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ORIGINAL ARTICLE

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Repair of neglected Achilles tendon rupture using gastrocnemius fascial flaps

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Abstract *Background:* Neglected Achilles tendon rupture is a rare disorder. In this article, we discuss the results of 10 patients with neglected Achilles tendon ruptures who were treated surgically. *Methods:* Between 1980 and 1997, we treated 10 patients (6 men and 4 women) using gastrocnemius fascial flaps according to the method described by Lindholm. The mean age of the patients at the time of the operation was 51 years (range 38–57 years). They were followed-up for 26–192 months. *Results:* There were significant differences between the American Orthopaedic Foot and Ankle Society (AOFAS) scale score before the operation (72.6±5.3) and the score at the most recent follow-up (98.1±2.5) ($p<0.0001$). On Cybex isokinetic strength testing, the peak torque deficiencies in plantar flexion ranged from 8% to 68% at the low setting and from 19% to 33% at the high setting preoperatively, and ranged from –9% to 17% at the low setting and from –13% to 23% at the high setting postoperatively. There were no re-ruptures. *Conclusion:* Our data indicate that the reconstructive technique using gastrocnemius fascial flaps can result in an excellent clinical and functional outcome.

Keywords Achilles tendon · Reconstruction · Fascial flaps · Gastrocnemius

Introduction

Because rupture of the Achilles tendon is a common injury in the middle-aged athlete, and most patients can achieve excellent results for normal daily and athletic activity if they receive appropriate treatment promptly, which may or may not include surgery, neglected Achilles tendon rupture is a rare disorder. However, if the patients do not receive suitable treatment immediately, the distance between the bilateral stumps widens, causing functional absence of the triceps surae and limping. It is difficult to fit the stumps with fresh sections in almost all patients, and there are many reports on reconstructive techniques with the objective of bridging the gap by grafting and thereby maintaining the continuity of the Achilles tendon [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30].

Gabel and Manoli [7] defined neglected Achilles tendon rupture as a rupture of the Achilles tendon with a delay in treatment of 4 weeks or more. During the period between 1980 and 1997, we diagnosed 10 pateints with neglected Achilles tendon ruptures and treated them using gastrocnemius fascial flaps according to the method described by Lindholm [18]. In the current report, we describe the results at 2 to 17 years after operation.

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Patients and methods

Between 1980 and 1997, a total of 64,140 outpatients visited our office at Shimane Medical University. Among them, 84 (89 feet) were diagnosed with a fresh Achilles tendon rupture (0.14%) and 10 (10 feet) with neglected Achilles tendon rupture (0.016%). We performed reconstructive surgery using gastrocnemius fascial flaps according to the method described by Lindholm [18] for the patients suffering a neglected Achilles tendon rupture. The mean duration between injury and operation was 4 months (range 2–7 months). The patients' progress was followed for a mean duration of 6 years and 3 months (range 2 years and 2 months to 16 years). There were 6 men and 4 women. The mean age of the patients at the time of the operation was 51 years (range 38–57 years), and they were followed-up for 26 to 192 months (Table 1). Different causes were responsible for the neglected Achilles tendon ruptures. Four patients had received inappropriate treatment due to misdiagnosis (ankle sprain) at another hospital, three did not seek treatment after injury, two were re-ruptures after conservative treatment of the original Achilles tendon rupture, and one was a re-rupture after open treatment of the original Achilles tendon rupture. No patient had ecchymosis, swelling, or tenderness. All of the patients suffered major weakness of active plantar flexion, were unable to stand on tiptoe, and limped. Furthermore, all of the patients underwent magnetic resonance imaging (MRI), which revealed high intensity areas in the Achilles tendon on a T2-weighted

Table 1 Data on the 10 patients diagnosed with neglected Achilles tendon rupture (*AOFAS* American Orthopaedic Foot and Ankle Society)

Case	Gender, age at operation (years)	Duration from rupture to repair (months)	Duration of follow-up (months)	AOFAS score		
				Preoperative	6 months	Latest
1	F, 45	4	192	69	86	94
2	M, 44	3	188	81	90	99
3	F, 51	7	82	70	88	94
4	M, 52	5	53	68	90	100
5	F, 78	2	50	76	98	100
6	M, 48	3	44	71	92	100
7	M, 68	3	43	72	90	97
8	M, 72	2	40	82	100	100
9	M, 38	2	33	69	98	100
10	F, 41	5	26	68	97	97

image and fibrous tissue filling the defective area of the ruptured Achilles tendon. The Thompson test was positive for all patients.

The operation was performed with the patient under spinal anesthesia. The patient was placed in a prone position on the operating table. The Achilles tendon and the lower part of the gastrocnemius were exposed by a curved medial skin incision. The skin incision extended from approximately the middle of the calf down to the calcaneus. To avoid scarring over the tendon, the distal part of the skin incision did not extend beyond the midline. The flap of skin was freed from the crural fascia. Sural nerve injury was carefully avoided while performing blunt dissection of the subcutaneous tissue. The crural fascia and the external peritenon were then divided by a longitudinal incision at the midline, and the Achilles tendon was exposed, showing the rupture site. The tendon stumps were trimmed and the fibrous tissue resected. For all 10 patients, a specimen of the fibrous tissue was taken for pathological examination.

Next, the tendon was sutured with 1–0 nylon thread which provides suitable tension with the ankle at the maximum plantar flexed position. It was not necessary to join the surface of the tendon stumps. When the tendon had been sutured, a flap approximately 1.0 cm wide and 7 to 8 cm long was cut from either side of the fascia of the gastrocnemius at about 1.0 cm from the midline. When the flaps had been freed, they were twisted backward through 180 deg so that the smooth surface lay against the skin. The origin of the flaps was 3–4 cm above the tendon suture, and the tissue which had been rotated and drawn downward adequately covered the suture line in the tendon and was fixed in the distal stump with a few interrupted sutures. The incision in the fascia of the gastrocnemius was closed (Fig. 1). Finally, the crural fascia, the external peritenon, the subcutaneous tissue, and the skin were sutured.

After the operation, seven patients who were operated on between 1980 and 1994 (cases 1, 2, 3, 4, 5, 6, and 7) had their knee and ankle immobilized by a plaster cast for 3 weeks with the knee flexed at 30 deg and the ankle in a 30-deg plantar flexed position. For the following 3 weeks, the ankle was immobilized in a 15-deg plantar flexed position. Six weeks after the operation, the plaster cast was removed, and the patients began a series of toe touch and active range-of-motion exercises of the ankle. Seven weeks after the operation, passive range-of-motion exercises were initiated. Partial weight-bearing was allowed 6 weeks after the operation, and full weight-bearing at 8 weeks. The remaining three patients, who were operated on between 1995 and 1997 (cases 8, 9, and 10), had only their ankle immobilized by a plaster cast with the ankle in a 30-deg plantar flexed position for 3 weeks. Two weeks after the operation, toe touch was allowed. Three weeks after the operation, the plaster cast was removed, and active range-of-motion exercises of the ankle were begun. Four weeks after the operation, passive range-of-motion exercises were initiated. Partial weight-bearing was allowed after 2 weeks and full weight-bearing after 4 weeks. Active full range of motion of the knee was allowed the first day after the operation. For both groups A and B, jogging was permitted 3 months after the operation, and full sports activity 6 months after the operation.

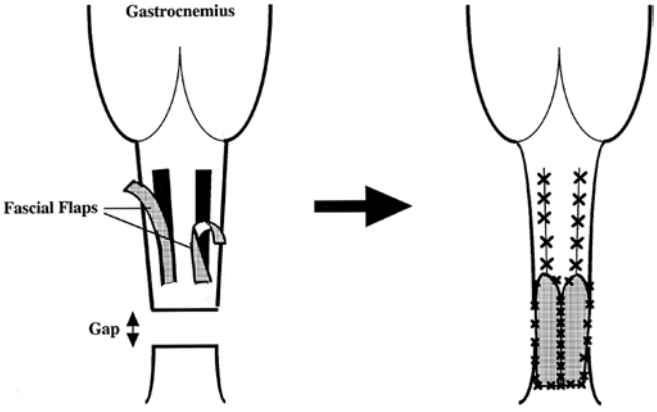

Fig. 1 Operative technique using gastrocnemius fascial flaps according to the method described by Lindholm. A flap approximately 1.0 cm wide and 7–8 cm long is cut from either side of the fascia of the gastrocnemius at about 1.0 cm from the midline. When the flaps have been freed, they are twisted backward through 180 deg so that the smooth surface lies against the skin. The origin of the flaps should be 3–4 cm above the tendon suture, and the tissue which has been rotated and drawn downward should adequately cover the suture line in the tendon and be fixed to the distal stump with a few interrupted sutures

The patients were followed once a month for the first year following surgery and twice a year beginning with the second year after surgery. At 6 months after the operation and at the most recent follow-up, all patients were examined by means of the AOFAS ankle-hindfoot scale [14]. MRI was taken for all patients at the most recent follow-up. Cybex isokinetic strength testing was performed on both ankles for comparison in 5 of the 10 patients (cases 6, 7, 8, 9, and 10) before the operation and the most recent follow-up. Each limb went through a rapid range of motion at both low and high machine settings (30 and 120 deg/s).

The AOFAS before the operation and follow-up scores were compared by means of Student's *t*-test. Differences between the two groups were considered to be statistically significant when p was less than or equal to 0.05.

Results

The mean AOFAS scale score was 72.6±5.3 points (range 68–82 points) before the operation and 98.1±2.5 points (range 94 to 100 points) at the most recent follow-up. There were significant differences between the score be-

Table 2 Cybex isokinetic strength values (unaffected/affected)

Case	30 deg/s plantar flex. peak torque (Nm)		120 deg/s plantar flex. peak torque (Nm)		30 deg/s plantar flex. peak torque def. (%)		120 deg/s plantar flex. peak torque def. (%)	
	Preop	Latest	Preop	Latest	Preop	Latest	Preop	Latest
6	58/73	66/77	30/37	37/38	26	17	23	3
7	28/47	41/45	16/19	17/15	68	10	19	13
8	24/26	25/24	12/16	13/16	8	–4	44	23
9	41/58	61/62	26/34	33/38	42	2	31	15
10	20/33	38/35	16/20	21/22	65	–9	25	5

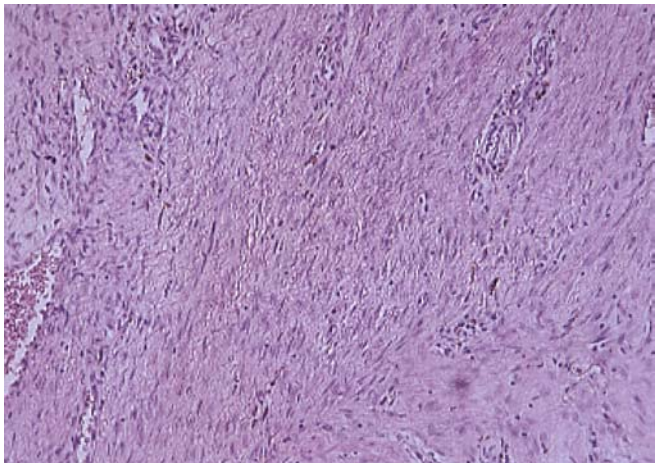

Fig. 2 Pathological findings of fibrous tissue between the tendon stumps (case 6). There was no tendon tissue in any specimen

Fig. 3 MRI findings at the final follow-up (case 6). The diameter of the heel cord at the disrupted site had increased. There was a small high intensity area on T2-weighted images, indicating fibrous tissue

fore the operation and at the most recent follow-up ($p<0.0001$). The mean AOFAS scale score was 90.6±3.8 (range 86–98 points) at 6 months after operation and 97.7±2.8 points (range 94–100 points) at the most recent follow-up in the standard postoperative rehabilitation group (cases 1, 2, 3, 4, 5, 6, 7), and 98.3±1.5 points (range 97–100 points) at 6 months after operation and 99.0±1.7 points (range 97–100 points) at the most recent follow-up in the accelerated postoperative rehabilitation group (cases 8, 9, 10).

On Cybex isokinetic strength testing, the peak torque deficiencies in plantar flexion ranged from 8% to 68% at the low setting and from 19% to 33% at the high setting preoperatively, and ranged from –9% to 17% at the low setting and from –13% to 23% at the high setting postoperatively (Table 2). Muscle strength in plantar flexion of the ankle was improved in all of the patients.

On the basis of the pathological findings of fibrous tissue between the stumps, we were unable to find tendon tissue in any specimens (Fig. 2). MRI findings at the final follow-up showed an increase in the diameter of the heel cord at the disrupted site and a small high intensity area on T2-weighted images indicating fibrous tissue (Fig. 3). There were no re-ruptures, and no patient suffered a deep wound infection or a lesion of the sural nerve.

Discussion

Functional ankle plantar flexion is critical for an efficient gait. In the patients with neglected Achilles tendon rupture, the triceps surae was shortened and the distance between the proximal and distal stumps had lengthened with fibrous tissue. Therefore, the muscle strength of the plantar flexion of the ankle was weakened. For that reason, reconstruction of the Achilles tendon to a functional length is important in the treatment of neglected Achilles tendon ruptures. There was a report that primary suture of both stumps was a useful treatment [25], but since it is difficult to approximate the stumps for almost all patients in spite of maximal plantar flexion of the ankle, many surgical techniques have been reported for repair of the neglected Achilles tendon rupture.

Some reports discuss surgical techniques combining the use of different tissues for reconstruction or augmentation such as the fascial flap or flaps of the gastrocnemius

[4, 8, 11, 18, 26], proximal Achilles tendon (advanced in a V-Y fashion) [1, 13, 15, 21], plantaris tendon [19], fascia lata [5], posterior tibial tendon [24], peroneus brevis tendon [27, 28], flexor digitorum longus tendon [20], flexor hallucis longus tendon [29, 30], bone-patellar tendon [2], and combined surgical technique [3]. Others examine the use of artificial tendons such as carbon fiber [10, 23], collagen tendon prosthesis [12], Marlex mesh [6, 22], Dacron vascular graft [17], and Gortex vascular graft [16]. The results of these treatments have been reported to be equally or almost equally favorable. Nevertheless, there were some disadvantages. Reconstruction using other tendons such as the plantaris tendon, posterior tibial tendon, peroneus brevis tendon, flexor digitorum longus tendon, or flexor hallucis longus tendon involves a sacrifice of healthy tissue. Furthermore, it causes significant interference in function compared with the function of the original tendon. Artificial prostheses, such as carbon fiber, collagen tendon prosthesis, Marlex mesh, Dacron vascular graft, or Gortex vascular graft, have not been proved to maintain their durability for many years. Utilizing gastrocnemius fascial flaps for the reconstruction of a neglected Achilles tendon rupture has the advantage that it provides a firm connection between the distal and proximal stumps without damaging healthy tissues. It is therefore possible to begin postoperative rehabilitation such as muscle strength training, weight-bearing, and range-of-motion exercises at an early stage.

In conclusion, the current study shows that the reconstructive technique using gastrocnemius fascial flaps according to Lindholm can result in an excellent clinical and functional outcome. We considered this operative technique useful for the treatment of neglected Achilles tendon ruptures.

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