Dynamic Chiropractic

CHRONIC / ACUTE CONDITIONS

Achilles Injuries, Part 2: Paratenonitis and Non-Insertional Achilles Injuries

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Unlike the less common insertional Achilles tendon injuries [see part 1 of this article, Feb. 26 issue], paratenonitis and non-insertional Achilles tendon injuries are almost ubiquitous in the running community. Because this injury is more prevalent in older athletes, sooner or later almost every runner will have to deal with one of these annoying injuries.

The least troublesome of the Achilles tendon overuse injury is paratenonitis. This injury represents an inflammatory reaction in the outer sheath of cells that surround the tendon. The first sign of this injury is a palpable lump that forms a few inches above the Achilles attachment. Treatment for Achilles paratenonitis is to reduce the swelling with frequent ice packs. Night braces are also effective with paratenonitis because tissues immobilized in a lengthened position heal more rapidly.[1]

If the paratenonitis worsens, it may eventually turn into a non-insertional Achilles tendinosis. This injury involves degeneration of the tendon approximately 2-4 cm above the attachment on the heel. Because this section of the tendon has such a poor blood supply, it is prone to injury and tends to heal very slowly.

Unlike paratenonitis, non-insertional tendinosis represents a degenerative noninflammatory condition. Apparently, repeated trauma from overuse causes fibroblasts to infiltrate 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 assists in the repair process, but is relatively weak and inflexible compared to the type 1 collagen found in healthy tendons. As healing progresses, greater numbers of fibroblasts appear and collagen production shifts from type 3 to type 1.

Unfortunately, the tendon is frequently unable to adequately remodel and a series of small partial ruptures begin to form that can paradoxically act to lengthen the tendon. An asymmetrical increase in the range of ankle dorsiflexion on the side of the injured Achilles tendon is a clinical sign indicative of advancing tendinopathy.

Although the classic treatment for Achilles tendinosis is six weeks of rest (which theoretically allows the fibroblasts more time to remodel), a randomized controlled trial by Silbernagel, et al.,[2] reveals that tendinopathy patients who continue to exercise, but monitor pain by not allowing tendon discomfort to exceed 5 on a scale of 10, do just as well as a non-exercising tendinopathy control group, even at the 12-month follow-up. The authors emphasize that a training regimen of continuous, but pain-monitored tendon-loading physical activity represents a valuable option for patients with non-insertional Achilles tendinopathy.

Several biomechanical factors may make an individual prone to developing non-insertional Achilles tendinosis. In a study of military recruits by Mahieu, et al.,[3] the authors demonstrate that the recruits who later developed Achilles tendon injuries initially presented with weaker ankle plantarflexors and excessive ankle dorsiflexion. Apparently, the weaker more flexible muscles were less able to resist the forces of propulsion and the Achilles eventually broke down.

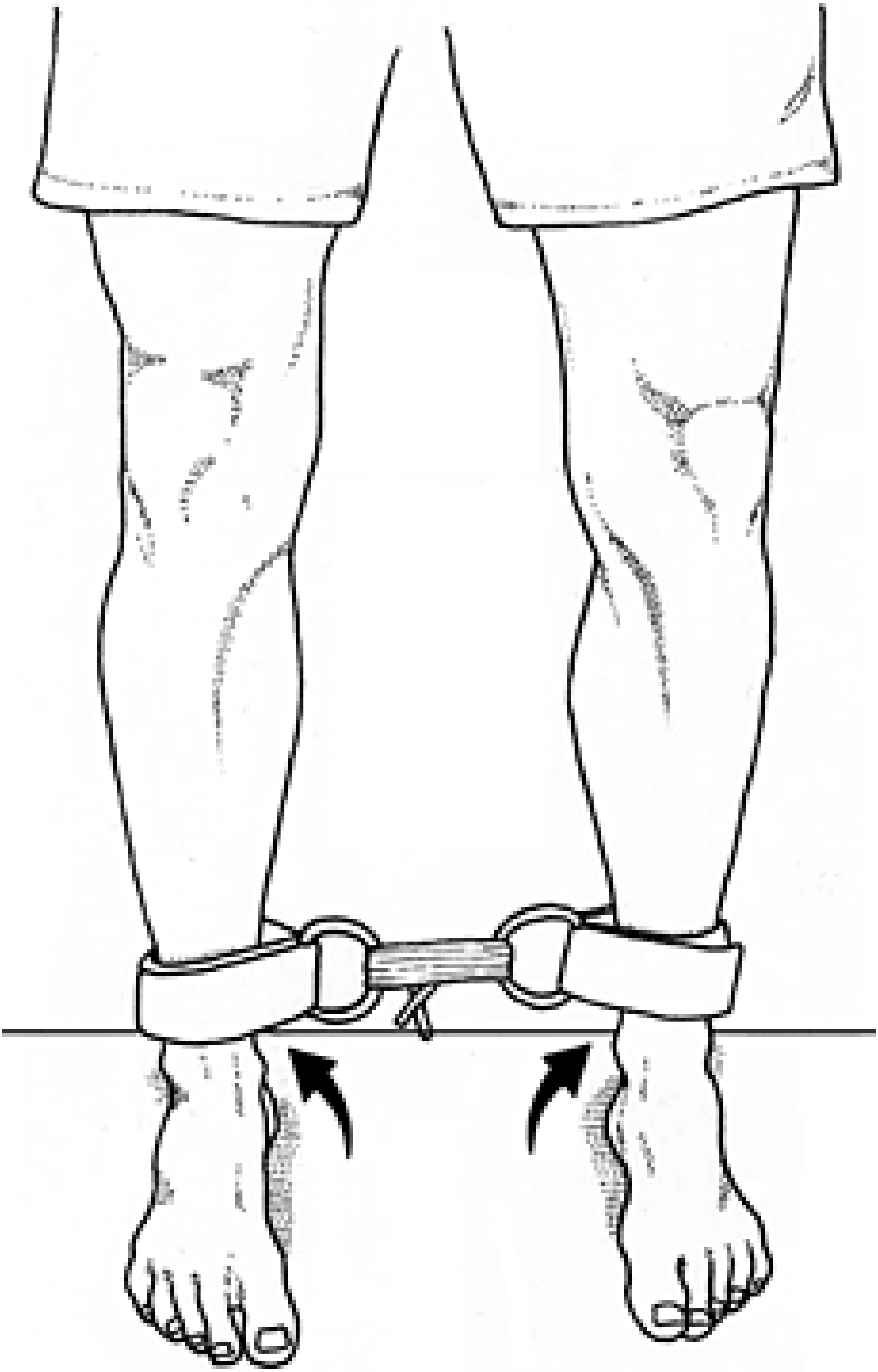

Fig. 2: A closed-chain tibialis posterior exercise. This exercise is performed by pronating and supinating the foot (arrows) with resistance provided by an elastic cord wrapped between the ankle straps. This exercise theoretically teaches tibialis posterior to supinate the rearfoot during early propulsion.

When this combination is present, an effective treatment protocol is to prescribe heavy-load eccentric exercises (Fig. 1). These exercises have been repeatedly shown to be highly effective in the management of non-insertional Achilles injuries, and have all but replaced ineffective, potentially dangerous treatments such as cortisone injections, which have been proven to lower the stress necessary to rupture the Achilles tendon.[4]

In an important study comparing three-dimensional movement patterns between runners with and without Achilles tendinopathy, Williams, et al.,[5] determined that compared to controls, runners with Achilles tendinopathy moved through the gait cycle with reduced ranges of peak knee internal rotation and reduced external tibial rotation moments (i.e., their knees turned in farther and they were lass able to rotate their legs outwardly during late stance phase). Because internal femoral rotation simultaneously displaces the lateral gastrocnemius origin anteriorly and the medial gastrocnemius origin posteriorly, the medial side of the gastrocnemius muscle is placed under greater strain. The increased muscle strain is transferred into the Achilles tendon during the latter half of stance phase, potentially resulting in injury.

The reduced external rotation moment discovered in this study is also significant; the authors claim it is most likely associated with underlying weakness of the tibialis posterior muscle. This could result in injury to the Achilles tendon because the medial side of the gastrocsoleus complex is forced to assist with eccentric control of the excessive tibial rotation present during early stance. Because the Achilles tendon is terrible at controlling frontal plane motion (compared to the tibialis posterior, it has an extremely short lever arm for controlling inversion/eversion), compensation for a weakened tibialis posterior muscle would greatly increase the workload placed on the gastrocsoleus complex, which in turn would increase tensile strain placed on the Achilles tendon.

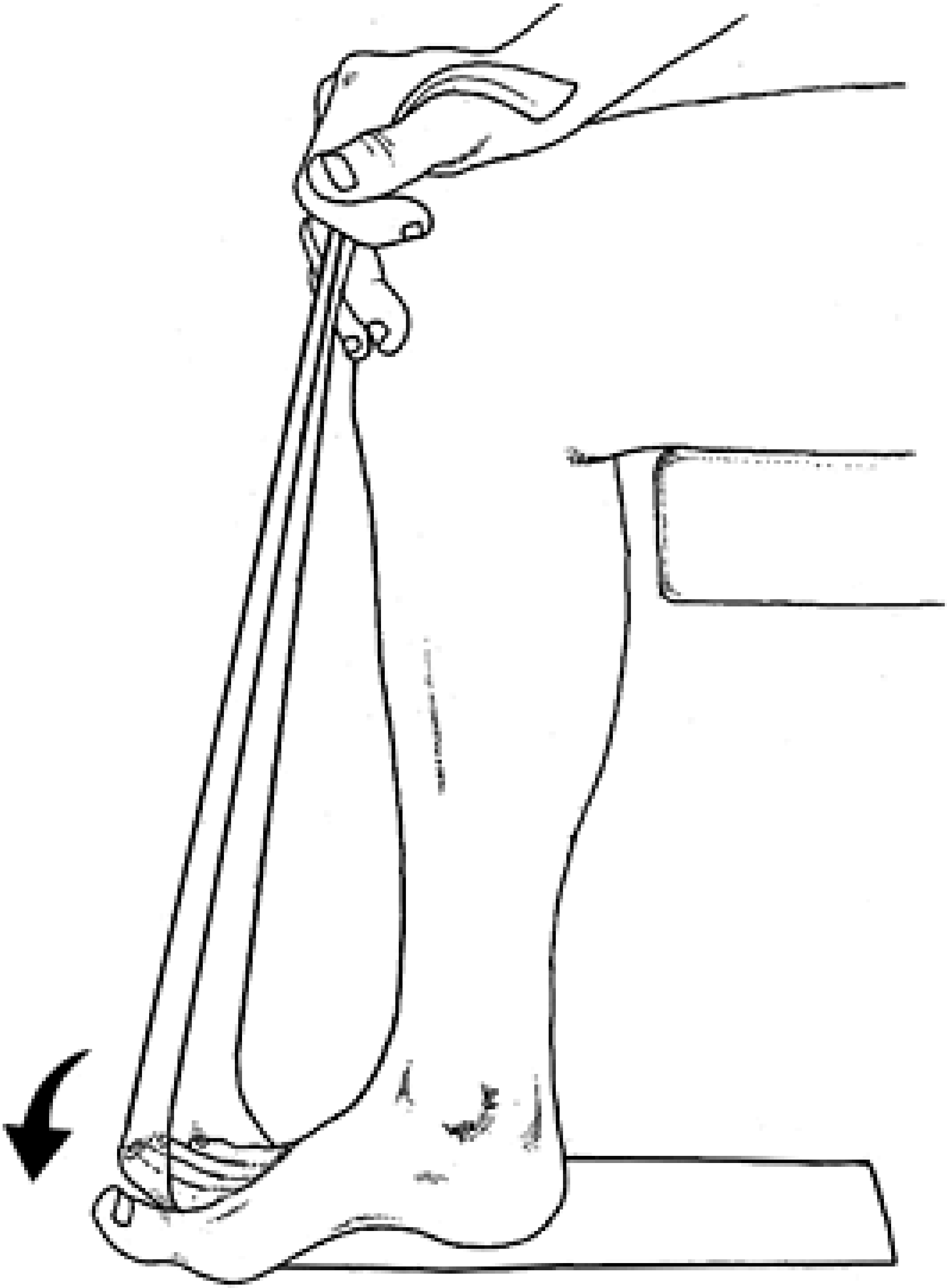

Fig. 3: Flexor digitorum longus home exercise. The seated patient places an exercise bandbeneath the foot, traversing beneath the lesser toes up to the knee. Tension in the band is determined by the pulling force at the knee and the patient actively plantarflexes the toes against resistance (arrow). To strengthen flexor hallucis longus, this exercise is repeated beneath the big toe. Eight sets of 40 repetitions are usually performed daily.

Based on the results of this study, I've developed a closed-chain concentric exercise to specifically enhance the ability of tibialis posterior to externally rotate the leg during late midstance and early propulsion (Fig. 2). This exercise is especially helpful when coupled with the use of orthotics, which have been shown to improve the mechanical efficiency of the tibialis posterior.[6]

Besides aggressive strengthening exercises, another effective method for improving Achilles tendon function is deep-tissue massage. As described by Hammer,[7] this type of massage can be augmented with tools designed for use with Graston Technique. The theory is that aggressive massage induces microtrauma that stimulates fibroblasts to accelerate repair of tissues in the extracellular matrix (e.g., collagen, elastin and proteoglycans).

To test this theory, researchers from the Biomechanics Lab at Ball State University[8] surgically damaged the Achilles tendons of different groups of rats. In one group, an aggressive deep-tissue massage was performed for three minutes on the 21^{st}, 25^{th}, 29^{th} and 33^{rd} day post-injury. Another group served as a control. One week later, both groups of rats had their tendons evaluated with light and electron microscopy. Laboratory results revealed that tendons receiving deep-tissue massage showed increased fibroblast proliferation that the authors claimed would create an environment favoring tendon repair. The ability of deep-tissue massage to accelerate healing was also confirmed in an animal study by Loghmani and Warden.[9]

Regardless of the type or severity of an Achilles tendon injury, an important method for lessening stress on the Achilles tendon is to strengthen the flexor digitorum longus muscle. Because this muscle works synergistically with the soleus muscle to decelerate the forward motion of the leg during late midstance, it may significantly lessen strain on the Achilles tendon by decelerating elongation of the tendon. Figure 3 illustrates the simple home exercise necessary to strengthen this muscle. It is also important to emphasize calf endurance exercises, since decreased endurance has been correlated to Achilles tendinopathy.[10] This is especially true following surgical repair of Achilles tendon ruptures.[11]

In addition to toe and endurance exercises, gait changes should be recommended in which the patient is instructed to shorten the length of stride, land on the heel during the contact period and deliberately plantarflex the toes during the propulsive period. Emphasizing a rearfoot contact point is essential because forefoot strike patterns result in increased rearfoot eversion excursions and eversion velocities during early stance phase,[12-13] which would place unnecessary strain on an injured Achilles tendon. Conscious plantarflexion of the toes during the latter half of stance allows flexor digitorum longus and flexor hallucis longus to assist in distributing tensile strains away from the Achilles tendon.

It is possible to evaluate the degree in which the digital flexors are participating in load sharing by observing wear patterns present on the insole: When the digital flexors are strong, well-defined indents form beneath the tips of the toes. Conversely, when the digital flexors are weak, there are no indents beneath the toes and excessive wear is present in the center of the forefoot only.

Using electron microscopes to evaluate soft-tissue healing and three-dimensional imaging systems to identify faulty movements present during the gait cycle, modern researchers are proving what chiropractors and other manual therapists have known for years: Hands-on manual therapy, orthotics and rehabilitative exercises provide safe, inexpensive and effective long-term solutions for the majority of gait-related injuries.

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