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Imler Partial Foot Prosthesis IPFP—"The Chicago Boot"

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INTRODUCTION

Surgeons, because of better technology and advances in surgical technique, are now performing a greater number of distal amputations, including those of the forefoot. Consequently, a need exists for a prosthesis that allows a more functional gait pattern and is more energy conservative, with ankle motion left intact in the saggital plane and dorsi/plantor flexion unrestricted. The prosthesis needs to be light in weight, be structurally strong, provide ankle support, have an anterior lever arm, act as a shoe filler, and be cosmetically acceptable.

The Imler Partial Foot Prosthesis fulfills these needs. This prosthesis is utilized for LisFranc, Chopart, Boyd, and other difficult forefoot amputations.

The essential element of the prosthesis is the interface, consisting of a vacuum formed co-polymer† U.C.B. type insert, and a toe filler of soft foam. This interface is then inserted into a laminated, flexible rubber-epoxy-resin (Lynadure††) cosmetic sleeve that encompasses the entire foot. This sleeve extends proximally to above the malleolus and has an anterior opening. The interface is removable, and enabled the prosthetist to make necessary adjustments (i.e. alignment and/or relief). Closure is obtained by eyelets and laces for greater suspension, or Velcro® for more cosmesis.

CASTING PROCEDURE

A negative impression may be obtained using any conventional method. A midfoot amputation should be placed on a casting board or covered with a plastic bag and inserted into the patient's shoe to simulate heel height. Very little weight should be applied to avoid spreading of the foot. With a Chopart amputation, where the calcaneous is plantar flexed or rotated posteriorally, a casting board is not used. The casting in all cases is similar to the procedure used when casting for a U.C.B. shoe insert.

MODIFICATION OF THE POSITIVE MODEL

Modifications include a standard 3mm. anterior relief. A 1mm. relief for the malleolus is added, along with relief for any

†Co-polymer, Colyene: Orthotic Prosthetic Enterprises, 1316 Sherman Avenue, Evanston, Illinois 60202.

††Lynadure: Medical Center Prosthetics, 6955 Almeda Road, Houston, Texas 77021.

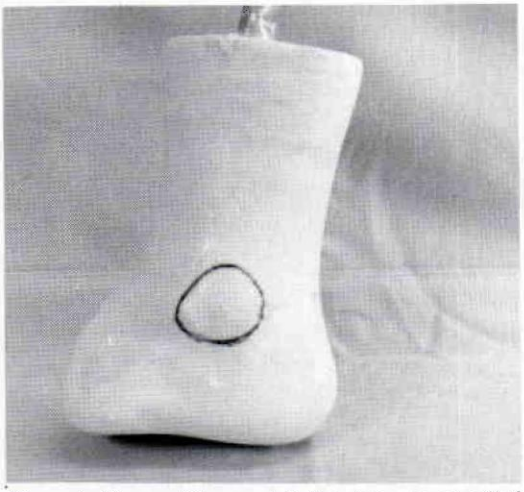

Figure 1. The positive model showing area of relief over malleoli.

bony prominence or scar tissue as needed. Remove 2mm. of plaster both medially and laterally, proximal to the calcaneous to enhance the support effect of the U.C.B. type insert. There is no relief formed for the anterior tibia (Figure 1).

SHOE INSERT WITH TOE FILLER

Over the modified positive model, thermo-form a section of 5mm. firm density Pelite,® for an anterior end pad. Trim and bevel the edges to achieve a smooth transition (Figure 2). A sheet of 3/16" Colyene is vacuum formed over the cast and end pad (Figure 3). The interface may also be laminated with either acrylic or polyester resin. The posterior trim line is proximal to the calcaneous. The medial and lateral trim lines are distal to the malleolus, and the anterior is at mid-height level. Care should be taken not to cut into the Pelite® pad as it extends above the trim line (Figure 4). The anterior toe section can be constructed by various means. Pelite® of 5mm. firm density should be added until a flat surface distally is attained (Figure 5).

It is at this juncture that adjustments, during or after fitting, are to be made. The heel cup toe filler can be bisected, and the heel cup interface rotated, to produce eversion, inversion, plantar/dorsi-flexion, toe in, or toe out. Due to the flexibility of the outer sleeve, these changes may be accommodated without the need for a new lamination.

Figure 2. Corrected positive model with Pelite® end pad.

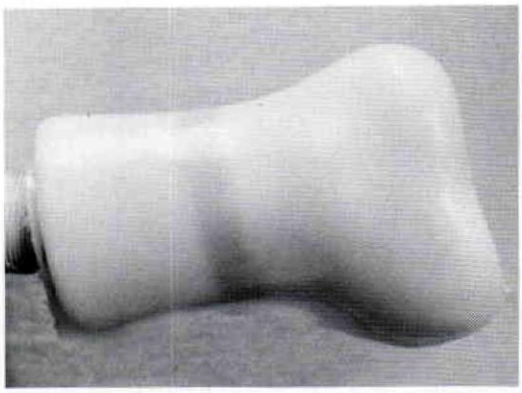

Figure 3. Vacuum formed colyene over positive model.

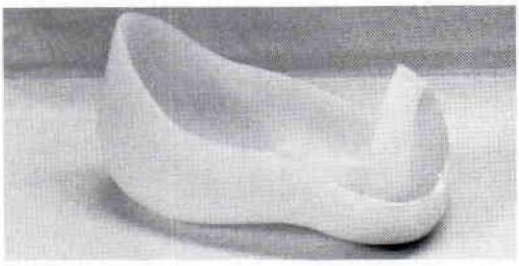

Figure 4. Trimmed heel cup with Pelite® end pad.

Figure 5. Heel cup with flat anterior surface created by Pelite® buildup.

The anterior toe section is constructed of 12mm. firm density Pelite,® bonded together lengthwise. This toe section is bonded to the heel cup and shaped to size. Using a mold or the patient's shoe, the toe section can be formed using a flexible foam. Additional material is removed to leave room for the outer lamination (Figure 6). The finished heel cup interface with toe filler is replaced on the cast and inserted into the patient's shoe. At this point, a final determination is made of the alignment.

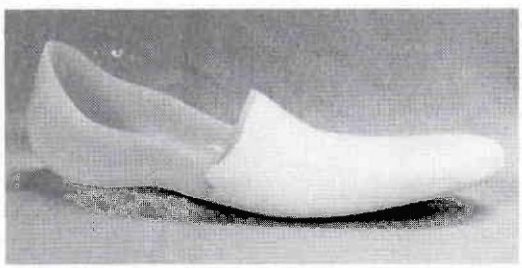

Figure 6. Heel cup with toe section.

A 1.5mm. thick strip of polyethylene is thermo-formed over the anterior surface. This will act as a separating agent, forming the tongue and overlap. A center line is drawn with parallel lines on either side, making the overall width approximately 2.6cm. The length extends from the proximal edge of the cast, to 5mm. past the proximal edge of the Pelite® toe filler. The strip is trimmed to length, and the edges beveled for a smooth transition.

The layup for the rubber epoxy sleeve lamination consists of a nylon hose covered by a PVA bag, which has been capped off and put under full vacuum. Two layers of stretch nylon stockinette are applied. The strip of polyethylene wrapped in Dynalon is sandwiched between this and four additional layers of stretch nylon and one layer of ortholon, for a smooth outer finish. A second PVA bag is applied with vacuum, and the rubber epoxy resin is introduced (Figure 7).

Figure 7. Lamination with rubber epoxy resin (Lynadure®).

Before final trimming, it should be determined if closure is to be achieved by eyelets and lace or Velcro.® If eyelets are used, make a center cut through to the polyethylene strip, with inverted T slits to the edges of the strip. Heat the laminate lightly, remove the polyethylene strip and cut the inner tongue along the medial and distal edges only. To obtain a Velcro® closure, first cut along the medial and distal edge of the polyethylene strip, remove the strip, and cut the inner tongue along the lateral and distal border. To complete the prosthesis, insert eyelets, or sew in Velcro.® Before cutting the laminate, be sure

the material has fully cured, otherwise it may fray.

Initially, the first prosthesis made extended proximally to 1/3 the length of the lower limb. This trim line has since been lowered to just proximal to the malleolus.

The I.P.E.P. weighs approximately 250 grams, depending on the shoe size. It is extremely lightweight, but very durable.

A leg length discrepancy may be accommodated for in the prosthesis by adding a Pelite® pad of the proper height, either before or after the interface is vacuum formed.

The prosthesis is thinly constructed to be used by the patient with regular shoes. There is no need for split-sized, over-sized, or extra depth inlay shoes, in most cases. Figure 8 shows the finished prosthesis in a patient's shoe.

Figure 8. Finished prosthesis in a patient's shoe.

CONCLUSION

During a two year period, approximately 50 partial foot prostheses were fabricated at a central fabrication laboratory, for facilities throughout the United States. The response of first time prosthesis wearers was mixed, whereas former wearers of other types of prostheses were very favorable in their comments. A 65 year old patient with a three year old amputation indicated that he feels there is no comparison. His previous prosthesis weighed 10 pounds and his "Imler boot" weighs 10 ounces. There is increased mobility with the ability to use the right foot when driving. A 70 year old congenital amputee with 3/4" leg length discrepancy comments that the boot is comfortable and light in weight and says she feels more sure-footed than previously.

This is not the answer to every partial foot amputation, but an alternative to the problem of fitting a difficult prosthesis.

AUTHOR

Mr. Imler is with The Orthotic Prosthetic Center, Fairfax, Virginia. He previously was in charge of the Prosthetic Department at Orthotic Prosthetic Lab Service, Evanston, Illinois, a central fabrication facility where he developed his partial foot prosthesis.