Posterior tibial tendon dysfunction: a silent but disabling condition

Posterior tibial tendon dysfunction is common and a major cause of flat foot (pes planus) and functional impairment in adults. It is frequently undiagnosed and therefore inappropriately managed. This review raises awareness of posterior tibial tendon dysfunction with the intention of improving patient management.

Posterior tibial tendon dysfunction was first reported by Kettelkamp and Alexander (1969) and can be described as an acute or gradual loss of strength of the tibialis posterior tendon (Mendicino, 2000). A study reported that 3.3% of women aged over 40 years were undiagnosed despite having prolonged characteristic symptoms (Kohls-Gatzoulis et al, 2009). Another study found that on occasions general orthopaedic surgeons and experienced physiotherapists can miss the diagnosis (Haddad et al, 2000). Fortunately patients who have flat foot secondary to systemic or generalized medical conditions such as peripheral neuropathy, diabetes mellitus or inflammatory arthropathy are more likely to be diagnosed and treated appropriately. *Table 1* lists the causes of acquired adult flat foot.

Unfortunately in patients who have acquired adult flat foot deformity secondary to posterior tibial tendon dysfunction the diagnosis is often delayed or misdiagnosed as ankle sprain or arthritis. Patients with posterior tibial tendon dysfunction usually complain of a change in foot shape, flattening of the medial foot arch, abducted forefoot, medial foot pain and/or walking dysfunction (Johnson and Strom, 1989; Chao et al, 1996). *Table 2* outlines the symptoms of posterior tibial tendon dysfunction.

Anatomy and function of posterior tibial tendon

Understanding the role of the tibialis posterior tendon in a normal individual is important because the loss of function plays an important role in the development of an acquired flat foot. This tendon is within the posterior compartment of the leg and is the most central of all leg muscles. The muscle originates on the inner border of the tibia and fibula in the proximal third of the leg. It then descends posterior to the medial malleolus and inserts to multiple sites, the most important being the navicular tuberosity (medial aspect of the foot). The other attachment sites include the three cuneiform bones in addition to the bases of the second to fourth metatarsals.

Contraction of the tibialis posterior results in inversion and plantar flexion of the foot, prevents pronation and internal rotation of the tibia when the heel strikes the ground (Richie, 2005) and locks the mid-tarsal bones making the mid and hind foot rigid upon heel rise (Imhauser et al, 2004). This action allows the powerful gastrocnemius and soleus muscles to act with greater efficiency during ankle plantar flexion (Chao et al, 1996). This has found to be the primary dynamic stabilizer of the medial longitudinal arch of the foot (Basmajian and Stecko, 1963; Chao et al, 1996). Without this tendon functioning normally other ligaments become weak, resulting in a flat foot; in addition to this the power of the gastrocnemius is reduced and gait disturbances occur.

Table 1. Causes of acquired flat foot deformity

Posterior tibial tendon dysfunction
Trauma: fracture, dislocation, tendon laceration
Arthrosis: rheumatoid arthritis, talonavicular joint, tarsometatarsal joints
Neuropathic foot (Charcot foot): secondary to diabetes, peripheral neuropathy
Neuromuscular disorder: cerebral palsy, poliomyelitis
Tumour of foot

Table 2. Symptoms of posterior tibial tendon dysfunction

Pain along medial aspect of foot
Swelling posterior to medial malleolus
Difficulty walking on tiptoes
Changes in foot shape
Diminished capacity to play sports or reduction in walking distances

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Pathogenesis

The pathogenesis and aetiology of posterior tibial tendon dysfunction is debatable. Histological examination has shown that the underlying mechanism is degenerative tendinosis (degeneration) rather than tendinitis (inflammation) (Mosier et al, 1998). Other proposed aetiologies include acute traumatic injury, inflammatory synovitis secondary to systemic disease or mechanical overuse, and chronic tendon degeneration (Bare and Haddad, 2001; Meehan and Brage, 2003). Owing to the numerous theories present most clinicians suspect a multifactorial aetiology (Mosier et al, 1999).

Classification

Johnson and Strom (1989) classified the different stages of posterior tibial tendon dysfunction as stages 1, 2 and 3. Each stage gets progressively more severe. An additional stage 4 was added by Myerson (1996). In this stage degenerative changes within the ankle joint occur. This classification also serves a guide to management. *Table 3* summarizes the classification of posterior tibial tendon dysfunction.

Diagnosis of posterior tibial tendon dysfunction

History

Most patients with posterior tibial tendon dysfunction present with a gradual onset of symptoms and approximately 50% recall a history of trauma (Mann, 1993). Bilateral posterior tibial tendon dysfunction is rare and most cases are unilateral.

Early symptoms in stage 1 of the disease process includes pain along the medial aspect of the foot and swelling posterior to the medial malleolus. Patients report finding standing on their toes painful and difficult. Functional capacity to play sports is also diminished, and wearing high-heeled shoes becomes problematic in women. As the disease process progresses into stage 2 there are more complaints from the patient in relation to loss of function and flattening of the foot. In the final stages the medial arch of the foot is lost, and pain and swelling becomes more prominent on the lateral hind foot secondary to calcaneofibular or lateral subtalar impingement (Pomeroy et al, 1999). Sometimes lateral hind foot pain may be the only presenting symptom.

Table 3. Classification of posterior tibial tendon dysfunction

Stage 1	Tendonitis occurs, but no rupture. Foot is flexible with too many toes sign no X-ray changes
Stage 2	Tendon is elongated with partial or complete rupture. Foot is flexible. X-ray changes of abduction of forefoot, collapse of talo-navicular joint occurs
Stage 3	Severe degeneration with likely rupture of tendon. Fixed flat foot X-ray changes abduction of forefoot, collapse of talo-navicular joint and subtalar degeneration
Stage 4	Fixed flat foot deformity. X-ray changes degenerative changes at subtalar and ankle joints

Examination findings

The examination of the foot in a patient with posterior tibial tendon dysfunction is important in order to confirm the diagnosis and exclude other possible foot pathologies such as fractures, metatarsalgia, bunions and hallux rigidus.

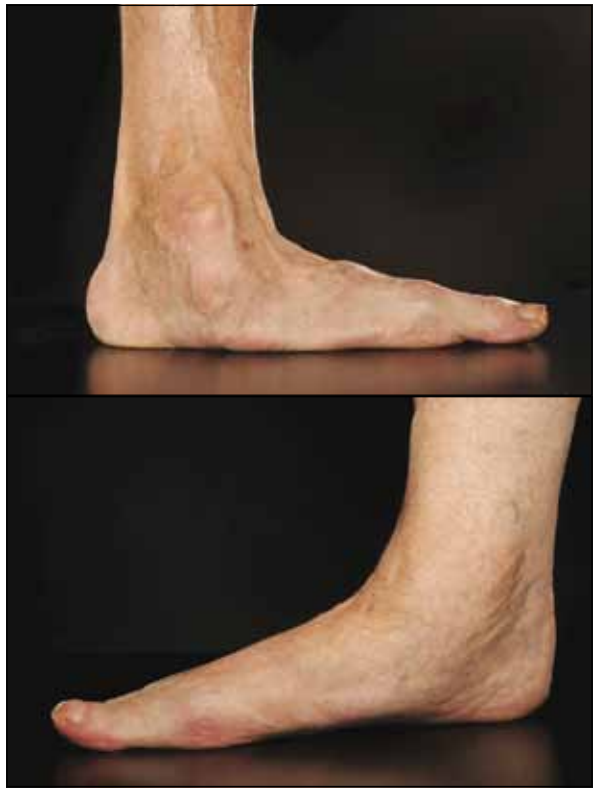
In stage 1 of posterior tibial tendon dysfunction there is swelling and fullness on the posteromedial aspect of the medial malleolus. There might be pain and/or weakness with foot inversion and the patient could have difficulty in heel raising (putting weight on tip toes).

When examining the patient standing up, it is best to examine the patient from behind and compare with the unaffected foot. The examiner will note the loss of medial arch of the foot (*Figure 1*), increased hind foot valgus deformity (*Figure 2*) and the appearance of the 'too many toes sign' (*Figure 3*) described by Johnson and Strom (1989). In this sign more than the normal number of toes (one to two toes) is visible on the lateral border of the foot as a result of forefoot abduction in the advanced deformity. It is important to ensure that the patellae are facing forward when assessing this sign.

When posterior tibial tendon dysfunction reaches stages 2 and 3 the tendon is no longer functioning. It is irrelevant whether this is caused by a rupture, adhesion or degenerative stretching. All of these result in a functional loss of its action – hence the term posterior tibial tendon dysfunction rather than rupture.

The single heel raise test (*Figure 4*) is the most commonly used functional test available. This is performed

Figure 1. Loss of medial arch of foot in two different patients.



by asking the patient to stand facing a wall with his/her arms resting on the wall for balance, asking the patient to raise the unaffected foot off the floor then stand on only the toes of his/her affected foot. A partial elevation of the heel counts as a failure. Patients in stage 2 and above will be unable to perform this test.

In the latter stage 3 there is a fixed flat foot deformity which is no longer passively correctable by holding the heel and attempting to correct the valgus of the hind foot and the arch. In stage 4 there is a valgus tilt (*Figure 5*) of the talus in the ankle joint as well because there is failure of the deltoid ligament as well as the tibialis posterior. This results in degeneration of the ankle.

Figure 2. Hind foot valgus deformity.

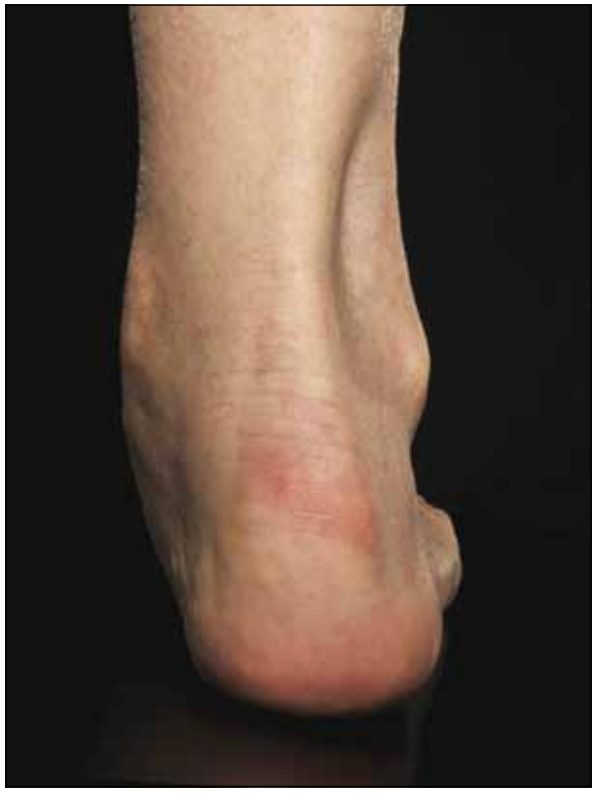
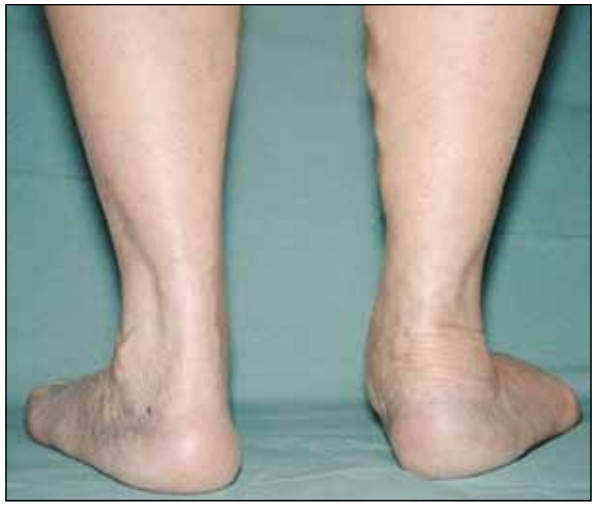


Figure 3. Too many toes sign.



Imaging modalities

Posterior tibial tendon dysfunction is primarily a clinical diagnosis, but plain radiographs are essential. Antero-posterior and lateral weight bearing of both feet and ankle should be obtained to assess the presence or absence of degenerative changes and/or joint subluxation (*Figure 6*). They can also exclude accessory navicular and tarsal coalitions. Use of ultrasound allows colour Doppler and dynamic assessment (Kong and Van der Vliet, 2008). Magnetic resonance imaging can be used to assess soft tissue abnormalities and bony changes such as bone oedema (Kong and Van der Vliet, 2008). However, in most cases the only imaging modality required is plain radiographs.

Treatment

The options for managing posterior tibial tendon dysfunction are both non-surgical and surgical. Treatments are based upon accurate staging of the disease and preventing progression to the next stage. A key factor is whether the foot deformity is flexible or fixed. A problem

Figure 4. Patient unable to perform single heel raise test.

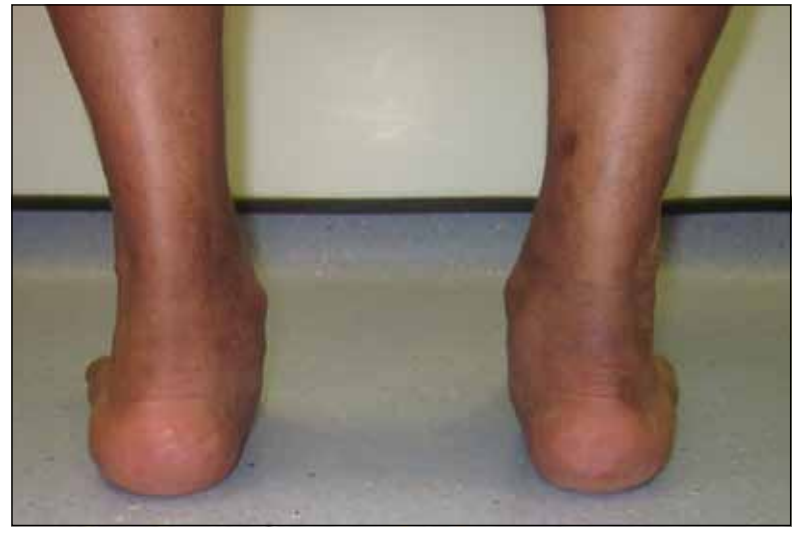
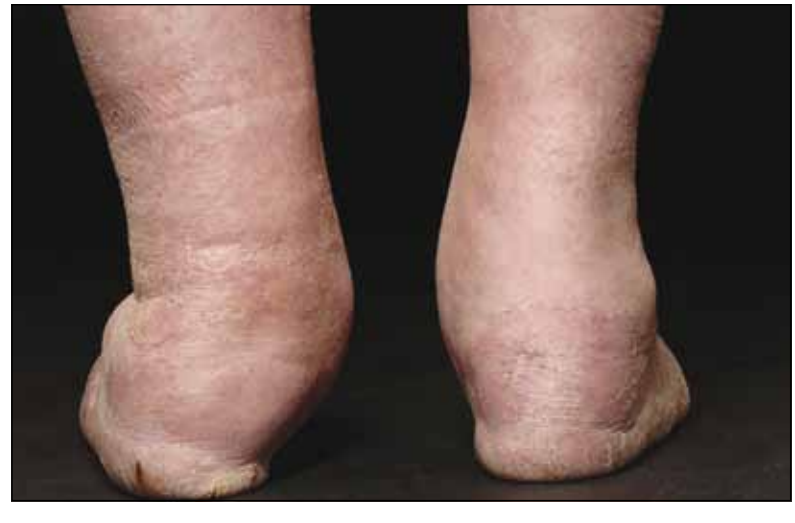


Figure 5. Valgus tilt of talus/hind foot deformity.



with conservative management is patient compliance with foot and ankle orthoses. Kulig et al (2006) stated that the management of posterior tibial tendon dysfunction requires effective patient education. The role of podiatrists and physiotherapists is of paramount importance.

Non-surgical

Stages 1 and 2: the flexible flat foot

A walking cast or a removable boot is indicated for patients with acute tenosynovitis. A minimum period of 4–8 weeks is recommended before inflammation is under control (Myerson, 1996; Pomeroy et al, 1999; Wapner and Chao, 1999). Anti-inflammatories can also be used. If symptoms are improved then custom-made foot and ankle orthoses may be fitted to the patient, to provide medial arch support and correct the flexible deformity. Up to two thirds of patients have good to excellent results (Chao et al, 1996).

Stages 3 and 4: the fixed flat foot

With fixed flat foot, conservative treatment is concerned with relieving symptoms and accommodating the deformity as opposed to correcting it. Custom-made foot and ankle orthoses are used.

Surgical management

Surgical treatment is usually undertaken if conservative management has failed. Postoperatively the foot is immobilized for approximately 2–3 months with the foot plantar flexed to reduce stress and traction upon the tendon. The interventions below have good to excellent results for more than 80% of patients at 5-year follow up (Myerson, 1996; Pomeroy et al, 1999).

Stages 1 and 2: flexible flat foot

Surgically a synovectomy will remove any hypertrophic synovium which helps to reduce pain and permit improved function. Any necrotic tissue can be removed and, if adequate length is available, end to end tendon repair can be carried out (Teasdall and Johnson, 1994). Tendon transfers (such as the Cobb procedure, using the distal half of the anterior tibial tendon) are other procedures for direct reconstruction of the posterior tibial tendon.

There is growing consensus that a combination of tendon transfer and corrective osteotomy should be the surgical treatment of choice (Johnson and Strom, 1989; Myerson, 1996). Several calcaneum osteotomies are advocated to correct the bony alignment (Johnson and Strom, 1989; Myerson, 1996; Wacker et al, 2002). The combination of the two procedures allows for normal bony alignment which in turn provides the correct biomechanics for the repaired posterior tibial tendon to function normally.

Figure 6. a. Anterior-posterior and (b) lateral radiographs showing pes planus.

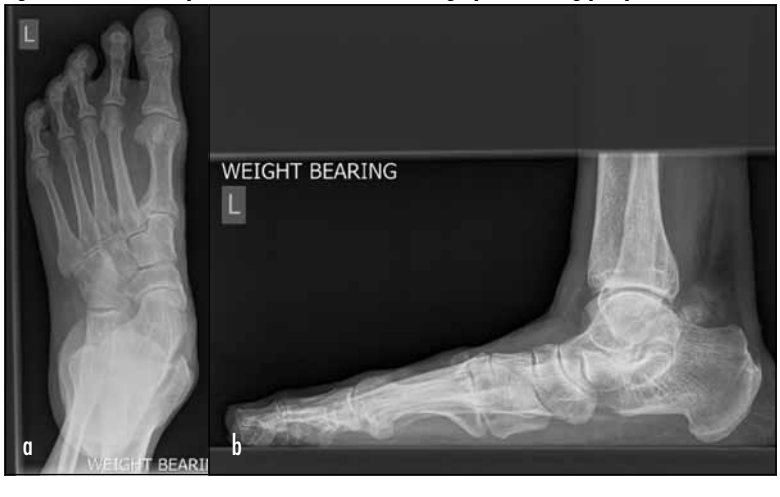
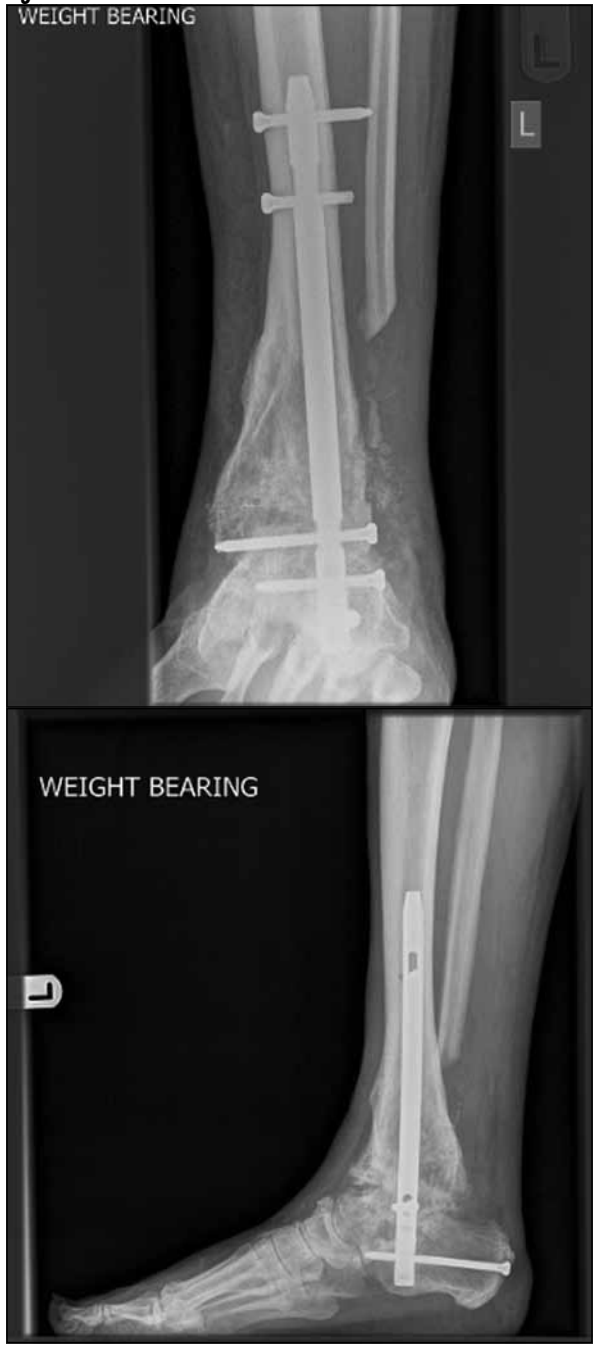


Figure 7. Pan talar arthrodesis.



Stages 3 and 4: the fixed flat foot

Surgery in this stage of posterior tibial tendon dysfunction is symptomatic relief. A triple arthrodesis of the calcaneocuboid, subtalar and talonavicular joints is made. When stage 4 is reached salvage surgery is undertaken with pan talar arthrodesis (*Figure 7*) involving the calcaneocuboid, subtalar, talonavicular and ankle joints.

Conclusions

Posterior tibial tendon dysfunction is usually misdiagnosed which has debilitating consequences for the patient. An accurate diagnosis requires an understanding of flat foot deformity. Allied health-care professionals such as podiatrists and physiotherapists are essential to the management of posterior tibial tendon dysfunction. With increased awareness of this silent condition hopefully patients can be managed and referred appropriately to foot and ankle specialists, therefore reducing the functional impairment that they have to endure. BJHM

Conflict of interest: none.

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KEY POINTS

- Posterior tibial tendon dysfunction is a common cause of flat foot (pes planus).
- Women older than 40 years of age are most at risk.
- Posterior tibial tendon dysfunction is commonly misdiagnosed even with general orthopaedic surgeons and experienced physiotherapists.
- A multidisciplinary approach is required to effectively treat posterior tibial tendon dysfunction.