

Plantar Fasciitis: A Comprehensive Review Literature on Pathophysiology, Diagnosis, and Management

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Abstract:

Plantar fasciitis is one of the most common causes of heel pain worldwide, affecting more than 10% of the population and frequently seen in individuals aged 45–65, athletes, military personnel, and those who stand for prolonged periods. It occurs due to repetitive mechanical strain on the plantar fascia, leading to microtears, inflammation, and progressive myxoid degeneration. Structural foot abnormalities such as pes cavus, pes planus, and excessive pronation or supination, along with tight posterior compartment muscles, further increase the biomechanical load on the fascia. Histologically, the condition is characterized by fascial fragmentation, extracellular matrix changes, and fibrocyte-mediated responses triggered by elevated tension. Diagnosis relies on clinical history, physical examination, and targeted tests such as the windlass test, heel squeeze, and assessment of ankle dorsiflexion. Imaging modalities including X-ray, ultrasound, and MRI assist in evaluating fascia thickness, heel spurs, and excluding differential diagnoses.

Management of plantar fasciitis follows a structured four-phase approach. Initial treatment emphasizes rest, NSAIDs, ice therapy, orthotics, night splints, and structured stretching programs to reduce pain and improve functional biomechanics. Intermediate and specialized therapies address chronic degeneration through modalities like extracorporeal shockwave therapy, which stimulates angiogenesis and collagen remodelling; photo biomodulation, which enhances fibroblast activity and extracellular matrix repair; and phonophoresis, which augments drug delivery through ultrasound-enhanced tissue permeability. Biologic treatments such as platelet-rich plasma and polydeoxyribonucleotide injections promote tissue

regeneration by activating fibroblasts, increasing collagen synthesis, and improving vascularity.

Minimally invasive options—including corticosteroid with local anaesthetic injections, botulinum toxin therapy, and transcatheter arterial embolization—provide pain relief by modulating inflammation, reducing muscle tension, and decreasing blood flow to the inflamed region. Surgical interventions are reserved for refractory cases. Procedures such as proximal medial gastrocnemius release, endoscopic plantar fascia release, and arthroscopic spur removal reduce tension within the fascia, offering effective symptom reduction with low complication rates.

Overall, plantar fasciitis requires individualized, stepwise management that balances conservative, biologic, and surgical approaches. Treatment selection should be based on symptom severity, chronicity, anatomical factors, and response to prior therapies to achieve optimal functional outcomes.

Introduction:

Planter fasciitis also known as painful heel syndrome, heel spur syndrome or planter heel pain. The planter fascia is a thick band of tissue which connects calcaneum to the toes. This thick band gets inflamed due to various reasons and causes pain. [1] The role of planter fascia is to absorb the shock during day-to-day activities and support the planter arch. When there will be repetitive stress on the planter fascia there will be micro tears on it and that cause inflammation. Most common cause of heel pain is planter fasciitis accounting more than 10% of world's population. [2]

Planter fasciitis is mainly affecting the patients aged 45-65 though it can occur at other age too. Athletes, over-weight patients, workers who are standing for prolonged period of time or military persons are mostly affected. Gender correlation is not generally seen. [3]

Anatomy

The plantar fascia originates from the calcaneum bone and is divided into three bundles: medial bundle, central bundle, and lateral bundle. The medial bundle covers the adductor hallucis, the central bundle originates from the medial tubercle of the calcaneum and represents the true plantar fascia, and the lateral bundle covers the abductor digiti minimi. These bundles overlay the intrinsic muscles of the foot, providing support and stability. Distally, the fascia divides into five bands that attach to the bases of the proximal phalanges of the five toes. This arrangement allows the fascia to maintain tension across the plantar surface of the foot. It contributes to load distribution during weight-bearing activities. The plantar fascia also supports the longitudinal arches of the foot. By doing so, it increases the stiffness of the medial longitudinal arch. This stiffness helps maintain arch integrity and prevents collapse during gait. [3] The plantar fascia increases the stiffness of the medial longitudinal arch thus maintaining its integrity. [4]

Aetiology

Due to repetitive strain of the plantar fascia, there will be microtears. It can also occur due to other causes like trauma. Plantar fasciitis is correlated with some conditions like pes cavus, pes planus, or excessive pronation or supination. Due to pes planus, there is increased strain at the origin site. While in pes cavus the foot cannot effectively evert or absorb the shock, and it gives excessive strain on the fascia. Tightness in posterior compartment muscles alters the biomechanics of ambulation. The combined effects of foot structure abnormalities and muscle tightness increase the likelihood of plantar fascia injury. Repetitive mechanical stress exacerbates microdamage and contributes to chronic inflammation. These factors collectively reduce the fascia's ability to absorb shock during gait. [4]

Pathophysiology:

Plantar fasciitis is an acute inflammatory disease that develops when the plantar fascia undergoes excessive mechanical loading during standing, walking, or running. Histological findings showed myxoid degeneration of the fascia with fragmentation. Repetitive stress causes microtears and constant stretching leads to chronic degeneration that ultimately results in pain. Gap junctions among fibrocytes detect elevated tension within the fascia, triggering changes in the extracellular matrix that ultimately result in myxoid degeneration and weakening of the plantar fascia. [7] In addition to mechanical overload, several intrinsic and extrinsic factors contribute to disease progression. Hyperthermia, genetic factors, excessive free radicals and vascular factors are also associated with this condition. [6]

Diagnosis

Diagnosing plantar fasciitis begins with obtaining a thorough patient history. Key information—including where the pain is felt, its characteristics, when it started, and how long it has persisted—is crucial for making an accurate diagnosis. Diagnosis begins with examining the foot for swelling, bruising, deformity, gait issues, and tenderness over the plantar medial calcaneal tubercle. Ankle dorsiflexion is checked for Achilles tightness. A lateral heel squeeze rules out calcaneal stress fracture. The windlass test, done by dorsiflexing the big toe, reproduces heel pain and supports plantar fasciitis. X-ray, ultrasound, or MRI may be used to exclude fractures and identify heel spurs. [8] A weight-bearing X-ray is done first to assess foot shape; heel spurs may appear but don't always indicate plantar fasciitis. Ultrasound shows fascia thickness and inflammation and helps track treatment. MRI provides the most accurate view of the fascia, heel bone oedema, and stress fractures, while CT and bone scans are rarely needed. EMG is used only when nerve-related heel pain is suspected. [3]

Methodology:

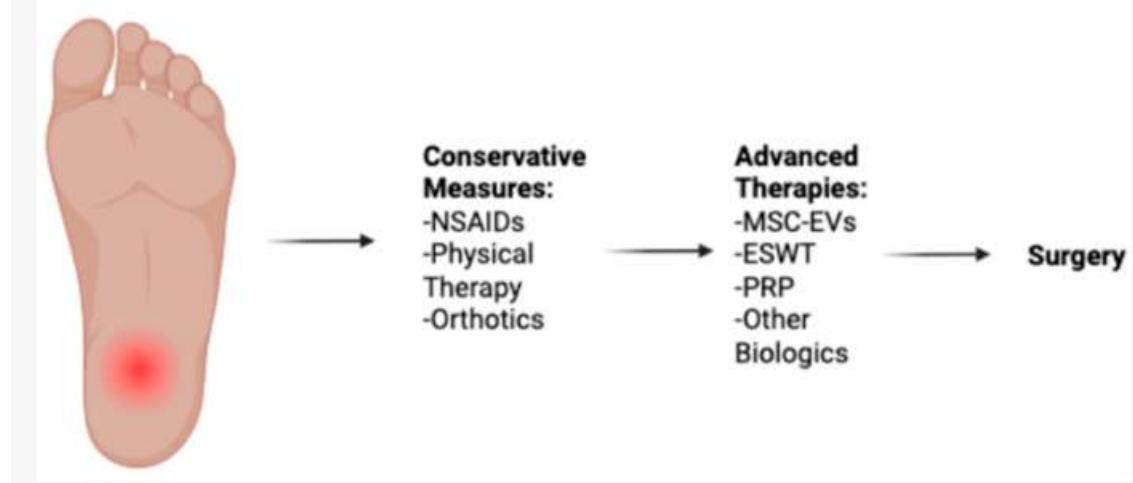
To make this review literature on planter fasciitis overview with various types of management options comprehensive literature search was performed using PubMed, Google Scholar and Cochrane. The majority of articles used were studies from 2020 to 2025. Over 15 high quality studies were selected for analysis based on their relevance and contribution to understand the anatomy, aetiology, pathophysiology, diagnosis and treatment options. The four phase treatment framework was developed and were included in this literature.

Treatment:

Basically, treatment is divided into 4 phases: 1) Initial non-invasive therapies, 2) Intermediate therapy, 3) specialised therapies, 4) surgical therapies. [2] Initial treatment is guided by pain severity and begins with relative rest from aggravating activities. Ice after activity and oral or topical NSAIDs can reduce discomfort. Deep friction massage, shoe inserts or orthotics, and night splints have shown benefit. Prefabricated heel pads and regular stretching exercises are also useful. Patients should be taught proper stretching and strengthening of the plantar fascia, Achilles tendon, gastrocnemius, and soleus. [5]

Figure 1. Conservative treatments remain the first-line approach for plantar fasciitis and include NSAIDs, stretching, orthotics, and physical therapy. In cases resistant to conservative measures, advanced therapies such as ESWT, MSC-EVs, and PRP injections may be utilized and prevent the necessity of surgical intervention. NSAIDS = non-steroidal anti-inflammatory drugs; ESWT = extracorporeal shockwave therapy; MSC-EVs = mesenchymal stem/stromal cell-derived extracellular vesicles; PRP = platelet-rich plasma.

Future Progression of Therapy in Plantar Fasciitis



The shockwaves stimulate blood vessel formation, improve blood flow, and break down degenerated fascia tissue. They also reduce pain receptor activity and activate fibroblasts to promote collagen repair. These effects help relieve pain and support proper healing of the plantar fascia. [9]

Photo biomodulation therapy (PBMT) uses visible and near-infrared light to stimulate cellular photochemical reactions. The light penetrates through skin and soft tissues to reach structures like tendons and fascia. PBMT acts mainly on fibroblasts, enhancing collagen production and promoting better collagen fibre organization. It also activates matrix metalloproteinases (MMPs), helping remodel damaged extracellular matrix. The therapy stimulates neovascularization, improving blood supply and tissue repair. Since chronic plantar fasciitis involves degeneration rather than inflammation, PBMT supports healing by restoring fascia structure. Its effectiveness depends on correct dosing parameters such as wavelength, energy density, and duration.

Phonophoresis therapy uses therapeutic ultrasound to enhance the delivery of topical drugs, such as diclofenac, into deeper tissues. The ultrasound increases local temperature and cell membrane permeability, while mechanical vibrations help push drug molecules through the skin. Once in the tissue, the drug reduces inflammation by inhibiting prostaglandin production. Ultrasound also improves blood flow and may modulate pain pathways at the spinal level. This combination helps relieve pain and improve function in conditions like plantar fasciitis. Studies show phonophoresis is more effective than manual therapy alone. [11]

Platelet-rich plasma (PRP) injections significantly reduced heel pain and improved foot function in patients with chronic plantar fasciitis. The treatment works by delivering high concentrations of growth factors (like PDGF, TGF- β , IGF) that stimulate fibroblasts to regenerate collagen and repair the degraded fascia. PRP also supports blood vessel formation and the recruitment of stem cells to the damaged tissue. A single injection, delivered using a “peppering” technique, led to sustained improvements in pain and fascia thickness over six months. [12]

Polydeoxyribonucleotide (PDRN) therapy involves injecting PDRN directly into the plantar fascia. This compound interacts with adenosine receptors, promoting new blood vessel formation and activating fibroblasts. As a result, it supports collagen production and aids in the repair of damaged plantar fascia tissue. Typically, 5–10 mg in 1–2 mL is administered at the fascia insertion over three to five treatment sessions. [2]

Corticosteroid with local anaesthetic injections reduce plantar fasciitis pain by suppressing inflammation and blocking nerve signals. The corticosteroid decreases inflammatory mediators and fibroblast activity, while the anaesthetic provides immediate relief. Typically, the drugs are mixed (e.g., triamcinolone with lidocaine) and injected into the plantar fascia, sometimes under ultrasound guidance. Studies show short-term pain relief is common, but benefits often decline over time. Repeated injections carry risks, including plantar fascia rupture. [13]

Botulinum toxin injections reduce plantar fasciitis pain by blocking acetylcholine release, decreasing muscle and fascia tension, and modulating pain signals. The toxin is injected into the plantar fascia or nearby calf muscles, often under ultrasound guidance. This relaxes the fascia and reduces strain on the heel. Clinical studies show significant pain relief and improved foot function. Effects typically last several weeks to months, especially in patients unresponsive to conservative treatments. [14]

Transcatheter arterial embolization (TAE) is a minimally invasive procedure that targets and blocks specific small blood vessels. During the procedure, embolic materials are delivered through a catheter navigated into arteries supplying the heel, such as the peroneal and posterior tibial arteries. By reducing blood flow to the inflamed area of the plantar fascia, TAE helps decrease inflammation and alleviate pain. [2]

Proximal Medial Gastrocnemius Release (PMGR) reduces plantar fasciitis pain by lengthening the medial gastrocnemius, decreasing tension on the Achilles-calcaneus-plantar fascia system. The procedure involves a small posteromedial incision below the knee, cutting the medial gastrocnemius fibres, and stretching the muscle through ankle dorsiflexion. Patients typically experience significant pain relief within 2–3 months and a rapid return to activities. Satisfaction rates are high, with low complication risks such as hematoma or delayed healing. Functional

and quality-of-life scores improve, even if MRI shows minimal changes in the plantar fascia. The main benefit comes from biomechanical unloading rather than structural repair. [15]

The two-portal endoscopic plantar fascia release treats chronic plantar fasciitis by partially cutting the medial edge of the plantar fascia to relieve tension. It uses a small “working” and “viewing” portal for precise, minimally invasive access. Endoscopic visualization allows accurate release while minimizing soft-tissue damage. Patients experience reduced postoperative pain and faster recovery compared to open surgery. The procedure has a low complication rate when performed correctly. Overall, it effectively decreases heel pain and improves function in recalcitrant cases. [16]

Arthroscopic surgery treats chronic plantar heel pain by removing calcaneal spurs and partially releasing the plantar fascia. It reduces tension and decompresses the fascia under endoscopic guidance. The procedure uses small arthroscopic portals for precise, minimally invasive access. Patients show significant pain relief and improved function with faster recovery. Complications are low, making it an effective option when conservative treatment fails. [17]

Discussion:

Plantar fasciitis is a common cause of heel pain, primarily resulting from repetitive microtrauma to the plantar fascia, leading to inflammation, myxoid degeneration, and impaired fascia integrity. Conservative management remains the first-line approach, focusing on activity modification, NSAIDs, stretching, orthotics, and night splints to reduce pain and improve function. Emerging non-invasive modalities such as extracorporeal shockwave therapy, photo biomodulation, and phonophoresis provide additional benefits by promoting neovascularization, fibroblast activation, collagen remodelling, and enhanced drug delivery, thereby addressing the degenerative changes in chronic cases. Biologic injections, including platelet-rich plasma and polydeoxyribonucleotide, further support tissue regeneration by delivering growth factors, stimulating fibroblasts, and enhancing angiogenesis. Minimally invasive interventions—corticosteroid and local anaesthetic injections, botulinum toxin, and transcatheter arterial embolization—primarily reduce inflammation, modulate pain, and relieve mechanical strain on the fascia. Surgical options, such as proximal medial gastrocnemius release, endoscopic plantar fascia release, and arthroscopic calcaneal spur resection with fascia release, are reserved for recalcitrant cases and provide rapid symptom relief by biomechanically unloading the fascia or precisely releasing tight fibres, with minimal soft-tissue disruption and low complication rates. Overall, treatment choice should be guided by symptom severity, chronicity, patient comorbidities, and response to prior therapies, balancing efficacy with invasiveness.

Conclusion:

Plantar fasciitis is a multifactorial condition resulting from repetitive stress and degeneration of the plantar fascia. Conservative management with activity modification, NSAIDs, stretching, orthotics, and night splints remains the first-line treatment and is effective in most cases. Non-invasive modalities such as shockwave therapy, photo biomodulation, and phonophoresis can enhance healing by promoting angiogenesis, collagen repair, and fibroblast activity. Biologic therapies like platelet-rich plasma and polydeoxyribonucleotide support tissue regeneration and restore fascia integrity. Minimally invasive interventions—including corticosteroid injections, botulinum toxin, and transcatheter arterial embolization—help reduce

pain and mechanical stress. Surgical options, such as gastrocnemius release and endoscopic or arthroscopic fascia release, are reserved for refractory cases and provide rapid symptom relief with low complication rates. Overall, a stepwise approach tailored to symptom severity, chronicity, and patient factors offers the best outcomes in plantar fasciitis management.

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