



Functional Outcome in Percutaneous Achilles Tendon Repair

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Abstract

Background Rupture of the Achilles tendon is a considerable cause of morbidity with reduced function following injury. Randomized studies have so far failed to show a difference in outcome between operative and nonoperative management of Achilles tendon rupture, provided that no re-rupture occurs. Percutaneous Achilles repair has been suggested to result in superior patient satisfaction compared with open repair in patients with an acute Achilles tendon rupture.

Aim and Objectives To assess and evaluate the functional outcome after percutaneous repair in patients of the acute and closed Achilles tendon ruptures.

Materials and Methods It was a prospective study conducted on patients diagnosed as having rupture of the Achilles tendon. A total of 25 patients with mean age of 44.4 (range 19–65) years were taken, who underwent percutaneous Achilles tendon repair.

Results The number of patients who reported excellent or good scores (ATRS > 80) at 3, 6 and 12 months were 0%, 16% and 100%, respectively. The mean AOFAS hind foot score at 3-, 6- and 12-month follow-ups was 77.9 ± 4.3 , 92.04 ± 2.4 and 96.1632 ± 1.1 , respectively. The number of patients who reported excellent or good scores (AOFAS > 74) at 3, 6 and 12 months were 76%, 100% and 100%, respectively. Most of the patients in our study showed no complications, and only 2 (8%) of patients had the features of sural nerve injury which was resolved in the subsequent follow-ups.

Conclusion Percutaneous repair of the Achilles tendon is an effective procedure which gives excellent functional outcome with very few complications. The percutaneous technique gives an additional advantage of less operative time, no wound complications, less damage to the soft tissues, and improved cosmesis as compared to the open repair.

Keywords Achilles tendon · Percutaneous repair · Achilles tendon total rupture score

Background

The Achilles tendon is a thick band of tissue that attaches calf muscle to heel bone. It is the largest and longest tendon in the body and is built to handle a lot of stress. This thick band of tissue is very strong, which gives leg strength to walk, run and jump.

Achilles tendon rupture is an injury that affects the back of lower leg. An Achilles tendon rupture is a partial or full

tear of the Achilles tendon. This sudden injury occurs when the tendon stretches to its breaking point. It mainly occurs in people playing recreational sports, but it can happen to anyone. It happens most frequently while playing sports. Tripping, falling or twisting ankle. Rupture usually occurs in the section of the tendon situated within 2.5 inches (about 6 cm) of the point where it attaches to the heel bone. This section might be prone to rupture because blood flow is poor, which also can impair its ability to heal. The vulnerability and morbidity caused by pathologies of the Achilles tendon was recognized by Hippocrates “The Achilles tendon if bruised or cut causes the most acute fever, induces choking deranges the mind and at length brings death.”

Treatment of a ruptured Achilles tendon often depends on patient age, activity level and the severity. In general, younger and more active people, particularly athletes tend to choose surgery. Open repair surgeries allow for direct confirmation of ruptured Achilles tendon and accurate suturing with tension, thereby reducing the frequency of recurrent

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ruptures. However, large incisions leading to potential infection, adhesion, and wound-related complications have been highlighted as the drawbacks of open repair surgery [1, 2]. While minimally invasive surgery has shown considerably reduced risk of superficial wound infection and a 3 times greater patient satisfaction rate [3, 4]. Percutaneous repair was described in 1977 by Ma and Griffith with no re-ruptures and only two minor complications. Since then, there have been mixed results in studies where some have shown higher re-rupture rates and sural nerve complications. These have led some authors to develop alternative methods of percutaneous repair [5–8]. Meanwhile numerous studies reported relatively favorable outcomes from conservative treatment. Although the proportion of favorable outcomes is increasing [1, 9], the possibilities of recurrent rupture and tendon elongation remain [10]. To overcome these limitations, less invasive techniques have been developed. Nonetheless, there have been reported issues of recurrent rupture and sural nerve injuries from these innovative techniques [2, 11–14]. The aim of this study is to assess the functional outcome in percutaneous Achilles tendon repair.

Materials and Methods

The present study was conducted in the Postgraduate Department of Orthopedics, Government Hospital for Bone and Joint Surgery, an associated Hospital of Government Medical College Srinagar from July 2019 to February 2021. It was a case series conducted on patients diagnosed as having rupture of the Achilles tendon and fulfilling the inclusion criteria for the study. Diagnosis was made via physical examination (presence of a palpable gap within the tendon, the loss of the normal resting tone of the ankle and lack of tendon continuity on performing a calf squeeze test [15].), and ultrasonography (Fig. 1). A total of 25 patients with mean age of 44.4 (range 19–65) years were taken, who underwent percutaneous Achilles tendon repair.

Inclusion criteria:

- Acute tendon ruptures (duration less than 3 weeks)
- Closed tendon ruptures.
- Tendon ruptures occurring within 2–8 cm from the insertion site.
- Tendon gap less than 2 cm.
- Compliant patients.
- All sexes

Exclusion criteria:

- Chronic tendon ruptures (duration greater than 3 weeks)
- Open tendon ruptures.
- Re-rupture after previous repair.
- Non-compliant patients.

Surgical Technique

The patients were operated under spinal or regional anesthesia, and all inductions of anesthesia were performed using ultrasound-guided peripheral nerve block (femoral nerve, sciatic nerve, and posterior femoral cutaneous nerve block). The patient was put in prone position with tourniquet before the induction of anesthesia. Injured foot was put in about 25 degrees of plantar flexion. Starting distally first a suture on long straight or semi-curved needle is passed through the tendon followed by a diagonal cross-suture and thread was then led longitudinally, subcutaneously and extratendinously. The next cross through the tendon was done proximally and both thread ends were led extratendinously back through the second and third holes distally and pulled symmetrically back until both ends of the torn Achilles tendon are completely approximated and the defect is no longer palpable. After approximating the torn Achilles tendon ends, the lateral end of the thread was passed medially, the final simultaneous tightening of both ends of thread is done and suture is tied. Hence, the procedure was started and finished medially and distally and the knots were buried subcutaneously in the widened 2nd

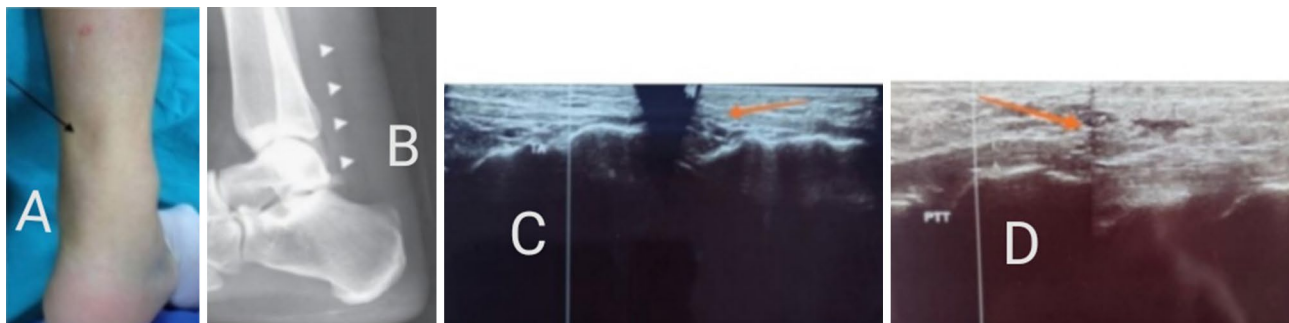


Fig. 1 A Visible gap at the rupture site. B X-ray showing obliterated Kager's triangle. C, D Ultrasonography showing ruptured Achilles tendon

medial stab incision. This procedure leaves only 8 small stab incisions visible and these incisions were closed with fine silk sutures (Fig. 2). Antiseptic dressing is applied. Foot and ankle were fixed in gravity equinus position using a short leg cast.

Follow-Up

The passive range of motion of the ankle started 3 weeks post-operatively, but partial weight-bearing started after 4 weeks and full weight-bearing by 6 weeks. At 6 weeks post-operatively, patients were advised for straight leg raises, hip and knee exercises. Between 8 and 12 weeks post-operatively, the patients were given transition from cast to shoes with heel lift. Full weight-bearing with heel lift as tolerated was advised for ankle and foot range of motion exercises. After 12 weeks, the patients were allowed to perform jogging and single heel raise motions. Continuity of the tendon was confirmed at 3, 6, and 12 months post-operatively using ultrasonography. In addition, bilateral ankle angles were compared in the neutral position with the patient in the prone position and knee joint bent at 90 to check for potential recurrent rupture or elongation of Achilles tendon. The functional outcomes were assessed using AOFAS (American Orthopaedic Foot and Ankle Society) hindfoot score (1994) and ATRS (Achilles Tendon Total Rupture Score) (2007) (Tables 1, 2).

Results

In our study, 25 patients with Achilles tendon rupture were treated with percutaneous Achilles repair. Mean age of patients was 44.4 years (range 19–65 years). Mean operative time was 23.6 (range 15–30) minutes and mean hospital stay was 2.36 (range 2–3) days. The median ATRS results at 3, 6 and 12 month follow-up was 66.16 ± 2.9 , 77.84 ± 2.2 and 89.32 ± 2.2 , respectively. The number of patients who reported excellent or good scores (ATRS > 80) at 3, 6 and 12 months were 0%, 16% and 100%, respectively. The mean AOFAS hind foot score at 3-, 6- and 12-month follow-ups was 77.9 ± 4.3 , 92.04 ± 2.4 and $96.16.32 \pm 1.1$, respectively. The number of patients who reported excellent or good scores (AOFAS > 74) at 3, 6 and 12 months were 76%, 100% and 100%, respectively. Most of the patients in our study had no complications, and only 2 (8%) of patients had the features of sural nerve injury which was resolved in the subsequent follow-ups (Tables 3, 4).

Discussion

Achilles tendon rupture incidence is increasing and is attributed to increasing recreational sport activities [16, 17]. More than 75% cases are related to sport and athletic activities [16, 18]. In our study, sport activity (38.50%) is the most common mode of injury and occupational injuries (30%) have a significant percentage. Mean age of our study was 44.4 which is comparable to the study done by Carmont et al. 2013 [19] where mean age was 45.5. The majority of the patients in our study were males. The likely cause of more male sex involvement in our study was more involvement of males in heavy occupational and sports-related activities. The male to female ratio in our study was 2.6:1, which is comparable to the study done by Maffulli et al. 2020 [20] where male to female ratio was 2.5:1. Yong Li et al. 2021 [21] did a comparative study in which the mean operative time of the percutaneous group was 23.1 min comparable to our study. The mean operative time in our study was 23.6 min with a range from 15 to 30 min.

The present study shows that the treatment of acute Achilles tendon repair with a percutaneous repair technique delivers good clinical results combined with very low re-rupture and surgical complication rates. The clinical scores were very good in the present study. Since Ma and Griffith [22] have reported percutaneous repair as an eclectic treatment of open repair surgery and conservative treatment, multiple studies have compared this innovative technique with open repair surgery, and there are ongoing studies on different minimally invasive surgery techniques, which are improved versions of these operative techniques. Several previous studies have mentioned that percutaneous repair decreases the prevalence of skin complications and provides a similarly exceptional level of clinical and functional outcomes [23]. Yang et al. [24] suggested that percutaneous repair is better than open repair in operative time, infection, and AOFAS scores.

In our study, mean AOFAS Hindfoot Score improved from 77.9 at 3 months to 96.16 at final follow-up which is near about equivalent to the study by Andrej Cretnik et al. 2005 [2] where mean AOFAS Hindfoot score at 12-month follow-up was 96.1. The mean ATRS Score improved from 66.16 at 3 months to 89.32 at final follow-up equivalent to the study by Carmont et al. 2013 [19] where it was 89 at 12-month follow-up.

However, the sural nerve has varying anatomical pathways, and thus, percutaneous repair will always expose the patient to the risk of sural nerve injury [25]. The possibility of sural nerve injury during percutaneous repair was approximately 15% [14, 26]. In our study, we had complications like sural nerve injury in 2 (8%) of patients,

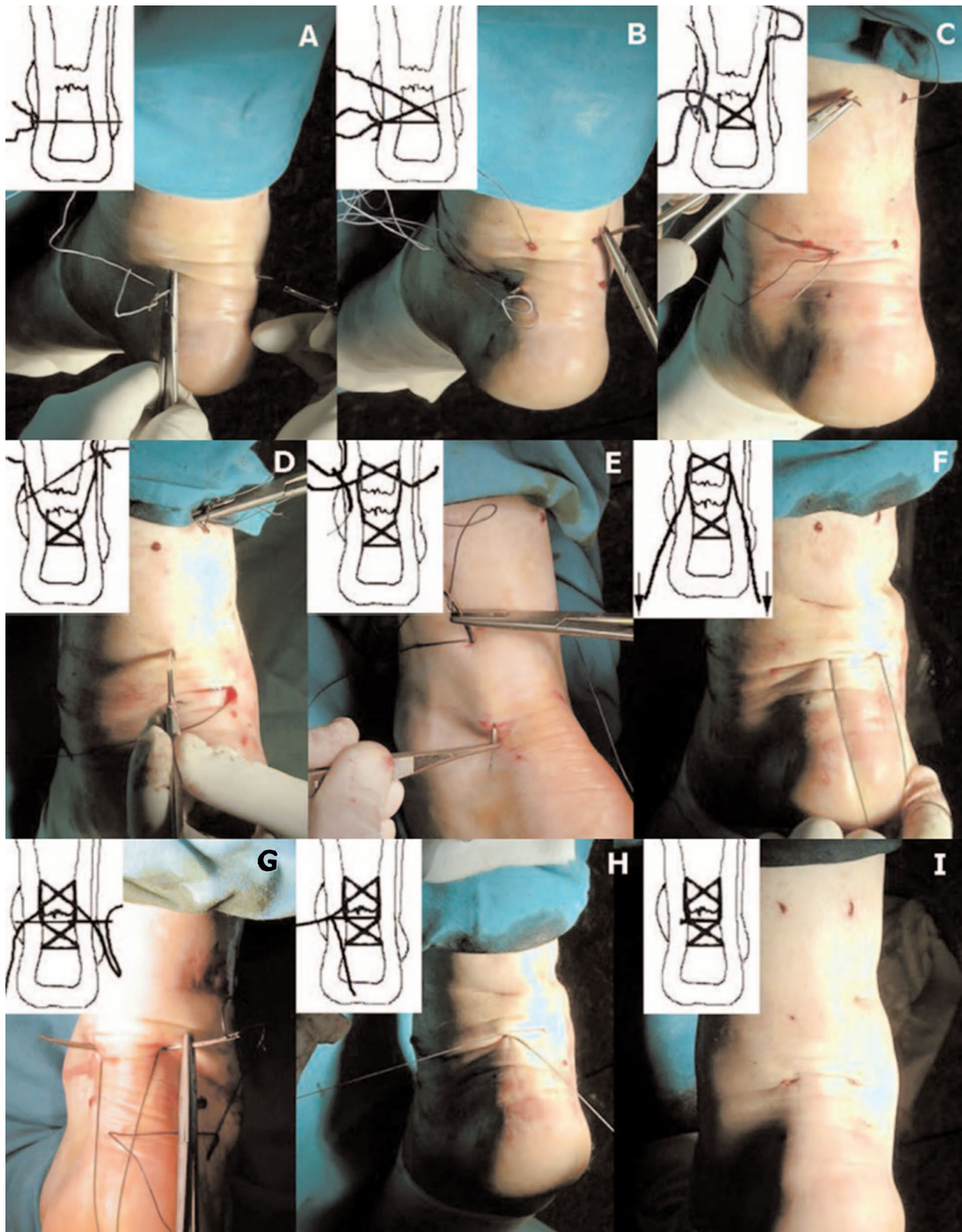


Fig. 2 A distally semi-curved needle passed through the tendon. B Diagonal cross-suture. C Longitudinally, subcutaneously and extra-tendinously thread pass. D Proximal cross through tendon. E Distally

back of both thread ends through the second and third holes. F No palpable defect. G Medially pass of the lateral end of the thread. H Suture is tied. I Buried knots subcutaneously

Table 1 Descriptive statistics of the study population (N=25)

Variables	No. of patients	Percentage
Sex		
Male	18	72
Female	7	28
Age group		
15–25 years	3	12
26–35 years	6	24
36–45 years	2	8
46–55 years	8	32
56–65 years	6	24
Mode of trauma		
Fall	12	48
Twisting injury	6	24
Blunt impact	3	12
Road accidents	2	8
Others	2	8
Side involvement		
Right	12	48
Left	13	52

Table 2 Grading of AOFAS (American Orthopaedic Foot and Ankle Society) hindfoot score (1994) and ATRS (Achilles Tendon Total Rupture Score) (2007)

Rating	Score	
	AOFAS	ATRS
Excellent	95–100	91–100
Good	75–94	81–90
Fair	51–74	71–80
Poor	0–50	0–70

Table 3 ATRS (2007) at 3, 6 and 12 months post-operative

ATRS	3 months post-operative		6 months post-operative		12 months post-operative	
	No. of patients	Percentage	No. of patients	Percentage	No. of patients	Percentage
≥91 (excellent)	0	0	0	0	9	36
81–90 (good)	0	0	4	16	16	64
71–80 (fair)	2	8	21	84	0	0
≤70 (poor)	23	92	0	0	0	0
Mean ± SD (range)	66.16 ± 2.9 (61–72)		77.84 ± 2.2 (73–84)		89.32 ± 2.2 (85–93)	

Table 4 AOFAS hind foot scores (1994) at 3, 6 and 12 months post-operative

AOFAS Hindfoot Score	3 months post-operative		6 months post-operative		12 months post-operative	
	No. of patients	Percentage	No. of patients	Percentage	No. of patients	Percentage
≥95 (excellent)	0	0	5	20	25	100
75–94 (good)	19	76	20	80	0	0
51–74 (fair)	6	24	0	0	0	0
≤50 (poor)	0	0	0	0	0	0
Mean ± SD (range)	77.9 ± 4.3(74–84)		92.04 ± 2.4(87–95)		96.16 ± 1.1(95–98)	

which is likely less as demonstrated in previous studies. To minimize the risk of sural nerve injury, Webb and Bannister [8] described a technique of percutaneous repair using posterior incisions.

The main finding of the present investigation is that patients reported marked limitation of function by 3 months, little limitation of function by 6 months, and a near excellent/good outcome at 6–12 months following surgery. The success of this treatment method is similar in younger and older patients, and the timing of surgery within a week of injury does not appear to influence the results. This method of percutaneous repair of the Achilles tendon rupture is a reliable and reproducible method of restoring good function, with minimal limitation or complications.

Conclusion

Percutaneous repair of the Achilles tendon is an effective procedure which gives excellent functional outcome with very few complications. The percutaneous technique gives an additional advantage of less operative time, no wound complications, less damage to the soft tissues, and improved cosmesis as compared to the open repair. The disadvantages are that it is technically demanding, long learning curve and inherent risk of injury to the Sural nerve due to its blind nature.

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Declarations

Conflict of Interest None.

Ethical Approval Manuscript read and approved by all the authors.

Informed consent Informed consent was obtained from all the participant individuals included in the study after ethical approval by ethics committee.

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