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Achilles Tendon Rupture Treatment: Operative Versus Nonoperative

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Abstract: Acute Achilles tendon ruptures are common injuries with increasing incidence. Management of acute ruptures is controversial. Early evidence suggested that nonoperative treatment led to a significantly higher rerupture rate; however, operative modalities have also been shown to have a higher risk of wound complications. Advances in therapeutic protocols have normalized the rerupture rate between operative and nonoperative modalities, and many have recommended nonoperative treatment because of the mitigated complication profile. The purpose of this review is to report contemporary management of Achilles tendon ruptures and provide our preferred technique of management.

Level of Evidence: Diagnostic Level IV. See Instructions for Authors for a complete description of levels of evidence.

Key Words: Achilles tendon, rupture, treatment, nonoperative, operative

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HISTORICAL PERSPECTIVE

The Achilles tendon is the largest and strongest tendon in the human body and endures a large amount of strain, particularly in the context of athletic activity. In fact, Achilles tendon ruptures are relatively common injuries with a global incidence in the general population of 5 to 10 ruptures per 10,000 people, with recent data suggesting significantly increasing incidence.^{1–4} Observational data suggests that 24% of competitive athletes will rupture their Achilles tendon during their lifetime, and 18% of athletes younger than 45 will sustain a rupture. Overall, men have a 4 to 5 times increased risk of rupture as compared with women, and middle-aged men have the highest incidence of Achilles tendon ruptures; however, recent studies have suggested a bimodal sex distribution, with men aged 30 to 40 years and women aged 60 to 80 years old having a higher predilection for rupture.^{5,6}

The 3 calf muscles, the medial, lateral gastrocnemius and the soleus, converge to form the “triceps surae” also known as the Achilles tendon. The tendon courses distally, and rotates 90 degrees internally and inserts onto a 2×2 cm area on the posterosuperior portion of the calcaneal tuberosity. The soleus portion of the tendon is medial to that of the gastrocnemius. The blood supply to the proximal portion of the tendon is from the muscle tissue, and the distal tendon receives its blood supply from the calcaneal insertion. The paratenon, consisting of a single layer of cells surrounding the tendon, supplies the remainder of the vascularity. The middle portion of the tendon, located 2 to 6 cm proximal to the insertion site, is a hypovascular zone, and is the most common site of rupture. This zone is also the narrowest in cross-sectional area. The sural nerve crosses the tendon medial to lateral ~10 cm proximal to the insertion, and then courses distally to lie a mean of 18.8 mm lateral to the insertion at the distal portion of the tendon.⁷ The plantaris, which is

absent in ~10% of patients, is often intricately associated with the Achilles tendon complex. This muscle originates from the lateral femoral condyle and passes obliquely between the gastrocnemius and soleus and resides medial to the Achilles tendon and inserts on to the calcaneus.

There has been lot of controversy surrounding the optimal treatment. Traditional management of acute Achilles ruptures has been operative based on early evidence suggesting the nonoperative treatment has led to a higher rerupture rate (12.6%) as compared with those patients treated surgically (3.5%).⁸ Patients treated surgically, however, run the risk of increased surgical complications including namely wound complications, nerve injury, and infections.⁹ One of the first case series suggesting superiority of nonoperative treatment was published in 1981 by Nistor who reported on 105 patients treated operatively and nonoperatively. He suggested that both treatments had a similar frequency of complications, however, nonsurgical treatment had significantly less morbidity.¹⁰ Despite this, many surgeons elect to proceed with operative management because of lower rerupture rate and perceived restoration of the length-tension relationship of the tendon.

There has been an evolution in the management of nonoperative Achilles management. Traditionally, Achilles tendon ruptures treated without surgery were treated in a cast for 6 weeks and then mobilized. In 2010, Willits et al¹¹ performed a multicenter randomized study showing equivalent outcomes between operative and nonoperative treatment in strength, range of motion, and calf circumference when functional rehabilitation was used with the surgical group having a high complication rate. In an effort to decrease the surgical complication rate while benefiting from the decrease in traditional higher rerupture rate of conservative management, minimally invasive techniques have been popularized. Operative modalities, nonoperative modalities, and our preferred technique for acute Achilles tendon repair will be discussed in the following section.

INDICATIONS AND CONTRAINDICATIONS

The best management for acute Achilles tendon ruptures is subject to persistent debate. These ruptures can be treated operatively or nonoperatively. Traditionally, many surgeons pursued nonoperative treatment in elderly, sedentary patients with comorbidities such as diabetes, smoking, and steroids who were at high risk for wound healing issues because of a poor soft tissue envelope, poor vascularity, and medical comorbidities. These indications are expanding as recent research has shown equivalent outcomes with nonoperative management. Surgical management is often the treatment in choice for younger patients with active lifestyles. Many surgeons contend that operative repair results in a favorable functional outcome with a significantly lower rerupture rate, although more recent studies show low rates of rerupture with nonoperative treatment.^{12,13}

PREOPERATIVE PLANNING

Identifying an Achilles rupture is often based on history and examination. Most ruptures occur during athletic activity.

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Patients often report a sudden painful snap, shooting pain, or the sensation of being “kicked” or “hit” in the lower leg. Many describe an aberration in ankle mechanics with a sudden weakness of the foot to push-off and inability to bear weight. On examination, patients often report distal leg swelling and stiffness, and have a palpable defect if acute enough.¹⁴ Often, patients exhibit increased dorsiflexion as compared with contralateral unaffected side, plantar flexion weakness, and a positive Thompson test (squeezing the calf muscle results in nonreactive plantarflexion). Simmonds’ triad is often used to describe the constellation of symptoms seen in an Achilles rupture and consists of a palpable gap felt over the tendon, lack of plantarflexion on calf squeeze test, and a greater degree of resting dorsiflexion when the patient is laying prone. It has been found to detect a rupture in nearly all cases.¹⁵

Surgeons must be cognizant of severe tendon degeneration or a large gap, which may necessitate a large incision or tendon lengthening/advancement. The surgeon must be mindful of these considerations and counsel patients appropriately. Further patient evaluation should evaluate peripheral vascular status, soft tissue quality, and other patient factors that could increase wound complications. A lateral ankle radiograph should be obtained to rule out a calcaneal avulsion. If the diagnosis of a rupture is in question, an ultrasound or magnetic resonance imaging can be diagnostic, which may also be helpful in evaluating tissue quality and measuring tendon gapping.

TECHNIQUE

The optimal surgical technique for Achilles tendon repairs is also subject to debate. There is the standard “open” technique, the “mini open” technique, and the percutaneous technique. The standard open technique is performed with the patient in a prone position. Many surgeons elect to drape out both legs for intraoperative comparison and accurate restoration of the resting tendon length. Through a paramedian incision just medial to the Achilles tendon fully exposing both ends of the ruptured tendons. The skin and subcutaneous layer is mobilized, and great care is taken to protect the paratenon. The sural nerve and lesser saphenous vein can be found just lateral to the paratenon. At this point of time, it is appropriate to incise the paratenon through a midline incision. Do not dissect anterior to the tendon, as the vascular supply of the tendon must be preserved. Primary end-to-end repair may be done in a modified Bunnell, Kessler, Krackow, and/or triple-bundle techniques with a heavy nonabsorbable suture. It is recommended to debride the ends of the ruptured tendon in a limited manner. Regardless of techniques, soft tissue handling and epitenon management is paramount.

Two alternative methods of repair merit mentioning. The “mini open” incision implies a smaller incision in which the tendon/foot is mobilized to allow repairing the tendon without compete exposure. Finally, the percutaneous technique employs a 1 to 2 cm incision and the proximal and distal ends of the tendon is fixated through percutaneous suture that is then sutured in the 1 cm incision or the proximal tendon is fixated to the calcaneus through suture anchors. It is important to be mindful of the amount of suture material used—the larger the suture the greater the concern or prominent knot stack. In a biomechanical study, Jaakkola et al¹⁶ found that the triple-bundle was the strongest suture repair because of multiple strands and tying the knots away from the repair site, however, the large amount of suture material and its implications on tendon vascularity was of particular concern.¹³ “Gift Box” modification has been shown to increase repair strength 2× compared with traditional Krakow repair by increasing the strands across the repair site and less gap formation since the knots are not at the repair site.^{17,18}

RESULTS

Operative Versus Nonoperative

There is fierce debate among surgeons regarding the appropriate treatment modality for an acute Achilles tendon tear. Traditionally, nonoperative treatment has been plagued by a higher rerupture rate 12.6% versus 3.5%,^{8,9} however, the operative treatment modality has a significantly higher incidence of complications such as adhesions, altered sensation, and wound infections (34.1% operative vs. 2.1% nonoperative).⁹ With advances in therapeutic modalities and a great understanding of achilles pathology, more recent cohort studies and meta-analyses have shown that there is no significant difference with regard to rerupture rate, strength, range of motion, and calf circumference between nonoperative and operative modalities.^{11,19}

The greatest advancement in nonoperative Achilles treatment was the addition of accelerated functional rehabilitation to the nonoperative protocol. Nilsson-Helander et al,²⁰ investigated patient outcomes and rerupture rates between patients reported operative and nonoperatively following Achilles tendon ruptures in 2010 and found a similar rerupture profile, similar Achilles tendon Total Rupture scores, and similar leg function after 1 year of follow-up. The authors made note that early mobilization favored better outcomes in their study. Willits et al,¹¹ substantiated these claims found no significant differences between between operative and functionally rehabilitated nonoperative patients with regard to rerupture rate, strength, range of motion, calf circumference, or Leppilahti scores. These findings were even further substantiated by a case report by Wallace et al²¹ in 2011, where they reported a 2.8% rerupture rate in 945 patients treated with the functional rehabilitation protocol, which is a rate comparable to rerupture rates after operative treatment.

One apparent benefit to surgical fixation is an earlier return-to-work. In a study by Renninger et al,²² investigating active duty military members with an Achilles tendon tear, patients who underwent operative management returned to duty on average ~1.5 months earlier (6.7 vs. 8.2 mo) than nonoperative patients ($P = 0.04$). These findings were substantiated by a meta-analysis by Grassi et al,¹⁹ which showed that patients treated operatively returned to work on average 19 days sooner as compared with conservative treatment. Encouragingly, Lerch and colleagues investigated the return-to-sport retrospectively reviewed the return-to-sport and patient satisfaction of 114 patients treated nonoperatively after Achilles tendon tear and found an overall return to sport rate of 70% (67% in high-activity level vs. 91% in low activity level at 5-y follow-up). The compares similarly to professional soccer players who returned to sport at a rate of 82% following operative repair of Achilles ruptures.^{23,24}

Open Versus Minimally Invasive

Trials comparing open versus percutaneous Achilles repair have failed to illustrate a difference in functional outcomes or rerupture rates. There has, however, been a notable decrease the risk of postoperative complications, particularly wound infection. In a prospective evaluation of 40 patients treated with open surgical repair versus percutaneous repair, Aktas and Kocaoglu²⁵ found equal functional outcomes, but significantly fewer skin tenderness, scar adhesions, and more favorable scar thickness and tendon thickness. Gigante et al²⁶ substantiated these findings and found that both open and percutaneous repair produce equivalent results, however, the percutaneous technique was favored because of decreased surgical time and fewer skin complications. Early studies suggested that sural nerve

entrapment was a major risk of percutaneous repair,²⁷ however, more recent studies have shown equivalent rates of sural nerve injury.¹⁹ Endoscopically assisted percutaneous techniques have been also described. This technique allows direct visualization of the lesion with the benefits of direct suture repair with a reduction of scar complications; however, the use endoscopy in the application of repairing Achilles tendons is not supported by strong evidence.²⁸ A meta-analysis by Grassi et al¹⁹ found that patients treated with minimally invasive surgery were also more likely to report good or excellent subjective results as compared with those treated with open surgery (relative risk = 1.18, 95% confidence interval = 1.04-1.33, $P=0.009$) with no differences in time to return to work, ankle range of motion, return to preinjury activity level, or reruptures.

COMPLICATIONS

The risk of complications is greatest with the surgical management of Achilles tendon ruptures. The most common surgical complications are deep and superficial wound infections, skin and tendon necrosis, deep vein thrombosis/pulmonary embolism, fistulas, scar formation, sural nerve injury, and tendon over lengthening. The most common nonoperative complication is deep vein thrombosis (1.2%).¹² The overall risk ratio for a complication with surgical management as compared with nonsurgical management is 3.897, and surgery was associated with an absolute risk increase of 15.8% as compared with operative management ($P=0.016$) for complications other than rerupture.¹³ In a retrospective review of 423 patients of surgically repaired Achilles tendon rupture by Jilkeh and colleagues the overall infection rate was 2.8% with a 1% rerupture rate. The median time between surgery and superficial infection was 30 days, and the media time between surgery and rerupture was 38 days.²⁹ Smokers, longer tourniquet times, and greater estimated blood loss were associated with a higher risk of deep site infections. The findings of Stavenuiter et al,³⁰ substantiated these findings, and found that advancing age and tobacco use were independent risk factors for developing risk factors.

POSTOPERATIVE MANAGEMENT

There is high variability between surgeons regarding postoperative management of surgically repaired Achilles tendons. Historically, surgeons would restrict patient weight-bearing for 6 weeks. Recent studies have advocated for earlier weight bearing with improved clinical outcomes. One of the benefits of operative repair that has born out of the literature is the accelerated return to work and activity.^{13,22} Maffuli et al,³¹ demonstrated that patients that were casted and allowed immediate weight-bearing required less physical therapy, discontinued crutches 2.5 weeks sooner, and ultrasound showed no difference in tendon thickness and there was no difference in isometric strength. After a short course of immobilization for wound healing, the patient is placed in a removable boot. Weight bearing is begun between 2 and 8 weeks after surgery. In a more recent study, Okoroha and colleagues found that patients exhibited similar outcomes between traditional (weight-bearing at 6 wk) versus accelerated (gradual weight-bearing at 2 wk) rehab protocols following operative repair. This study also sought to assess tendon lengthening using radiostereometric beads and found that the Achilles repair was noted to elongate on average 1.6 cm, which was found to occur in both accelerated and traditional protocol without any statistically significant difference.³² We recommend an accelerated rehabilitation protocol for postoperative management of

an Achilles tendon tear. In this protocol, patients are placed in a posterior splint in plantarflexion and non-weight-bearing with crutches for the first 2 weeks postoperatively. At 2 weeks, patients are allowed weight bear as tolerated in a boot with 2 heel wedges, and transitioned to 1 heel wedge in the boot at 4 weeks. At 6 weeks postoperatively, patients may begin flatfooted weight bear as tolerated, without a heel lift, and may begin physical therapy for strengthening. By weeks 12 to 16, patients may participate in range of motion, stretching, and proprioceptive training as needed and would be expected to achieve 4/5 plantarflexion strength. By 20 weeks postoperatively, patients may begin light plyometrics, isokinetic exercises, and have equal range of motion to the contralateral side. Lastly, by 5 to 6 months postoperatively patients may be discharged as long as they demonstrate a good gait pattern (defined as single leg balance and hop-for-distance 85% of contralateral leg) and can participate in activities of daily living without difficulty.

POSSIBLE CONCERNS, FUTURE OF THE TECHNIQUE

As nonoperative and operative techniques continue to advance, there are many areas that require additional research. Operatively, more work must be done in optimizing minimally invasive Achilles repair systems, which includes ease-of-use and mitigation of the complication profile. Operatively, the implications of tendon lengthening following operative repair and restoring the length-tension relationship of the Achilles tendon is not fully understood. Okoroha and colleagues found that all operatively treated Achilles patients experienced lengthening of the tendon (in both traditional and accelerated rehabilitation groups). Lastly, as functional rehabilitation protocols become more prevalent, more work must be done investigating the optimal therapeutic aggressiveness following both nonoperative and operative modalities.

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