Lepr Rev (1995) **66,** 229–234.

Tibialis posterior transfer in the correction of footdrop due to leprosy

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Accepted for publication 27 March 1995

Summary In the correction of footdrop due to leprosy neuritis the tibialis posterior muscle is re-routed and used to provide dorsiflexion of the foot. This study of tibialis posterior transfer was carried out to compare the results of the circumtibial and interosseous routes. There is no significant difference in the range of motion between either route though the range of the interosseous route is more functional (better dorsiflexion). The interosseous route is preferable as this results in a significantly lower incidence of recurrent inversion deformity of the foot at long-term follow-up when compared with the circumtibial route.

Introduction

Footdrop due to the paralysis of the anterior tibial and peroneal muscles is found in 2–5%[10,16] of newly diagnosed leprosy patients as a result of leprosy neuritis.

Leprosy neuritis affects nerves where they are close to the skin and pass through a narrow fibro-osseous canal. In the lower limb this involves the lateral popliteal nerve around the neck of the fibula (leading to footdrop) and the posterior tibial nerve at the tarsal tunnel (leading to anaesthesia of the plantar surface). When both these nerves are damaged then the main impact during walking falls on the anaesthetic forefoot rather than the heel, with plantar trophic ulceration being the almost inevitable result. This study assesses the outcome of tibialis posterior transfer (TPT) in the correction of footdrop due to leprosy and specifically compares the circumtibial (CT) with the interosseous (IO) route.

Methods

One hundred and ten footdrop corrections in 95 patients (83 male and 12 female) on a total of 105 feet were followed-up. These were performed in the years 1987–93. Ten patients had bilateral corrections. Nine operations were redone when the earlier operation had failed, i.e. the patient developed recurrent inversion or footdrop

0305-7518/95/066229+06 $1.00

persisted. For all patients, data was collected prospectively (pre-operative, immediately out of Plaster of Paris (POP) and discharge 'angles'). Final follow-up data (at least 6 months post-op) on recurrent inversion was available in 69 patients. This was carried out during 1994. In 59 (53·6%) of these patients 'angles' (measurement of active dorsiflexion (ADF) and active plantarflexion (APF)) and further data on recurrent ulceration and bone loss are also available.

Angle measurements for the foot were taken with neutral as 90° and 20° dorsiflexion as 70°. Inversion of more than 5° was considered as significant. Range of motion (ROM) was measured as active APF—active ADF.

Abbreviations used for some muscles include: tibialis anterior (TAN), extensor hallucis longus (EHL), extensor digitorum longus (EDL), peroneus brevis (PB), peroneus tertius (PT), tibialis posterior (TP).

Technique

The main details of technique for the IO route have been described elsewhere, however some important points need to be made. I routinely lengthen the tendo achilles by an open Z lengthening so as to enable easy passive dorsiflexion to at least 65°. It is important that the IO membrane is widely opened and that the TP is rerouted from the posterior compartment to the anterior compartment lateral to the wasted belly of TAN in order to prevent adhesions to the tibia and to get better lateral lift. The lateral slip is attached to the PB or PT tendons at maximum tension. The medial slip is sutured to the TAN tendon at neutral tension. The leg is placed in a POP cast for 3 weeks with the foot dorsiflexed to 65° to relieve tension on the joins. In the CT route the TP tendon is brought medially around to the front of the tibia subcutaneously. After being withdrawn into the lower medial leg the TP tendon is split into two slips and tunnelled to the dorsum of the foot. The slip to the peroneal tendons must cross the ankle joint at least 3 cm above the mid-ankle to ensure eversion.

After 3 weeks the cast is split and intensive reeducation is begun. This includes contracting only TP to dorsiflex the foot and later practicing co-ordination exercises (alternate dorsiflexion and relaxation but not plantar flexion) and relearning 'swing phase walking' with crutches. In the third week the patient is allowed partial weight bearing in parallel bars or with crutches and continues to practice swing phase walking in parallel bars. From the fourth week out of POP (at least 6 weeks post-op) plantar flexion is encouraged and the patient is given a sandbag (500–1000 gm) to use during exercising to encourage strengthening of the muscle. They also gradually increase weight bearing so that by the sixth week out of POP they can walk without crutches. In the sixth week out of POP they practice on stairs and usually at the end of that week are ready for discharge.

Results

The average age was 33·5 years (13–75 years). Fifty-two operations were on the left foot (47%) and 58 on the right foot (53%). The average duration of footdrop prior to operation was 4 years 5 months. Eighty feet (73%) had a complete footdrop while in 30

feet (27%) only the dorsiflexors were affected and the evertors were normal. The CT route was used in 43 feet (39%) mostly before 1992. The IO route was used in 67 feet (61%).

The medial slip of the TPT was attached to TAN in 104 feet (95%) and to EHL (an old preferred method) in 6 feet (5%). The lateral slip was attached to EDL in 56 feet (51%) and to the peronei in 54 feet (49%). It is my impression that the attachment to EDL leads to a higher incidence of claw toes in mobile toes and so is not now used.

The average duration of immobilization in POP was 28 days (21–42 days) and the average time to discharge from the date of operation was 10 weeks (6–30 weeks). The average final follow-up was 31 months (6–85 months). Of the 59 feet for whom pre-op and final follow-up data on further bone loss (ditigal or metatarsal absorption—a measure of recurrent ulceration) is available, 45 (76%) did not have any further bone loss and only 2 feet (4%) suffered more than 2 'points' bone loss after the operation. (Each toe and each metatarsal head counts as one 'point'.)

All of the CT TPTs and half of the IO TPTs were done prior to 1992. Since 1992 we have performed IO TPT almost exclusively (2 exceptions—patients with a calcified unyielding IO membrane). Thus there is a significant difference in the duration of follow-up (CT = 4·27 years, IO = 1·55 years) between CT and IO TPTs.

Long-term follow-up data regarding inversion was available in 69 patients. Of 26 patients who had CT TPTs 21 had recurrent inversion compared with only 1/43 of those who had an IO TPT. (Even this one patient had an unusual variation of the operation performed by another surgeon with the whole TP tendon attached medially and a fascia lata graft connecting the peroneus to the TP tendon at the anterior lower leg. In this case, apparently, the fascia was not attached with enough eversion and may have stretched.)

The relative risk for inversion at final follow-up for the CT route compared with the IO route is 8·97 with an odds ratio of 176·4 (χ-square 45·91, $p = 0{\cdot}0000000$). Having only an anterior muscle paralysis (normal evertors) was not protective against inversion at final follow-up in CT TPT. Of 16 patients with medial footdrop 3/6 who underwent CT TPT developed recurrent inversion *vs* 0/10 in the IO TPT group ($p = 0{\cdot}036$). For differences in angles between CT and IO routes see Table 1.

Only 6 patients in this study did not have a TAL. At final follow-up patients who had a TAL had a significantly greater likelihood of an ADF above 90°. Failure to do a TAL can lead to a poor result.

Table 1.

	Circumtibial	Interosseous	*p* value
No. of feet operated	34	67	–
Long term follow-up	26	43	–
Recurrent inversion	21	1	0·00001
ADF at discharge	81·9°	77·3°	0·00003
APF at discharge	102·6°	89·5°	0·0264
ADF final follow-up	90·3°	81·6°	0·00009
APF final follow-up	111·6°	98·8°	0·003
ROM final follow-up	21·3°	18·3°	0·374*
Final follow-up years	4·27	1·55	

*Not statistically significant.

Discussion

In this study TPT (either route) provides ADF above 90° in 80% of patients, with restoration of normal gait (ADF above 95°) in 94% of patients. A summary of some of the literature is given in Table 2. ADF above 90° is possible in between 65 and 95% of patients according to these studies. Richard[9] has pointed out that for the transfer to function well, it should partly function as a tenodesis. That the transfer also has an active component is obvious from the 22° ROM of patients in this study. However it is important that this ROM should be in the functional range (80°–100°) for normal gait. Depending on the terrain a patient with ADF (only up to 90°) may still have a normal gait if they live on the plains. Patients who live in the hills require a greater ROM (10°ADF and 10° APF) in order to clear the ground going uphill and easily walk downhill.

The CT route however is associated with an unacceptably high rate of recurrent inversion leading to recurrent lateral border foot ulceration. This observation was made

Table 2. Comparison of published results of TPT

	Route	Attachment	Result
Author (number of feet)			
Andersen[1] (108)	CT/IO	tarsal bone or TA/EHL	heel-toe gait in 65 excellent or good in 72
Andersen[2] (12)	CT	EHL/EDL	excellent/good in 11
Carayon[3] (23) (TPT+FDL)	IO	TP-TA FDL-EDL	excellent (>50 ADF) in 18
Fritschi[4]	CT/IO	tarsal bone	CT better ROM than IO
Gunn[5] (56)	CT/IO	tarsal bone	49 satisfactory criteria not stated
Hall[6] (65)	IO	EHL/cuneiform	3 good, 1 poor (4 total)
	CT	EHL/EDL (35)	10 good, 16 fair
			6/23 recurrent inversion
	CT/IO	TP-TA (26) FDL-EDL	7 good, 11 fair
Malaivya[7] (98)	CT	cuneiform (20)	15 good heel-toe gait
		EHL/EDL (78)	53 good heel-toe gait
Palani[8] (76)	CT/IO		62 ADF above 90°
Richard[9] (39)	IO	EHL/EDL, PL	37 ADF above 90°
Selvapandian[11] (39)	CT/IO	tarsal bone	CT better ROM than IO
Srinivasan[12] (39)	CT	EHL/EDL, PT	22 ADF above 90° 12 ADF up to 90°
Thangaraj[13] (68)	CT	TA/EDL	60 patients >25° ROM 5 patients recurrent inversion
Warren[14] (13)	IO	TA/PB 5th MT	9 had good gait
Weber[15] (25)	CT/IO	TA/PB	21 ADF above 90°
Soares (110)	CT (43)	TA/EDL	38 ADF above 90°
	IO (67)	TA/PB	65 ADF above 90°

by Hall[6] and Thangaraj[13] in smaller groups of patients. CT TPT should be reserved for those patients with a calcified and unyielding IO membrane (usually elderly with recurrent inflammation/infection in the foot). If CT TPT is performed, the tendon bifurcation must be at least 3 cm above the ankle so that the line of pull is as close to the vertical as possible. Wherever possible IO TPT should be used.

There is no evidence (from this study) of the crippling adhesions associated with the IO route mentioned by Anderson[1] as there is no signficant difference in active ROM at final follow-up (CT 14/16 more than 10° *vs* IO 28/30 more than 10°, $p = 0{\cdot}244$). It is possible that if only a small window is made in the IO membrane that the transfer would get adherent there. This may explain previous observations[4,11] that the CT route provides a better ROM than the IO route. In this series the IO membrane was widely opened. There have been no vascular complications from this. The ROM of both groups in this study was similar (CT 21·3°, IO 18·3°, $p = 0{\cdot}374$).

The IO route is associated with better active ADF though less active plantar flexion both at discharge and at final follow-up when compared with the CT route. This may reflect the attachment of the tendon at a higher tension. It also reflects the greater efficiency of the transferred force from the tendon acting at a better angle of pull in the IO route.

It is noteworthy that the ADF will drop by 10° between the angle of suture and discharge from hospital. The ADF will drop a further 5°–10° between discharge and late follow-up (average fall—CT 8·4°, IO 4·3°). It is essential to suture the tendons with the foot dorsiflexed to at least 70° to allow for later stretching of the muscle-tendon unit.

Conclusion

TPT is an excellent procedure for the correction of footdrop due to leprosy neuritis, resulting in a normal gait in 94% of patients. To avoid recurrent inversion the IO route is preferred. An open TAL should always be performed. The TP tendon should be attached to TAN and to PB or PT tendons wherever possible. It may be attached to toe extensors only if there are no toes or the toes are not mobile otherwise clawtoes may result. The tendons should be sutured with the foot dorsiflexed to at least 70° as the foot will drop at least 10° between removal of POP and follow-up at one year. Three weeks immobilization in a POP cast at 65° to relieve tension on the anastomosis is sufficient, and is followed by 6 weeks graduated postoperative re-education. Full weight bearing and active plantar flexion are permitted at 6 weeks postoperation.

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