CALCANEO-VALGUS DEFORMITY

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A discussion of the essential deformity in calcaneo-valgus feet develops a theme originally put forward in 1961 on the relapsed club foot (Evans 1961). Whereas in the normal foot the medial and lateral columns are about equal in length, in talipes equino-varus the lateral column is longer and in calcaneo-valgus shorter than the medial column. The suggestion is that in the treatment of both deformities the length of the columns be made equal. A method is described of treating calcaneo-valgus deformity by inserting cortical bone grafts taken from the tibia to elongate the anterior end of the calcaneus.

The material in this article arises out of a mistake made in the treatment of club foot and develops a theme put forward in a previous article in this Journal (Evans 1961). In that article I described an operation which could correct club foot in the older child. It was based on the concept that one element in the deformity of club foot is relative overgrowth of the lateral column of the foot, and I suggested that in the older child it might be necessary deliberately to equalise the columns by excising bone from the lateral column at the level of the calcaneo-cuboid joint. It was important to excise the correct amount of bone because removal of too little bone resulted in under-correction of the deformity, whereas removal of too much bone produced a short rigid valgus foot with a convex medial border. The radiological features of such a case are shown in Figures 1 to 3. Logic suggested that if this shape had been produced by excessive shortening of the lateral column, it should be possible to improve the shape by lengthening the lateral column by the insertion of a bone graft. The calcaneo-cuboid arthrodesis was therefore undone, the calcaneus and cuboid bones were prised apart and the gap was plugged with cortical bone taken from the tibia.

The result was gratifying and the experience was illuminating because it seemed to justify two theoretical assumptions: first, that varus and valgus are opposite

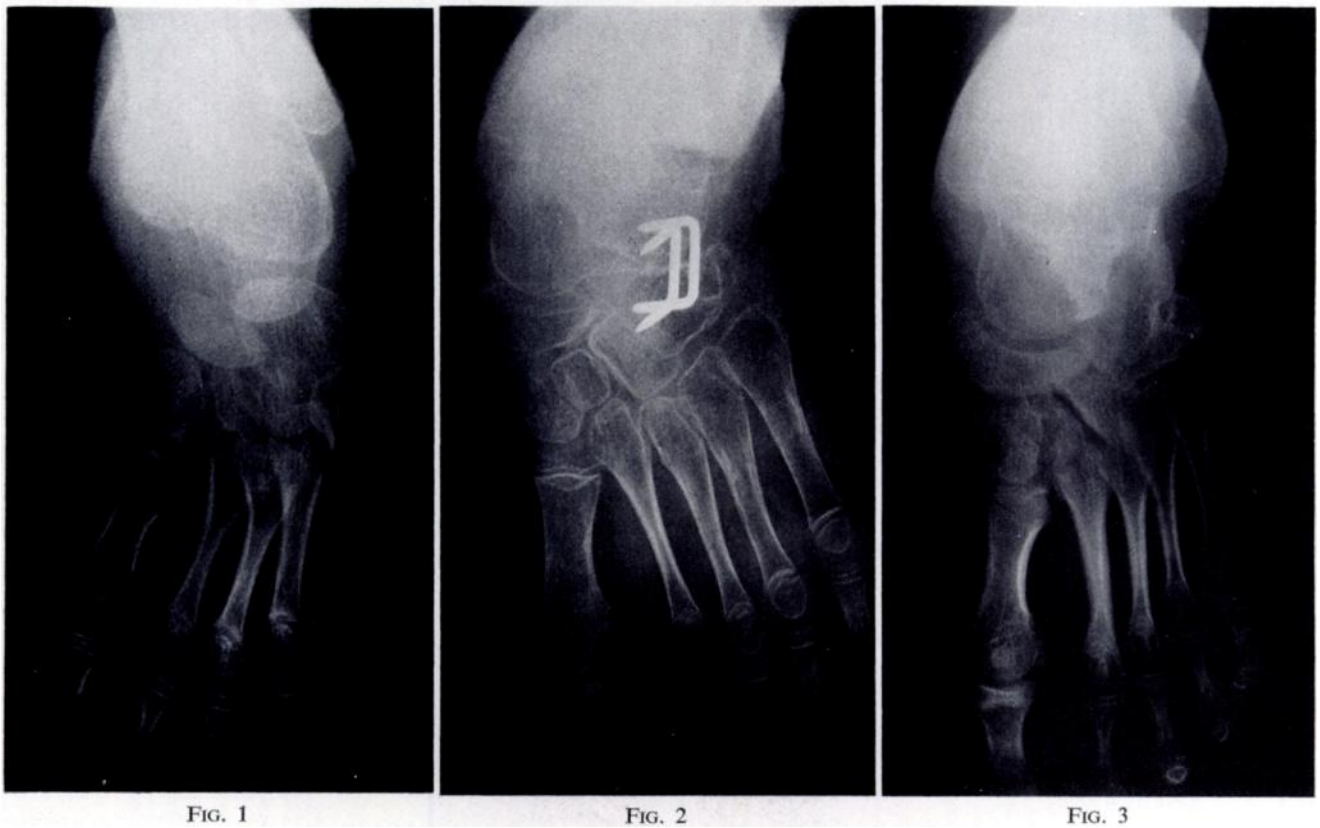

FIG. 1 FIG. 2 FIG. 3

Figure 1—A radiograph of the original relapsed club foot showing the medial displacement of the navicular bone on the head of the talus. Figure 2—After wedge resection of the calcaneo-cuboid joint. Too much bone has been removed and the talo-navicular dislocation is over-corrected. The clinical effect is a rigid valgus deformity of the foot. Figure 3—After lengthening the calcaneus. The normal talo-navicular relationship has been restored and the clinical shape of the foot is satisfactory.

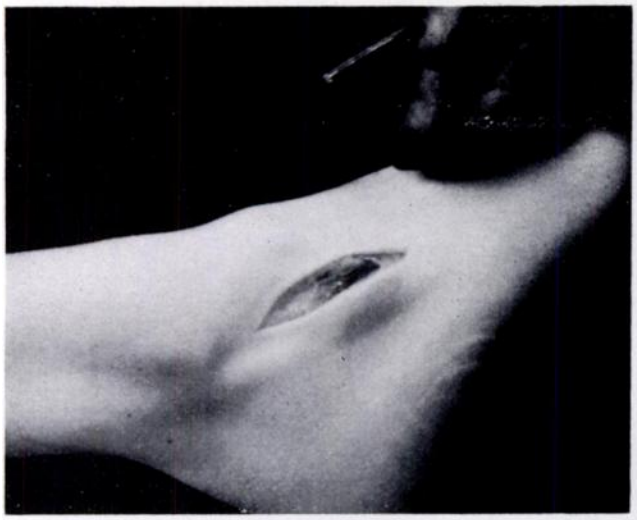

FIG. 4

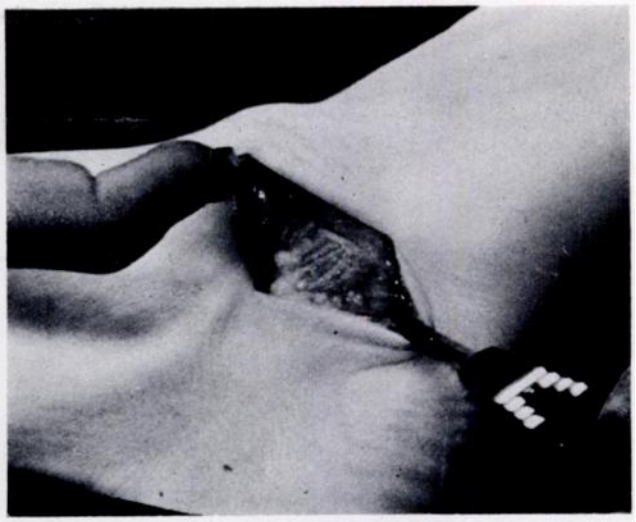

FIG. 5

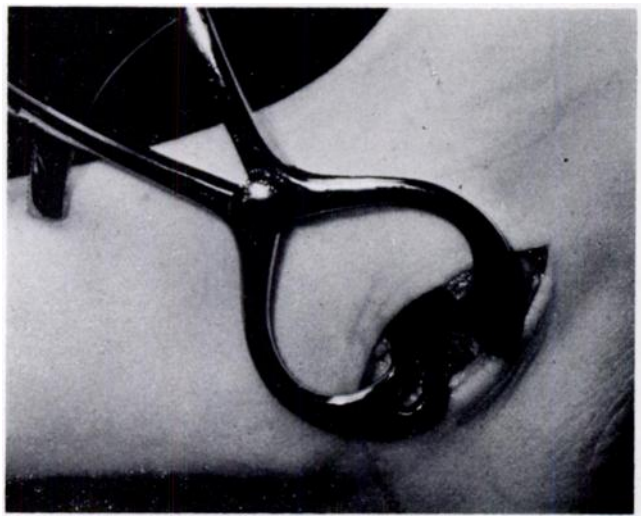

FIG. 6

FIG. 7

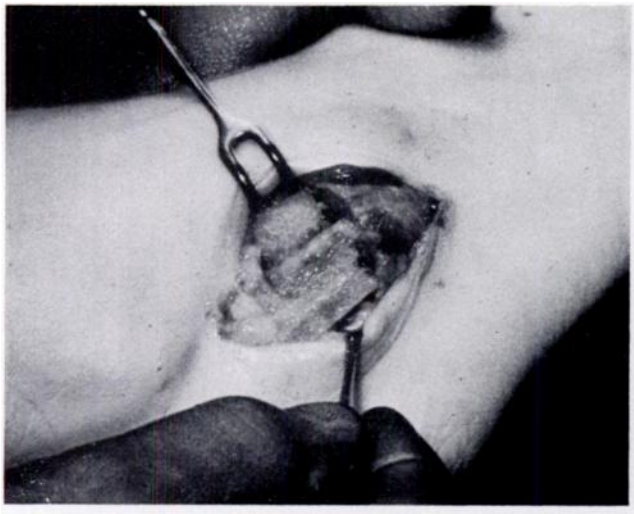

FIG. 8

FIG. 9

The operation. Figure 4—The incision. Figure 5—The exposure. Figure 6—The calcaneus has been divided and the "spreader" is in position. This instrument, which has proved invaluable, is described in the text. Figure 7—Insertion of the first graft between the blades of the instrument. Figure 8—Three grafts in position. Figure 9—The wound is usually closed easily.

deformities; and, second, that the difference between the two in terms of tarsal structure lay in the relative lengths of the two columns of the foot. A long lateral column was associated with varus deformity of the tarsus, including a varus heel and possibly also equinus, whereas a short lateral column was associated with valgus deformity of the tarsus, including a valgus heel and possibly also calcaneus deformity.

If these assumptions are sound it should be possible to improve other calcaneo-valgus deformities by lengthening the lateral border of the foot; but at what level should it be lengthened? Experience had shown that the only point at which the lateral column could be effectively shortened in club foot was at the calcaneo-cuboid joint, because of the need to pull the navicular bone laterally in relation to the talus. It was obviously desirable, however, to preserve the calcaneo-cuboid joint, and it seemed reasonable to think that if the calcaneus itself could be lengthened near its anterior end this might have the effect of pushing the navicular bone medially and so straightening the foot. It was reasonable, therefore, to do an osteotomy of the anterior end of the calcaneus about 1·5 centimetres behind the calcaneo-cuboid joint and in a plane parallel with that joint. The two parts of

FIG. 10

FIG. 11

FIG. 12

FIG. 13

A boy, born in November 1949, developed anterior poliomyelitis at the age of 15 months which caused a calcaneo-valgus deformity of the left foot. This deformity, which was passively correctable, was treated by talo-navicular arthrodesis in the hope that this would hold the foot in the corrected position. It failed to do so. In July 1959, when he was 10, the left calcaneus was elongated. It was found that this corrected the deformity but only after the talo-navicular arthrodesis had been undone to free the midtarsal joint. Figures 10 and 11 show the clinical appearance before and after the operation and Figures 12 and 13 show the radiographs before and after the lengthening of the calcaneus.

the calcaneus could then be forced apart to lengthen the lateral column, and the gap could be plugged with bone.

The first case chosen for this operation was that of a calcaneo-valgus deformity resulting from poliomyelitis —in a foot that had been selected for triple arthrodesis— and it was found that what had been anticipated in theory came about in practice. As the anterior part of the calcaneus was pushed forward, the valgus deviation of the forefoot disappeared, the heel took up a more varus position and passive extension at the ankle became more restricted. It was apparent as this was happening that if the calcaneus were lengthened enough the equinovarus deformity of club foot would be produced.

The clinical result was encouraging and it seemed justifiable to apply the operation to other types of valgus foot, but before discussing indications and contra-indications, I shall describe the operation.

THE OPERATION

The operation is constant in principle but the practical details vary with the aetiology of the valgus deformity.

The constant factors are shown in Figures 4 to 9. An incision is made over the lateral surface of the calcaneus parallel with, and just above, the peroneal tendons, avoiding the sural nerve lest it become involved in the scar. The anterior half of the bone is exposed and the calcaneo-cuboid joint is identified. The anterior end of the calcaneus is then divided through its narrow part in front of the peroneal tubercle by an osteotome, the line of

FIG. 14

FIG. 15

FIG. 16

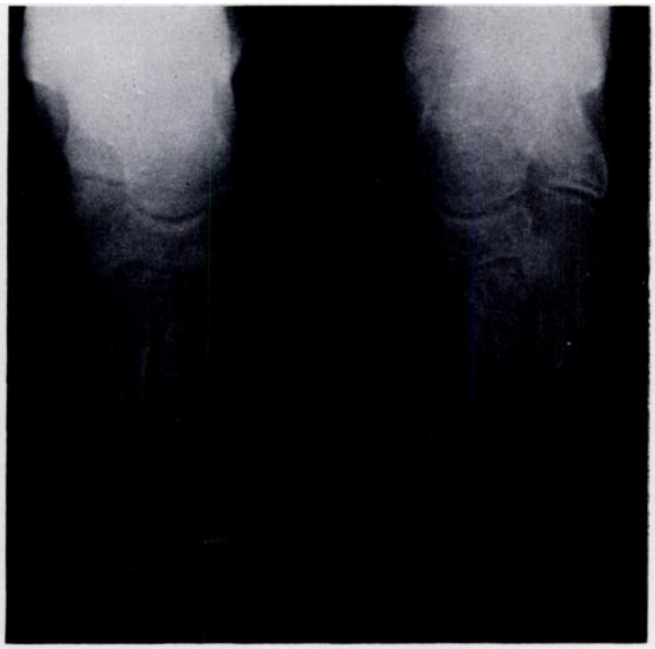

FIG. 17

A boy sustained a cut over the inner side of the left foot at the age of 6 which divided the tendon of tibialis posterior. He developed a secondary valgus and planus deformity of the foot. The calcaneus was elongated at the age of 15 years. Figures 14 and 15 show the clinical appearance before and after operation, and Figures 16 and 17 the corresponding radiographs.

division being parallel with and about 1·5 centimetres behind the calcaneo-cuboid joint. The cut surfaces of the calcaneus are then prised apart by means of a spreader and a graft of cortical bone taken from the tibia is inserted between the blades of the spreader to maintain separation of the two pieces of the calcaneus. The spreader* that I use (Fig. 6) was designed for this purpose by Mr Q. S. Otto, now of Johannesburg; its blades are so arranged that they not only enable the cut surfaces of the calcaneus to be prised apart but they also allow the first, or holding, graft to be inserted before the instrument is withdrawn. Inspection of the foot at this stage will reveal that the forepart of the foot has become adducted, that the heel has moved into varus and that extension of the ankle has become less free. The spreader is removed and further grafts are inserted above and below the first graft to ensure that the two cut surfaces of the calcaneus remain apart. All grafts are obtained from the tibia of the same side. The wound is then closed and the foot immobilised comfortably in plaster in a position of slight equino-varus. The plaster is retained for about four months to allow consolidation of the new calcaneus, but weight-bearing is allowed at four weeks. No after-care is needed when the plaster is removed.

CLINICAL MATERIAL

The operation was first done in 1959 and it has been found to be of value as an alternative to triple arthrodesis in valgus deformity from four causes—over-corrected talipes equino-varus, calcaneo-valgus following poliomyelitis, rigid flat foot, and gross idiopathic calcaneo-valgus. These deformities all show a radiological feature which indicates a need for the operation; an antero-posterior radiograph of the foot in the standing position shows that the talus points in a medial direction and that the navicular bone is displaced laterally in relation to the head of the talus—that is, the reverse of the deformity of club foot.

FIG. 18 FIG. 19

A girl born in 1949 developed anterior poliomyelitis at the age of 7 in 1956. She was first seen in 1961 and found to have 2·5 centimetres of shortening in the left leg, weakness throughout the limb, valgus and pronation of the left foot and much weakness of tibialis anterior and posterior muscles. The extensors of the toes were strong and there was "dropping" of the forepart of the foot. In May 1961 the calcaneus was elongated. This produced an equinus deformity (despite the fact that extension was possible to 10 degrees above the right angle before the operation) and the calcaneal tendon was therefore elongated. The long extensor tendon of the great toe was transferred into the neck of the first metatarsal bone to improve the "dropping" of the forefoot. Figure 18 shows the appearance before operation, and Figure 19 afterwards.

The operation has been done on fifty-six feet. Four operations were for over-corrected talipes equino-varus, twenty-five for deformities resulting from poliomyelitis (Figs. 10 to 13 and 18 and 19), two for deformity following traumatic division of the tendon of tibialis posterior in infancy (Figs. 14 to 17), nine for rigid flat foot, and eighteen for idiopathic valgus (Figs. 20 to 29) including one case of Marfan's syndrome (Figs. 30 to 33). It has been found (Figs. 18 to 25) that the operation restricts extension of the ankle and that it reduces the range of

* Obtainable from Messrs Downs Surgical Ltd.

FIG. 20 FIG. 21

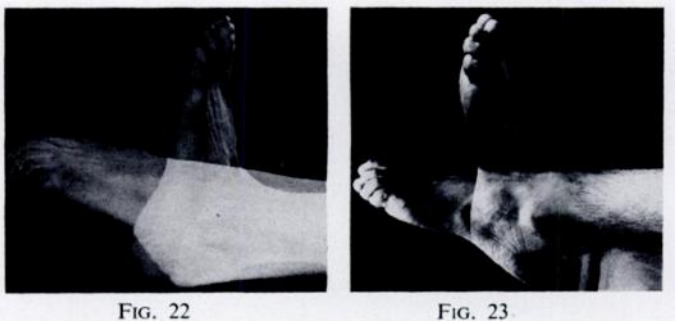

FIG. 22 FIG. 23

FIG. 24 FIG. 25

A boy presented at the age of 15 because of pain in the calves of both legs after activity. His feet were found to be of the plano-valgus-abductus type and the calcaneal lengthening was done on both feet. Figures 20 and 21 show the clinical appearance before and after operation and the range of movement before and after this is shown in Figures 22 and 23, from which it is seen that there has been restriction of dorsiflexion. Figures 24 and 25 are the radiographs before and after operation.

side-to-side movements in the foot by eliminating excessive eversion. An occasional, and unnecessary, error has been damage to the sural nerve, which produces a painful scar and sensory impairment along the lateral border of the foot.

Calcaneo-valgus from poliomyelitis (Figs. 10 to 13 and 18 and 19)—The ideal age for correction is between eight and twelve years, but the operation can be done earlier if the severity of the deformity makes this necessary. If done early in life, or if the deformity is very severe, the operation may have to be repeated between the ages of eight and twelve. Full correction may not be possible with severe deformity at the first attempt, but it should be possible to obtain full correction at a second operation done two or three years later.

Experience has shown that it is not possible to overcorrect valgus deformity of this aetiology. On the contrary, adequate correction may be difficult because sufficient separation of the divided parts of the calcaneus may not be possible without dividing all the soft tissues on the lateral side of the foot, including the peroneal tendons. When this has been done, difficulty in skin closure becomes the limiting factor.

Rigid flat foot—These cases tend to present in early adolescence; the foot is rigid and, as in paralytic cases, it tends to resist correction; the soft tissues have to be

FIG. 26 FIG. 27

FIG. 28 FIG. 29

A child of 12 had idiopathic calcaneo-valgus feet, with no symptoms but the muscles were weak and the movements of inversion and eversion were restricted. The parents were concerned about the shape of the feet. Figures 26 and 27 show the clinical appearance before and after calcaneal lengthening and the radiograph before operation is shown in Figure 28 and another, taken ten years afterwards, in Figure 29.

divided and over-correction is not possible. The operation has succeeded in feet in which a calcaneo-navicular bar has been present. The shape of the foot is slightly improved but the most gratifying features are relief of pain and a subjective feeling of freedom within the foot.

Severe idiopathic valgus (Figs. 20 to 33)—Here it is necessary to distinguish between simple mild valgus which is a variant of normal, and severe valgus which is clearly abnormal. Correction is necessary only when deformity is severe and the foot is obviously abnormal, with marked valgus of the heel and of the forefoot and with a convex bulging medial border; lateral displacement of the navicular in relation to the head of the talus will be seen in radiographs taken standing. Such cases do not usually present until about the age of eight, and it is important to know that over-correction is possible and that it is all too easy to produce an equinovarus deformity. In this group the calcaneus should be lengthened only as far as is necessary to produce a normal shape; the soft tissues must not be divided and the peroneal tendons must not be injured.

Conditions in which the operation is contra-indicated—The operation is inappropriate for neurological disorders including spasticity in children and spina bifida. Over-correction is too prevalent in spastic disorders, and in spina bifida the calcaneus is too soft to allow correction and the grafts tend to sink into the bone.

FIG. 30 FIG. 31

FIG. 32 FIG. 33

A boy, born in February 1957, presented in June 1961. He had Marfan's syndrome, with long feet, plano-valgus in shape, and hypermobile. There was also valgus deviation and pronation at the midtarsal joints with a valgus deformity of the heels on weight-bearing. The head of the talus was prominent on the medial side of each foot. The left calcaneus was elongated in June 1961 and the right calcaneus in June 1962. The wound on the right foot failed to heal by first intention and a skin-graft was necessary. Figures 30 and 31 show the clinical appearance, and Figures 32 and 33 the radiographs, also before and after calcaneal lengthening.

DISCUSSION

The operation has proved to be of practical value as a means of averting triple arthrodesis but it also has theoretical implications which are of some interest, because it throws some light on the nature and structure of some deformities of the tarsus. Three conclusions are drawn from this study.

Firstly, the deformities of equino-varus and calcaneo-valgus are opposites. Some believe that the opposite of club foot is congenital vertical talus, but I have found little to support this view, and most of the evidence, theoretical and experimental, points to calcaneo-valgus as being the opposite of equino-varus.

Secondly, in regard to an equinus deformity, it has been assumed that it is a deformity at the ankle produced by a short calcaneal tendon and because of this belief, it is accepted by many that this is produced in a club foot by contracture of the calf muscles. This, however, is not necessarily so; the experiences recorded in this article suggest that rearrangement of tarsal relationships may produce immediate equinus on the operating table without anything being done to the ankle or to the calf structures (Figs. 18 to 25). It is therefore possible that there may be two kinds of equinus: one produced primarily by contracture of the calf structures, and another produced primarily by deformity of the tarsus, such as in club foot.

Against this it may be said by some that it is unacceptable because experience has shown that transection of the calcaneal tendon in a baby's foot will reduce equinus. This, of course, is true but it is true only under certain conditions; these are, first, that the tarsal deformity is corrected by other means such as by manipulation or by division of other tight structures, and second, that the operation is done at an early age when the tarsal bones are still cartilaginous and plastic. It is demonstrably not true in the older child when the bones have ossified and lost much of their plasticity. This, combined with the fact that it is possible to produce a club foot (including the equinus deformity) simply by over-lengthening the calcaneus suggests that equinus may be a more complex subject than it has appeared to be.

Thirdly, the lateral column is the foundation of the skeletal structure of the foot. It is the base on which the foot stands. It does not vary much in shape but it varies in length, and the length of this column relative to the length of the medial column has an enormous influence on the shape of the foot, even if it is not the only factor. It plays no part in some deformities, such as the cavo-varus foot so well described and so effectively treated by Dwyer (1959).

It is also doubtful if the lateral column of the foot is in fact the primary factor in producing a deformity; more likely is it a secondary, or adaptive, consequence of deformity initiated by other factors such as congenital abnormality or the forces of muscle imbalance acting on a plastic growing skeleton. But whatever its origin, once this factor of inequality has developed—and it is betrayed radiologically by relationship of the talus and navicular bones--the foot cannot be restored to a good shape until the inequality has been eliminated by equalising the columns. It is possible, sometimes, to twist a weakened, paralytic foot into a good shape and to feel that arthrodesis of the talo-navicular joint should hold it there, only to find in practice that it does not do so (Figs. 10 to 13); the foot falls back into valgus when it has to take the weight of the body and this is because the foundation of its structure—the lateral column—is unsound. It appears from this study that the lateral column of the foot is the key to structural equino-varus and calcaneo-valgus.

The operation has been successful in over-corrected talipes equino-varus (four cases), calcaneo-valgus caused by poliomyelitis (twenty-five cases), by old injury to the tendon of tibialis posterior (two cases), in painful rigid flat foot in young people (nine cases), and in severe disabling idiopathic calcaneo-valgus (eighteen cases). It is of no value in spastic disorders (in which there is a tendency to over-correct and so produce equino-varus) or in cases of spina bifida in which the bones of the foot are soft and too yielding.

I wish to thank Miss B. Wales and Mr C. M. Walker of the Departments of Radiology and Clinical Photography at the Prince of Wales Orthopaedic Hospital for their contribution to this article and Miss L. M. Thomas, Miss M. A. Angove and Miss H. R. Taylor for their secretarial help.

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