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Posterior tibial tendon transfer for drop-foot

20 cases followed for 1–5 years

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From 1991 to 1997 we performed 20 tibialis posterior tendon-transfer operations in 17 patients with drop-foot, in 11 of peripheral neurogenic origin and in 6 because of neuromuscular disease. Postoperatively, all patients could walk without an ankle-foot orthosis. At follow-up after mean 2 (1–5) years, all patients had active dorsiflexion of the foot and toes, with a median active ankle dorsiflexion of 5° (-15–10°). The median active plantar flexion was 40° (10–45°), and the total range of movement was 40° (15–50°). At follow-up, the gait was good in 15 and improved in 2 of the 17 patients.

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Transfer of the tibialis posterior may be indicated to diminish the supinated equinovarus deformity (Richard 1989, Coert and Dellon 1994). The technique most commonly used is through the interosseous membrane to the dorsum of the foot (Watkins et al. 1954) with fixation of the transfer into an osseous tunnel or with a bone-anchor in the lateral cuneiform or third metacarpal. However, another method of fixing the transferred tendon, the tendon-to-tendon technique, has been recommended (Andersen 1963, Richard 1989).

We report our experiences with interosseous transfer of the tibialis posterior tendon for drop-foot, fixed with the tendon-to-tendon technique.

Patients and methods

During 1991–1997, tibialis posterior transfer was performed at our department on 20 ankles in 17 patients (14 men), median age 24 (12–59) years. All the patients had had a drop-foot for more than 1 year. 2 patients had "spontaneous", 7 a traumatic paralysis, 2 had a benign tumor of the peroneal nerve, 5 had Charcot-Marie-Tooth or other neuromuscular disease and 1 had leprosy (Table).

Preoperatively

Each patient was taught by the physiotherapist to contract the tibialis posterior muscle independently and voluntarily. Patients with passive dorsiflexion of the ankle of less than 20° had stretching exercises of the Achilles tendon for several weeks (Watkins et al. 1954, Andersen 1963, Richard 1989).

Operative technique

Through a medial incision, the tendon was divided at its insertion to the navicular, preserving as much length as possible. A second incision was made parallel and lateral to the lower third of the tibial crest, and a window was made through the interosseous membrane. Using gentle traction, a part of the muscle belly and the tendon of the tibialis posterior was delivered into the anterior compartment of the leg. A third incision was made at the dorsum of the foot and, with a tendon tunneller, the tendon was passed subcutaneously, under the extensor retinaculum, and out through the third incision (Watkins et al. 1954).

The distal part of the tendon was then split longitudinally into two tails; the medial tail was inserted into the tendon of the extensor hallucis longus and the lateral tail into the tendons of the extensor digitorum longus and peroneus tertius (Andersen 1963, Srinivasan et al. 1968). The knee was then held flexed to approximately 90° and the ankle in dorsiflexion of at least 20°. Tendon interweaving sutures were completed with the leg in this position and the motor tendon in moderate-to-high tension. The knee was still held at 90°, the skin closed, and a below-knee plaster was applied with the foot dorsiflexed to release any tension on the tendon sutures during healing (Richard 1989).

During the operations, 5 ankles (Table) did not reach a dorsiflexion of at least 20 degrees and had a complementary Achilles lengthening. Case 2 had the motor tendon rerouted around the medial border of the tibia, the circumtibial route (Ober 1933), instead of the interosseous or transmembraneous route (Watkins et al. 1954), and cases 5 and 8 had the trans-

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Patient characteristics

Op. no. [a]	Sex	Age	Diagnosis	Duration (years)	Operation	Dorsal-flexion [b]	Plantar-flexion [b]	ROM	Toes [c]	Gait
1	M	33	Spontaneous	10	Interosseous	–15	35	20	+	Poor
2	M	30	Leprosy		Circumtibial	10	35	45	+	Fair
3	M	41	Pelvis fracture	2	Interosseous Achilles lengthening	10	35	45	+	Good
4	M	19	Pelvis fracture, crus fracture, compartment syndrome	1.5	Interosseous	0	15	15	+	Good
5	M	24	Traumatic nerve damage (traffic acident)	2	Interosseous Tendon to bone	–10	3	20	+	Fair
6	M	13	Charcot-Marie-Tooth		Interosseous + reop	–10	40	30	+	Poor
7					Interosseous Achilles lengthening	–5	40	35	+	
8	M	16	Charcot-Marie-Tooth		Interosseous Tendon to bone	0	45	45	+	Good
9					Interosseous (to tendon)	0	45	45	+	
10	M	22	Acetabelum fracture Luxatio coxae	1	Interosseous	10	30	40	+	Good
11	F	15	Congenital? Anisomelia	15	Interosseous Achilles lengthening	–10	45	35	+	Good
12	M	46	Charcot-Marie-Tooth		Interosseous	10	10	20	+	Good
13	M	12	Neuromuscular disease		Interosseous					Good
14					Interosseous Achilles length. × 2					
15	M	26	Benign tumor of the peroneal nerve	13	Interosseous	10	40	50	+	Good
16	F	59	Foot deformity Spontaneous		Interosseous Achilles lengthening	10	20	30	+	Good
17	M	22	Tibiacondyl fracture	2	Interosseous	5	40	45	+	Good
18	M	13	Benign tumor of the peroneus communis	3	Interosseous	5	40	45	+	Good
19	M	42	Disc prolapse	3	Interosseous	–5	40	35	+	Fair
20	F	47	Disc prolapse	3	Interosseous	0	40	40	+	Good

[a] Operation number, [b] active flexion, [c] + active dorsalflexion of toes.

ferred tendon inserted into the third metatarsal. The tendon of the peroneus tertius was not included in the first operations (cases 1–4).

Postoperative treatment and follow-up

The ankles remained in plaster (incorporating a toe guard) for 4 weeks. The patients were allowed to walk with full weight-bearing after removal of the plaster, but several weeks with physiotherapy was necessary for optimal results. Training out of plaster was reinforced by visual feedback, the patient walking towards a mirror.

At follow-up after median 2 (1–5) years, the ability of heel-toe gait and active dorsiflexion of the ankle and toes was assessed. The maximum angle of active dorsiflexion and plantar flexion at the ankle, and the range of movement (ROM) of the foot were measured using a goniometer. All angle measurements were brought to the nearest 5°.

Active dorsiflexion to 0° and more was classified as excellent outcome, between –10° and 0° as good, and between –20° and –10° as fair outcome (Ninkovic et al. 1994).

The gait was assessed according to Hall (1977)—i.e., good, the patient walks naturally; fair, the patient walks well, but there is still an obvious difference between the operated foot and a normal foot on the other side; poor, the patient still tends to drag his foot, although there is some improvement in the position of the foot; bad, the operation has not at all improved the patient's gait or the position of the foot.

Outcome

At follow-up, after median 2 (1–5) years, all patients could walk without an ankle-foot orthosis. In most cases, the heel-toe gait was attained within a few weeks. There were no ruptures of the transferred tendons or infections. All the patients had postoperatively active dorsiflexion of the foot and toes, 16 of the 20 operated ankles had an excellent or good end-result (Table). Case 6 had to be be operated on a second time to shorten the tendon and case 1 is waiting for a new operation, because of inadequate tension of the transposed tendon.

The median (range) active dorsiflexion was 5° (–15° to 10°), the active plantar flexion was 40° (10–45°) degrees, and the total range of movement was 40° (15–50°) (Table). The active dorsiflexion of the toes was 5–20°.

Some of the first operated patients (cases 1–4) without suture to the peroneus tertius tendon, had some remaining foot inversion and more load on the outer border of the foot. By including the peroneus tertius in the procedure we improved the stability of the foot.

Discussion

Posterior tibial tendon transfer has been used in a variety of disorders with weakness of dorsiflexion of the ankle to restore a normal heel-toe gait (Miller et al. 1982, Mont et al. 1996). The technique is difficult to perform, because the tibialis posterior has an excursion or amplitude of only 2 cm, whereas the dorsiflexors it replaces (tibialis anterior and extensor hallucis longus) have excursions of from 3–5 cm (Brand 1974). Therefore, the degree of tension between the transposed muscle and the sutured tendons is important. Andersen (1963) claims that the transfer must be sutured under high tension. In our series, 2 of the patients had a fair outcome, with reduced active dorsiflexion due to inadequate tension between the transfer and the sutured tendons.

It is clear that the tibialis posterior works well as a dorsiflexor when transposed forwards, irrespective of the method used (Watkins et al. 1954, Andersen 1963, Turner and Cooper 1972). Mechanically, the different techniques vary only marginally, regarding range and strength of dorsiflexion of the ankle.

Many surgeons fix the transfer into an osseous tunnel in the tarsal or metatarsal bones. This has several disadvantages: consequent neuropathic arthropathy of the tarsal joints has been reported (Andersen 1963). The dropping of the forefoot and toes is not corrected and the point of fixation is important for later inversion or eversion deformity (Warren 1968).

Many advantages are claimed for the tendon-to-tendon technique. It is easy to do, it does not involve elaborate dissection and it does not damage the tarsal bones. Because two slips are used, the difficulty of trying to balance the foot, using a single guy rope, is avoided. The motor tendons are attached to the recipient tendons beyond the joint over which they have to act. The pull is spread evenly over the entire forefoot, producing a more physiological function, and the dropping of the forefoot and toes is also corrected (Andersen 1963, Srinivasan et al. 1968).

The tendon of the tibialis posterior can be brought to the dorsum of the foot by two routes—i.e., the interosseous or the circumtibial route. Both methods have resulted in good outcome (Watkins et al. 1954, Andersen 1963, Srinivasan et al. 1968, Warren 1968, Hall 1977). The circumtibial, subcutaneous route is technically easier, but the cosmetic result is not so good. Adhesions are likely to form, using the interosseous route if the window in the membrane is too narrow (Rodriguez 1992).

The failure rate of the procedure is low. We have found it important to give the patients a preoperative training program, with exercises for the tendon to be transferred and stretching exercises of the Achilles tendon for better passive dorsiflexion. It is recommended to lengthen the Achilles tendon, when passive dorsiflexion to at least 20° above the right angle is not possible (Srinivasan et al. 1968, Hall 1977, Richard 1989). We also recommend inclusion of the peroneus tertius tendon in the operative procedure. This provides lateral lift and better stability of the foot.

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