Review Article

Plantar fasciitis: A review of literature

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ABSTRACT

Plantar fasciitis (PF) is one of the most common causes of inferior heel pain managed by many physical therapists in a variety of clinical settings and wildly treated conservatively and it is usually caused by a biomechanical imbalance resulting in tension along the plantar fascia. It is estimated that 11-15% of all foot complaints requiring medical attention can be attributed to this condition. In general, the patient presents with inferior heel pain on weight bearing. Pain associated with PF may be throbbing, searing, or piercing, especially with the first few steps in the morning or after periods of inactivity. This article presents on overview of the current knowledge on PF and focuses on biomechanics, etiology, diagnosis and treatment strategies, conservative treatment including the physical therapy management are discussed. This information should assist health care practitioners who treat patients with this disorder.

Key words: Biomechanical imbalance, heel pain, micro trauma

التهاب اللفافة الأخصمية (PF)واحد من الأسباب الأكثر شيوعا لآلام أسفل الكعبين و يجد هذا الالتهاب يجد اهتماما من اختصاصي العلاج الطبيعي في مجموعة من الجلسات السريرية و يتم التعامل معه بشيء من الرقة و التحفظ. وغالبا ما يكون هذا الالتهاب ناجما عن اختلال في النشاط الحيوي ؛ ممّا يؤدي إلى توتر على امتداد اللفافة الأخمصية وتعزى نسبة 11– 15٪ من شكاوى القدمين إلى هذه الحالة . وعموما فإن المريض بهذا الالتهاب يشكو من ألم في أسفل الكعب أثناء المشي قد يكون حادا مصحوبا بارتجاف و ذبول خاصة مع الخطوات الأولى في الصباح أو بعد فترات من الخمول. وهذه المقالة تقدم نظرة عامة عن التهاب اللفافة الأخمصية مع التركيز على استراتيجية التشخيص و العلاج الطبيعي و العلاج التحفظي .

INTRODUCTION

Plantar fasciitis (PF) is a degenerative syndrome of plantar fascia resulting from repeated trauma at its origin on the calcaneus.[1] Although a misnomer, this condition is sometimes referred to as heel spurs by the general public. There are many diagnoses within the differential of heel pain.[2] The typical presentation is sharp pain localized at the anterior aspect of the calcaneus. PF is often associated with a heel spur; however, many asymptomatic individuals have bony heel spurs, whereas many patients with PF do not have a spur.[3] PF can be a difficult problem to treat, with no panacea available. Fortunately, most patients with this condition eventually have satisfactory outcomes with nonsurgical treatment.[4] Therefore, management of patient expectations minimizes frustration for both the patient and the provider. PF is a common cause of heel pain, affecting 10% of the general population. Men, usually between ages 40 and 70, are affected more than a woman.[5] The pain is worst early in the morning and often improves with activity. Patient complains of pain in the sole or heel during weight bearing and is relieved once it is discontinued.[6] On examination, there is tenderness over the medial side of the calcaneus. It is characterized by pain at the insertion of the plantar fascia. Diagnosis is based on the patient history and on the result of the physical examination. The patient typically presents with inferior heel pain on weight bearing. Pain associated with PF may be throbbing, searing, or piercing, especially with the first few steps in the morning or after periods of inactivity.[7] Planter fasciitis is usually treated conservatively. Conservative treatment includes medical therapy and physical therapy. Medical therapy includes NSAIDs,

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injecting local steroids etc.[8] Physiotherapy includes taping, stretching, night splints, shoe insert, thermal modalities, ultrasound therapy, laser therapy and custom foot orthosis etc., Conservative treatment is almost always successful; most patients respond and are better within 9 months of physiotherapy treatment.

BIOMECHANICS

The plantar aponeurosis is a dense fascia that runs nearly the entire length of the foot. Although other passive structures contribute to arch support, the role of the plantar aponeurosis (plantar fascia) is particularly important. It begins posteriorly on the medial tubercle of the calcaneus and continues anteriorly to attach by digits to the plantar plates and then, through the plates, the proximal phalanx of each toe.[9] From the beginning to the end of the stance phase of gait, the tension of the plantar aponeurosis increases shows that the plantar fascia deforms 9-12% on stretching during this time.[10] The plantar fascia, primarily as a result of its anatomical position, great mechanical and biomechanical properties. Rupture and partial or complete surgical sectioning of the plantar fascia may lead to progressive pes planus with associated.[11] The plantar aponeurosis, as the tie-rod, holds together the anterior and posterior struts when body weight is loaded on the triangle. This structural design is efficient for the weight-bearing foot because the struts (bone) are subjected to compression forces; whereas the tie-rod (aponeurosis) is subjected to tension forces. Bending moments of the bone that can cause injury are minimized. The fibrocartilaginous plantar plates of the metatarsophalangeal (MTP) joints are organized not only to resist compressive forces from weight bearing on the metatarsal heads but also to resist tensile stresses. Plantar aponeurosis, as the tie-rod, holds together the anterior and posterior struts when the body weight is loaded on the triangle. This structural design is efficient for the weight-bearing foot because the struts (bone) are subjected to compression forces; whereas the tie-rod (aponeurosis) is subjected to tension forces. Bending moments of the bone that can cause injury are minimized.[12] The fibrocartilaginous plantar plates of the MTP joints are organized not only to resist compressive forces of weight bearing on the metatarsal heads but also to resist tensile stresses presumably applied through the tensed plantar aponeurosis.

The tension in the plantar aponeurosis (the tie-rod) in the loaded foot in evident if active or passive MTP extension is attempted, while the triangle is flattened (i.e., when the subtalar and transverse tarsal joints are pronated). The range of MTP extension will be limited.

Through the pulley effect of the MTP joints on the plantar aponeurosis, the plantar aponeurosis, acts interpedently with the joints of the hind foot to contribute to increasing the longitudinal arch (supination of the foot) as the heel rises during the metatarsal break, thus contributing to converting the foot to a rigid lever for effective push-off. The tightened plantar fascia at the MTP joints, prevents excessive toe extension that might stress the MTP joints or allow the line of gravity to move anterior to the toes.[13]

ETIOLOGY

The cause of PF is often unclear and may be multifactorial. Because of the high incidence in runners, it is best postulated to be caused by repetitive microtrauma. Possible risk factors include obesity, occupations requiring prolonged standing and weight-bearing and heel spurs.[14] Other risk factors may be broadly classified as either extrinsic (training errors and equipment) or intrinsic (functional, structural, or degenerative). Training errors are among the major causes of PF. Athletes usually have a history of an increase in distance, intensity, or duration of activity. The addition of speed workouts, plyometrics and hill workouts are particularly high-risk behaviors for the development of PF. Running indoors on poorly cushioned surfaces is also a risk factor. Appropriate equipment is important. Athletes and others who spend prolonged time on their feet should wear an appropriate shoe type for their foot type and activity (see treatment).[15] Athletic shoes rapidly lose cushioning properties.[16] Athletes who use shoe-sole repair materials are especially at risk if they do not change shoes often. Athletes who train in lightweight and minimally cushioned shoes (instead of heavier training flats) are also at higher risk of developing PF.

RISK FACTORS

Structural risk factors include pes planus, overpronation, pes cavus, leg-length discrepancy, excessive lateral tibial torsion and excessive femoral anteversion.[17]

Athletes with pes planus (low-arched) or pes cavus (high-arched) feet have increased stress placed on the plantar fascia with foot strike.[18] Pronation is a normal motion during walking and running, providing foot-to-ground surface accommodation and impact absorption by allowing the foot to unlock and become a flexible structure. In athletes, planter fasciitis appears to be associated with overuse, training errors,

training on unyielding surfaces and wearing improper footwear. Sudden increases in weight bearing activity, particularly those involving running, can cause micro trauma to the planter fascia at a rate that exceeds the body's ability to recover.[19] In athletes, planter fasciitis appears to be associated with overuse, training errors, training on unyielding surfaces and wearing improper footwear. Sudden increases in weight bearing activity, particularly those involving running, can cause micro trauma. Leg-length discrepancy, excessive lateral tibial torsion and excessive femoral anteversion can lead to an alteration of running biomechanics, which may increase plantar fascia stress. As regards, functional risk factors, tightness in the gastrocnemius and soleus muscles are mainly involved. Achilles tendon is considered as a risk factor for PF. Reduced dorsiflexion has been shown to be an important risk factor for this condition.[20] Weakness of the gastrocnemius, soleus and the intrinsic foot muscles is also considered to be a risk factor for PF.

PATHOPHYSIOLOGY

A subcalcaneal pain syndrome in athletes is thought to be brought on by an overload of the plantar fascia. However, the mechanism of this overload is debated. Overload causes micro-tears at the fascia bone interface of the calcaneus or within the substances of the plantar fascia alone.[21] The central band of the plantar fascia is primarily affected where a hyper-cellular, an inflammatory response occurs within the fibers of the fascia, leading to degenerative changes.

SIGN AND SYMPTOMS

Acute diffuse swelling of digits, pain at the medial calcaneal tuberosity, swelling over Achilles insertion, enthesopathy, periostitis. The classical presentation of PF in pain in the sole of the foot at the inferior region of the heel. Patient report the pain to be particularly bad with the first few steps taken on rising in the morning or after an extended refrain from weight-bearing activity. The pain can be so severe the patient limps or hobbles around with the affected heel off the ground. After a few steps and through the course of the day, the heel pain diminishes, but returns if intense or prolonged weight-bearing activity is undertaken. In general, the pain is more significant when weight bearing activities are involved and can often be correlated to the increased amount or intensity of physical activity prior to the onset of symptoms. Some patients may also secondarily develop lower back pain.

DIAGNOSIS

Diagnosis of planter fasciitis is usually made on the basis of history and physical examination. Pain on first rising in the morning is typical of planter fasciitis and may be helpful in distinguishing it from other forms of heel pain. For example, in the case of a calcaneal stress fracture or nerve entrapment; the pain would actually increase with more walking rather than diminish after the first few steps. Associated paraesthesia is not a common characteristic of planter fasciitis. Nocturnal pain should raise suspicion of other causes of heel pain, such as tumors, infections and neuralgia (including tarsal tunnel syndrome). Planter fasciitis is usually unilateral, but up to 30% of cases have a bilateral presentation. Bilateral disease in young patients may indicate Reiter's syndrome. The diagnosis of PF is made with a reasonable level of certainty on the basis of a clinical assessment alone.[22] Patients should be questioned about other features of seronegative arthritidities.[23] Patients typically report an insidious onset of pain under the plantar surface of the heel upon weight bearing after a period of non-weight bearing. This pain in the plantar heel region is most noticeable in the morning with the first few steps after walking or after a period of inactivity. In some cases, the pain is so severe that it results in an antalgic gait. The patient will usually report that the heel pain becomes less with increasing levels of activity (i.e. walking, running), but will tend to worsen toward the end of the day.

Differential diagnosis

The following differential diagnoses have been suggested for plantar heel pain.

- Calcaneal stress
- Bone bruise
- Fat pad atrophy
- Tarsal tunnel syndrome
- Soft-tissue, primary or metastatic bone tumors
- Paget disease of bone
- Saver's disease
- Referred pain as a result of an SI radiculopathy.

MANAGEMENT

Non-operative management

Conservative treatment for plantar fasciitis should focus on decreasing pain, promoting healing, restoring range of motion and strength, correcting training errors, limiting biochemical deviations caused by structural abnormalities and improving the nutrition.[24]

Orthosis

Foot orthosis is used to decrease abnormal foot pronation that is thought to cause increased stress on the medial band of the plantar fascia. Foot orthosis can reduce the strain in the plantar fascia during static loading, reduce the collapse of the medial longitudinal arch and reduce elongation of the foot associated with pronation.[25]

The primary objects in using heel pad and orthotic were:

- To promote proper biomechanical alignment of the foot (neutral).
- To achieve maximum comfort by using materials that absorb shock.
- To provide cushioning and comfort exactly to the contour of the foot.
- To attain time and cost efficiency.

This device should be considered as a first line of treatment for older persons with planter fasciitis.

Night splints

Posterior tension night splint maintains ankle dorsiflexion and extension, creating a constant mild stretch of the plantar fascia that allows it to heal at a functional length. Physicians can make custom splints in the office or purchase prefabricated splints. One Cochrane review found limited evidence to support the use of night splints to treat patients with pain lasting more than 6 months. Patients treated with custom made night splints improved, but patients treated with prefabricated night splints did not. The purpose of night splinting is to keep the patient's ankle in a neutral position overnight, passively stretching the calf and plantar fascia during sleep. The intent is to allow the fascia to heel. Clinically study of night splinting has yielded mixed reviews. Some reports claim improvement in approximately 80% of patients. In contrast, one study 116-120 patients showed no benefits after 3 months compared to no treatment.[26] Shoes should have adequate arch support and cushioned heels. For individuals with pes planus, a shoe with longitudinal arch support can help decrease pain associated with long periods of standing. A change in footwear was cited by 14% planter fasciitis patients as the treatment that worked best.[27]

Anti-inflammatory agents

Anti-inflammatory agents, whether administered orally, topically or through an injection, have been a cornerstone in the treatment of PF. There is limited evidence to support the use of steroid injection to provide short-term pain relief.[28]

Physiotherapy treatment

Ultrasound therapy

Ultrasound may control pain by its transmission on perception or by modifying the underlying condition causing the pain. These effects may be the result of stimulation of the cutaneous thermal receptors on increased soft-tissue extensibility due to increased tissue temperature. The result of change in nerve conduction due to increased tissue temperature is the non-thermal effect of ultrasound. The modulation of inflammation is due to the non-thermal effects of ultra-sound. Continuous ultrasound of 0.5-2.0 w/cm^2 intensity and 1.5 MHz frequency has also been reported to be more effective than superficial heating with paraffin or deep heating with short wave diathermy for relieving the pain from soft-tissue injuries when applied within 48 h of injury.

Laser therapy

Low-intensity laser therapy or low level laser therapy is a generic term that defines the therapeutic application of relatively low out putt (<500) laser and monochromatic super luminous diodes for the treatment of disease and injury at a dosage (usually < 35/cm^2) generally considered to be too low to affect any detectable heating of the irradiated tissue. The radiation generated by therapeutic laser device differs from that produced by other sources in three respects.

Stretching and strengthening

Stretching and strengthening programs are valuable because they can help correct functional risk factors, such as tightness of the Achilles tendon and weakness of intrinsic muscles of the foot. Commonly used stretches are curls or stair stretches, which focus on stretching the gastrocnemius and soleus muscles. Stretching of the plantar fascia can be conducted similarly like the self myofascial release technique.[29]

The dosage for calf stretching can be either 3 times a day or 2 times a day utilizing either a sustained (3 min) or intermittent (20 s) stretching time as both are shown to produce similar effects.

Taping

Studies indicate that taping causes improvement in function of planter fascia in planter fasciitis. Calcaneal or low-dye taping can be used to provide short-term (7-10 days) pain relief. Low dye taping of the foot has been shown to be effective in limiting pronation.

Extra corporeal shock waves therapy

Extra corporeal shock waves have been applied since 1990, principally in Europe for treatment of numerous musculoskeletal disorders. Proponents of extra corporeal shock wave therapy also referred to as orthotripsy, claim it offers an effective means of treatment for chronic PF among the non-surgical treatments. It uses pulses of high-pressure sound waves to bombard damaged tissue to relieve pain associated with PF. It is non-invasive and has a relatively short recovery time.[30]

Operative treatment

Isolated partial or complete release of the plantar fascia or a fascia release combined with resection of

the plantar calcaneal spur and excision of the spur are surgical treatment options for recalcitrant PF.[31] An open procedure requires a 3-6 mm plantar medical incision to release the fascia never decompression and/or resection of the calcaneal spur may also be performed at this time. Devise *et al*. reported that 50% of patients with heel pain were totally satisfied with the results of surgical intervention. Although Confetti and Tarquinii noted a high satisfaction rate, only 57% of their patients had functional recovery postoperatively. Consequently, it is believed that it is important to further optimize imperative treatments prior to considering surgical options.

CONCLUSION

PF is considered to be one of the most common causes of inferior heel pain in both athletic and non-athletic population. The diagnosis is generally based on the history and the finding of localized tenderness. Many treatment options exist, including rest, stretching, change of footwear, low dye taping, ultra sound therapy, orthotics, night splints, anti-inflammatory agents and surgery.

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