Technical Note:

A Reinforcing Technique In Orthotics and Prosthetics

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Since the advent of sheet plastics and its utilization in the field of Orthotics and Prosthetics, many new innovative devices have been developed. The plastic custom molded ankle foot orthosis (AFO) and knee ankle foot orthosis (KAFO) come to mind quickly when referring to such devices.

However, along with these advanced techniques in the field have come certain areas of frustration. The problem of rupturing of the plastic device in high stress areas is one of the problems, but there are others, such as memory retention of the plastic sheet after the vacuum forming process and the plastic being flexible during certain phases of gait when flexibility is not desired.

Obviously, discontinuing the use of sheet plastics in orthotics and prosthestics is not being suggested, but only that certain areas need to be improved.

Several techniques of reinforcing have been used in the plastic rigid ankle foot orthosis (AFO). One type which utilizes metal struts at the ankle was developed at Rancho Los Amigos Hospital.[1] Also, similar to the Rancho style, is one which uses carbon composite inserts instead of metal.[2] These systems are extremely effective when rigidity of the ankle is desired. However, there are other areas which can be reinforced quickly and effectively using the left over portions of polypropylene.

The orthotist-prosthetist at his discretion determines the location, thickness, and width of the plastic strip desired. Recommended steps in actual fabrication are stated below using the overlapping procedure.

- Take the necessary steps and prepare the modified positive mold for drape vacuum forming process. NOTE: It will be assumed by the reader that all processes described in this article refer to the drape molding process.
- Decide where the strips of plastic will be located and measure exact circumference. Cut the strip only as long as the circumference.
- Select the width and thickness desired for the strip.
- Bevel edges lengthwise if desired for a more cosmetic effect.

- Measure and cut the main piece of polypropylene.
- Spray a parting agent on the non-beveled side of strip.
- Place pieces of material on the plate with the parting agent down. Place beveled side of the strip up. (Fig. 1)
- After the plastic has been heated to its proper forming state, remove metal sheet from the oven.
- Pick up strip of the heated plastic and place where previously marked. Twist end into place and work quickly (use powder on gloves) (Figs. 2a and 2b).
- Secure large sheet and form over strip as quickly as possible without moving the extra strip. Note: It is advisable that two knowledgeable people attempt this process (Figs. 3a and 3b).
- After sealed and air is evacuated, remove excess material from the mold. Process is now completed (Fig. 3b).

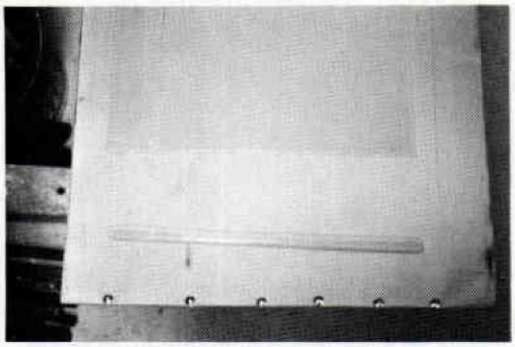
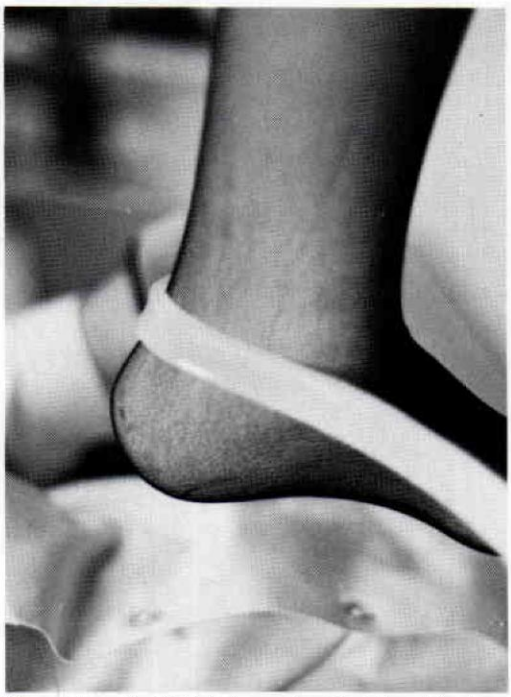


Fig. 1—Main sheet of plastic with 7/8" x 3/16" strip with beveled side up. Note: beveling the strip makes a more cosmetic look to the finished device.

Advantages:
* Cosmetically acceptable
*More durable
*Inexpensive as far as material cost
*Lightweight compared to metal reinforcement
*Inhibits spreading of the plastic away from positive mold after the forming process



Figs. 2a and 2b—Strip is placed over apex of the medial and laterial malleoli. It is important that the strip does not move during the forming process.

Fig. 3a—Large sheet is placed over heated strips on a posterior section of a floor reaction orthosis.

Fig. 3b—Complete forming process on an ankle foot orthosis.

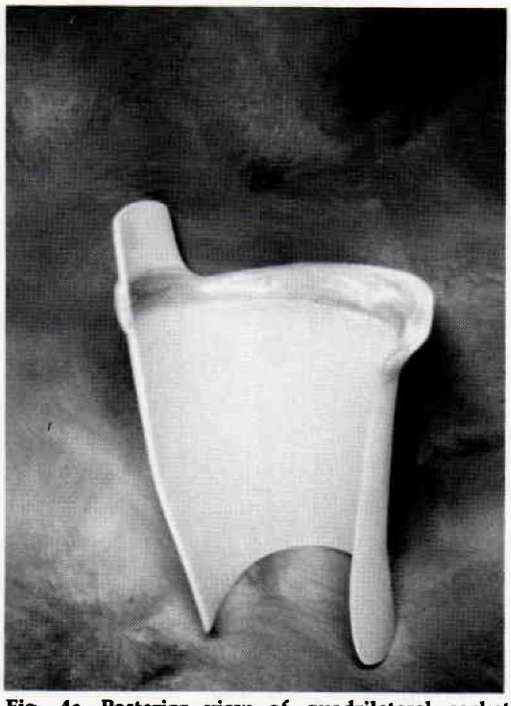


Fig. 4a—Posterior view of quadrilateral socket. Darkened area shows area of concentrated reinforcement.

Fig. 4b—Anterior view of quadrilateral socket (posterior section).

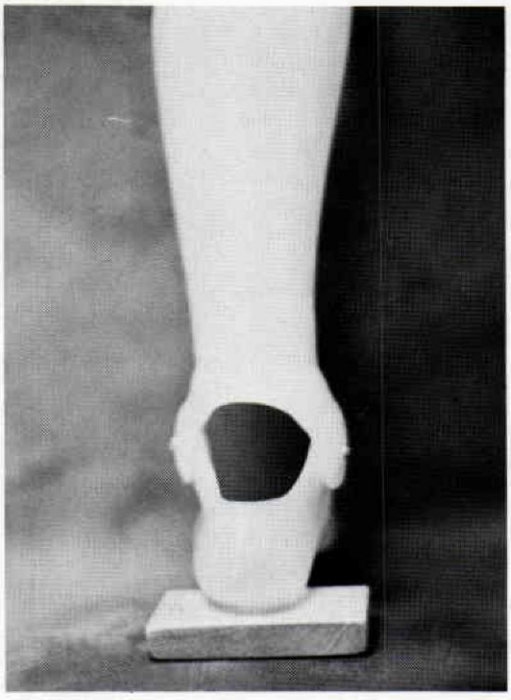


Fig. 5—Reinforcement over and articulated AFO.

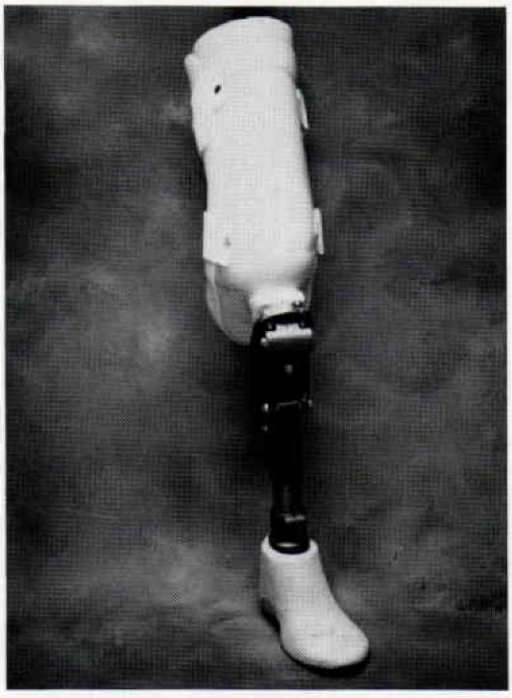


Fig. 6a—Reinforcement of an anterior section of a temporary prosthesis.

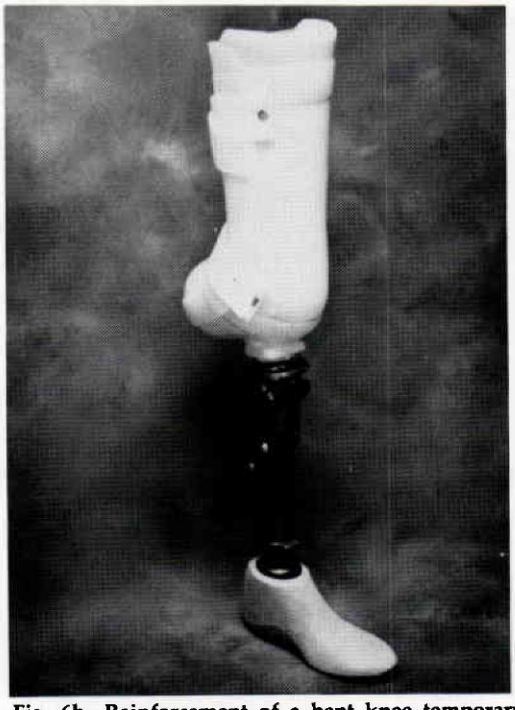


Fig. 6b—Reinforcement of a bent knee temporary prosthesis. One layer is distal and the other is proximal.

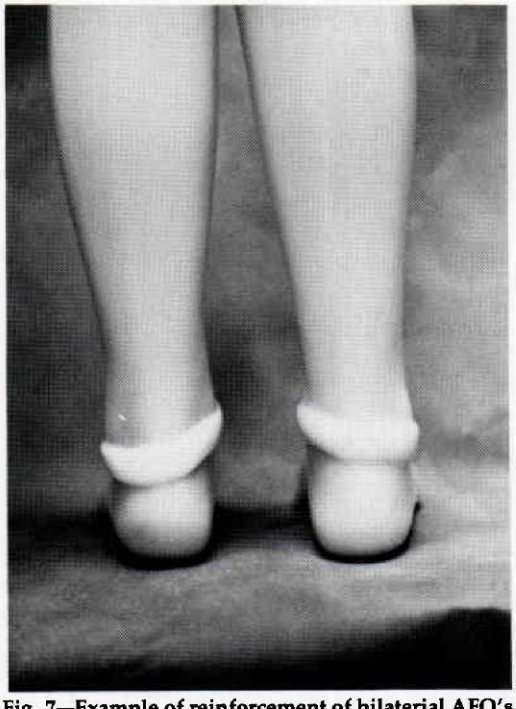


Fig. 7—Example of reinforcement of bilaterial AFO's for a patient afflicted with ALS.

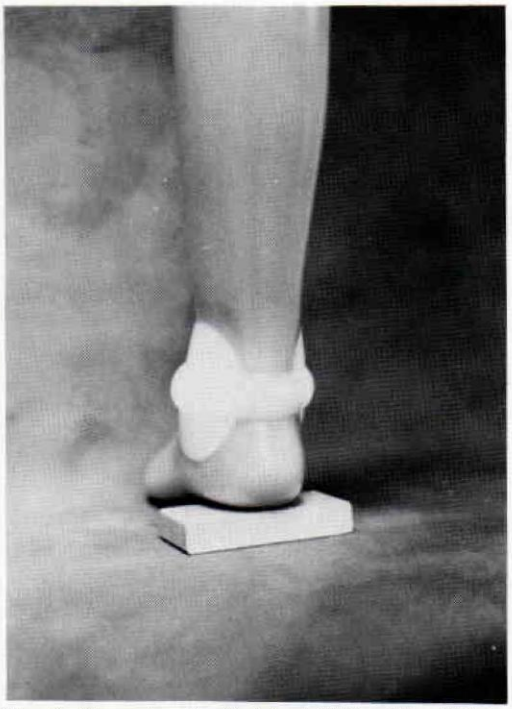


Fig. 8—Example of a finished AFO with a ¼" beveled reinforcement for a CVA patient.

*Plastic may be removed sooner after vacuum forming

Disadvantages:

*More skill with a greater risk of error in forming process

*More difficult to change M-L of the orthosis

*Only adaptable when wrapping circumferentially

*More preparation before vacuum forming

For the past three years the overlapping reinforcing technique has been utilized on many different devices. Some of these other than the ankle complex of the plastic molded ankle foot orthosis (AFO) have been: the calf of the leg in a single upright knee ankle foot orthosis (KAFO) and ankle foot orthosis (AFO), the gluteal area of a quadrilateral socket in prosthetic and orthotic cases (Figs. 4a and 4b), over knee and ankle hinges of KAFO and AFO (these hinges were both plastic (Fig. 5) and metal articulations). Anterior forms have been reinforced in orthotics and used to attach plates for below knee and above knee pylons (Figs. 6a and 6b).

We must emphasize that we do not use this technique in all cases, nor are we suggesting that anyone else do so. We are also not suggesting that we have solved all of our problems by using this technique. But, what we are proposing is a system which might be helpful to orthotists and prosthestists who work extensively with sheet plastics.

REFERENCES

[1]Darrell R. Clark, Thomas R. Lunsford, Reinforced Lower-Limb Orthosis-Design Principles, *Orthotics and Prosthetics*, (32:2:35-45, 1978)

[2]Carlton Fillauer, C.P.O., A New Ankle Foot Orthosis With A Moldable Carbon Composite Insert, *Orthotics and Prosthetics*, (35:3:13-16, 1981)

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