ISCHIAL-THIGH-KNEE-ANKLE ORTHOSIS

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We will be unorthodox and make our acknowledgments at the beginning of this article rather than at the end. We will not use space unnecessarily by providing a long list of references because there are so many that could be cited. However, we would like to thank Arthur Guilford and Jack Greenfield of Rancho Los Amigos Hospital (3) and Siegfried Paul of Newington Children's Hospital. Siegfried Paul provides an excellent example by doing what most of us just talk about. Our acknowledgments also go to Richard Lehneis of New York University for the Advanced Orthotics Course, held there in 1971 and to Thorkild Engen who was an instructor in that course when he introduced us to the TIRR ankle-foot orthosis and polypropylene (1) (2).

To all of these practitioners, the staff and our patients are extremely grateful.

Fresh from the course at NYU, we fabricated many versions of the TIRR ankle-foot orthosis. While mastering the technique of working with this material in our own facility, we had many laughs over our mistakes.

We had polypropylene stuck to the oven, polypropylene stuck to our gloves, and we spent too long a time molding one area while creating wrinkles in another area. Many results of the first attempts found their way to the trash can before our staff became proficient in working with this material.

The corrugations provided by tacking Teflon rods over the surface of the plaster positive model in differing patterns gave us some interesting results. All of the polyester below-knee orthoses (AFO) we had been making for rigid ankles for the previous four or five years are now being replaced with polypropylene orthoses with ribs or corrugations placed anteriorly and posteriorly over the malleoli.

We also have converted all of our polyester pretibial shells on new above-knee orthoses with ones made of polypropylene and have found no problem in using copper or steel rivets to fasten this material to other parts.

The next step, to fabricate an above-knee orthosis completely from polypropylene, seemed logical, but as a private facility we were hesitant because of the necessity of "close follow-up" of the patient and the responsibility we must bear should anything go wrong.

Our decision was made when a patient we have served for nine years presented herself. She is a post-poliomyelitis patient, has a severe valgus condition at the knee and the ankle, and is overweight. She has had one pregnancy (with future ones possible) which had caused great problems while wearing her previous orthosis because of the increased girth in her thigh followed by a decrease in circumference in the post-pregnancy period.

Her prior orthosis, an AKO, consisted of an ischial ring, cam-lock knee joints (bail lock), a limited-motion ankle joint, and a molded leather sandal with metal foot plate.

With an eager patient and a cooperative and responsive physician, we proceeded.

Our goals were:

1. An orthosis that would be cosmetically more acceptable, just as the TIRR AFO was to the BK patients.
2. More comfortable fit and feel for the patient.
3. Lightness when compared to the conventional, previous orthosis.

At this time, we had two young orthotists who were preparing for the examinations given by the American Board for Certification, and who

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also were eager to show the prosthetists of our facility something evolutionary in orthotics.

When we finished, the orthosis weighed 3½ pounds. The result delighted the patient as well as our staff. The orthosis is completely washable, the patient is even able to shower while wearing the orthosis by wrapping a "Coban" bandage[3] over the foot and ankle complex. This secures the foot, as the shoe would, and presents a slip-resistant plantar surface.

The medial wall of the ischial socket was provided with a flare which made the polypropylene more rigid at the proximal aspect. We were not proficient in welding polypropylene, so we decided to simply lap the anterior aspect. This provided us with an interesting time during the fitting stage.

The patient was stable in the socket and we were made aware that the socket clung to the thigh in the push-off and swing phase of gait; and, on heel-strike, the seat acts as a shock absorber rather than as a source of shock to the ischial tuberosity and associated tissues. The comfort experienced in stance and swing phase of gait was very gratifying.

We also elected to keep the socket as a lapjoint in order that it might expand with increase of weight and, in so doing, not give the feeling of constriction.

The only fastener on the orthosis is the posterior closure of the pretibial shell.

We did make mistakes. Our first was to make an overzealous manual correction of the valgus knee. At the fitting we gave way to patient comfort, and sacrificed esthetics by allowing some valgus at the knee.

Another mistake was in not providing horizontal ribs in the proximal third of the femur section, and, in order to provide rigidity to assure maintenance of joint alignment, an inverted "U-type" reinforcement of stainless steel was needed. This arrangement is very similar to that used in the Fillauer prefabricated ischial sockets. This, of course, means that an orthosis constructed without this reinforcement will weigh even less than 3½ pounds.

After delivery we noted a slight "plastic-squeak" on the anterior part of the ischial thigh shell. This was solved by fastening a piece of ⅛-inch thick Plastizote with Barge cement under the surface that was offending. This does not detract from the original appearance because it acts as an interface.

For our first try it would have been easier to have a patient who preferred drop locks. Cosmetically, the bail lock detracts from the beauty of this orthosis, especially when using an inverted "V" elastic strap to close the bail.

We, in our laboratory, have dubbed this the polypropylene Ischial-Thigh-Knee-Ankle (ITKA) orthosis.

FABRICATION

A plaster negative cast from the ischium to the plantar surface of the foot is made, and in turn a positive model is made. We found that it was not necessary to use casting brims. By using the Fillauer A-P measuring stick, closing it with "just firm" pressure and holding it while it is wet and still on the patient until the plaster has set, a good usable cast can be obtained. After any necessary corrections are made to the positive

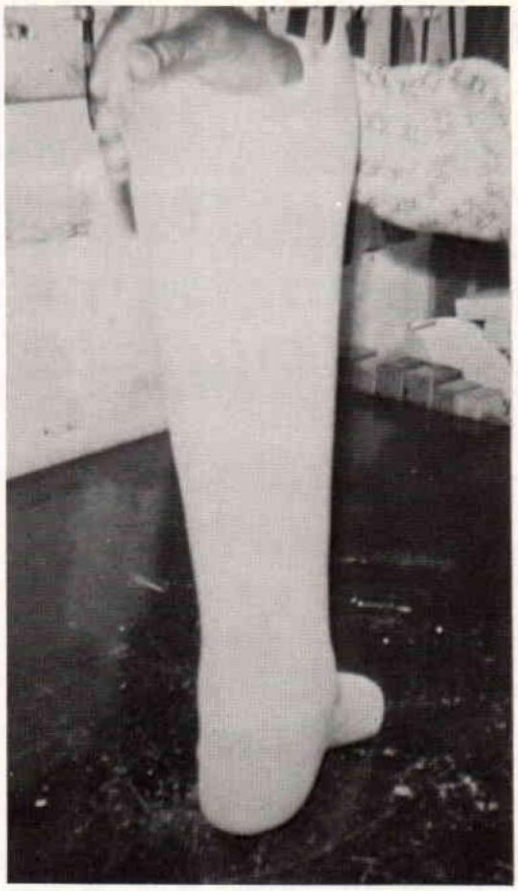

Fig. 1. Polypropylene foot-ankle section.

[3]Made by 3M Company. "Coban" is similar to an Ace bandage but is made of plastic fibers.

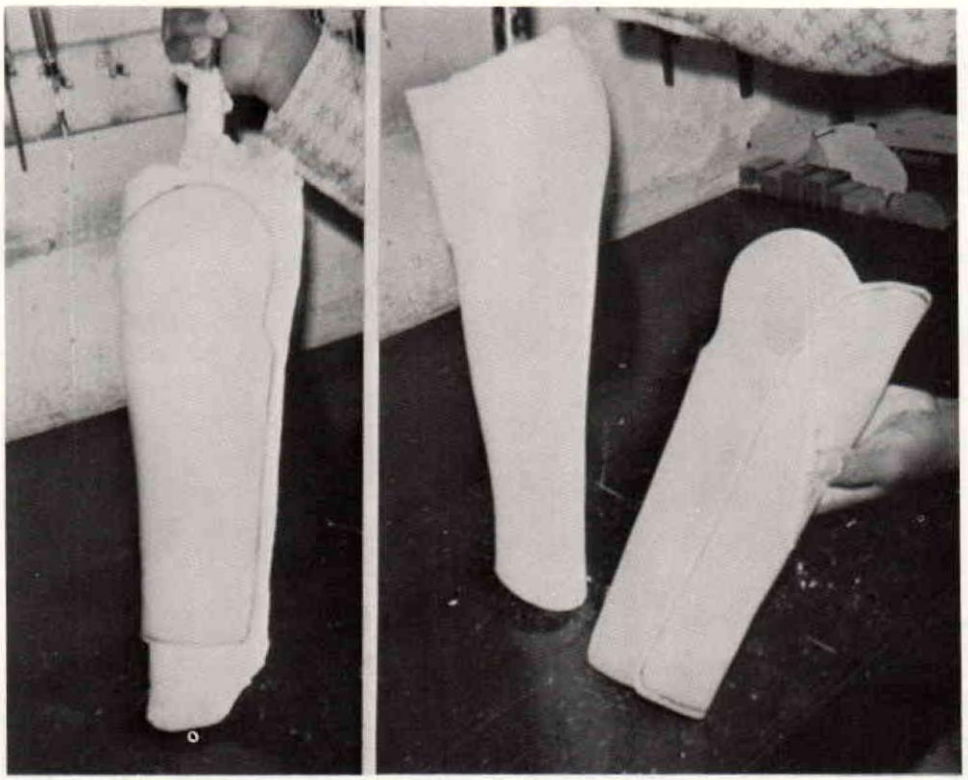

Fig. 2. *Left*, molded pretibial shell on positive model; *right*, same shell removed from the positive model.

model, the fabrication can be initiated even over a wet cast.

The BK section is made in accordance with the instructions given in an article by Engen in the December 1972 issue of Orthotics and Prosthetics (2) and in his manual on application of the TIRR orthosis (Fig. 1).

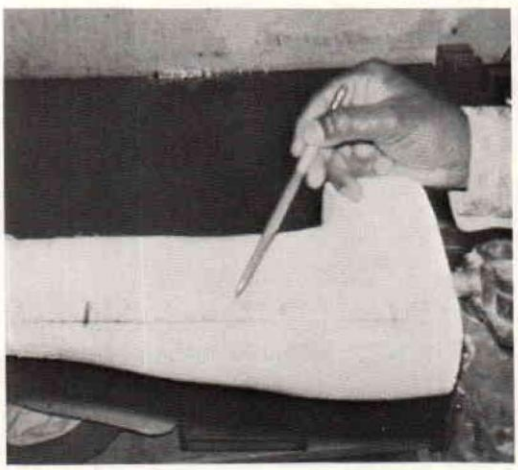

Fig. 3. Vertical anterolateral line on the positive model.

After the ankle-foot part has been finished, the pretibial shell is molded (Fig. 2).

Molding of the ischial thigh section should be done by starting the polypropylene on a vertical line anterolaterally (Fig. 3) and pulling medially, then posteriorly, following around the circumference until the originating edge is met. At this time, and very quickly, an assistant generously powders the anterior section already completed and to be overlapped so that the polypropylene will not adhere to itself. The polypropylene is brought around to meet a vertical line that dissects the medial third of Scarpa's triangle (Figs. 4 and 5).

The positive model and the three polypropylene sections are shown in Figure 6. Each of the three sections is trimmed and placed back on the cast (Fig. 7). Any of the jigs developed for cast bracing may be used in shaping the uprights.

After the plastic components are placed back on the positive mold in the original position, a

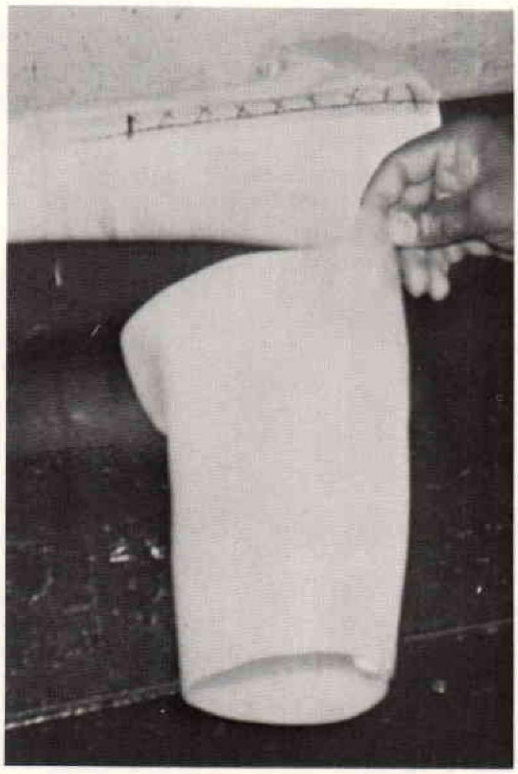

Fig. 4. Molded ischial thigh shell.

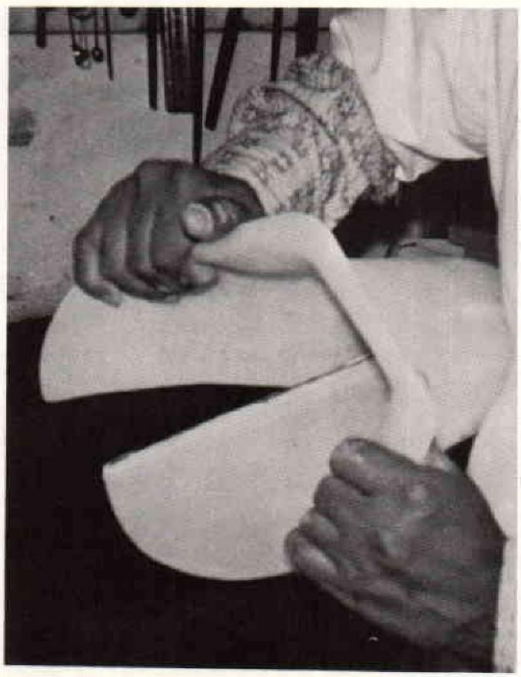

Fig. 5. The spring-like tension qualities of ischial thigh shell are shown here.

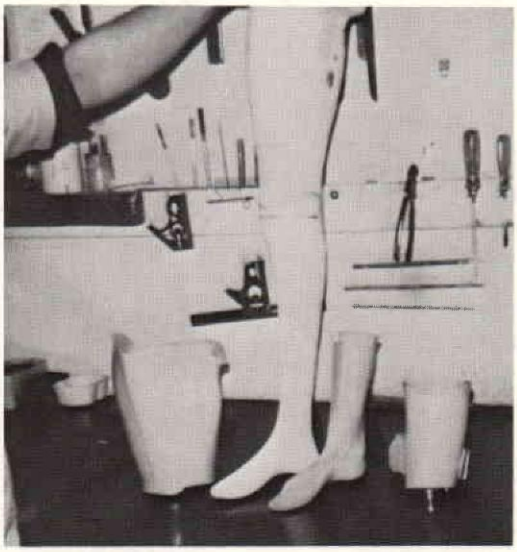

Fig. 6. Positive model with plastic components shown on the bench.

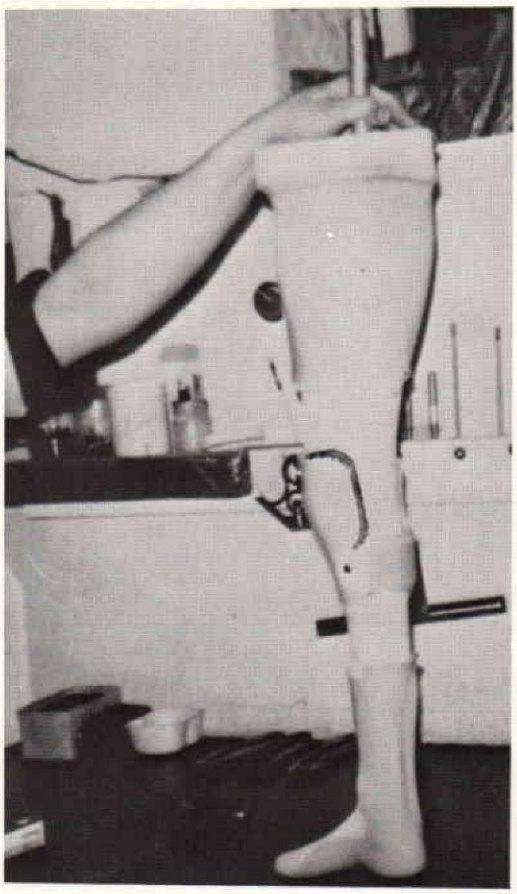

Fig. 7. The three plastic sections replaced on the model after completion.

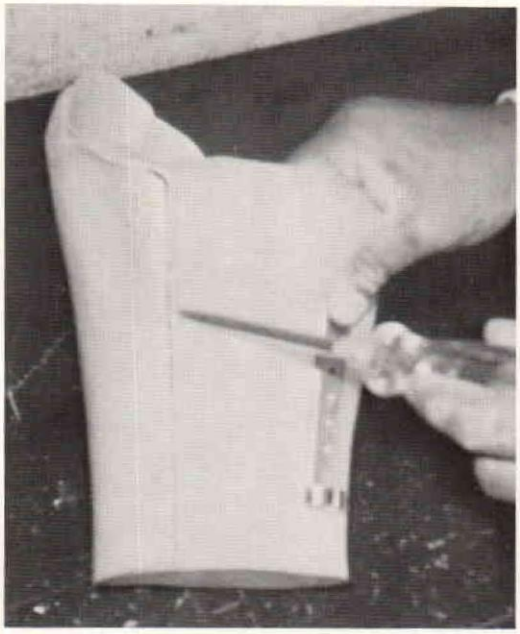

Fig. 8. Anterior view of ischial thigh socket with overlap.

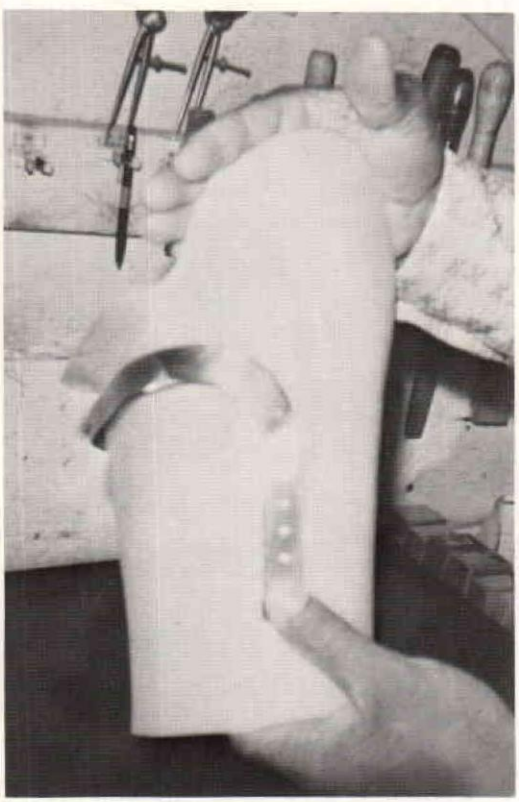

Fig. 9. Lateral view of socket with inverted "U-type" reinforcement piece.

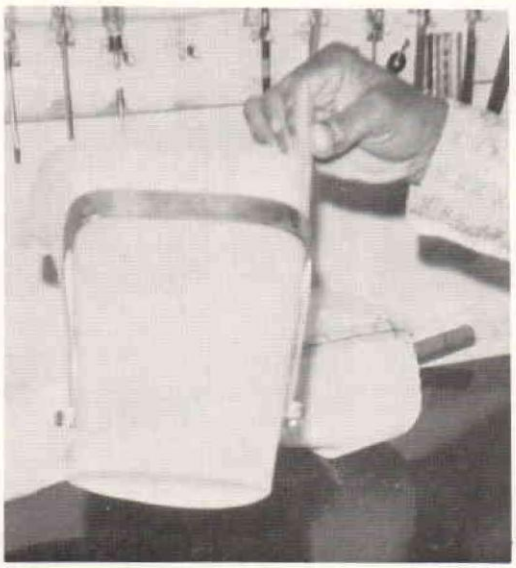

Fig. 10. Posterior view of socket and reinforcement parts.

Fig. 11. Completed plastic sections on model alongside of the metal frame.

pattern is made for the inverted "U-type" reinforcement made of stainless steel. After shaping the straps over the plastic socket, it is attached temporarily with two rivets only. In the definitive orthosis four rivets have been found to be adequate (Figs. 8, 9, and 10). Of course, corrugations in the polypropylene should eliminate a need for the inverted "U" strap.

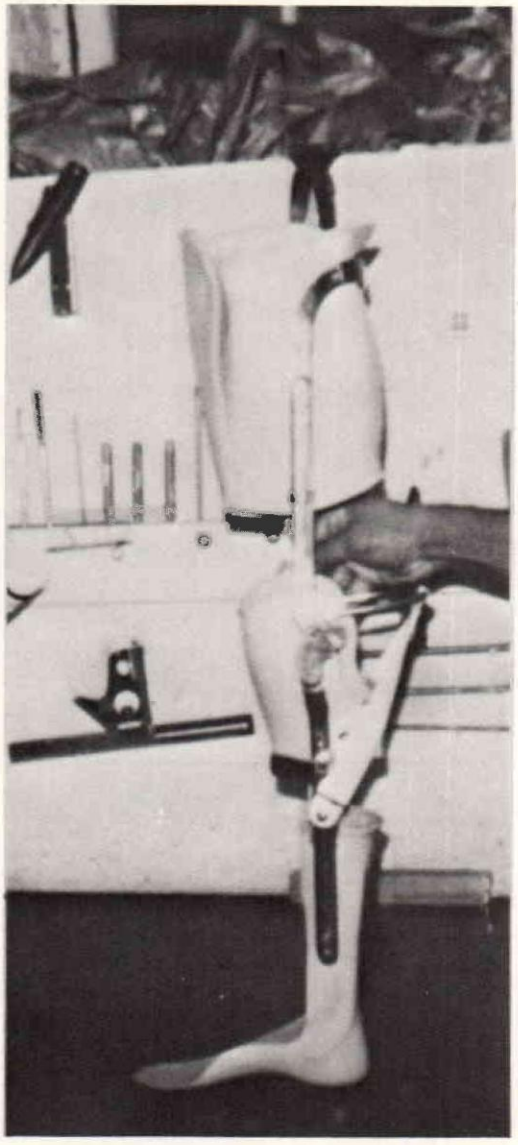

Fig. 12. Completed ITKA orthosis.

Small diameter copper rivets are used to attach the uprights temporarily to the three sections for fitting purposes. After the initial fitting all components are rechecked and an anterotibial band is made and riveted to the exterior surface of the uprights. The metal frame is now complete (Fig. 11).

All plastic sections are riveted to metal uprights. The alignment of the knee joint is rechecked to insure proper function of the bail lock. An inverted "V" elastic strap is attached to the bail and secured to the below-knee uprights with screws (Fig. 12).

A Velcro strap is used to provide closure of the pretibial shell on the orthosis. The only padding used was a piece of ⅛-inch thick Plastizote on the ischial thigh socket as mentioned earlier to prevent plastic squeak, and another piece on the Velcro strap used to close the posterior of the pretibial shell.

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