

Functional Outcome of Percutaneous Achilles Tendon Repair Vs Open Repair: A Comparative Study

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Abstract: Achilles tendon rupture treatment by percutaneous technique and open repair are well established procedures. There is no consensus as to whether there is difference in outcome between percutaneous and open repair. Achilles Tendon rupture score, an outcome measure developed and validated was used to assess the final outcome in addition to clinical assessment and complications. ATRS was documented at admission of the patient and every third month visit up to one year from surgery. Ankle range of motion and complications were also charted. Patients who did not complete one year follow up are excluded from the study. 26 patients successfully completed the follow up. 11 patients fall into percutaneous group and 15 patients into open repair group. In addition to sports injury we found occupational injuries as common mode of injury in our cohort. At end of 1 year the mean ATRS was 89.4 in percutaneous group and 81.6 in open repair group. Complication rate of 30.6% was identified (20.4% minor and 10.2% major). Our results conclude that there is no significant difference in functional outcome between the two groups. We found wound complications and infection are higher in open repair and sural nerve is at more risk for injury in percutaneous technique.

Keywords: Achilles tendon, percutaneous, open repair, outcome, complications.

1. Introduction

Achilles tendon is the thickest and strongest tendon of the human body. Despite being strongest tendon ruptures are frequent in young athletes as well as in the 3rd and 4th decade sedentary patients [1]-[3]. The treatment can be broadly classified into surgical (open, minimal invasive, percutaneous, endoscopic or ultrasound assisted repairs) and non surgical (cast or brace). Treatment of choice is still controversial as both surgical and non surgical options have been considered optimal. Open operative treatment is commonly used in young, percutaneous technique for middle aged and those who refuse open repairs and non surgical treatment in elderly patients [4]-[7].

Complication (wound infection, nerve injury, re-rupture) rates in each type of management still plague the surgeons. Cochrane review in 2005 and the update in 2010 has shown that re-rupture rates are less in open repair but at a risk of increased of infection and other complications. Functional assessment and studies in young athletes was lacking in most studies. Percutaneous repair had low rates of infection compared to open repair in the small number of patients' reviewed [8]-[9].

Minimally invasive procedures are being considered to avoid the complications of open repair [10]. We discuss the use of percutaneous technique in our patients and comparative outcomes with open repair. Outcomes were commonly evaluated with American Orthopaedic Foot and Ankle Hind foot score [11] (AOFAS), Merkel's scale [12], Leppilahti score [13], Victorian Institute of Sports Assessment questionnaire for patella and achilles tendinopathy [14] (VISA & VISA A questionnaires). These scores were not thoroughly evaluated or validated prior to their use. In 2007 a research group has developed achilles tendon rupture score [15] (ATRS) with supporting validation data. It is a simple questionnaire

evaluating symptoms and physical activity. ATRS has shown high internal consistency and responsiveness in comparison to others. We have used ATRS to report outcomes of our patients in addition to clinical assessment and complications of the surgery.

Different techniques are available for percutaneous repair of the ruptured Achilles tendon. Ma and Griffith [16] developed first percutaneous technique in 1977 and is still commonly used. Several modifications of Ma and Griffith have been proposed. 8 strand repair using No 1 Maxon and 9cm Mayo needle is considered current version on the technique. Deplonte [17], webb & banister [18], Mafulli [19] & Achillon Jig [20] techniques were developed over time and have been successfully used in various studies. Cochrane review and update were not able to recommend on the type of repair technique as well [7]-[8]. We have used the classic Ma & Griffith technique in the percutaneous repair group.

2. Methods & Materials

Ours is a prospective comparative study done at Guntur Medical College, Andhra Pradesh. Patients diagnosed with primary complete Achilles tendon rupture from April 2011 to Jan 2013 were included in the study. 31 patients were counselled about the different management options (Open repair, percutaneous repair and non operative pop cast management) and necessity for follow up for 1 year. 2 patients treated with pop cast were excluded from the study. 3 patients who were lost to complete follow up were excluded from the study.

2.1 Open Repair and post op follow up

Open repair of Achilles tendon was done under spinal anaesthesia or general anaesthesia in the prone position.

After application of pneumatic tourniquet 1cm posterior paramedian incision to the medial side of around 10 cm was given. Subcutaneous dissection was avoided reaching paratenon directly. After opening the paratenon edges were minimally debrided. Modified Kessler suture using number 2 non absorbable suture was used for tendon repair. Paratenon, subcutaneous and skin was closed followed by above knee plaster cast application with 15° knee flexion and around 20° of plantar flexion.

First wound inspection was done on 3rd postoperative day and sutures removed on 14th post operative day. Above knee cast was removed at end of 4th week and converted to below knee with ankle in neutral to gravity equines. Below knee cast was removed at 8 weeks. Gradual stretching and strengthening exercises were continued till end of 4 months. Gradual return to active sports was allowed only after 6 months.

2.2 Percutaneous repair and follow up

Percutaneous repair of ruptures of Achilles tendon was done using Ma & Griffith technique [16]. Six skin incisions three lateral and three medial to the achilles tendon. Bunnell's crisscross suture was applied through proximal tendon, box suture in the distal stump and sutured on the tendon. Non absorbable sutures were applied for the stab incisions. Below knee cast was applied for 4 weeks with non weight bearing. After 4 weeks cast was removed and protected gradual weight bearing with crutches was allowed. Gradual stretches and strengthening exercises were continued till 3rd month. Gradual return to sport activities was allowed after 4 months.



Figure 1: Percutaneous technique

2.3 Outcome measure

ATRS was used to assess the post operative outcome of achilles tendon repair. ATRS is a patient reported questionnaire which measures outcome of symptoms and physical activity after treatment. It was compared with AOFAS [11] and VISA-A-S [21] questionnaires and found to be highly reliable. ATRS has 10 simple questions of which 5 focus on symptoms and 5 on physical activity. ATRS was found to be both patient and clinician friendly [22].

3. Observation & Results

3.1 Age & sex Incidence

Our cohort was predominantly in 4th and 5th decade with few elderly patients. We did not have any patient in the second decade and only a few patients in third decade. Our study group had all male patients with only 1 single female patient.

Table 1: Age incidence of groups and cohort

Open repair	≥51
	41-50
Percutaneous Repair	31-40
Total AT ruptures	
	0 2 4 6 8 10 12 14

3.2 Mode of Injury

Table 2: Different modes of injury

11.50%	Sports
8.50%	Occupational
38.50%	pit fall or uneven road
11.50%	bike kick injury
30.00%	miscellaneous

3.3 Percutaneous vs Open Repair

Surgery was done within an average of 7 days in percutaneous repair group and 10.33 days in open repair group. 26 patients who completed follow up of 1 year were eligible for study. 11 patients underwent percutaneous repair and 15 underwent open repair.

Table 3: ATRS score percutaneous vs open repair

100	
80	Percutaneous repair
60	
40	open repair
20	
0	Max ATRS

Table 3: Percutaneous vs open repair testing ATRS scores

Paired T test	T value	P value
Pre op ATRS Percutaneous Versus Pre op ATRS Open repair	21.17	<0.001
3 rd month ATRS Percutaneous Versus 3 rd month ATRS Open repair	21.66	<0.001
6 th month ATRS Percutaneous Versus 6 th month ATRS Open repair	22.46	<0.001
9 th month ATRS Percutaneous Versus 9 th month ATRS Open repair	23.86	<0.001
1year ATRS Percutaneous Versus 1year ATRS Open repair	22.56	<0.001

3.4 Range of motion at ankle

Range of motion was significantly low at injury when compared to uninjured side. On comparison over time the operated side ROM increased significantly at 3rd, 6th, 9th and 12th month (P value <0.001). There was a mean difference of 7degree of ankle range of motion compared to uninjured limb in open repair group and 4 degree in percutaneous group. The difference between two groups is not significant.

3.5 Complications

In percutaneous group, we had one case of superficial infection which had responded to intravenous antibiotics. We also had 1 case of paraesthesia over sural nerve territory. Area of paraesthesia had decreased over time but still persists. We did not encounter any other significant complications.

In open repair group, we had one superficial infection which healed secondarily over 2 months with regular dressings and antibiotics. We also had a case of deep infection with wound necrosis which required debridement and later reverse sural artery fasciocutaneous flap to cover the defect. Symptomatic deep venous thrombosis has not been recorded in our cases. Sural nerve paraesthesia has been recorded in one of the open repair patients but has completely recovered. In our short follow up we did not encounter any re-rupture.

Complications (26 patients)	Percutaneous repair (11 patients)	Open repair (15 Patients)
Superficial infection	1	1
Deep infection	0	1
Wound necrosis	0	1
Nerve injury	1(persistent)	1(transient)
Ankle stiffness	0	2



Figure 2: Deep infection



Figure 3: Superficial infection

4. Discussion

Achilles tendon rupture incidence is increasing and is attributed to increasing recreational sport activities [23],[24]. More than 75% cases are related to sport and athletic activities [23],[25]. In our cohort though sport activity (38.50%) is the most common mode of injury and occupational injuries (30%) have a significant percentage. This is probably because of our cohort has predominantly farmers and occupations involving heavy labour. Male to female ratios vary in the literature, ranging from 5:1 to 30:1 [26],[27]. Incidence is more in males in our study group with hardly a few cases of female patients operated. We have 1 in 26. Mean age of the cohort is 44.

Operative versus non operative management is still largely at debate. Despite the recent studies showing non operative treatment as optimal with a little increased re-rupture rates many surgeons prefer surgical management. Most of the trials published before 2005 suggested better outcome after surgery due to a higher rate of re-rupture in the nonsurgical group [27]-[28]. Surgical treatment was the treatment of choice in Danish, Norwegian, and Swedish hospitals regardless of the increasing evidence favouring non operative treatment [29]. Tendon re-rupture remains a significant source of concern with non operative management [30]. Open operative treatment is commonly used in young, percutaneous technique for middle aged and those who refuse open repairs and non surgical treatment in elderly patients [4]-[7],[31]. This is probably because most injuries occur in athletic young persons who would prefer to avoid re-rupture and return to sports after treatment. Most of our patients are from low socioeconomic status and are heavy labourers. Decreased re-rupture rate has motivated most of our patients to undergo surgical repair.

Different varieties of evaluation of treatment response are available; clinical, patient satisfaction report and patient outcome scores. Nillson- Healand et al [32] developed the patient reported ATRS in 2007 and validated the test. Before the ATRS, foot and ankle outcome score (AFAOS) was the only validated score commonly used. According to patients and physicians this questionnaire was concise and easy to understand. 10 point difference was considered significant and clinically relevant. Clinical assessment of range of motion of ankle, heel rise test and gait analysis are also used in addition to assess the outcome. In our study, we have used ATRS and ankle ROM to assess the outcome of surgery. The mean ATRS of the cohort at admission was 13.66 and ATRS in percutaneous group at 3 months was 40, while that in open group was 31.2. This difference is probably because of longer immobilization in cast in the open repair group. The progress of ATRS at 6 months, 9 months and at end of 1 year did not have a significant difference between the open and percutaneous groups (mean ATRS difference was less than 10 at all the time periods).

Ankle range of movement was restricted more in open group than percutaneous group. However, the difference did not have any effect on the ATRS. Eric J Strauss et al [31] reported

similar outcome is his series of 83 patients with moderate ankle ROM restriction and 96.3% good to excellent Boyden score and AOFAS score.

Complications of Achilles tendon repair surgery are common and influence the final outcome. Most common reported symptoms in the literature are infection, wound necrosis, re-rupture etc. In our series we had total of 8 complications out of 26 (30.6%) surgeries. Three quarters of them (20%) of them are minor which were managed non operatively and 10% (2 in single patient) of them are major which were managed with surgery. Incidence of post operative complications was around 34.1% in the meta-analysis done by Khan et al^[8]. Wound complications of the cohort are 15%. Beskin et al reported 7% wound complications in his cohort of 42 patients^[33]. We did not come across any re-ruptures in our follow up. We also have not seen any clinically significant deep vein thrombosis in our patients.

There are significant limitations in our study. Follow up time period in the study is only one year. This can be considered as a short follow up and so more definite conclusions cannot be drawn. The sample size of the study is also small and limits the possibility to draw definite conclusions.

5. Conclusion

Occupational Achilles tendon ruptures in farmers and heavy labourers' were found to be a common mode of injury which has not been reported in the earlier literature. Percutaneous repair and open repair had good functional outcomes with minimal complications in the percutaneous technique. Potential damage to sural nerve is a concern with percutaneous repair. Wound necrosis and infections are limitations to open repair. We recommend additional research should focus on new minimal invasive techniques performing repairs with sural nerve under vision or ultrasound or endoscopy assisted percutaneous techniques. Increased data is required in the long term functional status and time required to return to previous occupation or sport. A large randomised trial to assess long term functional outcomes and compare novel techniques with the standard techniques to avoid sural nerve injury would be ideal.

References

- [1] Hattrup SJ, Johnson KA. A review of ruptures of the Achilles tendon. *Foot and Ankle* 1985;6(1):34-8.
- [2] Movin T, Ryberg A, McBride DJ et al. Acute rupture of the Achilles tendon. *Foot Ankle Clin* 05;10:331-56.
- [3] Moller A, Astron M, Westlin N. Increasing incidence of Achilles tendon rupture. *Acta Orthop Scand* 1996;67:479-81.
- [4] Bossley CJ. Rupture of the Achilles tendon. *J Bone Joint Surg Am.* 2000; 82:1804.
- [5] Maffulli N. Rupture of the Achilles tendon. *J Bone Joint Surg Am.* 1999; 81:1019-36.
- [6] Martinelli B. Rupture of the Achilles tendon. *J Bone Joint Surg Am.* 2000; 82:1804.
- [7] Khan RJK, Dan Fick, Angus Keogh, John Crawford, Tim Brammar and Martyn Parker Treatment of Acute Achilles Tendon Ruptures. A Meta-Analysis of Randomized, Controlled Trials. *J Bone Joint Surg Am.* 2005;87:2202-2210.
- [8] Khan RJK, Carey Smith RL. Surgical interventions for treating acute Achilles tendon ruptures. *Cochrane Database of Systematic Reviews* 2010, Issue 9. Art. No.: CD003674.
- [9] Inglis AE, Scott WN, Sculco TP et al. Ruptures of the tendo achillis. An objective assessment of surgical and non-surgical treatment. *J Bone Joint Surg Am* 1976;58:990-3.
- [10] Angelo Del Buono, Andrea Volpin, and Nicola Maffulli Minimally invasive versus open surgery for acute Achilles tendon rupture: a systematic review. *British Medical Bulletin* 2013; 1-14.
- [11] Kitaoka HB, Alexander IJ, Adelaar RS, Nunley JA, Myerson MS, Sanders M: Clinical rating systems for the ankle-hindfoot, midfoot, hallux and lesser toes. *Foot Ankle Int* 1994, 15:349-53.
- [12] Merkel M, Neumann HW, Merk H: A new score for comparing outcome of surgical management of Achilles tendon ruptures. *Chirurg* 1996, 67:1141-6.
- [13] Leppilähti J, Forsman K, Puranen J, Orava S: Outcome and prognostic factors of Achilles rupture repair using a new scoring method. *Clin Orthop Relat Res* 1998, 346:152-161.
- [14] Visentini PJ, Khan KM, Cook JL, Kiss ZS, Harcourt PR, Wark JD: The VISA score: an index of severity of symptoms in patients with jumper's knee (patellar tendinosis). *Victorian Institute of Sport Tendon Study Group. J Sci Med Sport* 1998, 1:22-28.
- [15] Nilsson-Helander K, Thomee R, Gravare-Silbernagel K, Thomee P, Faxen E, Eriksson BI, Karlsson J: The Achilles tendon Total Rupture Score (ATRS): development and validation. *American Journal of Sports Medicine* 2007, 35:421-426.
- [16] Ma GWC, Griffith TG. Percutaneous repair of acute closed ruptured Achilles tendon: a new technique. *Clin Orthop* 1977;128:247-55
- [17] Delponte P, Potier L, de poulpique P, Buisson P: Treatment of subcutaneous ruptures of the Achilles tendon by percutaneous tenorrhaphy. *Rev Chir Orthop Reparatrice Appar Mot* 1992, 78:404-7.
- [18] Webb JM, Bannister GC: Percutaneous repair of the ruptured tendo Achilles. *J Bone Joint Surg Br* 1999, 81:877-880.
- [19] Maffulli N, Longo UG, Ronga M, Khanna A, Denaro V: Favourable outcome of percutaneous repair of Achilles tendon ruptures in the elderly. *Clin Orthop Relat Res* 2010, 468:1039-1046.
- [20] Rippstein PF, Jung M, Assal M: Surgical repair of acute Achilles tendon rupture using a mini-open technique. *Foot Ankle Clin* 2002, 7:611-619.
- [21] Silbernagel KG, Thomee R, Karlsson J. Cross-cultural adaptation of the VISA-A questionnaire: an index of clinical severity for patients with Achilles tendinopathy, with reliability, validity and structure evaluations. *BMC Musculoskelet Disord.* 2005;6:12-18.
- [22] Suk M, Hanson B, Norvell D, Helfet D. *AO Handbook, Musculoskeletal Outcomes Measures and Instruments.* Stuttgart: Thieme; 2005.

- [23] Leppilahti J, Puranen J, Orava S. Incidence of Achilles tendon rupture. *Acta Orthop Scand.* 1996;67(3):277-9.
- [24] Houshian S, Tscherning T, Riegels-Nielsen P. The epidemiology of Achilles tendon rupture in a Danish county. *Injury.* 1998;29(9):651-4.
- [25] Jozsa L, Kvist M, Balint BJ, et al. The role of recreational sport activity in Achilles tendon rupture. A clinical, pathoanatomical, and sociological study of 292 cases. *Am J Sports Med* 1989;17:338—43.
- [26] Kellam JF, Hunter GA, McElwain JP. Review of the operative treatment of Achilles tendon rupture. *Clin Orthop Relat Res* 1985;201:80—3.
- [27] Cetti R, Christensen SE, Ejsted R, et al. Operative versus nonoperative treatment of Achilles tendon rupture. A prospective randomized study and review of the literature. *Am J Sports Med* 1993;21:791-99.
- [28] Moller M, Movin T, Granhed H, Lind K, Faxen E, Karlsson J. Acute rupture of tendo Achillis. A prospective, randomized study of comparison between surgical and non-surgical treatment. *J bone Jt Surg.* 2001(August);83.
- [29] Barfod KW, Nielsen F, Helander KN, Mattila VM, Tingby O, Boesen A, Troelsen A. Treatment of acute Achilles tendon rupture in Scandinavia does not adhere to evidence based guidelines. A cross-sectional questionnaire-based study of 138 departments. *American Journal of Foot and Ankle Surgery.* 2013;52(5):629–633.
- [30] Ingvar J, Tagil M, Eneroth M. Nonoperative treatment of Achilles tendon rupture: 196 consecutive patients with a 7% re-rupture rate. *Acta Orthop* 2005;76:597—601.
- [31] Eric J. Strauss et al., Operative treatment of acute Achilles tendon ruptures: An institutional review of clinical outcomes, *Injury, Int. J. Care Injured* (2006), doi:10.1016/j.injury.2006.06.005.
- [32] Katarina Nilsson-Helander,* MD, Roland Thomeé, PT, PhD, Karin Grävare-Silbernagel, PT, Pia Thomeé, PT, Eva Faxén, PT, Bengt I. Eriksson, MD, PhD, and Jon Karlsson, MD, PhD. The Achilles Tendon Total Rupture Score (ATRS). Development and Validation The American Journal of Sports Medicine, Vol. 35, No. 3.
- [33] Beskin JL, Sanders RA, Hunter SC, Hughston JC. Surgical repair of Achilles tendon ruptures. *Am J Sports Med* 1987;15:1—8.

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