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Treatment Options for Plantar Fasciitis: Surgical Release vs. Conservative Therapy

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ABSTRACT

Introduction

Plantar fasciitis is one of the most common reasons for visits to orthopedic clinics. This tendinopathy can cause medial heel pain, stiffness, and tenderness on the plantar surface of the foot. Both conservative and surgical methods are employed in its treatment.

Aim

The aim of this study is to evaluate selected conservative treatment methods, such as stretching, the use of orthotic insoles, splints, injections, extracorporeal shockwave therapy, and taping, as well as surgical treatment options. The study presents a comparison of these methods in terms of their effectiveness, advantages, and disadvantages.

State of Knowledge

The plantar fascia is a stiff, connective tissue structure extending along the plantar surface of the foot. Biomechanical load on the fascia, which supports the medial longitudinal arch, can lead to degenerative changes that underlie plantar fasciitis. Symptoms include pain, particularly in the mornings and late evenings, which intensifies with palpation of the heel area.

Summary (Conclusions)

Conservative treatments for plantar fasciitis are effective in 90% of patients. There are no studies that conclusively demonstrate the superiority of one treatment method over another. Thus, the choice of therapy should be tailored to the patient's lifestyle, activity level, and financial capability. Surgical intervention is necessary in cases of chronic plantar fasciitis which remains resistant to conservative treatments.

Keywords: plantar fasciitis, tendinosis, heel pain, surgical treatment, conservative treatment, Achilles tendon

INTRODUCTION

Definitions

Plantar fasciitis is one of the most common causes of heel pain. Other names for this pathology include fascial degeneration or pathology (tendinopathy) of the plantar fascia. All terms seem appropriate and refer to two underlying causes of pain. "Inflammation" refers to the sudden onset of pain, while "tendinopathy" describes the chronic nature of this condition. Recent studies have shown that a significant component of fascia dysfunction consists of degenerative changes in the structures forming the fascia, arising from the continuous biomechanical loading of the proximal attachment of the fascia (Motley, 2021). The plantar fascia exhibits complex rheological behavior, resembling both tendon and ligament, possessing time-dependent elastic properties. Its unique structure defines the function of the fascia as support for the medial longitudinal arch of the foot. Furthermore, ex vivo studies have also demonstrated a stabilizing function for the transverse arch. The biomechanics of the fascia are based on increasing system stiffness during rising pressure—this is a propulsive mechanism (Wearing et al., 2006). Repetitive pressure and loading directed at the proximal attachment of the fascia during walking or running can generate pain around the calcaneal

tuberosity. Muscle weakness in the foot may also be a contributing factor to pain associated with plantar fasciitis (Latey et al., 2014).

Epidemiology

Plantar fascia tendinopathy is the most common cause of heel pain. According to various sources, the lifetime risk of developing plantar fasciitis is 10%, which results in over 1.7 million physician visits in the United States (Rhim et al., 2021a) . The incidence of this tendinopathy in the running population is estimated at 17.4% (Lopes et al., 2012) . In the physically active population, risk factors documented include a high BMI, increased body mass, prolonged standing, and occupations that require sustained standing posture (e.g., soldiers), sedentary lifestyles, as well as increased plantarflexion range of motion (Trojian & Tucker, 2019) . Factors such as height, static pronation, training volume, and dorsiflexion range of motion did not influence the occurrence of plantar fasciitis (Riddle et al., 2003).

Symptoms

The diagnosis of plantar fascia tendinopathy is primarily based on results gathered during the interview and physical examination. The patient typically complains of intense pain localized in the anteromedial aspect of the heel. Characteristic of this condition is the occurrence of pain at the onset of walking after a period of inactivity (in the morning), which gradually diminishes or resolves during continued activity, only to return by the end of the day. The patient may report a recent increase in physical activity, particularly activities that load the lower extremities. During the physical examination, pain is noted upon palpation of the area of the proximal attachment of the plantar fascia to the anteromedial surface of the calcaneus (Yi et al., 2011).

Diagnostics

Subjective and objective examinations are usually sufficient for making an accurate diagnosis. The correctness of the diagnosis is confirmed by the resolution of pain symptoms within 3-6 months after conservative treatment. An ultrasound examination may provide additional assistance to the clinician. In the ultrasonographic image, thickening of the plantar fascia (>4 mm) and a decrease in tissue echogenicity are observed (McMillan et al., 2009) . Magnetic resonance imaging (MRI) is another helpful, albeit more expensive, diagnostic tool. Radiographic imaging may be necessary for differential diagnosis, including other causes of heel pain. Common causes include: entrapment neuropathy of the first branch of the lateral plantar nerve (Baxter neuritis), entrapment neuropathy of the medial plantar nerve, tarsal tunnel syndrome, aseptic inflammation of the calcaneal tuberosity (apophysitis) (Haglund's

disease and Sever's disease), pain related to soft tissue or bone injuries, bone tumors, Achilles tendonitis, spondyloarthropathies, and (Goff & Crawford, 2011).

Anatomy

The plantar fascia is a connective tissue structure that radiates under the subcutaneous tissue. Its proximal attachment is the medial tubercle of the calcaneus. As it extends towards the distal attachment in the region of the proximal phalanges, the fascia divides into three bands: medial, central, and lateral. At the level of the cuboid bone, the lateral band branches into lateral and medial limbs. The lateral limb, characterized by more resilient fibers, extends to the base of the fifth metatarsal, where it gives rise to its bands, forming the plantar ligament. The medial limb of the lateral band, receiving some fibers from the central band, penetrates deeper into the plantar plate of the metatarsophalangeal joints. The central band constitutes the main mass of the plantar fascia. Triangular in shape, this strong band of fibers extends from the calcaneal tuberosity to the ligaments of the metatarsophalangeal joints. Between the various attachments, transverse bundles at the level of the proximal phalanges form the superficial transverse metatarsal ligament (Stecco et al., 2013) . The central bands of the plantar fascia split into five deep branches, which create medial and lateral sagittal septa. These septa run along the digital flexor, surrounding it from both sides, and then cross each other, attaching to various structures such as the tendon sheath, interosseous fascia, the fascia of the adductor hallucis muscle, deep transverse metatarsal ligament, and the bases of the proximal phalanges, via the plantar plate and collateral ligaments of the metatarsophalangeal joints. Fibers from each septum also diverge laterally, interdigitating with fibers from adjacent structures. The most medial septa also attach to the sesamoids of the tibial and fibular bones as well as the two heads of the flexor hallucis brevis muscle (Latt et al., 2020) . The upper surface of the plantar fascia connects with the superior compartment of the foot muscles, which consists of three prominences: the medial prominence (hallux), the intermediate prominence, and the lateral prominence (little toe), separated by two septa. The abductor hallucis muscle, the flexor digitorum brevis muscle, and the abductor digiti minimi muscle support the functions of the plantar fascia in maintaining the longitudinal arch of the foot and ensuring proper distribution of propulsive biomechanical forces.

Histology

Studies of the histological structure of the plantar fascia from the late past century revealed that the structure of the fascia is not identical to that of tendons or ligaments (Davis et al., 1996). Fibrocytes, which constitute the main cellular mass of the fascia, are arranged in rows and suspended between dense collagen fibers. The cells responsible for its production are

interconnected through processes rich in gap junctions. The theory of a three-dimensional network formed by fibrocytes implies the possibility of continuous intercellular communication. Such a scenario would allow for the regulation and adjustment of the extracellular matrix composition in response to the loading of the plantar fascia (Newell & Miller, 1977).

Recent studies on the histological structure of the fascia using the van Gieson method revealed the presence of few thin elastic fibers and hyaluronic acid detected via Alcian blue staining. Specific HABP antibodies showed the characteristic arrangement of this glycosaminoglycan in connective tissue. The highest concentration of large cells with basophilic cytoplasm (characteristic of chondrocytes) was found around the proximal attachment of the fascia (Stecco et al., 2013) .

The plantar fascia is characterized by a rich network of free nerve endings and the presence of Ruffini and Pacini corpuscles. The highest concentration of these structures has been described in the medial, lateral, and distal parts of the fascia, which are the thinnest sections of this structure. Elements of the nervous system were most abundant on the inner surface of the fascia, where it connects with the fibers of the plantar muscles situated above. The vascularization of the plantar fascia is rather sparse, similar to the vascularization of structures such as tendons and ligaments, where the vascular network is visible in the superficial layer, with only a few vessels penetrating deeper (Davis et al., 1996) . Structures particularly poor in blood supply include the bony-cartilaginous attachments and the central zone of the fascia. These areas, also known as "critical zones," are located in regions most exposed to friction and loading, which may result in degenerative changes occurring in these areas (Wearing et al., 2006).

TREATMENT APPROACHES

Tabl 1. Comparison of Treatment Methods

(Ahmad et al., 2017; Arshad et al., 2022; Charles et al., 2023; Chou et al., 2016; Gamba et al., 2020, 2022; Hamstra-Wright et al., 2021; Huffer et al., 2017; Johannsen et al., 2019; Katzap et al., 2018; Kim & Lee, 2023; Latt et al., 2020; López & Carrasco, 2014; Luffy et al., 2018; Melese et al., 2022; Naterstad et al., 2022; Nayar et al., 2023; Ng et al., 2021; Papathanasiou et al., 2023; Rhim et al., 2021b; Schuitema et al., 2019; Shetty et al., 2019; Siriphorn & Eksakulkla, 2020; Thor et al., 2022; Tsikopoulos et al., 2016)

METHOD	DESCRIPTION	EFFECTIVENESS	PROS	CONS
Calf stretching	Stretching of gastrocnemius muscle and Achilles tendon	Moderate effectiveness, comparable to other conservative methods	Easy to perform independently Serves as a simple intervention method	Lower effectiveness in short-term treatment May cause pain during stretching
Plantar fascia stretching	Stretching toes toward the shin bone	Greater effectiveness in pain reduction compared to CS in short-term therapy	Does not involve weight-bearing No side effect	Not suitable for individuals seeking quick results or a larger therapeutic effect
Orthotics	Appling prefabricated or customized insoles including heel pads or full-length orthotics	Improvements in both pain and function	Method applied in short (less than 6 weeks), medium (6–12 weeks), and long terms	the need for footwear adapted to the footbridge
Night splints	Worn during sleep to prevent the foot from	Increases calf and plantar muscle fl	Significantly lower pain scores	Possible sleep disturbance

	resting in a plantar-fl exed position	exibility and reduces tension on the plantar fascia during the first steps of the day	after night splint use	
Steroid injections	Injection of steroids to reduce inflammation	Short-term reduction of pain and swelling	Quick acting in releasing the pain	Expensive method Increases the risk of plantar fascia rupture Reduces fibroblast proliferation and ground substance proteins
Platelet-rich plasma injections	Injections of plasma rich in thrombocytes Increases healing due to concentration of multiple growth factors	The long-term results and low reinjection and/or surgery rate	Good long-term results	Expensive method Requiring specialized equipment
Autologous blood injections	Injections with usage of whole blood product previously taken from the patient	Improvement and in pain in long-term follow-up	No serious side effects	Expensive method Poorly researched
Botox injections	Injections of BTX into the plantar fascia and gastrocnemius-soleus muscles	Protective, paralyzing effect on muscles that reduces tendon tension and Analgesic effect due to inhibition of the neurotransmitters involved in pain	the multitude of studies on the effects of botulinum toxin	Potential muscles wickness

		transmission		
Shock wave therapy	Administering high-pressure sound waves to injured tissue to offer pain relief	Moderate beneficial effect in pain reduction, foot function and proprioception	No side effects reported	Potential plantar fascia thickness
Dynamic taping	Taping using the material which stretches both horizontally and vertically Focuses on the mechanical effect of muscles, helping muscles work and maximizing energy efficiency	Effective in reducing pain and plantar fascia thickness Beneficial for foot function	Allows for participation in daily activities without restrictions	Specialized knowledge of how to apply the tape is necessary Possible skin irritation
Kinesiology taping	Taping which improves the disadvantages of existing rigid tapes due to the elasticity of the tape focuses on improving circulation and stimulating proprioception	Effective in reducing pain and plantar fascia thickness Beneficial for foot function	Can correct ligament damage and improve proprioceptive sensation	Specialized knowledge of how to apply the tape is necessary Possible skin irritation
Muscles strength training	Minimalist running shoe IFM strengthening IFM foot exercises Plantar aponeurosis	Reduces pain and improves foot function.	Ability to improve the strength of the internal muscles of the foot.	No significant reduction in plantar fascia thickness. A limited

	loading		The possibility of long-term impact on foot function with regular training	number of studies, particularly in populations at increased risk of fasciitis.
Endoscopic plantar fasciotomy	Endoscopic fasciotomy involves making an incision in the plantar fascia using an endoscopic technique with resection of inflamed or fibrous tissue and possible bone spurs	Significantly greater improvements in the subjective and objective functional outcomes, with less pain and greater satisfaction comparing to open	Short recovery period, with equivalent long-term outcomes,	Risk of infection, hematomas or scarring after the procedure Risk of nerve damage
Open plantar fasciotomy	Method involves making a small incision on the medial side of the plantar fascia Blunt preparation is carried out The medial third of the aponeurosis is cut at a length of 2-3 cm from its attachment	Good results in terms of pain, function, satisfaction, and health perception	Numerous studies show the effectiveness of the method	Prolonged recovery observed
Proximal medial gastrocnemius release	Technique that is performed to relieve tension in the Achilles-calcaneus-plantar system when	Reduction in pain and good functional results	Short operative time Rapid return to recreational and labor activities	Relatively low rate of calf hematomas and delayed wound healing

	a biomechanical overload is present			
Radiofrequency microtenotomy	A radiofrequency microtenotomy probe is inserted and applied to the plantar fascia in fixed, grid like pattern	Significant improvement in pain	Short operative time Shorter post-operative recovery time to normal function	Complications included persistent pain, recurrence of pain, deep vein thrombosis, transient probe site pain and flexor hallucis longus tendonitis

CONCLUSIONS

In the treatment of acute plantar fasciitis, conservative methods are employed, including calf stretching, specific plantar fascia stretching, shoe orthotics, night splints, muscle strengthening exercises, and elastic taping techniques. Therapeutic options also encompass minimally invasive methods such as corticosteroid injections, botulinum toxin, platelet-rich plasma, and autologous whole blood injections. In cases of chronic plantar fasciitis, consideration should be given to qualifying the patient for one of the surgical methods, which may include open or endoscopic fasciotomy, proximal medial gastrocnemius release, or radiofrequency microtenotomy. Due to the lack of consensus regarding the single best treatment modality, the choice of method should take into account the individual predispositions of the patient, financial capabilities, and level of physical activity.

Disclosure

Author's contribution

Conceptualization: F. Czyżewski; methodology: I. Wiak; F.Jasiński; software: K.Wojtach; check: F. Banyś, F. Czyżewski; formal analysis: K.Bochen, K.Pasierb, J.Szałajska; investigation: F.Czyżewski, A.Łukawski, I. Wiak; resources: S. Dudek, K. Wojtach, F.Banyś; data curation: K.Bochen; F.Jasiński; writing-rough preparation: F.Czyżewski, K. Pasierb, J.Szałajska; writing – review and editing: A.Łukawski, I.Wiak, S.Dudek; visualization: F.Banyś, A.Łukawski, K. Wojtach; supervision: F.Czyżewski, J.Szałajska; project administration: F.Czyżewski

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The authors deny any conflict of interest.

REFERENCES

Ahmad, J., Ahmad, S. H., & Jones, K. (2017). Treatment of Plantar Fasciitis With Botulinum Toxin. *Foot & Ankle International*, *38*(1), 1–7. https://doi.org/10.1177/1071100716666364

Arshad, Z., Aslam, A., Razzaq, M. A., & Bhatia, M. (2022). Gastrocnemius Release in the Management of Chronic Plantar Fasciitis: A Systematic Review. *Foot & Ankle International*, *43*(4), 568–575. https://doi.org/10.1177/10711007211052290

Charles, R., Fang, L., Zhu, R., & Wang, J. (2023). The effectiveness of shockwave therapy on patellar tendinopathy, Achilles tendinopathy, and plantar fasciitis: a systematic review and meta-analysis. *Frontiers in Immunology*, *14*. https://doi.org/10.3389/FIMMU.2023.1193835

Chou, A. C. C., Ng, S. Y. C., & Koo, K. O. T. (2016). Endoscopic Plantar Fasciotomy Improves Early Postoperative Results: A Retrospective Comparison of Outcomes After Endoscopic Versus Open Plantar Fasciotomy. *The Journal of Foot and Ankle Surgery : Official Publication of the American College of Foot and Ankle Surgeons*, *55*(1), 9–15. https://doi.org/10.1053/J.JFAS.2015.02.005

Davis, W. H., Sobel, M., Dicarlo, E. F., Torzilli, P. A., Deng, X., Geppert, M. J., Patel, M. B., & Deland, J. (1996). Gross, histological, and microvascular anatomy and biomechanical testing of the spring ligament complex. *Foot & Ankle International*, *17*(2), 95–102. https://doi.org/10.1177/107110079601700207

Gamba, C., Álvarez Gomez, C., Martínez Zaragoza, J., Leal Alexandre, C., Bianco Adames, D., & Ginés-Cespedosa, A. (2022). Proximal Medial Gastrocnemius Release: Surgical Technique. *JBJS Essential Surgical Techniques*, *12*(1). https://doi.org/10.2106/JBJS.ST.20.00039

Gamba, C., Serrano-Chinchilla, P., Ares-Vidal, J., Solano-Lopez, A., Gonzalez-Lucena, G., & Ginés-Cespedosa, A. (2020). Proximal Medial Gastrocnemius Release Versus Open Plantar Fasciotomy for the Surgical Treatment in Recalcitrant Plantar Fasciitis. *Foot & Ankle International*, *41*(3), 267–274. https://doi.org/10.1177/1071100719891979

GOFF, J. D., & CRAWFORD, R. (2011). Diagnosis and Treatment of Plantar Fasciitis. *American Family Physician*, *84*(6), 676–682. https://www.aafp.org/pubs/afp/issues/2011/0915/p676.html

Hamstra-Wright, K. L., Huxel Bliven, K. C., Bay, R. C., & Aydemir, B. (2021). Risk Factors for Plantar Fasciitis in Physically Active Individuals: A Systematic Review and Meta-analysis. *Sports Health*, *13*(3), 296–303. https://doi.org/10.1177/1941738120970976

Huffer, D., Hing, W., Newton, R., & Clair, M. (2017). Strength training for plantar fasciitis and the intrinsic foot musculature: A systematic review. *Physical Therapy in Sport : Official Journal of the Association of Chartered Physiotherapists in Sports Medicine*, *24*, 44–52. https://doi.org/10.1016/J.PTSP.2016.08.008

Johannsen, F., Konradsen, L., Herzog, R., & Rindom Krogsgaard, M. (2019). Plantar fasciitis treated with endoscopic partial plantar fasciotomy-One-year clinical and ultrasonographic follow-up. *Foot (Edinburgh, Scotland)*, *39*, 50–54. https://doi.org/10.1016/J.FOOT.2019.02.002

Katzap, Y., Haidukov, M., Berland, O. M., Ben Itzhak, R., & Kalichman, L. (2018). Additive Effect of Therapeutic Ultrasound in the Treatment of Plantar Fasciitis: A Randomized Controlled Trial. *The Journal of Orthopaedic and Sports Physical Therapy*, *48*(11), 847–855. https://doi.org/10.2519/JOSPT.2018.8110

Kim, D. H., & Lee, Y. (2023). Effect of Dynamic Taping versus Kinesiology Taping on Pain, Foot Function, Balance, and Foot Pressure in 3 Groups of Plantar Fasciitis Patients: A Randomized Clinical Study. *Medical Science Monitor : International Medical Journal of Experimental and Clinical Research*, *29*. https://doi.org/10.12659/MSM.941043

Latey, P. J., Burns, J., Hiller, C., & Nightingale, E. J. (2014). Relationship between intrinsic foot muscle weakness and pain: a systematic review. *Journal of Foot and Ankle Research*, *7*(Suppl 1), A51. https://doi.org/10.1186/1757-1146-7-S1-A51

Latt, L. D., Jaffe, D. E., Tang, Y., & Taljanovic, M. S. (2020). Evaluation and Treatment of Chronic Plantar Fasciitis. *Foot & Ankle Orthopaedics*, *5*(1). https://doi.org/10.1177/2473011419896763

Lopes, A. D., Luiz Carlos Hespanhol, Jr., Yeung, S. S., & Costa, L. O. P. (2012). What are the Main Running-Related Musculoskeletal Injuries?: A Systematic Review. *Sports Medicine (Auckland, N.z.)*, *42*(10), 891. https://doi.org/10.1007/BF03262301

López, A. M. D., & Carrasco, P. G. (2014). [Effectiveness of different physical therapy in conservative treatment of plantar fasciitis: systematic review]. *Revista Espanola de Salud Publica*, *88*(1), 157–178. https://doi.org/10.4321/S1135-57272014000100010

Luffy, L., Grosel, J., Thomas, R., & So, E. (2018). Plantar fasciitis: A review of treatments. *JAAPA : Official Journal of the American Academy of Physician Assistants*, *31*(1), 20–24. https://doi.org/10.1097/01.JAA.0000527695.76041.99

McMillan, A. M., Landorf, K. B., Barrett, J. T., Menz, H. B., & Bird, A. R. (2009). Diagnostic imaging for chronic plantar heel pain: a systematic review and meta-analysis. *Journal of Foot and Ankle Research*, *2*(1). https://doi.org/10.1186/1757-1146-2-32

Melese, H., Alamer, A., Getie, K., Nigussie, F., & Ayhualem, S. (2022). Extracorporeal shock wave therapy on pain and foot functions in subjects with chronic plantar fasciitis: systematic review of randomized controlled trials. *Disability and Rehabilitation*, *44*(18), 5007–5014. https://doi.org/10.1080/09638288.2021.1928775

Motley, T. (2021). Plantar Fasciitis/Fasciosis. *Clinics in Podiatric Medicine and Surgery*, *38*(2), 193–200. https://doi.org/10.1016/J.CPM.2020.12.005

Naterstad, I. F., Joensen, J., Bjordal, J. M., Couppé, C., Lopes-Martins, R. A. B., & Stausholm, M. B. (2022). Efficacy of low-level laser therapy in patients with lower extremity tendinopathy or plantar fasciitis: systematic review and meta-analysis of randomised controlled trials. *BMJ Open*, *12*(9). https://doi.org/10.1136/BMJOPEN-2021-059479

Nayar, S. K., Alcock, H., & Vemulapalli, K. (2023). Surgical treatment options for plantar fasciitis and their effectiveness: a systematic review and network meta-analysis. *Archives of Orthopaedic and Trauma Surgery*, *143*(8), 4641–4651. https://doi.org/10.1007/S00402-022-04739-0

Newell, S. G., & Miller, S. J. (1977). Conservative Treatment of Plantar Fascial Strain. *The Physician and Sportsmedicine*, *5*(11), 68–73. https://doi.org/10.1080/00913847.1977.11710665

Ng, A., Cavaliere, R., & Molchan, L. (2021). Biologics in the Treatment of Plantar Fasciitis. *Clinics in Podiatric Medicine and Surgery*, *38*(2), 245–259. https://doi.org/10.1016/J.CPM.2020.12.009

Papathanasiou, M., Georgoulas, P., Perikleous, E., Tilkeridis, K., Ververidis, A., & Drosos, G. (2023). Endoscopic Plantar Fasciotomy as an Effective and Reliable Treatment for Plantar

Fasciitis: An Overview of the Literature. *Journal of the American Podiatric Medical Association*, *113*(4). https://doi.org/10.7547/21-239

Rhim, H. C., Kwon, J., Park, J., Borg-Stein, J., & Tenforde, A. S. (2021a). A systematic review of systematic reviews on the epidemiology, evaluation, and treatment of plantar fasciitis. *Life*, *11*(12). https://doi.org/10.3390/LIFE11121287/S1

Rhim, H. C., Kwon, J., Park, J., Borg-Stein, J., & Tenforde, A. S. (2021b). A Systematic Review of Systematic Reviews on the Epidemiology, Evaluation, and Treatment of Plantar Fasciitis. *Life (Basel, Switzerland)*, *11*(12). https://doi.org/10.3390/LIFE11121287

Riddle, D. L., Pulisic, M., Pidcoe, P., & Johnson, R. E. (2003). Risk factors for Plantar fasciitis: a matched case-control study. *The Journal of Bone and Joint Surgery. American Volume*, *85*(5), 872–877. https://doi.org/10.2106/00004623-200305000-00015

Schuitema, D., Greve, C., Postema, K., Dekker, R., & Hijmans, J. M. (2019). Effectiveness of Mechanical Treatment for Plantar Fasciitis: A Systematic Review. *Journal of Sport Rehabilitation*, *29*(5), 657–674. https://doi.org/10.1123/JSR.2019-0036

Shetty, S. H., Dhond, A., Arora, M., & Deore, S. (2019). Platelet-Rich Plasma Has Better Long-Term Results Than Corticosteroids or Placebo for Chronic Plantar Fasciitis: Randomized Control Trial. *The Journal of Foot and Ankle Surgery*, *58*(1), 42–46. https://doi.org/10.1053/J.JFAS.2018.07.006

Siriphorn, A., & Eksakulkla, S. (2020). Calf stretching and plantar fascia-specific stretching for plantar fasciitis: A systematic review and meta-analysis. *Journal of Bodywork and Movement Therapies*, *24*(4), 222–232. https://doi.org/10.1016/J.JBMT.2020.06.013

Stecco, C., Corradin, M., Macchi, V., Morra, A., Porzionato, A., Biz, C., & De Caro, R. (2013). Plantar fascia anatomy and its relationship with Achilles tendon and paratenon. *Journal of Anatomy*, *223*(6), 665–676. https://doi.org/10.1111/JOA.12111

Thor, J., Mao, D. W., Chandrakumara, D., Zheng, Q., Yoo, T. W., & Kon Kam King, C. (2022). Radiofrequency microtenotomy for plantar fasciitis: A systematic review and meta-analysis. *Foot (Edinburgh, Scotland)*, *50*. https://doi.org/10.1016/J.FOOT.2021.101869

Trojian, T., & Tucker, A. K. (2019). Plantar Fasciitis. In *American Family Physician www.aafp.org/afp* (Vol. 99). www.youtube.com/watch?v=fg0PtnoAzSs

Tsikopoulos, K., Vasiliadis, H. S., & Mavridis, D. (2016). Injection therapies for plantar fasciopathy ('plantar fasciitis'): a systematic review and network meta-analysis of 22 randomised controlled trials. *British Journal of Sports Medicine*, *50*(22), 1367–1375. https://doi.org/10.1136/BJSPORTS-2015-095437

Wearing, S. C., Smeathers, J. E., Urry, S. R., Hennig, E. M., & Hills, A. P. (2006). The pathomechanics of plantar fasciitis. *Sports Medicine (Auckland, N.Z.)*, *36*(7), 585–611. https://doi.org/10.2165/00007256-200636070-00004

Yi, T. I., Lee, G. E., Seo, I. S., Huh, W. S., Yoon, T. H., & Kim, B. R. (2011). Clinical characteristics of the causes of plantar heel pain. *Annals of Rehabilitation Medicine*, *35*(4), 507. https://doi.org/10.5535/ARM.2011.35.4.507