SURGICAL PROCEDURES IN GENERAL PRACTICE

This is one of a series of articles contributed by invitation

THE TREATMENT OF FLAT-FOOT

BY

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Flat-foot has been defined as a condition in which the arch of the foot is abnormally low. But as nobody knows what the height of a normal arch ought to be it is not always easy to tell when it is abnormally low. Alternatively, flat-foot has been defined as a condition in which the arch of the foot is depressed sufficiently to cause symptoms. But, curiously enough, the completely flat foot is usually painless, while the worst symptoms of flat-foot occur in feet which are not flat. Perhaps flat-foot is best defined as an habitual attitude of relaxation, a position assumed by the foot under the influence of the body weight when the muscles are relaxed. This attitude or position is abnormal, because standing is normally an active process controlled by muscular action, and the foot was never meant to be merely stood upon and crushed down by the body weight.

Causative Factors in Flat-foot

In standing the body weight is transmitted to the ground through the heel, the outer border of the foot, and the heads of all the metatarsal bones, especially the first. The inner border of the foot is raised in the form of an arch or concavity which gradually slopes downwards to the outer border of the foot. It is commonly believed that this arch is maintained to a great extent by the ligaments and fasciae in the sole, and that when these give way the patient suffers from flat-foot. But it is not the function of ligaments to withstand continuous strain; this is a function of muscles. The correct attitude of the feet in standing is maintained by continuous reflex muscular activity. This postural activity, as it is called, is part of the postural reflex which maintains the body as a whole in the upright position, and, so far as the feet are concerned, it consists of a continuous resistance to abduction eversion and flattening by the superimposed body weight.

Postural activity may be deficient for many reasons. In young children who are beginning to walk this reflex is usually imperfectly developed, and nearly all such children stand with their feet everted and flattened at first. In rickets postural deficiency is as much a part of the disease as is softening of the bones, and the association of flat-foot with genu valgum and other rachitic deformities is almost constant. Adolescent girls and boys, especially those who are growing rapidly, are prone to develop postural deformities, such as spinal curvatures, knock-knees, and flat feet, and postural deficiency is common also in conditions of general debility following illness, neurasthenia, overwork, etc.

But the commonest cause of flat-foot or foot strain is sheer exhaustion of the postural reflex by prolonged standing or over-use of the foot. For, although the postural activity of muscle is almost insusceptible to fatigue, there are limits to the amount of work which any muscle can be called upon to do. Lastly, pain inhibits the postural reflex, so that any painful condition of the

foot may lead to standing with the muscles relaxed and consequent flattening of the arch, or foot strain.

The effect upon the foot of a constant attitude of relaxation depends upon the anatomical conditions present in each case. The foot is composed of a number of small bones and joints which collectively have a considerable range of movement in two directions. The principal movements of the foot below the ankle-joint are: (1) adduction and inversion with more or less raising or arching of the sole, and (2) abduction and eversion with more or less flattening of the sole. The actual range of these movements varies a great deal in different subjects. Some people can flatten their feet completely by standing with their muscles relaxed. Other people have a much more restricted range of movement; they have, in fact, more or less fixed arches, so that their feet cannot be flattened completely. Whether this is a natural and desirable state of affairs or whether it is an acquired disability is an academic question which need not concern us here. What does concern us is the undoubted fact that if a foot is mobile so that it can be flattened without resistance it is painless; whereas if a foot has a fixed arch so that it cannot be flattened without resistance it is painful when weight is borne on the foot with the muscles relaxed. These people then suffer not from flat-foot but from inability to flatten their feet—that is, foot strain.

Foot Strain

Foot strain is by far the commonest cause of pain in the feet. It is due, as we have seen, to failure of the muscles to prevent passive abduction eversion and flattening of the feet by the body weight. The pain is felt chiefly at the inner border of the foot beneath the astragalo-scaphoid joint. Often there is pain also on the outer side just below and in front of the external malleolus, and there is aching in the muscles of the leg. When the patient stands the feet may be obviously flat or they may appear to have well-developed arches. In either case there will be some resistance to flattening when the feet are manipulated in the direction of abduction and eversion. The radiographs of the feet are normal.

Treatment.—The treatment of foot strain is simple and effective. The feet should be forcibly manipulated under an anaesthetic, and this should be followed immediately by massage and exercises. In practice the foot is manipulated in all directions, but especially in the direction of abduction and eversion so as to stretch the soft parts on the inner side and in the sole. The object of the treatment is to restore or increase mobility, so that the foot can yield without encountering resistance—that is, strain. In the great majority of cases when this is done the pain is promptly relieved, and it only remains to preserve the increased mobility and to re-educate the postural muscles in order to complete the treatment. These objects are attained by massage and active movements or exercises. The chief, if not the only, exercises required are: (a) movements of circumduction—that is, in all directions—while the patient is sitting; and (b) inversion of the feet—that is, getting on to the outer borders and rising on the toes when the patient is standing. The patient should be told to make a habit of these last two exercises, and not merely to do them occasionally at set times.

Congenital Flat-foot

Of conditions more properly called flat-foot there are several varieties. Congenital flat-foot is quite different from the mobile flat-foot commonly seen in children who are beginning to walk. Congenital flat-foot is a severe structural deformity present at birth. The heel is drawn up and the astragalus is plantar-flexed so that it occupies an almost vertical position in the ankle-joint. The fore-foot in front of the medio-tarsal joint is drawn up and sharply angulated with the astragalus and os calcis behind so that there is a convexity instead of a hollow in the middle of the sole and inner border. The most prominent part of the convexity is formed by the head of the astragalus projecting downwards. The posterior part of the deformity is fixed by contraction of the tendo Achillis and the posterior ligament of the ankle; the anterior part is fixed by contraction of all the tendons and ligaments on the dorsum of the foot. On manipulation the foot is quite rigid.

Treatment.—In congenital flat-foot treatment is difficult. Some improvement may be obtained by forcible manipulation and plaster repeated at intervals. But in most cases operative measures (tarsectomy) are required before the foot can be brought into a more or less normal shape.

Mobile Flat-foot

This is merely a faulty posture, an habitual attitude of relaxation due to deficient postural muscular activity or tone. As we have seen, it is a common passing phase in young children. Apart from these it is most often met with in adolescents and young women with loose joints and weak muscles. As the feet are supple they are quite painless, except for some aching due to fatigue. The patients complain of the appearance of the feet, of the ankles going over, and of treading down the inner sides of the shoes.

Treatment.—This consists in relieving the muscles from strain by directing the body weight towards the outer side of the foot, and then restoring the postural action of the muscles by exercises. In young children little more is required than a wedge one-eighth to one-quarter of an inch thick on the inner side of the heel of the shoe, and such exercise as the child naturally takes. Occasionally the deformity is so pronounced that a light outside steel support with an inside (or valgus) T-strap is required to hold the foot in position. In young women it is usually not practicable to wedge the narrow heel of a conventional shoe, and a shoe must be found which is cut in such a way that the body weight is directed more to the outer side. The usual exercises (see section on foot strain) should then be done until the muscular balance is restored.

Stiff Flat-foot (Fibrous)

A distinction should be drawn between stiff (fibrous) flat-foot and rigid (osseous) flat-foot. In the former case the foot is stiff from fibrous adhesions or thickening in and around the ligaments. It may be due to the long duration of the deformity or to injury (traumatic flat-foot), or to conditions such as rheumatism, gonorrhoea, etc. On manipulation the foot feels stiff and all its movements are restricted, but there is a certain spring or elasticity about it which distinguishes it from rigid flat-foot. Pain is felt in the middle of the foot and under the heads of the metatarsal bones.

Treatment.—The treatment of stiff flat-foot ideally is first to make the foot supple and then to re-educate its muscles. Many cases require manipulation under an

anaesthetic; but some experience is necessary to determine which cases are likely to be benefited by manipulation and which are not. When the stiffness is of long duration and very pronounced the reaction following manipulation may be so severe and the re-formation of adhesions so great that nothing is gained in the end. This is particularly true of cases of rheumatoid arthritis, which as a rule are best left alone. In some cases more gentle manipulation repeated several times, and combined with radiant heat, massage, and exercises, may bring about sufficient improvement. In less severe cases, and particularly in traumatic cases, forcible manipulation may be employed without hesitation and with great benefit.

"Contracted" Flat-foot

This name has been given to a type of stiff flat-foot associated with severe clawing of the toes and (usually) hallux valgus. The sole of the foot may or may not be quite flat. The ball of the foot is prominent, with large flat callosities upon it, and the heads of the metatarsals can be felt just beneath the skin. Corns on the dorsum of the interphalangeal joints and bunions complete the picture. The patient complains chiefly of pain from excessive pressure under the heads of the metatarsals and of the painful toes (corns).

Treatment.—It is seldom possible to restore the contracted flat-foot to anything like normal: the condition has usually been present for many years, the foot is very stiff, and the contractions of the toes are severe. In some cases straightening the toes by tenotomy of the extensor tendons and arthrodesis of the interphalangeal joints may give some relief. In not a few cases excision of all the metatarsal heads (except the fifth) is the only way to relieve the intolerable pressure on the ball of the foot. Thereafter the patient must wear a shoe with a flat sole and a soft spongy rubber insole.

Rigid (Osseous) Flat-foot

This is the type of flat-foot met with as the result either of generalized osteo-arthritis or of secondary osteo-arthritis changes which have supervened. It also occurs after severe bony injuries or diseases of the foot. The rigidity is absolute and permanent.

Treatment.—Such feet should not be interfered with. The sole of the shoe should be flat, like the foot, and a soft insole should be provided.

Spasmodic Flat-foot

People with painful conditions of the foot often have some spasm of the muscles, which resist painful movements. But spasmodic flat-foot is a clinical entity quite different from these fortuitous cases of muscular spasm. Spasmodic flat-foot is most often met with in children or adolescents between the ages of 13 and 18. Not infrequently the patient is a boy who on leaving school has spent long hours on his feet as an errand-boy or standing at a bench in a workshop. The condition may be bilateral, but usually only one foot is affected. The sole of the foot is not necessarily very flat, but the whole foot is abducted and everted, and it is held fixedly in this position by spasmodic contraction of the peroneal muscles and long extensors of the toes. The patient complains of pain in the foot and he limps or walks awkwardly. On examination any attempt to adduct and invert the foot is strongly resented and is apparently very painful. The tendons of the peronei and extensors stand out as tense cords. If the surgeon likes to spend sufficient time over it he can in many cases make the patient relax the spasm,

and he can even make him stand on the outer border of the foot with the sole inverted. But if the patient is allowed to evert the foot even for a moment it at once becomes fixed again in the position of abduction and eversion. Nothing is known about the aetiology of this condition. It is obviously a reflex protective spasm due to pain in the foot. It has been attributed to arthritis of some of the tarsal joints, but there is no clinical, pathological, or radiological evidence of this.

Treatment.—The treatment of spasmodic flat-foot is uncertain and often disappointing. The most common method is manipulation under an anaesthetic and fixation of the foot in plaster in the inverted position for a considerable time. The usual result is that the spasm returns as soon as the plaster is removed and the patient bears weight on the foot. Some cases respond surprisingly well to manipulation followed by radiant heat, massage, and exercises; but it is necessary to keep the patient in bed during the whole of this treatment. Afterwards he should wear an outside steel with a valgus T-strap to prevent passive eversion of the foot. In some very resistant cases arthrodesis of the astragalo-scapoid joint has been done. This abolishes the pain and spasm, but of course it leaves a permanently stiff foot.

A RAPID AND PAINLESS METHOD OF REMOVING PLASTER CASTS

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[Work undertaken with aid from the Medical Research Council and the Ministry of Health.]

In most fracture clinics the surgeon relegates the arduous task of removing plasters to the student or nurse and consequently becomes oblivious of the pain and discomfort suffered by his patients during this operation. Watson Jones, having himself been a patient, voices the same opinion in a recent textbook on fractures:

"A professor of surgery retains one vivid childhood memory, the removal of a plaster. The pain of the plaster is forgotten, but not the pain of cutting down the plaster. Even the most gentle of surgeons seem to lose their sympathy on these occasions, to brush aside the victim's protests, and hasten through the work as though time was the only factor."

Clearly, the plaster shears, though well adapted to opening the padded plaster, is a cumbersome instrument when employed on the modern unpadded cast.

Advantages

The method to be described has the following advantages over those at present in use:

- (1) Removal is effected without pain or discomfort.
- (2) It is more rapid—for example, a walking iron and plaster may be removed in two minutes, as compared with ten to twenty minutes by the shears method.
- (3) It renders bivalving of plasters so simple and rapid that the method might be used for treating gunshot wounds requiring frequent redressing.
- (4) It is inexpensive.

Essentials of Method

The method consists in laying a thin steel wire beneath the plaster when it is first applied. One end of the wire is anchored by turning it back and incorporating it between the layers of the plaster, while the other end remains

free. When removal of the plaster is required the free end of the wire is wound round a key lying on the surface of the plaster. The plaster may then be cut cleanly from end to end by manual rotation of the key, so that the steel wire is torn through the plaster.

Materials

Wire.—Best quality steel piano wire is used for cutting the plaster. The thickness of plaster which can be cut without the wire snapping depends on its gauge. Rotation of the key is difficult with wire of greater thickness than 22 gauge, due to the excessive tension developed. A gauge of less than 26 does not possess sufficient strength. Experience has shown that 24 is the most suitable gauge for general purposes. This will cut 30–35 layers of "cellona" plaster bandage, which amounts to half an inch in thickness. Hand-made muslin plaster bandages are cut more easily, as they do not hold so much plaster. Rusting of the wire may be prevented by coating it with a thin layer of shellac or varnish. Piano wire rusts slightly in the plaster, but this is not necessarily a disadvantage, as the thin coating of rust anchors the wire more firmly in the plaster, yet does not seem appreciably to affect the strength. The relatively low tensile strength of stainless steel wire renders it unsuitable for use. The wire may be laid directly on the skin in plasters which are to be bivalved in a few days, and in those in which the limb is not to be used for active movements. In other cases a layer of stockinet is put on the limb, and the wire is then "tacked" on to the stockinet in the required position by threading it through one or two stitches at intervals along the limb. Only a small amount of stockinet should be caught up in this way, as the wire does not cut it cleanly and tends to break at these points. Plastering may then be carried out in the usual way. Permanent plasters without stockinet can be applied if the skin is protected by adhesive tape. A one-inch strip is laid down and the wire is held between it and the plaster. When a fracture is plastered immediately after reduction a specially designed wire* with an adhesive backing may be used. This adheres firmly to the limb and leaves the surgeon's hands free to manipulate the fracture. In the case of children the skin is particularly susceptible to irregularities in the plaster and therefore the wire should never be laid on the bare skin. When these simple precautions were observed, ulceration did not occur in a series of over 100 cases. The extra cost of the wired plaster is practically negligible, as a shilling roll of wire is sufficient for about ninety casts.

Key.—An old six-inch Spencer-Wells forceps may be used as a key to wind out the wire (a sardine tin-opener serves well for thin plasters). The forceps should be rotated in such a direction that their handles are pressed together and the wire should be kept at their broadest part. A few shreds of plaster often lift with the wire. They should be pulled free occasionally from the key if a clean cut is desired. It is important that a strong and even tension should be kept on the wire and sudden jerks avoided, as they tend to snap it. Should this accident occur, the anchored end of the wire is freed and the broken end seized and wound round a Spencer-Wells, thus forming a new anchorage. The freed end is gripped in a second Spencer-Wells and wound along in the direction of the new anchorage. When many plasters have to be removed it is more convenient to use a specially designed key.* The plaster is removed by separating the cut edges by hand. The stockinet tears easily, as it has been weakened by the rusting of the overlying wire.

Slotted Plate.—It has been found that undue lifting of the plaster occurs if cutting is attempted before it has dried. To overcome this difficulty I have employed a steel plate, inserted between the plaster and the key, with a slot through which the wire is pulled. The plate is moved along with the key and prevents lifting of the plaster, thereby ensuring a clean cut. A slot 1/8 inch wide and 3 inches deep cut into a steel plate will be found adequate for most purposes. I have designed a more elaborate device* in which the slot width is adjustable, and which is made of flexible steel and can therefore be

* These instruments are supplied by Allen and Hanburys Ltd.