

# New Exercises For Fixing Achilles Injuries

Avoid chronic issues by strengthening your tendons and making them more resilient.

by Thomas C. Michaud, DC

*Published Jul. 15, 2017 by Competitor Magazine*

Despite its broad width and significant length, runners injure their Achilles tendons with surprising regularity.

In a recent study of 69 military cadets participating in a six-week basic training program (which included distance running), 10 of the 69 trainees suffered an Achilles tendon overuse injury. The prevalence of this injury is easy to understand when you consider the tremendous strain runners place on this tendon (e.g., during the push-off phase of running, the Achilles is exposed to a force of seven times body weight). This is close to the maximum strain the tendon can tolerate without rupturing. Also, when you couple the high strain forces with the fact that the Achilles tendon significantly weakens as we get older, it is easy to see why this tendon is injured so frequently.

Anatomically, the Achilles tendon represents the conjoined tendons of the gastrocnemius and soleus muscles. Approximately five inches above the Achilles attachment to the back of the heel, the tendons from gastrocnemius and soleus unite to form a single, thick Achilles tendon.

These conjoined tendons are wrapped by a single layer of cells called the paratenon. This sheath-like envelope is rich in blood vessels necessary to nourish the tendon. The tendon itself is made primarily from two types of connective tissue known as type 1 and type 3 collagen. In a healthy Achilles tendon, 95 percent of the collagen is made from type 1 collagen, which is stronger and more flexible than type 3. The strong cross-links and parallel arrangement of the type 1 collagen fibers give the Achilles its strength.

Unlike the vast majority of tendons in the body, the Achilles is unique in that at about the point where the gastrocnemius and soleus muscles unite, the tendon suddenly begins to twist, rotating a full 90 degrees before it attaches to the back of the heel. This extreme twisting significantly improves efficiency while running because it allows the tendon to function like a spring, absorbing energy during the early phases of the gait cycle and returning it in the form of elastic recoil during the propulsive period.

In spite of its clever design and significant strength, injuries to the Achilles are often difficult to treat and tend to become chronic. Depending on the location of the damage, Achilles injuries are divided into several categories: insertional tendinitis, paratenonitis and non-insertional tendinosis. As the name implies, insertional tendinitis refers to inflammation at the attachment point of the Achilles on the heel. Fortunately, this type of Achilles injury is relatively uncommon and its treatment is reviewed here in a previous article of mine.

The most common type of Achilles injury is paratenonitis. This injury represents an inflammatory reaction in the outer sheath of cells surrounding the tendon. The inflammation results in a visible lump that forms about two inches above the Achilles attachment. This mass represents localized thickening of the paratenon in response to microtrauma. If running is continued, the size of the lump increases and it eventually becomes so painful that running is no longer possible.

Treatment for Achilles paratenonitis is to stop running for 10 days and reduce the swelling in the paratenon with frequent ice packs. Cross-training with cycling is great but swimming should be avoided as it can tighten your Achilles. A night brace is often helpful because tendons immobilized in lengthened positions heal more quickly.

When you first return to running, you have to significantly reduce your stride length. Speed workouts have to be avoided until the Achilles is no longer sensitive to touch and if you are a midfoot or a forefoot striker, you should consider temporarily striking the ground along your outer heel.

If caught in time and the problem is corrected, Achilles paratenonitis is no big deal. If untreated, however, this injury can turn into a classic Achilles non-insertional tendinosis. This injury involves degeneration of the tendon approximately 1-2 inches above the attachment on the heel. Because this section of the tendon has such a poor blood supply, it tends to heal very slowly. Unlike insertional tendinitis and paratenonitis, non-insertional tendinosis represents a degenerative noninflammatory condition (i.e., the suffix -osis refers to wear and tear, while -itis refers to inflammation).

In response to the repeated trauma associated with running, specialized repair cells called fibroblasts move inside the tendon, where, in an attempt to heal the injured regions, they begin to synthesize collagen. In the early stages of tendon healing, the fibroblasts manufacture almost exclusively type 3 collagen, which is relatively weak and inflexible compared to the type 1 collagen found in healthy tendons. If everything goes right, as healing progresses, greater numbers of fibroblasts appear and collagen production shifts from type 3 to type 1.

Unfortunately, many runners don't give the tendon adequate time to remodel (which can take up to 6 months) and a series of small partial ruptures begin to occur, which can paradoxically act to lengthen the tendon—resulting in an increased range of upward motion at the ankle. At this point, pain is significant and the runner is usually forced to stop running altogether.

Various factors may predispose to the development of non-insertional tendinosis. In the previously mentioned study of military recruits, the recruits developing Achilles injuries were overly flexible and had weak calves; it is likely these two factors create a whipping action that strains the Achilles tendon.

The good news about non-insertional tendinosis is that there is an exercise intervention you can do at home that's been proven to be effective. Referred to as heavy load eccentric exercises, this treatment involves wearing a weighted backpack while standing on the edge of a stair with your heels hanging off the stair, as seen in the exercise demonstrated on Page 4 of this article. Using both legs, you raise your heels as high as possible and then remove the uninjured leg from the stair. The injured leg is then gradually lowered through a full range of motion. The uninjured leg is then placed back on the stairway and both legs are again used to raise the heels as high as possible. Most runners should perform 3 sets of 15 repetitions daily for 12 weeks. The orthopedic surgeon who first published the eccentric protocols, Hakan Alfredson, recommends the eccentric protocol be continued unless your Achilles pain becomes "disabling." I find Alfredson's approach a little extreme, so I tell athletes to reduce the weight while exercising if the pain exceeds more than 4 on a scale from 0 to 10 (0 being no pain, 10 being unbearable pain).

While the 3 sets of 15 protocol works well for recreational athletes, competitive runners have to work harder to heal a non-insertional Achilles injury. In a recent study evaluating tendon resiliency with different strengthening protocols, researchers from Taiwan discovered that high-level athletes have no change in tendon resiliency unless they perform 4 sets of 80 repetitions. This research explains why elite athletes do not do as well with conventional eccentric protocols as recreational athletes. (Almost all studies on eccentric exercise use the 3 sets of 15 protocol.) I recommend the 4 sets of 80 repetitions protocol for runners averaging more than 50 miles per week.

In addition to eccentric exercises, non-insertional Achilles injuries also respond very well to the strengthening exercises illustrated here on Page 5. In a recent study comparing three-dimensional motion between runners with and without Achilles tendinopathy, researchers from East Carolina University determined that compared to controls, runners with Achilles tendinopathy failed to rotate their legs outward during the pushoff phase. The authors theorized that weakness of a specific calf muscle (tibialis posterior) forced the leg to twist excessively, which in turn increased strain on the Achilles tendon. These exercises encourage outward rotation of the leg during push-off.

Another great exercise for lessening stress on the Achilles tendon are the flexor digitorum longus exercises. This muscle, which originates along the back of the leg and attaches to the tips of the toes as shown on page 6 of this article, lies deep to the Achilles and works synergistically with the Achilles to lift the heel during propulsion. Contraction of the flexor digitorum longus muscle while running can significantly reduce strain on the Achilles tendon. The exercise to strengthen this muscle is simple to perform. I recommend three sets of 40 repetitions performed daily.

In order to strengthen the flexor digitorum longus, it is also important that the runner forcefully curl the toes downward into the insole during the push off phase of the running cycle. This naturally strengthens the muscle and reduces strain on the Achilles tendon. It's easy to see if you have weakness in this muscle by looking at the insole of your running shoe. Normally, when the flexor digitorum muscle is strong you will see well-defined indents beneath the tips of the second through fifth toes, whereas a weak flexor digitorum produces no marks beneath the toes and shows signs of excessive wear in the center of the forefoot only.

Besides strengthening, an alternate method for improving Achilles function is deep tissue massage. The theory is that aggressive massage breaks down the weaker type 3 collagen fibers and increases circulation so healing can occur. To test this theory, researchers from the Biomechanics Lab at Ball State University surgically damaged the Achilles tendons in a group of rats. In one group, an aggressive deep tissue massage was performed for three minutes on the 21st, 25th, 29th and 33rd day post injury. Another group served as a control. One week later, both groups of rats had their tendons evaluated with electron microscopy. Not surprisingly, the tendons receiving deep tissue massage showed increased fibroblast proliferation, which would create an environment favoring tendon repair.

A more high-tech method of breaking down scar tissue involves extracorporeal shock wave therapy. This technique involves the use of costly machinery that blasts the Achilles with high frequency sonic vibrations. Recent research has shown comparable outcomes between shock wave therapy and heavy load eccentric exercises in the treatment of non-insertional Achilles tendinosis. As a result, shock wave therapy is typically used only after conventional methods have failed.

It's important to emphasize that runners with Achilles injuries should almost always avoid cortisone injections because they weaken the tendon by shifting the production of collagen from type 1 to type 3. In a study published in *The Journal of Bone and Joint Surgery*, cortisone was shown to lower the stress necessary to rupture the Achilles tendon and was particularly dangerous when done on both sides, because it produced a systemic effect that further weakened the tendon.

An overview of the management of Achilles tendon disorders can be summarized as follows: With mild injuries, warm the Achilles tendon up slowly by running at least one minute per mile slower than your usual pace for the first mile and try to remain on flat surfaces. In all situations, try to run with the shortest stride length you find comfortable, since long strides are notorious for stressing the Achilles tendon.

If you are a midfoot or a forefoot striker and you've been troubled with chronic Achilles pain, consider switching

to a rearfoot strike since this reduces strain in the Achilles tendon during initial contact. Because they increase strain in the Achilles by effectively lengthening the foot, runners should avoid wearing heavy motion control running shoes. In my experience, runners with Achilles injuries prefer flexible running shoes with duo-density midsoles and high toe springs. If you've been plagued with recurrent Achilles injuries, you should consider performing the strengthening exercises described in this article at least three months out of the year. These exercises may be tedious, but they can produce long-term changes in tendon strength and resiliency.