adhesive strapping are applied; these strips are prolonged about twelve inches beyond the end of the stump and attached to the aluminium ring. The ring is then suspended by three pieces of cord, tied to it equidistant from one another, the cords passing through pulleys hooked to a

FIG. 1.—The extension apparatus applied to a stump after amputation through the upper third of the arm.

Balkan splint, to which an extra bar of wood has been bolted (Figs. 1 and 2).

The free ends of the cords are tied together and one or more weights are hooked on, at or near the point of junction, so adjusted that the tension on the three cords is approximately equal. For a thigh amputation a weight of about 8 lb. is used, and for the arm about 5 lb. suffices. For an amputation stump of the lower extremity, the foot of the bed is raised on blocks to provide counter-extension.

The wound is accessible for dressing through the open ring, the pull on the soft parts being kept up uninterruptedly.

The method is used as soon as the acute inflammation of the wound has subsided. If long flaps have been fashioned, they are pulled down by the appliance and their edges approximated. If it has not been possible to form

FIG. 2.—The extension apparatus applied to an amputation stump of the thigh.

long flaps the bone may not be covered, but the soft parts are kept from retraction until such time as a secondary removal of bone can be carried out.

When the wound is granulating and sufficiently healthy to permit of partial closure, the soft parts are dissected up from the bone, and the necessary amount of the latter is removed; in some cases the skin edges can be approximated by a few mattress sutures, free drainage being provided. The extension is then reapplied and kept up until the wound is completely healed.

If at the first operation it is possible to suture the amputation wound, it is advantageous to take the tension

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off the flaps in the way here described, and for the same purpose it may be of use for amputations in civil practice.

The appliance allows the patient free movement and encourages mobility of the joint above; if necessary, the position of the Balkan splint is moved from day to day for this purpose.

I have used the aluminium ring attached to a Thomas's splint, but the method of extension by weight and pulley gives more powerful and continuous traction than a fixed extension, it allows more movement in the joint above, it adjusts itself to the patient's movements in bed, and he is more comfortable and more easily nursed.

I wish to express my thanks to Lieutenant-Colonel T. McDermott, R.A.M.C., for permission to publish this note, and to Lieutenant C. H. Hopwood, R.A.M.C., for the photographs with which my description is illustrated.

REFERENCE.

¹ BRITISH MEDICAL JOURNAL, October 16th, 1915, p. 574.

A METHOD OF TREATING GUNSHOT FRACTURES BY AN EXTERNAL FIXATION APPARATUS.

BY

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THE difficulty of maintaining the bones in good position in some cases of gunshot wound, in which large septic wounds were present, led me to devise this method.

My plan is by means of an aseptic operation to insert into the bone, at a distance from the seat of fracture, screws which are long enough to project well beyond the surface of the skin, and to immobilize the fragments by means of a rigid plate fixed to the screws by nuts, the whole operation being done without interfering with the original wound.

Since I have devised this operation I find that other methods of fixation by means of an external apparatus have been used, but can find no record of such an apparatus being used for the treatment of compound fractures. Parkhill, by means of an open operation, exposed the fractured ends of the bone, placed them in correct position, inserted long screws and fixed them in position by an apparatus external to the skin, afterwards closing the wound. Lambotte has described an apparatus for the treatment of simple fractures by means of a rigid bar external to the skin attached to four long screws inserted into the bone. In this case also the bones are placed in position by means of an open operation, and I can find no statement that he has used it in septic compound fractures. Further, the apparatus also is complicated and expensive.

Experience in all recent wars up to the present has taught that in cases of septic compound fractures the wound should in no case be explored, on account of the risk of the serious spread of infection. But in the present war some surgeons have plated these fractures, leaving the wounds freely open, with excellent results. This operation, I believe, however, is not recommended by the majority of surgeons, the results in many cases being unsatisfactory.

The apparatus which I have been using is shown in Fig. 1. It consists of a plate of the form indicated made

FIG. 1.—The apparatus used in the operation.

of sheet brass $\frac{1}{8}$ in. thick and plated with tin, four screws long enough when fixed in the bone to extend about $1\frac{1}{2}$ to 2 in. beyond the skin, and a pair of nuts for each screw by means of which the plate is fixed in position. The screws I have been using consist of a wood screw thread for screwing into the bone, attached by means of a collar to

a $\frac{1}{8}$ in. steel rod in which is cut a thread for the nuts. The collar by means of which the two are joined forms a shoulder up to which the wood thread is screwed home into the bone. The distal end of the screw has a square section, to which a clock key is fitted for screwing it into the bone.

The operation is performed as follows:

The arm is shaved and the skin cleaned as far as possible the day before the operation, and the parts above and below the wound are covered with a sterile dressing and a mackintosh, to prevent as far as possible any soiling by the discharge from the wound. When the patient is under the anaesthetic the wound is covered with dressings

FIG. 2.—Arm after operation.

and a sterile bandage, the whole of which is painted with tincture of iodine. The bandages above and below the wound are then removed, the skin is well cleaned with petrol or acetone, and when quite dry is painted with iodine.

The limb is then manipulated to bring the fragments into as perfect position as possible. In the case of the humerus and radius the posterior surface of the bone is selected for operation; in the case of the tibia the subcutaneous surface.

The point for insertion of the first screw is the highest point of the shaft of the bone, paying due regard to important structures, such as the circumflex nerve. A longitudinal incision, $\frac{1}{2}$ in. long, is made over the centre of the surface of the bone at the point selected. With a blunt dissector a passage is cleared down to the bone, the compact layer of which is then drilled with a hand drill. The point of the screw is made to enter the hole, and by means of the clock key is screwed home. It is very important that no pressure whatever shall be used

FIG. 4.—Fractured tibia. Lateral view immediately after operation.

when the screw has once commenced to bite, the clock key merely being held between the finger and thumb so that the screw cuts its own way into the bone. In a similar way the second screw is inserted in the lower end of the shaft. These two screws can now be used if necessary in order to manœuvre the fragments into more perfect position. The plate is then placed in position over these two screws and used as a guide in making the incisions for the third and fourth screws, which are inserted in the same way. Great care must be exercised in inserting the screws parallel to each other and at right angles to the surface of the bone; if this is not done accurately the screws will not pass through the slot in the plate.

The nuts are placed one on each side of the plate on each screw, and when the plate is in position are tightened with a spanner. The wounds through which the screws pass are then dressed with small pieces of gauze soaked in collodion or Whitehead's varnish.

The plate can be bent slightly to counteract any slight error in the position of the screws, but only in the first case I treated in this way was any bending necessary.

The plate used for the radius is made slightly curved to follow the curve of the bone; for other bones it is straight.

In cases of fracture of both bones of the forearm it is only necessary to correct the displacement of the radius, as when this is brought into correct position the ulna always corrects itself. I first noticed this fact by examining skiagrams of several dozens of cases of badly comminuted fractures of the shaft of the ulna in which the radius was intact. In no case was there any linear displacement of the fragments whatever. The only exception I have seen was a case in which the interosseous membrane and muscles were badly lacerated, the upper fragment of the ulna projecting through the wound.

The converse does not hold true on account of the attachment of the pronators and supinators to the radius.

FIG. 3.—The same case. Lateral view of forearm after operation. The screws were left in for nine weeks, during which time there was no rise of temperature, and no suppuration in any of the screw holes.

In the majority of the cases treated in this way there was no rise of temperature whatever following the operation. In one case of gunshot wound of the forearm, with comminuted fractures of the middle of the shafts of the radius and ulna and large septic entrance and exit wounds, the plate was left in position for nine weeks; when the screws were removed there was no sign of suppuration in any of the screw holes. In some other cases there has been some superficial suppuration in some of the screw holes, which did not, however, necessitate removal of the screws till firm union was obtained.

The great advantages of this method are: First, that the apparatus is simple and inexpensive; those I have used have been made on the premises by the engineer at Graylingwell War Hospital, Chichester, at the cost of a few shillings. Secondly, that the operation is simple and rapidly performed, the original wound is not interfered with, and healthy tissues are not extensively opened.

I have not tried this method in cases of fracture of the femur, as most of our cases have been four or five weeks

FIG. 5.—Fractured tibia. The same case, four weeks after removal of screws. Lateral view.

old when admitted. The apparatus, however, would be suitable for cases sufficiently recent to enable one to get the fragments into position by extension on the operating table. For this purpose I have had screws made sufficiently long to pass right through the femur, thus penetrating both compact layers of the bone, and so giving much greater strength to the apparatus.

With suitably shaped plates I intend to try it in cases of fractured jaw, clavicle, and other bones.

Owing to the difficulty of joining a wood screw to one with a thread for nuts the collar is somewhat clumsy, and I am now having screws made in one piece, the thread for screwing into the bone being cut with an ordinary die and at the end being ground to a point in such a way that it forms a tap to cut its way into the bone.

P.S.—Messrs. Down Bros. are now making these plates of steel in four sizes for radius, tibia, humerus and femur, and screws for these made in one piece.

THE late Surgeon-Major Frederic Carter, of Ongar, Essex, who served in the Mutiny, left estate valued at £34,343.