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Original Research

Evaluation of a New Knotless Suture Anchor Repair in Acute Achilles Tendon Ruptures: A Biomechanical Comparison of Three Techniques

James M. Cottom, DPM, FACFAS [1], Joseph S. Baker, DPM, AACFAS [2], Phillip E. Richardson, DPM [2], Jared M. Maker, DPM, AACFAS [2]

[1] *Fellowship Director, Attending Physician, Florida Orthopedic Foot & Ankle Center, Sarasota, FL*
[2] *Fellow, Foot and Ankle Surgical Fellowship, Florida Orthopedic Foot & Ankle Center, Sarasota, FL*

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ABSTRACT

Acute ruptures of the Achilles tendon are a common injury, and debate has continued in published studies on how best to treat these injuries. Specifically, controversy exists regarding the surgical approaches for Achilles tendon repair when one considers percutaneous versus open repair. The present study investigated the biomechanical strength of 3 different techniques for Achilles tendon repair in a cadaveric model. A total of 36 specimens were divided into 3 groups, each of which received a different construct. The first group received a traditional Krackow suture repair, the second group was repaired using a jig-assisted percutaneous suture, and the third group received a repair using a jig-assisted percutaneous repair modified with suture anchors placed into the calcaneus. The specimens were tested with cyclical loading and to ultimate failure. Cyclical loading showed a trend toward a stronger repair with the use of suture anchors after 10 cycles ($p = .295$), 500 cycles ($p = .120$), and 1000 cycles ($p = .040$). The ultimate load to failure was greatest in the group repaired with the modified knotless technique using the suture anchors ($p = .098$). The results of the present study show a clear trend toward a stronger construct in Achilles repair using a knotless suture anchor technique, which might translate to a faster return to activity and be more resistant to an early and aggressive rehabilitation protocol. Further clinical studies are warranted to evaluate this technique in a patient population.

Acute rupture of the Achilles tendon is a common injury in sporting activities, constituting 35% of all tendon injuries (1,2). Acute Achilles tendon ruptures can be treated surgically or nonsurgically. Open repair remains the most commonly performed surgical procedure for acute Achilles tendon ruptures; however, percutaneous repair techniques are available (3–6). Recent studies have documented similar results when comparing percutaneous approaches to the open repair techniques (7–9). An in vitro biomechanical study of the Achillon® device (Integra Life Sciences Corporation, Plainsboro, NJ) showed the use of this percutaneous Achilles tendon repair system provided strong repair to failure (10). A recent cadaveric biomechanical study by Demetracopoulos et al (11) compared the Achillon® device (Integra Life Sciences Corporation), which uses 3 nonlocking sutures, with the Percutaneous Achilles Repair System® (PARS®; Arthrex, Naples, FL), which has a combination of locking and nonlocking sutures. They found that the PARS® device (Arthrex) provided for a stronger construct than that provided by the Achillon® device (Integra Life Sciences Corporation), with a greater resistance to cyclic loading and ultimate failure testing. Using this model, we have performed a biomechanical study of 36 cadaveric limbs comparing the strength of the Krackow technique, the PARS® to PARS® (Arthrex) technique, and the PARS® (Arthrex) to a new suture anchor technique. Our hypothesis was that the new PARS® (Arthrex) to suture anchor would provide a stronger construct compared with the first 2 techniques.

Materials and Methods

We obtained 36 fresh-frozen cadaver limbs, which were randomized into 1 of 3 groups, with 12 specimens placed in each group. Each of the specimens was free of any obvious foot or ankle pathologic features. The cadavers were kept at −20°C and were thawed the day of the experiment. Group 1 received Achilles tendon repair with a traditional Krackow suture method; group 2 received Achilles tendon repair using the PARS® system (Arthrex) both proximally and distally on the tendon (PARS® to PARS®; Arthrex); and group 3 received repair of the Achilles tendon using the PARS® device (Arthrex) proximally and suture anchors into the calcaneus distally.

In each of the specimens, the Achilles tendon was transected 4 cm proximally to its insertion into the calcaneus using a no. 15 blade. All repairs in each of the 3 groups were performed through an open approach. This was done to ensure that the sutures were passed through the mid-portion of the Achilles tendon. This effectively eliminates tendon targeting as a possible confounding variable. In group 1, the Achilles tendon was

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Address correspondence to: James M. Cottom, DPM, FACFAS, Florida Orthopedic Foot & Ankle Center, 2030 Bee Ridge Road, Suite B, Sarasota, FL 24239.
E-mail address: drcottom@FLOFAC.COM (J.M. Cottom).

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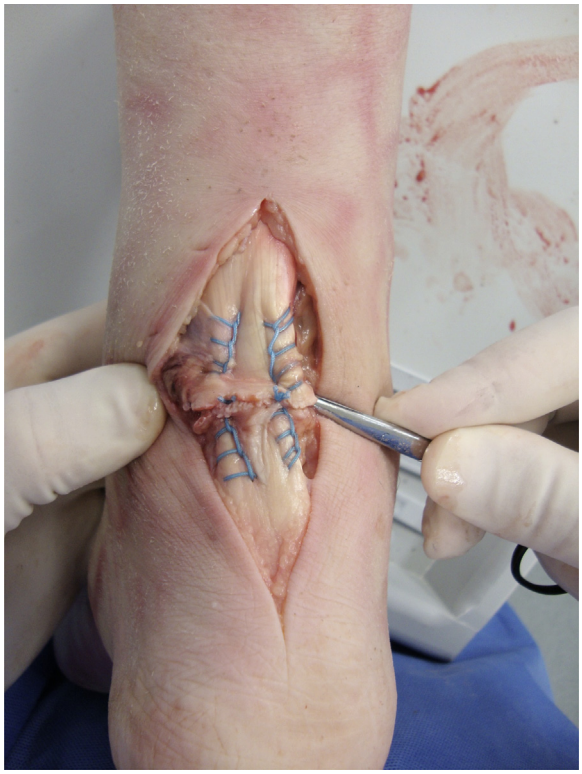

Fig. 1. Krackow suture pattern used to repair Achilles tendons in group 1.

then repaired using no. 2 polyblend sutures (FiberWire®; Arthrex). Four locking sutures were used on either side of the tendon, with a 4-strand construct obtained at the level of the simulated rupture (Fig. 1).

The tendons in group 2 were repaired using the PARS® system (Arthrex) on the proximal portion of the rupture and on the distal portion. The PARS® jig (Arthrex) is designed with 4 extensions. The 2 inner extensions are placed within the paratenon, effectively centering the Achilles tendon. The 2 outer extensions are used to pass and retrieve the sutures. Individual strands of FiberWire® (Arthrex) are then placed on a straight Keith needle and passed from medial to lateral in numerical order as designated on the outer extensions of the device. Locking sutures are created by using 2 looped passing sutures through the jig and pulling the strands of Fiberwire® (Arthrex) back through the tendon. Once the sutures were passed through the proximal portion of the Achilles tendon, 6 strands (3 medial and 3 lateral) were coming into the rupture site. These strands of FiberWire® (Arthrex) were separated, and the process was repeated on the distal stump of the Achilles tendon. The strands of Fiberwire® (Arthrex) were then tied off to repair the Achilles tendon (Fig. 2).

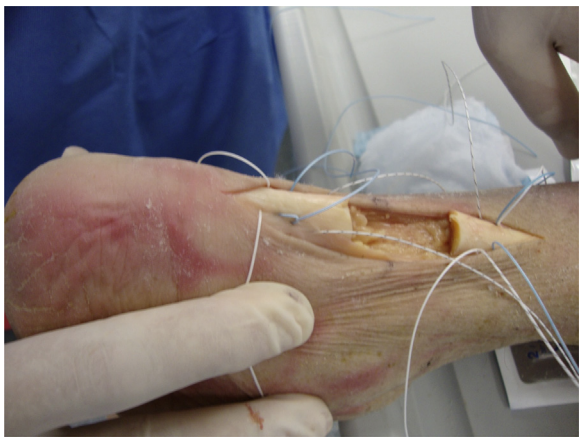

Fig. 2. Representative specimen from group 2. The PARS® jig (Arthrex) has been used to pass sutures both proximally and distally. The sutures were then tied down to complete the repair.

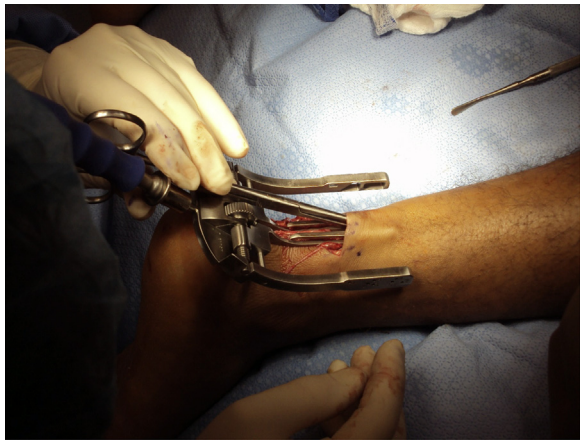

Fig. 3. Placement of the PARS® jig (Arthrex) within the paratenon proximally. PARS® jig appears in photo with permission of Arthrex.

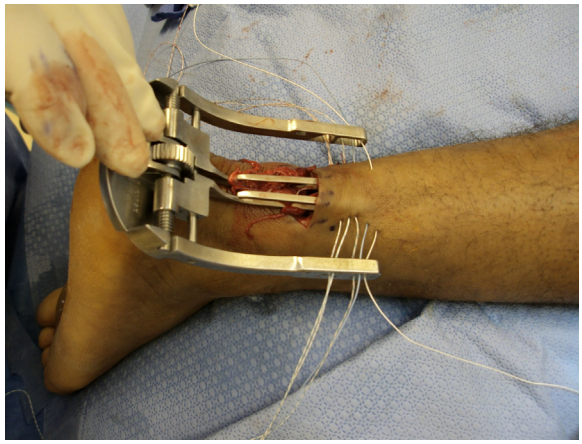

Fig. 4. With the PARS® jig (Arthrex) in place, the sutures are then passed from laterally to medially through the numbered holes on the jig. Attention should be given to ensure the sutures are engaging the tendon. This can be done by palpating the tendon as the needles are placed through the jig. PARS® jig appears in photo with permission of Arthrex.

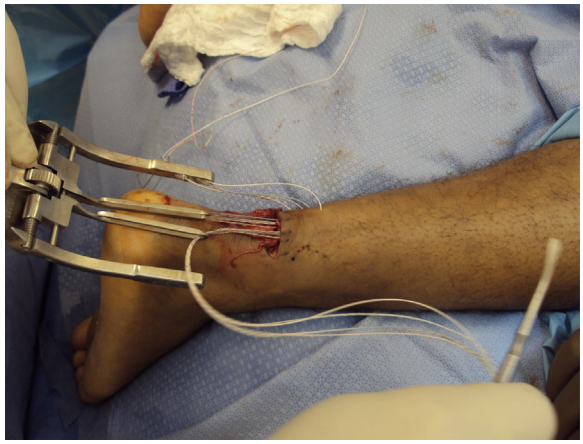

Fig. 5. With the suture passed through the PARS® jig (Arthrex), the jig is then removed, leaving the suture strands within the paratenon. The suture strands are then passed and locked according to the technique guide. PARS® jig appears in photo with permission of Arthrex.