

Technical Note: A Case Study— Special Choparts Prosthesis with Custom Molded Foot

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INTRODUCTION

The patient for whom this prosthesis was made had a severe problem that needed to be contended with: fixed equino-varus condition that was present in the amputated side (plantarflexion and inversion). This is a condition normally present in this level of amputation due to loss of the dorsiflexors and both longitudinal and transverse arches. This allows the calcaneus to collapse because the plantarflexors are still intact and unopposed. This problem was more pronounced and more rigidly fixed in this patient than in most.

The patient was hemiparetic with accentuated proprioceptive deficiency on the contralateral limb, making the amputated limb the better of the two. Age is also a factor to be considered in overall prosthetic treatment.

The prosthesis needs to be lightweight, as thin as possible, contoured to offer the greatest amount of stability possible in the shoe, accommodate the equino-varus condition in the residual foot, and be as cosmetic as possible. It was determined that the best way to meet all these criteria was to

use special materials and to custom fabricate a foot to fit the shoe as intimately as possible.

Fabrication of the custom foot was fairly complex. An impression of the patient's residual limb was taken, utilizing the anterior-posterior splint technique and a foot board under partial weight bearing. The positive model was made, and a normal cast modification and trim lines for a posterior opening, patellar tendon height chopart prosthesis, were utilized.

A PPT® foam pad was prepared to cover the anterior of the residual foot. To allow sock room in the prosthesis, an orlon post-operative sock was put over the plaster positive before the inner PVA bag was applied.

IPOS-Ipocast System® using carbonacryl resin and carbon fiber and fiberglass stockinette (Figure 1) is the material used to add strength without weight or thickness in the socket. A layup of one layer of dacron felt, two layers of the Ipocarbon® stockinette, and four layers of nylglass® stockinette was used. The Ipocarbon® stockinette is coarse textured and black, so the socket was roughed up for good bonding, and two



Figure 1. I.P.O.S. Carbonacryl[®] resin and carbon fiber and fiberglass stockinette.

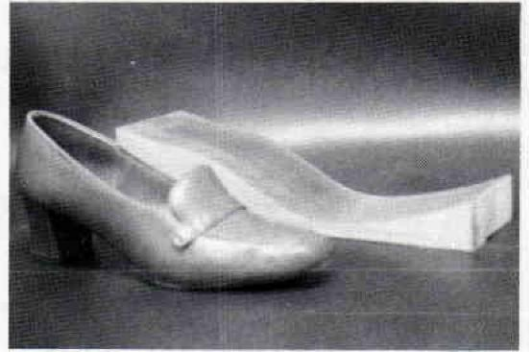


Figure 2. Shoe with custom foot plate.

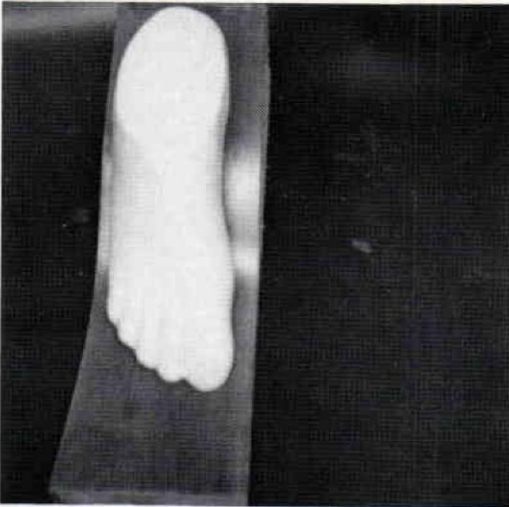


Figure 3. Dorsum of modified foot.



Figure 4. Plantar surface of modified foot.

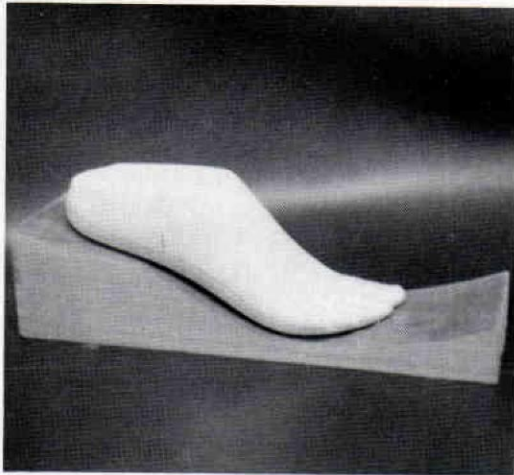


Figure 5. Lateral modified foot.

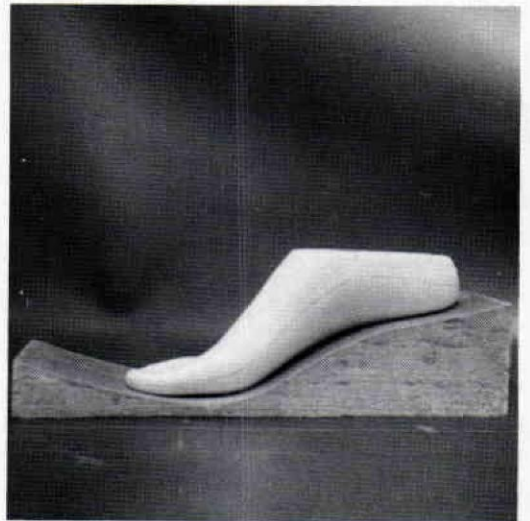


Figure 6. Medial modified foot.

layers of nylglass® were laminated over the socket to give it a smooth finish and cover the dark color.

Since intimate fit in the patient's shoe was a major concern, it was important to make a foot plate that matched the shoe sole contour (Figure 2) of the shoe provided. A partial weight bearing alginate impression of a similar sized-foot was made on the custom foot plate. This impression was then filled and modified by smoothing, filling in the plantar toe spaces and between the toes (Figures 3 & 4), and

modifying toe lengths and widths for a better fit in the toe area of the shoe. The modified foot was then allowed to dry and coated with a plastic parting lacquer before making a three-piece mold. The peak width was drawn around the entire foot to locate the trim lines for the mold (Figures 5 & 6).

The bottom portion of the mold (Figures 7 & 8) was made first by using a sand casting technique. The modified foot was placed on a platform upside down and sand contoured to the lines drawn around

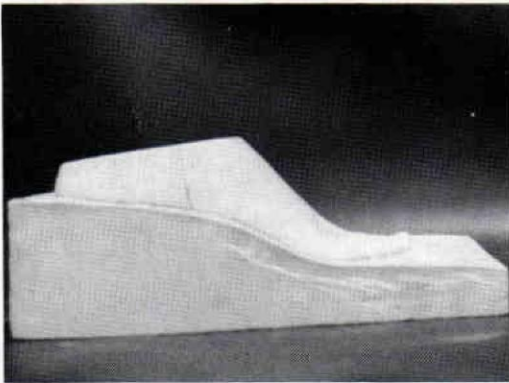


Figure 7. Lateral foot in mold base.

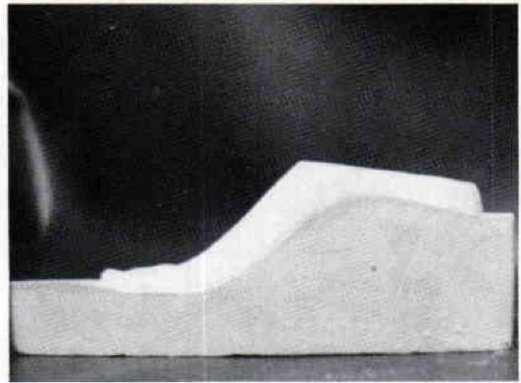


Figure 8. Medial foot in mold base.

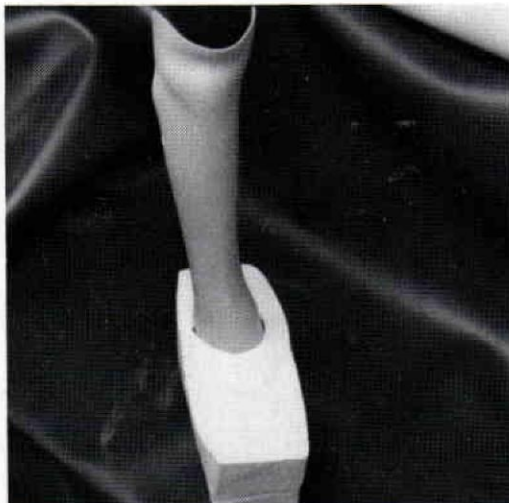


Figure 9. Adduction alignment of socket in mold.



Figure 10. Flexion alignment of socket in mold.

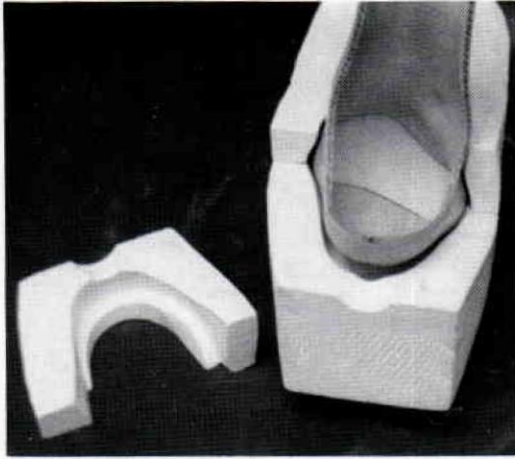


Figure 11. Posterior view—socket in mold.



Figure 12. Socket with keel and belting attached.



Figure 13. Posterior socket showing screws and P.P.T. pad.

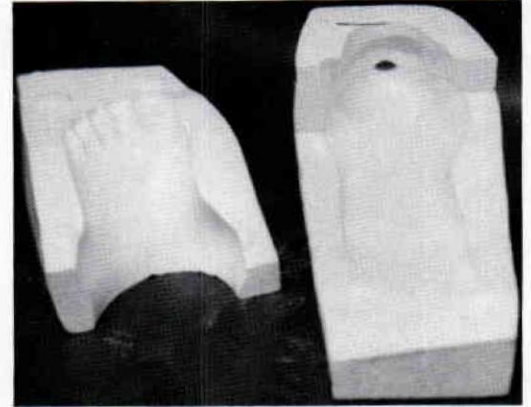


Figure 14. Partially assembled mold.

the foot. Plaster was then mixed thinly and carefully poured over this arrangement, avoiding displacement of sand. Pouring the plaster in this manner allows all bubbles to rise away from the modified foot. When set, this section was trimmed to the peak lines and trued up. Key marks were carved into the base of the mold for locating the other mold sections. A water-soluble wax of the type used by pottery makers was used as a mold release agent. The anterior dorsal portion of the mold was done next, followed by the posterior section.

To achieve full functional and cosmetic integrity, the three-piece mold was carved to accept the socket in correct adduction and flexion alignment for the heel height of the shoe provided (Figures 9 & 10). Just

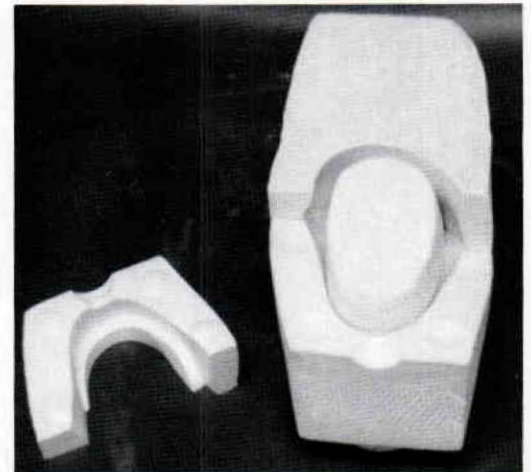


Figure 15. Mold partly assembled over modified foot, showing areas removed to fit socket.

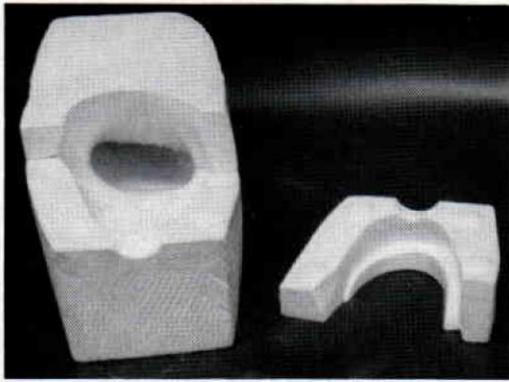


Figure 16. Partially assembled mold.

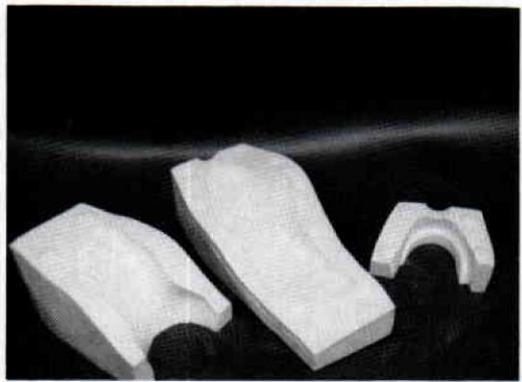


Figure 17. Disassembled three piece mold.

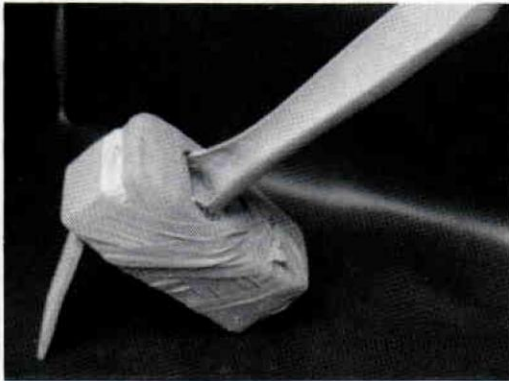


Figure 18. Socket and mold in position for pouring Calthane®.

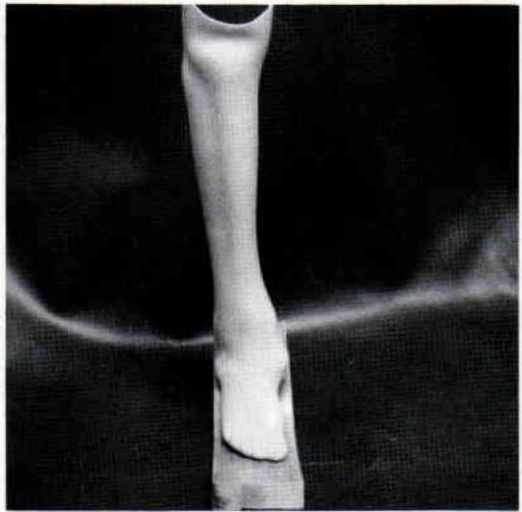


Figure 19. Anterior view of prosthesis.

enough plaster was removed around the sides of the socket to allow the foot to flow into the socket (Figure 11). In order to provide functional stability to the prosthetic foot, a wooden keel was attached to the anterior socket (Figure 12). It was affixed with epoxy and screws extending through from the inside of the socket (Figure 13).

A piece of belting was attached to the plantar surface of the keel extending into the toe area of the foot (Figure 12). Calthane® foam was used to mold the foot directly into the socket. The Calthane® was poured into the mold through a sprue provided in the heel area of the mold (Figures 14, 15, 16, & 17) at an angle to allow any bubbles to rise into areas of least importance.

When completed, this prosthesis offered complete contact with the sole of the shoe over its full length, providing a very stable

base of support. The foot is integrated into the overall lines of the socket and doesn't require additional covering to be cosmetically acceptable (Figures 19, 20, 21, 22). The appearance and volume of the foot is closer to normal in the toe area because it was modified from a real foot instead of a prosthetic foot.

Total weight of the prosthesis including all straps (Figures 23, 24, 25) is 2¼ pounds. Thickness of lamination was kept to a minimum even around the cutout area (Figures 11, 13, 26) because of the extra strength of the carbon acrylic materials in the socket. Taking into consideration the special problems listed in the beginning of the article, the extra time and special mate-



Figure 20. Lateral view of prosthesis.



Figure 21. Medial view of prosthesis.



Figure 22. Postero-lateral view of prosthesis.



Figure 23. Antero-lateral view of prosthesis complete with straps.



Figure 24. Postero-lateral view of prosthesis complete with straps.



Figure 25. Medial view of prosthesis complete with straps.



Figure 26. Socket halves.

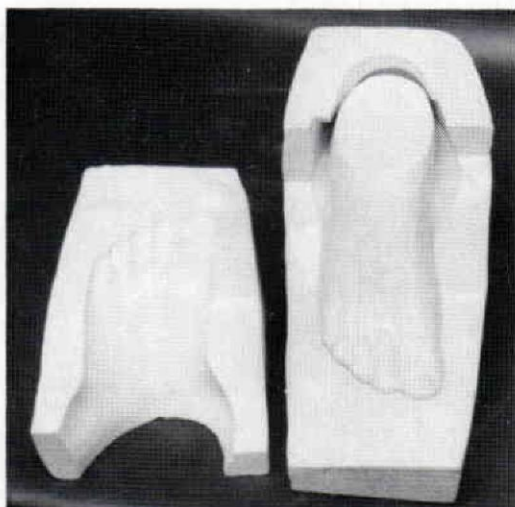


Figure 27. Partially assembled mold with modified foot in place.

rials' expense was warranted for this patient (Figures 14 & 27 show relationships between the modified foot and mold sections).

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