A SIMPLE METHOD OF MECHANICAL FIXATION FOR FRACTURE OF LONG BONES.

By JOS E. ADAMS, M.S.LOND., F.R.C.S.ENG.,
CAPTAIN R.A.M.C.(T.).

SURGEON WITH CHARGE OF OUT-PATIENTS, ST. THOMAS'S HOSPITAL, ETC.

THE methods commonly employed in the operative treatment of fractures are all more or less laborious, and although the results amply justify the necessary expenditure of time and trouble, it appears to me that the methods of carpentry as exemplified by the use of plates, bolts, and screws, require modification in their application to a surgical problem.

The use of a bone graft may be more strictly surgical, but it is certainly laborious even with electrical saws and similar apparatus at the surgeon's disposal. Simplicity in all operative procedures is greatly to be desired, for, when the technique of an operation is easy, the risks of failure are correspondingly diminished. In the case of broken bones it is also most desirable to have a method of fixation applicable to compound as well as simple fractures, and it is the former which in reality present the more difficult problem. Bone grafting in the presence of sepsis is always doomed to failure, and the use of screws is condemned because they carry infection before them into the substance of the bone, they become loose, and they may soon fail to hold a plate in position. It is generally held also that whilst metal plates applied to fractures tend to delay bony union, their function is fulfilled if they hold the fragments in good anatomical apposition during the healing process. It is urged, on the other hand, that the bone graft promotes bony growth, and therefore hastens union. To my mind, the explanation lies in the fact that the graft is used as a wedge to press bony surfaces together, whereas the plate tends to press itself against the bone, and bone to bone is obviously essential for rapid union.

The bone clip of which I give an illustration is designed to partially encircle the fragments and to press them together and thus favour rapid healing of the breach in bone tissue. It is made of tempered spring steel and the upper half of Fig. 1 shows its application in the case of

FIG. 1.

FIG. 2.

an oblique fracture, drawn from an actual specimen. In the lower half of the diagram is seen a clip with a metal flange, designed for the treatment of a strictly transverse fracture, secured by means of a second clip. These clips exercise continuous elastic pressure on the fragments of bone within their grasp and the size selected must be proportionate to the size of the bone operated upon. It is not intended that more than two-thirds of the circumference of the bone should be grasped by the clip. The strength of the spring is quite sufficient to counteract laterally acting forces tending to displace the fragments, and the teeth by which the bone is gripped will resist a force acting in its long axis. All that is necessary after the clip is in position, therefore, is sufficient immobilization by splintage to avoid violent movement and no extension need be applied to the limb. A transverse fracture, as I have found from recent experience, can sometimes be quite well secured by a single clip of the ordinary dimensions, or by one which is made especially wide. It is to be admitted that in the case of a true transverse fracture one does not get the ideal pressing together of the raw surfaces of bone, but this merely indicates the need for longer immobilization of the limb before union can be expected. As a matter of fact the fractures which call for mechanical fixation are rarely absolutely transverse.

The technique of this method of operating is extremely simple, and the only special instruments required in addition to the clip and the introducer are two pairs of Lane's curved bone retractors.

The steps of the operation are as follows: A linear incision is made down to the seat of injury, the long fragments are identified, and the way in which they require to be fitted so as to obtain perfect apposition is noted. In oblique fractures forcible extension with rotation of one or other fragment is usually satisfactory, but with jagged and irregular bone surfaces protrusion of the ends through the wound and then dovetailing them into position by manipulation is the better plan. The muscles are first retracted by Lane's instruments and pushed out of the way, and then the curved portion is passed over the bone between it and its separated periosteum, this separation being largely the result of the fracture rather than purposely carried out by the surgeon. In this way four retractors are placed in position, one on each aspect of each main fragment, in the same way as a tyre lever is passed between a tyre and the rim of a motor wheel; the two pairs can be pushed away from one another along the bone until a sufficient subperiosteal space is exposed for the application of the clip. The bone ends must then be got into perfect apposition and the clip lifted from the instrument table by passing the prongs of the introducer through the small loops at its ends. Nothing which will be introduced into the wound need be touched even by the gloved hand, and the introducer is made of considerable length so that the clip is easily lifted and opened without coming near the surgeon's hand. The next step consists in passing the open clip round the bone at the seat of fracture and adjusting it until it holds the fragments in a firm grip; it is important not to dislodge the introducer until the best position has been obtained, and then a tap with one of the retractors on the side of this will readily disengage the prongs from the loops of the clip, whose spikes give it a firm hold on the partially encircled bone. The strength of this method of fixation can immediately be tested by moving the limb, and the security of the joint will at once become apparent. The spikes or teeth obviate the need for any screws or nails to affix the clip to the bone, and they leave a small space between the metal and the osseous tissue, so that pressure necrosis is hardly to be feared. Even in the femur of a young child they do not tend to bury themselves in the bone, and thus bring the clip into complete apposition with the bony surface. This is an important point, which has a bearing on the removal of the clip, if this should be called for at a later date.

The accompanying diagram shows the operation completed as far as the bone is concerned.

FIG. 3.

Since I first described this method of operating on fractures¹ I have gained further experience of its value and am convinced of its suitability in a large number of compound fractures and even gunshot wounds, provided that the treatment is adopted at the outset. I have recently operated on about six cases of simple fracture of the femur at the East London Hospital for Children, and the results have been most gratifying, for in all but one perfect results, functional and anatomical, were obtained in about four weeks, with no shortening. In the exceptional case I have to admit that suppuration occurred, and this has delayed union by a few weeks, and has, up to the date of

writing, caused difficulty in securing movement at the knee-joint, but it has not affected the satisfactory alignment of the femur, and the experience gained by what I admit to be due to some error of technique has emboldened me to extend the use of the clip to the treatment of compound fractures. I may add that this case was a T-shaped fracture at the lower end of the femur, which is a type notoriously difficult of treatment. By frequent examination of these cases I have found that the presence of suppuration appears to double the time for firm union to take place, and in this particular case the bone was solidly united at the end of four weeks, whereas in all the others no rocking at the site of fracture could be obtained a fortnight after operation. Naturally the amount of callus formed in compound fractures is excessive and the healing that one obtains is of the "third degree," comparable to that seen in a septic wound of soft tissues. In the process of healing by first intention of a superficial wound the amount of granulation tissue is limited to the line of the scar, but this result is only secured by accurate apposition of the edges of the wound, which, by suture, are actually pressed together, and I claim that by the use of such elastic pressure as is provided by my bone clip a similar result is achieved, and healing of the fracture occurs by first intention by proliferation of bone cells and not by ossification of callus. It is well known that where there is perfect apposition of the fractured surfaces there is little or no callus formation, but it appears to me that we have been too long content with secondary union of bone, and that in all probability the period of healing in a fracture can be very materially reduced in many cases by operative treatment.

While admitting that these clips naturally fit best over bones with a circular contour, such as the femur, I have found them of considerable service in fractures of the tibia and have used them for difficult oblique fractures which could not be reduced by manipulation. In a recent compound fracture of the tibia, which failed to unite after several weeks' treatment by splintage and the use of a Steinmann's pin to secure extension of the lower fragment, the clip was successfully applied, and was removed at the end of about four weeks, when solid union had been secured, and the small granulating wound which had been present healed rapidly. As to the removal of these clips, I have devised no special instrument for the purpose, but I have had the introducer made in two pieces, so that each prong can be inserted in one of the loops and the instrument locked in a similar way to that in which mid-wifery forceps are applied. As a matter of experience, however, it is difficult to find these loops without opening up the wound considerably, and I have found that the point of one of the Lane retractors can be used as a lever to lift up the spring and dislodge it from the bone. Except in the case of compound fractures, of course, their removal will seldom be required.

In considering their applicability to the treatment of compound fractures, I wish to lay emphasis on the fact that no screws are required, and therefore there is no penetration of even the cortex of the bone, and very little stripping up of the periosteum is needed to secure a sufficient area of bone for the adjustment of the clip. When once they are placed in good position they grip surprisingly firmly by their small teeth; they act automatically in the case of oblique fractures in securing firm contact of the bony surfaces and withstanding displacement of the fractured ends. As I have already mentioned, the introducer should not be removed until perfect apposition and security have been obtained. I have recently employed one of the flanged clips in the case of a transverse fracture of the femur in a child, the flange being secured to the upper fragment with a clip having no teeth, and have been agreeably surprised by the firm hold obtained, seeing that the operation was not done until three weeks after the injury, when there was already some union in bad position with an inch overlap.

The most important, and unfortunately the commonest, type of compound fracture with which one has to deal at the present time is that due to gunshot wound, and I am convinced that these clips are worthy of trial in cases of this type, selected with due reference to the accessibility of the bone ends, if applied within a short time of the receipt of the wound. They are not open to the same objections as Lang's plates, in that they are not likely to carry infection before them and produce extensive osteitis. In my

experience, they are calculated to hasten the repair of the fractured surfaces even in the presence of infection, and I do not think that the treatment of the wound by Carrel's or similar methods would in any way militate against their efficiency as an internal splint. That such an internal splintage for the treatment of gunshot wounds of the femur and the bones of the upper extremity is desirable must be obvious to any one who has had to do with the compound fractures of the present war with their tendency to angular deformity, their shortening, and the disability of adjacent joints due at the same time to the necessity for prolonged splintage and the imperfection of every kind of external splint. It is idle to deny that these splints all possess drawbacks, and the simple explanation of their inefficiency is that we do not obtain sufficiently rapid union of the bone, but if care is exercised in the selection of cases and such clips are applied at the first dressing under anaesthesia, I believe our end results can be improved. Oblique fractures are obviously most amenable to this method of fixation, but I do not think the existence of comminution is any bar to success, and this type of fracture is much more common than the transverse. When there is a considerable gap in the bone some form of external extension apparatus is clearly required if the normal length of the limb is to be retained, and clips are not suitable. In compound fractures they should be removed as soon as the bone is solid enough, for otherwise they might be the cause of a persistent sinus.

The necessary apparatus has been made for me by Messrs. Lewis and Sons, Westmoreland Street, W.1, and one introducer suffices for all sizes of clips, since the prongs can be separated from contact up to three inches. The clips are made of spring steel in diameters ranging from half an inch to one and a half inches with quarter-inch increments. Those suitable for oblique fractures are provided with teeth turned over from the edge by which they grip the cortex of the bone, but I have found that in the case of the flanged clip for transverse fractures the flange is best held in contact with the bone by a clip without teeth so that it rests close against the bony cortex, after passing over the steel flanges. It is desirable always to use the smallest clips which will embrace the bone so as to secure the maximum degree of elastic pressure, and, at present, they are made of the lightest steel which will stand the necessary strain. It is desirable to open the clips with the introducer slowly and gently since with all their tempering they are apt to be slightly brittle.

Owing to difficulty in producing skiagrams satisfactorily at the present time, I regret that I am unable to illustrate this article with examples of cases operated upon, but I hope to do so at a later date. One of the satisfactory features of the operation is that in a straightforward case of simple fracture it can all be done easily in half an hour. In applying them to compound fractures where the bony surfaces lie already exposed in the wound the necessary steps would only add a few minutes to the length of the operative procedure.

REFERENCE.

¹ *Lancet*, May 12th, 1917, p. 725.

ACCORDING to a statement recently made by the New York State Department of Health, during the first nine months of 1917 motor cars caused 775 deaths in that State, being more than the number due to typhoid and scarlet fever taken together. In September such accidents were responsible for 155 deaths, more than the combined mortality from murder and suicide. The number of deaths caused by motor cars exceeds the number for the corresponding period of any previous year.

SWITZERLAND is believed to be one of the countries most afflicted with cancer. The Association Suisse pour la Lutte contre le Cancer has undertaken to collect statistical and clinical notes as to the most frequent localizations of the disease. Cancer of the breast, the increase of which is particularly notable, has been chosen as the first subject for investigation. The inquiry will be directed to the influence of lactation, inflammatory affections, and the pre-existence of mastitis, fibro-adenoma, and cysts, and of operation on prognosis in general and the formation of metastases in particular. Other points are the value of x-ray, radio-active, and other methods of treatment. All practitioners in Switzerland are invited to supply information as to cases treated by them from 1911 to the end of 1915. A special appeal for help in the inquiry is made to the surgical staff of hospitals and to pathological institutes.