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Long-term Results of Chronic Achilles Tendon Ruptures Repaired With V-Y Tendon Plasty and Fascia Turndown

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Abstract

Background: This study aimed to evaluate the long-term follow-up results of V-Y tendon plasty with fascia turndown, for repairing chronic Achilles tendon ruptures.

Methods: Seventeen patients (12 males, 5 females), who were diagnosed with chronic Achilles tendon rupture and met the inclusion criteria, were included in the study. These patients received treatment by means of V-Y tendon plasty with fascia turndown from January 1995 to December 2001. Clinical outcomes of the patients were assessed by using isokinetic strength testing, questioning the patient regarding residual discomfort, pain, or swelling and having the ability to perform heel rises and using American Orthopaedic Foot & Ankle Society's (AOFAS's) Ankle-Hind Foot Scale score. Mean follow-up duration was 16 years (13-18 years).

Results: Mean time from the injury to operative treatment was 7 months. Mean operative defect of Achilles tendon in neutral position after debridement was 6 cm. During the follow-up, the mean calf atrophy was 3.4 cm. The mean 30 degrees/s plantarflex and 120 degrees/s plantarflex peak torques were 89 and 45 Nm, respectively. The mean 30 degrees/s plantarflex peak torque deficiency was 16%. The mean 120 degrees/s plantarflex peak torque deficiency was 17%. The average peak torque deficiency was 17%. The pre- and postoperative mean AOFAS Ankle-Hindfoot Scale scores were 64 and 95, respectively. No patient had a rerupture. Superficial wound infection was treated with oral antibiotic therapy in 2 patients (11%).

Conclusions: The V-Y tendon plasty with fascia turndown for repairing chronic Achilles tendon ruptures yielded results comparable with the literature regarding clinical outcomes. This method did not require synthetic materials for augmentation and was an economic alternative compared to other repair methods.

Level of Evidence: Level III, retrospective comparative study.

Keywords: chronic Achilles tendon tear, Achilles tendon reconstruction, neglected rupture

Introduction

Chronic Achilles tendon rupture is a challenging condition to treat. Delay in treatment causes the tendinous ends to retract and atrophy, leaving a wide separation that becomes occupied with fibro-adipose scar tissue. After excising the intervening scar tissue, it is difficult to perform end-to-end repair.[9,25] Patients with a chronic Achilles tendon rupture have a greater tendency to develop complications and poorer functional results than patients with a fresh rupture.[14,22] The role of operative and nonoperative treatment in acute ruptures continues to be debated, but some investigators agree that chronic ruptures should be treated operatively unless there are contraindications for surgery or the patient has minimal functional demands.[14,20] The aim of surgery is to restore and maintain the length of the Achilles tendon to achieve propulsive gait by the gastrocsoleus muscle complex.[17,27] Nonoperative treatment should be used for patients who have minimal functional demands, poor healing capacity, high medical morbidity such as uncontrolled diabetes mellitus, or vascular disease; however, increased rerupture rates and decreased functional results are seen with nonoperative

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treatment.[29] On the other hand, there have been reports of a lower rerupture rate with nonoperative management involving functional orthosis for acute ruptures[13] with a reported rate of rerupture of 2.9% in 945 patients who were managed with a functional orthosis.[26] The success of nonoperative treatment depends upon the type of mobilization, rupture type, and compliance of the patients.

Delay in operative repair causes the proximal tendon stump to often adhere to the posterior fascia of the flexor hallucis longus, contract and atrophy, and the gap formation becomes filled with scar tissue between the stumps. This scar tissue is not as strong as normal tendon. After excising the intervening scar tissue, it is difficult to perform end-to-end repair.[16,25] Numerous techniques have been used for treatment of chronic Achilles tendon rupture, such as primary repair, scar tissue repair, tendon transfer, V-Y advancement, turndown flaps, and synthetic graft augmentation.[2,7,15,17,22] The goals of all these techniques are to restore the length of the tendon, and thus symmetric gait should be demonstrated.

No consensus exists regarding the specific time in which an acute Achilles tendon rupture becomes a chronic rupture. Although the most commonly accepted time interval is 4 weeks, chronic ruptures have in common the fact that end-to-end repair is difficult even with plantarflexion of the foot.[2,17] It has been shown that in patients with chronic ruptures, fatty infiltration in the gastrocnemius and soleus muscle occurs.[12] Fatty infiltration may lead retraction of the triceps surae muscle complex, which makes end-to-end repair impossible.

In this study, we have evaluated the long-term follow-up results of patients with chronic Achilles tendon ruptures who underwent a V-Y tendon plasty with the fascia turndown.

Methods

All of the patients included in this study were admitted to our clinic with a diagnosis of closed Achilles tendon rupture from January 1995 to December 2001. The inclusion criteria included a closed, chronic Achilles tendon rupture at least 4 weeks from the time of injury. Patients who had received operative treatment before 4 weeks were excluded from the study.

Twenty-one patients meeting the criteria were included in our study; however, 2 patients died because of cardiac problems and 2 patients were lost during the follow-up period as a result of change of address (Table 1). Mean follow-up time was 195 months (range, 158-226 months) in 17 patients (12 males, 5 females)

The patients underwent combined operative techniques: V-to-Y gastrocnemius recession, excision of fibroadipose tissue, end-to-end tendon repair, and gastrocnemius aponeurotic flap turndown in order to reinforce the anastomosis. The diagnosis of Achilles tendon rupture was based on the patient's history, clinical, and imaging assessments. The rupture was diagnosed by a positive Thompson test (calf squeeze test) in all cases. Clinical examination identified a palpable defect in all patients, and none were able to do a single-heel raise. Detailed neurologic examinations were performed. In addition to these tests, maximum calf circumference was also measured in both the injured and uninjured leg with a tape measure. Radiographs were obtained to rule out osseous injuries; magnetic resonance imaging and/or ultrasonographic assessments were obtained for each patient to confirm the

Table 1. Data of Patients.

Number of patients, n	17
Age (y), M (SD)	33 (7)
Gender, n (%)	
Male	12 (71)
Female	5 (29)
Affected side, n (%)	
Right	9 (53)
Left	8 (47)
Injury mechanism, n (%)	
Spore	12 (70)
Dance	2 (12)
Motorcycle accident	1 (6)
Fall	2 (12)
Treatment prior to repair, n (%)	
None	13 (76)
Cast	4 (24)
Time from injury to surgery (mo), M (SD)	7 (3)
Follow-up time (mo), M (SD)	195 (20)
Operative defect (cm), M (SD)	6 (1)
Calf atrophy (cm), M (SD)	3.4 (2)
30 degrees/s plantarflex peak torque, unaffected side (Nm), M (SD)	107 (19)
30 degrees/s plantarflex peak torque, affected side (Nm), M (SD)	90 (20)
120 degrees/s plantarflex peak torque, unaffected side (Nm), M (SD)	55 (10)
120 degrees/s plantarflex peak torque, affected side (Nm), M (SD)	45 (9)
30 degrees/s plantarflex peak torque deficiency (%), M (SD)	17 (6)
120 degrees/s plantarflex peak torque deficiency (%), M (SD)	18 (3)
Average peak torque deficiency (%), M (SD)	17 (3)
Preoperative one-leg heel rise, n (%)	0 (0)
Postoperative one-leg heel rise, n (%)	17 (100)
Postoperative residual discomfort, pain, or swelling, n (%)	0 (0)
Postoperative ability to perform preinjury activities, n (%)	15 (88)
Postoperative ability to walk, n (%)	17 (100)
Postoperative ability to run, n (%)	17 (100)
Postoperative ability to jump, n (%)	17 (100)
Postoperative ability to climb stairs, n (%)	17 (100)

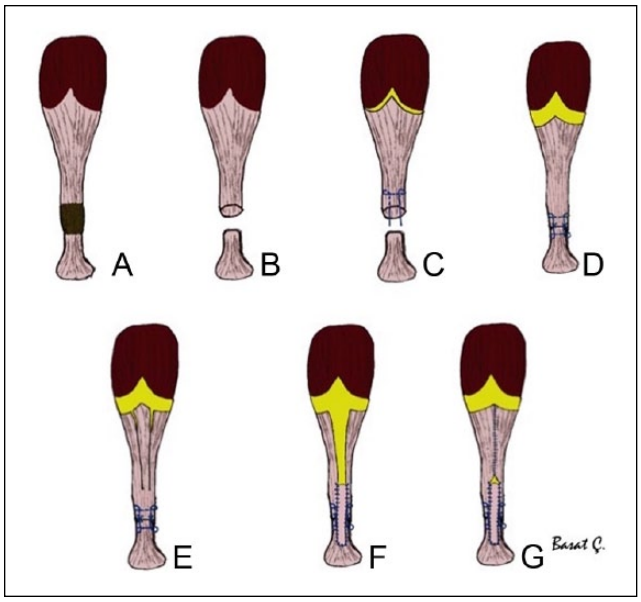

Figure 1. Schematic diagram of the method. (A-F) Combined operative technique: (A) Fibroadipose tissue between tendon ends. (B) Excision of fibroadipose tissue. (C) Proximal end is pulled down and "V" recession is made. (D) End-to-end anastomosis is completed. (E) A gastrocnemius aponeurosis flap is prepared. (F) Anastomosis is reinforced with flap. (G) The defect of the flap is repaired.

diagnosis and the size of the gap. One patient had type 1 diabetes and another patient had coronary artery disease, whereas the other patients had no other significant medical diagnosis.

Operative Technique

V-Y recession and fascia turndown was performed in all patients (Figure 1). Patients were operated under general anesthesia with a thigh pneumatic tourniquet inflated to 350 mmHg in a prone position. A posterior operative approach was used to expose the gastrocnemius muscle belly and posteromedial insertion of the Achilles tendon (Figure 2). The paratenon was reflected. The defects were typically 3 to 6 cm proximal to the Achilles's insertion. The length of the gap had a range of 4 to 8 cm whereas the foot was in neutral position and contained loosely formed hemorrhagic tissue or fibroadipose tissue. The dystrophic tendon ends were sharply debrided to reveal healthy, viable tendon stumps that could be repaired. A "V" gastrocnemius recession was then performed. The arms of the V were approximately 10 cm in length or about one and a half times longer than the length of the defect, to allow sufficient lengthening. The proximal stump of the Achilles tendon was pulled with the help of suspender sutures distally until it could bridge the gap with the foot held in plantarflexion. Next, repair was performed with 1-0 nonabsorbable polyester suture with a modified Kessler method. A flap was prepared from gastrocnemius aponeurosis distal to the V recession, 6-8 cm in length and 1.5 cm in width. It was inverted and the anastomosis was reinforced with this flap by 2-0 absorbable polyglactin, interrupted sutures. The defect between gastrocnemius aponeurosis was repaired with 0 absorbable polyglactin suture with running sutures. The paratenon was then repaired using 4-0 absorbable suture and the skin closed in layers. The lower extremity was immobilized in an above-knee cast in 30 degrees plantarflexion.

Postoperative Management

Postoperative management included a change of cast with removal of the skin sutures at 14 days. Four weeks after the operation, the patient was placed in a below-knee cast in 5 degrees plantarflexion. Cast immobilization was discontinued at 6 weeks. The patient was then allowed partial weight bearing. Physical therapy was initiated, in which passive and active range-of-motion exercises and strengthening exercises were given. After 2 to 3 weeks of therapy, the patient was allowed unprotected full weight bearing and gradually returned to daily life activity level within a month's time.

Assessment Protocol

Patients were available for evaluation and functional testing of their affected versus unaffected gastrocnemius-soleus complex via isokinetic strength testing at last follow-up. Each limb underwent isokinetic strength testing (Cybex International, Medway, MA) at each of 2 different machine settings (30 and 120 deg/s). The evaluation included questioning the patient regarding residual discomfort, pain, or swelling; ability to perform preinjury activities; ability to walk, run, jump, and climb stairs. The patients were also examined for ability to perform 20 repetitions of single-heel rises. Preoperative and last follow-up assessments included an AOFAS (American Orthopaedic Foot & Ankle Society) Ankle-Hind Foot Scale score.

Statistical Analysis

Analyses were performed with SPSS 22 software (IBM SPSS, Turkey). The study data were evaluated for suitability to normal distribution by the Kolmogorov-Smirnov test and, according to this, it was detected that the variables were normally distributed. Paired sample test was used for assessment of preoperative and postoperative AOFAS Ankle-Hindfoot Scale scores. Pearson correlation test was used for assessment of correlations between parameters. The confidence level was assumed to be 95%, and significance was set at $P < .05$.

Results

The mean time from the injury to operative treatment was 7 months (range, 4-12 months) (Table 1). Mean operative defect of the Achilles tendon after debridement was 6 cm

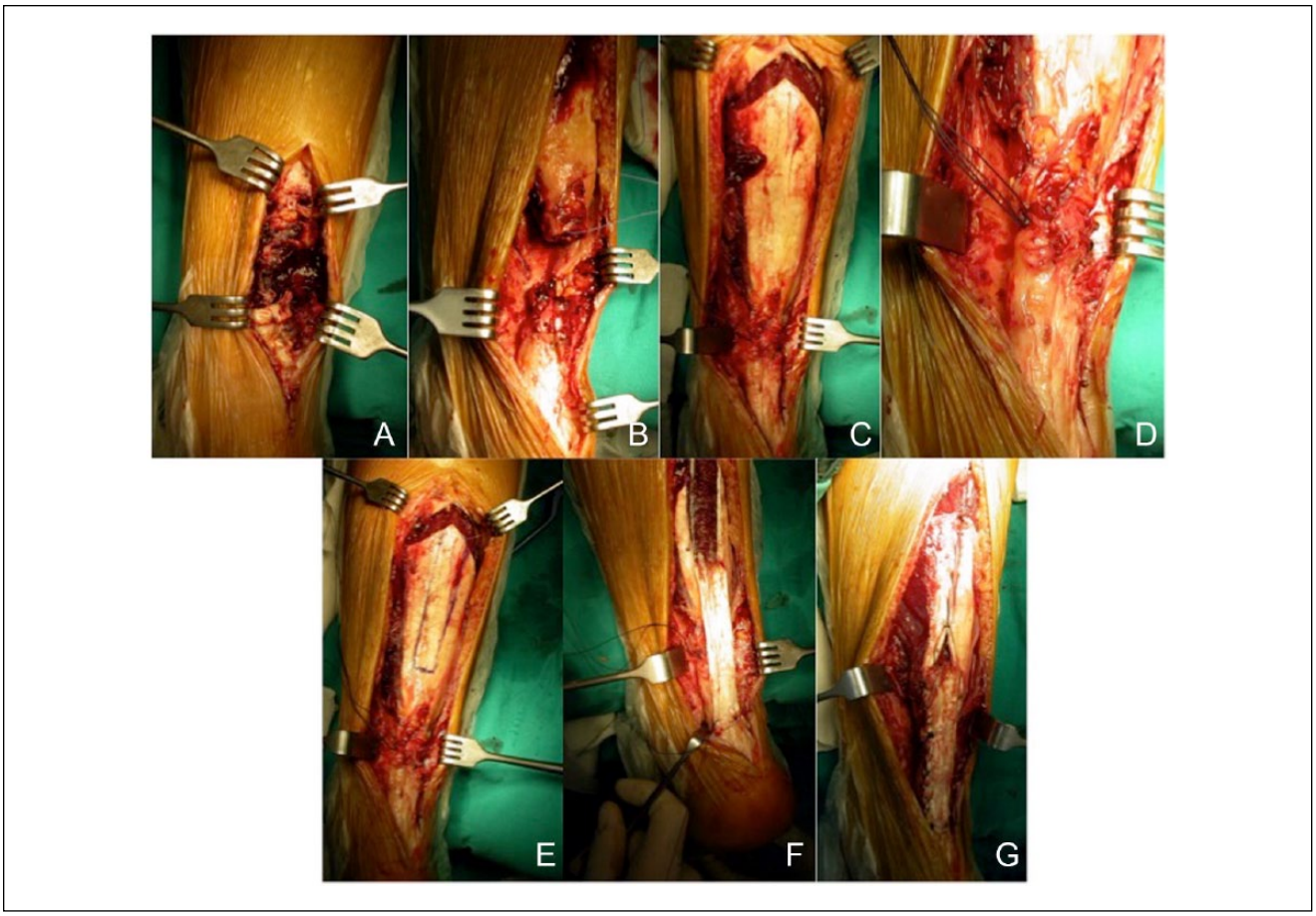

Figure 2. The operative procedure. (A) The defects between tendon ends. (B) Excision of fibroadipose tissue. (C) A "V" recession is made and the proximal stump pulled down. (D) End-to-end anastomosis is completed. (E) A gastrocnemius aponeurosis flap is prepared. (F) Anastomosis is reinforced with flap. (G) The defect of the flap is repaired.

Table 2. AOFAS Ankle-Hindfoot Scale Scores of Patients.

AOFAS	Mean (SD)	*P*
Preop	64 (4)	.001**
Postop	95 (3)	

Abbreviation: SD, standard deviation.
**$P < .01$ (paired samples *t* test).

(range, 4.5-8). During the last follow-up, the mean calf atrophy was 3.4 cm (range, 1-6).

The mean AOFAS score was 94 at the most recent follow-up, which was significantly higher than the preoperative AOFAS score (Table 2). Time from the injury to operative treatment negatively affected the average peak torque deficiency but had no effect on the postoperative AOFAS score. Patients had significantly reduced 30 and 120 degrees/s plantarflex peak torque, which also was associated with defect size (Table 3). Operative defect size had no impact on postoperative AOFAS Ankle-Hindfoot Scale scores. Based on these, time from the injury to operative treatment, calf atrophy, and size of the defect adversely affected the patients' calf power; however, these situations did not affect the postoperative outcomes.

All patients who could not perform a single-leg heel raise preoperatively could perform one at the last follow-up. No patients had symptomatic pain or swelling on the operated side. Superficial wound infection was treated with oral antibiotic therapy in 2 patients (11%) within 6 weeks of surgery without further complications.

Discussion

Extensive tendon defects after debridement are challenging problems. Tendon retraction and debridement of fibrotic tissue can leave a substantial defect that cannot be repaired by primary repair techniques. The primary focus of the treatment is to restore anatomic continuity, muscle strength, and functional length so patients are able to perform a single-heel raise and have a symmetrical gait. Numerous operative techniques have been described to restore continuity of the Achilles tendon. They can be classified as V-Y advancement, interposed scar tissue repair, local tendon transfer, free tissue

Table 3. Bio-statistical Findings.

	r	*P*
Time from the injury to operative treatment (wk)		
Average peak torque deficiency (%)	0.54	.02*
AOFAS Postop	0.16	NS
Operative defect of Achilles tendon (cm)		
30 degrees/s plantarflex peak torque (Nm)	−0.96	.001**
120 degrees/s plantarflex peak torque (Nm)	−0.94	.001**
30 degrees/s plantarflex peak torque deficiency (%)	0.48	.048*
120 degrees/s plantarflex peak torque deficiency (%)	0.56	.018*
Average peak torque deficiency (%)	0.64	.005**
AOFAS Postop	0.02	NS
Calf atrophy		
Average peak torque deficiency (%)	0.61	.009**
AOFAS Postop	0.16	NS
Follow-up duration		
30 degrees/s plantarflex peak torque (Nm)	−0.02	NS
120 degrees/s plantarflex peak torque (Nm)	−0.06	NS
30 degrees/s plantarflex peak torque deficiency (%)	0.06	NS
120 degrees/s plantarflex peak torque deficiency (%)	0.23	NS
Average peak torque deficiency (%)	0.14	NS
AOFAS Postop	−0.01	NS
Postoperative AOFAS		
30 degrees/s plantarflex peak torque (Nm)	−0.07	NS
120 degrees/s plantarflex peak torque (Nm)	−0.19	NS
30 degrees/s plantarflex peak torque deficiency (%)	−0.25	NS
120 degrees/s plantarflex peak torque deficiency (%)	0.25	NS
Average peak torque deficiency (%)	−0.11	NS

Abbreviation: NS, not significant.
** $P < .01$ (Pearson correlation analyses).

transfer, and using of synthetic graft materials.[1,4,6,9,15-18,24,25] Combining the V-Y tendon plasty with the fascia turndown graft creates continuity of the Achilles tendon and restores functional length. Successful results were reported in a study combining the V-Y tendon plasty with the fascia turndown graft to bridge defects of 4 to 6 cm.[25] In another study, 3 patients who had large aseptic defects of up to 10 cm were treated by the V-Y advancement.[16] Their results showed that gastrocnemius-soleus muscle size decreased; however, muscle strength and function were not affected adversely. The operative technique was described by the senior author and had good long-term patient-reported functional results without operative complications. The follow-up time with a mean duration of 16 years in our study demonstrated no cases of rerupture. In this study, our main defect size was 6 (4-8) cm and main AOFAS Ankle-Hindfoot Scale scores of patients were 95. When isokinetic results (30 degrees/s plantarflex and 120 degrees/s plantarflex peak torques) between affected and unaffected legs were compared, we found reduced plantarflexion power but no functional disability which we feel might be due to the gastrocnemius recession. Patients had returned to their preinjury activity levels and performed a single-leg heel raise on the repaired side. We believe that decrease in plantarflexion strength had minimal clinical significance because the muscle was not transected.

Flexor hallucis longus (FHL) transfer has been commonly used for irreparable Achilles tendon rupture with excellent clinical outcomes and improved plantarflexion strength.[11,23,27,28,30] In addition to mechanical support, the FHL transfer provides additional blood supply to the ruptured tendon.[23] However, there are arguments that FHL harvesting eventually reduces push-off during the stance phase.[8] Chronic Achilles tears can also be managed by free autologous gracilis tendon graft. In one study, this technique was reported as a safe but technically demanding procedure, and it was noted that plantarflexion strength could be significantly reduced compared to the contralateral side.[19] We think donor side complications should be kept in mind when considering Achilles tendon reconstruction using autologous tendon grafts. A strong reactive immune response has been reported after undergoing revision Achilles tendon surgery with synthetic augmentation.[3] Adverse immune reactions may lead to catastrophic complications that may eventually require removal of the graft.

After the operative treatment of chronic Achilles tendon ruptures, calf atrophy is seen commonly. In our study, mean calf atrophy was 3.4 cm, but it did not seem to correlate to our functional scores. In one study, 9 patients were followed with an early chronic Achilles tendon rupture who were treated with combined technique for 3.6 years and it was demonstrated that the calf atrophy measured 0.83 cm.[2] In the literature, mean calf atrophy has also been reported as 1.29 and 4 cm.[5,10] In these studies, it was revealed that calf atrophy did not adversely affect patient outcomes.

Only 2 patients (11%) had a superficial wound infection which healed with oral antibiotic therapy. In the literature, major complications include DVT, rerupture, and deep infections. Seroma, hematoma, and superficial wound infection were minor complications. In one study, the major complication rate was reported as 9% (1/11) and minor complication rate as 9% (1/11).[29] In another review study, major complication rates were reported as 5% to 20% and minor complication rates as 10% to 30%.[21]

The main limitation of our study was the small number of patients. However, it is not unusual to have a small number of patients with this condition. The second limitation was retrospective design. We think further prospective studies are needed to illuminate the best treatment option for chronic Achilles ruptures.

In conclusion, this study had one of the longest follow-up periods for patients who underwent repair of a chronic Achilles tendon rupture. Our study has shown that combined V-Y tendon plasty with fascia turndown provided high patient

satisfaction and good long-term patient-reported functional results. This effective and straightforward technique did not require synthetic materials or allografts for augmentation and was a good alternative compared to other methods.

Declaration of Conflicting Interests

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