

"PAINFUL FEET"*

By REX L. DIVELEY, A.B., M.D.

Assistant Professor of Orthopedic Surgery, Kansas University;
Chief Orthopedic Consultant, U. S. Veterans Administration

The individual with painful and aching feet is a real invalid and deserves careful consideration and helpful advice. He is also often an economic problem from the standpoint of employment. Unfortunately, most doctors and many orthopedic surgeons feel that treatment for the individual with a functional foot disorder is beneath their dignity and level of interest, yet it has been estimated that approximately forty per cent of the civilian population over the age of twenty years has some foot disorder of a degree sufficient to cause lowered efficiency and, in many instances, serious disability. During the late war, it was shown only too often that disabling foot conditions slowed down the training of large sections of our army.

It is not my intention this evening to take up all the intricacies of the etiology, diagnosis, and treatment of functional foot disorders, but rather to discuss the more common conditions which cause pain and disability in the feet and outline to you the kind of treatment which will give relief.

We should start in childhood to train the feet to grow along correct lines. During the first months of life, the foot is not called upon to function in a weight-bearing capacity and needs no support; therefore, any soft-soled, wide-toed shoe which allows free movement of the foot and toes may be worn. When weight bearing starts, however, the environment of the foot changes materially and it has an entirely new set of conditions to meet—namely, supporting the entire body weight. The superimposed

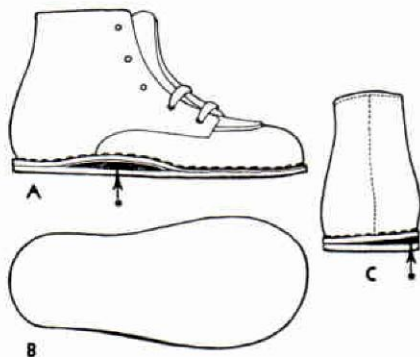


Fig.

Fig. 1. The correct shoe for the growing child after walking begins. A. Side view showing the wedge of the sole which elevates the longitudinal arch; B. Shape of the sole—gives ample toe room; C. Rear view showing heel wedge which tilts the foot on the medial side—tends to overcome pronation.

weight at this age is thrown upon a foot in which the bones are still immature, the muscles not yet developed, and ligaments weak. As the child takes its first steps, his rudimentary sense of equilibrium makes him insecure in his balance so that he stands with the feet spread wide apart. This position of the feet causes the line of transmitted weight to fall through the inner side of the foot, or even medial to it, so that the body weight is concentrated on the inner side of the foot which tends to roll downward and inward under the stress. Such a position is known as pronation; with continued pronation, the foot flattens out and no longitudinal arch develops.

The child whose feet are allowed to remain in and be used in a position of pronation is a potential foot case of the future.

* Delivered at the Orthopedic Appliances Symposium, National Assembly of the Limb and Brace Profession, OALMA, Washington, D. C., October 13, 1952.

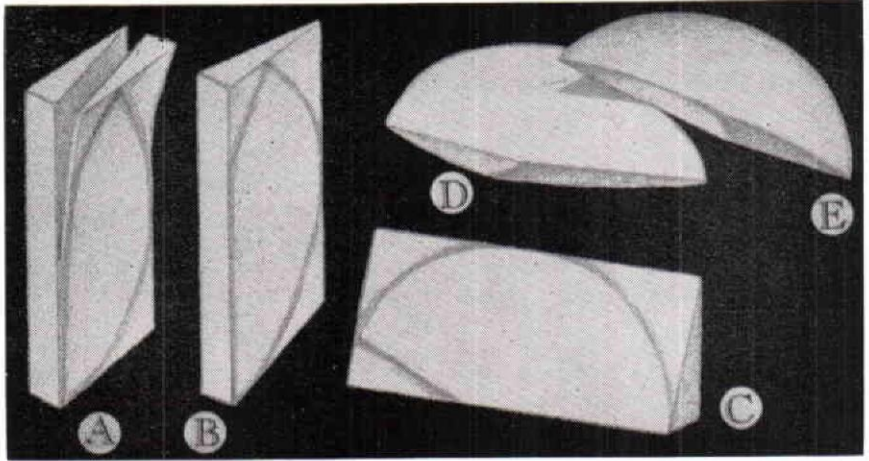


Fig. 2. Method for cutting felt inlay support. A. Unit block is split into a pair of wedges. B. C. D. Flat bottom side of inlay with bevel to fit inside of shoe. E. Support skived to a feather edge forward, lateral and to the rear side.

A shoe which will hold the growing foot of the child in a correct position and tend to overcome pronation should have these characteristics: The shoe should be wide in the toe to permit free movements of the toes. The sole should be heavy enough for protection and preferably the medial side of the heel of the shoe should be raised to overcome any pronation and inrolling of the foot, thus tending to hold the foot in a properly balanced position for growth. (Figure 1).

If the foot is properly shod, most children will develop normal feet and legs. However, a fair number continue to pronate under such mild correction and fail to develop an arch. Such pronation in childhood is generally associated with knock knee, bowlegs, or tibial torsion of varying degrees due, as a rule, to faulty calcium balance. Correction can be brought about by balancing up the shoe already described in such a way as to alter the weightbearing stresses on the lower extremities so that, as the child grows, the leg bones will gradually straighten themselves out. Effective correction of faulty weight-bearing stresses on the growing leg bones and bones of the

arch can be secured by these simple shoe alterations:

1. Shaped hard felt support placed in the shoe to elevate the inner side of the foot and roll it out, thus encouraging the development of the arch. The correction of in-rolling and pronation at the same time corrects the faulty weight stresses on the bones of the lower extremities, whether this faulty weight stress is due to knock knee, bowlegs, or tibial torsion. (Figure 2-3).
2. Wedging the heel one-eighth inch on the inner side, unless the shoe used already has such a wedge. (Figure 4).
3. A small wedge, or dutchman, one-eighth inch high is placed in the outer side of the sole opposite the base of the fifth toe to prevent the foot from sliding outward in the shoe and to keep the foot firmly on the arch support. (Figure 5).

The foot of childhood is the precursor to the foot of adolescence and adult life. The correction of foot faults during this period is much simpler

than in later life when the foot bones have become set in a faulty position. Attention to foot faults in childhood frequently saves the individual from pain and disability, and even incapacity, during the most active period of his or her life.

The causes and treatment of functional foot disorders in the adolescent and adult are essentially the same and may be discussed together. Time does not permit a discussion of the etiology of functional foot disorders in adolescents and adults. It must suffice to say that in addition to incorrect foot attitude dating back to childhood, there are a variety of causes for symptom-producing foot conditions in the mature foot. The purpose of this discussion is to describe briefly the forms of foot imbalance which are responsible for the most of the suffering and disability which accompany foot disorders, to outline some simple conservative measures which you may find useful in treatment, and indicate what additional means are available if conservative measures prove unavailing to relieve pain and restore the individual to normal activity.

The Shoe of the Adolescent and Adult

In adolescence and adult life shoes can support and protect the feet from the strains and fatigues of use if properly designed, or can throw strain on and distort the foot if they are of incorrect design. While not admitted by all authorities, it is generally conceded that ill-fitting and incorrectly designed shoes are important factors in the development of functional foot ailments. The feminine part of our population seem to have made style their god, and are inclined to follow its every change and dictate. This style worship of footwear may account, in part at least, for the high incidence of foot disorders in women today.

Men, as a rule, wear shoes which will protect and support the feet, and prevent foot strain with its sequelae.

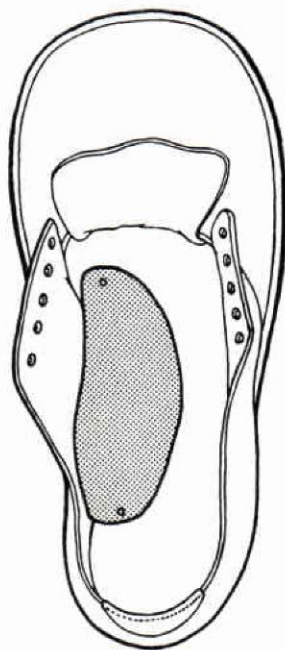


Fig. 3. The placement of the oval inlay support in a child's shoe to overcome pronation.

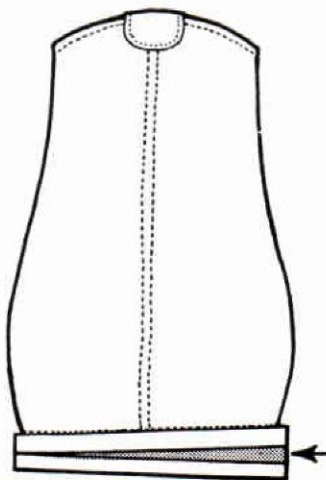


Fig. 4. Rear view of child's shoe showing the heel wedged on the inner side to overcome pronation.

Women seldom, however, care to wear a sensible supporting shoe even while at work, where they are frequently called upon to spend long hours at occupations which require a great deal of standing and little walking about. High-heeled, flimsy pumps, or low-heeled sandals, cannot, under such circumstances, give adequate support and protection to the over-worked feet, and the stage is set for foot strain and general tire and decreased efficiency which follows. Actually, the design of shoes for men and women should follow the same general pattern, only differing in style. Such a shoe should be of a val or blucher oxford type, and have straight lines along the inner side with a well-rounded toe. There should be ample room in the cap and ball of the shoe for normal function of the toes and metatarsal arch. The sole should be of a flat type and sufficiently heavy to give protection and support. The shank should be rather broad and carry a built-in steel support. The counter should be narrow enough to fit the heel snugly, and the vamp should lace firmly over the instep. The heel should be of a straight side type, the height for men $6/8$ inch and for women from $12/8$ to $14/8$ inch.

Most shoes for men conform to these requirements, but women's shoes do not. Therefore, it is important that women who are on their feet extensively, be they factory workers or housewives, wear a shoe of proper construction or design during the working hours of the day. Certainly, no other type of shoe lends itself to the corrections which are necessary to gain relief from foot strain. Such shoes may be replaced by a more pleasing and lighter shoe for dress and evening wear.

To catalogue all the ills which affect the foot would be a task of some magnitude. I, shall then only call to your attention briefly the more common forms of foot disorders in

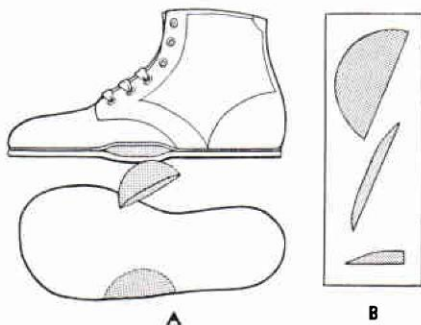


Fig. 5. Position of metatarsal wedge on the outer side of the sole. B. Shape of wedge.

which you as brace makers will be interested:

1. Depression of the longitudinal arch or flat foot is the most common.
2. High arched foot or pes cavus is seen most often in women.
3. Depression of the anterior arch or metatarsalgia may be associated with either one of the afore mentioned conditions.

(1) *Flat Foot*. This condition characterized by inrolling or pronation of the foot and depression of the longitudinal arch. A low-arched foot is in itself not necessarily abnormal; it may be for that individual the normal foot conformation. When, however, depression of the arch is associated with inrolling of the foot or pronation, a real architectural weakness is present, and the foot must be classed as abnormal. A foot which is architecturally weak is mechanically insufficient and cannot perform the work demanded of it. Inrolling of the foot is important because it brings about a concentration of the superimposed body weight on the inner border of the foot, so that the entire thrust of the body weight is thrown on the longitudinal arch, which breaks down under the burden and becomes painful.

Subjectively, a flat foot causes tiring and discomfort in the longitudinal arch, and in the calves of the legs. This discomfort may, and usually does, increase in severity and in time becomes a real and often disabling pain. As time goes on, general tiring and lack of endurance develops, the knees may become painful, and discomfort and tiring in the low back and thighs may be eventually complained of. The knee and back pain is the result of constant strain on these regions due to faulty attitude of the entire body, for which flat foot is responsible.

Objectively, flat foot shows depression of the longitudinal arch to a greater or lesser degree. Pronation or inrolling causes the scaphoid bone and the internal malleolus to become prominent. Pain is elicited on pressure beneath the longitudinal arch and over the scaphoid bone.

Treatment

Since in pes planus we have inrolling of the foot, displacement of the line of transmitted weight toward the medial border of the foot, depression of the longitudinal arch, and tired and often spastic muscles, our problem of correction is three fold:

1. Correct pronation and bring the line of transmitted weight toward the lateral border of the foot.
2. Elevate and support the depressed arch.
3. Build up the natural support of the arches, the muscles and ligaments with proper exercises, so that they may function as efficiently as possible.

Correct distribution of weight stress and elevation of the longitudinal arch are brought about by bringing the foot into balance, or approximately so. To accomplish this, the foot must be first fitted in a well designed and strong shoe as described. A support must be placed under the foot which will roll it outward, thus shifting the transmitted weight toward the lateral border of the foot, and, at the same

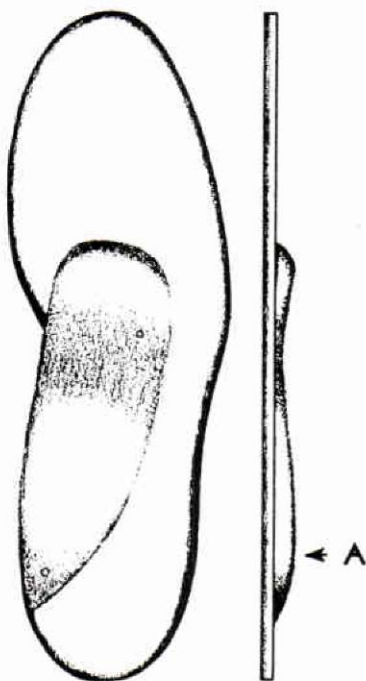


Fig. 6. Shape, contour and placement of the support for pes planus or flat foot. A. Indicates high point of support.

time, provide support for the relaxed and depressed longitudinal arch. Such a support may be made of metal, the Whitman plate, or a support may be fashioned of sponge rubber or hard felt. We prefer the molded sponge rubber supports, since they are more comfortable and much more easily adjusted than the metal type. (Figure 6). Whatever material is used, the support must be molded to the foot if it is to accomplish the twofold purposes for which it was designed—outward rotation and support. Since such a support rolls the foot outward in the shoe, a wedge or dutchman, one-eighth to three-sixteenths of an inch high should be placed in the sole of the shoe opposite the fifth metatarsophalangeal joint to prevent the foot from sliding outward in the shoe and off the support. In severe cases, the inner side of the heel may be elevated one-eighth of an inch; in extreme

cases, the extended or Thomas heel should be used.

To build up muscle and ligamentus tone, which is the third requisite in treatment, physical therapy and exercises should be employed.

With the proper shoe and correctly designed support, it is nearly always possible to relieve pain in the feet, overcome muscle tire, knee ache, back ache, and to increase the efficiency and endurance of the individual.

(2) *High Arched Foot.* High arched foot, or pes cavus, is characterized by a high longitudinal arch with little or no pronation, but with a contracted plantar fascia and prominence of the ball of the foot.

Subjectively, pain is complained of in the ball of the foot, and cramps are noted in the calves of the legs. A tiring sensation in the long arch is a constant symptom, and back ache is often complained of.

To bring such a foot into balance and relieve symptoms, we must redistribute the weight over the foot so that all the bones of the foot will carry their proportionate part and the metatarsal arch will be relieved of the burden of bearing the major portion of the body weight.

The inlay or support in this case should be moderately high under the central portion of the longitudinal arch, but cut off or well skived out under the heel. (Figure 7). In this type of foot, there is little or no pronation or inrolling. Therefore, the foot must not be tilted outward, but the high longitudinal portion of the inlay used only to take the strain off the plantar fascia and the longitudinal arch of the foot. The anterior portion of the support should be fairly high and carried as far forward as is possible with comfort, as in this type of foot, the strain falls principally on the metatarsal arch.

(3) *Depression of the Metatarsal Arch, Metatarsalgia.* The metatarsal arch is formed by the heads of the metatarsal bones; it extends transversely across the forefoot forming

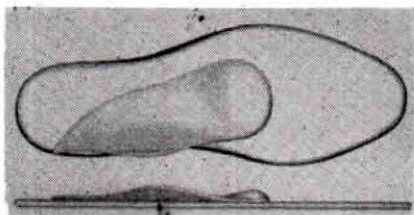
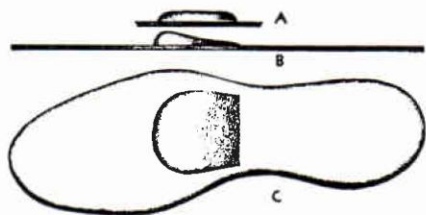


Fig. 7. Shape, contour and placement of inlay support for pes cavus or high-arched type of foot. A. High point of support well forward under the apex of the longitudinal arch.

the ball. Depression of the metatarsal arch may occur as a separate entity. As a rule, however, depression of the metatarsal arch is associated either with pes planus or pes cavus. Depression of the metatarsal arch is more common in individuals over thirty years of age and occurs much more frequently in females than in males.

As in flat foot, depression of the metatarsal arch is due to improper distribution of weight stresses over the foot. Such improper stress on the heads of the metatarsal bones, which comprise the metatarsal arch, is usually due to failure of the foot as a whole to function in a normal manner because of some skeletal defect or because of a depressed longitudinal arch, or one which is congenitally abnormally high. High-heeled, narrow and pointed-toed shoes play an important role in the descent of the metatarsal arch, as shoes of this type throw most of the burden of weight-bearing upon the metatarsal arch and at the same time compress the forepart of the foot and toes, thus interfering with normal use and muscle action.

When the metatarsal arch is depressed, the discomfort complained of is generally in the ball of the foot. Often the statement is made that it feels as though the weight was being borne directly upon the heads of the metatarsal bones. In severe cases, an acute cramp-like pain is complained of in one or two toes; usually the second or fourth toes, the so-called Morton's toe.



Above: Fig. 8. Shape, contour and placement of support for transverse arch (Anterior heel). A. Front view. B. Side view rounded in front and skived gradually to the rear. C. Position on the insole of the shoe.

At right: Fig. 9. Metatarsal bar on the sole of the shoe.



Examination of the foot with a fallen metatarsal arch will reveal loss of the normal concave line of the heads of the metatarsal bones; instead, the metatarsal heads are flat to the plantar surface of the ball of the foot. With the dropping down of the metatarsal heads, there occurred contractures of the toes which assume a hammertoe position. Callous formation is present across the ball of the foot, or at least under the heads of metatarsals, one, two, and/or five.

The treatment of this type of foot is aimed toward the correction of weight distribution over the foot, so that the metatarsal arch will be relieved of the excessive burden of weight bearing that is placed upon it. The support must be shaped and fashioned to elevate the depressed metatarsal arch (Figure 8) and also re-distribute the weight over the remaining portion of the foot as a whole. If a pes planus is present, the support must correct this fault; if a high arch is noted, the support must be designed to fill in the space between the high arch and the shank of the shoe so that the entire sole of the foot is in contact with the weight-bearing surface, not merely with the heel and the metatarsal heads. Unless the high arch is compelled to bear a portion of the weight, the pressure over the metatarsal heads will not be relieved.

In severe cases of depressed anterior arch, it may be necessary to place a bar of leather one-half to three-fourths of an inch in width across the sole of the shoe just posterior to the ball of the foot. (Figure 9). This metatarsal bar, as it is called, shifts the major part of the weight to a point posterior to the heads of the metatarsal bones and so relieves them of part of their burden. A metatarsal bar may be used alone or to augment other corrections.

Exercises designed to build up the intrinsic muscles of the foot and overcome contracture of the toes are very helpful and should be used. Picking up marbles or jacks with the toes is a useful exercise for this purpose.

To summarize: Careful supervision of the foot of childhood to insure its development along normal lines will prevent a great deal of foot disturbance in adolescent and adult life.

Most cases of functional foot disorders in later life can be relieved by wearing correctly designed shoes balanced to correct the architectural weakness responsible for the pain and disability.

Severe grades of foot imbalance that do not respond to intelligent conservative treatment as a rule can be relieved by properly planned surgery in competent hands.