

# Hybrid Achilles Tendon Repair



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**Abstract:** In the treatment of acute Achilles tendon rupture, recent studies demonstrate that conservative treatment with functional rehabilitation provides good results, with nearly identical postoperative rerupture rates when compared with surgical treatment. Surgical treatment is indicated in patients with particular conditions, such as patients who are young active athletes who require early return to play or those who wish to avoid the muscle atrophy associated with conservative methods. If surgery is the selected option for treatment, the postoperative complications of each type of surgery must be considered. In conventional open repair, the most common complication is soft-tissue infection due to the high tension of soft tissue affected from the bowstring of the repaired tendon being kept in the equinus position of the ankle. For percutaneous methods, sural nerve entrapment and injury are the most commonly reported complications. Other methods, including endoscopy, require technical expertise as well as special equipment. Several types of combination approaches have been explored in the literature. We describe a combined open and percutaneous technique to repair the Achilles tendon, called the hybrid Achilles tendon repair. This technique has been developed to provide a simplified and reproducible method of hybrid repair in which the complications of previous methods are avoided and which can be done without special equipment.

The Achilles tendon is the strongest and thickest tendon in the human body. However, acute ruptures are frequent in young athletes and the middle-aged population that participates in recreational sports.<sup>1</sup> Previous studies have reported high rerupture rates with conservative treatment, but recent studies have demonstrated that conservative treatment with functional rehabilitation and early motion protocol provides good results. Currently, both conservative and surgical options of treatment have nearly identical rerupture rates.<sup>2</sup> Nevertheless, surgical treatment is still indicated in patients with particular conditions,

such as patients who are young active athletes who require early return to play or those who wish to avoid the muscle atrophy associated with conservative methods.<sup>3</sup> Many surgical techniques had been proposed and have reported favorable outcomes.<sup>2-4</sup> These include conventional open repair, percutaneous repair, minimally invasive approaches using special equipment or endoscopy, and, most recently, combination approaches.<sup>2</sup> As evidence in support of satisfactory results with nonsurgical treatment grows, the postoperative complications of each type of surgical technique must be carefully considered if surgery is the selected treatment option. Conventional open repair has been reported to have relatively high complication rates of up to 10%. The most prominent complication is wound dehiscence, which can lead to serious soft-tissue infection, which may ultimately end up requiring difficult reconstruction surgeries. The high transferred tension at the surgical wound site found in the commonly used vertical incision usually occurs from the bowstring effect of the repaired tendon when the ankle joint is kept in the equinus position.<sup>5</sup> The percutaneous repair was previously a popular minimally invasive approach. However, complications related to sural nerve entrapment and sural nerve injuries have since been reported.<sup>6</sup> Combined open and

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**Fig 1.** A 2-cm long transverse incision is made at the site of the tendon tear.

percutaneous techniques and other modified techniques using special equipment have been proposed in an attempt to avoid the previously described complications.<sup>2</sup> Recently, endoscopic Achilles tendon repair has been reported, but its demands for high skill and the steep learning curve may be an obstacle for general orthopaedic and trauma surgeons.<sup>7</sup>

In this study, we describe a combined open and percutaneous technique to repair the Achilles tendon, called the hybrid Achilles tendon repair. This technique has been developed in order to provide a simplified and reproducible method of hybrid repair in which the complications of each previously specified method can be avoided. This method also takes the strengths of each type of surgical technique and applies it in a combined approach. Other advantages include the fact that no additional special equipment is required and that it can be done without high surgical skill in endoscopic techniques. This technique itself is easily reproducible, does not have a steep learning curve, and can be implemented by a general orthopaedic and trauma surgeon.

## Surgical Technique

### Indication

The indication for the technique is acute Achilles tendon rupture <6 weeks.

### Patient Positioning

After regional spinal anesthesia, the patient is placed in the prone position with the ankle joint placed at the rim of the operating table.

### Procedure

The tendon gap is palpated, and Thompson's test is confirmed ([Video 1](#)). The ruptured end of the tendon is then identified and labeled. A 2-cm long transverse incision is made at the site of the tendon tear ([Fig 1](#)).

### Percutaneous Repair

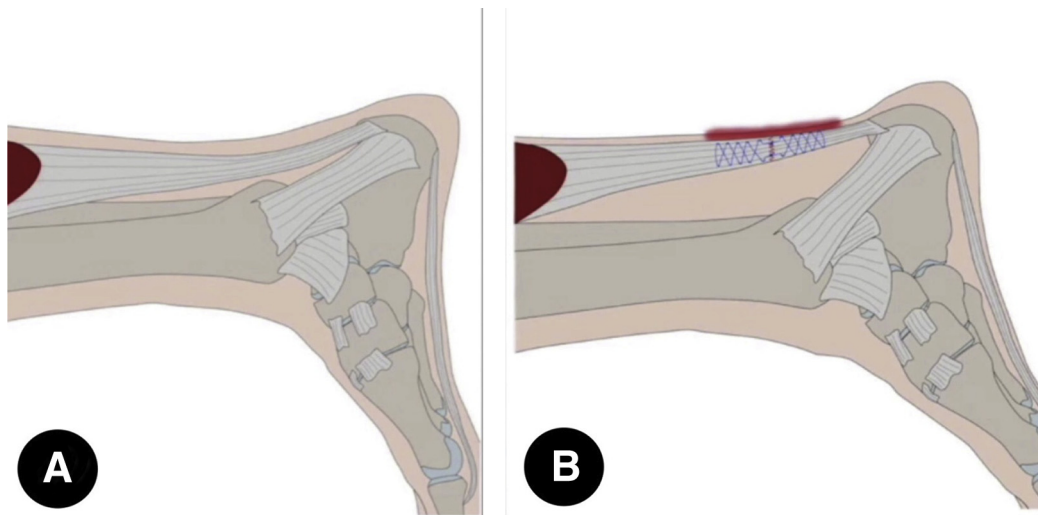
The next step is the percutaneous repair at the distal tendon stump, as this is appropriate for the large



**Fig 2.** The repair is performed distally to proximally using FiberWire no. 5 suture material with a 1.5-mm straight needle.



**Fig 3.** The adequacy of the sutures of distal stump is periodically tested while performing the percutaneous repair (A) and when the repair is complete (B).



**Fig 4.** The normal contour of the Achilles tendon (A) and the area of high tension of the soft tissue that usually occurs at the site of tendon repair due to the bowstringing effect of the repaired tendon in the equinus ankle as seen labeled in red (B).





**Fig 5.** The repaired proximal tendon stump is delivered back into its original incision and toward the distal transverse incision using a retrograde clamp technique (A). Both transverse and vertical incisions are closed by subcuticular absorbable sutures, as there is relatively low tension at both sites (B). The high-tension skin area is free of any vertical incision (white arrow).

**Fig 6.** Two plastic bottle caps (black arrow) from a 1-L normal saline bottle (A) are applied as a spacer above and below the surgical wound in order to facilitate patient comfort. A compressive dressing is applied over the surgical wound site (B).



**Table 1.** Step-by-Step Guide for Hybrid Achilles Tendon Repair

1. Spinal anesthesia, prone position, ankle joint placed at rim of operating table.
2. Percutaneous repair at the distal tendon stump using FiberWire no. 5 suture material with a 1.5-mm straight needle.
3. Direct open repair at the proximal stump through a 5-cm long vertical incision created 5 cm proximal to the tear site to avoid vertical incision in high-tension skin area.
4. Reattach the torn Achilles tendon with at least 5 surgical knots for each suture end.
5. Apply short leg cast in neutral equinus position, leaving the window open for surgical wound compressive dressing.

subcutaneous Achilles tendon that can be superficially palpated due to its distinct demarcation underneath the skin. Multiple stab incisions are made at the border of the tendon on each side with a no. 11 scalpel blade. At least 3 percutaneous stitches are placed in the distal stump in a crisscross formation. Prevention of dimpling is done by clearing the passage of the suture material through the soft tissue with mosquito clamps. The repair is performed distally to proximally using FiberWire no. 5 suture material (Arthrex, Naples, FL) with a 1.5-mm straight needle (Fig 2). While performing the percutaneous repair, the adequacy of the sutures is periodically tested (Fig 3A) and is confirmed when the repair is complete (Fig 3B).

### Open Repair

For the proximal Achilles tendon stump, an open direct repair is chosen in order to avoid injury to the sural nerve. To avoid soft-tissue complications that are found commonly in open techniques, a 5-cm long vertical incision is created 5 cm proximal to the transverse incision, leaving the high-tension skin area free of any vertical incision (Fig 5B). Figure 4A shows the normal contour of the Achilles tendon, and Figure 4B shows the area of high tension of the soft tissue that usually occurs at the site of tendon repair due to the bowstringing effect of the repaired tendon in the equinus ankle as seen labeled in red. The proximal stump of the tendon is then gently milked out of the vertical incision. A direct repair is then performed using FiberWire no. 5 suture material in the same crisscross formation as the distal stump. The final repair is again

tested for adequacy before rerouting the proximal stump back into its original incision and toward the distal transverse incision using a retrograde clamp technique (Fig 5A). The 2 tendon stumps are then reattached by tying the 2 FiberWire suture ends from each stump together, using at least 5 surgical knots for each suture end. The repair site of the tendon can be palpated percutaneously along the midline area of the Achilles tendon.

### Wound Closure

Both transverse and vertical incisions are closed by subcuticular absorbable sutures, as there is relatively low tension at both sites (Fig 5B). Additional surgical wound closure can be done using adhesive steri-strips. A short leg cast is applied in the neutral equinus position, leaving a window open for surgical wound dressing. Two plastic bottle caps from a 1-L normal saline bottle (Fig 6A) may be applied as a spacer above and below the surgical wound in order to facilitate patient comfort. A compressive dressing is then applied over the surgical wound site (Fig 6B). A step-by-step guide for the hybrid Achilles tendon repair is presented in Table 1. A summary of tips and tricks for this procedure is shown in Table 2, and the advantages and limitations of proximal tendon stump repair using more proximal vertical incision are concluded in Table 3.

### Postoperative Rehabilitation

The patients are instructed to retain non-weight-bearing status on the affected foot for up to 4 weeks postoperatively. We recommend that 2 weeks postoperatively the cast be changed to a short leg cast in decreased plantarflexion compared with the initial cast. After 6 weeks postoperatively, the cast may be removed and active range of motion exercises may be commenced with dorsiflexion limited to neutral. At 6 weeks the patients may begin full weight bearing, and sports activities can be resumed at 12 weeks.

### Discussion

Surgical repair of the Achilles tendon is still indicated in particular specific conditions, even though recent reports in the literature have clearly demonstrated almost identical rerupture rates in both surgically and conservatively treated patients. If surgery is indicated,

**Table 2.** Tips and Tricks for Hybrid Achilles Tendon Repair

Tips	Tricks
<ul style="list-style-type: none"> <li>• Percutaneous repair is selected for distal tendon stump repair.</li> <li>• Direct open repair is selected for proximal tendon stump repair.</li> </ul>	<ul style="list-style-type: none"> <li>• Achilles tendon is a large subcutaneous tendon that can be superficially palpated due to its distinct demarcation underneath the skin. Small multiple stab wounds have less risk for soft-tissue complications.</li> <li>• Direct open repair minimizes risk for sural nerve injury. In order to avoid soft-tissue complications from open repair, a vertical incision is made 5 cm more proximally.</li> </ul>

**Table 3.** The Advantages and Limitations of the Proximal Tendon Stump Repair Using a More Proximal Vertical Incision for Repair

Advantages	Limitations
<ul style="list-style-type: none"> <li>• A more proximal vertical incision for proximal tendon stump repair can avoid incisions in high-tension skin areas that usually cause soft-tissue complications in direct open repair techniques.</li> <li>• Minimize risk to sural nerve.</li> </ul>	<ul style="list-style-type: none"> <li>• Two more steps are required, and risk to surrounding structures must be avoided.               <ul style="list-style-type: none"> <li>Step 1. The proximal tendon stump is gently milked out of the more proximal vertical incision for direct repair.</li> <li>Step 2. When the proximal tendon stump repair is complete, the stump is gently delivered back to its place using a retrograde clamp technique.</li> </ul> </li> </ul>

the postoperative complications of each type of surgery must be considered. Direct open repair has an advantage in its capacity for direct visualization, resulting in higher strength of the repaired tendon when compared with other methods. A major disadvantage is the relatively high rate of soft-tissue complications due to damage to the blood supply, which leads to surgical wound infection and further difficult soft-tissue reconstruction procedures. Skin-tendon adhesions, delayed healing, and suture granulomas are also common complications. The percutaneous technique for repair was first introduced in order to minimize serious soft-tissue complications that resulted after direct open repair. However, with this technique, higher rerupture rates and higher risk of sural nerve entrapment and injury were reported. Higher rerupture rates may be due to unsatisfactory contact of the tendon stumps, leading to delayed healing and failure to restore the original length of the tendon, which results in tendon elongation.

Several types of combination techniques including an endoscopic approach have been proposed, but most require specially designed instruments and high skill. This technique has been developed to provide a simplified and reproducible method of hybrid repair in which the complications of the previous methods are avoided and can be performed independently. Some limitations of this hybrid Achilles tendon repair are that it does cause some disruption to the blood supply due to the miniopen nature of the repair, there is risk of

minimal soft-tissue complications as well as exposure of the paratenon, and the percutaneous repair method used may result in skin-tendon adhesions and does not allow for direct visualization.

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