

Achilles Tendon Disorders



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What do Misty May-Treanor, Liu Xiang (China's most famous athlete), Dan Marino and Boris Becker have in common? They have all been affected by disorders involving the Achilles tendon.

The Achilles tendon is named after the Greek warrior Achilles. Achilles was dipped into the river Styx by his mother Thetis to render him invulnerable except for the non-submerged area of his heel where he was held. Achilles was mortally wounded during the siege of Troy when struck in his unprotected heel by an arrow shot by Trojan Prince Paris.

The Achilles tendon is the strongest and largest tendon in the body. It is the conjoined tendon of the gastrocnemius and soleus muscles, known as the triceps surae. The Achilles is a strong plantarflexor of the ankle, subject to high loads up to 10 times an individual's body weight with running or jumping activities. Blood vessels come into the Achilles both from the top portion and the bottom portion leaving the middle part of the Achilles relatively avascular. This involves a zone approximately 2-6 cm above its insertion point into the heel -- the area most commonly involved in Achilles tendon pathology. The tibial nerve is the major nerve in the lower leg that innervates the muscles of the Achilles; it also receives some sensory input especially during a pathologic process by the sural nerve. The gastrocnemius muscle crosses the knee and the ankle and flexes both the knee and the ankle. This muscle has fast twitch muscle fibers and is a strong plantarflexor when the knee is straight. The soleus muscle has slow twitch muscle fibers and is more of a postural muscle, keeping the body upright with the knee when the knee is flexed. It is a powerful flexor of the ankle. The Achilles tendon inserts over a broad area about 2 cm x 2 cm on the posterior aspect of the calcaneus (heel bone). The tendon rotates approximately 90 degrees before its attachment.

Near its attachment point to the heel bone, there is a bursal sac known as the retrocalcaneal bursa that lies between the Achilles and the calcaneus. The area between the Achilles and the deep flexor tendons of the leg, known as Kager's triangle, contains blood vessels that provide nutrition to the Achilles. The Achilles is comprised of collagen, which is nicely aligned, in parallel fashion made up of what is called type 1 collagen. The Achilles is also covered by a thin membrane called the paratenon that provides a loose gliding membrane. The Achilles tendon membrane blends with the covering of the heel bone called the periosteum along with fibers that blend and connect with the plantar fascia (a band of tissue along the sole or arch of the foot).

This article features Achilles tendinopathy or diseases of the Achilles tendon, with focus on para-tendinopathy or abnormalities around the tendon; tendinopathy or disease of the main body of the Achilles; as well as insertional tendinopathy, where the Achilles attaches to the heel bone.

Tendinopathy is described as *acute* when symptoms have lasted two weeks or less, *subacute* when symptoms have lasted 2 to 6 weeks; and *chronic* when symptoms have continued for over six weeks. Many terms are used when describing pain involving the Achilles tendon. Currently there is less use of 'tendinitis' as a description of

these conditions, as studies have shown that inflammatory cells and markers of inflammation are not seen in most cases/conditions. The term tendinopathy describes pathologic process of the Achilles and is more appropriate. Most abnormalities of the Achilles are due to overuse injuries such as running and jumping. Incidence is 7-9% in top level runners; 55-65% involves tendinopathy of the tendon itself, and 20-25% involves insertional tendinopathy at the attachment point. Most patients are men. Chronic conditions are more common in older athletes. There is a 41% chance of bilateral involvement.

CAUSES

Causes of Achilles tendinopathy involve both intrinsic factors, such as gender, age, obesity, individual body constitution, blood group, autoimmune disease processes, and abnormalities of the blood supply to the tendon. Additionally, malalignment of the lower extremity can occur such as foot hyperpronation or hypopronation, forefoot rotational abnormalities, high arch or low arch feet, leg length discrepancies, muscle weakness or imbalances and decreased flexibility. Other causes can include use of corticosteroids, use of fluoroquinolone, antibiotics, anabolic steroids, marijuana, heroin and cocaine. Sports related causes may be a result of excessive loads and training errors in 60-80% of patients. Environmental causes can include training in cold weather, running on a hard ground surface, slippery or icy surfaces and factors related to humidity and altitude. Factors related to running include running too long of a distance, running too high in intensity, increasing distance too rapidly, too much uphill or downhill work, as well as monotonous asymmetric or specialized training. Fatigue, poor technique and/or equipment, such as not changing running shoes when the shock absorption has worn out, are all things to consider.

With respect to Achilles tendon ruptures, the incidence is increasing to approximately 18 occurrences per 100,000 individuals in industrial countries. In 75% of rupture cases, these are associated with sports activities. Almost all cases have evidence of pathology even without prior symptoms. More ruptures have been seen in professional white-collar workers with causes attributed to sedentary lifestyle and sudden movements. These are often considered 'weekend warrior' types of athletes.

PERI-TENDINOPATHY

Peri-tendinopathy is a condition that occurs in the tissues surrounding the Achilles tendon. Early in the disease process, there is an inflammatory cell reaction in the region of the paratenon. Fluid forms around the Achilles tendon and because swelling occurs, there can be some circulatory impairment around the small vessels that supply the Achilles. Sometimes individuals can feel crepitus or a crunching sensation as the tendon moves within the paratenon that is filled with this fluid. If normal healing fails to occur, scar formation may occur with adhesions between the tissue that surrounds the Achilles and the Achilles tendon. Patients often present with pain in the main area of the Achilles and swelling and tenderness in the middle third of the Achilles. The tender area does not typically move with dorsiflexion or plantarflexion of the ankle. In more chronic conditions, pain is primarily associated with exercise. A nodular swelling occurs in the Achilles tendon and elicits pain with pressure. The tender spot does move when the ankle is flexed with dorsiflexion and plantarflexion. Clinical evaluation, ultrasound or MRI can help make an accurate diagnosis. Treatment for peritendinitis typically involves rest, immobilization, decreasing activity, icing, gentle stretching and the use of heel lifts. Anti-inflammatories are often given in the early disease process, although recent studies indicate they have minimal effects in more chronic processes. When biomechanical abnormalities are present, occasionally orthotics will be used for correcting overpronation of the foot. As a rule, we recommend no athletic activity for at least 7 to 10 days. Occasionally an individual may have an inflammation that requires a fracture boot or cast immobilization for a brief period of time. Normally one abstains from the activities that caused the discomfort until the pain resolves. Once resolved, a slow return to prior activity can be initiated. Modification of the training plan is evaluated upon returning to a sport. It usually takes 3 to 6 weeks to recover from an acute flare up and up to 6 months to recover from chronic tendinopathy. Surgical treatment for peri-tendinopathy is indicated for those who fail to improve with nonoperative treatment in a time period greater than 3 to 6 months. Surgery involves excision of the scar tissue

from around the Achilles and debridement (clearing away) of any paratenon as necessary. Long-term prognosis is typically good – with 80% return to pre-injury activity levels. Thirty percent of those with peritendinitis may require some type of surgical intervention.

TENDINOPATHY OF THE MAIN BODY

Tendinopathy of the main body of the Achilles tendon primarily presents as pain 2-6 cm above the attachment point of the Achilles. This occurs most often after exercise in the early phases. As the disease process progresses, many patients experience pain during exercise. In severe cases, some patients can experience pain with all activities. Many describe morning stiffness when dealing with this affliction. For runners, most describe pain at the beginning and at the end of their workout with a pain free period during the middle of a run. With further disease progression, most patients will present with a thickened nodular area in the midportion of the Achilles tendon. There are normally no signs of acute inflammation or excessive swelling present when they present at the office. However, the Achilles is tender with palpation by the examining doctor. Patients may experience some discomfort with footwear, such as boots that press on the back of the Achilles. Nonoperative treatment is similar to that previously described for para-tendinopathy; that is, abstaining from activities that cause discomfort, use of a heel lift or a fracture boot, some gentle stretching and range of motion and avoidance of excessive stretching and overuse of the Achilles. Steroid injections are usually avoided as some studies show a weakening effect on the Achilles. Other studies have shown some positive results with sclerosing agents which serve to decrease neovascularization which is often seen in patients with tendinosis. Neovascularization or the development of new blood vessels around the Achilles also can bring in nerve fibers which are thought to cause the pain felt in this disease. By sclerosing or obliterating the new blood vessel growth, this may decrease pain by limiting the new growth of nerve fibers around the Achilles. Physical therapy has also been used in treatment of Achilles tendinosis. The focus in physical therapy is on eccentric stretching and strengthening protocols. Eccentric training involves strengthening the Achilles while it is being stretched; for example, stretching the Achilles using one's body weight as on the edge of a stair. Eccentric training has shown to be superior to concentric training (pushing off or plantarflexion strengthening) in decreasing pain. Other studies indicate that topical glyceryl trinitrate, in addition to physical therapy, has decreased pain 78 % at 6 months, versus 49% decrease with physical therapy alone.

Surgical treatment for Achilles tendinosis is reserved for those who fail conservative treatment for more than 3-6 months. Surgery carries a success rate of 75-100% in different studies. Surgery has traditionally included open exploration and debridement of any abnormal-appearing scar tissue from within the midsubstance of the Achilles tendon. Depending on the extent of debridement, patients may occasionally require reconstruction of the Achilles if more than 50% of the tendon has been debrided. This involves transferring the flexor hallucis longus tendon from the back of the ankle joint into the heel bone just in front of the repair of the Achilles tendon. Increasing the power of the Achilles, it is also thought to bring a better blood supply into the diseased tendon to aid in healing. Other tendons can be utilized for this purpose as well; the most common tendon that may be used is the peroneus brevis tendon. For smaller lesions measuring less than 2.5 cm, percutaneous techniques can also be utilized with good results. This technique involves making small stab incisions over the diseased portion of the Achilles and small slits within the Achilles tendon. These tenotomies are thought to initiate a new healing response by bringing in a better blood supply to the diseased tendon. More recently, a new technology known as TOPAZ has been used in similar fashion and is a more minimally invasive type of treatment for Achilles tendinosis. TOPAZ technology uses a special wand to create small channels within the Achilles; it is theorized that causing microtrauma to the tendon will aid in a new reparative process.

INSERTIONAL TENDINOPATHY

Insertional tendinopathy is another condition involving the Achilles and a major cause of posterior heel pain. The condition is seen not only in older athletes, but in older, less athletic and overweight individuals as well. Most patients complain of pain over the posterior aspect of the heel where the Achilles attaches. This condition can

often overlap with a condition known as Haglund's syndrome—a syndrome involving an enlargement of the posterior aspect of the heel bone, often including retrocalcaneal bursitis. Other terms for an enlargement of the back of the heel have been termed pump bumps and include pain over the bony prominence, but do not involve the Achilles tendon. With insertional tendinopathy, it's important to look at the involved anatomy -- the area where the Achilles attaches to the back of the heel consisting of tendon, some fibrocartilage, and bone. With this condition, edema or swelling is often seen within the tendon. Some degeneration of the tendon is seen as well as disruption of the normal collagen arrangement. Necrosis or areas with inadequate blood supply, small hemorrhages and calcifications in the tendon are often seen. Bone spurs can result from ossification of the fibrocartilage where the tendon attaches to the bone. The bone spurs are thought to be due to repetitive traction forces on the back of the heel. The spurs associated with this condition are often seen clinically as well as on the x-rays seen in the office. (Fig. 1)

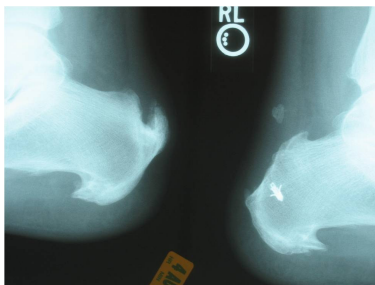


Fig. 1: X-ray, large posterior heel spur

Symptoms include early morning stiffness and pain at the insertion point, which worsens after exercise, after climbing stairs and after running. Examination reveals tenderness at the Achilles insertion, a thickening of the tendon and a palpable bony ridge or heel prominence. (Fig. 2)



Fig. 2: Enlarged heel from heel spur and Achilles tendinopathy

Sometimes posterior heel pain is associated with gout, elevated lipids, autoimmune diseases, chronic steroid use, fluoroquinolone use and other abnormalities causing posterior ankle pain. These must be ruled out prior to giving an adequate diagnosis of insertional tendinopathy.

The diagnosis is usually made upon physical examination. When the patient presents at the office, standing radiographs often show signs of the disease process. An MRI scan is often utilized not only for diagnosis but also to stage the extent of involvement; ultrasound can also be used.

Treatment involves rest, ice, modification of training, heel lifts, orthoses for biomechanical abnormalities and may include the use of nonsteroidal anti-inflammatory medications. Nonoperative treatment can yield an 85% improvement. Eccentric training for this condition only shows a 32% improvement compared to an 89% improvement with non-insertional Achilles tendinopathy. In a recent study, low energy shockwave treatment has

shown to be better than eccentric loading at four months. A 64% improvement was seen using low energy shockwave treatment versus 28% improvement with eccentric stretching techniques.

Surgery is also indicated for those who have failed conservative treatment. It consists of debridement of the calcific and diseased tendon from the insertion point, excision of the retrocalcaneal bursa and resection of the posterior superior calcaneal bony prominence of the heel. This involves some detachment of the Achilles tendon and may require repair of the Achilles tendon using suture anchors or augmentation, or depending on the extent of the disease, a tendon transfer often using the flexor hallucis longus (FHL) tendon. If the tendon is not extensively involved, and the main complaint involves prominence of the posterior heel bone, a lateral incision is commonly made with minimal elevation of the Achilles. Occasionally arthroscopic surgery is also utilized for this purpose with good results. For more extensive involvement where the Achilles shows disease throughout its substance and extension towards the inside and outside of the heel bone, usually a straight incision is made over the center portion of the heel in order to access the entire tendon. The tendon is detached, cleaned of its degenerative areas and reattached with bioabsorbable suture anchors. (Fig. 3)

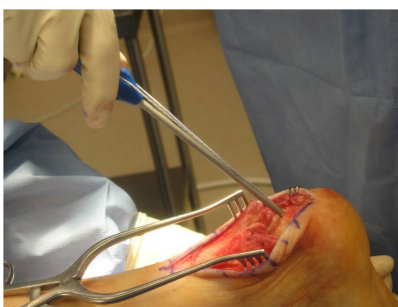


Fig. 3: *Suture anchors inserted for reattachment of Achilles after debridement*

If more than 50% of the tendon is involved or the tendinosis extends into the main body of the tendon, the repair may be reinforced with an FHL tendon transfer. This tendon is placed into a small bone tunnel created just anterior to the normal tendon attachment point and held in place with a bioabsorbable interference screw.

Most patients who have surgery for insertional tendinopathy have 80% or more improvement. The postoperative immobilization is dependent on the extent of surgery. Patients are placed in a cast from 2 to 4 weeks and then placed in a cast boot with or without a small foam heel wedge to allow for some range of motion and gentle stretching. Weight bearing is usually incorporated at this time. Physical therapy customarily begins 6 weeks after the surgical procedure with gradual training. Patients are instructed not to expect a return to competitive sports for at least 6 months. Additionally, patients are informed that it may take 9 to 12 months for complete recovery.

ACHILLES TENDON RUPTURE

Primarily a male disease, Achilles tendon rupture usually occurs during sports activities in middle-aged men who work in white collar professions. Its incidence has increased during the last couple of decades and can involve young or middle-aged athletes and older non-athletes. Dominance of men is evident in all studies, and most likely relates to the greater prevalence of men involved in sports. Most studies also reported dominance of left-sided Achilles ruptures -- attributed to right-sided dominant individuals who push off with the left leg. Ruptures occur in the midsubstance of the tendon, usually 2-6 cm above the attachment to the calcaneus. Most injuries occur when pushing off with a weight bearing foot while extending the knee; some occur during sudden ankle dorsiflexion or violent dorsiflexion of a plantarflexed foot. In the U.S., basketball is the most common sport involved. Most patients suddenly feel a pop or snap in the calf; occasionally this is audible. Often, people believe they have been struck or kicked in the posterior aspect of the lower leg; many describe it as feeling as if they were "shot" in the leg. There is generally an immediate pain, which resolves relatively quickly. Persistent weakness,

poor balance and a limp are common. When these injuries do not involve sports, the diagnosis may not be immediately evident. Diagnosis of an Achilles rupture is customarily made clinically, based on the history of injury, a palpable gap in the tendon, and weakness with plantarflexion of the ankle and hyperdorsiflexion upon patient examination. Diagnostic tests are often used. A calf squeeze test or Thompson test is usually employed and involves squeezing the calf to elicit flexion of the foot. If this is not present, it indicates a disruption in the Achilles and is known as a positive Thompson's test. If a patient presents with a chronic Achilles rupture that has not been treated, occasionally an MRI scan will be utilized to help confirm the diagnosis and evaluate the position of the retracted tendon ends.

Despite numerous developments of treatment in the last decades, there is no consensus on the best way to deal with Achilles tendon ruptures. Management is divided into surgical and nonsurgical treatments. Surgical treatments are categorized into open operative repair and percutaneous repair. Most surgeons in the U.S. suggest using open operative management in physically active patients. Controversy still exists regarding which surgical technique yields the best outcome. Most clinical studies have shown that there is a higher re-rupture rate with nonoperative treatment of Achilles ruptures versus operative repair. This risk of re-rupture must be weighed against the risks for minor surgical complications (e.g., wound healing complications and infection). Prior to any treatment/procedure, patients should always obtain essential information and understand the pros and cons of surgical versus nonsurgical treatment for Achilles ruptures.

Whether operative or nonoperative treatment methods are chosen, early mobilization and functional bracing have been shown to improve outcomes.

After an Achilles tendon rupture, individuals involved in heavy manual jobs may experience time off work of 100 days or longer. For sedentary workers, an average of 30 days of time off has been reported. Limping on the involved side usually disappears between 3 and 4 months. The calf muscle's strength and endurance gradually improves during the first year. A return to running or jumping sports can take more than 6 months. One study found that 54% of patients who had Achilles tendon rupture resumed sports at the same level as before the injury, whereas 30% had the ability but not the ambition to do so; 15% of the study's patients had not resumed sports at one year. Despite surgery, functional rehabilitation and early weight bearing, some strength deficits and muscle atrophy remain. Deficits in plantarflexion strength have been shown to be between 5% and 20% at one year after the injury.

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