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Heel pain: diagnosis and management

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One of the most common foot disorders encountered by podiatrists is heel pain. It has been estimated that over two million people each year receive treatment for heel pain, which affects as much as 10% of the population during the course of a lifetime [1,2]. Heel pain has been reported to occur in 15% of all adult complaints requiring a visit to a podiatrist and is prevalent in both the athletic and non-athletic populations [3,4]. Heel pain can affect anyone from the age of 8 to 80, but is generally observed in those over 40 years of age and does not seem to be gender specific [5]. The condition is bilateral in up to a third of cases.

Key Point

Heel pain has been reported to occur in 15% of all adult complaints requiring a visit to a podiatrist and is prevalent in both the athletic and non-athletic populations

AETIOLOGY OF HEEL PAIN

The cause of heel pain is poorly understood and is probably multifactorial. Risk factors such as obesity, occupations that require prolonged standing (over 8 hours a day on hard surfaces), mechanical factors (excessive pronation of the foot, reduced ankle joint dorsiflexion), and heel spurs have been reported in the literature (Table 1). Mechanical factors are the most common aetiological factors in heel pain. There are a number of other causes, these are known as non-functional causes of heel pain and include trauma, rheumatoid arthritis or other arthritic conditions, lower-back referred pain, infections or tumours [6]. Heel pain can either be mechanical plantar heel pain or mechanical posterior heel pain [7]. Mechanical plantar heel pain is one of the most frequent conditions presented to a clinician. Plantar heel pain is responsible for the majority of cases of mechanical heel pain and is associated with plantar fasciitis [7]. Plantar fasciitis and plantar heel pain are interchangeable terms used in the literature and for the purpose of this review plantar fasciitis will be used.

Table 1. Risk factors associated with heel pain

Intrinsic risk factors	Extrinsic risk factors
Mechanical • excessive foot pronation • limited ankle joint dorsiflexion	Footwear
Obesity	Occupation
Height	Standing for over 8 hours/day on hard surfaces
Age	Running excessively
Changes in the soft tissue properties of the heel pad such as stiffness and thickness	Suddenly increasing the distance run

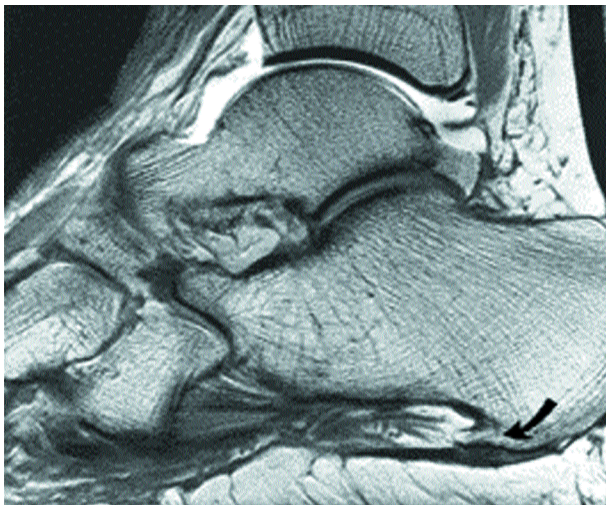

Figure 1. Structure of plantar fascia

Key Point

Mechanical heel pain such as plantar fasciitis is one of the most frequent conditions presented to a clinician

PATHOLOGICAL FEATURES

The site of abnormality is typically near the site of origin of the plantar fascia at the medial tuberosity of the calcaneus (Figure 1). Current thinking suggests that plantar fasciitis is a chronic

degenerative/reparative process caused by either repetitive micro-trauma to the fascia leading to macro-trauma, or by degenerative changes with an insidious onset of weeks to months [8].

DIAGNOSIS

DETAILED HISTORY

Even in this age of modern technology, the diagnosis of plantar fasciitis is based mainly on the medical history and clinical presentation. A careful description of the pain is essential including time(s) of day when pain occurs, current footwear, activity level both at work and at leisure, and any history of trauma.

Key Point

The diagnosis of plantar fasciitis is based mainly on the medical history and clinical presentation

Table 2. Differential diagnosis of heel pain

Site and diagnosis	Differentiating clinical features
Plantar fascia	
Plantar fasciitis	Morning pain
Enthesopathies	Unilateral or bilateral; bilateral symptoms = back pain; morning stiffness = inflammatory joint disease
Rupture of plantar fascia	Sudden acute, knife-like pain, ecchymosis
Nerve-entrapment of compression or syndrome	
Posterior tibial nerve (tarsal tunnel syndrome)	Burning pain and tenderness that follows the path of the posterior tibial nerve radiating into the planar aspect of foot and towards the toes
Medial calcaneal branch of the posterior tibial nerve entrapment	Medial and plantar heel symptoms
Sacro-iliac entrapment	Pain radiating down the leg to heel, with absent or reduced ankle reflex
Neuropathic pain	Diffuse foot pain; nocturnal pain
Bone	Bony point tenderness
Calcaneal stress fracture	Pain with weight bearing; worsens with prolonged weight bearing
Paget's disease	Bowed tibiae, bone pain elsewhere in body
Tumour	Deep bone pain; nocturnal pain
Calcaneal apophysitis (Sever's disease)	Posterior heel pain in adolescents
Soft tissue causes	
Fat pad syndrome	Occurs in older adult; atrophy of heel pad; pain and tenderness in central heel
Heel bruise	History of acute impact injury
Bursitis	Usually retrocalcaneal; swelling and erythema of posterior heel
Tendonitis	Pain with resisted motions

The most commonly stated complaints are pain upon first rising, after a long period of sitting, and at the beginning of weight-bearing activities such as walking. The most severe pain in the morning occurs within the first 50–100 steps and then decreases for ordinary walking. As the day progresses, pain gradually increases continuing after physical activities have ceased. The patient will often complain of pain originating in the plantar aspect of the heel, but often poorly defined and unable to recall any single event that precipitated the condition. The pain may be worse when the area is cold or contracted. The nature of the pain has been described as burning, aching, and occasionally lancinating. Runners may experience pain at the beginning of the run and increasing after the run [9].

A complete history may elicit conditions associated with heel pain, such as inflammatory arthropathies, spinal disorders and trauma (Table 2). For example, if compression of the medial and lateral margins of the calcaneus is painful, this may suggest a calcaneal fracture. Clinically, the patient presents with a history of diffuse pain involving the entire heel.

Key Point

A complete history may elicit conditions associated with heel pain, such as inflammatory arthropathies, spinal disorders and trauma

EXAMINATION OF THE FOOT AND ANKLE

The physical examination should include an observational gait analysis together with a recording of the foot type. Assessment for excessive foot pronation may be conducted together with assessing for the 'Windlass mechanism'. The Windlass test has many names: Hicks test, Jack test, and the Heusuber manoeuvre [10]. The patient stands and the hallux is dorsiflexed. Ideally the hallux should dorsiflex 60 degrees and the arch profile should increase. If the amount of dorsiflexion is below this and there is no arch elevation, then the Windlass mechanism is being inhibited, this is also described as a Functional Hallux Limitus [11]. There are a number of grading systems in use, utilising a scale between 1 and 5, 1 being less than 20 degrees hallux dorsiflexion with no arch elevation, to 5 being in excess of 60 degrees dorsiflexion and the arch fully rising.

Direct palpation of the medial calcaneal tubercle often causes severe pain along the plantar aponeurosis (Figure 2). Pain may be exacerbated by dorsiflexing the ankle and the

Figure 2. Direct palpation

metatarsophangeal joints, which stretches the plantar fascia. Pain may also be noted more medially, near the origin of the abductor hallucis muscle, and may extend distally along the plantar fascia. A tight Achilles tendon, as noted by limited ankle dorsiflexion with the knee extended, is commonly seen in this condition.

Key Point
Direct palpation of the medial calcaneal tubercle often causes severe pain along the plantar aponeurosis

A complete foot and ankle examination that includes neurovascular assessment should rule out most other causes of heel pain. An exam of other organ systems (i.e. eyes, mouth, spine and joints) is appropriate when other causes are suspected. A neurological examination should be included. Burning pain and tenderness that follows the path of the posterior tibial nerves inferior to the medial malleolus, radiating into the plantar aspect of the foot and towards the toes, suggest tarsal tunnel syndrome. The pain may also radiate proximally up the leg. Reproduction of symptoms with percussion to the medial aspect of the heel (Tinel's sign) suggests nerve involvement associated with plantar heel pain. If neurological heel pain is suspected, appropriate referral for diagnostic studies and/or assessment by a specialist should be considered. Other diagnostic studies may include electromyography (assessment of muscle activity and function) or nerve conduction velocity studies [7].

DIAGNOSTIC INVESTIGATION

When other sources of pain are possible, additional diagnostic tests may be appropriate. Plain radiographs will show calcaneal spurs but these are not felt to be diagnostic as they are commonly found in the asymptomatic population. It may however be useful to exclude other causes of heel pain. Ultrasound of the heel can confirm the diagnosis and can help exclude other entities, especially fascial rupture [12]. Other radiographic modalities may also be employed including computed tomography for the exclusion of stress fractures or magnetic resonance imaging (MRI) if the clinician suspects other soft tissue pathology [12]. Bone scintigraphy has been shown to be useful in observing 'hot-spots' in bone and soft tissues. Blood tests may be helpful when considering inflammatory arthropathies or infection.

Figure 3. Achiles tendon weight-bearing stretching exercise

Key Point
When other sources of pain are possible, additional tests may be appropriate, for example, radiological and blood tests

MANAGEMENT OF PLANTAR FASCIITIS

In general, heel pain is a self-limiting condition. Unfortunately, the time to resolution is often 6–18 months, which can lead to frustration for patients and clinicians [13]. Understanding the risk factors associated with the condition such as increased amount of weight-bearing activity, increased intensity of activity, change of occupation and worn shoes may lead to a shorter course of treatment as well as an increased probability of success with conservative measures.

Key Point
Understanding the risk factors associated with the condition may lead to a shorter course of treatment as well as an increased probability of success with conservative measures

Management options vary widely and the variety of interventions reported in the literature also attests to the uncertainty of the aetiology and pathogenesis [2]. Non-surgical approaches include: shoe modifications, use of foot orthoses, stretching exercises, physical therapies, NSAIDs (*non-steroidal anti-inflammatory drugs*), steroid injections, night splints, application of a cast, or any combination of the foregoing modalities [5]. Conservative treatment should address the inflammatory component that causes the discomfort and the biomechanical factors that produce the disorder. Patient education is imperative.

Key Point
Conservative treatment should address the inflammatory component that causes the discomfort and the biomechanical factors that produce the disorder. Patient education is imperative

PATIENT-DIRECTED TREATMENT

Initial treatment may involve a patient-directed approach that includes the use of NSAIDs, advice on footwear, stretching and muscle strengthening programmes.

STRETCHING AND STRENGTHENING PROGRAMMES

Stretching and strengthening programmes can correct risk factors such as tightness of the Achilles tendon and strengthening of the plantar fascia (Figure 3). Frequently used

Figure 4. Stair stretch

Figure 5. Cross-friction massage across the plantar fascia

stretching techniques include wall stretches and curb or stair stretches (Figure 4). Other effective techniques include using a slant board in areas where the patient stands for a prolonged period time (e.g. workplace) to stretch the calf [7]. Cross-friction massage above the plantar fascia and towel stretching may be undertaken before getting out of bed and serve to stretch the plantar fascia (Figure 5).

Key Point

Stretching and strengthening programmes can correct risk factors such as tightness of the Achilles tendon and strengthening of the plantar fascia

FOOTWEAR

A change to properly fitting, appropriate shoes may be useful in some patients. Wearing shoes that have a thicker, well-cushioned insole may decrease the pain associated with long periods of walking or standing [13]. The problem with athletic shoes is that the shock absorbing properties decrease with the age of the shoe and the simple advice to purchase a new pair of shoes may help in decreasing the pain. Shoes should be changed after 3 months or 500 miles of wear. Evaluation and assessment of shoe construction and the wear properties of materials are important parameters to review when dealing with heel pain. Shoes should not roll excessively inward or outward when resting on a level surface. Motion control shoes may also be helpful in patients with excessive foot pronation. Motion control shoes have the following characteristics:

- straight last
- board or combination lasted construction
- external heel counter
- wider flare
- extra medial support.

In one study of 267 patients with diagnosed heel pain only three patients reported an improvement in symptoms using motion control footwear [14]. An interesting observation from the study was that only 24% of patients could recall their running shoe brand suggesting that patient's preference may be based on costs rather than brand.

Key Point

Evaluation and assessment of shoe construction and the wear properties of materials are important parameters to review when dealing with heel pain

ORAL AND TOPICAL ANTI-INFLAMMATORY AGENTS

Anti-inflammatory agents include ice and NSAIDs. Ice is applied in the treatment of heel pain by ice massage, or an ice pack. For ice massage, the patient freezes water in a small cup and then rubs the ice over the painful heel using a circular motion and moderate pressure for 5 to 10 minutes [13]. Ice packs can be made by placing crushed ice in a plastic bag (or a bag of frozen peas can be used). This is then wrapped in a towel and applied to the painful area. Ice packs should be applied for 15 to 20 minutes. Ice is usually undertaken after completing exercise, stretching, strengthening and after a day's work.

Key Point

The use of ice reduces the inflammatory response

The advantages of NSAIDs are the acceptability of the use of oral and topical medication as a treatment modality by many patients in addition to the convenience and ease of administration. The disadvantages are many, including the risk of gastrointestinal bleeding, gastric pain and renal damage. NSAIDs are normally given in combination with other therapies [4].

Patients may have a clinical response within 6 to 8 weeks of treatment initiation. If improvement is noted, the patient-directed treatment is continued until symptoms are resolved. If no improvement, the patient should commence the clinician-directed treatment.

CLINICIAN-DIRECTED TREATMENT

This stage of treatment includes continuation of the patient-directed treatment with considerations for additional therapy: the use of foot orthoses, the use of night splints, limited number of corticosteroid injections, physical therapies or any of the above combinations.

Key point

There are two approaches to treatment: patient and clinician directed

FOOT ORTHOSES

A wide variety of pre-fabricated and custom-made orthoses are available, including heel pads and cups that are variously designed to elevate and cushion the heel, provide control and stability at the subtalar joint, or both [15]. The recent trend towards the prescription and supply of foot orthoses for heel pain has resulted in many products being introduced and many more established products being used in new contexts

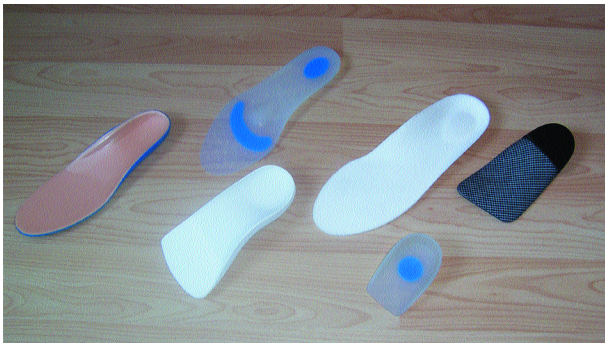

Figure 6. Example of a range of foot orthoses

(Figure 6). However, the selection and prescription of foot orthoses does not follow any set criteria, often based on consensus and opinion. Custom-made orthoses are normally taken from plaster casts. Modern technology using computerised systems such as CAD-CAM allow precision-made devices to be constructed from thermoplastic materials such as polypropylene and carbon-graphite. The orthotic devices are made to control risk factors identified in the initial diagnosis. For example, orthotic devices can be used to control excessive foot pronation; to increase ankle joint dorsiflexion; or to enhance shock absorbency. The choice of material will dictate the use of the foot orthoses but depends upon the thickness and density of the material.

- Rigid materials including carbon-graphite, polypropylene and high-density ethyl vinyl acetate are normally used to control motion.
- Semi-rigid materials including medium-density ethyl vinyl acetate and ortholene are normally used to stabilise and support structures.
- Soft materials including polyurethane, polyethylene, and low-density ethyl vinyl acetate are normally used to cushion and deflect load.

Combinations of materials can be used to control and cushion. The main disadvantage of custom-made devices in comparison to pre-fabricated devices is the cost. However, the long-term benefits may outweigh the original costs. Pre-fabricated devices that control motion and stabilise are highly variable and depend on the materials used to make the device. Heel cups are used to decrease the impact of the heel at contact when walking or running and therefore alleviate pain [13]. Heel cups are made from a variety of materials that include silicone and rubber. Other types of foot orthoses that can be used include cobra insoles, magnetic insoles, orthotics with a groove for the abductor hallucus or simple cushioned insoles with apertures over the heel region. Foot orthoses are commonly combined with other interventions such as strapping, night splints, and stretching.

Key Point

A wide variety of pre-fabricated and custom-made orthoses provide control and/or stability at the subtalar joint

NIGHT-SPLINTS

The use of night splints, designed to keep the ankle in a zero position with and without dorsiflexion of the metatarsophangeal joints during sleeping has been reported in the literature [16–18]. A night dorsiflexion splint allows passive stretching of the calf and the plantar fascia during sleep. A night splint can be moulded from plaster or fibreglass casting material or may be a prefabricated, commercially produced plastic brace. Disadvantages of night splints include mild discomfort, which may interfere with the patient's or partner's ability to sleep.

WALKING CASTS

The efficacy of a short leg-walking cast in the treatment of chronic heel pain is poor. In one study of 28 patients only seven revealed complete resolution of pain (25%), improvement for 17 (61%), and no improvement for four (14%). Ten (42%) patients were completely satisfied with cast treatment, three (12%) were satisfied with reservations, and 11 (46%) were dissatisfied [19].

STEROID INJECTIONS

The injection of corticosteroids, usually mixed with local anaesthetic, has been shown to provide short-term pain relief [20]. One concern is that corticosteroid injections may be associated with an increased risk of rupture of the plantar fascia and fat pad atrophy, although data to support this association are limited and inconclusive. Steroid injections can be used in conjunction with other therapies such as foot orthoses.

STRAPPING

There are a multitude of anecdotal papers in the literature that advocate and describe the use of low-dye taping in the management of plantar fasciitis [21,22]. Strapping provides only transient support.

PHYSICAL THERAPIES

Physical therapies include the use of ultrasound, short-wave diathermy, acupuncture, iontophoresis, homeopathy and manipulation. Physical therapies are normally incorporated into other treatment programmes such as the prescription of foot orthoses and acupuncture.

The use of physical therapies such as ***laser therapy*** and ***ultrasound*** in treating heel pain is controversial. Low-level lasers use a semi-conductor diode as a source of radiation. However, in one study 32 patients were placed into a treatment group that received low-intensity therapy, three times per week for four weeks and a control group received a dummy laser [23]. The results found no benefit of low-intensity laser therapy. In a clinical trial Crawford [24] evaluated 19 patients with true ultrasound or placebo ultrasound. All patients received eight treatments in four weeks. The results demonstrated the use of therapeutic ultrasound at a dosage of 0.5W/cm^2 pulsed 1:4 for eight minutes was no more effective than placebo.

Iontophoresis is the use of electric impulses from a low-voltage galvanic current stimulation unit to drive topical corticosteroids into soft tissue structures but has only short-term benefits [25]. There are no major complications of iontophoresis other than the technique is both time and labour-intensive. A typical course of treatment involves visits to a clinician two or three times weekly [13].

Acupuncture has been shown to have some benefit to patients with heel pain but there is limited evidence currently available. In a clinical trial 11 patients were recruited into a study of traditional and electro-stimulating acupuncture [26]. Acupuncture treatment was performed at the rate of one treatment per week for a maximum of six sessions, or until maximum favourable response was obtained to symptomatic trigger points in selected intrinsic foot muscles. The results demonstrated that nine patients reported an improvement in pain reduction of greater than 50%; and two patients reported a complete resolution of heel pain.

Traction or manual manipulation, with or without anaesthesia, to break up the adhesions at the first metatarsophangeal joint and restore function of the plantar fascia and the Windlass effect may be alternative options available to the clinician [27]. In a recent publication the use of specific foot mobilisations and manipulations combined with calf stretches were reported to be successful in four case studies [28].

Other forms of treatment have included ***homeopathy*** [29]. In a clinical trial of 18 patients over 14 days, all patients were issued with an 8mm high-density EVA insole covered with

1.55mm polyurethane foam [27]. Subjects were given sugar tablets either with two drops of 30C strength *Ruta graveolens* preparation (intervention) or without (placebo). Using a pain scale the results demonstrated a significant difference ($p<0.05$) between the two groups.

Key Point

A wide range of non-surgical interventions can be used in combination to treat heel pain

SURGERY

In cases that do not respond to any conservative treatment after 12 months, surgical intervention should be considered only for chronic pain [30]. Reports describe various surgical procedures including plantar fascia release, nerve decompression and excision of abnormal tissue. A plantar fascia release may be performed either through an open incision or through an endoscope [31]. Endoscopes are expensive and minimal incision plantar fasciotomy is technically simple to perform under local anaesthetic and creates minimal disruption to the patient's immediate post-op activities [32]. However, a small number of complications have been described in the literature which include infection, dehiscence, flatfoot, arch pain, lateral column instability and damage to vital structures.

Key Point

In cases that do not respond to any conservative treatment after 12 months, surgical intervention should be considered only for chronic pain

A NEW MODALITY

Recently, *extracorporeal shock wave therapy* with ultrasound has been proposed for the treatment of heel pain. Extracorporeal shock waves are focused, single pressure pulses of microsecond duration that may stimulate healing of soft tissue and inhibit pain receptors. The efficacy of extracorporeal shock wave therapy for the treatment of heel pain remains controversial and available evidence does not provide substantive support for its use [12,15].

CONCLUSION

Heel pain is a common problem that affects many people. It is probably caused by a combination of factors, including the effects of biomechanical alterations, footwear and prolonged standing on hard surfaces. The pain associated with this condition can lead to a reduction in everyday activities and a poor quality of life. Patients with heel pain may respond favourably to conservative management that may include self-management programmes such as prescription medications, flexibility and strengthening exercises. If the condition persists other conservative treatments may be used such as foot orthoses, strapping, night splints and physical therapies. However, if conservative treatment is unsuccessful then surgery may be the only option. The objective examination, differential diagnosis and treatment progression for patients with heel pain are the key points for this common musculoskeletal condition.

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Post-reading activity

Short Answer Questions

1. What is the incidence of heel pain requiring professional care among adults?

2. What are the most common intrinsic risk factors associated with plantar heel pain?

3. What is the most typical site for plantar fasciitis?

4. Which two criteria are commonly used in clinical practice in the diagnosis of plantar fasciitis?

5. What other diagnostic tests can be used to assess plantar fasciitis?

6. Name three types of patient-orientated management strategies that are available to clinicians.

7. Name three types of clinician-directed management strategies that are available to patients.

8. What class of foot orthoses are used to control excessive foot pronation?

9. What types of physical therapies are available to a clinician?

10. When would you consider surgery?

Reflection

After reading this CPD article, take a few minutes to reflect on heel pain and how it is managed. Areas for reflection may include:

- **How often do I recognise the condition in my practice?**
- **Am I treating the condition effectively and giving the patient the best care possible?**
- **How do I assess my treatment outcomes?**
- **How does this article change my practice, if at all?**

ANSWERS TO SHORT ANSWER QUESTIONS

1. Between 10–15%; 2. Intrinsic: obesity, age, excessive foot pronation, limited ankle dorsiflexion; 3. Medial tubercle of the calcaneum; 4. Full medical history and a clinical presentation; 5. Any from the following: MRI, ultrasound, vascular, blood tests, neurological; 6. Self-stretching, manipulation, NSAID, rest, change of footwear; 7. Foot orthoses, physical therapies, strapping, steroid injection, night splints; 8. Rigid foot orthoses made from rigid materials including carbon-graphite, polypropylene and high-density ethyl vinyl acetate are normally used to control motion; 9. Manipulation, acupuncture, ultrasound, laser therapy; 10. Normally after 12 months of conservative treatment.

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