Evidence-Based Treatments for Managing Plantar Fasciitis:
Why Men and Women Should Receive Different Interventions

By Tom Michaud, DC

The plantar fascia is a broad sheath of connective tissue that stabilizes the medial arch during the gait cycle. As the foot contacts the ground, it stretches to store and return energy, offloading neighboring muscles; during propulsion, it transfers force from the Achilles tendon into the ground, stabilizing the midfoot by preventing the arch from collapsing. The plantar fascia is one of the strongest tissues in the body, capable of withstanding tensile forces exceeding 3.7 times body weight with each running stride (1).

The plantar fascia's inherent strength comes from parallel type I collagen fibers organized into three bands (Fig. 1). Of these 3 bands, the central band is by far the thickest and strongest; however, its lack of elasticity makes it susceptible to injury and microtearing, particularly at its proximal attachment to the calcaneus (2). Despite its strength and resilience, plantar fascial disorders are surprisingly common, affecting more than 10% of the population and prompting over 2 million physician visits each year (3).

A Sex-Based Injury Gap

Though rarely discussed, plantar fascial injuries are significantly more common in women, as a 6-year study of over 130,000 people showed that females are nearly twice as likely to develop this frustrating injury (4). Even worse, a 15-year study by Hansen et al. (5) found that women are more likely to develop chronic plantar fascial pain as they respond less favorably to conventional plantar fascial treatment programs. The authors offered no clear explanation for the sex-based differences in injury frequency and chronicity, attributing them vaguely to "hormonal, physical, shoe wear, or some other factor."

To better understand women’s greater susceptibility, Shiotani et al. (6) used shear wave ultrasound to assess sex differences in plantar fascial mechanical properties and found that women have notably stiffer plantar fascias throughout the entire structure, not just at the proximal attachment. The authors speculate that because women have weaker arch muscles, which normally offload the plantar fascia during propulsion, they place greater stress on the plantar fascia due to inadequate muscular stabilization, leading to chronic injury, adhesions, and reduced flexibility.

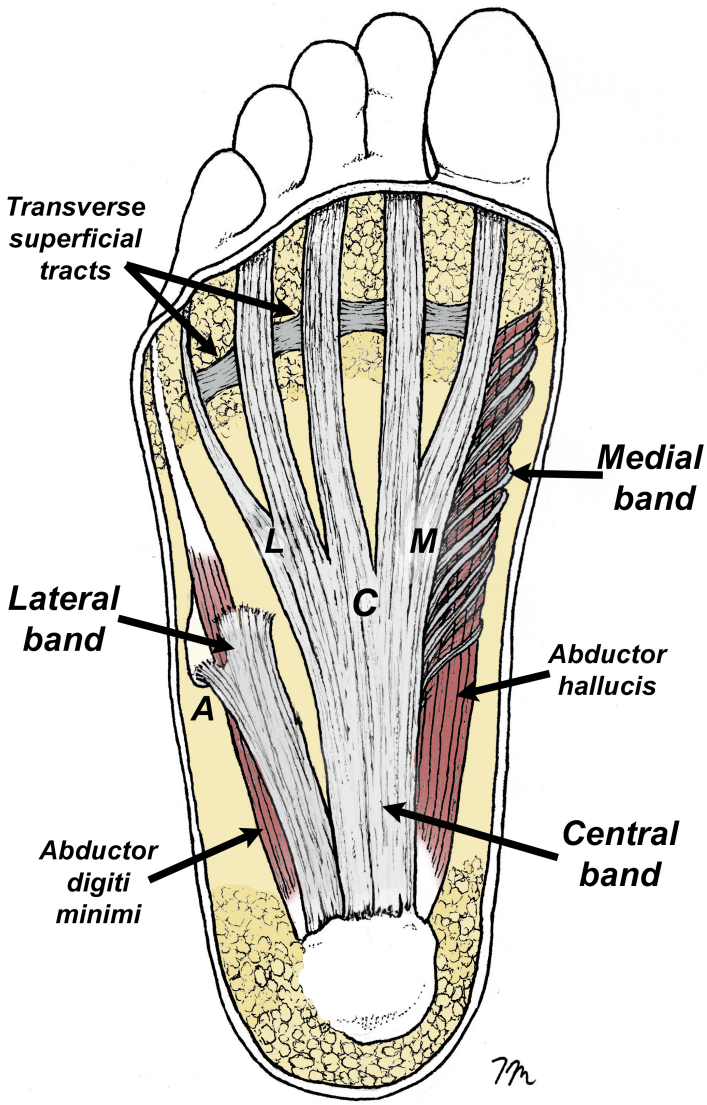

Fig. 1. The medial, lateral, and central bands of the plantar fascia. The medial band of the plantar fascia is only 0.6 mm thick (20), making it the weakest of the 3 bands. This band originates from the midportion of the central band, wraps around the abductor hallucis and inserts into the plantar plate and capsule of the 1st MTP joint. The lateral band of the plantar fascia covers the proximal portion of the abductor digiti minimi muscle and has a small slip that inserts into the base of the 5th metatarsal (**A**). Because the lateral band is approximately 2.3 mm thick (20), it is relatively strong and is an important stabilizer of the lateral column. The central band of the plantar fascia is divided into medial (**M**), central (**C**), and lateral portions (**L**), with the central portion being the thickest and the strongest (21). The average elongation of the central band of the plantar fascia is less than 6%, and the average thickness is approximately 4 mm (20). The central band originates from the medial tubercle of the calcaneus and has firm attachments to the plantar plates of the MTP joints and the undersurface of the flexor digitorum brevis muscle. In particular, the proximal portion of the central band of the plantar fascia has a direct attachment to flexor digitorum brevis (14), explaining why tightness or weakness of this muscle can contribute to plantar fascial pathology.

In a follow-up study evaluating plantar fascial and Achilles tension in males and females, Shiotani et al. (7) performed MRIs on 20 men and 20 women in a device specifically designed to measure tension in the Achilles and plantar fascia as the foot and ankle were moved into a dorsiflexed position. Using this detailed analysis, the authors determined that men have significantly stiffer Achilles tendons with more compliant plantar fascias, while women have stiffer plantar fascias with more flexible Achilles tendons. Since stiff connective tissue is more prone to failure under high loads, this research provides the most plausible theory explaining why women are twice as likely to injure their plantar fascia, while men are more prone to Achilles tendon injuries.

Why Calf Stretches Aren't Enough for Women

The clinical significance of Shiotani's research is huge, as the most commonly applied intervention for managing plantar fasciitis is to restore ankle mobility with calf stretches. According to Shiotani et al. (7), these stretches will not alter plantar fascial tension in women because their overly flexible Achilles tendons will absorb force that would otherwise have gone into stretching the plantar fascia. As a result, conventional calf stretches will increase Achilles flexibility in women (which is not necessary) but will not alter tension in their chronically tight plantar fascias. While men respond favorably to calf stretches, women need alternate stretches that specifically focus on lengthening their plantar fascia in isolation.

In 2003, DiGiovanni et al. (8) proved that a plantar fascia-specific stretching protocol yields significantly better results compared to conventional calf stretching (Fig. 2). In their study of 101 patients with chronic plantar fasciitis, DiGiovanni et al. (8) found that individuals performing the plantar fascia-targeted stretch showed greater pain reductions (83% vs. 58%), better improvements in daily function (50% vs. 11%), and overall higher patient satisfaction rates (91% vs. 61%). While the authors did not report sex-stratified outcomes, two-thirds of participants were female, which may partly explain the program's strong results, given that women with stiffer plantar fascias stand to benefit most from direct fascial stretching.

Fig. 2. The plantar fascia stretch described by DiGiovanni et al. (8). This stretch is performed by simultaneously stretching all the toes (**arrow**) while applying approximately 20 pounds of thumb pressure to the plantar fascia. The stretch is held for 10 seconds and repeated 30 times per day.

Despite DiGiovanni's impressive outcomes, no studies have been done to determine if there are alternate stretches that might more effectively improve plantar fascia flexibility. In 2026, researchers from Boston (9) embedded strain gauges into 12 cadaveric plantar fascias and tested a series of alternate plantar fascial stretches (Fig. 3). The DiGiovanni stretch produced modest lengthening of the plantar fascia, but adding 20–30 pounds of axial load through a small ball positioned beneath the midfoot nearly doubled plantar fascial elongation. The results of this study suggest that the best way for women to reduce stiffness in their plantar fascias is with the stretch illustrated in figure 4.

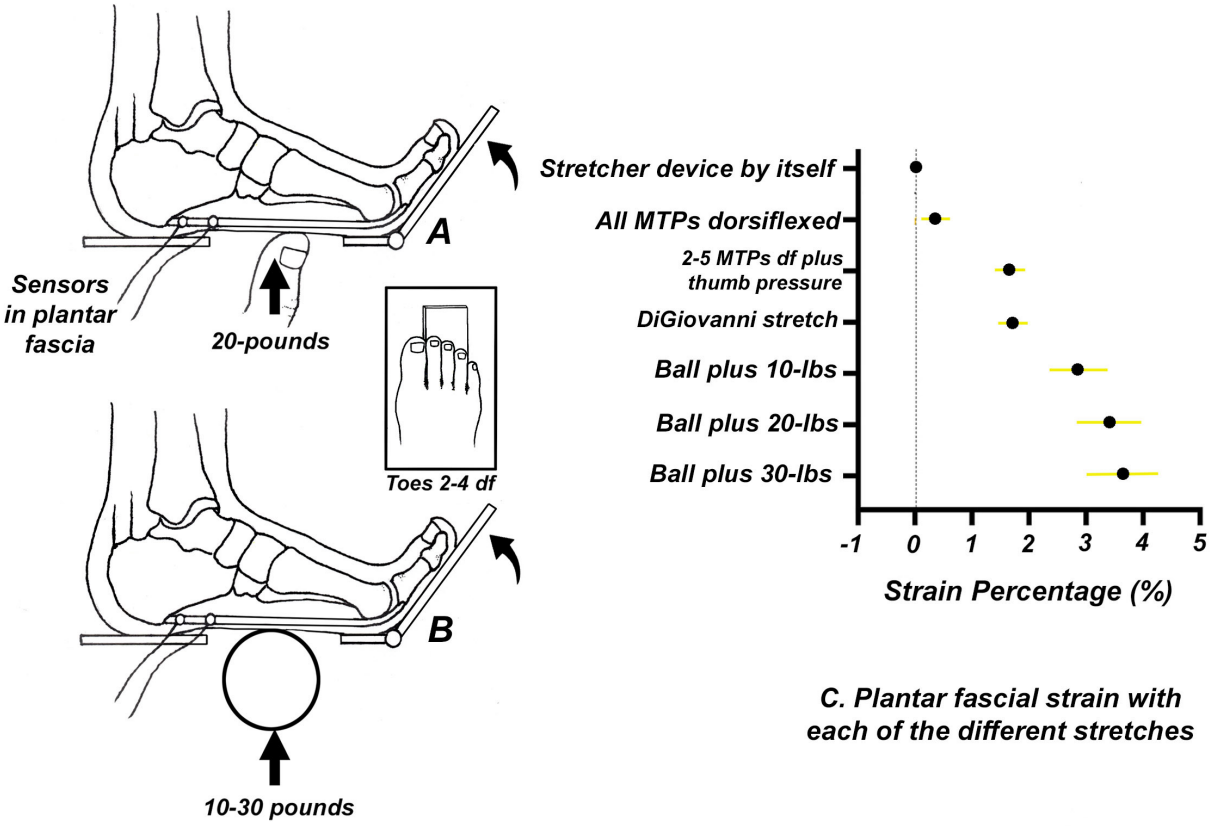

Fig. 3. Alternate plantar fascial stretches. Momenzadeh et al. (9) embedded strain gauges into cadaveric plantar fascias and measured tensile strain present in the plantar fascia during the DiGiovanni stretch (**A**), and while applying 10, 20, and then 30 pounds of pressure through a ball with a diameter of approximately 2.5 inches (**B**). The stretches were performed with all of the toes dorsiflexed 45° and again when only the central 3 toes dorsiflexed 45° (inset). Notice in graph **C** that applying between 20 and 30 pounds of pressure with a ball produced significant increases in plantar fascial tension, regardless of whether all of the toes or just the 3 central toes were dorsiflexed. This is a clinically meaningful finding, as it suggests that patients with 1st MTP joint osteoarthritis can still elongate the plantar fascia by combining central three-toe stretching with direct pressure over the fascia's midportion.

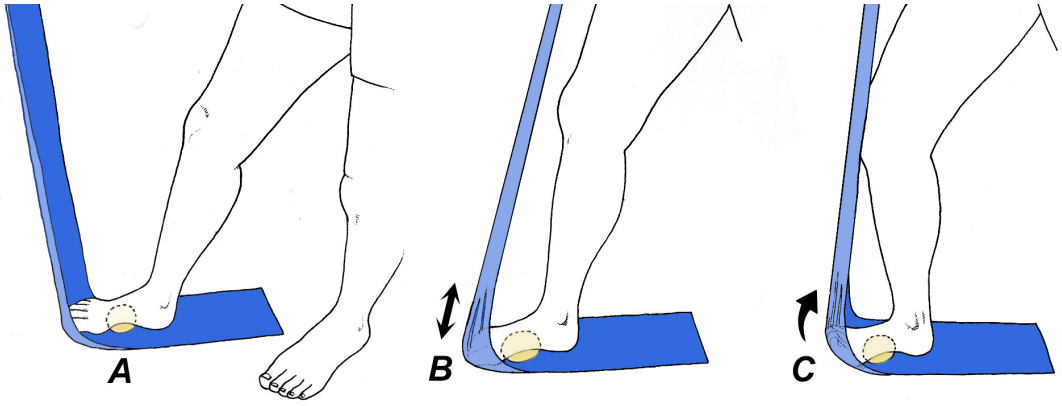

Fig. 4. The ideal plantar fascial stretch. To duplicate the tension in the plantar fascia created by Momenzadeh et al. (9), place the center of your arch on top of a soft foam ball that is positioned on a firm elastic band (**A**). Next, use your body weight to compress the ball into your arch, while simultaneously moving your toes up and down against resistance provided by the elastic band (**B**). Perform 12 repetitions moving your toes through a full range of motion and follow by stretching the plantar fascia for 45 seconds by bending your knee while keeping the toes fixed in an upward position (**C**). Repeat this routine 3 times and try to do it twice a day. Moving the toes up and down improves gliding between the plantar fascia and the flexor digitorum brevis muscle, which are often bound together by adhesions (14), while the prolonged stretch effectively lengthens even the stiffest plantar fascia. This stretch should never be uncomfortable, and people with extremely stiff plantar fascias should consider massaging their arches for a few minutes prior to beginning this stretch.

What Men Need Instead

While targeted plantar fascial stretches are crucial when treating women with plantar fasciitis, men should prioritize improving medial gastrocnemius and Achilles tendon flexibility without overloading the plantar fascia. Calf tightness, specifically tightness of the medial gastrocnemius, is a proven predictor of plantar fasciitis because it forces the heel to leave the ground prematurely, which greatly stresses the central band of the plantar fascia (10,11) (Fig. 5).

As confirmed in a cadaveric study by Ballal et al. (12), tightness of the medial gastrocnemius increases the potential for plantar fasciitis because there is a continuation of medial gastrocnemius fibers through the Achilles tendon directly into the plantar fascia. As a result, tightness of the medial gastrocnemius is transferred almost immediately into the plantar fascia following heel lift.

The best way to lengthen the medial gastrocnemius and Achilles tendon is to perform the long-duration stretches illustrated in figure 6. As demonstrated by Panidi et al. (13), performing prolonged stretching routines 5 times per week for 12 weeks increased ankle dorsiflexion by a remarkable 22%. This dramatic increase in ankle motion appreciably offloads the plantar fascia as the heel no longer leaves the ground prematurely.

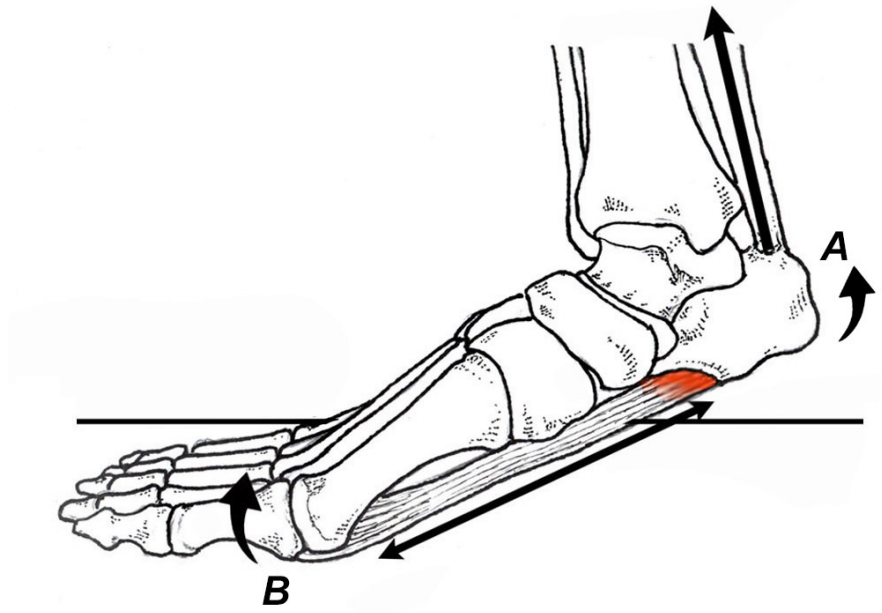

Fig. 5. When the calf muscles are tight, the heel leaves the ground prematurely (A) just as the toes begin to move upward (B). These two actions pull the plantar fascia in different directions, setting the stage for chronic plantar fasciitis. Note that because the central portion of the proximal plantar fascia is so stiff, it is the first to break down (**red**).

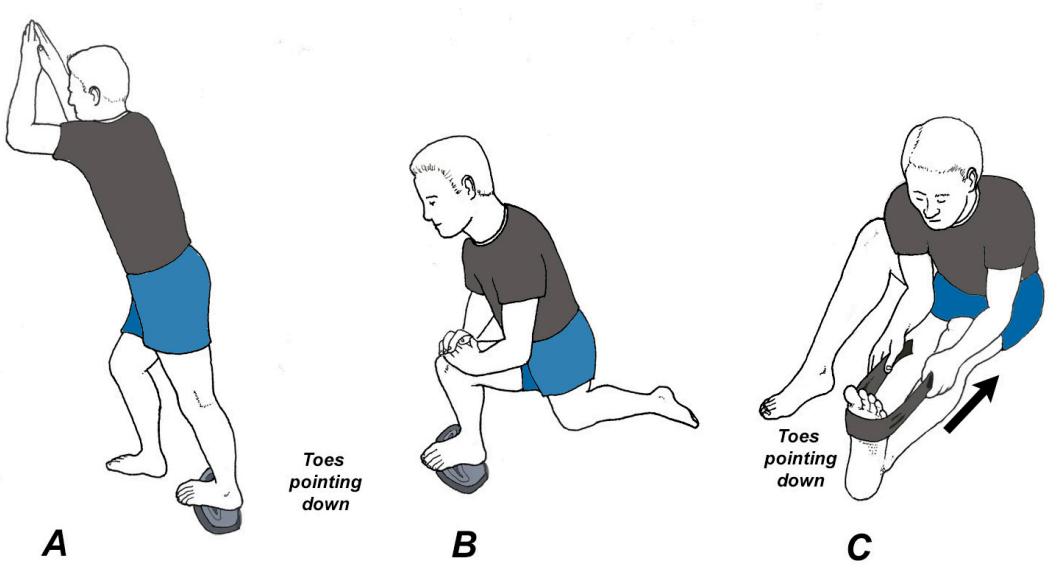

Fig. 6. Long-duration stretches to improve calf flexibility. Before beginning these stretches, massage the medial head of the gastroc for two minutes using a foam roller or a percussion massage tool. After rolling or massaging the medial gastrocnemius, hold stretches **A** through **C** for 60 seconds each, and repeat twice daily. The stretches should be held to the point of mild discomfort, and the stretch intensity in **A** and **B** is maintained by leaning forward so the heel is barely contacting the ground. In stretch **C**, pulling with greater force along the outside hand more effectively stretches the medial gastrocnemius (**arrow**). Throughout all of these stretches, the toes should be plantarflexed to better target the calf muscles and offload the plantar fascia. This entire routine should be performed 5 times per week for 12 weeks.

Strengthening for Both Sexes

Because the intrinsic and extrinsic arch muscles can markedly reduce plantar fascia tension during gait (14), strengthening these muscles is important for both sexes. In women, strong arch muscles may prevent chronicity by offloading the fascia following a plantar fascia-specific stretching routine. In men, it may reduce injury risk by stabilizing the plantar fascial origin during heel lift. The ToePro exercises illustrated in figure 7 efficiently target the peroneals and toe flexor muscles, which is important because weakness of these muscles strongly correlates with chronic heel pain (15). Because this device trains muscles while they are in a dorsiflexed position, strength gains occur up to four times faster than with conventional exercise (16). Osborne et al. (17) discovered that commonly prescribed exercises like short foot and marble pickups produce measurable EMG activity but fail to significantly enhance forefoot force output during gait. In contrast, the ToePro platform has demonstrated the ability to increase toe flexor strength by up to 35% in just six weeks (18).

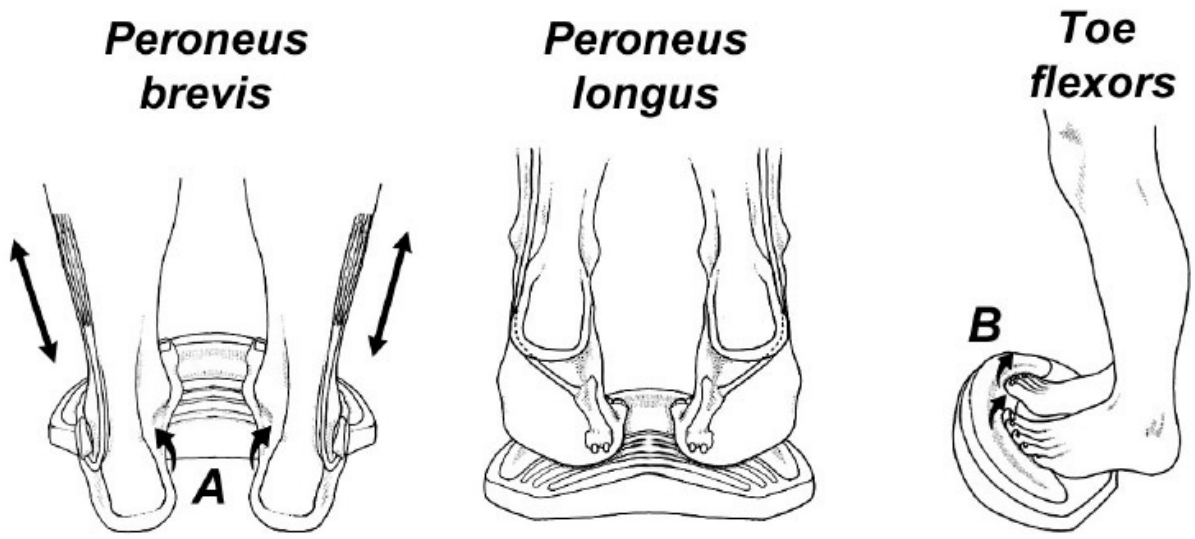

Fig. 7. As demonstrated by Sullivan et al. (15), people with plantar fasciitis are more likely to present with significant weakness of peroneus longus, brevis, and flexor digitorum brevis. These muscles are targeted with the ToePro exercise platform as this device angles down on each side to exercise the peroneal muscles in their lengthened positions (arrows in **A**), while the forward crest places the toe flexors in their lengthened positions, allowing for increased strength gains in the toes (**B**).

Toward Individualized Care

By creating an individualized treatment protocol that addresses the male/female differences between Achilles tendon and plantar fascia tension, it may be possible to improve clinical outcomes associated with this frustrating and difficult-to-treat condition. Of course, alternate interventions should also be considered, as a 2026 systematic review found that soft tissue massage improved clinical outcomes in people with chronic plantar fasciitis (19). Although not addressed in that study, it is likely that women are more likely to respond to soft tissue manual therapy applied to the plantar fascia, while men are more likely to respond to aggressive massage of the medial gastrocnemius. Interestingly, the authors state that in all of the studies included in their systematic review, manual therapy was most effective when coupled with stretching and strengthening exercises.

References:

1. Shiotani H, Mizokuchi T, Yamashita R, Naito M, Kawakami Y. Acute effects of long-distance running on mechanical and morphological properties of the human plantar fascia. Scandinavian Journal of Medicine & Science in Sports. 2020 Aug;30(8):1360-8.

2. Draghi F, Gitto S, Bortolotto C, Draghi AG, Ori Belometti G. Imaging of plantar fascia disorders: findings on plain radiography, ultrasound and magnetic resonance imaging. Insights into imaging. 2017 Feb;8(1):69-78.

3. Tong KB, Furia J. Economic burden of plantar fasciitis treatment in the United States. Phys Ther. 2010;8(11).

4. Scher CD, Belmont Jr LC, Bear MR, Mountcastle SB, Orr JD, Owens MB. The incidence of plantar fasciitis in the United States military. JBJS. 2009 Dec 1;91(12):2867-72.

5. Hansen L, Krogh TP, Ellingsen T, Bolvig L, Fredberg U. Long-term prognosis of plantar fasciitis: a 5-to 15-year follow-up study of 174 patients with ultrasound examination. Orthopaedic journal of sports medicine. 2018 Mar 1;6(3).

6. Shiotani H, Yamashita R, Mizokuchi T, Naito M, Kawakami Y. Site-and sex-differences in morphological and mechanical properties of the plantar fascia: A supersonic shear imaging study. Journal of Biomechanics. 2019 Mar 6;85:198-203.

7. Shiotani H, Takahashi K, Honma Y, Tomari K, Hayashi H, Sado N, Kawakami Y. Mechanical linkage between Achilles tendon and plantar fascia accounts for range of motion of human ankle–foot complex. Medicine and Science in Sports and Exercise. 2022 Aug 12;55(1):66.

8. DiGiovanni BF, Nawoczenski DA, Lintal ME, Moore EA, Murray JC, Wilding GE, Baumhauer JF. Tissue-specific plantar fascia-stretching exercise enhances outcomes in patients with chronic heel pain: a prospective, randomized study. JBJS. 2003 Jul 1;85(7):1270-7.

9. Momenzadeh K, Williamson PM, Williams C, Nazarian A, Miller CP. Cadaveric analysis of plantar fascia strain and the development of a plantar fascia stretching device. Journal of Biomechanics. 2026 Apr 26:113320.

10. Arshad Z, Aslam A, Razzaq MA, Bhatia M. Gastrocnemius release in the management of chronic plantar fasciitis: a systematic review. Foot & ankle international. 2022 Apr;43(4):568-75.

11. Pearce CJ, Seow D, Lau BP. Correlation between gastrocnemius tightness and heel pain severity in plantar fasciitis. Foot & ankle international. 2021 Jan;42(1):76-82.

12. Ballal MS, Walker CR, Molloy AP. The anatomical footprint of the Achilles tendon: a cadaveric study. The bone & joint journal. 2014 Oct 1;96(10):1344-8.

13. Panidi I, Bogdanis GC, Terzis G, Donti A, Konrad A, Gaspari V, Donti O. Muscle architectural and functional adaptations following 12-weeks of stretching in adolescent female athletes. Frontiers in physiology. 2021 Jul 16;12:701338.

14. Fessel G, Jacob HA, Wyss CH, Mittlmeier T, Müller-Gerbl M, Büttner A. Changes in length of the plantar aponeurosis during the stance phase of gait–an in vivo dynamic fluoroscopic study. Annals of Anatomy-Anatomischer Anzeiger. 2014 Dec 1;196(6):471-8.

15.Sullivan J, Burns J, Adams R, Pappas E, Crosbie J. Musculoskeletal and activity-related factors associated with plantar heel pain. Foot & ankle international. 2015 Jan;36(1):37-45.

16. Goldmann JP, Sanno M, Willwacher S, Heinrich K, Brüggemann GP. The potential of toe flexor muscles to enhance performance. Journal of sports sciences. 2013 Feb 1;31(4):424-33.

17. Osborne J, Menz H, Landorf K, Whittaker G, Cotchett M, Kelly L. The influence of body posture and added mass on intrinsic and extrinsic foot muscle activation and force output during common foot strengthening exercises. Journal of Sport and Health Science. 2025 Dec 16:101110.

18. Song J, Gorelik S, Husang D, Morgan T. Effects of eccentric exercises on foot structure, balance, and dynamic plantar loading. Gait Study Center, Temple University School of Podiatric Medicine. 2019.

19. Jawade SS, Jawade SA, Bankar N, Vardhan V. Effectiveness of soft tissue manual therapy in managing chronic plantar fasciitis: a systematic review. Journal of Manual & Manipulative Therapy. 2026 Mar 26:1-8.

20. Ehrmann, Christine, et al. Calcaneal attachment of the plantar fascia: MR findings in asymptomatic volunteers. *Radiology* 272.3 (2014): 807-814.

21. Guo, Junchao, et al. Biomechanical and mechanical behavior of the plantar fascia in macro and micro structures. *Journal of Biomechanics* 76 (2018): 160-166.