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The Indiana University Clubfoot Orthosis

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INTRODUCTION

During the past 50 years, the treatment of clubfoot has been the subject of considerable controversy.[1] Talipes equinovarus (TEV), commonly termed "clubfoot," is considered the most significant congenital fixed deformity of the foot. It is found more in boys than girls and is considered a defect in prenatal development. Clubfoot may occur either unilaterally or bilaterally. In the newborn, clubfoot can be determined by an inflexible adducted forefoot, a varus heel, and a plantarflexed inverted foot that cannot be brought into a dorsiflexed or everted position.[2] The Indiana University Clubfoot plastic ankle-foot orthosis is indebted to the principles introduced by H. von Baeyer.[4] We have been providing this AFO since the mid-70s from the Orthotics Department, Indiana University Medical Center, James Whitcomb Riley Hospital for Children. The Indiana University Clubfoot AFO has become the preferred orthosis for postoperative orthotic management of clubfoot by the Orthopaedic staff at James Whitcomb Riley Hospital for Children.

The large majority of patients fitted are referred postoperatively. After six weeks, the physician removes the postoperative cast, then applies another cast for the remainder of the eight-week healing period. Before the second corrective cast is applied, the patient is referred to the Orthotic Department, where they will be cast and measured for their AFO. The patient then returns two weeks later for delivery and post-fitting evaluation in the Orthopaedic Clinic.

DESCRIPTION OF THE AFO

The anterior panel ground reaction force design ankle-foot orthosis is vacuum-formed[3] (Figure 1). The 1/8" polypropylene AFO is lined with 1/4" non-perforated Plastazote™, which is easily tolerated by the tender post-surgical foot.

After it cools, the formed plastic is then cut transversely, bisecting the malleolus (Figure 2). A 12mm wedge is cut into the lateral side, allowing for overcorrection and variability in range of motion. Slotted polypropylene slides 5/8" wide by 1/8" thick, have a milled slot 3/16" wide and 1 5/8" to 2" in length. These slides are placed medially and posteriorly, attaching the calf portion with the foot portion (Figure 3). The placement of these slides must allow the maximum amount of corrective eversion and dorsiflexion range. Nyloplex rivets are then used to attach these slides to the orthosis. Velcro® straps are used across the instep, across the anterior distal edge just proximal to the ankle, and at the posterior proximal calf. The overcorrection strap is attached at the head of the fifth metatarsal and is passed through a loop located 12mm distal to the fibular head. For dynamic correction, elastic is added to the lateral correction strap. The forces generated by the corrective strap are applied to the subtalor and talocrural joints to counteract the abnormal musculature imbalance caused by the antagonistic invertors and plantar flexors seen in clubfoot (Figure 2B).

This orthosis is used for at least six months and preferably up to a year. It is worn during the night and also during daytime naps. Straight last shoes are used in

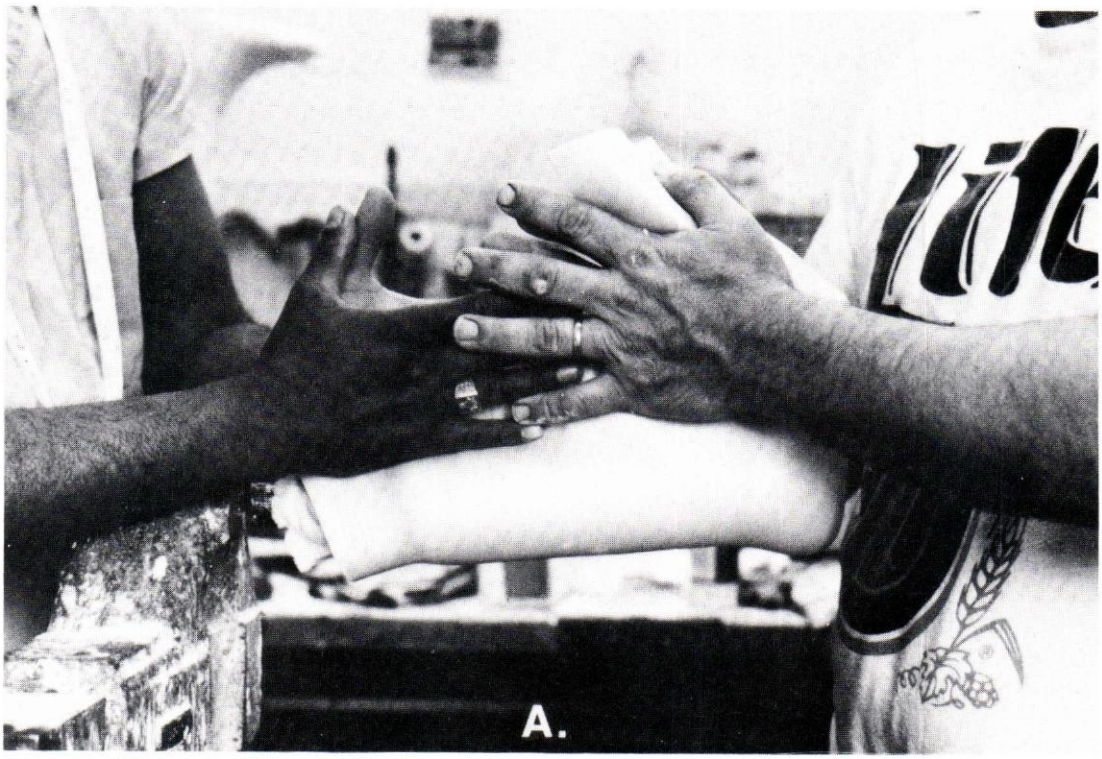

Figure 1A. The forming Plastazote™ lining.

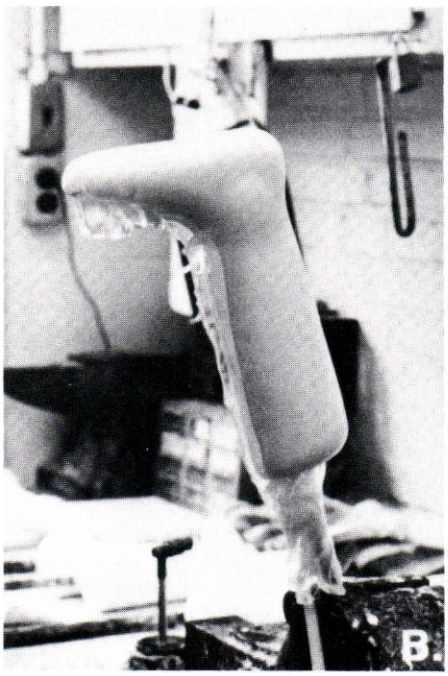

Figure 1B. Positive model after vacuum forming over Plastazote™ lining.

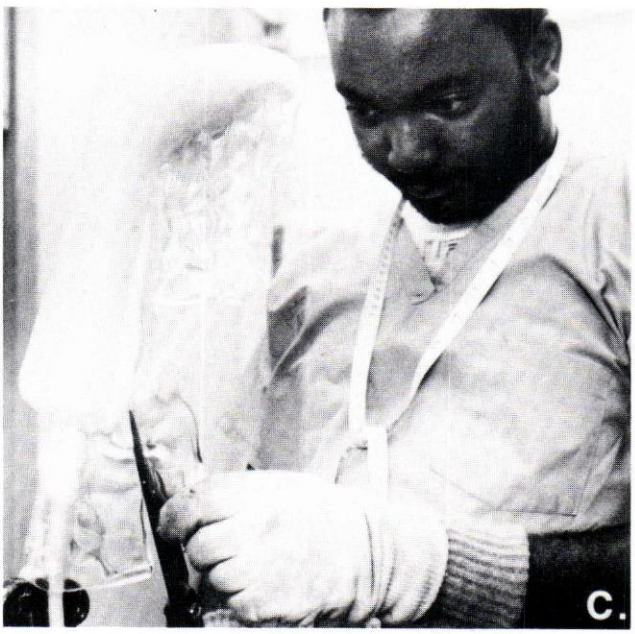

Figure 1C. Technician trimming excess polypropylene before the material cools.

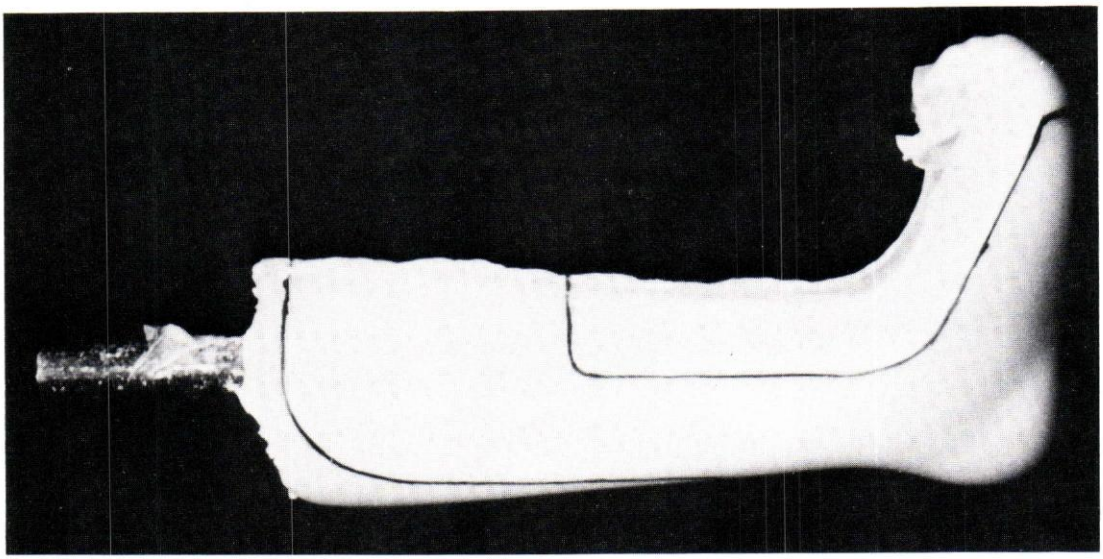

Figure 2A. Note weld on anterior panel. Trim lines allow removal of the AFO from the cast without having to cut the fused anterior panel.

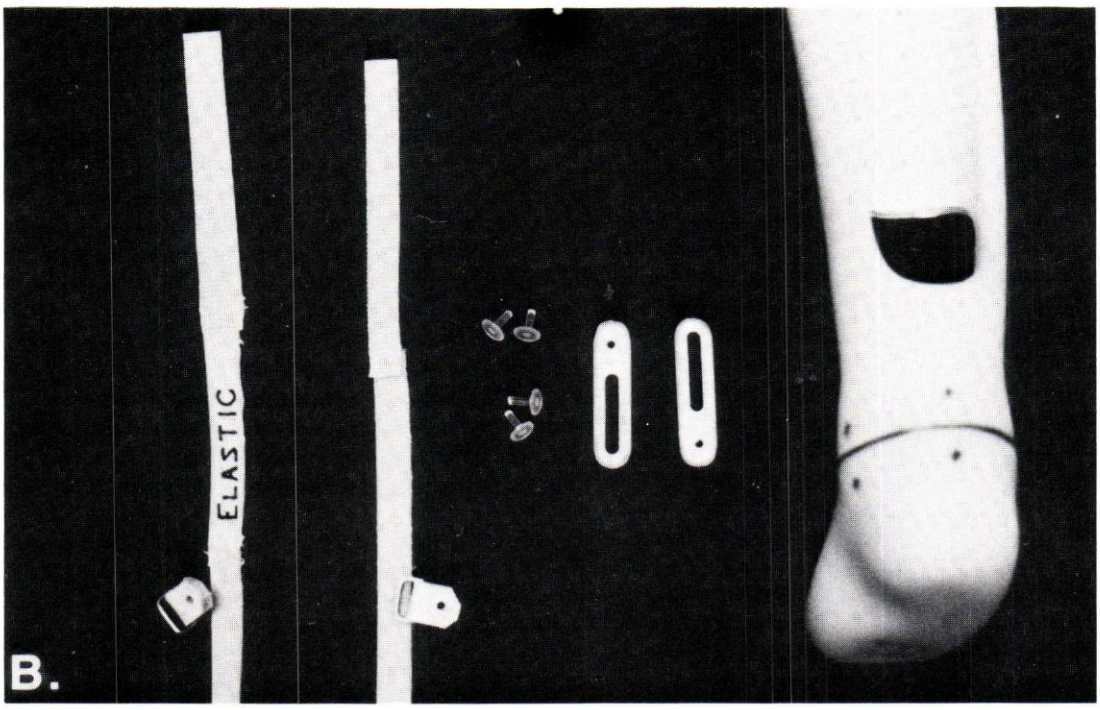

Figure 2B. Layout shows trim lines and slide attachments. Strapping is shown using either an elastic component or Velcro®. Left to right: 1) strap with elastic component, 2) Velcro® strap, 3) Nyloplex rivets, 4) Polypropylene slides and, 5) pre-marked AFO.

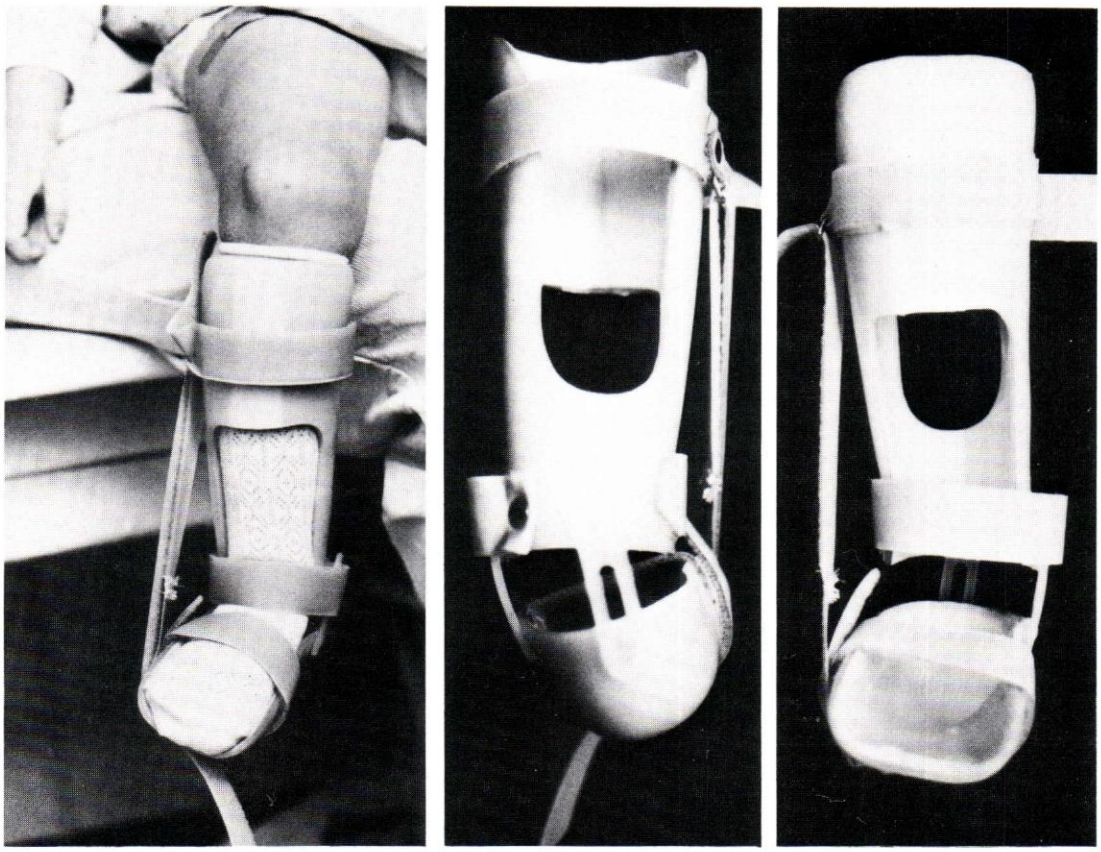

Figure 3. The finished AFO for right foot showing the range of correction possible.

conjunction with daytime weight bearing for both ambulatory and non-ambulatory patients. These shoes maintain the foot in a neutral position. This daytime approach of using straight last shoes allows the child greater comfort and normal development patterns are not hindered.

FABRICATION

- Use the conventional method of obtaining an AFO negative plaster impression. The ankle is held as close to a plantigrade position as possible at the time of casting. The medial aspect of the calcaneous and forefoot are maintained parallel to the mid-sagittal line.
- Modify the positive plaster model to your measurements, except for adding plaster of Paris to the heel in order to permit further correction.
- Vacuum form 1/8'' polypropylene over the positive model so that both the plastazote lining and the polypropylene seams are centered along the anterior of the model (Figures 1B and 1C).
- Draw the outline of an anterior panel ground reaction force type AFO. Trim distal to metatarsal heads, or include toes (Figure 2A).[3]
- Draw a line, bisecting as close as can be determined, between the medial and lateral malleolus transversely (On smaller children, a transverse line may be superior to malleolus to ensure a good grasp of the heel to hold the foot.) (Figure 2B).
- Slides are placed posteriorly and medially, and must be parallel not only to each other but also to the long axis of

the tibia. Remember that placement of these slides must enhance the greatest range of motion (Figure 2B).

- Draw a lateral wedge on the AFO using 6mm on calf portion and 6mm on foot portion. The size of the wedge may increase with the size of the child. Begin the wedge at the center of the posterior calf at the bisection line.
- Drill a #30 hole where marks have been placed for slide attachment. These holes are locations for 3mm nyloplex rivets.
- At this point, cut the AFO shell transversely on the premarked line. Cut out the wedge; smooth and finish all edges.
- Attach the slides, connecting calf and foot portions medially and posteriorly with nyloplex rivets (Figure 3B).
- Attach Velcro® straps, 1) across the instep, 2) across the anterior distal edge proximal to the ankle, and 3) across the posterior proximal edge of the calf portion. The overcorrection strap is attached on the lateral side of the foot portion at the fifth metatarsal head passing up through a loop located 12mm distal to the fibular head.

ADVANTAGES

A major biomechanical advantage of the Indiana University Clubfoot AFO is that it avoids adverse forces to the knee and hip joints.

This orthosis is lightweight, durable, and clinically adaptable to a continuous correction schedule. Due to the design, it is easily applied to the foot of an infant, and one orthosis usually is sufficient for the full length of treatment.

Early removal allows selective freedom of motion. Other advantages include less skin breakdown, better hygiene, increased comfort, and better acceptance.

SUMMARY

An anterior panel ground reaction force design ankle-foot orthosis is presented and its fabrication described in detail. The Division of Orthotics records show that since 1976, an average of 50 patients a year have been fit with the Indiana University Clubfoot AFO. The overall results have been excellent.

AUTHORS

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[4]von Baeyer, H., in Jordan, J.H., *Orthopedic Appliance*. Oxford University Press, New York, 1939, p. 277.