Journal of Orthopaedic Surgery 2009;17(2):194-8

Flexor hallucis longus tendon transfer for reconstruction of chronically ruptured Achilles tendons

Ravindra H Mahajan, Rakesh B Dalal
Department Of Orthopaedics, Stepping Hill Hospital, Stockport NHS Foundation Trust, Stockport, United Kingdom

ABSTRACT

Purpose. To report the mid-term results of flexor hallucis longus (FHL) tendon transfer for reconstruction of chronically ruptured Achilles tendons.
Methods. 24 men and 12 women aged 56 to 78 (mean, 70) years underwent FHL tendon transfer for reconstruction of chronically ruptured Achilles tendons by a single surgeon. Ruptures were secondary to trauma (n=20), long-term steroid intake (n=12), or chronic renal failure (n=6). Two patients had bilateral ruptures. The mean interval from rupture to surgery was 15 (range, 12–24) weeks. Pre- and post-operative American Orthopaedic Foot and Ankle Society (AOFAS) hind foot scores were compared. Wound healing, push-off, and patient satisfaction were evaluated.
Results. The mean follow-up period was one year. The mean AOFAS scores were 69 (range, 58–76) preoperatively and 88 (range, 79–94) postoperatively; the mean improvement was 19 ($p<0.001$). 28 patients had excellent and 8 had fair results. 33 patients graded their outcome as 'very satisfactory' and 3 as 'satisfactory'. Five patients developed wound healing complications but only one needed debridement. There was no fixation-related complication or sural nerve injury.
Conclusions. Transfer of the FHL for reconstruction of chronically ruptured Achilles tendons is effective, safe and easily performed in patients with low-to-moderate demands.

Key words: *Achilles tendon; rupture*

INTRODUCTION

A chronically ruptured Achilles tendon is debilitating and difficult to treat, as there is usually a gap between the ends of the tendon, scarring, and retraction of calf muscles.[1,2] Surgical reconstruction is superior to conservative treatment.[3–8] Autogenous tissues used include a strip of the central aponeurosis of

Address correspondence and reprint requests to: Dr Ravindra H Mahajan, M1 Willow House, Stepping Hill Hospital, Poplar Grove, Stockport, SK2 7JE, United Kingdom. E-mail: drtanu_mhas@hotmail.com

the gastrosoleus complex,[5] the peroneal tendon,[9] the fascia lata,[10] a VY-plasty of the gastrosoleus,[4] and either the flexor digitorum longus (FDL) or flexor hallucis longus (FHL) tendon.[7] Other materials used include an allograft,[11] synthetic materials such as Dacron weave,[12] carbon fibre,[13] and Marlex mesh.[14] We report the mid-term results of FHL tendon transfer for reconstruction of chronically ruptured Achilles tendons.

MATERIALS AND METHODS

Between 2000 and 2005, 24 men and 12 women aged 56 to 78 (mean, 70) years underwent FHL tendon transfer for reconstruction of chronically ruptured Achilles tendons by a single surgeon. Ruptures were secondary to trauma (n=20), long-term steroid intake (n=12), or chronic renal failure (n=6). Two patients had bilateral ruptures. The mean interval from rupture to surgery was 15 (range, 12–24) weeks.

Each patient was placed in a prone position under general, spinal or popliteal block anaesthesia and a thigh tourniquet was applied (3 patients were operated on without a tourniquet). The ruptured tendon was approached via a posteromedial incision; the rupture site was left untouched. The gastrosoleus complex was exposed proximally, and the incision extended distally over the superior part of the calcaneum. A separate medial plantar incision was made to expose the FHL and FDL tendons at the Knot of Henry. The FHL tendon was detached as distally as possible and delivered through the proximal incision (Fig.). This entailed division of numerous septae that connect to various soft-tissue structures in the foot and ankle, including the FDL tendon. The distal segment of the FHL tendon was sutured to the FDL tendon. A tunnel calibrated according to the tendon thickness was made in the calcaneum near the insertion of the Achilles tendon in a superomedial to plantarlateral direction, using a core reamer. The FHL tendon was then fixed in the tunnel with the ankle in a neutral position using bone grafts (n=20) or interference screws (n=16) to secure fixation. The belly of the FHL tendon was sutured to the gastrosoleus and proximal part of the Achilles tendon. Wounds were closed in layers.

A below-knee cast was applied with the ankle in a neutral position for 6 weeks, with partial weight bearing allowed. The cast was changed at week 3. Physiotherapy to mobilise the ankle and strengthen the Achilles tendon was started at week 6.

Patients were followed up at week 3 and 6, and month 3, 6, and 12. Pre- and post-operative American Orthopaedic Foot and Ankle Society (AOFAS) hind foot scores were compared using Student's paired *t* test (1 tailed). Wound healing, push-off, and patient satisfaction were also evaluated.

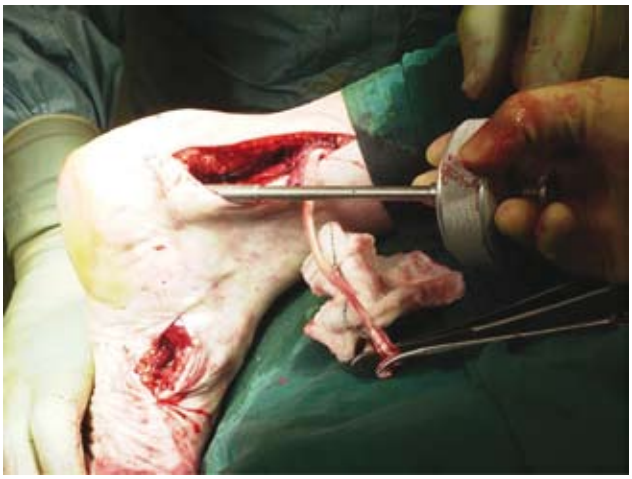

Figure The flexor hallucis longus tendon is delivered through the proximal incision, and a drill hole is made in the calcaneum.

RESULTS

The mean follow-up period was one year. The mean AOFAS scores were 69 (range, 58–76) preoperatively and 88 (range, 79–94) postoperatively; the mean improvement was 19 ($p<0.001$, Table). 33 patients were able to stand on tiptoe and regained the spring in their step. 28 patients had excellent and 8 had fair results. 33 patients graded their outcome as 'very satisfactory' and 3 as 'satisfactory'. Five patients developed wound healing complications but only one needed debridement. 33 patients had satisfactory push-off and 3 had weak push-off but endured no restriction in the activities of daily living. There was no fixation-related complication or sural nerve injury. There was no anatomic variation in the FHL tendon prohibiting the transfer.

DISCUSSION

Acute Achilles tendon ruptures may go undiagnosed in as many as 25% of patients, resulting in chronic or neglected states that become difficult to treat.[15] The most appropriate reconstructive technique remains controversial.[16] Rupture is classified as chronic if

Table
Patient characteristics and treatment outcomes

Patient no.	Sex/age (years)	Injured side	Time since rupture (weeks)	Injury mechanism	Fixation secured with	Complication	Immobilisation (weeks)	Follow-up (years)	Satisfaction*	AOFAS score†	
										Preop	Postop
1	M/76	R	12	Trauma	Bone graft	-	8	1	VS	63	87
2	M/69	R	16	Trauma	Bone graft	-	8	1	VS	72	89
3	M/63	L	15	Trauma	Bone graft	-	8	1	VS	60	84
4	F/74	R	15	Trauma	Bone graft	-	8	1	VS	68	90
5	M/69	R	20	Trauma	Bone graft	-	8	1	VS	72	94
6	F/67	L	18	Trauma	Bone graft	-	8	1	VS	68	90
7	F/73	L	18	Trauma	Screw	Wound infection	10	1	VS	64	89
8	M/70	Both	16	Chronic renal failure	Screw	-	10	1	VS	58	86
9	M/72	R	16	Trauma	Bone graft	-	8	1	VS	64	86
10	M/68	R	16	Trauma	Bone graft	Weak push-off	8	1	S	68	79
11	M/72	L	12	Trauma	Bone graft	-	8	1	VS	62	86
12	F/62	L	14	Trauma	Bone graft	-	8	1	VS	72	88
13	M/74	L	14	Steroid intake	Screw	-	8	1	VS	70	88
14	M/72	R	12	Trauma	Bone graft	-	8	1	VS	74	92
15	M/70	R	16	Steroid intake	Screw	-	8	1	VS	76	84
16	M/64	R	14	Trauma	Bone graft	Wound infection	8	1	VS	76	88
17	M/67	L	18	Steroid intake	Bone graft	-	8	1	S	74	86
18	F/76	R	14	Trauma	Bone graft	-	8	1	VS	72	88
19	M/76	L	16	Steroid intake	Bone graft	Wound infection	8	1	S	76	89
20	M/68	R	14	Trauma	Screw	-	8	1	VS	72	92
21	F/74	R	14	Chronic renal failure	Bone graft	Weak push-Off	8	1	VS	72	86
22	M/70	R	18	Trauma	Screw	-	8	1	VS	68	91
23	M/61	L	14	Trauma	Screw	-	8	1	VS	74	92
24	M/56	R	16	Trauma	Bone graft	-	8	1	VS	70	92
25	M/66	R	12	Steroid intake	Screw	-	8	1	VS	66	84
26	F/78	Both	14	Steroid intake	Screw	Weak push-off	8	1	VS	58	84
27	M/74	R	14	Trauma	Bone graft	-	8	1	VS	64	90
28	F/76	R	18	Steroid intake	Screw	-	8	1	VS	64	87
29	M/75	R	16	Steroid intake	Screw	-	8	1	VS	72	90
30	M/69	L	16	Chronic renal failure	Screw	-	8	1	VS	68	84
31	F64	R	14	Steroid intake	Bone graft	-	8	1	VS	70	85
32	M/72	R	16	Chronic renal failure	Screw	-	8	1	VS	63	86
33	F/74	R	14	Chronic renal failure	Screw	-	8	1	VS	74	90
34	M/68	R	12	Trauma	Screw	-	8	1	VS	73	92
35	F/73	L	18	Steroid intake	Screw	-	8	1	VS	66	89
36	F/76	R	24	Steroid intake	Bone graft	Wound break-down	8	1	VS	66	86

* VS denotes very satisfactory and S satisfactory
† AOFAS denotes American Orthopaedic Foot and Ankle Society

older than 4 weeks.[2] Contraction of the gastrosoleus complex occurs as early as 3 to 4 days.[5] Reconstruction becomes necessary if the treatment is delayed >4 weeks and the tendon defect is >2 cm.[17]

The FHL tendon has the following advantages over the FDL and peroneus brevis (PB) tendons. (1) It

is the second strongest tendon after the gastrosoleus and offers stronger plantarflexion than the FDL and PB tendons. (2) The axis of contraction is more in line with the Achilles than FDL and PB tendons. (3) The FHL tendon fires in phase with the gastrosoleus complex. (4) It has anatomic proximity to the Achilles tendon.[18,19] Therefore, the FHL tendon is particularly well suited to calcaneal tendon reconstruction.[19]

Digitations present between FDL and FHL tendons help retain great toe flexion after the FHL tendon transfer.[20] Passing the tendon through multiple transverse drill holes in the calcaneum involves a more extensive skin incision through an area of compromised vascularity.[8] We sutured the distal stump of the FHL tendon to the FDL tendon to help maintain great toe flexion. This offers simpler exposure and easier fixation of the tendon to the calcaneus, minimising the risk of complications, particularly in patients with multiple co-morbidities. Reinforcement of the calcaneal tendon with transfer of the FHL tendon is recommended treatment for pre-rupture syndrome, acute rupture caused by tendinosis, avulsion of the tendon from the calcaneal attachment, and late repairs.[21] This is particularly applicable to chronic tendinosis of the calcaneal tendon, which results in a large defect after debridement of the degenerative and calcified tendon sections.[18–26] If the calcaneal tendon is not sufficiently load-stable after debridement, a transfer of the FHL tendon is indicated.[21] There are 4 different topographic anatomic variations of the distal end of the FHL tendon. Surgeons should be aware of these before planning the operation.[21]

In patients with FDL tendon transfer, 57% had excellent, 29% had good, and 14% had fair results.[3] In our patients with FHL tendon transfer, 83% had excellent and 17% had fair results. Sural nerve injury is common after lateral foot and ankle procedures,[27,28] but no such injury occurred in our series.

Tendon allografts are costly and limited in supply and there is a risk of infection.[29] A synthetic product can result in an inflammatory response.[30] The use of mesenchymal stem cells in a collagen matrix is still preliminary for this purpose.[31] The FHL transfer is biomechanically and anatomically well-suited for chronic achilles tendon deficiency. It is effective, safe and easily performed in patients with low-to-moderate demand.

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