

LEARNING OBJECTIVES

- Describe the anatomy of the Achilles tendon and its blood and nerve supply
- Discuss the clinical presentation of a ruptured Achilles tendon
- Outline the diagnostic process used to evaluate a ruptured Achilles tendon
- Review the treatment options and complications associated with this injury

How to diagnose and manage an acute Achilles tendon rupture

This complex and disabling injury has several treatment options. Regardless of which treatment is used, PAs should prepare their patients for a long and slow healing process.

David V. Cary, MPA, PA-C

The Achilles tendon is the most commonly ruptured tendon in the body.¹ It is also the largest and strongest tendon.^{2,3} Rupture of the Achilles tendon is a disabling injury that can vary in complexity.

Anyone can rupture his or her Achilles tendon; however, athletes who play running sports, such as softball, basketball, or soccer, or racket sports, such as racquetball or tennis, are most likely to incur this injury.⁴ Additional risk factors for acute rupture include preexisting conditions, such as tendinitis and Haglund's deformity; participation during learning phase of a new physical activity; administration of corticosteroid injections into the Achilles tendon; use of oral corticosteroid therapy to treat inflammation or pain; age 30 to 50 years; and use of fluoroquinolones.⁵

The mechanism of injury is usually an abrupt change in direction and speed with a stop-short-and-go action. The acute injury is described as the feeling of being kicked or hit on the back of the ankle and lower calf muscles from behind. An Achilles tendon rupture is painful, heals slowly, and requires long-term follow-up. Treatment options are casting, functional bracing, and/or surgery. Patients must walk with crutches for an extended period of time, which can severely limit activities of daily living. Patients may also experience additional soft-tissue damage from the acute injury and postoperative complications, including rupture recurrence.

ANATOMY AND PATHOPHYSIOLOGY

The Achilles tendon forms from the distal ends of the gastrocnemius and soleus (calf) muscles and inserts at the superior posterior aspect of the calcaneus. The plantar fascia on

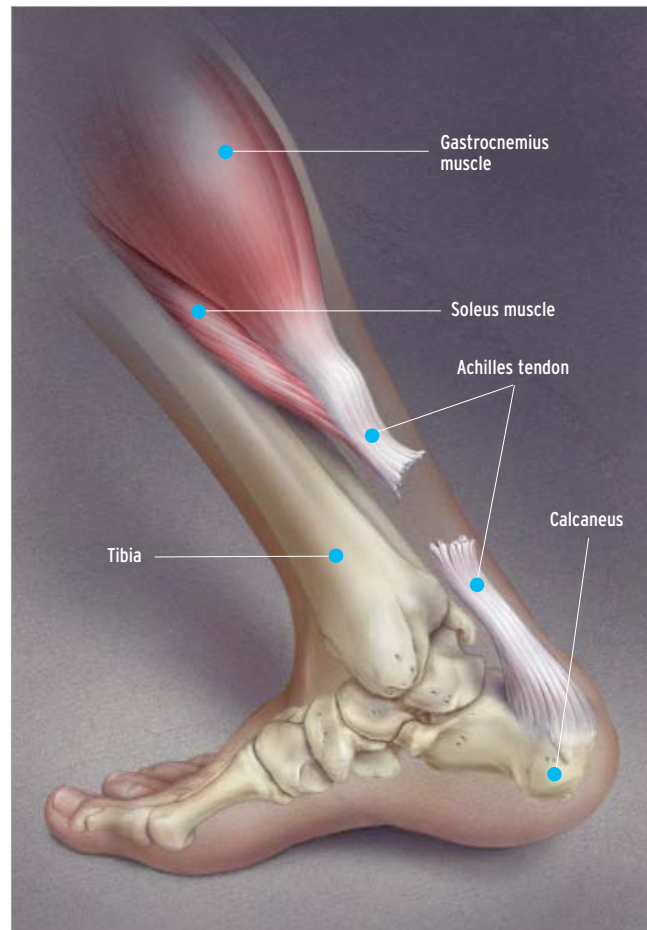


FIGURE 1. Anatomy of the tendocalcaneal joint with a ruptured Achilles tendon

© Krystyna Srodulski

the bottom of the foot is anchored to the inferior aspect of the calcaneus, which forms the tendocalcaneal junction (the bone and soft tissues at the ankle). Dorsiflexion and plantar flexion of the foot occur when the Achilles tendon pulls against connective tissue of the plantar fascia. Blood supply is carried to the Achilles tendon via the calf muscles and at the tendocalcaneal junction.

Rupture of the Achilles tendon can occur with an abrupt dorsiflexion of the foot; a rapid, forced plantar flexion; then dorsiflexion of the plantar-flexed foot.⁵ Most tears occur approximately 3 to 6 cm proximal to the insertion at the calcaneus because this area has the lightest vascular flow⁴ (Figure 1). The major blood vessel to the Achilles tendon is the posterior tibial artery. The ability to plantar flex the foot is controlled by the tibial nerves S1 and S2. A severed Achilles tendon provides no tension to hold the foot up, leaving the foot in plantar flexion.

Achilles tendinopathy includes two types of tendinitis that can occur at the tendocalcaneal junction: *Insertional tendinitis* manifests where the Achilles tendon is anchored on the calcaneus. *Noninsertional tendinitis* manifests in the areas proximal to the retrocalcaneal bursa.⁶ *Haglund's deformity* is a protuberance of bone originating on the calcaneus at the tendocalcaneal junction. Haglund's deformity becomes more of a concern over time, as it rubs against the Achilles tendon at the posterior heel when a person is wearing shoes and promotes a cyclic inflammatory process. Thus, it can be a contributing factor in Achilles tendinopathy. *Haglund's syndrome* results when a patient with the deformity develops pain and swelling in the posterior aspect of the ankle.

Sports that incorporate running activities involve a constant alternation between dorsiflexion and plantar flexion. A weak area in the Achilles tendon coupled with a strong force can result in a rupture. A sudden takeoff from a stopped position puts a significant amount of force through the Achilles tendon. Still, many patients say that they were running when the injury occurred, and they looked to see who hit them from behind because the injury can mimic a kick.⁷ The rotational motion used on elliptical trainers, bicycles, and when swimming are safer exercises for the Achilles tendon than running and jumping.

PHYSICAL EXAMINATION

The Simmonds' test, also known as the *Thompson test*, is a gross screening examination for an Achilles tendon rupture. The patient lies prone on the examination table with the feet and ankles positioned over the edge of the table. In a person with an intact Achilles tendon, the foot should move into plantar flexion when you squeeze the calf muscles bilaterally. No movement in the foot indicates a rupture. This is a modified technique used by some clinicians; the standard technique is to flex the knee 90° with the patient prone and squeeze the calf, observing for plantar flexion.⁷

The acute Achilles tendon rupture is a closed wound unless the tendon was cut by an external object or as a result of a penetrating injury. Patients often present with swelling in the posterior ankle, foot, and toes (Figure 2); pain can be variable. The foot on the affected leg is more equinus than the unaffected leg when the patient sits on the examination table. Patients who have not elevated the foot or applied ice before the examination may have significant swelling. The neurovascular status of the injured leg must be checked for signs of vascular compromise and neuritis. Most patients cannot resist passive dorsiflexion of the foot because a complete rupture drastically weakens the ankle. Some patients with a partial tear can resist dorsiflexion but with obvious weakness compared to the degree of resistance in the uninjured leg. Thus, muscle strength in the affected ankle would be less than 5/5 on physical examination. The examiner can often feel the defect when palpating the contour and shape of the Achilles tendon. People with a marked Haglund's deformity have a palpable prominence on the back of the lower leg at the tendocalcaneal junction. However, the prudent clinician performs a thorough orthopedic examination of all limbs, especially both lower limbs, to decrease the probability of missing other injuries.

DIAGNOSTIC TESTS

Conventional plain film radiographs are of limited usefulness unless Haglund's deformity, a fracture, or presence of a foreign body is suspected. In uncomplicated cases, health care providers rely on the physical examination to make the diagnosis. MRI is obtained only if trauma to other soft-tissue structures is suspected. However, a more cost-effective

KEY POINTS

- The Achilles tendon forms from the distal ends of the gastrocnemius and soleus (calf) muscles and inserts at the superior posterior aspect of the calcaneus. The plantar fascia on the bottom of the foot is anchored to the inferior aspect of the calcaneus, which forms the tendocalcaneal junction (the bone and soft tissues at the ankle).
- The Simmonds' test, also known as the *Thompson test*, is a gross screening examination for an Achilles tendon rupture. The patient lies prone on the examination table with the feet and ankles positioned over the edge of the table. In a person with an intact Achilles tendon, the foot should move into plantar flexion when you squeeze the calf muscles bilaterally. No movement in the foot indicates a rupture.
- Immobilization with a short-leg cast that holds the foot in a slight plantar flexion is effective. However, the patient must wear the cast for approximately 3 months before a determination can be made that a good connection has occurred at the rupture site.
- Surgical repair of the rupture is superior to nonsurgical treatment because of the risk of rupture recurrence. Surgical repair is also indicated for tears that are older than 2 weeks.

“Most wound-related complications are caused by the anatomy of the skin at the posterior ankle. Skin tension is increased in this area.”

method of evaluating the thickness and shape of an Achilles tendon is musculoskeletal ultrasonography (US). Traditionally, US is quick and does not use ionizing radiation.⁵ CT is used regularly to confirm fractures and osteochondral lesions, but it is not commonly used to evaluate acute Achilles tendon rupture. Thus, radiographic studies are the most effective adjuncts to the history and physical examination.

TREATMENT OPTIONS

Achilles tendon rupture is treated with a cast regimen, functional bracing, or surgical repair, based on whether the rupture is a partial or complete tear. When discussing the treatment options with patients, clinicians should provide details about the healing process, including length of time and success and failure rates. The etiology of the injury and the patient's health status are factors to consider when deciding on a treatment method. For example, an athlete who wants to return to sports quickly may decide to undergo a surgical repair. However, a person with multiple comorbidities, recent MI, or poorly controlled diabetes or a person who is a poor candidate for anesthesia may favor the cast regimen. In most cases, the dilemma is in determining whether the injury is a partial or complete tear.

Unfortunately, some patients may refuse both surgical repair and the cast regimen; opting to allow the injury to heal on its own. This approach is neither medically advised nor endorsed because the ends of the Achilles tendon must be in close proximity to encourage reattachment. The patient who chooses this option is advised that a poor prognosis is to be expected. The patient is instructed to use crutches and not to walk on the injured leg.

Immobilization with a short-leg cast that holds the foot in a slight plantar flexion is effective. However, the patient must wear the cast for approximately 3 months before a determination can be made that a good connection has occurred at the rupture site. The cast is changed every 3 to 4 weeks, sooner if the patient experiences problems with the cast. Complications are variable and include skin irritation at the pressure points, itching, circulation compromise, cast laxity, neuritis, and cast breakdown. Patients are advised to remain nonweight-bearing on the affected leg for at least the first 6 weeks of the treatment period. A functional brace, also known as a *boot brace*, is used either alone or in postoperative treatment.

Surgical repair of the rupture is superior to nonsurgical treatment because the risk of rupture recurrence is less with surgery.⁸ Surgical repair is also indicated for tears that are

older than 2 weeks. A randomized controlled clinical trial compared minimally invasive treatment (n = 42 patients) with nonoperative treatment (n = 41 patients). The results of this study showed that risk of complications other than rupture recurrence were approximately 21% with minimally invasive surgical treatment versus 37% with nonoperative treatment by bracing. However, the study also showed that functional bracing had fewer overall complications than minimally invasive surgery.⁹ In addition, percutaneous surgery on the Achilles tendon has fewer intraoperative risks than an open procedure.¹⁰

Fibrin glue has been used since the early 1980s to repair ruptured tendons. A long-term study in Switzerland followed patients for an average of 12.5 years after surgical repair with sutures and with fibrin glue.³ The researchers found that fibrin glue yielded a stronger tensile strength at the rupture site of an Achilles tendon than did suture material. An additional advantage of fibrin glue is that it is less likely to cause tissue ischemia and disproportionate approximation of the Achilles tendon.³

During open surgery, an incision is made on the posterior lower leg. The fascia is dissected to expose the Achilles tendon. The ends of the ruptured tendon are reattached. The decision about whether to use nonabsorbable or absorbable, monofilament or polyfilament suture material is most often based on the preference of the surgeon performing the procedure. Gentle dorsiflexion and plantar flexion are used to assess the reattachment before closing the wound. The foot is placed in a splint or cast at 20° of plantar flexion—a greater



FIGURE 2. Swelling caused by rupture of Achilles tendon

© Dr P. Marazzi / Photo Researchers, Inc.

degree of plantar flexion decreases vascular perfusion, which can lead to a poorly healing wound and tendon.¹¹

The affected leg must be kept in nonweight-bearing status for 2 weeks. Walking on the leg too soon increases the risk of rupture recurrence. At the first follow-up visit, the superficial sutures or staples are removed and the foot is placed in a new cast—a rigid orthosis or functional brace, such as a foam boot walker (Cam walker)—for 4 to 6 weeks with weight bearing as tolerated. The Achilles tendon is allowed increased dorsiflexion with each splint or cast change to allow for a gradual return to a neutral foot position.^{8,12} In general, casts and splinting materials are routinely changed every 2 to 4 weeks.

“Stretching is an important factor when treating the Achilles tendon. Tight calf muscles are more susceptible to injury.”

A heel lift, which is a small foam pad placed inside the boot, is often used to offload the Achilles tendon during standing and walking.¹³ Patients are instructed to avoid walking without the boot walker until their physician expressly tells them they can walk without it. Most patients need to use crutches during the first 4 to 6 weeks of the healing phase. One group of researchers found that postoperative use of a rigid splint that allowed for active mobile plantar flexion but limited dorsiflexion of the ankle promoted early range of motion.¹⁴

Stretching, applying ice and/or heat, walking, bicycle riding, and swimming are therapeutic, low-impact activities that help rehabilitate the leg. Surgical repair of the Achilles tendon does not require formal postoperative physical therapy; however, some patients may require it to strengthen the tendon. Physical therapy is used more often as an adjunctive treatment. Until muscle strength in the repaired leg is regained, patients will use the unaffected leg to assist in performing a heel raise with the repaired tendon. Therefore, muscle strength is measured by the patient's ability to perform a single-heel raise with the repaired tendon. Patient strength progresses to a double-heel raise at 7.5 to 8 weeks after surgery, and a single-heel raise at 12 weeks after surgery.¹⁵

Surgeons in the United Kingdom developed a minimally invasive technique for repairing chronic ruptures of the Achilles tendon.¹⁶ They reconstructed the Achilles tendon using the semitendinosus tendon as the graft tissue. Study results showed that the semitendinosus is an effective graft for a large defect (6 cm or more) in the Achilles tendon.¹⁶ Another group of surgeons strengthened the Achilles tendon by grafting the flexor hallucis longus (FHL) tendon to it.¹⁷ In this study, the procedure is used to enhance a ruptured Achilles tendon or treat chronic Achilles tendinopathy. Follow-up was by MRI, and the FHL graft was found to be functioning well with the Achilles tendon.¹⁷

COMPLICATIONS

Adverse events from a rupture of the Achilles tendon include exacerbation of a preexisting condition, soft-tissue damage from the traumatic injury, infection, neuritis, poor wound healing at the incision site, and rupture recurrence.¹² Preexisting conditions of greatest concern are Haglund's deformity, Achilles tendinosis, and a prior rupture on the affected leg. Patients experience soft-tissue swelling around the ankle, mid-foot, and forefoot; neuritis around the ankle; and pain after an acute injury. Preoperative care includes elevating the foot and applying ice for 20 minutes three times per day, which can help reduce swelling. Patients who have excessive preoperative swelling will have more skin tension at the wound site when the wound is closed. This increases the risk of a poorly healing wound. Anti-inflammatories and/or pain medication may be prescribed for patient comfort. If immobilization therapy fails, surgery should be reconsidered.

Achilles tendon repair, as with all surgical procedures, has risks. Therefore, health care providers must take the time to explain to the patient the risks and benefits of surgery, especially the long recovery period. Infection is treated with antibiotics, rupture recurrence may warrant another surgical procedure, and most cases of postoperative neuritis resolve without interventions. Pressure sores and ulcers are prevented by moving regularly to avoid continuous pressure on one area for a prolonged period of time. Sural nerve deficits have been noted, and these may resolve over time.⁹ Most wound-related complications are caused by the anatomy of the skin at the posterior ankle. Specifically, skin tension is increased in the heel area. In addition, the skin is retracted for adequate visualization of the defect in an open surgical approach. Closing the wound can be problematic because the skin is delicate, and overstretching can compromise the vascular supply.

Patients must elevate the foot and apply ice to minimize swelling and reduce skin tension at the surgical site. Increased swelling in the ankle can leave small areas of the wound not fully approximated, which can delay wound healing and lead to infection and scarring, particularly after the sutures or staples are removed. Consequently, significantly fewer incision-related complications occur after a percutaneous procedure than occur after an open repair. If infection is a concern, oral antibiotics should be prescribed. Nevertheless, postoperative care of the surgical incision can be difficult, and patients must be educated on how to care for the wound and keep it clean in order to minimize the risk of infection.

PATIENT EDUCATION

Prevention of an Achilles tendon rupture is not always possible, especially in the case of a traumatic injury. Patient education is an essential part of preventing further injury, especially during the healing process. Stretching is an important factor when treating the Achilles tendon. Tight calf muscles, like other muscles in the body, are more susceptible to injury. Athletes and nonathletes should take the time to warm up and stretch. Sometimes injury occurs because a person resumed participation in a sport or exercise program after a

long hiatus. In this case, the person should perform a runner's stretch against a wall. Unfortunately, some people will attempt to return to an original level of physical activity too soon and risk a rupture. Persons who cannot perform this stretch can use stretch bands or wrap a towel around the ankle and dorsiflex the foot from a sitting position to stretch the Achilles tendon. Although sometimes underrated as a treatment approach, nutrition is beneficial for bones and tendons as well. People should always consult their health care provider before beginning any exercise regimen.

Recovery from an Achilles tendon rupture is slow, and patients should be informed of the healing process. A detailed plan that meets the patient's expectations and goals can be worked out with the health care provider when the patient describes activities of daily life. With appropriate treatment, patients can have a positive outcome after repair of an Achilles tendon rupture. [JAAPA](#)

David Cary is an assistant professor in the physician assistant program at Nova Southeastern University, Orlando, Florida. He has indicated no relationships to disclose relating to the content of this article.

REFERENCES

1. Maffulli N, Ajjis A, Longo U, Denaro V. Chronic rupture of tendo Achillis. *Foot Ankle Clin.* 2007; 12(4):583-596, vi.
2. Sorosky B, Press J, Plastaras C, Rittenberg J. The practical management of Achilles tendinopathy. *Clin J Sports Med.* 2004;14(1):40-44.
3. Hohendorff B, Siepen W, Spiering L, et al. Long-term results after operatively treated Achilles tendon rupture: fibrin glue versus suture. *J Foot Ankle Surg.* 2008;47(5):392-399.
4. Skinner H, ed. *Current Diagnosis and Treatment in Orthopedics.* 4th ed. New York, NY: McGraw-Hill; 2006:527.
5. Jacobs BA, Lin DY, Schwartz E. Achilles tendon rupture. eMedicine Web site. <http://www.emedicine.com/sports/topic1.htm>. Updated June 24, 2009. Accessed July 6, 2009.
6. Wheelless CR III. Achilles tendinitis/tendinosis. Duke Orthopaedics presents *Wheelless Textbook of Orthopaedics.* http://www.wheellessonline.com/ortho/Achilles_tendinitis_tendinosis. Updated February 1, 2009. Accessed July 6, 2009.
7. Saglimbeni AJ, Fulmer CJ. Achilles tendon injuries and tendonitis. eMedicine Web site. <http://emedicine.medscape.com/article/309393-overview>. Updated January 27, 2007. Accessed July 22, 2009.
8. Canal ST, Beatty JH. Rupture of muscles and tendons. In: Canal ST, Beatty JH, eds. *Campbell's Operative Orthopaedics.* 11th ed. Philadelphia, PA: Mosby; 2007:chap 46.
9. Metz R, Verleisdonk EJ, van der Heijden GJ, et al. Acute Achilles tendon rupture: minimally invasive surgery versus nonoperative treatment with immediate full weightbearing—a randomized controlled trial. *Am J Sports Med.* 2008;36(9):1688-1694.
10. Khan RJ, Fick D, Keogh A, et al. Treatment of acute Achilles tendon ruptures: a meta-analysis of randomized controlled trials. *J Bone Joint Surg.* 2005;87(10):2202-2210.
11. Poynton AR, O'Rourke K. An analysis of skin perfusion over the Achilles tendon in varying degrees of plantarflexion. *Foot Ankle Int.* 2001;22(7):572-574.
12. Carmont MR, Maffulli N. Management of insertional Achilles tendinopathy through a Cincinnati incision. *BMC Musculoskelet Disord.* 2007;8:82.
13. Rettig AC, Liotta FJ, Klootwyk TE, et al. Potential risk of rerupture in primary Achilles tendon repair in athletes younger than 30 years of age. *Am J Sports Med.* 2005;33(1):119-123.
14. Kangas J, Pajala A, Ohtonen P, Leppilahti J. Achilles tendon elongation after rupture repair: a randomized comparison of two postoperative regimens. *Am J Sports Med.* 2007;35(1):59-64.
15. Uchiyama E, Nomura A, Takeda Y, et al. A modified operation for Achilles tendon ruptures. *Am J Sports Med.* 2007;35(10):1739-1743.
16. Maffulli N, Longo UG, Gougoulas N, Denaro V. Ipsilateral free semitendinosus tendon graft transfer for reconstruction of chronic tears of the Achilles tendon. *BMC Musculoskelet Disord.* 2008;9:100.
17. Hahn F, Meyer P, Maiwald C, et al. Treatment of chronic Achilles tendinopathy and ruptures with flexor hallucis tendon transfer: clinical outcome and MRI findings. *Foot Ankle Int.* 2008;29(8):794-802.