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A Comparison of Wound Complications With Surgical Treatment of Achilles Tendon Conditions Using 2 Surgical Approaches

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Abstract

Background: Wound complications are a concern with the open treatment of Achilles tendon conditions. The location of the incision may impact the risk of wound complications because of its relationship to the blood supply to the skin. There is no consensus as to the safest incision location. The purpose of this study was to evaluate and compare the rates of sural nerve injury and wound complications including superficial or deep infections and wound dehiscence between posterior midline and posteromedial surgical incision locations.

Methods: 125 patients with Achilles tendon rupture or Achilles tendinopathy were treated with open surgery through a longitudinal posterior midline or posteromedial incision. An L-shaped incision was used in the posteromedial group for cases of insertional repair. Postoperative complications including sural nerve injuries, superficial wound complications, superficial infections, deep wound infections, return to the operating room, and need for soft tissue coverage were recorded and rates were compared between the groups.

Results: No significant differences were detected between the posteromedial and posterior incision groups in rates of sural nerve injuries, superficial infection, or deep wound infection. The posterior incision group had significantly fewer wound complications. The wound complications in the posteromedial group primarily occurred when an L-shaped incision was used for insertional repair. No patients in either group required debridement or soft tissue/flap coverage.

Conclusion: The posterior incision location had significantly fewer wound complications. The use of an L-shaped incision was likely responsible for the wound complications in this group rather than the location of the incision. The use of a medial incision was not found to decrease the rate of sural nerve injury.

Level of Evidence: Level III.

Keywords: Achilles tendon, surgical approach, complication

Introduction

Open surgery for the treatment of Achilles tendon rupture and Achilles tendinopathy has a wound complication rate of 8% to 9.7%.[11,15] The location of the surgical incision may be a factor in the development of wound problems as the Achilles tendon is contained within a peritenon and the fascia of the superficial posterior compartment and is covered only by a thin layer of skin and subcutaneous tissue.[16] Planned incisions must provide adequate exposure, there must be adequate blood supply on both sides of the incision to allow healing, and an incision should spare any sensory or motor nerves. There is a debate in the literature on whether the safest incision for an Achilles tendon repair is directly midline between the 2 angiosomes of the posterior leg or slightly off the midline medially to avoid the vascular

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watershed area.[1,4,16] The posterior midline of the integument of the lower leg is a vascular watershed area based on the angiosomes supplied posteromedially by the posterior tibial vessels and posterolaterally by the peroneal vessels.[1,4,13,16] A cadaveric study using whole-body arterial perfusion and angiography investigated the vascular supply of the skin and subcutaneous tissues covering the Achilles tendon and found that a longitudinal hypovascular area was located consistently over the posterior cutaneous midline covering the Achilles tendon and that the medial and lateral areas adjacent to the tendon had denser patterns of vascularity.[16] Thus, it was recommended that skin incisions be placed 1 cm medial to the Achilles tendon and to incise the peritenon without dissecting it from the subcutaneous fat overlying the tendon to avoid more wound complications that could potentially be seen through a direct midline incision where there is less vascular density.[16] However, others have recommended that the safest incision to make is along the border between 2 adjacent angiosomes as each side of the incision has maximal blood flow and thus recommended incisions be made along the central raphe over the Achilles tendon in between the peroneal and posterior tibial angiosomes.[1]

Moreover, wound healing concerns may impact the risk-benefit analysis between operative and nonoperative management of acute Achilles tendon tears.

The sural nerve is a significant cutaneous nerve of the lower extremity that supplies sensation to the lateral region of the hindfoot and midfoot. It is located an average of 1.94 cm lateral to the lateral border of the Achilles tendon at the superior aspect of the calcaneal tuberosity and does not cross the lateral border of the Achilles tendon until 8 to 10 cm proximal to the superior aspect of the calcaneal tuberosity before penetrating the crural fascia in the posterior leg.[3] Damage to the nerve during surgery can cause sensory disturbances, severe neuropathic pain, or complete numbness in the lateral hindfoot and midfoot. Given its lateral location in the lower leg, it is thought that a posteromedial incision may pose less risk to the nerve than a posterior or posterolateral incision.

The purpose of this study was to compare the rates of sural nerve injury and wound complications between posterior midline and posteromedial surgical incisions. We hypothesized that incision location would not significantly impact the rates of sural nerve injury or postoperative wound complications.

Materials and Methods

This study was approved by the Institutional Review Board at our institution prior to initiation. Between 2004 and 2015, 165 cases of Achilles tendon ruptures or chronic tendinopathy disorders treated operatively by 1 of 2 foot and ankle fellowship trained orthopedic surgeons at a single center were identified using Current Procedural Terminology (CPT) codes of 27650, 27652, and 27654. All clinic notes and operative reports were reviewed. Patients with a clinically documented acute Achilles tendon tear, calcific tendonitis, insertional tendonitis, and partial tears from chronic tendonitis who underwent open Achilles operative repair were included. Patients with diabetes mellitus with or without peripheral neuropathy, smokers, and those augmented at the time of surgery with plantaris or flexor hallucis longus tendons were not excluded. Patients that had revision procedures on their Achilles tendon, open injuries, or a percutaneous repair were excluded.

To obtain adequate power with an alpha of 0.05 and a beta of 0.80, 39 patients per group were needed to detect a difference in infection rates seen between open and percutaneous repair of 19.6%.[7] When comparing open to percutaneous repair in the literature, total wound complication rates (other than infection) specifically have not been evaluated and thus could not be used to estimate our sample sizes.[7] Differences among group means were evaluated with analysis of variance with post hoc testing using Bonferroni-Holm with significance set at $P < .05$. Differences in proportions between groups were evaluated using Fisher exact tests with significance set at $P < .05$.

Open Achilles repair was performed either through a longitudinal posterior midline incision centered between the medial and lateral borders of the Achilles tendon or a longitudinal posteromedial incision made 5 to 10 mm from the medial border of the Achilles tendon. In cases of insertional tendon disorders, a posteromedial L-shaped incision was used with a transverse limb across the posterior aspect of the heel pad at the level of the calcaneal tuberosity. Each surgeon used only 1 incision location in their operative cases throughout the study period. Surgery was performed in the prone position under general anesthesia with a thigh tourniquet. Sharp dissection was carried through the skin and subcutaneous tissue, with blunt dissection used proximally to identify and protect the sural nerve. The fascia of the superficial posterior compartment was sharply opened over the tendon, but no dissection was performed to separate it from the subcutaneous fat. Soft tissue handling principles were similar between the 2 surgeons as retraction of the skin and soft tissues was avoided during the case to minimize trauma to the skin edges. For insertional tendinopathy cases, the degenerative tendon was sharply debrided with a scalpel blade both longitudinally and off the calcaneal tuberosity before any prominent exostosis on the tuberosity was removed with a micro sagittal saw and power rasp. The tendon was then reattached to the tuberosity either via trans osseous repair using No. 1 Ethibond suture (Ethicon, Somerville, NJ) or with 3.5-mm suture anchors in the calcaneus utilizing No. 1 Ethibond (Ethicon). The longitudinal tenotomy was repaired with Vicryl (Ethicon) suture.

Acute Achilles tendon ruptures were repaired in the following fashion: the proximal and distal stumps of the ruptured tendon were debrided, and then Krackow or Kessler suture repair with No. 1 Ethibond (Ethicon) were placed in both ends of the tendon so that 4 sutures crossed the repair. These were tied with the ankle held in full plantarflexion and oversewn with Vicryl (Ethicon) suture. In both tendinopathy and tendon rupture cases, the peritenon was closed using a

Table 1. Patient Demographics.

	Longitudinal Posteromedial	L-Shaped Posteromedial	Posteromedial (Combined)	Posterior	*P* Value
Number of patients	17	34	51	74	n/a
Tendinopathy	0	34	34	36	n/a
Tendon rupture	17	0	17	38	n/a
Follow-up, mo					
Mean ± SD	5.1 ± 3.7	18.1 ± 25.2	13.8 ± 21.4	7.9 ± 9.7	**.01**
Range (min-max)	1-15	2-98	1-98	2-68	
1-3	5	8	13	13	
4-6	10	10	20	34	
7-9	0	4	4	13	
10-12	1	1	2	6	
>12	1	11	12	8	
Sex, female, n (%)	6 (35)	22 (65)	28 (55)	39 (53)	.27
Age, y, mean ± SD			52.4 ± 13.5	46.6 ± 14.4	
Tendinopathy		56.7 ± 8.8		50.7 ± 13.1	
Tendon rupture	44.1 ± 16.8			42.6 ± 14.6	**<.01**
Smokers, n (%)			5 (9.8)	5 (6.8)	
Tendinopathy		1 (3)		1 (2.7)	.10
Tendon rupture	4 (23.5)			4 (10.5)	
Diabetes, n (%)			5 (9.8)	7 (9.5)	
Tendinopathy		5 (14.7)		5 (13.9)	.46
Tendon rupture	0 (0)			2 (5.3)	

Abbreviations: SD, standard deviation.

running Monocryl (Ethicon) suture followed by subcutaneous tissue closure and skin closure in separate layers. A short leg nonweightbearing cast or splint was applied at the end of the case with the ankle in full plantarflexion.

Patients in both groups were kept nonweightbearing in a cast or splint for the first 2 weeks after surgery. Additional casting was performed for 1 to 4 weeks (for a total of 3-6 weeks of immobilization). Postoperative treatment in both groups evolved to shorter immobilization periods as evidence emerged supporting early functional rehabilitation. Patients were then allowed to weight-bear as tolerated in a tall nonarticulated walker boot with heel lifts in the boot. The patients were weaned out of heel lifts over the course of 2 weeks. Most patients remained in a boot for 4 to 6 weeks, and physical therapy was started at that time with range of motion, stretching, and nonimpact strengthening exercises. At 8 to 12 weeks, patients were weaned out of the walker boot, and from 12 to 16 weeks, activity was increased to the point where running and jumping were allowed after 16 weeks postoperatively.

A total of 125 patients were identified for this study. Fifty-one patients (34 in the tendinopathy group and 17 in the tendon rupture group) received the posteromedial approach and 74 patients (36 in the tendinopathy group and 38 in the tendon rupture group) received the direct posterior approach. Average age for all patients was 49.0 ± 14.2 years. In addition, 9.8% of the posteromedial group were smokers compared to 6.8% of the posterior group, with 80% of the smokers in the posteromedial group having acute midsubstance ruptures treated with a longitudinal posteromedial incision. Furthermore, 9.8% of the posteromedial group had diabetes mellitus compared to 9.5% of the posterior group, with all the diabetic patients in the posteromedial group having chronic insertional tendonitis treated with a L-shaped posteromedial incision. Post hoc analysis of variance indicated that the posterior group at 46.6 ± 14.4 years of age and the longitudinal posteromedial group at 44.1 ± 16.8 years of age were significantly younger compared to 56.7 ± 8.8 years of age for the L-shaped posteromedial group. All other baseline patient demographics were similar between groups (Table 1). Average follow-up for all patients was 10.3 months (posteromedial 13.8 months vs posterior 7.9 months) (Table 1). Only 1 patient (posteromedial group) had follow-up less than 2 months.

Sural nerve injuries, superficial infections, and wound complications were recorded and analyzed. Three types of wound complications were identified: (1) superficial wound complication as demonstrated by skin necrosis, wound drainage, or wound dehiscence treated with oral antibiotics and/or wound care alone; (2) deep wound infection requiring a return to the operating room for debridement with postoperative antibiotics; and (3) deep wound infection requiring debridement and soft tissue/flap coverage with postoperative antibiotics. Dermatitis related to cast/soap usage was identified as a macular rash that subsequently resolved but was not considered a wound complication. Rates of wound complications were compared between surgical approach groups.

Results

No significant differences were detected between the longitudinal posteromedial, L-shaped posteromedial, posteromedial combined, and posterior incision groups in rates of sural

Table 2. Complication Rates.

Complications	Longitudinal Posteromedial, n (%)	L-Shaped Posteromedial, n (%)	Posteromedial (Combined), n (%)	Posterior, n (%)	*P* Value
Sural nerve injury	1 (5.9)	1 (2.9)	2 (3.9)	1 (1.4)	.47
Superficial infection	0 (0)	2 (5.9)	2 (3.9)	2 (2.7)	.82
Dermatitis related to cast/soap	0 (0)	0 (0)	0 (0)	4 (5.4)	.23
Superficial wound complication	0 (0)	6 (17.6)	6 (11.8)	1 (1.4)	<.01
Deep wound infection OR debridement	1 (5.9)	0 (0)	1 (2.0)	1 (1.4)	.42
Deep wound infection OR soft tissue coverage	0 (0)	0 (0)	0 (0)	0 (0)	1
Total wound complications	1 (5.9)	6 (17.6)	7 (13.7)	2 (2.7)	.03

Abbreviation: OR, operating room.

nerve injuries ($P = .47$), superficial infection ($P = .82$), dermatitis ($P = .23$), or deep wound infections requiring operative debridement alone ($P = .42$) or debridement and soft tissue coverage ($P = 1.0$) (Table 2). The direct posterior group did have significantly less superficial wound complications ($P < .01$) and total number of wound complications ($P = .03$). Furthermore, none of the patients that smoked or that had diabetes mellitus required operative debridement.

In patients treated with a posteromedial incision, there were 2 cases of sural nerve paresthesias (3.9%) that were improving at final follow-up at 6 months postoperation, with 1 case occurring in both the longitudinal and L-shaped posteromedial incisions. There were 2 cases of superficial infection (3.9%) as demonstrated by erythema at the first postoperative visit in the L-shaped posteromedial group. These had completely resolved after 1 week of oral antibiotics. There were 6 cases of superficial wound complications (11.8%) involving skin necrosis, wound drainage, and wound dehiscence as well as 1 case (2.0%) of deep wound infection that required secondary surgery. All 6 cases of superficial wound necrosis or dehiscence occurred at the corner of the L-shaped incision used for insertional tendon disorders and were noted at 6 to 12 weeks after surgery. The superficial wound complications healed with a combination of local debridement in clinic, wet to dry dressings, oral antibiotics, and antiseptic ointments. The single case of deep wound infection that required secondary surgery occurred in a patient treated for an acute Achilles mid substance rupture with a longitudinal posteromedial incision that required additional flexor hallucis longus (FHL) augmentation. This patient that required secondary surgery had recurrent serous drainage and wound dehiscence at 2 and 4 months postoperatively that resolved with oral antibiotics. At 9 months postoperation, the patient experienced a relapse with drainage and a stitch abscess requiring an irrigation and debridement below the fascia with removal of a retained suture. No postoperative antibiotics were given to this patient after the irrigation and debridement. There were no deep wound infections requiring debridement and soft tissue coverage. Overall, the total wound complication rate in the posteromedial group was 13.7% (7 cases), with 17.6% (6 cases) in the L-shaped posteromedial group and 5.9% (1 case) in the longitudinal posteromedial group.

In patients treated with a direct midline posterior incision, there was 1 case of sural nerve paresthesias (1.4%) that had resolved by 2 months postoperatively. There were 2 cases of superficial infection (2.7%) as demonstrated by erythema at early postoperative visits that resolved after 2 weeks of oral antibiotics. There were an additional 4 cases of a macular rash thought to be secondary to dermatitis related to cast or soap usage (5.4%) that resolved with avoidance of the offending agent and/or antihistamine/steroid medications. There was 1 case (1.4%) of superficial wound dehiscence noted at early follow-up treated successfully with oral antibiotics, antiseptic ointments, and dressings. There was 1 case (1.4%) of deep wound infection requiring secondary surgery. This patient required an irrigation and debridement and wound closure 2 months postoperatively after a stitch abscess removal in the clinic and antiseptic ointments, wound cleaning agents, and oral antibiotics failed to resolve the wound. This patient also received a week of oral antibiotics postoperatively. Both of these wound complications occurred in patients with FHL augmentation. There were no cases of deep wound infection requiring debridement and soft tissue coverage. Overall, the total wound complication rate in the posterior group was 2.7% (2 cases).

Discussion

The overall wound complication rate for all patients in this study treated with open Achilles repair was 7.2% (posteromedial 13.7% and posterior 2.7%) which is similar to the 8-9.7% rate reported in 2 studies evaluating acute Achilles tendon ruptures and Achilles tendon overuse injuries.[11,15] Even though meta-analyses have shown that open repair of Achilles tendon ruptures have a significantly lower rerupture rate compared to nonoperative treatment, this comes at the price of higher rates of other complications including deep and superficial wound infections, sural neuritis, and wound dehiscence requiring secondary surgeries.[2,6,7,14] In a study that reviewed the literature, wound complications were compared between posterior and posteromedial incisions used on the posterior leg for a variety of ankle surgeries in addition to

Achilles tendon debridement and repair.[5] They found that the total wound complication rates were similar (7.0% vs 8.3%) between the posterior and posteromedial groups, but the posteromedial group had higher rates (7.4% vs 0%) of skin necrosis.[5] However, no statistical analysis was done on these complication rates. Furthermore, the 2 groups differed in their mean age and gender makeup and there was a variety of tourniquet usage in the surgeries adding possible confounding factors.

The posterior incision group in our study had significantly fewer superficial wound complications and lower wound complication rates, but no difference was found between the groups when comparing the rates of deep wound infections requiring operative debridement. The 6 cases in the posteromedial group that had superficial wound complications occurred at the corner of the L-shaped incision, suggesting that the corner of the incision is a potential cause of wound complications. In this study, the L-shaped incision was only used for insertional tendonitis cases, and a straight posterior midline or a more curvilinear posteromedial incision may have been a safer choice.[16]

No significant differences were detected between the longitudinal posteromedial, L-shaped posteromedial, posteromedial combined, and posterior incision groups in rates of sural nerve injuries. Although there has not been any clinical studies in the literature comparing sural nerve injury rates in different incision locations, it is thought that because of the lateral location of the sural nerve in the posterior lower leg, a posteromedial incision would have less risk of injury to the nerve than a posterior or posterolateral incision. Given that our study did not find a difference in sural nerve injury rates between the posteromedial and direct posterior incision locations and due to the fact there was a trend toward decreased sural nerve injury rates in our study group as a whole compared to historical rates (2.4% vs 8.8%), this would suggest that a more medially based incision location is not as crucial when trying to avoid sural nerve injury.[7,14,15]

A limitation of this study is that the posteromedial group had 30% less patients in their group and were significantly older than those in the direct posterior group. The age difference is likely secondary to the posteromedial group having a higher percentage of patients with chronic tendinopathy. All other baseline demographics were similar, and the average age difference of 52 compared to 47 years of age may not be clinically relevant in this study population. A possible future next step would be to consider a multicenter study evaluating acute midsubstance Achilles ruptures separately from chronic insertional Achilles tendinopathy to help address these limitations. Another limitation was the addition of concomitant procedures that may have introduced a confounding factor in assessing the rates of wound complications as 3 of the 9 total wound complications seen in this study had these additional procedures performed. Moreover, the length of postoperative immobilization was not consistent over the duration of this study, but both groups evolved to shorter immobilization periods secondary to medical evidence that emerged in the literature supporting early functional rehabilitation.[10,12,15] This is a retrospective review that did not have standardized criteria for the surgeon to use when describing wound complications and average follow-up in this study was 10 months with 1 patient having follow-up less than 2 months. Most wound complications are expected to be seen within the first few months postoperatively, so we do not feel that the follow-up in our study is inadequate to assess our primary question. We also did not assess whether the use of general anesthesia or an intraoperative tourniquet could affect our postoperative complication rates. However, no differences were found in complication rates when comparing Achilles tendon repairs performed under general versus local anesthesia.[9] No studies have compared open Achilles tendon repair with and without usage of a tourniquet to evaluate complication rates, but tourniquet usage was not found to have any effect on wound complication rates when treating ankle fractures with open reduction and internal fixation.[8]

The choice of incision location was not random but rather due to individual surgeon preference, thus adding potential performance bias. However, both surgeons are senior foot and ankle fellowship–trained surgeons, thus making it likely that there was not a learning curve effect that could alter the results between the 2 incision locations. In conclusion, we found a lower rate of wound complications in the posterior as compared to the posteromedial incision group. However, the majority of the wound complications in the posteromedial group occurred in patients with an L-shaped incision, suggesting that the corner of the incision rather than the location of the longitudinal incision may have been the cause. Moreover, the use of a posteromedial incision does not appear to reduce the rate of sural nerve injury.

Declaration of Conflicting Interests

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