however, the saving of time is less significant. Many small fractures (as, for instance, an undisplaced fracture of an external malleolus) may be completely rehabilitated within four weeks if treated in a flexible dressing, but against this is the fact that the patient may be totally incapacitated from work for the first two weeks, whereas in plaster he may be ambulant earlier though with a slightly longer overall disability.

CASES SUITABLE FOR TREATMENT WITHOUT PLASTER

The following list comprises those fractures which are suited to early mobilisation without plaster fixation :

Shafts of fibula.
Tarsal bones.
Metatarsals.
' March ' fractures.
Styloid process of fifth metatarsal.
Phalanges of toes.
Metacarpals.
Os calcis.
Tibial condyles (in the aged).
Thoracic spine.
Olecranon (if undisplaced).
Patella (if stellate or transverse without separation).
Elbow fractures.
Tuberosity of carpal scaphoid.
Other carpal bones (excluding waist of scaphoid).
Mild compression fractures lumbar spine.
Pelvis.
Central dislocation of the hip.

POSITIVE INDICATIONS FOR PLASTER FIXATION

To contrast with the preceding list of fractures suitable for treatment by early movement, the *positive indications for the treatment of fractures by plaster* might be stated in the following terms :

1. To maintain a position secured by reduction.
2. To ' immobilise ' if movement is likely when adjacent joints are moved.
3. To ' immobilise ' when one fragment is prone to ischæmic necrosis.
4. To permit weight-bearing in order to stimulate bony union in delayed union of long bones.
5. For economic reasons, *i.e.*, to evacuate hospital beds or make a patient ambulant for his personal convenience.

THE PRESSURE BANDAGE

In the treatment of simple fractures without plaster of Paris the application of a well-designed and well-applied pressure dressing often does not receive the

attention which its importance merits. A carefully applied pressure dressing can provide some degree of *splintage by reason of its rigidity* and yet at the same time allow of *movement through a restricted range.* The efficacy of bandaging painful joints is well known in veterinary practice and the methods of the hunting field which can keep a horse at work with knees and fetlocks bandaged can be applied equally well to the rider.

The most highly organised example of the semi-flexible pressure dressing is that applicable to the knee and often referred to as the 'Robert Jones bandage' (Fig. 68). It consists of three layers of wool and three layers of domette bandage. The layers are put on gently but firmly and the whole bandage extends some

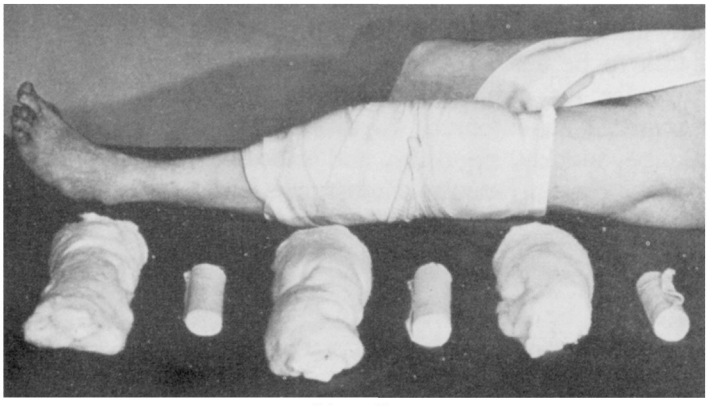

FIG. 68

Robert Jones pressure bandage. Final bandage extends from the mid-calf to mid-thigh, is 2 inches in thickness, and its special features are: local support from its turgidity, control of swelling by its pressure, and slight movement by its trace of flexibility.

6 inches above and below the joint and attains a thickness of about 2 inches. By reaching well down the calf the troublesome swelling of the calf, with painful cutting in of the bandage which results with short knee bandages, is prevented. In this connection it is worth noting that adhesive strapping applied as a pressure dressing to a knee is a most unsuitable and most uncomfortable dressing, and should be avoided at all costs. By reason of its bulk the Jones bandage provides an effective check to movement of more than about 10 degrees.

This type of dressing for the majority of knee injuries is infinitely better than any form of plaster cast; **a plaster is incapable of applying continuous gentle pressure once an effusion has started to diminish.** As soon as the efficacy of this simple but highly scientific dressing is appreciated it will be found that **very few plaster cylinders need be used for the non-operative treatment of knee injuries or fractures of the patella.**