

The Ideal Exercises for Managing Insertional Achilles Injuries

By Tom Michaud, DC

Despite the fact that nearly 30% of all Achilles injuries happen at the insertion point (1) (Fig. 1), the overwhelming majority of research has focused on managing the more common non-insertional injuries. This is unfortunate because insertional injuries are notoriously difficult to treat, and current protocols have never been proven to be that efficacious. Some interesting new research suggests the poor outcomes associated with managing insertional Achilles injuries may have something to do with the fact that exercise interventions prescribed to treat insertional injuries have not been targeting the right muscles.

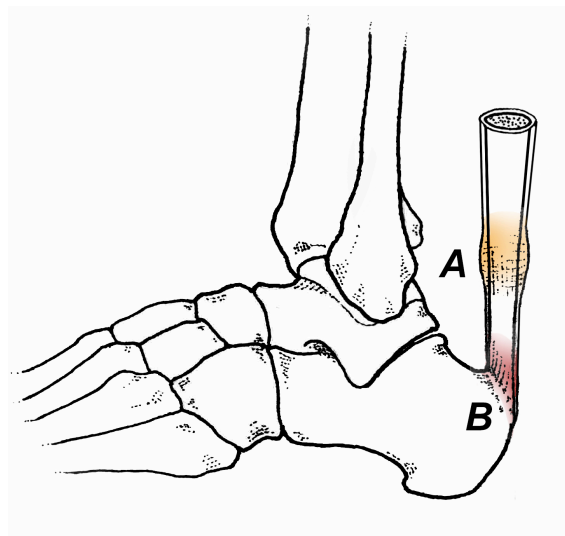


Fig. 1. While the majority of Achilles injuries occur in the tendons midsection (A), the most difficult to treat injuries occur where the Achilles tendon attaches to the heel (B). Note the characteristic swelling of the paratenon associated with midportion Achilles injuries.

The most popular exercise intervention for managing insertional Achilles injuries was originally described nearly 20 years ago by Lyman et al. (2). These researchers placed strain gauges in different portions of the Achilles insertion and determined the anterior aspect of the tendon, which is the most frequently injured component, is exposed to significantly less stress than the posterior portion of the Achilles tendon. The authors suggested the reduced stress present in the forward aspect of the Achilles tendon may cause that section of the tendon to weaken and eventually fail (Fig. 2). Based on their results, the authors suggested that it is possible to strengthen the anterior aspect of the Achilles tendon by performing calf raises from a neutral position ankle to full ankle plantarflexion, which shifts strain from the posterior to the anterior aspect of the tendon (Fig. 3). While logical, I've been using this exercise prescription for 15 years and I've never been impressed with the outcomes.

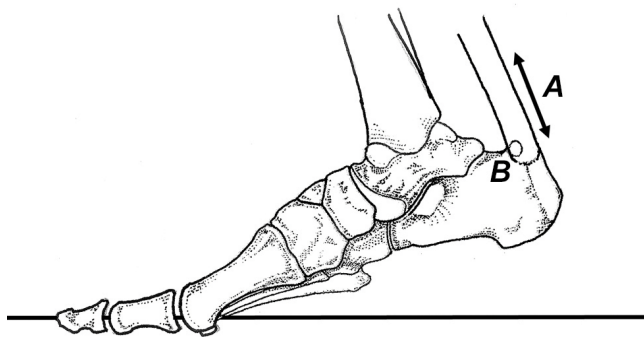
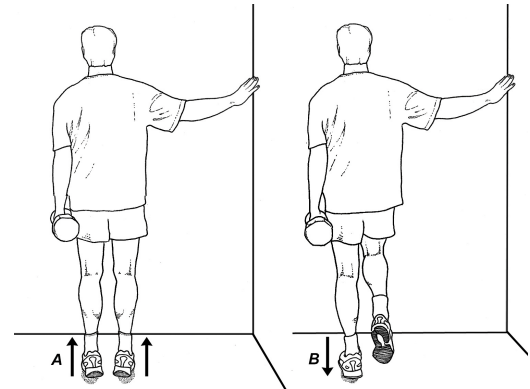


Fig. 2. Even though the back of the Achilles tendon is exposed to greater strain while walking and running (A), almost all insertional injuries happen in the front of the tendon (B), which is exposed to relatively little stress throughout the day.

Fig. 3. Nearly all insertional Achilles injuries are treated with heavy-load eccentric exercises in which the individual goes up with both legs and then slowly lowers themselves on one leg. The typical prescription is 3 sets of 15 repetitions with enough weight to produce fatigue.



Some great new research suggests that it might be possible to improve outcomes when managing insertional Achilles injuries by prescribing exercises that specifically target the muscles that attach to the anterior aspect of the Achilles insertion. A recent anatomic study using ultrasonography confirmed that because the Achilles tendon rotates nearly 90° from start to finish, only the soleus and lateral gastrocnemius tendon fibers attach directly to the anterior aspect of the calcaneus, which is the exact point that insertional tendinopathies form (3) (Fig. 4). Importantly, in about half the population, the entire anterior aspect of the Achilles insertion is represented by the lateral gastrocnemius only (3).

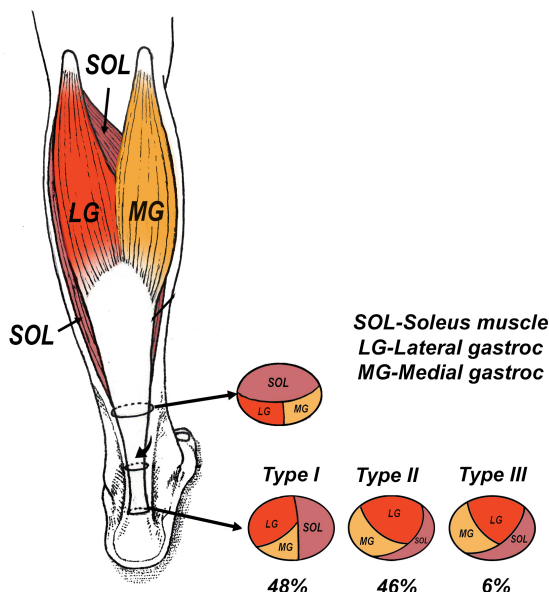
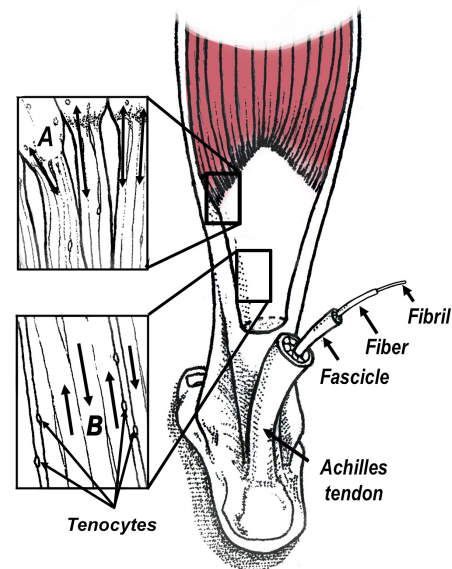


Fig. 4. Because the Achilles tendon rotates approximately 90° before attaching on the heel, tendon fibers originating from the different calf muscles reposition themselves in 3 distinct patterns (3). Notice that tendon fibers from the lateral gastrocnemius occupy the forward most aspect of the insertion in more than 50% of the population.

The clinical implication of this research is that weakness of the soleus and/or lateral gastrocnemius, in particular the lateral gastrocnemius, will result in insertional Achilles injury owing to the fact that there is reduced strain at the attachment points. Without strain, the cells responsible for healing the tendon, the tenocytes, fail to initiate remodeling (Fig. 5). The fact that a weak lateral gastroc may play a role in insertional tendinopathy should not come as a surprise, as previous research has shown that weakness of the lateral gastrocnemius strongly correlates with the development of non-insertional Achilles injuries (4).

Fig. 5. Because muscle fibers (A) attach to corresponding tendon fibers (B), when individual muscle fibers contract, their respective tendon fibers slide over one another, generating a mechanical shear force that stimulates tenocytes to remodel.



To be effective, exercise prescriptions for insertional injuries need to specifically recruit the soleus muscle and preferentially target the lateral gastrocnemius over the medial gastrocnemius muscle. Increasing force output from the lateral gastrocnemius is essential for recovery, as a growing body of research is showing that some people preferentially recruit their medial gastrocnemius over their lateral gastrocnemius, with ratios as high as 8 to 1. As demonstrated by Crouzier et al. (4,5), everyone has different recruitment ratios for firing the medial versus the lateral gastrocnemius, and when some individuals plantarflex their ankles while exercising, they generate 8 times more force in their medial versus their lateral gastrocnemius. This research explains why the standard insertional Achilles exercise program has had such poor outcomes: individuals with high output in their medial gastroc will continue to overuse the medial gastroc when exercising with their feet straight, and the anterior aspect of the Achilles insertion will be deprived of the tensile strain necessary to stimulate remodeling despite the fact that they are moving through a smaller range of motion.

To identify which specific exercises target the lateral gastrocnemius, researchers from Brazil placed EMG sensors in the different calf muscles and determined that doing straight leg heel raises with the toes pointing in preferentially recruited the lateral gastrocnemius over the medial gastrocnemius (6). Additionally, using high-speed MRIs, Handsfield et al. (7) demonstrate that bent knee heel raises greatly increase interfascicular sliding within the sub tendons of the soleus muscle. The authors claim this exercise will have “a major role in the future of tendon rehabilitation” as the enhanced interfascicular sliding stimulates tendon remodeling.

The latest research makes it clear that in order to target the specific section of the tendon damaged in insertional tendinopathies, you have to perform straight knee toe-in heel raises and bent knee heel drops.

Rather than exercising muscles in their shortened position as is done in the standard insertional protocol, it's okay to drop the heel slightly below horizontal, as you can increase strength gains nearly fourfold by exercising muscles in their lengthened versus their shortened positions (8,9). To reduce overall stress on the Achilles insertion, I recommend the 4 sets of 24 protocol performed at about 30% full effort. This particular exercise prescription has been shown to produce greater hypertrophy than conventional heavy resistance programs (10), and the lighter loads associated with this routine reduce the risk of injury during recovery. Because isometric contractions have been proven to stimulate tendon remodeling (11), at the end of each set, I recommend holding a 30-second contraction until the calf muscles are fatigued. My favorite exercise routine for managing insertional Achilles tendinopathy is illustrated in figure 6.

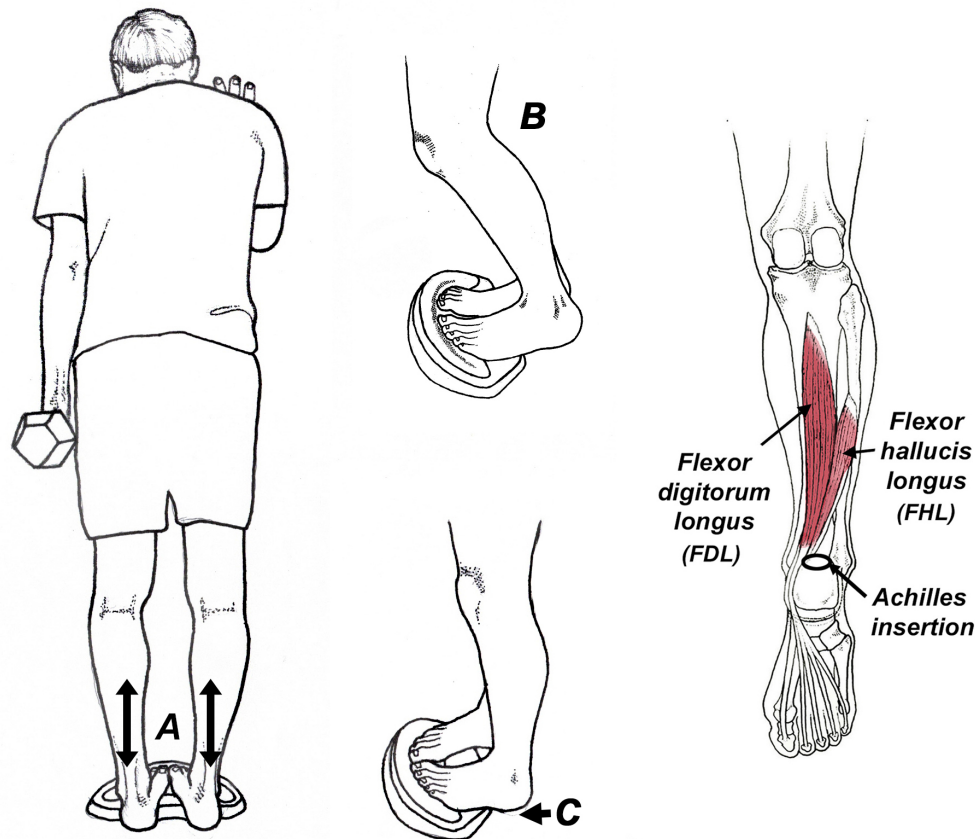


Fig. 6. Home exercise protocol for insertional Achilles injuries. Place a ToePro next to a wall and do 4 sets of 24 heel raises with your feet pointing in 20° (A). You should be holding enough weight so that you are fatigued when you finish the 24th repetition. When doing the heel raises, you should spend 2 seconds going up and 2 seconds going down and your heels should drop slightly below horizontal. Two sets should be performed with the knees straight and the toes pointing in (A), and 2 sets should be performed with the feet straight and the knees bent (B). At the end of each set, hold an isometric contraction for 30 seconds with your heels just slightly off the floor (C). Because the long toe muscles effectively redistribute force away from the Achilles tendon, it is important to push down with your toes while performing all of these exercises. I typically have people do this routine 5 times per week.

Because insertional injuries are so difficult to treat, to be comprehensive, you should evaluate the individual's foot biomechanics as people with insertional injuries tend to have high arches, which shifts an excessive amount of weight to the outer side of your heel (Fig. 7). This alignment pattern can easily be accommodated with *Peel and Stick Valgus Posts*. Nutritional factors should also be considered. Some promising research has shown that the amino acid proline and vitamin C taken 30 minutes before exercise stimulates tendon remodeling (12). Also, because the Achilles insertion was recently found to be largely fibrocartilaginous (13) (unlike the rest of the Achilles tendon, which is mostly made of flexible collagen), I've been recommending 1000 mg of glucosamine sulfate daily. In addition to its role in improving cartilage resiliency, glucosamine supplementation has been strongly associated with increased longevity and was recently proven to improve aerobic capacity (14). In all cases, it is important to avoid the routine use of oral nonsteroidals and/or corticosteroid injections, which have been proven to inhibit remodeling and have been correlated with poor long-term outcomes when managing tendon injuries (15). By prescribing the proper exercises, addressing faulty foot biomechanics and encouraging dietary changes that enhance cellular recovery, clinical outcomes for managing this difficult to treat condition should improve significantly.

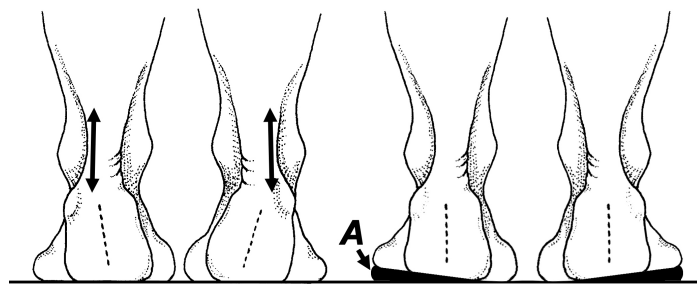


Fig. 7. People with high arches tend to put a lot of weight along the outside of their feet, which increases stress on the outer aspect of the Achilles tendon (double arrows). *Peel and stick Valgus Posts* (A) lift up the outer side of the foot and can reduce strain on the Achilles insertion. People with low arches should consider using *Peel and Stick Varus Posts*, as excessive pronation can twist the Achilles tendon thereby aggravating an insertional injury.

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