RESTORATION OF MUSCLE BALANCE OF THE FOOT BY TRANSFER OF THE TIBIALIS POSTERIOR

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A new technique of tibialis posterior transfer is described which has been used in a wide variety of conditions producing muscular imbalance in the foot. The results in eighty-five feet are reviewed in terms of range of motion, power and voluntary control of the transfer. The effect of the transfer on shoe wear, on the necessity for bracing and on the child's or his parents' assessment of the results are used to allocate an overall evaluation of the operation. Recommendations on the indications for the operation are given.

Muscle imbalance in the foot is common, particularly in children, and is caused by many different neuromuscular diseases. Transfer of the tibialis posterior has been done to restore muscle balance in some such feet with varus or equinovarus, but because of the difference in the nature and the prognosis of the diseases and of the different methods used to transfer the tendon, the value of the procedure is uncertain. For this reason a study was made of the value of this transfer in a variety of neuromuscular diseases in a large series of children.

The first description of the transfer through the interosseous membrane was given by Watkins (1954), although it had been in fairly common use before that time. Ober (1933) had previously described the transfer round the medial border of the tibia to the dorsum of the foot. Singer (1961) described a minor modification of the Watkins technique as applied to the treatment of club foot. The technique used in this series was designed by Sandhu in 1962 and communicated to the author soon after that time, but has not been described before.

The essential feature is that the tendon is brought out through the interosseous membrane to emerge in front of the tibia and then travels under peroneus tertius in front of peroneus longus and brevis. It has the advantage of simplicity, the scars have good cosmesis and the line of action of the tendon is more direct than with other methods.

CLINICAL MATERIAL

The operation of tibialis posterior transfer has been done on 108 feet in eighty-six patients. Some could not be traced, or insufficient time had elapsed since operation, so that this review concerns seventy patients (eighty-five feet) who were recalled for examination. The average length of follow-up was three and a half years with a spread of one to nine years. The average age of the patients at the time of operation was nine years and nine months with a range from three to twenty-two years.

Assessment—Each patient was interviewed with at least one parent and assessed by a senior physiotherapist who recorded range of motion, power, voluntary control and phasic activity. Also noted were the effects of the operation on shoe wear, the necessity for bracing and the assessment of the result by the patient or parent. Finally the therapist allocated each case an overall evaluation of good, fair or poor. A good result implied that improvement had been gained in all categories. A fair result implied improvement—the result being acceptable but not ideal. A poor result indicated that no benefit had been obtained by the operation.

INDICATIONS FOR OPERATION

Spastic equinovarus in cerebral palsy—Most of the children in this category had already had bracing which had gradually become ineffective. Apart from the deterioration of gait, rapid destruction of footwear was a striking feature in nearly every child. While walking the foot would twist into varus and equinus and it could easily be shown that there was strong overaction of both tibialis posterior and the calf musculature. If muscle overactivity was present at other levels, notably the hamstrings at the knee, this was usually dealt with first as a separate procedure. Very rarely did a release affect the indications for tibialis posterior transfer in the foot. Occasionally a foot used in equinovarus was found to have a tibialis posterior with a strength well below normal even though overacting (even weaker peroneals were usually associated). In these circumstances tenotomy was preferred to transfer.

The age at operation varied from five to sixteen years. It was surprising how few of the cases in the older age group had developed any varus deformity which could not be corrected under anaesthesia.

Drop foot—Various forms of lower motor neurone disease provided the indications in this group. The placement of the tendon in its new location was varied according to the strength of the peroneals. If the peroneals were strong the transfer was placed about 0.5 cm medial to the midline and if paralysed the same distance lateral to the midline.

Paralytic varus or equinovarus—Most of the cases in this category were children with peroneal muscular atrophy or various types of muscular dystrophy. The latter were operated on after they had lost their ability to walk. In all cases the transfers were placed lateral to the midline.

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Recurrent club foot—It has been the vogue from time to time to support various transfers in the treatment of recurrent club foot. A tibialis anterior transfer was used but it was soon found that it had a regrettable tendency to produce gross over-correction. Later a tibialis posterior transfer enjoyed a brief popularity but the number done was small.

SURGICAL TECHNIQUE

In a bloodless field the first incision is made on the medial side of the foot in the line of the tendon of tibialis posterior and extended proximally 2-5 centimetres from the tubercle of the navicular (Fig. 1). The tendon is detached close to the bone and the rather bulbous end is trimmed and connections to the sheath are severed.

The second incision is placed along the medial border of the calcaneal tendon which almost always needs to be lengthened and this is done in the sagittal plane; before it is sutured together the sheath of the tendon of tibialis posterior is incised just behind the medial crest of the tibia and the tendon withdrawn. The first incision is closed.

A third incision is made along the anterior border of the fibula just above the ankle (Fig. 2) and after dividing the deep fascia the peroneus tertius is retracted medially to expose the interosseous membrane which lies only a centimetre or so deep to the skin surface. The membrane is incised over a length of an inch and a half and the point of a pair of curved artery forceps pushed through to the posterior compartment. The tendon of the tibialis posterior is grasped and withdrawn.

It is very important to ensure that the tendon is brought through in the correct plane because it is possible to loop it around the tendon of flexor digitorum longus unless care is taken. Should this event occur it will be found later that there is insufficient length available for the transfer to reach the dorsum of the foot. The second incision is now closed.

A fourth incision is made in the midline of the dorsum of the foot and the tendon rerouted to this through the subcutaneous tissue. The third incision is now closed. The question now arises as to where the tendon should be placed in relation to the midline of the foot. In cerebral palsy and other spastic conditions it should be directly in the midline because experience has shown that overaction into valgus or varus is likely if the tendon is placed away from the midline. In other circumstances the insertion should be varied according to the strength of the peroneal and tibialis anterior muscles in an attempt to produce muscular balance. However, in any circumstances it is unwise to insert the tendon more than one centimetre wide of the midline. A drill hole is made through whatever bone seems to occupy the midline, and the tendon is passed through this with a suitable chromic catgut suture which is tied under tension over a button on the sole of the foot. The junction of tendon and periosteum, at the margins of the drill hole, is reinforced with a few catgut sutures. With the foot held at a right angle to the leg by an assistant, the last incision is closed and a padded below-knee plaster cast applied. It is important to close the skin incisions as soon as they are no longer needed because once the transfer is completed it is difficult to get access to them while holding the foot in the correct position. The use of 00 plain catgut is recommended for skin closure.

If both feet are to be operated upon at the same sitting it has been found most convenient to have two surgeons and one assistant, the latter being seated at the end of the table. One surgeon can operate on the medial side of the first foot and the other on the lateral, each changing his side for the second foot without changing position. An experienced team should be able to complete two feet and have them in plaster within the hour.

RESULTS

Cerebral palsy (spastic equinovarus)—Patients with cerebral palsy provided the most frequent indication for tibialis posterior transfer. There were forty-two patients with fifty-three feet in this group, and an analysis of these brought forth the following facts. 1) Of twenty-eight patients who had needed below-knee bracing, twenty-three were able to discard this after the operation. 2) Twenty-four feet showed improved shoe wear and thirty-eight had improved gait. The gait transformation was often remarkable because not only was the foot used in a plantigrade position but the associated internal rotation of the limb was largely corrected. 3) No less than twenty-six feet demonstrated voluntary control and twenty-three had active contraction of the transfer when walking. Seven feet had a spastic tenodesis in which all the muscles below the knee were in spasm and the foot was frozen at a right angle to the leg. This was associated with remarkably good function. 4) Out of a total of fifty-three feet only five needed further operation to obtain a satisfactory result. Of these, three had had a triple arthrodesis and, in retrospect, it was obvious that the transfer had been done too late, with some fixed varus of the hindfoot persisting and leading to the recurrence of the deformity. One foot developed a spastic calcaneal deformity possibly because of over-lengthening of the calcaneal tendon and the transfer had to be lengthened. In another foot the transfer had to be shortened to overcome a drop foot. Disinsertion of the transfer did not occur in any of the feet in this group. The overall rating of the transfers in the forty-two cerebral palsy patients was good in twenty-two feet, fair in fourteen and poor in six.

These bare facts do not perhaps do full justice to the procedure which we regard as one of the most successful and reliable operations in cerebral palsy. In this group over three-quarters of the patients and parents were enthusiastic about the end-result and the girls were particularly grateful for their new-found ability to wear fashion shoes.
Lower motor neurone disease (paralytic drop-foot)—There were only seven feet in this group and the cause was shared between sciatic palsy and spinal dysraphism. Analysis showed that disinsertion of the transfer occurred once and one transfer had to be moved medially because of overaction. Only four feet had strong voluntary control of the transfer and only two showed phasic contraction when walking.

The overall results in this group are disappointing because of a combination of weakness in the transfer and inability to phase correctly. The rating was good in two feet, fair in four and poor in one. It is not clear why the transfer fared so badly in this group because the conditions would be expected to be particularly favourable for a good result.

Muscular dystrophy—There were five children with ten feet in this group with the pseudohypertrophic or Duchenne type of dystrophy. All were affected bilaterally and were confined to wheelchairs before operation was undertaken. Most of these children had developed inverted feet so that weight was being taken on the dorsum and this was a source of considerable discomfort to them. Nurses and other attendants complained of the difficulties in dressing. Braces and night splints had ceased to be tolerated.

Analysis showed that complete correction of the deformity was achieved in all feet with consequent alleviation of the various complaints. All were alive at the time of assessment (average follow-up five years) and the transfers were acting strongly.

Although not usually considered an indication for tendon transfer, these cases of muscular dystrophy provided excellent reasons for operation; the results were uniformly satisfactory for a surprisingly long period. The children remained more comfortable and the burden of care was lessened. The overall rating was good in all ten feet.

Peroneal muscular atrophy—Although peroneal muscular atrophy initially appears to provide an ideal indication for transfer, the five patients with nine feet in this group had good results initially but deteriorated after two years until the transfer ceased to function when the muscle was involved by the disease. Thus it seems doubtful that the operation is justified when its effect is so short. The final assessment of the nine feet on average five years after operation was poor in all.

Relapsing club foot—Six patients with seven feet were in this small group. It is of interest that only one foot subsequently relapsed and all children had strong voluntary control of the transfer and good phasic activity.

This might suggest that tibialis posterior transfer deserves a more important position in the treatment of club foot than it has, but experience with large numbers of resistant and relapsed club feet has led to the belief that under-correction is the most common cause of relapse and it is preferable to rely on radical medial, plantar and posterior release as the best insurance against this. Nevertheless the analysis showed the results to be good in six feet and fair in one.

Spina bifida—Again this group was small with four patients and five feet. There were no good results and in all patients the transfer worked weakly if at all. Review of the indications showed that the transfer was done using a muscle in each case that was below normal strength. In the paralytic situation so often seen in spina bifida there is a great temptation to try and make the best of the material available. That this is not justified in terms of tendon transfer is well shown by these results.

DISCUSSION

The surgical technique used in this series was found to be satisfactory and easier than those previously described. It has the advantage of providing a straight line of pull, a low incidence of detachment and cosmetically acceptable scars. Repositioning was occasionally required when the strength of the peroneal muscles had been misjudged. The study shows that tibialis posterior transfer is a most valuable adjunct to the treatment of cerebral palsied children who have spastic varus or equinovarus deformities of the feet. It is also valuable for controlling deformity in cases of muscular dystrophy and the effect is continued for a surprisingly long period of time.

Relative indications exist in the drop foot of sciatic palsy and spinal dysraphism, and in the control of congenital talipes equinovarus.

Experience with peroneal muscular atrophy suggests that tendon transfer is hardly worth doing because of the rate of progress of the disease; all the patients showed progressive deterioration after two years.

In spina bifida the results were poor because the muscle was too weak and this is likely to be so in most cases.

The study shows that the expectation of a good result from tibialis posterior transfer relies to a great extent on the strength of the transfer and its positioning as well as the disease producing the muscle imbalance.

Despite all these obstacles a good result was obtained in sixty-three out of a total of eighty-five feet and with the experience gained, better selection should improve the results in the future.

I wish to record my thanks to Miss Patricia Fitzgerald, Senior Physiotherapist, who examined and independently assessed all the children in the series.

REFERENCES


Sandhu, H. S. (1965) Personal communication.
