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SYMPOSIUM: ARTHROSCOPY

Is Percutaneous Repair Better Than Open Repair in Acute Achilles Tendon Rupture?

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Abstract

Background Open repair of Achilles tendon rupture has been associated with higher levels of wound complications than those associated with percutaneous repair. However, some studies suggest there are higher rerupture rates and sural nerve injuries with percutaneous repair.

Questions/purposes We compared the two types of repairs in terms of (1) function (muscle strength, ankle ROM, calf and ankle perimeter, single heel rise tests, and work return), (2) cosmesis (length scar, cosmetic appearance), and (3) complications.

Patients and Methods We retrospectively reviewed 32 surgically treated patients with Achilles rupture: 17 with percutaneous repair and 15 with open repair. All patients followed a standardized rehabilitation protocol. The minimum followup was 6 months (mean, 18 months; range, 6–48 months).

Results We observed similar values of plantar flexor strength, ROM, calf and ankle perimeter, and single heel raising test between the groups. Mean time to return to work was longer for patients who had open versus percutaneous repair (5.6 months versus 2.8 months). Mean scar length was greater in the open repair group (9.5 cm versus 2.9 cm). Cosmetic appearance was better in the percutaneous group. Two wound complications and one rerupture were found in the open repair group. One case of deep venous thrombosis occurred in the percutaneous repair group. All complications occurred before 6 months after surgery. We identified no patients with nerve injury.

Conclusions Percutaneous repair provides function similar to that achieved with open repair, with a better cosmetic appearance, a lower rate of wound complications, and no apparent increase in the risk of rerupture.

Level of Evidence Level III, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

Introduction

Acute Achilles tendon rupture is a common injury. A variable incidence is reported, depending on the population studied, with 5.5 to 9.9 ruptures per 100,000 people in North America [29] and six to 18 ruptures per 100,000 in reports of European communities [19]. They occur more commonly in men in the third or fourth decade of life and more frequently on the left side [29]. Most ruptures occur during sports activities [18, 22, 24]. Moller et al. [24] suggested the incidence is increasing, perhaps due to an increase of sport activities in the population.

The best strategy for treating acute Achilles tendon ruptures remains controversial [17, 22, 32], but they can be treated nonoperatively or operatively with either open or percutaneous repairs. Although there is still no consensus about the best approach, the literature suggests a tendency for operative treatment [4, 14, 17, 26–28, 30, 32, 33].

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Each author certifies that his or her institution has approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent was obtained.

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Several studies suggest nonoperative treatment is associated with high rates of rerupture (9.8%–12.6%) [17, 18, 32] and long periods of cast immobilization leading to stiff ankles and weak calf muscles [31]. Surgical repair has been associated with a lower rate of rerupture [17, 32] and early return to preinjury activities but is associated with a higher risk of other complications, including adherence of the scar, wound infection, keloid formation, sloughing of overlying skin, and patient dissatisfaction with the scar [10, 15].

Percutaneous repair reportedly has a low rate of complications and a high grade of satisfaction [12, 20]. Percutaneously repaired Achilles tendons are less thick than those repaired with open procedures, often with better cosmesis. However, several studies [13, 20, 21] suggest a higher rate of rerupture after percutaneous repair than after open technique, with rates ranging from 3% to 10%. Further, with percutaneous techniques, injury of the sural nerve has been reported to range from 3% to 18%, with persistent paresthesias, and even the need in some patients to have formal operative exploration to remove the suture and release the nerve [6, 16, 20, 21, 23]. Both of these procedures have been used for patient treatment at our institution but at different times. Open surgery was performed until 2006, after which percutaneous repair according to the technique of Amlang et al. [2] was selected as a first choice of treatment for acute rupture of Achilles tendon.

As a preliminary study, we compared the two repairs in terms of (1) function (ankle ROM, calf and ankle perimeter, plantar flexor strength, single heel rise tests, and work return), (2) cosmesis (scar length, cosmetic appearance), and (3) complications.

Patients and Methods

We retrospectively reviewed the medical records of 93 patients who had undergone surgical repair of an Achilles tendon rupture from January 2005 to January 2008. We excluded 38 patients who had an open rupture, steroid drug use, rerupture, previous surgery in the Achilles tendon, rupture at the musculotendinous junction, rupture at the calcaneal insertion, or rupture with more than 14 days of evolution. These exclusions left 55 patients of whom 23 (42%) were lost to followup. The sample for our study was composed of 32 patients (58%), 28 men and four women, with a mean age of 40 years (range, 23–57 years). Fifteen had an open repair and 17 a percutaneous repair. The minimum followup was 6 months (mean, 18 months; range, 6–48 months). Patients were recalled and evaluated specifically for this study. Our study was performed with the approval of our clinical institution and all participants signed an approved informed consent form for participation in the study.

Until December 2006, our team performed exclusively open surgery for acute Achilles tendon rupture. In all cases, we centered the incision over the gap, slightly medialized, avoiding the sural nerve. The paratendon was opened and the defect was identified. Tendon repair was performed using two strands of Number 2 FiberWire® (Arthrex Inc, Naples, FL) in an end-to-end Kessler suture. From January 2007, the percutaneous technique was performed in all patients according to the description by Amlang et al. [2]. In this technique, a small incision was made 2 cm proximal to the gap. Once the crural fascia was open, the instruments were carefully introduced beyond the gap until they reached the distal end, which was brought proximally and sutured using two strands of Number 2 FiberWire®.

All patients (open and percutaneous) were discharged from the hospital with a short leg cast 1 day after surgery. The first check was scheduled 3 weeks after surgery, which included cast removal, wound revision, and stitch removal. Once checked, they were referred to a trained foot and ankle physiotherapist of our institution in charge of supervising all patients of this study. They were referred back to the surgeon if they had any complications or wound problems.

Three to 6 weeks postsurgery, we removed the cast and sutures and patients continued in nonweightbearing. A physiotherapist instructed all patients in passive stretching exercises as tolerated. Six to 9 weeks postsurgery, patients began progressive loading with a 1-cm heel lift, and neuromuscular control exercises (balance training: wobble board and star excursion balance) were performed. At 9 weeks, we initiated full weightbearing and concentric muscle strengthening in bipodal support. At 12 weeks, patients progressed to eccentric muscle strengthening in unipodal support and advanced neuromuscular control exercises (pliometric training: squat jumps and single-leg hop). Patients were permitted to return to work after 9 and 12 weeks depending on each case and to return to sport activities after 15 weeks postsurgery.

Between 6 and 48 months postoperatively, all patients were contacted and evaluated at our institution by two trained foot and ankle surgeons (HH, LLS). We evaluated the following: (1) ROM of the ankle: range of ankle dorsiflexion and plantar flexion; (2) calf perimeter measured 15 cm below the knee; (3) ankle perimeter measured on the malleolar line; (4) plantar flexor strength measured with a modified dynamometer (according to the method of Gillies and Chalmers [10]); (5) length of the scar; (6) time from surgery to return to work and sports; (7) cosmetic appearance of the scar by subjective evaluation of the patient as excellent, good, regular, or bad; and (8) all complications from surgery.

Table 1. Functional parameters measured in both groups

Parameter	Open repair group (n = 15)			Percutaneous repair group (n = 17)		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Muscle strength (N)	144	85	195	120	55	200
Dorsal flexion (°)	15	5	30	15	5	30
Plantar flexion (°)	40	30	50	40	25	50
Ankle perimeter (cm)	24.2	21.5	28	23.2	21	28
Calf perimeter (cm)	39	34.5	41.5	39	34.5	42
Single heel raising test (out of 20 lifts)	18.5	3	20	17.6	3	20
Time to work return (months)	5.6	3	30	2.8	2	7

Results

We observed similar function in both groups (Table 1). In open repaired patients, mean muscle strength tended to be greater (147 N versus 120 N). Both groups had similar mean ankle dorsal flexion (15°) and plantar flexion (40°). Mean calf perimeter and ankle perimeter showed similar values for both groups. Mean time to return to work was longer for open repaired patients (5.6 months) than for percutaneous repaired patients (2.8 months). The minimum time for work return in the open repair group was 3 months, with a maximum of 30 months in one patient who presented wound complications and required surgical treatment with a soleus flap and augmentation with flexor hallucis longus tendon. In the percutaneous repair group, the minimum time to work return was 2 months in a patient who could attend to his work with nonweightbearing on the operated side.

Mean scar length was greater in the open repair group (9.5 cm) than in the percutaneous repair group (2.9 cm) (Table 2). The largest incision (19.5 cm) was present in the same patient with wound complications who required soleus flap and augmentation. A higher number of patients in the percutaneous repair group (nine) than in the percutaneous repair group (three) qualified the cosmetic appearance as excellent (Table 2). A similar number of patients qualified the incision as good in both groups. No regular and bad appearance evaluations were present in the percutaneous repair group.

Three of the four postoperative complications (Table 3) occurred in patients from the open repair group. Two wound complications and one rerupture were found in this group. Rerupture and wound dehiscence occurred in the same patient. This patient needed surgical grafting and transposition of the flexor hallucis longus tendon. Another complication occurred in a patient with a dehiscence treated medically. In the percutaneous repair group, one case of deep venous thrombosis of the calf occurred. After medical treatment, the patient was discharged and had no additional complication. All of the complications presented themselves before 6 months after surgery in both groups.

Table 2. Aesthetic results

Parameter	Open repair group (n = 15)	Percutaneous repair group (n = 17)
Scar length (cm)		
Mean	9	2.8
Maximum	19.5	3.8
Minimum	6	2.3
Cosmetic appearance rating (number of patients)		
Excellent	3	9
Good	8	8
Regular	3	0
Bad	1	0

Table 3. Postoperative complications

Group	Complication (number of patients)		
	Wound dehiscence	Rerupture	Deep venous thrombosis
Open	2	1	0
Percutaneous	0	0	1

Discussion

Acute Achilles tendon rupture is a common traumatic injury usually associated with sports activity [24], which has been treated preferentially with surgery over the two last decades [4, 17, 26, 27, 30, 33], because it has been associated with a lower rate of rerupture than nonoperative treatment [14, 15, 17]. Open repair is associated with a high rate of wound complications [10, 15] while the percutaneous repair technique, which has been chosen increasingly over open repair in recent years, is associated with a higher incidence of rerupture and injury of the sural

nerve [13, 20, 21, 23]. Our objective was to compare the short-term function, cosmesis, and complications of the two surgical approaches.

We acknowledge the limitations of our study. First, the number of patients was small, limiting our ability to perform a statistical analysis that would control for potentially confounding variables. Therefore, this must be considered a preliminary study. Second, we had a high percentage (42%) of patients lost to followup. Our findings could be altered if some of these patients had reruptures or other complications. Third, we had a short followup for three of the patients. All three patients were contacted by telephone again 1 year after surgery for the sole purpose of assessing complications, and none reported a complication. Fourth, our measure of cosmetic appearance was subjective and was not based on a rigorously validated measure.

Postoperative function is important to patients and clinicians. In the patients we could follow, we found similar values of ankle ROM, calf and ankle perimeter, and single heel rise test in the two groups. The mean muscle strength was slightly greater in the open repair group than in the percutaneous repair group (147 N versus 121 N). Earlier return to work was observed in the percutaneous repair group (2.8 months versus 5.6 months). Faster recovery after surgery could be explained by the lesser amount of soft tissue affected by the percutaneous repair. Similar observations have been reported for percutaneous repair [1, 9, 11, 12]. Gorschewsky et al. [12] reported satisfactory function in 66 patients with percutaneous repair, with similar values of muscle strength and ROM for left and right ankles in 65 patents. One patient with rerupture had decreased ankle strength and ankle motion. Goren et al. [11] in a prospective study compared isokinetic and endurance of the plantar flexor muscle tendon unit in 20 patients, 10 for each type of repair, and concluded biomechanical outcomes of open surgery and percutaneous repair are both effective. Aktas and Kocaoglu [1] compared both techniques in 40 patients and showed similar function as measured by American Orthopaedic Foot and Ankle Society scale. Gigante et al. [9] compared 40 patients with open and percutaneous repair and reported only ankle circumference was greater in the percutaneous repair group, with no differences in isokinetic and SF-12 assessment.

Cosmesis (scar length, cosmetic appearance) was probably the most remarkable difference found in our study. The incision length was smaller in the percutaneous repair group (2.9 cm versus 9.4 cm). This is a relevant difference, considering a smaller incision is more acceptable to patients and decreases the risk of wound complications. These facts could explain the good cosmetic appearance rating shown in the percutaneous repair group. Previous studies regarding the cosmesis of both techniques made no objective assessment of this topic, but it is generally concluded patients prefer the appearance of the percutaneous approach [5, 20, 22].

Several authors have described complications associated with the two techniques (Table 4). Wound complications are widely described in the literature as a limitation of open surgery [7, 9, 18, 20]. Carden et al. [7] reported a rate of 17% complications in an open surgically treated group versus 4% in a nonoperative group. Lim et al. [20] reported in a prospective study of 66 patients comparing open and percutaneous repair techniques a higher rate of wound complications in the open repair group, with seven cases of wound infections (21%) and two cases of adhesions (6%) compared with just three cases of wound puckering (9%) in the percutaneous repair group. Gigante et al. [9] reported delayed wound healing in two cases in open repair. We also had two wound complications in patients with open repair and none in the percutaneous repair group. Two patients had wound dehiscence, and one had subsequent surgery. The cause of wound complication associated with open surgery is presumably owing to the poorly vascularized skin surrounding the Achilles tendon [8] and length of

Table 4. Literature overview

Study	Surgery	Number of cases	Results
Haji et al. [13]	Percutaneous (Ma-Griffith modified) versus open	108	No statistical difference in complications
Maes and Copin [21]	Percutaneous (Tenolig®)	124	High rate of rerupture and sural nerve lesions
Majewski et al. [23]	Percutaneous (exposed versus no exposed sural nerve)	84	18% sural nerve lesions in no exposed group
Lim et al. [20]	Percutaneous (Ma-Griffith) versus open	66	More infective wound complications in open group
Aktas and Kocaoglu [1]	Percutaneous (Achillon) versus open	40	Lower complications in percutaneous surgery
Gigante et al. [9]	Open versus percutaneous (Tenolig®)	40	No difference in complications
Henríquez et al.	Percutaneous (Amlang) versus open	32	No sural nerve injury in both groups; higher wound complications in open surgery

the incision compared to percutaneous surgery, exposing soft tissue and causing inevitably greater damage to it.

Rerupture is a described complication of the percutaneous technique, with different rates reported in the literature. Maes and Copin [21] reported 10% of rerupture in a series of 124 patients treated with the percutaneous technique (Tenolig®; Smith and Nephew, Memphis, TN). They proposed as causes the immediate weightbearing allowed without an orthosis, inadequate apposition of the tendon ends, and delayed repair. Lim et al. [20] described a 3% rerupture rate, Haji et al. [13] a 2.6% rate, and Amlang et al. [3] a 3.2% rate. In contrast to these findings, we found no reruptures in our percutaneous repair group, and for the open group, our finding is similar to that reported in the literature [8, 10, 12]. Another of the most described complications for the percutaneous approach is sural nerve injury [13, 20, 21, 23]. Haji et al. [13] in a retrospective analysis of 38 patients operated on using a modified Ma-Griffith repair described four patients (10.5%) with sural nerve lesions and a rate of 1.4% of sural nerve injury in 70 patients with open repair. Maes and Copin [21] reported an incidence of 5.2% of the same problem in 124 patients operated on using the percutaneous technique, and Lim et al. [20] reported one case (3%) of persistent paresthesia in sural nerve territory. This complication may be associated mainly with lack of vision during surgery, which leads to damage of the nerve. Majewski et al. [23] retrospectively reviewed 84 patients operated on using the percutaneous technique. In 38 patients, the sural nerve was exposed, and in 46 patients, it was not exposed. All lesions (18%) were in the second group. Amlang et al. [3] reported no lesions of the sural nerve in 62 ruptures operated on using their technique. In agreement with the study of Amlang et al. [3], we did not find any sign of sural nerve injury in our study. We used a paramedial incision and the suture was deepened to the muscle fascia, avoiding the sural nerve, for which reason we prefer this technique for percutaneous repair. Deep venous thrombosis is another complication reported after Achilles tendon rupture. In a prospective study, Nilsson-Helander et al. [25] evaluated 95 patients 8 weeks after Achilles rupture with a color duplex sonography and found thrombosis in 32 patients. Majewski et al. [23] reported three cases among 84 patients treated with the percutaneous technique. In our study, one patient presented a deep venous thrombosis in the percutaneous repair group.

In conclusion, based on our findings and compared to the reviewed literature, the percutaneous repair according to the technique described by Amlang et al. [2] is a reproducible technique that leads to function as good as that achieved with open repair, without its complications and its unappreciated aesthetic appearance. For these reasons, we recommend percutaneous surgery for treating acute Achilles tendon rupture.

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