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### Cannulated percutaneous repair for closed tendo Achilles rupture- Alleppey technique

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#### Abstract

**Background:** The incidence of closed Achilles rupture is on rise year after year reflecting the increased sports and recreational activities and life style diseases. The disability both long term and short term are profound if not promptly diagnosed and properly treated. The complications of non-operative treatment and conventional open surgical procedures are well known and documented.

**Materials & Methods:** Thirty patients with acute closed rupture of Achilles tendon were treated between 2010 and 2015 using a new technique of percutaneous repair using cannula. Twenty four patients were males and six patients were females. 20 patients were between 40 and 50 years of age. 8 patients were between 30 and 40 years of age while 2 patients were above 50 years of age. The mean time between injury and index surgery was 8 days (range 5 to 14 days).

**Results:** The average range of ankle plantar flexion was 130° (range, 120°-140°) on the repaired side and 143° (range, 120°- 155°) on the non-injured side. The average range of ankle dorsiflexion was 17° (range, 16°-21°) on the operated side and 19° (range, 18°-22°) on the non- injured side. The mean calf diameter was 40.5 cm (range, 37-44 cm) on the operated side and 42.5 cm (range, 39-45 cm) on the non-injured side. The interval between injury and return to regular work was 13 weeks (range 10-16 weeks). The mean AOFAS score was 90 (80-98) at the most recent follow-up and 80% of patients' results were considered excellent while 20% were good. There was no re-rupture, skin necrosis or sural nerve injury in our series

**Conclusions:** Percutaneous "cannula" technic repair of closed tendo Achilles rupture is an excellent and simple outpatient technic without much possibility of soft tissue complications. The only drawback of this technique is the possibility of sural nerve injury. This can be eliminated by close puncture of the tendon on lateral side.

**Keywords:** Percutaneous repair; Achilles tendon; closed rupture

#### 1. Introduction

Rupture of the Achilles tendon is increasingly common, and an incidence of 18 per 100,000 has been reported [1]. The Achilles tendon is the strongest tendon in the human body which takes its name from Achilles, from Homer's Iliad. Hippocrates said "this tendon, if bruised or cut, causes the most acute fevers, induces choking, deranges the mind and at length brings death". Since Ambroise Paré initially described in 1575 and reported in the literature in 1633, Achilles tendon breakage has received a lot of attention [2]. The role of triceps surae and tendo Achilles in maintaining the posture and normal gait is well analysed and documented. Achilles tendon ruptures are the most common tendon rupture of the lower extremity. The profound disabilities like weak plantar flexion with deficient push off and flat foot gait will alter the normal gait pattern energy expenditure. Flat foot may lead to foot strain and tarsal arthritis.

The current treatment options can be classified as non-operative (casting or functional bracing) or operative. Although some authors recommend conservative management strongly, cast immobilization may lead to elongation of the tendon with reduced strength of the calf muscles and in a high rate of rupture [3]. As a common concept, operative treatment results in lower re-rupture rate, early functional rehabilitation, stronger push off with lower incidence of calf atrophy. But open surgical repair of the Achilles tendon also includes potential problems like joint stiffness, muscles atrophy, tendo-cutaneous adhesions, deep venous thrombosis due to prolonged immobilization after surgical repair, infection, scarification, and wound breakdown [4].

Percutaneous repair was described in 1977 by Ma and Griffith [5] with no re-ruptures and only two minor complications; these have led some authors to develop new and alternative methods of percutaneous repair. Percutaneous or minimally invasive techniques are being used to minimize the typical complications associated with open surgery, and results are reported to be satisfactory, but an increased incidence of sural nerve injury has been reported after percutaneous repair [6].

Closed rupture can occur at any age but is more common in 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> decade. 40 to 80% of ruptures occur during sports and recreational activities. But intrinsic structural, biochemical and biomechanical changes may play a significant role. The risk factors involved in closed Achilles rupture are smoking, diabetes, gout, rheumatoid arthritis, systemic steroids, fluoroquinolones, anabolic steroids and local steroids. Ageing significantly decreases tendon glycosaminoglycans and increase collagen concentration with reduced collagen cross linking. This make the tendon less elastic and susceptible to closed rupture.

The usual mechanism of rupture is eccentric contraction of a loaded tendo Achilles. Typically rupture occurs at a relatively avascular area 2-4 cm proximal to the calcaneal insertion. Less frequently tendon may get detached from calcaneum. Very rarely musculotendinous junction may be the site of rupture. Clinical signs of rupture are well known including hyperdorsiflexion, visible or palpable gap, thompsons or Simmonds test, obriens test, matles sign, Copeland sphygmomanometer test and a flat foot gait with an absent tip-toeing (the senior author consider this as the most reliable and

Consistent sign).

Plain radiograph may reveal an altered kagers triangle. Ultrasound and MRI may be needed infrequently. The mainstay of management of rupture is open repair. But the complication rates and re rupture rate are very high. In our technic rupture site is not opened at all. This will maintain an intact paratenon which is the main source of tendon healing mesenchymal pleuripotent cells (Like periosteum). Judicious use of a cannula will reduce the chance of missing the tendon while taking the bites. Cannula will also stabilize or fix the tendon. Taking the suture material (prolene, ethibond or steelwire) through thick of the tendon will be confirmed by placing a cannula across the tendo Achilles

**2. Materials and Methods**

The study was done in Govt TD Medical College, Alleppey, Kerala, India between a period of 2010 and 2015 for patients with acute traumatic closed rupture of Achilles tendon. Total number of patients included in the study were 30 of which 24 were males and 6 were females [chart-2]. Out of the 30 patients 20 patients were between 40 and 50 years of age while 8 patients were between 30 and 40 years of age and 2 patients were above 50 years of age [chart-1]. Out of the 30 patients stress or sudden acceleration were experienced for 18 patients while walking, 6 patients while using stairs or slope and 6 patients with occasional sporting activity. 10 patients were diabetic and 8 patients were smokers and 4 patients had rheumatoid arthritis.

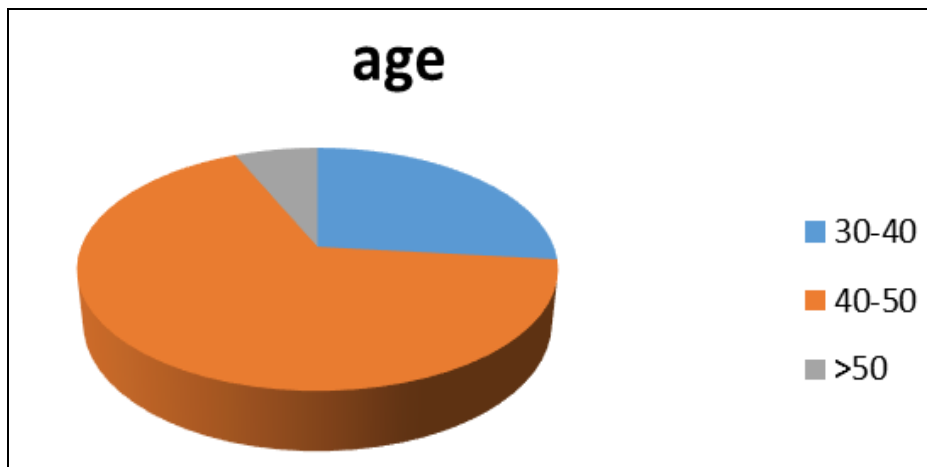


Chart 1: age distribution

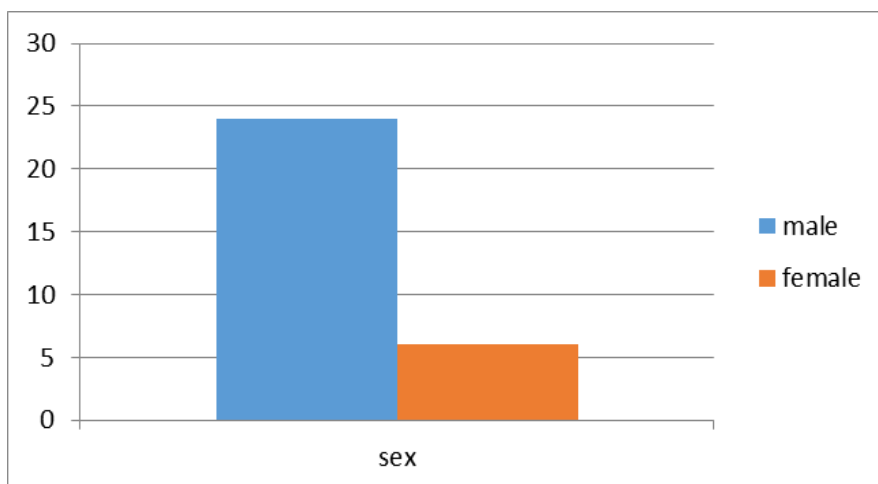


Chart 2: sex distribution

### 2.1 The exclusion criteria were

- 1) Re rupture
- 2) Open rupture
- 3) Associated fractures
- 4) Insertional avulsions

Physical examination revealed a palpable defect within the Achilles tendon and a positive Thompson's test. (Figure 1)



Fig 1



Fig 2: Closed TA rupture-visible and palpable gap

All patients underwent preoperative MRI or ultrasound evaluation to assure that there was a distal tendon stump at least 2 cm and an appreciable gap between the two ends of the tendon (Figure 3)



Fig 3: MRI revealed type of rupture and available stump

All the subjects of this study have been evaluated clinically at 8 weeks, 3, 6 months and then annually. We used AOFAS[American orthopaedic foot and ankle society] ankle-hind foot score to evaluate the subjective satisfaction at the most recent follow-up. Results were rated as excellent (100-90 points), good (89-80 points), fair (79-70), or poor (<70) according to Kitaoka *et al* [7].

### 2.2 Surgical technique: “percutaneous cannulated technique” [Alleppey technique]

**Position-prone**

**Anesthesia-local or regional**

16 G cannula is used to thread the suturing material across the tendon through a small nick on either side of the tendon in a continuous manner. Try to avoid sural nerve injury by selecting the entry point close to the tendon on lateral side. No 2 PDS, prolene, ethibond or 22 G steel wire can be used. Small nicks can be closed to prevent sinus formation if steel wire is used to repair the rupture. [fig-4, 5, 6]



Fig 4



Fig 5: No.2 ethibond, prolene or 22G steel wire can be passed through 16 G cannula



Fig 6: Suture threading across the rupture site



Fig 7: Single sutures on nick site



**Fig 8:** Minimal scar-cosmetically acceptable

**2.3 Post-operative protocol:** A below knee anterior POP slab is applied in 20 degree plantar flexion. After 2 weeks sutures removed. After 4 weeks of surgery, ankle mobilization started with restricted dorsiflexion. Toe touch down with gradual weight bearing is permitted. Full weight bearing is allowed at 8 weeks

**3. Results**

All the patients were followed-up for 24 months after surgery. At final follow-up the average range of ankle plantar flexion was 130° (range, 120°-140°) on the repaired side and 143° (range, 120°- 155°) on the non-injured side. The average range of ankle dorsiflexion was 17° (range, 16°-21°) on the operated side and 19° (range, 18°-22°) on the non- injured side[fig-10]. The mean calf diameter was 38.5 cm (range, 36-44 cm) on the operated side and 42.5 cm (range, 39- 45 cm) on the non-injured side. The interval between injury and return to regular work was 17 weeks (range 16-18 weeks).

All patients returned back to their previous activities, At the most recent follow-up, all of the patients were able to stand on their toe tips for more than 30 seconds. (Figure 9).



**Fig 9:** Active plantar flexion at 8 weeks post op

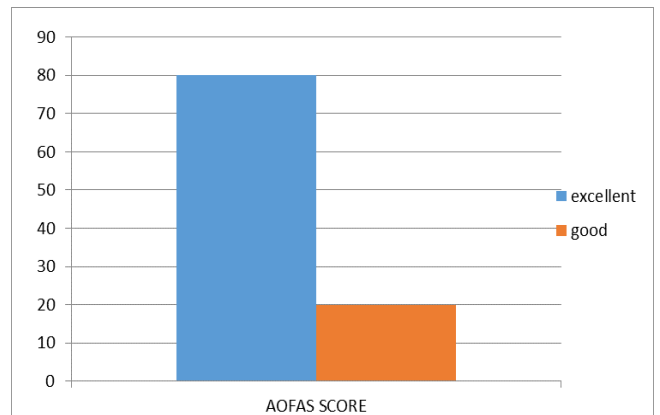


**Fig 10:** Dorsiflexion at 8 weeks post op

The mean AOFAS score was 90 (80-98) at the most recent follow-up and 80% of patients' results were considered excellent while 20% were good [chart-3]. We had no re-ruptures.

The optimal recovery of strength and endurance of the calf muscles; for regular activity was regained at 3 months and for strenuous activities at 6 months after surgery.

**Complications:** One patient experienced transient hypoesthesia in the dermatome of the sural nerve for 2 months after the operation and resolved spontaneously. two patient had superficial wound infection which got controlled with antibiotics and wound care. One case developed discharging sinus probably due to steel wire and diabetes. Subsequently we had to remove the steel wire at 12 weeks. Sinus healed with antibiotics and diabetes control.



**Chart 3:** Analysis of the Outcome

**4. Discussion**

It is not uncommon to encounter cases of closed traumatic rupture of the Achilles tendon. Perhaps the recorded rising incidence of new cases annually in trauma centers is multifactorial i.e. prevalence of diabetes mellitus, obesity and ageing athletes. Because of increasing incidence of the Achilles tendon rupture during the past decade it has been a subject of focus in many studies and meta-analyses. To achieve optimum return of function, surgical repair is clearly superior to non-operative treatment [1].

Conservative treatment has less functional results with higher rerupture rates. It carries also the risks of prolonged immobilization such as arthro-fibrosis, joint stiffness, calf atrophy, damage of the articular cartilage and deep vein thrombosis. The high rate of re-rupture is most probably due to prolonged immobilization that leads to a weakened atrophic less vascularized tendon which is prone to re-ruptures. That is why it should be kept for elderly and low demanding patients [8]. Numerous open surgical procedures have been proposed for repairing ruptures of the Achilles tendon, but there is no single, uniformly superior technique. Delayed wound healing, necrosis, suppuration and adhesions are potential complication of open procedures which are not rare especially in diabetic patients and smokers. Augmented open procedures have to be performed for neglected or defective Achilles tendon ruptures [9]. Percutaneous repair was 1st described in 1977 by Ma and Griffith with no re-ruptures and only two minor complications [5]. This has led some authors to develop new and alternative methods of percutaneous repair. Percutaneous or minimally invasive techniques are being used to minimize the typical complications associated with open surgery, and results are reported to be satisfactory and superior to open surgical procedures. On the other hand, an increased incidence of sural

nerve injury has been reported after percutaneous repair [10]. This is probably due to the blind passing of the sutures through the skin and tendon. In a comparative study by Cretnik *et al.*, [11] a higher percent of disturbance in sensibility was reported with a percutaneous repair group compared to an open repair group.

Flavin *et al.*, [13] suggested US mapping of the sural nerve in conjunction with percutaneous Achilles tendon repairs. The authors reported that the sural nerve can be easily visualized posterior to the lateral malleolus and along the lateral border of the Achilles tendon. They also reported that US had poor sensitivity for detection of the sural nerve approximately 4 cm proximal to the insertion of the Achilles tendon due to the presence of a network of subcutaneous veins. It is clear from the work of these authors that reliance on sonographic mapping of sural nerve during the procedure is not reliable [13]. The original technique described by Ma and Griffith suggested using six skin incisions, three lateral and three medial to the ruptured tendon [5]. In their series of 18 patients, there was no injury to the sural nerve or re-rupture. However, Rowley and Scotland [14] reported injury to the sural nerve in one of ten patients using the same technique and Klein *et al.*, [15], reported five nerve injuries in 38 patients.

Cretnik *et al.* [11] suggested a percutaneous repair through eight holes, which were later used for needle entry and enlarged. The procedure was begun and finished medially and distally with crisscross sutures. This procedure is contraindicated in the following situations, Pathologic rupture, more than 14 days since injury, beyond this timeline successful repair is unlike due to chronic muscle/tendon retraction and interposed scar tissue and if the distal stump of the ruptured tendon less than 2 cm.

Variability in Sural nerve anatomy may be an important risk factor for direct injury in percutaneous techniques [16].

The proximal course of the sural nerve is from the midline toward the lateral border of the Achilles tendon. The nerve intersects with the lateral border of the Achilles tendon approximately at half the length of the tendon, 10.4 cm (range 5.7-15.5 cm) proximal to the lateral malleolus. Sutures placed near the lateral border of the tendon at a proximal level may put the sural nerve at risk of injury. Whereas sutures put into the tendon distal to the 55% fraction may have a lesser risk of sural nerve injury [16].

We totally agree with Cretnik that the blind passing of the sutures through skin and tendon is the real cause of sural nerve injury during the procedure. Our study is designed to avoid sural nerve injury during percutaneous repair of the Achilles tendon. The idea is to make a series of small 3- 5 mm stab incisions on both sides of the tendon. **On the lateral side of the tendon where the sural nerve is at risk, pass the cannula close to the tendon as much as possible on lateral side. Pass the suture through the cannula only. This will ensure that no tissue comes between suture and the tendon. With this technique we can make sure that the sural nerve is well protected and we had no sural nerve injury in all our cases.**

Regarding functional recovery, we observed that the healing time of the tendon was around 9 weeks (range 8 to 10 w) based on MRI studies. This was a major advantage of this procedure especially for our diabetic and smoker patients. This is probably because the paratenon is not violated by this technique. Also skin healing was optimal because of the limited stab incisions especially in diabetic patients [fig-7, 8]. Because of these observations we were able to start rehabilitation program at 8 weeks post-operative.

The power of the calf muscle was greatly restored by this technique as all the patients were able to stand on their toe tips for more than 30 seconds. The mean AOFAS score was 90 (80-98) at the most recent follow-up and 80% of patients' results were considered excellent while 20% were good.

We had no re-ruptures.

The advantage of minimally invasive procedures is that it avoids the potential complications of open procedures which are not rare especially in diabetic patients and smokers.

These complications include,

1. Delayed wound healing, necrosis, suppuration and adhesions.
2. Delayed tendon healing time, it is estimated in most studies describing open Achilles tendon repair that tendon healing time is around 3 to 6 months compared to only 9 weeks in percutaneous procedures.
3. It also carries the risks of prolonged immobilization such as arthro-fibrosis, joint stiffness, calf atrophy, damage of the articular cartilage and deep vein thrombosis. The high rate of re-rupture is most probably due to prolonged immobilization that leads to a weakened atrophic less vascularized tendon which is prone to re-ruptures

We had three cases reported mild occasional pain with increased activities. Of these two were diabetic patients who developed superficial wound infection; unfortunately these three patients were also smokers. The final AOFAS score for these three cases were 80% and their final results were rated good. Surgeons should keep in mind that diabetes and smoking delay the healing time of the tendon and the overall results are less than optimal.

The other cases included in the study had a final AOFAS score above 90 and their results were rated excellent. All patients returned back to their previous profession. The overall patient satisfaction with surgery was excellent due to the relatively short recovery time and the cosmetic appearance of the surgical wound.

## 5. Conclusion

Percutaneous repair of acute closed rupture of Achilles tendon is a reproducible simple and effective method of treating closed Achilles rupture. It results in a strong and sound tendon healing in a relatively short time that allowed for early functional rehabilitation. The operative scar was minimal and cosmetically acceptable that added more to the overall patient satisfaction. The soft tissue complications are virtually nil with this technic.

Only drawback of this technique is the possibility of sural nerve injury. This can be eliminated by keeping the lateral entry close to the tendo Achilles.

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