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Operative treatment of acute Achilles tendon ruptures: An institutional review of clinical outcomes

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Summary

Purpose: To retrospectively review the clinical outcome and incidence of post-operative complications after open end-to-end repair of acute Achilles tendon ruptures.
Methods: Seventy consecutive patients (74 open Achilles tendon repairs) operated on between 1989 and 2002 were identified for inclusion in this investigation. The medical records were reviewed and patients were contacted for a follow up interview in order to survey their post-operative function. Outcome scores were calculated based on the Boyden outcome and AOFAS ankle—hindfoot scoring systems.

Post-operative complications were documented during the chart review and follow up interview, including an additional nine patients (nine repairs), who were not included in the clinical evaluation portion of the study.
Results: Fifty-two patients (54 repairs) were successfully contacted and completed the follow up interview. Within this cohort there were 44 males and 8 females with a mean age of 41 years. Achilles tendon rupture in this population was attributable to participation in athletic activity in 87% of cases. At a mean post-operative follow up of 45 months, 96% of cases achieved an overall Boyden outcome score of good to excellent. The mean AOFAS ankle—hindfoot score was 96, with 74% of cases scoring greater than 90. Forty-two cases (78%) reported no pain and 40 cases (74%) reported no activity limitations.

Fourteen post-operative complications were identified after 83 open Achilles tendon repairs, resulting in an institutional complication rate of 16.8%. The complications

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included four superficial wound infections, five deep wound infections requiring irrigation and debridement, one heel ulcer secondary to post-operative boot wear, three partial Achilles tendon re-ruptures, and one complete Achilles tendon re-rupture. *Conclusion:* Our results demonstrate that open end-to-end repair of acute Achilles tendon ruptures provides long-term functional outcomes with consistent good to excellent results. However, this high clinical success rate was associated with a relatively high incidence of post-operative complications. With careful attention to the surgical wound and patient adherence to post-operative rehabilitation protocols, operative repair of acute Achilles tendon ruptures is a reliable treatment for active patients.

Introduction

Rupture of the Achilles tendon is a relatively common injury, with a reported incidence of 18 per 100,000 people.[2,23] These injuries typically occur in males between the ages of 30 and 50 years, and account for approximately 40% of all operative tendon repairs.[7,13,17] Approximately 75–80% of cases can be attributed to participation in athletic activities, including ball and racquet sports.[4,7,10,16,23] The appropriate management of acute Achilles tendon rupture continues to be a controversial issue in the orthopaedic literature, with proponents for both non-operative and operative treatments.

Non-operative management of acute Achilles tendon ruptures involves either cast immobilisation for 6–8 weeks or functional bracing. Clinical evaluations of conservative treatment have demonstrated a re-rupture rate of 10–30%, which is considerably higher than that reported after operative intervention. Additionally, patients treated with immobilisation often exhibit decreased plantar flexion strength and endurance compared to those repaired surgically. However, several reports in the literature have suggested that the results of non-operative treatment are equivalent to those of operative repair.[5,7,9,11,21,26,27,31]

Recent reports have favoured operative treatment of acute rupture of the Achilles tendon in physically active patients, using either open or percutaneous techniques.[4,22,25,29,30] Operative repair appears to provide superior functional results and a lower rate of re-rupture compared to conservative management, however it is associated with an increased incidence of post-operative complications.[8] Complications have been reported to occur in 7–42% of cases and have included difficulty with wound healing, skin necrosis, infection, re-rupture and sensory loss.[7,20,27,32]

The present study was undertaken to evaluate the long-term clinical outcome and post-operative complication rate associated with the operative repair of acute Achilles tendon ruptures at our institution.

Materials and methods

Patient profile

The study population consisted of all patients who underwent operative Achilles tendon repair at our institution from 1989 to 2002. Of the 90 patients identified by CPT coding, the medical records were incomplete for 11 patients and the follow up was inadequate for nine patients leading to their exclusion from the study. The medical records of the remaining 70 consecutive patients (74 repairs) were reviewed to confirm that the inclusion criteria for this study were met. These inclusion criteria included patients 18 years of age or older, closed Achilles tendon rupture, complete tendon rupture, and no previous Achilles tendon injury. Each chart was reviewed for demographic information, mechanism of injury and clinical presentation.

Operative technique and post-operative care

All patients underwent open surgical repair of the Achilles tendon in the prone position under general or spinal anaesthesia, with the use of a pneumatic tourniquet. A longitudinal incision was made 1 cm medial to the Achilles tendon, preserving the lesser saphenous vein and the sural nerve. Dissection was carried directly down to the Achilles paratenon, and a full thickness flap was created by dissecting between the Achilles tendon and the paratenon. The tendon rupture was identified and the edges minimally debrided. Repair of the tendon was achieved using either the Bunnell or modified Kessler method with number five non-absorbable suture and a running epitendinous absorbable 2.0 suture. Careful repair of the paratenon was performed in all cases. The procedure was finished with closure of the subcutaneous tissue and skin and application of a plaster cast in approximately 20° of plantarflexion.

At post-operative days 5–7, the plaster cast was removed and the patients' wound examined. Pro-

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vided the wound was healing well, patients were converted to an orthotic boot/CAM walker with heel lifts. Heel wedges were gradually removed over the next 3—4 weeks to achieve neutral ankle position while the patient progressed with weightbearing. Patients were instructed to perform isometric contractions of the gastrocnemius—soleus complex early in the rehabilitative process. Physical therapy focused on stretching and strengthening exercises was continued, with light jogging permitted at 3—4 months. Full return to running and jumping sports was permitted between 4 and 6 months after surgery, if adequate strength gains had been made.

Clinical outcome measurement

Clinical outcome after operative Achilles tendon repair was assessed using two separate outcome measures: the Boyden clinical outcome score[3] and the ankle—hindfoot scale developed by the American Orthopaedic Foot and Ankle Society.[19]

The Boyden score grades clinical factors such as pain, appearance, footwear restrictions, and patient satisfaction. A patient with an excellent result has no pain, no limitations in recreational or daily activities, no footwear restrictions, and is satisfied with the treatment outcome. A patient with a good result has mild occasional pain, limitation of recreational but not daily activities, no footwear restrictions and is satisfied with minor reservations. A patient with a fair result has mild to moderate pain, limitation of recreational and daily activities, moderate footwear restrictions and is satisfied, but with major reservations. A patient with a poor result has moderate to severe pain, limitation of recreational and daily activities, severe footwear restrictions and is dissatisfied or had an Achilles tendon re-rupture.

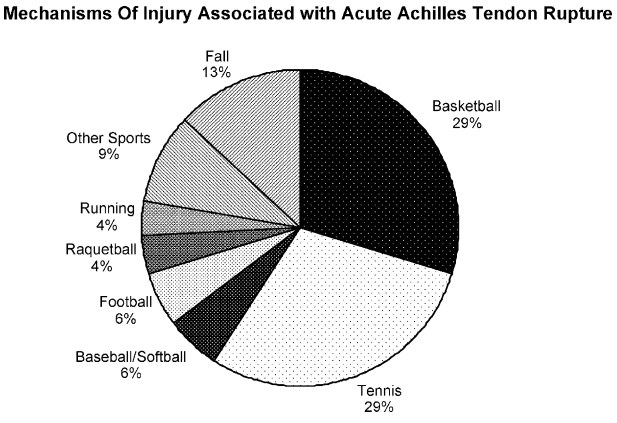

Figure 1 Mechanisms of injury associated with acute Achilles tendon rupture in the 54 cases comprising the functional outcome cohort.

The AOFAS ankle—hindfoot scale assigns 50 points to function, 40 points to pain, and 10 points to alignment. A perfect score of 100 points indicates that the patient has no pain, a full range of ankle and hindfoot motion, no ankle instability, good alignment, the ability to walk more than six blocks on any walking surface, no limp, no limitation of either occupational or recreational activities, and no need of any assistive devices for walking.

Study patients were contacted via telephone to complete a structured survey assessing each component of the outcome scoring systems. Based on their responses, a post-operative Boyden outcome score and an AOFAS ankle—hindfoot score were calculated for each patient.

Complication rate

Post-operative complications were documented for each patient based on the review of the medical record and the telephone interview. Included in this assessment are the complications drawn from chart review of the 18 patients who were not able to be contacted via telephone for the follow up survey and the nine patients who underwent Achilles tendon surgery at our institution, but had inadequate follow up for inclusion in the clinical outcome assessment portion of our study (79 patients, 83 operative repairs). The total number of post-operative complications was used to determine an institutional complication rate after operative Achilles tendon repair based on 83 operative procedures.

Results

Fifty-two patients (54 repairs) were successfully contacted and completed the follow-up telephone survey (response rate of 74%). Within this cohort, there were 44 males and 8 females with a mean age of 41 years (range 22—64 years). Injuries occurred during participation in athletic activities in 47 cases (87%) and non-sport related activities in seven cases (13%). Basketball and tennis were the most common activities associated with Achilles tendon rupture, with 16 cases attributable to each sport (Fig. 1).

At a mean follow up of 45 months (range 10—165 months), 52 of 54 cases (96%) achieved an overall Boyden outcome score of good to excellent (Table 1). Forty patients (76%) reported no pain associated with the Achilles tendon repair, while 12 patients (24%) reported mild or occasional pain. None of the patients reported moderate or severe pain at the operative site. Thirty-seven patients (71%) reported no limitation in their activities, with full return to their previous level of function. Eight

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Table 1 Functional outcome following open Achilles tendon repair

Outcome	Number of patients (%)
Boyden score good to excellent	52 (96.3)
Boyden score fair to poor	2 (3.7)
AOFAS score >90	40 (74.1)
AOFAS score 80–90	13 (24.1)
AOFAS score <80	1 (1.8)
No pain	42 (77.8)
Mild pain	12 (22.2)
No activity limitation	40 (74.1)
Limitations with recreational activities	13 (24.1)
Limitations with daily activities	1 (1.8)
No difficulty with ambulation	53 (98.2)
Difficulty with ambulation	1 (1.8)

patients (15%) reported no limitations in their activities of daily living, but described limitations in their recreational activity and inability to resume their previous level of function. Forty-nine patients (94%) reported no footwear restrictions and were able to tolerate any type of shoe wear, while three patients (6%) described moderate shoe wear restrictions with the inability to tolerate fashionable shoes with or without an insert. None of the patients reported severe footwear restrictions or the need for modified shoe wear. Overall, 85% of patients were satisfied with their final functional outcome and would undergo the procedure again, if necessary. Six patients (12%) reported minor reservations with the final functional outcome due to either stiffness of the Achilles tendon or due to the cosmesis associated with a thickened Achilles tendon or scarring at the operative site.

The mean AOFAS ankle–hindfoot score of this patient cohort was 96.04 (range 78–100) (Table 1). Forty repairs (74%) scored between 90 and 100, of which 37 had scores greater than 95. Thirteen repairs (24%) scored between 80 and 90 and one case resulted in an AOFAS score of less than 80. This patient reported mild pain with limitations in both daily and recreational activities, difficulty with uneven surfaces, and moderate restriction in ankle range of motion.

Fourteen post-operative complications occurred after operative repair in 83 cases, for an institutional complication rate of 16.8% (Table 2). Superficial wound infections occurred in four cases, which were successfully managed with an oral antibiotic regimen with no long-term sequelae. Five deep infections were seen in the early post-operative period, three of which were associated with wound dehiscence. All three cases necessitated a return to the operating room for irrigation and debridement, along with intravenous antibiotic coverage. None of these patients required graft coverage and all went on to heal uneventfully. One patient developed a superficial heel ulcer due to post-operative boot wear, which healed uneventfully after treatment with wet to dry dressings.

Partial Achilles tendon re-rupture occurred in three patients (3.6%). Two of these patients reported stepping awkwardly while out of their post-operative brace, while one patient sustained a re-rupture after being non-compliant with post-operative brace wear and returned to athletic activity prematurely. Partial re-ruptures were diagnosed by clinical examination and an MRI. All three patients were treated non-operatively in a short leg cast in equinus for 4–6 weeks at which time they were converted to a functional brace and resumed the standard rehabilitation protocol. One patient sustained a complete Achilles tendon re-rupture,

Table 2 Post-operative complications which occurred after operative repair in 83 cases

Post-operative complication	Number of patients (%)	Management	Long-term outcome
Superficial wound infection	4 (4.8)	Oral antibiotic regimen	Infection cleared, no long-term sequelae
Deep infection	5 (6), three cases with wound dehiscence	Intravenous antibiotics, operative debridement	Infection cleared in all cases, wounds healed uneventfully, no long-term sequelae
Heel ulcer	1 (1.2)	Wet-to-dry dressing changes	Ulcer healed completely within 8 days, no long-term sequelae
Partial Achilles re-rupture	3 (3.6)	Short leg cast in equinus for 4–6 weeks then converted to a functional brace	No long-term disability
Complete Achilles re-rupture	1 (1.2)	Operative repair with grafting	No complaints, no reported long-term disability

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which was diagnosed by clinical examination and confirmed by MRI, requiring re-operation with grafting. Re-rupture of the Achilles tendon was not associated with any of the other reported complications.

Discussion

Rupture of the Achilles tendon is a common injury among high-level athletes, recreational athletes, and sedentary individuals, with an estimated incidence of approximately 18 per 100,000 individuals.[23] More than 75% of Achilles tendon ruptures occur in association with ball, racquet, or other athletic activities.[4,7,16,22] Male to female ratios vary in the literature, ranging from 5:1 to 30:1.[1,7,17] The present study cohort demonstrated a mean age of 41 years and a male to female ratio of 5.75:1. Similar to other reports, 83% of our patients were involved in an athletic activity at the time of injury, with more than half of the Achilles tendon tears being attributable to participation in basketball or tennis.

Intrinsic and extrinsic mechanisms to explain Achilles tendon rupture suggest a combination of pathologic tendon alteration combined with acceleration/deceleration forces resulting in injury. Soldatis et al., suggest that greater than 90% of sports related Achilles tendon ruptures occur secondary to eccentric loading during acceleration/deceleration activities.[29] Inglis and Sculco have theorised that a malfunction of the normal proprioceptive component of skeletal muscle may predispose athletes to rupture of the Achilles tendon.[14] It has been hypothesised that recreational athletes may lack the normal inhibitory neuromuscular pathways which serve to protect the musculotendinous unit. Particularly susceptible are athletes who begin training without adequate warm-up or resume training after a period of rest. In our patient population, more than 80% of Achilles tendon ruptures occurred during participation in an athletic event, with approximately 50% of patients reporting injury early after the onset of activity.

Operative versus non-operative management of acute Achilles tendon ruptures continues to be a subject of debate within the orthopaedic literature. Comparison studies have been difficult to evaluate secondary to a lack of universally accepted outcome measures, variation in operative techniques, and a diversity of rehabilitation protocols. A number of clinical investigations have demonstrated results of non-operative treatment that were similar to those of surgical repair.[5,7,11,27] Recent reports evaluating non-operative management with functional bracing have also shown good results.[6,26]

It is evident from these studies that the major factor motivating surgeons toward conservative management is the risk of wound complications that occur with an operative repair. Contrasted with these risks are the reports of higher re-rupture rates and decreased push off strength in patients treated conservatively. In a retrospective review of 20 patients treated non-operatively, Persson and Wredmark reported that seven patients had repeat Achilles tendon rupture leading to dissatisfaction with their final treatment result.[28] Lower rates of re-rupture (7%) were reported by Ingvar et al., in their evaluation of 196 cases of acute Achilles tendon ruptures treated conservatively, however tendon re-rupture remains a significant source of concern with non-operative management.[15]

An increasingly athletic patient population and improvements in surgical technique have favoured operative intervention in recent clinical studies. Operative repair has been shown to restore tendon length, lower the re-rupture rate and result in better functional outcomes.[4,7,14] In a prospective randomised evaluation of 111 patients with acute Achilles tendon rupture comparing operative and non-operative treatment methods, Cetti et al. reported that the patients treated operatively had a significantly higher rate of resuming athletic activities at their pre-injury level, a lesser degree of calf atrophy, better ankle range of motion, and fewer complaints 1 year after the tendon rupture.[7] Inglis et al., in a comparison of the results of 48 operative Achilles tendon repairs with 31 cases managed non-operatively, reported that the objective measures of functional outcome including strength, power, and endurance were significantly less in the conservatively managed group compared to patients treated with operative repair.[14]

Lo et al., reviewed the literature on the treatment of Achilles tendon rupture and identified 742 operative cases and 248 cases managed conservatively.[24] The overall rate of re-rupture was 3% for those managed operatively and 12% for those managed non-operatively. While the rate of re-rupture in the operative group was lower, the rate of minor and moderate complications associated with operative treatment was up to twenty times greater in some reports. A similar literature review by Cetti et al., identified 4597 cases of acute Achilles tendon rupture.[7] The mean rate of tendon re-rupture in 4083 cases treated operatively was 1.4% (range, 0–7.1%) compared to a mean rate of 13.4% (range 3.9–50%) amongst cases managed non-operatively. In a recent meta-analysis including 12 trials involving 800 patients, Khan et al. demonstrated that although open operative treatment of acute Achilles

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tendon ruptures significantly reduced the risk of re-rupture compared with non-operative treatment, there was a significantly higher risk of post-operative complications with surgical intervention.[18] Similar findings were also shown by Wong et al., in a meta-analysis including 125 peer reviewed articles on operative and conservative management of acute Achilles tendon ruptures.[32]

Surgical complications following open Achilles tendon repair have been commonly reported in the literature and include difficulty with wound healing, the development of wound necrosis, and infection. Such complications may be secondary to the longitudinal incision commonly used for the surgical approach, which traverses an area of poor vascularity.[12] Beskin et al., in an evaluation of the surgical results of 42 patients managed with various operative techniques, demonstrated a 7% incidence of wound complications.[1] The incidence of post-operative complications in the meta-analyses of Khan et al. and Wong et al., were higher with pooled rates of 34.1% and 14.6%, respectively.[18,32] In our series, the overall complication rate was 16.8%, which falls in the range of these reported studies. The majority of complications in our series were related to the surgical wound. One patient in our series (1.2%) sustained a complete re-rupture and three patients had partial Achilles tendon re-ruptures (3.6%), incidence rates which also fall within the ranges of other clinical series.

Limitations to the current study include the potential bias associated with the response rate to our telephone survey. It is possible that the patients who were not reachable were very satisfied with their results and had good functional outcomes, however it is also possible that those refusing to participate may reflect a population of dissatisfied patients who, due to less than ideal results, were unwilling to involve themselves in the investigation. Another limitation is the lack of objective measurements such as strength, endurance, and calf circumference. This limitation is currently being addressed and will be the focus of future studies.

Summary

Our study demonstrated that end-to-end surgical repair of acute Achilles tendon ruptures provides long-term functional outcomes with consistent good to excellent results as demonstrated by both the Boyden and AOFAS ankle–hindfoot scores. However, this high clinical success rate was associated with a relatively high incidence of post-operative complications. With careful attention to the surgical wound and patient adherence to post-operative rehabilitation protocols, operative repair of acute Achilles tendon ruptures is a reliable treatment method for active patients.

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