*Lepr. Rev.* (1969) **40**, 177-181

# The Use of Plastazote in Footwear for Leprosy Patients

## A Preliminary Report*

A. M. MONDL†
*Shoe Manufacturer*
JEAN GARDINER
*Physiotherapist*
J. BISSET
*Physician and Surgeon*
*McKean Leprosy Hospital, Chiengmai, Thailand*

This further paper on Plastazote gives full details and instructions for the build-up of insoles for the shoes of leprosy patients afflicted with deformed, ulcerated, or insensitive feet, together with photographs to illustrate the various stages of the process and also of 2 patients who, thanks to Plastazote and skilled treatment, were able to walk unassisted for the first time for 4 and 15 years respectively.

### INTRODUCTION

In leprosy patients anaesthesia of the feet and resultant plantar ulceration is a problem which continues to defy solution. Much has been written on the subject (Price, 1964; Brand, 1966) and much research has gone into producing suitable shoes and sandals which will offer protection to feet which have lost all sensation, as well as to feet which have actually undergone ulceration and even proceeded to deformity. The key to the problem, perhaps, is the elimination of all high pressure points on the sole of the foot, the starting point of many plantar ulcers. Microcellular rubber of 15-shore has been used widely in the making of sandals for such patients. The success of these sandals has varied in proportion to the degree of discipline in wearing them constantly exercised by the patient himself or by the institution where he was treated. In many places these sandals themselves became another stigma of the disease, and were reluctantly accepted by the patient and often discarded once he had returned to the home environment. Furthermore, lack of uniformity in the manufacture of the microcellular rubber, resulting in material that was too hard, was often a cause of failure.

Recently, a new plastic-foam material, marketed under the trade name of Plastazote, has been used to make built-up insoles, which when inserted into ordinary leather shoes or tennis shoes relieve all high pressure points; this also overcomes the objection of the patient that his footwear is different from that of non-leprous people.

### PLASTAZOTE

Plastazote is a polyethylene-foam splinting material which, on being heated to suitable temperatures, is capable of being moulded. It is light in weight, readily washable, and does not encourage bacterial growth. The 2 main conditions in which Plastazote is most useful are (a) anaesthetic foot, with or without high pressure points or with or without plantar

*Received for publication 27 January, 1969.

†A. Martin Mondl, Esq., is a retired shoe-manufacturer now residing in Wisconsin, U.S.A., who, at the request of Dr. Paul Brand, reviewed the above methods using Plastazote, and set up similar programmes in Taiwan, the Philippines, and Thailand. This is Mr. Mondl's third visit to McKean Leprosy Hospital.

(a) (b)

FIG. 1
Footprint taken before (a) and after (b) Plastazote build-up.

FIG. 2
Plastazote taken from oven after heating; now in a mouldable state.

FIG. 3
First stage in making Plastazote build-up.

FIG. 4
Build-up mixture being applied to under surface of Plastazote. Note drying build-ups, and last with build-up in background.

ulcers; and (b) anaesthetic foot with deformity, e.g. dropped foot, claw toes, or ankylosis of the ankle in inversion or eversion.

## INITIAL FOOTPRINT STUDIES

Before using Plastazote build-ups it is essential to obtain footprints, using Harris footprint mats. These will show the high pressure points which have to be relieved. After Plastazote build-ups have been provided for either ordinary or custom-made shoes, or for tennis shoes or sandals, a further footprint is then obtained. If this is satisfactory, it will show that these high pressure points have been relieved and the patient thus protected from possible callouses and ulcers. Details of this procedure have been given elsewhere by Price (1964), Shipley and others. It should be noted that a 3-mm mat is used for the initial footprint and a 1-mm mat for that taken inside the actual shoe or sandal (Fig. 1).

## PLASTAZOTE IN CONDITIONS LISTED UNDER (a)

A suitable piece of Plastazote, slightly larger than the foot, of $\frac{1}{4}$ or $\frac{1}{2}$ in. (0.5 or 1.25 cm) in thickness—the former is usually sufficient— is placed in an oven, at a temperature of 130°C for the former, 140°C for the latter, for a period of 3 to 5 minutes, by which time it becomes quite

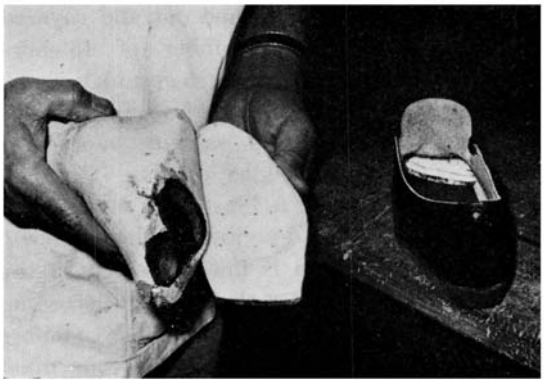

FIG. 5
Last with bubbles of foam rubber applied; Plastazote build-up and custom-made shoe. Note Plastazote cushion in toe of shoe.

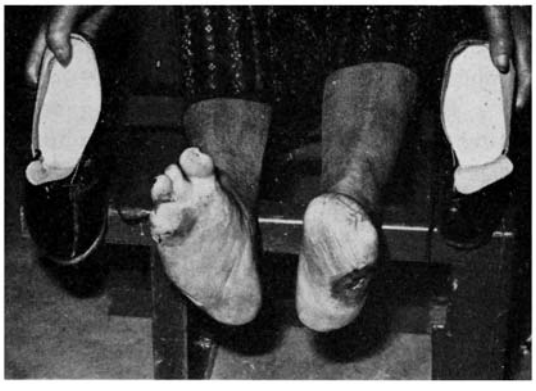

FIG. 6
Woman patient with finished footwear for chronically ulcerated feet.

FIG. 7
Custom-made boot with Plastazote; lateral marginal ulcer on foot with ankle ankylosed in inversion.

FIG. 8
Patients whose feet are seen in Figs 6 and 7. The woman walks unaided for the first time in 15 years, the man after 4 years!

mouldable (Fig. 2). It is then placed over a sheet of 4 in. (10 cm) synthetic-foam rubber which is neither too hard nor too soft. On top of the Plastazote is put a thin layer of plastic sheeting, such as is used in making plastic bags, to prevent a possible burn. The patient is seated on a chair and places his foot on the Plastazote while the technician exerts an even pressure on the patient's knee and over the toes, for about one minute. A perfect impression of the sole of the foot is thus obtained (Fig. 3). The margins of the foot are then outlined on the Plastazote with a pencil.

The next stage is to build up the under surface of the Plastazote. For this purpose, the following mixture has been found suitable: 1 part rubber dust (from grinding any type of rubber); 2 parts sawdust (after sifting through a fine sieve to remove unwanted foreign bodies); and rubber cement to make a mixture similar in consistency to soft putty. This mixture is applied to the Plastazote in such a way as to fill in the depressions, adding a little extra in support of the longitudinal arch. A suitable tool for this purpose is an old, highly polished, kitchen knife. As the mixture tends to stick to the knife a small can of gasoline (petrol) is kept at hand and the knife dipped into it frequently as the

mixture is applied (Fig. 4). This build-up material, too, is applied a little beyond the periphery of the outlined foot. A period of 12 to 15 hours is allowed for drying before cutting along the outline with a sharp knife and then sanding to produce a smooth finish, paying particular attention to the natural contour of the heel portion. The Plastazote build-up is now placed in the shoe or sandal and another foot-print taken, as mentioned above. Any remaining high-pressure point can be dealt with by further sanding at the site of pressure on the under surface. A week later the foot is examined for any blisters or red spots resulting from pressure, especially on the dorsum of the foot. Leather shoes can be stretched; while tennis shoes should have their tongue slit distally on either side and laced loosely. (It should be noted that when Plastazote build-ups are being used, a shoe one size larger than normal should be obtained to allow for the additional bulk of the build-up.)

## PLASTAZOTE IN CONDITIONS LISTED UNDER (b)

Here, a Plastazote build-up must be used in conjunction with a custom-made shoe or boot to compensate for a deformity which does not permit the use of an ordinary shoe or sandal. A plaster cast of the foot in question must be made first, in the following manner: high pressure points or bony prominences on the foot are outlined with indelible ink, and several layers of gauze impregnated with plaster of Paris are applied to the foot in order to form a shell. The foot is then withdrawn and the opened margins of the plaster of Paris shell taped together again. Freshly mixed plaster of Paris powder and water, still in fluid consistency, is poured into the shell; this will take about 45 minutes to harden. The original shell is now peeled off and the resultant cast is either allowed to dry in the sun or baked in an oven at 200°C (392°F). The cast is then pared down with a knife so that it now becomes a shoemaker's last. Gross abnormalities are filled out with the build-up material described in the previous section. Sites stained by indelible ink, representing high pressure points, are smoothed out and covered with bubbles of foam rubber of 15-shore cemented to the last, $\frac{1}{2}$ in. (1.25 cm) high in the centre which corresponds to the centre of the high pressure area, and sanded smooth to provide a regular moulded contour. The last is now used to make a Plastazote build-up in the same manner as described in detail above. The finished build-up is finally tacked to the last, from which a leather shoe is made according to routine methods of shoemaking. (Before building a shoe over a plaster cast one must add at least $\frac{1}{2}$ in. (1.25 cm) to ensure proper toe clearance, which will automatically help to blend a nice toe piece to the cast.) On completion the last is removed and the Plastazote build-up finished and inserted in the shoe, which is now ready for wear (Fig. 5).

Amputated or absorbed toes, fore-shortened feet, claw toes, and other deformities have to be compensated for by various methods which require some knowledge of shoemaking or prosthesis building. In brief, where toes are wholly or partly missing the cost is extended by adding $\frac{1}{2}$ in. of plaster of Paris, $\frac{1}{2}$ in. of Plastazote, and $1\frac{1}{4}$ to $1\frac{1}{2}$ in. (3 to 4 cm) of build-up material, in that order, before being finally shaped to conform to a normal last. In addition, where toes are absent a $\frac{1}{4}$ in. build-up is added to the under surface of the Plastazote at a point immediately behind the portion of the extension to the original cast.

When a deformity results in a sole which is not wholly plantigrade the build-up must be made so that the weight-bearing axis is always perpendicular, that is, the tibia and fibula are at right angles to the ground.

## RESULTS

So far, 78 patients have been provided with tennis shoes and Plastazote build-ups at this institution, and 8 with custom-made boots or shoes and Plastazote build-ups. The latter group included a woman who had only been able to hobble around with the aid of crutches for the previous 15 years (Figs 6 and 8). There was also an elderly man with an ankylosed right ankle in a position of inversion and so

subject to chronic ulceration along the outer margin of his foot; he is now able to walk unassisted for the first time in 4 years (Figs 7 and 8). A few months of continual wear in urban and rural situations, together with their use in the paddy-fields during the rainy season, will be required to prove the effectiveness of these shoes.

## SUMMARY

A new polyethylene-foam material, Plastazote, has been utilized in the making of built-up insoles in normal and custom-made footwear for patients with leprosy, subject to all the hazards of anaesthetic feet. With the help of this material it is now possible to provide leprosy patients with shoes of normal appearance which both give protection to their feet and at the same time are readily accepted by them. Economical to make, and cheaper than ordinary microcellular shoes, Plastazote build-ups may represent a significant advance in the care of the feet in leprosy.

## ACKNOWLEDGEMENTS

Our thanks to Dr. Chinda Singhanet, Superintendent of McKean Leprosy Hospital, and staff and patients for their kind cooperation; to Smith and Nephew Ltd. of Welwyn Garden City, England, through their Bangkok agent Weelok & Marden, for their generosity in providing Plastazote for this trial; to Dr. Paul Brand and Mr. David Welch of the U.S.P.H.S. Leprosarium, Carville, La., whose original ideas have been incorporated in the making of the build-ups; and to Dr. Edwin McDaniel who took all the photographs accompanying this paper.

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