TIBIALIS ANTERIOR TRANSFER IN CONGENITAL CLUB FOOT

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In 1950 a clinic was started at the Royal National Orthopaedic Hospital for the treatment of incompletely corrected or relapsed club feet. With a few minor modifications the Kite method was followed closely until it was considered that satisfactory correction had been achieved. The details of our methods and early results have already been described (Fripp and Singer 1953).

There are two stages in the treatment: correcting the deformity and then maintaining the correction. We are not concerned in this paper with the first stage, but the second presents points of interest and difficulty. Kite (1930) keeps the corrected foot in a retentive plaster for six months in order to prevent relapse, but this has the disadvantage of prolonging the immobilisation in plaster, and it was hoped that transfer of the tibialis anterior tendon to the outer side of the foot would restore muscle balance and shorten treatment. No originality is claimed for this, and there have been other reports of the tibialis anterior transfer (Garceau 1940, Garceau and Manning 1947, Critchley and Taylor 1952, Carpenter and Huff 1953).

A recent follow-up of our cases has just been completed, and as our results differ in some respects from those formerly reported it was considered worth while to record them.

The patients in this series were, with a few exceptions, between the age of one and eight years when treatment started. They all had some residual deformity, due either to relapse of a well corrected foot or to incomplete initial correction. Previous treatment had consisted in the accepted methods and included Denis Browne splints, forcible manipulations under an anaesthetic and, in a few cases, open operation such as elongation of the calcaneal tendon.

Our patients initially had deformities that were resistant to treatment and the club foot was of the most severe type. Furthermore, the difficulty was increased in many by the stiffness caused by forcible manipulations. Therefore the feet that came under our care constituted a "difficult" group.

CLINICAL MATERIAL

Sixty-one patients were reviewed, of whom thirty-three had both feet deformed and twenty-eight one foot, making a total of ninety-four feet. Seventy-six tendon transfers were performed, the average age at operation being four years nine months.

TECHNIQUE OF OPERATION

In seventy feet the tibialis anterior tendon was detached from its insertion into the medial cuneiform bone and the base of the first metatarsal bone, and transferred to the peroneus brevis tendon near its insertion. The tibialis anterior was buttonholed through the peroneus brevis tendon and then sutured to itself and to the peroneus brevis. In the remaining six feet the tibialis anterior tendon was inserted into one of the cuneiforms or the cuboid, just lateral to the midline. The leg was immobilised in a below-knee plaster in the "over-corrected" position for six weeks, after which the patient received a course of re-educative exercises.

RESULTS

For this review a *relapse* was defined as the return of a foot to a state in which it was not plantigrade and either the adduction, inversion or equinus components of the deformity were not corrected to the neutral position.

There were fifty-two relapses, and in every one the principal component, and usually the only one, was equinus. The pitch varied from a third of an inch to one and three-quarters inch (pitch is the expression of the extent of equinus in terms of the distance between the under-surface of the heel and the floor). In most patients when the knee was flexed to 30 degrees the pitch increased by as much as half an inch to an inch. This is contrary to what we expected, because with the gastrocnemii relaxed the pitch should have decreased. The explanation of this paradox is that some of the equinus is compensated for by the

FIG. 1
FIG. 2
FIG. 3
Figure 1—Club foot with equinus deformity. Figure 2—Equinus masked by hyperextension of the knee. Figure 3—Unmasking of equinus by knee flexion.

FIG. 4
FIG. 5
Figure 4—Normal foot. The foot remains plantigrade as the tibia glides forwards on the talus when the knee is flexed 30 degrees. Figure 5—Club foot with flat-topped talus. The pitch is increased with knee flexion because the tibia is unable to glide forwards on the deformed talus.

development of hyperextension of the knee, flexion at the hip and lumbar lordosis. The foot thus appears plantigrade, but there is complete lack of springiness in the gait, and the attitude of the patient is distinctive if the deformity is well marked. The true extent of the equinus becomes manifest when the knee is flexed and the lumbar spine flattened. This test for occult equinus resembles Thomas's test for fixed flexion deformity of the hip. Furthermore, in some cases of prolonged deformity there is incongruity in the ankle mortise from a flat-topped talus. When the knee is flexed the tibia cannot glide forwards on the talus; so the heel comes up off the floor (Figs. 1 to 5).

The relapse rate of fifty-two out of seventy-six transfers is considerable, even allowing that these feet were all "difficult" and that some of the relapses would be considered mild (Table I).

TABLE I
ANALYSIS OF RELAPSES AFTER TRANSFER OF TIBIALIS ANTERIOR FOR CLUB FOOT

Transfer	Number	Relapses	Component	Time after the operation
Tibialis anterior to peroneus brevis	70	50	Equinus	1 year 4 months (average)
Tibialis anterior to just beyond the midline	6	2	Equinus	Shortest—4 months Longest—7 years 2 months

Sequelae of the operation—It was thought that transfer of tibialis anterior might be followed by a dorsiflexed (cocked-up) big toe and dropped first metatarsal head, as is seen in feet in which the muscle actions of extensor hallucis longus and peroneus longus are unopposed. The cocked-up big toe occurs particularly in those club feet in which the plantaris or forefoot equinus element is marked and is comparable to that seen in the pes cavus. It may possibly be associated with the original deformity rather than with the transfer. Although there was

TABLE II
SEQUELAE OF TIBIALIS ANTERIOR TRANSFER FOR CLUB FOOT

	Mild to moderate	Severe	Pain	Length of time after operation
Dorsiflexed big toe	57	0	0	3½ years (average) Shortest—6 months Longest—7 years
Forefoot pronation over 10 degrees	11	—	—	
Depression in shoe under first metatarsal head	21	—	—	

evidence of a cocked-up big toe in fifty-seven feet in this series, the deformity was never severe and it did not give rise to symptoms.

In only eleven feet was there evidence of over-action of the transfer with more than 10 degrees of pronation of the forefoot when the foot was actively dorsiflexed. All the shoes were examined; twenty-one had a depression under the first metatarsal head (Table II).

DISCUSSION

Serial wedged plasters, sometimes supplemented by a soft-tissue operation (Brockman 1930), do correct the vast majority of difficult and relapsed congenital club feet. Like Garceau (1940) and others, we attributed recurrence after correction to a relative peroneal insufficiency, and the operation of transfer of the tibialis anterior tendon was based on the premise that this muscle is the most powerful deforming factor. In this review the criteria of relapse were strictly adhered to, so that some of the cases included were mild. But the relapse after tibialis anterior transfer was frequent and always in the direction of equinus.

It might be supposed that the operation would be more successful if transfer were to the midline or just beyond it. Evidence against this hypothesis is obtained from Carr (1956),

who transferred the tibialis anterior just lateral to the midline in fifteen comparable feet which had been corrected by serial wedged plasters; twelve of these subsequently relapsed into equinus.

If transfer of tibialis anterior encourages recurrence of equinus—and we do not know that it does—it probably does so because its new insertion makes it a mechanically less efficient dorsiflexor and because transfer always weakens a muscle.

It is interesting that in 53 per cent of feet in the series equinus and plantaris (forefoot equinus) was the predominant component of the deformity before the serial wedging was started. This is in accord with the experience of Kite (1953) who stated that it is the equinus that recurs first without tibialis transfer.

All the patients were kept under careful review and in many cases the relapse into equinus occurred several months, and in a few cases years, after treatment had been completed. Occasionally the parents noticed quite a rapid onset of the recurrence, not associated with intercurrent illness or other obvious factors. The reason for this late recurrence was not apparent.

In some cases the balance of the foot had been further disturbed because the transposed muscle had caused excessive pronation of the forefoot, and in three patients there was excessive valgus of the hindfoot so that the tendon had to be retransferred to the midline. Thus, this operation may replace one deformity by another. This feature has troubled other surgeons: Moore (quoted by Kite 1947) abandoned the operation twenty-four years ago because "the foot was thrown out of balance as time went on," and Camera (1950) devised the procedure of transferring the lateral two tendons of extensor digitorum longus to the distal third of the fifth metatarsal because he believed that the tibialis anterior transfer would lead to over-correction.

SUMMARY

1. The results of seventy-six transfers of the tibialis anterior tendon to the outer side of the foot to prevent relapse of congenital club foot are reviewed.
2. There were relapses in fifty-two of the seventy-six feet on which the operation had been performed.
3. The equinus component of the deformity is the dominant feature in all the relapses.
4. A test for occult equinus is described.
5. The factors contributing to the high relapse rate are discussed.

We are grateful to Miss S. Girardin for the diagrams.

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