

G.P. Review Article

FLAT FOOT: II*

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SUMMARY

The most important varieties of 'flat foot' are described and are classified into the 'congenital' and the 'acquired' groups.

A foot which on casual inspection appears to be 'flat' will on careful examination prove to be within the limits of normal in the majority of cases. The hasty labelling of a patient as 'flat-footed', whether child or adult, is severely condemned and is generally not justified. Both knowledge and skill are required in the diagnosis of a condition which is as important to the individual as wheels to a carriage and wings to a bird.

General rules in the choice of footwear suitable for children and adults in their various daily activities are laid down. Pedicure is strongly urged, so that the humble feet may enjoy the same degree of fragrance and pride of ownership as the hands. Let our motto be: 'Pale feet, pink-tipped, I loved beside sweet Shalimar' (with apologies).

* Date received: 4 February 1971.

'Flat-foot' is a generic term which covers a number of conditions involving the feet, conditions which differ in degree, in aetiology, in pathology, in prognosis, in treatment and in incidence as well as in age of incidence. The use of the terms 'pes planus' or 'pes plano-valgus' offers no particular advantage over 'flat-foot', and in either event assumes significance only when suitably qualified, e.g. 'congenital rigid flat-foot with vertical talus', or 'congenital rigid pes planus with vertical talus'. There are many kinds of flat-foot, of which only the most important are briefly described below. They are classified under two main groups, namely congenital and acquired flat-foot.

The term 'flat-foot' is deceptive because of its simplicity, and has led to a faulty diagnosis in countless normal individuals whose feet merely appeared to be flat. Worse, there are those individuals who, although they suffer from flat-foot in the incipient stages, are denied treatment on the grounds that the arches of the feet have not yet fallen.

It would be illogical to attempt a definition in the know-

ledge that 'flat-foot' is a generic term referring to numerous aetiological and morphological types of abnormality. There is, however, a more or less uniform clinical picture which is the end-result of every type of flat-foot, irrespective of the cause:

1. The medial border of the foot presents as a *convexity* rather than a *concavity*. The convexity is attributable to the head of the talus which 'bulges' both in a medial direction and into the sole of the foot (Fig. 1 (a)).
2. The mid-tarsal joints are everted (pronated), prominent and tender. Rigidity of these joints will be noted in the final stage of the condition, with pain on attempted active or passive movement (Fig. 1 (b)).
3. The heel is everted (Fig. 1 (c)) and efforts at inversion are painful.
4. The sole of the foot presents as a broad, flat surface, the imprint of which stands in marked contrast with the normal (Fig. 1 (d)).

The features described above are those of advanced 'flat-foot' in which deformity has become irreversible.

During the earlier, developing stages, the appearances are deceptively normal, yet in each case a tell-tale tenderness at the mid-tarsal region will be present, more particularly on the dorsum of the foot at the talo-navicular and calcaneo cuboid articulations.



Fig. 1 (a). Rigid flat-foot (acquired), with osteo-arthritis of the mid-tarsal joints. The convex medial border, and the flat-foot deformity are well displayed.



Fig. 1 (b). The same foot as in Fig. 1 (a).



Fig. 1 (c). The everted heels and the pronation of the fore-foot are seen.



Fig. 1 (d). Comparative impressions of feet, showing left: a severe case of flat-foot and right: a normal foot.

CLASSIFICATION OF FLAT-FOOT

Congenital Flat-Foot

Congenital, rigid flat-foot with vertical talus. This is a striking abnormality in which the foot presents a boat-shaped or 'rocker-bottom' deformity (Fig. 2 (a)). The condition is of serious significance, and the establishment of a correct diagnosis is of fundamental importance. When congenital vertical talus is suspected, then radiological examination is mandatory (Fig. 2 (b)). A study of radiographs will reveal persistence of the vertical (equinus) position of the talus, even when the foot and ankle joint are passively extended. The head of the talus 'points' in a plantar direction and differs in shape from the normal head which is round as opposed to the narrow pointed head of the vertical talus. The scaphoid occupies an abnormal position on the dorsal aspect of the head of the talus.

Treatment includes plaster of Paris cast correction, which is instituted at birth or in the earliest stages of infancy.

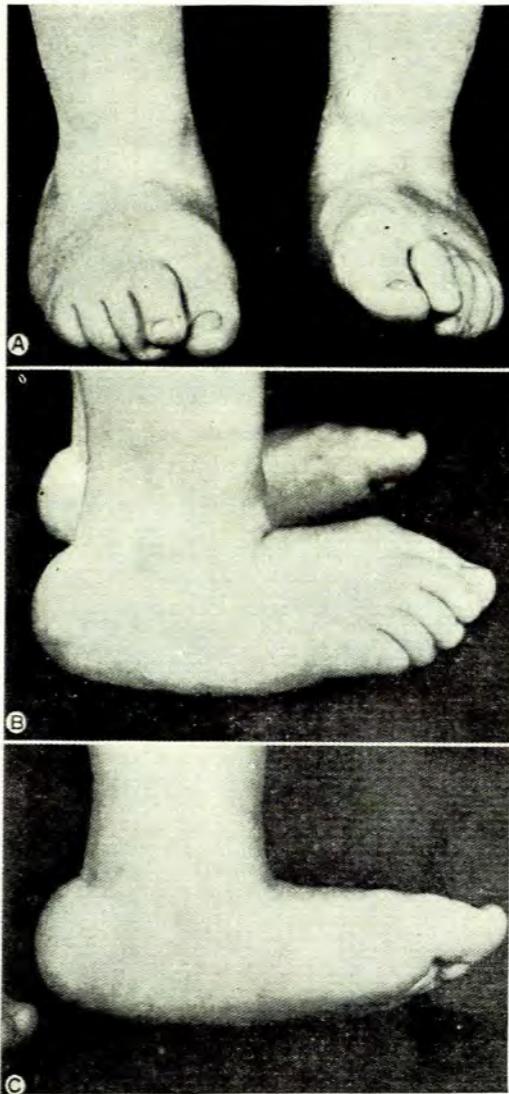


Fig. 2 (a). Congenital rigid flat-foot with vertical talus, showing the clinical appearances in an infant. (From Ferguson⁴).

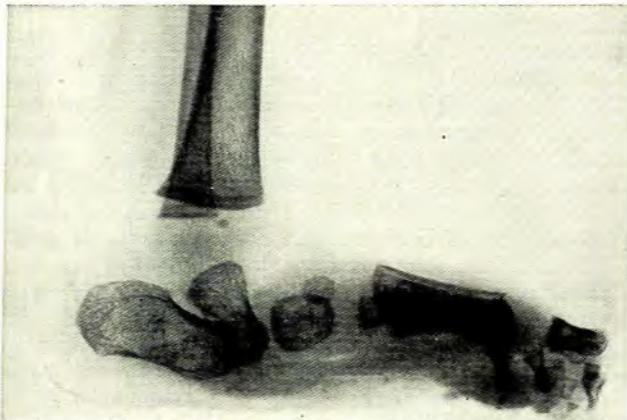


Fig. 2 (b). Radiological appearance of an infant foot. (Courtesy Prof. I. S. de Wet, Orthopaedic Hospital, Pretoria.)

Operative correction is generally indicated and is undertaken early, at 3 months if possible, and in all cases before walking commences. Failure to correct this serious deformity will result in crippling disability.

Congenital, mobile flat-foot or 'pes calcaneo-valgus'. The mid-tarsal joints display abnormal mobility and when passively extended, become subluxated. As a result, the foot appears to be 'double jointed'. It can be folded like a clasp-knife onto the dorsal surface of the leg (Fig. 3). The sole presents in the form of a uniform convexity. The radiological appearances are readily distinguishable from vertical talus. In this condition, the talus is of normal shape and it retains a normal position relative to the horizontal.

Plaster of Paris cast correction is instituted during the first week of life, and weekly renewal of the above-knee casts is necessary at least during the initial period when growth of child and feet is rapid. The knee joints are flexed to about 30° and the feet are held in plantar flexion. Renewal of the plaster of Paris casts may take place at 10 - 14 day intervals when the rate of growth and of weight increase is observed to be less rapid. At all times, the circular plaster of Paris cast must be regarded as a potential threat to the arterial circulation. The casts are continued for 3 - 6 months, until the foot is fully corrected, and the infant is able by voluntary effort to place and to hold it in the fully corrected position.



Fig. 3. Congenital mobile flat-feet with calcaneo-plano-valgus deformity. (Courtesy Prof. I. S. de Wet, Orthopaedic Hospital, Pretoria.)

Congenital 'valgus ex equino'. In this condition, there is shortening of the Achilles (triceps surae) tendon with the obvious consequence of an equinus deformity of the ankle joint. The mechanism of the normal gait is hampered, and the individual is faced with two alternatives, either to walk on the toes with the heel clear of the ground, or to rotate the entire limb outwards (Fig. 4), and then to 'roll' over the foot which is placed on the ground at an angle of 90° relative to the direction of the individual's progress. The condition is generally recognized at the age of 5 - 6 years or later.

Treatment in the case of minor deformity consists of an elevation of the heel of the shoe only, commensurate with the amount of the shortening of the Achilles tendon. In more severe cases, excellent results may be had by operation for tendon lengthening.



Fig. 4. Congenital valgus ex equino. The left foot only is involved and the secondary valgus deformity of the foot is clearly demonstrated.

Congenital accessory scaphoid or 'pre-hallux'. This is a common condition and is readily recognized by the presence of a bony prominence on the medial aspect of the foot, at mid-tarsal joint level. The prominence consists of an accessory ossicle (see Fig. 10¹), which replaces the tuberosity of the scaphoid. There is a false joint between the accessory and the parent scaphoid. The condition is not usually serious but should be kept under observation for a number of years.

Two complications may develop, namely: a painful callosity over the bony prominence, due to pressure exerted by the shoe; and flat-foot, with eversion at mid-tarsal joint level. The latter is due to the loss of the action of the tibialis posterior muscle which expends its action on the accessory rather than on the parent scaphoid. Operation for the excision of the ossicle and reattachment of the tendon to the scaphoid is sometimes desirable.

Congenital tarsal synostosis. While a number of abnormalities may be encountered, there are only 2 types which occur with relative frequency: calcaneo-navicular 'bar' or 'bridge',² and talo-calcaneal fusion.³

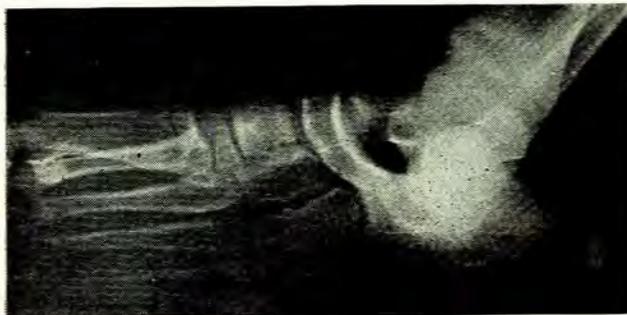


Fig. 5. Congenital calcaneo-navicular synostosis. (From Ferguson¹).

Pain and painful peroneal spasm are common to both types, and the presenting sign in each case is a painful foot with partial or total rigidity, and with peroneal spasm.

Diagnosis is by radiological examination and the treatment is determined by a study of each case on its own merits.

Flat-foot as the result of spurious correction of club-foot (congenital talipes equino-varus). Club-foot is relatively common, with an incidence of approximately 2.5 cases per 1 000 live births. (The condition will be the subject of a later publication.) The failures of treatment are in our midst, and present with 'rocker-bottom feet', which can be distinguished from congenital vertical talus only after a full consideration of the history, the clinical findings and the radiographic appearances of the case. Referral to a special clinic is essential, in order that salvage procedures may be instituted without delay.

Acquired Flat-Foot

Foot strain. This is the most common of all disabilities relating to the foot, and it constitutes a condition which, although eminently amenable to treatment, will, if untreated, progress to the ultimate stage of flat-foot with osteo-arthritis of the mid-tarsal joints. Basically, it may be referred to as a breakdown of the balance between the ligaments and the capsules of the tarsal joints (in particular the mid-tarsal and sub-taloid joints), and the muscles which act upon these joints. There are many factors which contribute to the breakdown, the commonest among them being the excessive demands which are often made on the feet, and the unsuitable footwear in which the feet are encased. The condition is encountered more frequently in women than in men.

The onset may be acute, with the rapid development of severe disability and of the clinical picture of 'spastic flat-foot'. On the other hand, it is usually of a less dramatic and more insidious nature which takes the form of pain, tenderness and swelling on the dorsal aspect of the mid-tarsal joints. It is rapidly relieved by rest in bed or by the application of a plaster of Paris cast. In the acute form, manipulation under general anaesthetic followed by diathermy, massage and non-weightbearing exercises will be found to give rapid relief.

Relapses are common, and with each attack the mid-tarsal and sub-taloid joints are swollen, tender and stiff. Osteo-arthritic changes will ultimately occur.

Chronic flat-foot with osteo-arthritis of the mid-tarsal and sub-taloid joints. At this stage of the development of acquired flat-foot the medial border of the foot will be seen to be convex in outline, while the swelling on the dorsum of the foot over the mid-tarsal joints will persist. Tenderness and rigidity of the feet will be found and the patient will complain of pain even at rest. The condition is characterized by osteo-arthritis with rigidity of the mid-tarsal joints, and by the outward appearances of feet which are literally 'flat' (Fig. 1).

Palliative measures only can be applied. Diathermy, gentle passive manipulation and the use of rigid, insole arch supports may give relief. Operative measures such as stabilization by means of triple arthrodesis and pan-talar arthrodesis are rarely advised. The tragedy of this condition is that it is a readily preventable deformity provided due care is given to the feet and to footwear during the early, active stage of a working-person's career. Wood Jones⁴ deplors the common practice of meticulous attention to the hands while neglecting the feet: 'For the most

part, we have but little pride in our feet and it is a pity that this is so The implication is obvious, namely that because the demands made upon the feet are much greater than those made upon the hands, it is to pedicure rather than to manicure that man (not to mention woman) should pay due attention.

Spastic flat-foot or spasmodic flat-foot. Acquired spastic flat-foot, so called on account of the protective spasm of the peroneal muscles, occurs in the presence of infective or rheumatoid arthritis of the sub-taloid and/or the mid-tarsal joints. Considerable disability accompanies the condition, which may be relieved by rest in bed, splinting of the foot and medication appropriate to the type of arthritis present. The diagnosis is suspected when pain, tenderness and spasticity of the foot predominate. It is confirmed by radiological and laboratory tests.

Traumatic flat-foot. This is a condition which closely resembles chronic flat-foot, described above. It is not infrequently seen in young men on exposure to unaccustomed and excessive physical exercise, and to the use of footwear which is strange to their feet. Conscripts into military service are sometimes affected during the early days of training and of parade-ground drill. Treatment is by a spell of relative rest, combined with physiotherapy and graduated exercises. It may also be encountered in persons called upon to resume activities of a relatively strenuous nature, after a prolonged period of enforced idleness due to illness or other factors. The diagnosis is straightforward, and the treatment is as described above.

Occasionally, when trauma has been severe and when irreversible changes in the articular surfaces of the mid-tarsal and sub-taloid joints have taken place, then resolution cannot be complete and osteo-arthritis, or fibrous ankylosis or bony ankylosis will ensue. Operation for stabilization of the foot may prove necessary to afford relief.

Paralytic flat-foot. This may be caused by anterior poliomyelitis, spina bifida, traumatic or infective neuritis and a host of other lesions involving the invertors of the feet. The appearances vary with the degree of paralysis, and the exact nature of the neurological lesion involved. Deviations from the features common to all flat-feet and described above will occur but the broad pattern of deformity remains the same.

The general practitioner who is aware of the existence of this type of flat-foot will realize that detailed recording of the musculature of the foot and the digits constitutes an integral part of the examination of the foot.

*The 'atrophic feet' of civilized society.*⁵ Commonly occurring among women, the picture is a familiar one—there are bunions with hallux valgus, there are hammertoe deformities with callosities on the dorsum of the toes and beneath the metatarsal heads. Subluxation or dislocation of the metatarso-phalangeal joints is associated with dorsal displacement of the proximal phalanx. Paralysis of the intrinsic muscles is partial or complete and the mid-tarsal joints are rigid, tender, osteo-arthritic and everted. There is little joy in these feet, neither to their owners nor to their medical advisers. At best, palliative measures directed at removal of painful bunions and corns may afford some relief. At worst, circulatory disturbances, devitalized skin and infected corns place the victims beyond surgical aid.

It is encouraging to note that modern fashionable foot-

wear bows to the form and function of the feet and grants priority where priority is due. Undoubtedly, the long-continued survival of current modes will profoundly affect the health of the feet of the female section of the community. It remains to be seen whether or not the fashion will last.

Secondary (acquired) flat-feet in association with developmental genu valgum. This is a common type of abnormality which is frequently overlooked because the complaint is of 'knock-knees' and not of the feet. In this condition, there is no structural abnormality of the feet in the early developmental stages, and the successful management of the knock-knee deformity will result in spontaneous resolution of the foot problem.

In mild cases, and especially in those under 6 years of age, boots with 'crooked and elongated heels' and $\frac{1}{4}$ -inch medial wedge on both heels will generally suffice. In severe cases with an inter-malleolar distance of more than 4

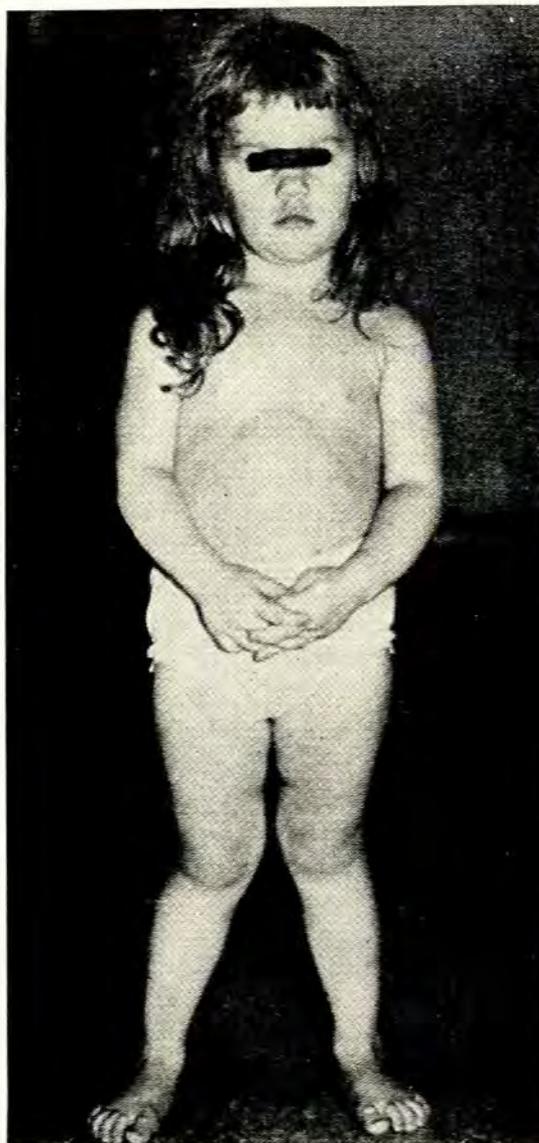


Fig. 6. Secondary (acquired) mobile flat-feet, in association with developmental genu valgum. (From Ferguson⁶).



Fig. 7 (a). Feminine footwear. The comparative size of the foot and the shoe into which it can be forced.



Fig. 7 (b). The radiological appearance of the unshod foot (left) and shod foot (right). The hallux is forced into a position of valgus and the remaining digits are lined up in a single direction.

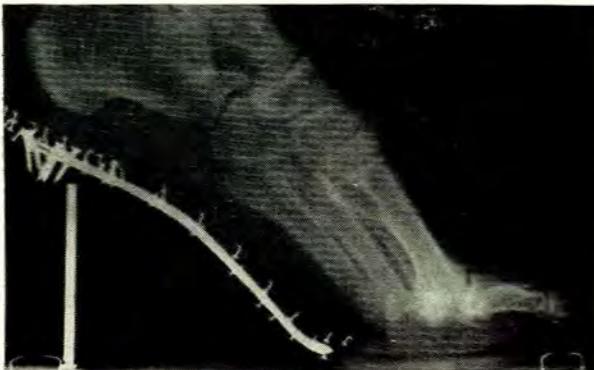


Fig. 7 (c). The position of passive hyper-extension at the metatarso-phalangeal joints, into which the digits are forced by the shoe, becomes irreversible and chronic after the elapse of a period of 10-20 years.

inches, knock-knee callipers are advised and are worn day and night. When the deformity is severe and the child is of an age approaching skeletal maturity, operation for correction of the deformity by means of supracondylar osteotomy may be advised.

FOOTWEAR

Confusion exists in regard to the function as well as the good or bad effects of footwear and it must be stressed that the term footwear includes both shoes and hose. In the child, in the healthy adult, and in the pathological foot, the problem differs as chalk does from cheese.

Children's Footwear

The healthy child reared under modern conditions requires protection for the feet from the harmful effects of physical factors such as heat, cold, granite chips, stones, broken glass and thorns. Sandals which protect the soles of the feet and permit the unhampered action of the digits as well as the tarsal joints are ideal. Those which constrict the free movement of the digits is harmful, especially in the case of the growing child.

Adult Footwear

Normal adults require hose and shoes for purposes of dress, and for protection from harmful objects and rough surfaces. As in the case of the child, a relatively firm sole is desirable in order to resist noxious extraneous factors. Eye-catching hose and footwear serve a different purpose, and should be neither discarded nor condemned. Their use should, however, be confined to the proper time and place. Ladies are accordingly advised to select suitable footwear for different occasions, and to dress appropriately for each activity, including sport. During working-hours, comfortable footwear which permits the unhampered action of the digits and the tarsal joints is essential to the health and care of the feet. Special attention must be paid to the free and unhampered flexor action of the digits at the metatarsophalangeal joints.

The female foot encased in constricting hose and in high-heeled shoes (Fig. 7 (a), (b) and (c)) which hold the digits in a position of enforced hyper-extension, while at the same time bunching them together so that they all converge upon the apex of a pointed shoe, makes a mockery of intelligence and common sense.

Footwear and Supports for Abnormal Feet

While special footwear and surgical supports are of value in many types of deformity, they should under no circumstances be supplied by untrained personnel or without medical prescription. Undoubted disadvantages to patients, especially to young children, may be the result of the use of ill-advised supports. The responsibility for the diagnosis and the management of abnormal feet, as in the case of illness and disease, belongs in the hands of the medical practitioner only. Details of the subject of surgical footwear and supports are beyond the scope of this article.

REFERENCES

1. Dommissie, G. F. (1971): *S. Afr. Med. J.*, **45**, 663.
2. Ferguson, A. B. (1968): *Orthopaedic Surgery in Infancy and Childhood*, 3rd ed., pp. 17, 52 and 54. Baltimore: Williams and Wilkins.
3. Harris, R. I. and Beath, T. (1948): *J. Bone Jt Surg.*, **30**-8, 624.
4. Wood Jones, F. (1943): *Structure and Function as Seen in the Foot*, p. 1. London: Ballière and Cox.
5. Dommissie, G. F. (1964): *S. Afr. Med. J.*, **38**, 885.