Hybrid Percutaneous Management of Acute Midsubstance Achilles Tendon Ruptures

Christopher J. McMellen,*†‡ MD, Bijal Desai,‡ BS, Margaret A. Sinkler,†‡ MD, and Shana Miskovsky,†‡ MD
Investigation performed at University Hospitals Cleveland Medical Center, Cleveland, Ohio, USA

Background: Operative management techniques of Achilles tendon ruptures can be categorized into open repair, mini-open repair, or percutaneous repair.

Indications: Surgical repair of acute ruptures of the Achilles tendon is indicated in athletic populations, with percutaneous repair being an effective technique with more favorable outcomes.

Technique: With the patient prone, the Achilles rupture is identified and the Percutaneous Achilles Repair System (PARS) jig is inserted under the proximal paratenon. A series of Keith needles and flat braided SutureTape sutures are passed transversely across the proximal stump of the tendon. The sutures are then shuttled through the distal stump using a SutureLasso through medial and lateral percutaneous incisions on the distal medial and distal lateral borders of Achilles, respectively. Sutures are passed, tensioned, and secured to the posterior tuberosity of the calcaneus with two SwiveLock anchors.

Results: Percutaneous repair, compared with open repair, results in lower wound complication rates, improved cosmetic appearance and fewer adhesions. Following surgery, patients follow a 5-stage rehabilitation protocol with return to sport when patients demonstrate dynamic neuromuscular control during multiplane activities without pain or swelling. Outcome studies have compared percutaneous repairs to open repairs, with percutaneous repairs demonstrating a quicker return to work or baseline activities (2.8 months versus 5.6 months) and a shorter return to play for athletes (average 18 weeks). Also, a greater number of PARS patients were able to return to baseline activities within 5 months (98%), compared with open repair patients (82%; $P = .0001$). In a prospective randomized controlled trial of 33 patients, Lim et al reported no postoperative wound infections in the percutaneous group and a 21% infection rate in the open repair group ($P = .01$). Finally, in a recent systematic review of only percutaneous repairs, reported rates of sural nerve injury and rerupture were only 3.3% and 2.1%, respectively.

Discussion/Conclusion: Compared to open repair, percutaneous Achilles repair allows for decreased risk of soft-tissue complications with comparable functional outcomes and earlier return to activity.

Patient Consent Disclosure Statement: The author(s) attests that consent has been obtained from any patient(s) appearing in this publication. If the individual may be identifiable, the author(s) has included a statement of release or other written form of approval from the patient(s) with this submission for publication.

Keywords: Achilles tendon; tendon repair; ankle; percutaneous; PARS

VIDEO TRANSCRIPT

In the following presentation, we will discuss the management of acute mid substance Achilles tendon ruptures with a hybrid percutaneous technique using the Arthrex (Naples, FL) Percutaneous Achilles Repair System (PARS) proximally with suture fixation distally in the calcaneus with SwiveLock anchors (Arthrex; Naples, FL).

Our disclosure is listed.

Acute ruptures of the mid-substance Achilles tendon in young, athletic populations should be managed primarily with end-to-end repair. Multiple repair techniques have been described, which can be broadly categorized into open, mini-open, or percutaneous repairs. PARS jig can be used to facilitate percutaneous repair for mid substance or distal Achilles ruptures. Percutaneous management has advantages such as reduced wound complications and

*Address correspondence to Christopher J. McMellen, Department of Orthopaedic Surgery, University Hospitals Cleveland Medical Center, 11100 Euclid Ave., Hanna House 5043, Cleveland, OH 44106, USA (email: christopher.mcmellen@uhhospitals.org).
†Department of Orthopaedic Surgery, University Hospitals Cleveland Medical Center, Cleveland, Ohio, USA.
‡School of Medicine, Case Western Reserve University, Cleveland, Ohio, USA.

Submitted August 30, 2022; accepted January 3, 2023.

The authors declared that they have no conflicts of interest in the authorship and publication of this contribution. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.

Video Journal of Sports Medicine (VJSM®), 3(2), 26350254231152660
DOI: 10.1177/26350254231152660

improved cosmesis relative to open Achilles tendon repair without compromising functional outcomes.

Our patient is a highly active 28-year old otherwise healthy man who sustained an Achilles tendon rupture playing basketball. He felt a pop on the posterior aspect of his ankle and had immediate inability to ambulate due to pain and an inability to plantarflex his ankle. Given his young age and high activity level, the patient was indicated for Achilles tendon repair.

The patient is positioned prone on a standard operating room table, and a pneumatic tourniquet is placed high on the proximal thigh. Notice that the Thompson test is positive preoperatively.

After identifying the rupture location, a transverse incision is made distal to the proximal stump. The paratenon is identified and carefully released. The sural nerve and neurovascular bundle are identified and gently retracted for the reminder of the case to prevent any damage to those structures.

The ruptured Achilles tendon is noted. The proximal stump is mobilized with a Freer elevator and any existing adhesions are released.

With the proximal stump grasped and pulled distally, the PARS jig is advanced proximally through the incision, beneath the paratenon and around the proximal stump. The sural nerve runs parallel and lateral to the Achilles superficial to the paratenon and is identified by the fat present around it. We take caution to gently retract the nerve bundle prior to insertion of the PARS jig through the proximal incision. We also confirm that the jig remains deep to the paratenon on insertion.

Next, a Keith needle is passed through hole 1 to stabilize the jig and a second needle is passed through hole 2 on the jig. The white-green SutureTape (Arthrex, Naples, FL) is threaded through needle 2 and pulled through until the suture limbs are equal on both the medial and lateral sides. A third Keith needle and our first passing stitch is shuttled through hole 3 with the loop portion on the right side. A fourth Keith needle and our second passing stitch is passed through hole 4 keeping the free end on the right side this time. A fifth Keith needle and the white-black SutureTape is shuttled through hole 5. Finally, the white SutureTape is threaded through needle 1 and pulled through.

The jig is pulled distally out of the incision, and the SutureTapes are organized in the following fashion: white (hole 1), white-green (hole 2), 2 passing stitches (holes 3 & 4), and white-black (hole 5).

Next, a locked Krackow stitch is created with the white-green suture, giving us good capture and control of the proximal stump.

The stitches are organized medial to lateral. Two small stab incisions are made on both the lateral and medial borders of the distal tendon for placement of the SwiveLock anchors. Blunt dissection is done through the small medial and lateral incisions using a mosquito hemostat to identify and clear the flat superior surface of the posterior tuberosity of the calcaneus. Starting in the lateral incision, we position our drill and drill guide just anterior to the Achilles tendon and drill at about a 45° angle in the coronal plane while aiming toward the plantar aspect of the proximal heel pad. We then use a tap to prepare the small tunnel for anchor insertion and then temporarily hold position of our tunnel by inserting a Keith needle. These steps are then repeated for the medial side.

Next, the SutureLasso (Arthrex, Naples, FL) is inserted through the posterolateral heel incision, advanced through the distal lateral half of the Achilles tendon stump, and delivered through our transverse incision. The Nitinol wire with loop is then pushed through the needle and loop end retrieved. The 3 lateral SutureTape sutures are then fed into nitinol loop and shuttled out the posterolateral incision, along with the SutureLasso. This process is repeated through the posteromedial heel wound to capture the medial portion of distal tendon stump.

Next, we unscrew the SwiveLock anchor and, with a blue marker, we mark the point where our anchor will be completely inserted. The lateral stitches are threaded through anchor's eyelet and needle holder is applied. Surgical Assistant tensions the medial sutures. After removing the Keith needle from the lateral tunnel, we pull tension on the lateral sutures, seat the anchor eyelet into the calcaneal tunnel using a mallet, and advance the interference screws to achieve bony purchase and fixation. We hold the ankle in 30° of plantarflexion to match the normal Achilles' resting tension. Once the position of the interference screw flush with the superior surface of posterior calcaneal tuberosity is confirmed, the inserter is removed. These steps are repeated on the medial side.

The Achilles tendon now has excellent apposition of the ruptured ends. Thompson test is negative, and the appropriate resting tension has been restored. We trim the suture ends with an 11 blade and irrigate the wound. The paratenon, subcutaneous layer, and skin are closed with 4-0 Vicryl, 4-0 Vicryl, and 4-0 nylon, respectively. Once the tourniquet is removed, we observe appropriate perfusion in the foot and intact distal pulses. Dressing is applied, and the athlete is placed in a well-padded posterior and sugar tong plaster splint with the ankle in slight plantarflexion.

Following surgery, patients follow a 5-stage rehabilitation protocol. During, phase I (weeks 0-2), patients remain nonweightbearing, protect the surgically repaired tendon, and begin a series of therapeutic exercises focused on flexing and extending the toes, ankle, knee, and hip when supine, sitting, and prone.

In phase II (weeks 3-4), weightbearing as tolerated on the surgical ankle with a boot and crutches is started to normalize gait and therapeutic exercises aimed at active ankle dorsiflexion are further incorporated.

During phase III (5-8 weeks), boot use is weaned to normalize gait on level surfaces. Therapeutic exercises focused on static balance, active range of motion and strengthening of the ankle, stepping drills, and functional movements are started. If the surgical wound is completely healed, pool exercises may begin.

Phase IV (2-4 months) further incorporates agility and low-impact cardiac exercises.

Finally, during phase V (4 + months), patients begin exercises aimed at impact control, movement control,

balance and proprioception, hip and core strengthening, and cardiac activities. During each phase, upper extremity, hip and core strengthening exercises are gradually incorporated.

Following completion of the rehabilitation protocol, athletes are cleared to return to sport when they demonstrate dynamic neuromuscular control during multiplane activities without pain or swelling.

The sural nerve transverses the Achilles tendon laterally, and we take caution to gently retract the nerve bundle prior to insertion of the PARS jig through the proximal incision. We also confirm that the jig remains deep to the paratenon on insertion.

Outcome studies reveal that athletes who were treated with PARS returned to sport significantly quicker than those treated with open repair. A greater number of patients treated with PARS have been able to return to baseline activities within 5 months compared with patients treated with an open repair technique (PARS: 98%, open 82%; $P = .0001$).[3]

In a prospective randomized controlled trial of 66 patients, Lim et al[4] reported no postoperative wound infections in the percutaneous group and a 21% infection rate in the open repair group ($P = .01$). The most commonly recorded complication of percutaneous Achilles fixation is sural nerve injury, which has been reported to complicate 3% for percutaneous repairs in a recent systematic review.[10]

Patients treated with percutaneous repair techniques returned to work and baseline activities quicker than those treated with open repair (2.8 months vs 5.6 months) with athletes returning to play in an average of 18 weeks after percutaneous repair.[1-3]

Our references are listed here.

ORCID iD

Christopher J. McMellen https://orcid.org/0000-0003-4995-3390

REFERENCES

1. Attia AK, Mahmoud K, d'Hooghe P, Bariteau J, Labib SA, Myerson MS. Outcomes and complications of open versus minimally invasive repair of acute Achilles tendon ruptures: a systematic review and meta-analysis of randomized controlled trials [published online ahead of print December 15, 2021]. *Am J Sports Med*. doi:10.1177/03635465211053619.
2. Henríquez H, Muñoz R, Carcuro G, Bastías C. Is percutaneous repair better than open repair in acute Achilles tendon rupture? *Clin Orthop Relat Res*. 2012;470(4):998-1003. doi:10.1007/s11999-011-1830-1.
3. Hsu AR, Jones CP, Cohen BE, Davis WH, Ellington JK, Anderson RB. Clinical outcomes and complications of percutaneous Achilles repair system versus open technique for acute Achilles tendon ruptures. *Foot Ankle Int*. 2015;36(11):1279-1286. doi:10.1177/1071100715589632.
4. Lim J, Dalal R, Waseem M. Percutaneous vs. open repair of the ruptured Achilles tendon: a prospective randomized controlled study. *Foot Ankle Int*. 2001;22(7):559-568. doi:10.1177/107110070102200705.
5. McGee R, Watson T, Eudy A, et al. Anatomic relationship of the sural nerve when performing Achilles tendon repair using the percutaneous Achilles repair system, a cadaveric study. *Foot Ankle Surg*. 2021;27(4):427-431. doi:10.1016/j.fas.2020.05.011.
6. Park SH, Lee HS, Young KW, Seo SG. Treatment of acute Achilles tendon rupture. *Clin Orthop Surg*. 2020;12(1):1-8. doi:10.4055/cios.2020.12.1.1.
7. Rozis M, Benetos IS, Karampinas P, Polyzois V, Vlamis J, Pneumaticos SG. Outcome of percutaneous fixation of acute Achilles tendon ruptures. *Foot Ankle Int*. 2018;39(6):689-693. doi:10.1177/1071100718757971.
8. Tarantino D, Palermi S, Sirico F, Corrado B. Achilles tendon rupture: mechanisms of injury, principles of rehabilitation and return to play. *J Funct Morphol Kinesiol*. 2020;5(4):E95. doi:10.3390/jfmk5040095.
9. Tejwani NC, Lee J, Weatherall J, Sherman O. Acute Achilles tendon ruptures: a comparison of minimally invasive and open approach repairs followed by early rehabilitation. *Am J Orthop*. 2014;43(10):E221-225.
10. Ververidis AN, Kalifis KG, Touzopoulos P, Drosos GI, Tilkeridis KE, Kazakos KI. Percutaneous repair of the Achilles tendon rupture in athletic population. *J Orthop*. 2016;13(1):57-61. doi:10.1016/j.jor.2015.09.004.