Ministry of Defence

Synopsis of Causation

Pes Planus

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Disclaimer

This synopsis has been completed by medical practitioners. It is based on a literature search at the standard of a textbook of medicine and generalist review articles. It is not intended to be a meta-analysis of the literature on the condition specified.

Every effort has been taken to ensure that the information contained in the synopsis is accurate and consistent with current knowledge and practice and to do this the synopsis has been subject to an external validation process by consultants in a relevant specialty nominated by the Royal Society of Medicine.

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1. Definition

1.1. Pes planus or flatfoot is defined as a condition in which the medial arch of the foot is diminished or absent, allowing the entire sole to touch the ground.

1.2. **Classification**. Flatfoot may be classified as congenital or acquired.

1.3. Congenital flatfoot can be further divided into rigid and flexible.

1.3.1. Congenital rigid flatfoot is due to a structural bony abnormality such as vertical talus or tarsal coalition.

1.3.2. Congenital flexible flatfoot is mostly physiological, asymptomatic and requires no treatment.[1]

1.4. Acquired flatfoot deformity in adults is a complex disorder with a diverse range of deformity and symptoms.

2. Clinical Features

2.1. Pes planus may present as an asymptomatic incidental finding on examination or as a symptomatic condition. Symptoms range from mild pain or restricted range of movement to severe disability and pain.

2.2. Symptoms do not correlate well with the clinical deformity.

2.3. The diagnosis of flatfoot is clear on physical examination. The medial arch of the foot is depressed with the sole of the whole foot touching the floor. The heel bone, when viewed from the rear is everted or in valgus. The forefoot is abducted relative to the hindfoot. When viewed from behind the lateral toes are more visible than on someone without flatfoot. The so-called "too many toes sign" is positive if more than 2 toes can be seen outside the heel.[2]

2.4. Individuals with flat feet may have no pain, or may have pain to varying degrees along the posterior tibial tendon, the outside of the heel, or along the plantar fascia.

2.5. Flatfeet may cause, or be associated with, other biomechanical causes of pain for example, genu valgum (knock knees), medial or anterior knee pain, shin splints, Achilles tendonitis, and low back pain.[3]

2.6. Flatfoot is associated with other medical conditions including rheumatoid arthritis, seronegative arthropathies, hypertension and diabetes.[4]

3. Aetiology

3.1. **Congenital flatfoot** may be familial in nature. The flatfoot deformity may be a marker of inherited generalised joint laxity.

3.2. **Adult flatfoot deformity** may be classified according to its cause:[2,3]

3.2.1. **Adult flexible flatfoot.** This is a progression of the paediatric condition with partial or complete loss of the medial arch; it may present as unilateral or, more commonly, bilateral deformity. The arch is recreated by standing on tiptoes with normal hindfoot (heel) movement. This condition is usually asymptomatic requiring no treatment. If symptoms do occur, they present with arch, heel or lateral foot pain. Symptoms are generally worse with weight-bearing activities (walking, running, hiking).

3.2.2. **Posterior tibial tendon dysfunction (PTTD).** This tendon is vital to the maintenance of the medial arch. Attenuation or rupture of the PTTD tendon will cause a flatfoot deformity; this problem is more common in women, and in the 45-65 year age group. A specific history of trauma is not usually evident in these cases and symptoms are typically preceded by overuse activity. Symptoms at presentation range from pain along the tendon path in early cases through to a severe fixed flatfoot.

3.2.3. **Tarsal coalition.** This is a congenital condition where bones in the midfoot and hindfoot are abnormally joined together. This causes a reduced range of movement and the transfer of mechanical forces to other joints causing pain. The pain is often activity-dependent. Tarsal coalition may be diagnosed in early childhood during investigation of a fixed flatfoot deformity. Occasionally the condition is diagnosed in adolescence with a sudden onset of pain during activity. This pain occurs when a cartilagenous coalition ossifies and then fractures. The abnormality is seen on radiographs. The coalition may also be asymptomatic and may be picked up incidentally, in adults, on radiographs of the foot or ankle.

3.2.4. **Peroneal spastic flatfoot** is a name given to flatfoot deformity with increased tone in the peroneal muscles. These muscles evert the foot and disrupt the balance of muscular pull around the ankle, causing the deformity. It is most commonly linked with a tarsal coalition, although a range of childhood arthritic and neuromuscular conditions can cause it. Occasionally no cause can be found and this is labelled idiopathic peroneal spastic flatfoot.

3.2.5. **Iatrogenic.** The treatment of childhood deformities of the foot and ankle carries a risk of inducing a flatfoot deformity. This is particularly the case in the surgical treatment of clubfoot (talipes equinovarus), where overcorrection is a common cause of iatrogenic flatfoot. This causative factor is decreasing as serial plaster splinting supersedes the surgical treatment of clubfoot.[5]

3.2.6. **Post-traumatic.** This can be the result of fractures of the ankle, midfoot or hindfoot that heal with malunion or fail to unite and

collapse into a valgus position. Soft tissue injury including laceration of the posterior tibial tendon can also cause a flatfoot deformity.[6]

3.2.7. **Arthritic.** Rheumatoid arthritis may result in a flatfoot deformity. In this case, the onset of pain and deformity will usually be slow and progressive.

3.2.8. **Charcot foot.** This is flatfoot, sometimes a rocker bottom foot, associated with a peripheral neuropathy. The most common cause is diabetes mellitus.[4] Syphilis, leprosy and other neuropathies are less common causes.

3.2.9. **Neuromuscular flatfoot.** This is the result of a number of conditions that cause weakness or overactivity of foot musculature. These may be congenital or acquired. Peroneal spastic flatfoot is mentioned above. Other causes include cerebrovascular accidents (strokes) and post-traumatic or iatrogenic causes.

4. Treatment

4.1. Treatment for flatfoot is only needed if the deformity is symptomatic.

4.2. Treatment can be either non-operative or operative.

4.3. **Non-operative treatment**. The initial treatment for all causes of flatfoot should be non-operative. Apart from failure of treatment, there is no risk with non-operative interventions. Treatment consists of activity modification, essentially avoiding the activities that increase pain; weight loss, if overweight; painkillers; and orthoses, which can consist of insoles to help correct heel and forefoot alignment.

4.4. **Operative treatments** are best described according to the cause of the flatfoot and are reserved for those people in whom conservative treatment has failed, and who have a clear abnormality justifying surgery.

4.5. **Adult flexible flatfoot.** This condition is rarely symptomatic and usually requires no treatment. If patients have symptoms, the non-operative measures mentioned above should be employed.

4.6. **Posterior tibial tendon dysfunction (PTTD)**

4.6.1. In the early stages before any rigid deformity or tendon rupture has occurred, debridement and synovectomy can help. In one study of 19 patients with early disease, 74% had complete pain relief and 84% had return of posterior tibial tendon function.[7]

4.6.2. Ruptured tendons can be repaired but there are no good results to prove that tendon repair alone improves pain or the flatfoot deformity. This may be because most ruptures, unless due to direct trauma (i.e. cutting), are repaired many months/years after rupture, at which point other tissues have tightened up and bony changes have occurred.

4.6.3. Most cases of chronic tendon rupture with flatfoot deformity are treated with tendon transfer (another tendon in the foot is sacrificed and used to repair the posterior tibial tendon) combined with a calcaneal osteotomy. This involves cutting the calcaneus (heel bone) and moving the bone to correct the flatfoot deformity. The bone is then secured with a staple or screws and allowed to heal. One review of 19 cases of flatfoot operated on with tendon transfer and osteotomy demonstrated that 79% had good or excellent results and were able to walk on uneven surfaces at an average of 66 months follow-up.[8] However, it is unlikely that these patients could perform any kind of heavy or high impact activity.

4.7. **Tarsal coalition.** Approximately 76% of patients with tarsal coalition are asymptomatic into adulthood. Where symptomatic problems occur, they usually begin in childhood as the bones mature. Failed conservative treatment requires surgery consisting of resection of the bony abnormality. One study of 17 adult patients with symptomatic tarsal coalition showed that 3 improved with conservative measures. Twelve patients had symptoms severe enough to require surgery. Of these patients, 10 of the 12 obtained pain relief at 3-year follow-up.[9]

4.8. **Peroneal spastic flatfoot.** If idiopathic, then treatment is conservative. If due to tarsal coalition, then treatment is as outlined above.

4.9. **Post-traumatic, arthritic, Charcot foot and neuromuscular flatfoot.** If these conditions become painful, there is usually evidence of degenerative change within the ankle or subtalar joints. Realignment procedures, for example, tendon transfer or osteotomy, are less helpful in reducing pain in these cases, as the pain tends to be due to the arthritic joint. In severe cases where conservative measures have failed, the surgical option most commonly used is arthrodesis (joint fusion). Only the degenerative joints are fused but the downside of fusion procedures is that movement is lost within the hindfoot placing higher stresses on remaining joints.

5. Prognosis

5.1. Prognosis of flatfoot is dependent on the aetiology. The extent of the deformity does not correlate well with the extent of symptoms.

5.2. The majority of people with flexible flatfeet will be asymptomatic, although studies place these individuals at higher risk of musculoskeletal injury. This is particularly true when accompanied by a short Achilles tendon and reduced dorsiflexion.[10]

5.3. Those with acquired flatfeet require investigation of the cause as continued activity in the presence of symptoms can predispose the individual to arthritic conditions in the ankle.

5.4. Several studies have looked at the effect of flatfeet in the military setting.

5.4.1. Flatfeet have been shown to be an independent risk factor for foot blisters during road marching. Those with flat feet were reported to have a 37% increased risk of developing blisters.[11]

5.4.2. A study of 449 US Navy Sea, Air, Land (SEAL) recruits demonstrated a significant increase in stress fractures of the foot in those who had dynamic flatfoot (i.e. flatfoot apparent only whilst walking) compared to those with normal arch height. This study also indicated an association with other types of lower limb injury (such as Achilles tendonitis and anterior knee pain) although these results were not statistically significant.[10]

5.4.3. However, another study looking at lower limb musculoskeletal injury in 246 US Army Infantry trainees during a 12-week training programme showed no increased incidence of injury in those with flatfeet.[12]

5.4.4. The biggest study into flatfeet in the military was conducted by Harris and Beath in 1947.[13] 3619 new male recruits in a Canadian army reception centre were studied radiographically and physically. Although this study dates from 1947, no study of this size has been repeated and the principles remain relevant.

- Overall 22.5% of the men had flatfoot
- 8% of men had flatfoot with a reduced range of movement
- One third of these men who were passed as medically fit by the reception centre were unable to complete the basic training and had to be medically downgraded
- Flexible flatfoot was seen in 14.5% of men with varying degrees of lowering of the arch. Harris and Beath regarded these as variations of normal which were stable with very little in the way of serious dysfunction
- Of these, only 13% developed symptoms and only 4% had serious symptoms preventing completion of training

5.5. There is no evidence that suggests footwear has any effect on symptomatology.

6. Summary

6.1. Flatfoot is common in the general population.

6.2. It can often be a variation of normal with no symptoms.

6.3. The extent of the deformity does not correlate well with the extent of symptoms.

6.4. More flexible deformity is less likely to cause activity-related symptoms than is flatfoot with a rigid element and reduced range of movement.

6.5. Treatable causes should be excluded with physical examination, full history including family history, and radiographs.

6.6. Treatments for all flatfoot deformities should initially be conservative (non-operative).

6.7. Operative treatment should be reserved for those patients in whom conservative measures have failed.

6.8. The type of operative treatment depends on the cause of the problem.

7. Related Synopses

Anterior Knee Pain

Shin Splints

Fractures of the Lower Limb

8. Glossary

abduction	Movement of a body part away from the midline.
arthritis	Inflammation of a joint causing pain, swelling, loss of function and ultimately joint destruction. Can be osteoarthritis or inflammatory rheumatoid arthritis.
arthrodesis	The surgical fusion of two joint surfaces. This is commonly used in degenerative arthritic conditions where joint movement is painful. Arthrodesis, while preventing movement at that joint, has the benefit of removing pain. Arthrodesis tends to be used as a last resort.
debridement	Removing unwanted, degenerate or diseased tissue.
diabetes	A disease which affects the body's ability to control sugar levels properly.
dorsiflexion	Movement of the foot in an upward direction relative to the lower leg. The opposite of tiptoe.
everted	Turned outwards.
hindfoot	The rear part of the foot, essentially the ankle bone and heel bone.
hypertension	High blood pressure.
iatrogenic	Any adverse condition resulting from medical intervention.
idiopathic	Of unknown causation.
malunion	Bones healing in an abnormal position.
peroneal muscles	A group of muscles on the outside of the lower leg that acts to evert the foot.
physiological	A normal feature of development.
plantar fascia	A normal sheet of fibrous tissue along the sole of the foot providing stability to the arches of the foot.
rheumatoid arthritis	An inflammatory disease which affects many systems of the body, commonly the joints causing arthritis.
seronegative arthropathy	A group of inflammatory disorders affecting the joints, which may also result in arthritis.
subtalar joint	One of the joints in the hindfoot that allows the foot to swing from side to side.
synovectomy	The removal of the synovium.

synovium	Normal tissue surrounding tendons and joints that may become inflamed causing pain and dysfunction.
talus	A bone in the hindfoot. Can be affected by congenital abnormality causing vertical orientation and flatfoot.
tarsal coalition	A congenital abnormality in which two bones of the foot are abnormally joined.
valgus	The outward angulation of the distal segment of a bone or joint.

9. References

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