The Egyptian Journal of Hospital Medicine (October 2022) Vol. 89, Page 4273- 4277

Results of Percutaneous Sutures Technique in the Treatment of Achilles Tendon Ruptures

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ABSTRACT

Background: The incidence rates of Achilles tendon (AT) ruptures varies, with previous studies reporting a rate of 18 patients per 100,000 patient populations annually and has been shown to be increasing. The treatment of acute Achilles tendon ruptures can be broadly classified into operative and non-operative.

Objective: Management of Achilles tendon rupture to evaluate the results of percutaneous suture technique followed by early functional postoperative treatment for surgical intervention of Achilles tendon ruptures, and to assess wound complication and hospital stay.

Patients and Methods: A prospective operation clinical study of 18 patients with complete tear of Achilles tendon who underwent percutaneous suture repair (the Ma–Griffith technique). Follow up clinical evaluation was performed and any complications were recorded.

Results: Mean of Achilles Tendon Total Rupture Score (ATRS) was 90.1 ± 4.2. The mean Overall patient's satisfaction was 8.8 ± 0.83 ranged from 8 to 10 and the mean Aesthetic satisfaction was 9.5 ± 0.51 ranged from 9 to 10. Only one patient had sural nerve injury and another one had infection.

Conclusions: Our results suggested that satisfactory clinical and functional outcomes can be obtained for percutaneous sutures technique in the treatment of Achilles tendon ruptures.

Keywords: Achilles, Percutaneous suture, Tendon, Rupture.

INTRODUCTION

Achilles, the ancient Greek hero of the Trojan war, gave his name to the AT. Achilles was the son of the nymph, Thetis, who tried to make him immortal by dipping him in the river Styx. However, he was left vulnerable at the part of the body she held him by: his heel[(1)]. Achilles was killed by a poisoned arrow fired by the Trojan prince Paris which embedded in his only vulnerable point; his heel. This has given rise to the description of a person weakest point being called their "Achilles heel"[(2)].

The Achilles tendon is the strongest tendon in the human body and transmits forces from the gastrocnemius and soleus muscles to the calcaneus enabling walking, jumping, and running[(3)]. However, the incidence of Achilles tendon rupture has increased over recent years [(4)]. The incidence rates of Achilles tendon ruptures varies, with previous studies reporting a rate of 18 patients per 100,000 patient populations annually and has been shown to be increasing[(5)]. In regard to athletic populations, the incidence rate of Achilles tendon injuries ranges from 6% to 18%[(6)], and football players are the least likely to develop this problem compared to gymnasts and tennis players. It is believed that about a million athletes suffer from Achilles tendon injuries each year [(7)].

Achilles tendon rupture has been shown to cause significant morbidity and regardless of treatment major functional deficits persist 2 years after acute Achilles tendon rupture and only 50-60% of sportsmen return to pre-injury levels following rupture [(8)]. Although most Achilles tendon ruptures occur during sporting activities, other factors such as gender, drugs, intrinsic structural variations, and biomechanical changes related to ageing may all contribute[(9)].

The treatment of acute Achilles tendon ruptures can be broadly classified into operative and non-operative. Clinical assessment involves using objective rating scales [(10)] and also the Achilles Tendon Total Rupture Score (ATRS) [(11)]. There is a need for a patient-relevant instrument to evaluate outcome after treatment in patients with a total Achilles tendon rupture.

The surgical treatment of ruptured Achilles tendon encompasses two distinct elements namely the actual surgical technique and the postoperative regime. The surgical management of a ruptured Achilles can be divided into four categories: open repair, percutaneous repair, mini-open repair, and augmentative repair. In general, operative intervention is usually preferred for younger patients and those patients who demand greater function[(9)].

In 1977 the percutaneous repair of an acute Achilles rupture was described, which had the benefit of a relatively low rerupture rate, while also reducing the rates of infection and other soft-tissue complications. **Yang *et al.*[(9)]** reported the percutaneous method involves suturing the Achilles tendon through multiple small incisions, made under local anesthesia without directly exposing the rupture site. Percutaneous repair has also been reported to be a good option for athletes tendon rupture, allowing for prompt return to sporting activities[(12)].

The aim of this study was management of Achilles tendon rupture to evaluate the results of percutaneous suture technique followed by early functional postoperative treatment for surgical

Received: 30/4/2022
Accepted: 29/6/2022

intervention of Achilles tendon ruptures, and to assess wound complication and hospital stay.

PATIENTS AND METHODS

The included study population were 18 adult patient with complete tear of Achilles tendon who were admitted to Orthopedic Department at Zagazig University Hospitals, from January 2020 to September 2020 treated by percutaneous suture repair (Ma–Griffith technique).

Ethical consent:

Detailed informed consent about the study was obtained from every patient. Approval was obtained from Zagazig University Institutional Review Board (ZU-IRB). This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Inclusion criteria: patients who had acute closed and complete Achilles tendon rupture in the tendinous portion within the last 7–10 days, a positive Thompson test, presence of pitting as assessed by observation and palpation between the two broken ends of the Achilles tendon and complete rupture confirmed by magnetic resonance imaging or ultra-sonography.

Exclusion criteria: Patients with incomplete rupture of the Achilles tendon, patients with open injury, patients with a repair time of more than 10 days and patients who had previous Achilles tendon or ankle surgery.

Measurements of some parameters:

All patients were subjected to the following: Full history taking including age, gender, BMI, comorbidities and cause of injury. Detailed clinical examination including skin condition, presence of edema, limitation of motion, and associated injuries. Radiological examination including X-ray, ultra-sonography and MRI.

Operative procedure:

Patient positioning: Eighteen adult patients were operated upon in prone position. All cases were operated upon by percutaneous repair (the Ma–Griffith technique)[3]. The pneumatic tourniquet was applied to the effected limb for all patients then preparation and draping the effected limb.

Approach to Achilles tendon:

Identify the rupture site by palpation and feeling the gap between tow end of the tendon and depending on the length of the tendon, five or six 1-cm stab incisions were performed lateral and medial of the tendon, proximally and distally to the gap. To minimize the risk of sural nerve injury, we always identified the nerve from the proximal lateral stab incisions. Percutaneous suturing was done with long Keith needles (Ethicon, Inc., Somerville, NJ) using the same type of sutures with open repair. The needle was inserted transversely through the proximal stab incisions, and the suture was advanced through the proximal tendon stump. Then, the needle was advanced obliquely to the opposite middle or distal stab incision to the distal stump of the tendon. The suture was secured to the distal tendon by transverse advancement of the Keith needle. Finally, the suture ends were advanced to the middle stab incision and tied with the ankle in plantar flexion to close the rupture gap. The skin incisions were closed with nylon sutures No. 3–0. Dressing was done and the effected leg was put in slab in maximum planter flexion.

Postoperative rehabilitation and evaluation:

Postoperative rehabilitation including 3 weeks of immobilization in a non-weight-bearing cast in maximum plantar flexion, followed by gradual decrease in plantar flexion until neutral ankle position in a functional brace and progressive weight bearing within the following 3–4 weeks [4]. Follow up and dressing was every two days from 3rd day postoperatively for all patients except one until skin suture removed. The skin sutures were removed within 15 days after surgery in all patients.

Routine clinical follow-up was performed at 2, 4, 8, and 12 weeks, and 6 months. Wound healing, complications, ankle's range of motion, and patients' return to work, activity level, weight-bearing, and subjective assessment of their treatment were recorded. Functional evaluation was done using The Achilles Tendon Total Rupture score (ATRS, 0–100)[5]. Results were rated as excellent (100–90 points), good (89–80 points), fair (79–70), or poor (<70)[6]. At the final follow-up, satisfaction level of the postoperative outcome was measured using the visual analog scale (VAS; 0 = extremely unsatisfied, 10 = extremely satisfied), as well as the VAS score (0–10) for aesthetic outcome of scars and the time point when single heel raise was possible.

Assessment of complications: including presence of infection, and sural nerve injury.

Statistic analysis

Data were analyzed using SPSS software version 18 (USA). The quantitative data were expressed as mean ± standard deviation (SD) and median (Min-Max). Categorical data were represented by frequency and percentage.

RESULTS

Table 1 shows that the mean age of patients was 31.7 ± 8.7 years, 94.4% of them were males with mean BMI 24.05 ± 3.1 kg/m^2 and only 5.6% of them had comorbidities (Diabetes mellitus).

Table (1): Demographic data of the studied patients

Variables	Achilles Tendon Ruptures Patients (N=18)
Age Mean ± SD Median (Min- Max)	 31.7 ± 8.7 30 (20 – 54)
Gender Male Female	 17 (94.4%) 1 (5.6%)
BMI Mean ± SD Median (Min- Max)	 24.05 ± 3.1 22.9 (21.6 – 31.6)
Co-morbidities Non Diabetes mellitus	 17 (94.4%) 1 (5.6%)

Table 2 shows that 55.6% of patients had right side ruptured tendon, 72.3% with dominant leg, and 83.4% due to sport injuries. The mean gab of rupture was 22.6 ± 9.03 mm and the mean operation time was 24.9 ± 3.6 minutes.

Table (2): Characters of the ruptured tendon and operation time of the studied patients

Variables	Achilles Tendon Ruptures Patients (N=18)
Side Left Right	 8 (44.4%) 10 (55.6%)
Dominant leg Yes No	 13 (72.3%) 5 (27.8%)
Sports injury Yes No	 15 (83.3%) 3 (16.7%)
Gab of rupture (mm) Mean ± SD Median (Min- Max)	 22.6 ± 4.81 22 (10-42)
Operating time (min) Mean ± SD Median (min- max)	 24.9 ± 3.6 25 (20-35)

Table 3 shows that the mean time to full weight bearing was 8.05 ± 0.8 weeks, the mean single heel raising after repair was 3.6 ± 0.76 months. The mean of ATRS was 90.1 ± 4.2.

Table (3): Postoperative follow up of the studied patients

Variables	Achilles Tendon Ruptures Patients (N=18)
Time to full weight bearing (weeks) Mean ± SD Median (Min- Max)	 8.05 ± 0.8 8 (7-10)
Single heel raising after repair (months) Mean ± SD Median (Min- Max)	 3.6 ± 0.76 3.5 (3-5)
ATRS Mean ± SD Median (min- max)	 90.1 ± 4.2 90 (80 – 95)

Table 4 shows that the mean overall patient's satisfaction was 8.8 ± 0.83 and the mean Aesthetic satisfaction was 9.5 ± 0.51.

Table (4): Postoperative satisfaction of the studied patients

Variables	Achilles Tendon Ruptures Patients (N=18)
Overall patient's satisfaction Mean ± SD Median (Min- Max)	 8.8 ± 0.83 9 (8 – 10)
Aesthetic satisfaction of scar Mean ± SD Median (Min- Max)	 9.5 ± 0.51 9.5 (9 – 10)

Table 5 shows that only one patient had sural nerve injury and another one had infection.

Table (5): Postoperative complications of the studied patients

Variables	Achilles Tendon Ruptures Patients (N=18)
Complications Non Sural nerve injury Infection	 16 (88.8%) 1 (5.6%) 1 (5.6%)

DISCUSSION

The Achilles tendon is the largest and strongest tendon in the human body. However, its rupture is common in middle-aged active men, especially athletes, with a male to female ratio of 4.8:1 [13]. Achilles tendon ruptures commonly occur during sportive activities and there is a tendency of increasing in the incidence of ruptures because of "weekend warriors" who are over 30 years of age [14].

Achilles tendon rupture has been shown to cause significant morbidity and regardless of treatment major functional deficits persist 2 years after acute Achilles tendon rupture and only 50-60% of sportsmen return to pre-injury levels following rupture[8]. Nevertheless, there is no consensus on the treatment method, and it is still determined by the surgeon and the patient. The current treatment can be classified as non-operative (casting or functional bracing) or operative[15,16]. Management often depends on the patient's activity level, age, personal preference, time interval from injury, and surgeon's preference[17]. Inappropriate treatment of Achilles tendon ruptures can lead to considerable functional impairment[18].

Percutaneous surgical repair of acute Achilles tendon ruptures combines the advantages of conservative and open surgical technique, with optimum postoperative function. Percutaneous repair of acute Achilles tendon ruptures has shown rapid return to full weight bearing, complete recovery of strength and full range of ankle motion due to stimulation of healing of the Achilles tendon in a more natural way compared to any treatment option [19,20].

The purposes of this study is the better management of Achilles tendon rupture to evaluate the results of percutaneous suture technique followed by early functional postoperative treatment for surgical intervention of Achilles tendon ruptures, and to assess wound complication and hospital stay.

Our results demonstrated that the mean age of patients was 31.7 ± 8.7 years ranged from 20 to 54 years, 94.4% of them were males with mean BMI 24.05 ± 3.1 and only 5.6% of them had comorbidities (Diabetes mellitus). 55.6% of patients had right side ruptured tendon, 72.3% with dominant leg, and 83.4% due to sport injuries. The mean gab of rupture was 22.6 ± 9.03 mm and the mean operation time was 24.9 ± 3.6 ranged from 20-35 minutes. In agreement with our study, **Lee *et al.*** [21] demonstrated that the mean age of patients who were treated with percutaneous repair was 39.4 (28-55) years and 91.6% of them were males. 91.6% of them were sports injury and the mean level of rupture from the calcaneal attachment was 58 (40.5-85) mm. The mean gap of rupture was 21.8 (7.5-40) mm.

In the present study, the mean time to full weight bearing was 8.05 ± 0.8 ranged from 7 to 10 weeks and the mean single heel raising after repair was 3.6 ± 0.76 ranged from 3 to 5 months. The mean of ATRS was 90.1 ± 4.2 ranged from 80 to 95. In agreement with our study, **Karabinas *et al.*** [22] found that the mean time of patients' return to work was 9 weeks for the percutaneous repair group. All patients were capable of full weight bearing by the 8th postoperative week time; the time to return to previous activities including non-contact sports was 5 months for both groups. At the last follow-up. In all patients, Thompson test was negative, and all were capable of single leg rise on their toes. Less than 5 degrees loss of dorsal and plantar ankle flexion of the injured leg was observed in all patients. **Lee *et al.*** [21] revealed that postoperative Arner–Lind-holm scale outcomes were as follows: there were 75% "excellent" and 25% "good" and mean ATRS scores was: 90.7 (80–94). All patients were able to perform single heel raises, and the timing was 3.75 (3–6) months.

In the current study, the mean overall patient's satisfaction was 8.8 ± 0.83 ranged from 8 to 10 and the mean aesthetic satisfaction was 9.5 ± 0.51 ranged from 9 to 10. In agreement with our study, **Karabinas *et al.*** [22] found that all patients expressed satisfaction and graded their treatment as good. As expected, cosmetic appearance was significantly better in the percutaneous repair. Also, **Lee *et al.*** [21] revealed that the overall satisfaction level of operative outcome was 9.1 (7–10), as was the aesthetic satisfaction level of scars 9.9 (9–10). Recovery of athletic ability compared to pre-rupture level was as follows: there were 3 cases of "same level", 4 cases of "diminished level", 5 cases of "stopped", and 0 cases of "never participated". Objective satisfaction levels were high in the patients treated with percutaneous repair under ultrasonography guidance.

In the present study, only one patient had sural nerve injury and another one had infection. In agreement with our study, **Karabinas *et al.*** [22] found that no patient experienced other complications such as re-rupture, infection, sural neuroma, or Achilles tendinitis within the period of their study. Also, **Lim *et al.*** [23] advocated percutaneous repair on the basis of the lower rate of complications and improved cosmetic appearance of the leg. **Guillo *et al.*** [24] and **Deangelis *et al.*** [25] concluded that percutaneous compared to open repair techniques are associated with a lower rate of complications without a significant increase in the rate of re-rupture.

In the **Li *et al.*** [26] study, 14.7% of cases had sural nerve injury. The sural nerve injury caused by this method may be mainly attributed to the nerve not being fully exposed during the operation and the suture needle being placed blindly, hence the risk of a direct puncture injury to the nerve. An increased risk of direct sural nerve injury or indirect irritation by sutures exists particularly when needles are pierced laterally into the proximal portion of the Achilles tendon. Simultaneously, it leads to tethering of the fascia cruris to the tendon. Therefore, minimally invasive Achilles tendon surgery should aim to avoid sural nerve injury.

Doral *et al.* [27] demonstrated that 29% of patients had minor complaints during increased activity. At the most recent follow-up, all of the patients were able to

stand on their toe tips for more than 30 seconds. 98.3% of patients could perform repeated toe rises for 30 seconds. 95.1% of them were able to perform single-limb hopping. No rerupture, wound problems, infection deep venous thrombosis, complex regional pain syndrome and uncomfortable shoeing were observed.

CONCLUSION

In conclusion, our results suggested that satisfactory clinical and functional outcomes can be obtained for percutaneous sutures technique in the treatment of Achilles tendon ruptures. As expected, cosmetic appearance was satisfactory for our patients who had a percutaneous treatment. Only one patient experienced a wound infection and another experienced sural nerve injury. The major and most common complication of percutaneous repair, sural nerve injury, was controlled by direct observation of the nerve through the proximal lateral wound stab incisions.

Conflict of interest: The authors declare no conflict of interest.

Sources of funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author contribution: Authors contributed equally in the study.

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