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Shoe inserts for small deformed feet

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Abstract

Modern materials and a better understanding of the biomechanical requirements enable adaptations to shoes to be made quickly and easily in cases where the deformed foot is small enough to fit satisfactorily into standard shop-bought or standard deep footwear. A flexible self-generating polyurethane foam is used inside the shoe. It expands to the internal shape of the shoe and the external shape of the foot. It can be used either against the patient's own foot or against a positive cast of the foot. The technique has been used for 75 patients and has proved successful. The insert so made is durable and economical.

Introduction

With the present shortage of surgical shoe makers and the high cost of bespoke footwear, (now at least £150 a pair in UK), it is necessary to maximise the use of standard footwear and provide adaptations whenever possible. Patients are pleased to wear standard shoes which provide the opportunity for better looking footwear with greater variety, even when they have to pay for them—and their repair and replacement. It is clearly more economical for a National Health Service.

Adaptations to standard footwear to accommodate misshapen feet have been made for centuries. The traditional methods still used for making these adaptations are often centuries old. Shoe stiffening is often achieved with steel plates built into the sole and "build-ups" are made in layered cork.

Modern materials, such as polyurethane foams and high molecular weight polyethylene can be used instead, with advantage, for making these shoe inserts.

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Method

Choice of using the foot or a cast of it

The technique for filling spaces between the small foot and the shoe which is described below can be performed using the foot itself (suitably covered) or a cast of it. The occasions when it is more satisfactory to use a cast are:

(a) When the attitude of the foot (or part of it e.g. forefoot) requires passive correction and this cannot be achieved when the foot is in the shoe whether weight bearing or not.

(b) When accentuation of build-up or relieved areas is required.

(c) When the foot tends to slide forward in the shoe during foaming and must be held back into the heel.

(d) When a thin layer of foam is required over the dorsum of the foot. (It is better to add a material like Pelite—which is stiff enough to stand on its own—to the cast.)

(e) When the patient has difficulty, e.g. with a flail foot, in inserting the foot into the shoe quickly.

The principle advantage of using the foot directly is, of course, that of speed. The production can proceed on a 'while-u-wait' basis. However, for this to be possible the patient has to attend with the correct shoes and an insert base to fit those shoes has to be ready. In most cases the patient will first present without shoes, especially if they are being transferred from surgical or other non-standard footwear. Thus in these cases it is easier to take a cast of the foot at the first visit and the insert (and subsequent ones) can be made up to the cast, with the patient attending on the second occasion for fitting and supply.

The insert base

Footwear containing a foot much smaller than that for which it was designed will usually need to be stiffened. The stiffening is very frequently satisfactorily achieved with an insole of 4 mm or 6 mm thick Ortholen® (high molecular weight polyethylene) shaped to the last for the shoe—or a similar last. The optimum amount of stiffening in each case has to be judged with skill. It is a biomechanical compromise to achieve flexing of the forepart of the shoe compatible with the movements of the foot. It will be influenced by the ranges of movement and muscle power at the knee, ankle, subtalar joint and toes. A wedge style shoe is sometimes stiff enough and does not require additional stiffening. Stiffeners sometimes need to be specially weakened across the region required to flex.

The foam filling technique

(a) The fit of the foot (or cast) in the shoe is checked, particular attention being paid to the heel area.

(b) The fit of the insole base (stiffener, if necessary) in the shoe and on the foot is checked. Any surface contouring (e.g. metatarsal pads, etc.) which is required is added.

(c) A shoe-shaped polythene bag (280–300 gauge) is cut, sealed and heat shrunk onto a last of approximately appropriate size for the shoe. This acts to protect the shoe and release the insert, when it is formed, from it.

(d) The insole base is placed in the polythene shoe bag and both are placed in the shoe.

(e) i. When using the patient's foot directly: The foot is clothed in stockinette and the material is bundled with extra thickness in areas such as beyond the toes and over tender prominences, where freedom is required (Fig. 1, left). The extra thickness of materials is held in place with thin adhesive tape. The foot is then covered with a shaped sock (cut and sealed with an electric hot knife (Fig. 1, right), made of Ambla P072 (polyurethane film outermost) which is then painted with a release agent, e.g. perchlorethylenum (Fig. 2, left) where adhesion to the foam is not required. The Ambla material serves to protect the foot as well as provide a lining interface to the foam.

ii. When using a cast: The cast is modified/rectified to achieve the necessary corrections of attitude or relief of pressure problem areas. The cast is then covered with a thin latex sheath. This does not require a release agent.

Fig. 1. Left, foot clothed in stockinette. Right, cutting of Ambla P072 shaped sock.

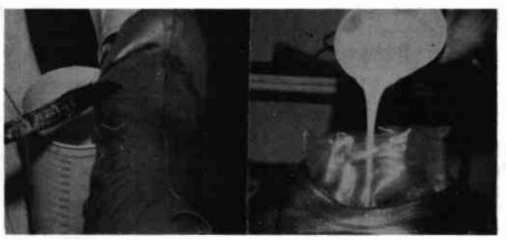

Fig. 2. Left, Release agent being applied. Right, flexible polyurethane foam being poured into polythene bag containing insole base.

(f) A suitable quantity of the components of a flexible self-generating polyurethane foam (e.g. Otto Bock Pedilen W150) are mixed and quickly poured into the polythene bag in the shoe (Fig. 2, right).

(g) The foot or the cast is placed in the shoe and the correct attitude (the patient should bear weight on the foot) is maintained for a further 2 minutes (Fig. 3, left). It should be held still for a further 3 minutes for completion of

Fig. 3. Left, foot placed in shoe and correct attitude maintained for appropriate time (see text). Right, when polymerization is complete the foot is removed from the shoe together with the bag and insert.

polymerization. The foam expands to fill the space in the shoe and it sets to the internal shape of the shoe and the external shape of the foot.

(h) The foot or cast is removed from the shoe together with the polythene bag and insert (Fig. 3, right). The foam can be peeled away from the areas not adhering and trimmed and machined as necessary. In the case of the Ambla lining, it is trimmed and cemented around its borders.

(j) The insert base, with the superimposed flexible foam filling is then completed by a layer of preformed polyurethane foam (e.g. Poron) which gives a durable and comfortable finish (Fig. 4, left).

The insert is best left a further 24 hours before being taken into use to ensure stabilization of the polymer.

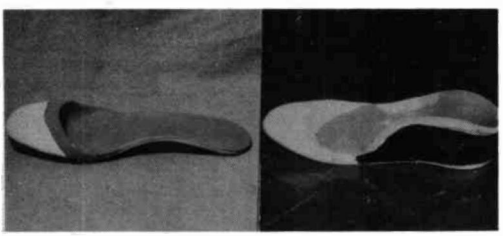

Fig. 4. Left, the finished insert. Right, insert with rigid foam under the raised heel area for patients with fixed equinus deformity.

The selection of footwear

Many factors are involved in the selection of footwear. There are certain obvious criteria such as that the foot must be capable of being contained in it. (Sometimes a pair of oversize shoes or boots can be used with a standard insole for the normal foot and a special insert for the odd one.) Where there is a degree of fixed equinus it is often possible to use standard shop-bought boots and an insert with rigid foam (e.g. Pedilen W300) under the raised heel area (Fig. 4, right).

Where the foot is too deep for ordinary shoes, standard 'Deep Shoes' may be used with the necessary insert. Mocassins are almost invariably unsuitable where there is any tendency to lateral instability. Problems involving retention of the shoe on the foot usually need boots or shoes with high fronts (preferably laced). Narrow and high-heeled ladies fashion shoes are seldom possible.

Patient selection

The basic criteria for patient selection should be:

(a) A desire to wear standard or normal-looking footwear.

(b) Feet or foot the dimensions of which (in the walking attitude) do not exceed the internal dimensions of the proposed footwear, including any necessary depth for plantar surface contouring. (The question of alteration of shape/dimension with dynamic loading has to be interpreted in the light of experience.)

(c) Sufficient forefoot and normal or near normal heel shape for the footwear to stay on the foot adequately. (Boots or bootees can overcome some of these problems.)

Results

This technique has been used to make more than 200 inserts for 75 patients. In all cases but 3 (early cases) the insert has outlasted the footwear. The average duration of patient trial was 13·6 months. Since the problems being treated should be regarded in terms of their anatomical and biomechanical abnormalities the disease conditions involved are not so important. They included 53% congenital malformations, 5% trauma sequelae and the remaining 42% from such conditions as anterior poliomyelitis, arthrogryposis, muscular dystrophy, amputation following malignancy and spina bifida.

In all but one case patients were pleased (often delighted) to convert to shop-bought or standard shoes even though they had to pay for them themselves.

Conclusions

A number of patients can be satisfactorily converted from bespoke surgical footwear to ordinary shop-bought or standard 'deep shoes' with consequent benefits to the patient in terms of appearance and to the economy in terms of Health Service savings.

The technique to make removable inserts as described and using if necessary, a flexible polyurethane filler is not difficult to learn, is relatively inexpensive and safe. It is, however, a technique for the surgical shoemaker rather than the orthotist, chiropodist or physiotherapist.