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Serum cholesterol is elevated in patients with Achilles tendon ruptures

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Abstract Forty-one patients were analyzed after surgical treatment of Achilles tendon ruptures. The following parameters served as the outcome measure: (1) duration of wearing cast, (2) length of hospital stay, (3) outpatient treatment, (4) time of absence from work, (5) complications, (6) re-rupture rate, (7) subjective evaluation by patients, (8) scar condition, (9) ability to stand on tiptoes, (10) Thompson test, (11) movement of talocrural joint, (12) circumference data of lower extremity, (13) radiographs, (14) power measurement of the ankle (in kg), (15) ultrasound examination, (16) blood cholesterol levels, (17) scoring by Trillat's score. Surgical treatment achieved an excellent or good outcome in 91% of patients as evidenced by the Trillat score. Furthermore, cholesterol levels were found to be elevated in 83% of patients. Given the good results, surgical treatment of Achilles tendon ruptures is recommended, but patients of status post-Achilles tendon rupture should be checked for high cholesterol levels. In the future, controlled, prospective trials need to prove a correlation between Achilles tendon rupture and a pathological blood lipid status.

Introduction

Over the last few years, a new debate regarding the current treatment of Achilles tendon ruptures has arisen. Prior to 1980, most publications pointed to the great benefit of surgery in treating fresh Achilles tendon ruptures [7, 8, 13]. This was based upon (a) a high recurrence of rupture rate following nonsurgical treatment, (b) the discomfort and risks (e.g., thrombosis, lung emboli) of wearing a cast, and (c) the high efficacy of surgical intervention. Nevertheless, nonsurgical procedures have recently been evaluated [22] with a reportedly good outcome using special devices instead of a cast.

We have analyzed the outcome of 41 surgically treated patients following Achilles tendon rupture in a retrospective study. Furthermore, based upon reports possibly linking patients with known hypercholesterolemia and combined Achilles tendon ruptures [10, 12, 17, 28], we measured cholesterol levels during follow-up.

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Patients and methods

In 41 patients, we performed a follow-up examination 2–12 years after the trauma (average 5.2 years). All patients were operated in the Department of Trauma and Reconstructive Surgery of the University Hospital Hamburg-Eppendorf. The average age of the 27 male (66%) and 14 female (34%) patients at the time of surgery was 40.2 years (range 24–78 years). In 19 cases (46%), the left Achilles tendon was ruptured, in 22 (54%), the right. Sport activities were the major cause for Achilles tendon rupture (90%) (Table 1).

The average time from accident to operation was 11.9 h (range 2–48 h). Our standard policy was to operate on patients with Achilles tendon ruptures as soon as possible. Reasons for a delay were, e.g., operating room capacities were fully booked in a level I trauma center with a high admission rate of polytrauma patients.

Table 1 Causes for Achilles tendon rupture

Sport activities:	Soccer	11 patients
	Tennis	7 patients
	Squash	4 patients
	Volleyball	3 patients
	Other sports	12 patients
	Total	37 patients
Other reasons:		4 patients

In all patients, a lateral longitudinal approach was chosen to keep the blood supply in the area as high as possible. We used two different operative methods for the primary repair of the ruptured Achilles tendon. (a) In 28 patients (68%) we performed a plantaris wrapping operation: The ruptured Achilles tendon was anatomically adapted with Vicryl 5/0. The plantaris longus muscle tendon was released with a tendon-stripper. The tendon was then used for an augmentation suture of the Achilles tendon following the Bunnell or Kessler suture technique. Finally, the distal part of the plantaris muscle tendon was spread out to "coat" the reconstructed part of the Achilles tendon, covering the surgical anastomosis and allowing the tendon to glide without adherence to the overlying tissue (Fig. 1). (b) In 13 patients (32%) without a plantaris tendon, the ruptured Achilles tendon was readapted with resorbable material, e.g., PDS, Vicryl using a Bunnell weave, or Kessler suture.

During the follow-up examination, we checked the following criteria: (1) length of cast treatment, (2) duration of hospital stay, (3) duration as outpatient, (4) length of absence from work, (5) complications, (6) re-ruptures, (7) graded subjective evaluation of the benefit of surgery by patients (excellent, good, fair, poor), (8) condition of the scar, (9) patient' s ability to stand on tiptoes, (10) result of the Thompson test, (11) movement of the talocrural joint, (12) circumference of the lower extremity at 15 cm, and (13) the smallest circumference. We also took radiographs of the operated foot to detect calcifications.

Fig. 1 "Wrapping" of the anatomically correctly readapted Achilles tendon using the distal part of the plantaris longus muscle

Fig. 2 Self-constructed instrument to measure the ankle-power in kilograms, while the patient is lying on a stretcher pushing against the scale

The force of the operated ankle was checked with a self-constructed instrument fixed to a wall (Fig. 2). Patients were asked to push against a scale of this device only using their ankle and without involving the quadriceps muscle. After measuring healthy volunteers with this new device, we assumed differences between the operated and nonoperated ankle greater than 3 kg to be pathological.

The Achilles tendon thickness was measured by ultrasound and also tendons were checked for degenerative changes and glide characteristics [1]. The ultrasound examination was performed with an Ultramark 4 Plus at 7.5 MHz linear, and the pictures documented on a Sony-850 printer. All examinations were done in the same standardized positions as previously described [25].

During follow-up examination, we checked the serum cholesterol levels of our patients and also asked if they were aware of hypercholesterolemia.

For scoring of the results, Trillat's score [23] was used. This score separates data into excellent (patient returned to all job and sports activities, no pain, free range of motion of the talocrural joint), good (patient satisfied with operative result, sports activities on a lower level than before the operation, sometimes pain in operated ankle, unsatisfactory cosmetic result of the scar), fair (no more sports activities, walking in part unsafe, no defect of Achilles tendon), and poor results (pain, limping, standing on operated leg not possible, weakness of Achilles tendon and muscles).

Results

A cast was worn for an average of 6 weeks (range 3–9 weeks) after the operation. Patients were treated as inpatients for 7.2 days (range 2–30 days) followed by an average outpatient management of 27.4 weeks. The average time of absence from work was 12.4 weeks. After 29.7 weeks, patients returned to their former sports activities. One 73-year-old patient was not able to return to sports activities because of cardiac problems. Four patients decided not to take up sports activities after the operation for personal reasons.

The subjective results based on the patients' evaluation were: (a) 19 (46%) patients felt that the result was excellent, (b) 11 (27%) good, (c) 4 (10%) fair, and (d) 7 (17%) complained of a poor outcome. The reason for poor scoring in all cases was an unsatisfactory cosmetic result of the scar from the patients' point of view. All 7 patients with a poor subjective result were able to return to their former sports activities and showed a good objective result according to the Trillat score.

We saw complications postoperatively in 5 patients (12%): Two receiving low-dose heparin developed a thrombosis 8–10 days after the operation. A successful high-dose heparin treatment was initiated after removing the cast and performing phlebography. One patient complained of a peroneal paresis, it remained unclear whether the positioning during surgery or cast treatment caused the complication. After physiotherapy, he demonstrated no residual symptoms. In one case, an adhesion of the Achilles tendon to the surrounding tissue was detected. After physiotherapy, a mild restriction of movement remained in the talocrural joint. One patient presented 4 weeks after the operation with a re-rupture after walk-

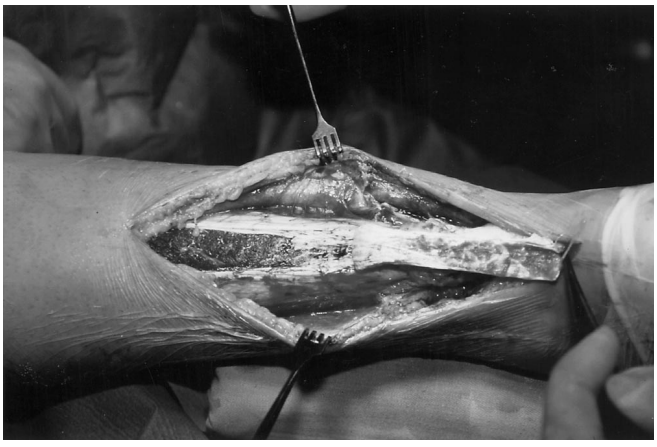

Fig. 3 Operative site of a 24-year-old patient with re-rupture of the right Achilles tendon 4 weeks after primary repair: a strip of the gastrocnemius-soleus complex was turned down and used to reinforce the repair

ing on a short cast. A strip of fascia from the gastrocnemius-soleus complex was turned down and used to reinforce the repair (Fig. 3). This procedure proved to be successful.

The scar did not produce irritation in any patient. Thompson test was positive postoperatively in 3 cases (7%). Circumference differences larger than 2 cm measured 15 cm below the knee joint occurred in 8 patients (19%); at the smallest point of the lower extremity, a difference of more than 2 cm was seen in 1 patient.

Movement restrictions in the talocrural joint with plantar flexion of less than 10 degrees were discovered in 4 patients (9%). Dorsal extension restrictions (less than 10 degrees) were found in 8 patients (19%).

Using our self-constructed device, a loss of strength in the operated ankle of more than 3 kg could be detected in 3 patients (7%), while 2 (5%) patients had a limited loss of power ranging between 2 and 3 kg. In all other patients (88%), no loss of strength in the operated ankle was seen.

On radiographs, calcifications of the Achilles tendon could be detected in one patient. All of the others showed no pathological findings.

Ultrasound examination revealed an average diameter of the operated Achilles tendon of 12.7 mm, while the nonoperated side had an average diameter of 7.8 mm (average difference 4.9 mm) (Fig. 4).

We saw no partial ruptures and no xanthomatosis in our patients. In 19 cases (46%), mild degenerative changes could be detected on the nonoperated side.

Thirty-one patients gave consent for blood sampling. Of these, 26 (83%) showed elevated cholesterol levels (> 200–335 mg/dl, normal value 150–200 mg/dl). Hypercholesterolemia was suspected only by 6 patients (19%) theirselves. We informed all patients with elevated cholesterol levels about their results and recommended visiting their physician for further treatment.

Evaluation using the Trillat score showed excellent outcomes in 35 (81%) patients, good in 4 patients (9.5%), and poor in 4 (9.5%).

Discussion

Detecting Achilles tendon ruptures in the emergency room should not be a problem. The history reported by the patient is typical in most cases: A sudden pop or snap in the lower extremity followed by an inability to walk. Clinical examination normally detects the injury by the patient's inability to stand on tiptoes, a positive Thompson test, and the gap over the Achilles tendon. In cases of doubt, an ultrasound examination should complete the diagnostic procedure and confirm the diagnosis.

The debate about treatment of Achilles tendon ruptures is not fully resolved. Despite the fact that 1486 papers have been published over the last 30 years [17], there is still no consensus of the best treatment of fresh Achilles tendon injuries.

Since the 1970s, there has been an increasing interest in nonsurgical treatment, which has been advocated by several authors [4, 5, 19] because they claim a high incidence of complications from surgical treatment. Furthermore, they argue that non-surgical treatment decreases the costs and that the function of surgically treated tendons is not significantly better. The re-rupture rate appears to be a major flaw with nonsurgical treatment. Nistor [19] noted

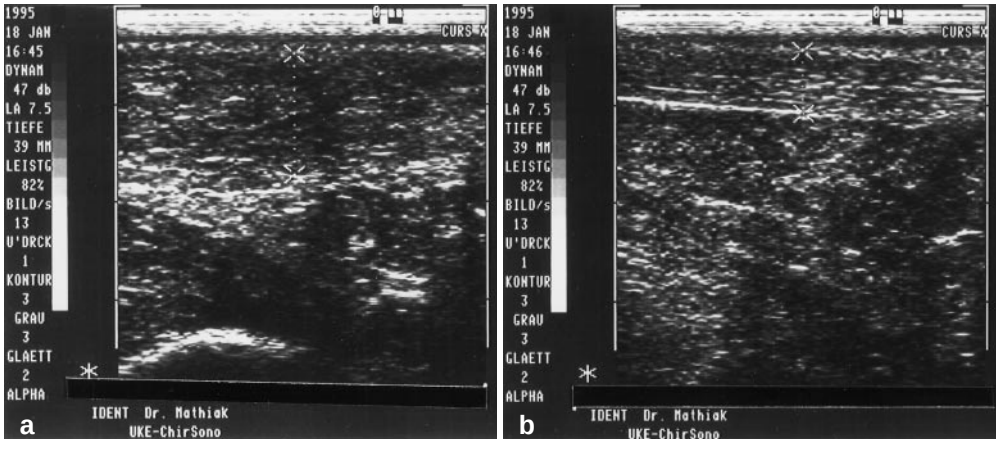

Fig. 4 a, b Ultrasound pictures of a 67-year-old patient 6 years after surgical repair of the right Achilles tendon with plantaris muscle augmentation with a difference of 5 mm in diameter (**a** right 12 mm, **b** left 7 mm) and mild degenerative changes on both sides

minor differences between operatively (re-rupture rate 4.5%) and nonoperatively treated patients (re-rupture rate 8.3%). Review articles from the 1980s [9, 29] report re-rupture rates of nonoperatively treated patients of 17.7% compared with 1.7% in surgically treated patients. In our patients, we saw a rerupture rate of 2.3%. A recent study by Cetti et al. [3] describes a higher resumption of preinjury function in operatively treated patients compared with nonoperatively treated controls.

In contrast to the publications in the 1980s, authors in the 1990s report good results for nonoperatively treated patients in special shoe devices, with re-rupture rates under 3% [22], but the number of patients is still too low for statistically relevant statements.

The majority of authors [7, 26, 27], however, favor surgical over nonsurgical treatment [13, 19, 22]. Good results after surgical treatment of fresh Achilles tendon ruptures with various techniques are reported by several authors [16, 20, 29], Zwipp and co-workers [29] described poor results in only 1.6% of their cases, Mayer et al. [16] did not see any unfavorable result. All these authors used the same scoring system of Trillat as we did. Although we were well aware of the fact that the score was developed at the end of the 1960s, a time before ultrasound, less knowledge of scoring systems, and no modern concepts of surgery, we still decided on using it to be able to compare our results with those in other publications.

The precise mechanisms that give rise to Achilles tendon injuries are still unknown. However, it is generally accepted that either a restricted blood supply or degenerative changes are the leading precipitants [29]. Systemic risk factors might include hyperuricemia and blood groups. Dodds and co-workers noted a significant increase in uric acid levels in 30 patients with Achilles tendon ruptures versus healthy controls. Beskin reported a 14% incidence of gout in 42 consecutive ruptures [6]. A correlation between blood groups and incidence of Achilles tendon ruptures is still unclear. Kujala and co-workers [11] reported a higher incidence of Achilles tendon ruptures in patients with blood groups A and 0, Leppilathi et al. [14] described no statistically significant relation between blood groups and Achilles tendon ruptures.

Interestingly, lipid blood levels might predispose individuals to Achilles tendon ruptures. A higher risk for patients with a pathological lipid status has been described by several authors. Kuriyama et al. [12] reported that patients with cerebrotendinous xanthomatosis complain more often of Achilles tendon xanthomas, which predispose to Achilles tendon ruptures. Murano [17] and Zehntner [28] published correlations between the thickness of the Achilles tendon, ruptures, and total cholesterol levels in patients with familial hypercholesterolemia.

In agreement with these reports, 83% of the patients in our study had an elevated serum cholesterol, and only 19% of them were aware of this fact.

During ultrasound examination in our patients, we could not see any partial ruptures or xanthomas, but there were degenerative changes. Due to financial restrictions, ultrasound examinations in all patients with a high cholesterol level is unrealistic. There is only one study evaluating degenerative changes with a significant risk for rupture by ultrasound [18]. In our opinion, ultrasound can be helpful in diagnosis, but it is not suitable as a screening method to detect patients at risk for future Achilles tendon ruptures.

To sum up, due to the good results reported herein as well as in previous studies, we recommend operative treatment of fresh Achilles tendon ruptures with an early postoperative start of physiotherapy using modern types of orthesis [2, 3, 15, 24]. The operation can be performed under general anesthesia or as outpatient treatment with local anesthesia [21]. In the future, controlled, prospective trials need to prove a correlation between Achilles tendon rupture and a pathological blood lipid status. Until then, the status post-Achilles tendon rupture should serve as an indicator to check patients for unknown hypercholesterolemia due to their higher risk of arteriosclerosis, stroke, and myocardial infarction. Drug treatment can improve their quality of life and reduce their mortality.

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