FIG. 3.—Radiogram of same patient seven months after grafting. Note that the grafts give the densest shadows in the foot.

FIG. 4.—Lateral radiogram showing the hinge in the graft at the level of the joint between the os calcis and the astragalus.

FIG. 7.—Antero-posterior radiogram of same patient as Fig. 6. The lowest half arrow-head marks the hinge on the fibular side.

[Figs. 1, 2, 5, and 6 are reproduced in the text.]

R. W. POWER: FRACTURE-DISLOCATION OF THE ANKLE-JOINT.

FIG. 1.—Antero-posterior view of injury, showing displacement of the medial malleolus and fracture of the fibula.

FIG. 2.—Lateral view, showing an anterior dislocation and forward displacement of the medial malleolus.

FIG. 3.—Antero-posterior view the day after the fracture-dislocation had been fixed in a three-piece sectional plaster casing; the alignment was considered satisfactory.

FIG. 4.—Lateral view (taken at the same time as Fig. 3), showing the anterior dislocation and forward displacement of the medial malleolus corrected.

FIG. 5.—Taken eight weeks after injury. Shows the position to be similar to that in Fig. 3.

FIG. 6.—Taken at the same time as Fig. 5. Shows the position to be similar to that in Fig. 4.

suture. When I was house-surgeon with Lord Lister in 1873 he had then begun to extend the scope of his operations, having full confidence in his antiseptic system. The two great objects Lister had in view when he came to Edinburgh in 1869 were, first, the importance of perfecting his technique in the matter of dressings so as to make them reliable for excluding the micro-organisms from the wound during its healing; secondly, he was desirous to increase the scope of his operations so as to furnish further evidence of the reliability of his antiseptic system of surgery. The cases he selected to extend his operative measures were the remedying of bone deformities and the wiring of ununited and badly united fractures. At that time he used silver wire, but was unwilling to leave the wire *in situ* after union had taken place, and it was nearly always removed, as,

apparently, he regarded it as a foreign body that might be an irritant and the cause of future trouble. The case reported to-day shows that he had evidently departed from that view, and had had no hesitation in leaving the wire *in situ*. It is interesting to note that he had left intact the olecranon process of the ulna, and I learn from Dr. Stewart of Halifax, N.S., who was then working with him in London, that when that process of bone was not diseased Lister was in the habit of leaving it. It is interesting, too, to note that the articulation of the upper extremity of the forearm bones with the anterior of the humerus about one inch above its lower end allowed the projection of the latter considerably beyond the joint, there being no surface of bone against which it worked, and which would have ensured its attrition.

A HINGED GRAFT FOR UNSTABLE FEET.*

BY

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(With Special Plate.)

In February, 1926, Rutherford Morison and W. Mackenzie published a method of treating cases of paralytic foot-drop in children.¹ In children, as in animals, it is notoriously difficult to secure ankylosis by operating on unstable joints without injuring the growing ends of bone. Morison and Mackenzie solved the problem for the ankle by taking osteo-periosteal strips from the tibia and implanting them into beds cut in the bones of the leg and tarsus. The grafts became "osseous ligaments" which completely fixed the joint.

This method of osteo-periosteal grafting is capable of wide application, and takes rank, I believe, with the notable contributions to orthopaedic surgery of the past twenty years. But while these grafts give the best available way of procuring absolute fixation in children with foot-drop, there are many unstable feet in which some movement may with advantage be preserved. Apart from those limbs in which enough contractile force remains to permit of tendon transplantation, there are others with muscles either unsuitably placed or too weak to be used with effect.

Talipes Calcaneo-Valgus.

The deformity of talipes calcaneo-valgus is a case in point, and many imperfect remedies have been proposed for its correction. Transplantation of the peronei is inadequate whether (a) their tendons are fixed directly to the inner border of the foot, or (b) are used to replace the long extensors of the toes, while these in turn are shifted to a medial insertion.

Tendon fixation is often followed by stretching, and astraglectomy—in young children at least—frequently results in an inward rotation of the front of the foot. At best, too, astraglectomy gives a squat, unshapely ankle. The need, then, in this deformity is for the strongest possible support compatible with useful movement, and this may be obtained by fixing the unstable articulation in bony splints provided with a false joint or hinge.

The Hinged Graft.

My first experience with osteo-periosteal grafting showed me that the method held an unexpected resource. Morison and Mackenzie, intent upon absolute immobility, fixed their cases of "dangle foot" firmly in plaster immediately after operation; the first dressing was done a month later, and the foot was at once put back into plaster for a further six weeks.

In my patient, whose peroneal nerve had been divided at another hospital in the treatment of a tuberculous fibula, there was a healing tuberculous ulcer on the dorsum of the foot which made enclosure in plaster undesirable. After grafting, therefore, his leg was put on a back-splint

with the footpiece set at a right angle. In spite of the unpromising skin condition the wound healed by first intention, but bandages, of course, could not give the rigid fixation of plaster-of-Paris. Small movements must have occurred, for after thirty-eight days a few degrees of mobility were present in the ankle. Radiograms showed that the grafts had fused respectively with the bones of the leg and tarsus, but where they crossed the ankle there was in each a small hinge. An opportunity soon occurred for utilizing this chance discovery.

A child, aged 7, who had had untreated infantile palsy for three years, was brought to me with a very marked calcaneo-valgus deformity. The right foot could be dorsiflexed till the instep touched the leg; the outward displacement, too, was extreme. Postural treatment in over-correction did not diminish

FIG. 1.—Girl, aged 7, three months after treatment of extreme calcaneo-valgus deformity of the right foot by hinged grafts.

FIG. 2.—Same patient as Fig. 1, seven months after grafting, standing on grafted foot.

the deformity, and I determined to try the effect of osteo-periosteal grafts. I employed the following procedure.

After the usual "double" preparation of the skin on two nights preceding operation, an incision was made which curved on to the tarsus behind each malleolus. The knife used for incising the skin was discarded and the skin edges were excluded from the wound by side curtains. (I find in orthopaedic operations which require neighbouring incisions that side curtains are best fixed to the lips of the wound by Michel clips, which occupy less space than towel forceps.)

On the medial side the tendons of the tibialis posterior and the flexor longus digitorum were dislodged from behind the malleolus and raised from the tarsus. On the lateral side the peronei were similarly dealt with. Grooves were then gouged in the beds of these tendons. An incision over the tibia (Fig. 1) allowed two grafts to be outlined with a knife on its subcutaneous surface; these were cut with a chisel from the tibia in the form of pliable strips of periosteum encrusted with bone, and were laid with their bony face on the gouged grooves. The displaced tendons were sutured back into position over the grafts and thus held them in place. Neither the grafts nor any part of the wounds were touched except with instruments. Unchromicized (and untouched) catgut was used for suturing, and the knots were tied with forceps. The skin was closed with Michel clips only, exact coaptation being secured by the transverse needle scratches which preceded the incisions.

* A paper read before the Egyptian Branch of the British Medical Association, January, 1927.

After-Treatment.

The limb was bandaged to a long back-splint, with the foot at a right angle to the leg, for one month. At the end of this time there was, as in my first case, a small degree of movement at the ankle-joint. The foot and leg were put into plaster for another month, and the child was allowed to stand on the plaster casing.

Three months after operation radiograms showed the grafts as well defined bony structures on either side of the ankle, with a distinct hinge at the level of the joint. The gait at this time was greatly improved though still rather clumsy.

Six months after operation the child returned for examination, when the photographs and radiograms shown in Figs. 1 to 4 were taken. She could then stand firmly and without deviation

FIG. 5.—Girl, aged 15, before operation, with left calcaneo-valgus deformity and right pes equino-varus (both paralytic).

FIG. 6.—Same patient as Fig. 5, nine weeks after hinge-grafting to correct the calcaneo-valgus of the left foot. (The equino-varus deformity of the right foot was treated by tendon transplantation seven weeks previous to the photograph by the method described by Dr. Handousa. (See p. 666.)

on the grafted foot while the other was raised (Fig. 2). Dorsiflexion of the ankle was present to the extent of 35 degrees, and there were 13 degrees of plantar flexion. The gait would have been normal but for a slight rotation inward of the untreated left leg.

I have since repeated this procedure in a girl of 15 with a paralytic calcaneo-valgus deformity in the left foot.

The right foot was fixed by contracture in the exactly opposite position—that is, in equino-varus (Fig. 5).

I first operated on the calcaneo-valgus deformity, using two osteo-periosteal grafts in the way I have described. I then over-corrected the opposite deformity in the right foot by manipulation and afterwards transplanted the tibialis anterior and extensor

hallucis longus to the outer side of the foot, using a technique for joining and fixing the tendons recently suggested by Dr. Ahmed Handousa, surgical registrar at Kasr el Aini, in the Surgical Unit, whose method is described, with figures, at page 666.

I mention the second intervention because of necessity it prevented weight-bearing on the grafted foot, and so caused such rarefaction of the grafts that at the risk of disturbing the transplanted tendons I made the patient stand for short periods on the plaster casing. After three weeks recalcification of the grafts was well marked, and her left foot was stabilized with a range of about 20 degrees of vertical movement at the ankle.

The strengthening of these grafts with use, shown in the figures of Morison and Mackenzie, who have observed some of their cases for five years, is in contrast to the weakening and stretching which are the end of so many alluring orthopaedic methods.

The hinged osteo-periosteal graft thus has the following advantages in the treatment of talipes calcaneo-valgus:

1. It promises a stability which depends upon function.
2. It requires a much shorter and less complex after-treatment than do tenoplastic methods.
3. It allows useful movements to persist.
4. It does not disfigure the ankle (see Figs. 1, 2, and 6).

Apart from their own peculiar value in calcaneo-valgus deformity, I would suggest that it may be possible by the aid of these grafts to extend the scope of tendon transplantation. The most fruitful cause of failure after this operation comes of stressing the tendons too much or too soon, and I believe that once hinge grafts have splinted a foot so as to prevent lateral or medial deviation the residual muscular force may be exploited with the greatest economy and effect. Thus a peroneal muscle which is too weak to procure both inversion and dorsiflexion (say in a case of equino-valgus) by suitable insertion may be made the dorsiflexor of a foot where deviation is prevented by hinged bony splints. We hope to investigate this suggestion more fully in the Surgical Unit at Kasr el Aini Hospital.

I am indebted to Dr. R. A. Gardner for the radiograms which illustrate this paper.

Summary.

A method is described of splinting an unstable foot by means of hinged osteo-periosteal grafts which allow a useful degree of mobility. The hinge is procured by conning, during after-treatment, at slight movements.

REFERENCE.

- ¹ An Operation for "Dangle Foot," *Surg., Gynecol. and Obstet.*, xlii, p. 178.

THE TREATMENT OF FRACTURE-DISLOCATION OF THE ANKLE-JOINT BY THE THREE-PIECE SECTIONAL PLASTER.

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(With Special Plate.)

THE treatment of fractures has in many cases become standardized and the results so perfect, when the treatment is efficiently carried out, that normal anatomical union and full function can almost be guaranteed. Fractures of the clavicle treated by Sayre's method, of the shaft of the humerus in Jones's humerus extension splint, those of the elbow in full flexion (with the exception of fractures of the olecranon), fractures of the shaft of the femur by extension, and of the neck of the femur by extension and full abduction in a long spica plaster, are fractures which are treated by a universal method, and, generally speaking, the results are good. There remain others which are treated by various methods, and it is little wonder that the results are not uniformly successful. Fracture-dislocation of the ankle-joint is one which comes in this category, as proved by the numerous splints that have been used in its treatment. The box splint, the blanket

splint with two lateral wooden splints, the pillow splint, also with two lateral wooden supports, a posterior moulded plaster splint, Volkmann's trough splint, Dupuytren's, and Syme's horseshoe splint are some of the more popularly used, and are recommended in modern textbooks and writings.

To procure a freely movable ankle-joint with the patient walking without pain after a fracture-dislocation of the ankle is indeed a great accomplishment, but in what percentage of such patients can we claim this? Writing on Pott's fracture Sir Robert Jones¹ states, "Pott's fracture has been generally looked upon as a most disabling accident, and many surgeons of experience complain that perfect function is rarely restored to the ankle." And again, to quote Sir William Wheeler,² "... yet the treatment and the results are far from being universally satisfactory. It is the old story: Want of proper reduction at the time of the injury and want of precautionary measures to prevent displacement when weight-bearing is permitted." The difficulties appear to be threefold: first, in obtaining accurate reduction; secondly, in maintaining the position over a period of several weeks; and thirdly, in the after-treatment.

Accurate reduction is usually a simple matter, provided a general anaesthetic is administered; the main difficulty arises in maintaining the corrected position. I think it is the experience of most surgeons that the treatment of