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POSTION STATEMENT
Management of Acute Achilles Tendon Ruptures

Position Statement

The American Orthopaedic Foot & Ankle Society (AOFAS) supports a balanced discussion regarding the treatment of acute Achilles tendon ruptures with patients. Both surgical repair and nonsurgical treatment are appropriate, and the choice requires careful consideration of specific patient factors.

The AOFAS is a medical specialty society of 2,500 members, primarily orthopaedic surgeons, specializing in the operative and nonoperative treatment of injuries, disease, and other conditions of the foot and ankle. The AOFAS promotes quality patient care through education, research, and training of orthopaedic surgeons and other healthcare providers, and serves as a resource for government, industry, and the healthcare community on issues concerning the medical and surgical care of the foot and ankle.

Background

The Achilles is the largest tendon in the human body. Treatment of acute Achilles tendon ruptures remains subject to a diversity of opinion on optimal treatment and rehabilitation. In 2010, the American Academy of Orthopaedic Surgeons (AAOS) published a clinical practice guideline (CPG) on Achilles tendon ruptures, but it has not been updated since. Both nonoperative and operative treatment options have been extensively studied in the literature. Despite these robust investigative efforts, controversies persist.[9]

Beyond the controversy of practice, recent fragility studies have found that the recent investigative research on this topic is subjected to a meaningful amount of fragility, decreasing our confidence in identifying true differences between nonoperative and operative management. This is assessed using a Fragility Index (FI), which is the number of dichotomous outcomes that must be reversed into change a finding from statistically significant to not significant. The number of outcomes necessary to reverse a finding must be considered relative to the overall sample size, this is described by the Fragility Quotient (FQ). Fackler et al. found that, among 17 comparative studies published since 2000, there was a low mean FI of 2.9 with a low mean FQ of 0.049.[13] A similar study, by Parisien et al. found that among 51 comparative studies there was a low mean FI of 4 and a FQ of 0.048.[38]

The Achilles rupture population is relatively high-functioning and outcome measurements may be subject to ceiling effects inherent to the method of assessment. Therefore, researchers have explored various metrics for assessing treatment that include 1) patient-reported outcome (PRO) scores, 2) clinician-scored rating scales, 3) objective clinical and radiographic measures of function, and 4) critical assessment of complications. There lacks consensus on which methods of assessment are the best. A recent review showed studies of Achilles ruptures have reported outcomes in over a dozen different ways.[45] However, among PRO instruments, only the Achilles tendon Total Rupture Score (ATRS)[34] has been validated through robust psychometric assessment.[31]

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Peer-Reviewed Publications on Acute Achilles Tendon Ruptures

1. Patient reported outcomes (PROs) after operative versus nonoperative treatment:
The perspective of the Achilles rupture patient has been measured in multiple ways. Both injury specific outcome measures and more general functional domain scores have been used to demonstrate outcome from Achilles rupture treatment. The only validated PRO for acute Achilles rupture is the Achilles tendon Total Rupture Score (ATRS).[34] Various studies have employed other outcome assessment instruments. Only two RCTs comparing operative to nonoperative treatment have used the ATRS as the primary outcome, and neither found a statistical difference between the two modes of treatment.[30,33,41] Another study contacted patients for long term follow up of ATRS and found no difference between operative and nonoperative treatment.[325] Investigators have also examined the Foot and Ankle Outcome Score (FAOS), EQ-5D, Leppilahti scores, MFAI, and RAND-36 outcome instruments. In only one study did authors find a statistical benefit to operative treatment in the case of RAND-36. [24]

2. Objective measures of strength after operative versus nonoperative treatment:
Several RCTs have evaluated strength after treatment for acute Achilles tendon rupture, with some showing improvement in strength and physical performance with operative treatment [22,30,33] and others showing little to no difference in strength between operative and nonoperative management.[18,43] There are two RCTs with a primary endpoint of strength (dynamometry), and neither found a statistically significant difference between treatment modalities. [11,18] Overall, with respect to strength after Achilles tendon rupture, neither operative nor nonoperative treatment carries a clear advantage, and objective methods of strength assessment remain inconsistent in the literature.

3. Achilles tendon elongation after operative versus nonoperative treatment:
Tendon elongation is a concern after acute Achilles rupture. Elongation results in an imbalance in the muscle-tendon unit with consequent loss of muscle excursion available for contraction, and there is evidence that tendon elongation corresponds inversely with strength and function.[26] An RCT found that nonoperatively managed patients experienced on average 19 mm more tendon elongation than those managed operatively. [12] The authors also reported that operative patients experienced less soleal muscle wasting and exhibited better strength performance. In terms of elongation, the conclusions were limited to a subset analysis without power calculation, and no internal comparisons were made to the contralateral limb.

The degree to which the Achilles tendon is tensioned during surgery is debated; some recommend restoring resting posture equal to that of the uninjured side at the time of surgery, while others recommend maximal tensioning. [7] It should be noted that open repair has not been shown to restore tendon length to that of the contralateral limb.[12,32] A level 3 study evaluated tendon lengths and muscle volumes, and the authors found tendon elongation occurred to a similar degree regardless of treatment rendered.[36] There remains no conclusive evidence that operative treatment is superior to nonoperative treatment in preventing tendon elongation.

4. Re-rupture rates after operative versus nonoperative treatment:
Eleven randomized controlled trials (RCTs) powered their primary outcome to compare re-rupture in operative and nonoperatively managed patients.[20,31,44] Aggregate data from the 11 studies found a re-rupture rate of 3.6% in the surgical group compared to 12.1% in the nonsurgical group with an RR of 0.3 in favor of surgical management ($P < .00001$, $I2 = 4\%$).[42]

Pooled total complication rate (other than re-ruptures) was found to be 18.5% in the surgical group and 7.1% in the nonsurgical group, with a RR of 3.1, in favor of nonsurgical management (P = 0.005, I2 = 60%). Major complications, defined as VTE, sural nerve injury, infection, and MI, was found to be 9.3% in the surgical group and 6.1% in the nonsurgical group, with a RR of 1.97 (P = .15). Minor complications, defined as stiffness, muscular atrophy, skin adhesions, and scar-related complications, was found to be 9.3% in the surgical group and 1.0% in the nonsurgical group, with a RR of 6.06 (P < .0001).

These pooled aggregate results suggest that individual RCTs may have been underpowered to detect a statistical difference on their own. Low heterogeneity among studies was observed in a recent meta-analysis, but one area of concern is in variability in rehabilitation protocol. Nevertheless, there is abundant Level 1 data suggesting that re-rupture rate is higher in patients managed non-surgically, but lower infection and total complication rate.

5. Deep infection rates in healthy patients after open Achilles repair:
There are no RCTs powered enough to compare infection rates between operative and nonoperative treatment of acute Achilles tendon rupture, and it stands to reason that nonoperative treatment should have a near 0% infection rate. A recent metanalysis pooled 10 studies comparing operative (n=450) to nonoperative (n=435) treatment of Achilles ruptures. The infection rate was 5.7% in the operative group and 0% in the nonoperative group, with a RR of 4.23 (P < .00001, I2=0%).[42] Based on numerous Level 1 studies, the deep infection risk with open treatment is relatively low among healthy patients. The decision on treatment should account for patient factors that might influence infection risk.

6. Risk of venous thromboembolic (VTE) after operative versus nonoperative treatment:
A level 3 retrospective review of 1172 patients indicated no difference in rates of VTE between operative and nonoperative treatment of acute Achilles tendon ruptures.[35] Pooled data from Level 1 studies showed no statistical difference in VTE rate between operative and nonoperative treatments (0.8% and 1.8% respectively, RR of 0.54, in favor of surgical management, P =.28).[40] A prospective study of open repair found that early range of motion did not reduce rates of VTE,[3] and the authors reported high rates of VTE in this cohort (30%). It should be noted that the study protocol involved no prophylaxis and routine screening at 2 and 6 weeks, but the authors reported only two major events - one pulmonary embolism and one popliteal clot. The remainder of the deep vein thromboses (DVTs) were in the distal calf veins. Another clinical trial of operatively treated patients reported a DVT rate of 37% at two weeks with casting. None of the DVTs were proximal, and no embolism occurred. [26] A study of nonoperatively treated patients indicated VTE rates as high as 47%, but only 2.3% were proximal.[5] Both level 1 and level 3 data suggest low rates of clinically significant VTE for both operative and nonoperative treatment, but concern exists regarding VTE for both treatment modalities.

Given the prolonged immobilization and the injury involvement of the calf muscles, surgeons may want to consider some form of DVT prophylaxis for both operative and nonoperative treatment of acute Achilles tendon ruptures, especially if there are known patient risk factors such as a clotting disorder, obesity, history of cancer, and/or history of DVT.

7. Infection rates after minimally invasive versus open Achilles repair techniques:
A meta-analysis of 3 RCTs comparing open (n=56) versus minimally invasive (n=47) Achilles tendon repair found no difference in infection rates (8.1% versus 6.2%[p=0.84]). Another meta-analysis showed that minimally invasive technique has an overall lower risk of superficial infection when compared to traditional open repair, but there was no difference in the risk of deep infection.[14] The authors acknowledged limitations including heterogeneity and bias among the studies included in the analysis. Level 3 studies have shown comparable infection rates between minimally invasive and open repair techniques.[15,16] Although the data are limited, there does not appear to be a major difference in the rate of deep infection between minimally invasive and open repair techniques for acute Achilles ruptures.

8. Outcomes after minimally invasive versus open Achilles repair techniques:
While there are numerous comparative studies examining outcomes of minimally invasive versus open treatment of acute Achilles ruptures, poor study design and quality limit ability to recommend one treatment over the other. Grassi et al. performed a comprehensive meta-analysis that evaluated outcomes of comparative studies, and found that minimally invasive treatment was superior to open in delivering 'good or excellent' results.[14] A more recent study compared minimally invasive and open techniques with the ATRS and found that the minimally invasive technique yielded superior outcomes at two years follow-up.[1] However, multiple other prospective RCTs have shown similar functional outcomes between the two surgical techniques.[14,21,29–31]

9. Utilization of ultrasonography to identify patients who would be good candidates for nonoperative treatment:
Some studies have proposed that the initial degree of gapping in acute Achilles ruptures can help guide suitability for conservative treatment. One such study used a 5 mm rupture gap on ultrasound as a threshold for surgical treatment and found a low rate of complications and re-rupture when patients with gaps < 5 mm were managed nonoperatively. It should be noted the measurements in this investigation were made with the foot held in maximal plantarfexion.[25] An investigation by Hutchison et al. found similarly low re-rupture rates when a 1 cm gap was used as a threshold for operative care.[18] In a case series of nonoperatively managed Achilles ruptures, a gap of > 1 cm predicted lower strength, but equivalent ATRS scores. In their series of Achilles ruptures, Amlang et al. proposed a classification and treatment strategy based on ultrasonographic findings.[1] Outcomes and complications were not discussed in useful detail. Overall, the data on ultrasound use in directing treatment and predicting outcome after Acute Achilles rupture remains limited.

10. Timing of the initiation of treatment:
Timing of treatment initiation for acute Achilles ruptures varies across studies, with most investigations rendering treatment within 4-14 days. For operative repair, early intervention might be advantageous by aligning surgical healing with the inflammatory response caused by initial injury. For nonoperative management, early initiation of treatment might avoid excessive gapping and clot interposition between tendon ends, thereby lessening risk of tendon elongation. One level IV study found no difference in strength, ATRS scores, or complications when evaluating patients undergoing operative treatment of Achilles ruptures at three intervals up to one week.[39] Similarly, level 3 and 4 data suggest late (2-4 weeks post injury) treatment of Achilles ruptures can be successful with both percutaneous repair and nonoperative management.[2,8] Overall, data are limited regarding timing of the initiation of treatment for acute Achilles ruptures, with studies supporting both early and late intervention.

11. Platelet-Rich Plasma (PRP) usage in acute Achilles tendon ruptures:
Several studies have assessed the effect of PRP in both nonoperatively and operatively managed ruptures. Three studies did not show any demonstrable benefit to adding PRP during treatment of acute Achilles ruptures.[6,23,41] A study by Zou et al. suggested benefit when adding PRP during open repair, but the investigation was limited by a small sample and the authors utilized a non-validated primary outcome measure.[46] A meta-analysis of two RCTs comparing open repair (n=34) versus open repair + PRP (n=32) found equivalent re-rupture rates but a lower rate of major complications in the PRP group (12.5% versus 6.7%).[42] Overall, the evidence regarding PRP usage in the setting of acute Achilles ruptures is limited by low quality studies. No definitive benefit has been demonstrated based on the current literature.

12. Rehabilitation protocols after treatment of acute Achilles tendon ruptures:
A meta-analysis from 2021 analyzed 19 RCTs with 1,758 patients who underwent either operative or nonoperative management of acute Achilles rupture, comparing early functional rehabilitation (n=928; within three weeks of treatment) versus traditional immobilization (n=828). The authors found no difference in re-rupture rate, time to return to work, and return to sporting activity. However, in the functional rehabilitation group, they did note improved ATRS scores and improved functional testing, including limb symmetry index and heel-rise work.[35] The authors of a 2015 meta-analysis found that early range of motion and weightbearing are elements in optimizing outcome.[17] Other more recent meta-analyses have arrived at similar conclusions.[43,44] A 2023 RCT of accelerated rehabilitation compared to traditional rehab after minimally invasive Achilles tendon repair found that accelerated rehabilitation was associated with better AOFAS and ATRS scores at 3 months post operative (no difference at 6mo and 12mo), decreased length of stay, faster return to work, and no difference in complication rates.[10] Another meta-analysis indicated no increase in complications with functional rehabilitation.[28]

One troubling aspect in assessing rehabilitation as a predictor of outcome involves variability in protocols utilized by individual studies. Early functional rehabilitation has been defined as weightbearing and range of motion within the first two weeks of injury.[45] Of 48 clinical studies included in the present review, 21 began weightbearing beyond 2 weeks. There were several studies that specifically compared early versus late weightbearing. Some noted functional benefit with early weightbearing following surgical repair.[26,37] Two noted that time to weightbearing yielded no difference in elongation after surgical repair.[11,32] Two showed that early weightbearing was non-inferior in nonoperatively managed patients. [4,44] One study showed improvement with early weightbearing in nonsurgical patients.[27] One RCT assessed the use of neuromuscular electrical stimulation (NMES) in patients after Achilles tendon repair. The authors compared a working NMES unit to a sham/non-working NMES unit and found slightly less volumetric calf muscle loss on subsequent MRI in the working NMES group, however the difference was not statistically significant. There was also no difference in calf circumference, ankle range of motion, AOFAS scores, or pain.[19] Despite the variability in rehabilitation protocols and the heterogeneity across studies, evidence suggests early functional rehabilitation with weightbearing within 2 weeks might offer some benefit for both operative and nonoperative patients. However, higher quality studies are needed to draw firm conclusions.

Conclusions

1. Nonoperative treatment of acute Achilles tendon ruptures is effective and appropriate for select patients in conjunction with early functional rehabilitation.

2. Surgical repair of acute Achilles tendon ruptures yields good outcomes with acceptable risk in healthy and active patients.

3. The AOFAS recognizes open and minimally invasive repair techniques as viable options for the surgical management of acute Achilles tendon ruptures.

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