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An
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Journal
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THE JOURNAL OF THE
ORTHOTIC AND PROSTHETIC PROFESSION

VOLUME 25
NUMBER 3
SEPTEMBER 1971

Editor
Audrey J. Calomino

Orthotics and Prosthetics: The Orthopedic and Prosthetic Appliance Journal is issued in March, June, September and December. Subscription price, payable in advance, is $6.50 a year in the Western Hemisphere rate elsewhere is $7.50 a year. Publication does not constitute official endorsement of opinions presented in articles. The Journal is the official organ of its publisher, The American Orthotic and Prosthetic Association. All correspondence should be addressed to: Editor: **Orthotics and Prosthetics,** 1440 N St., N.W., Washington, D.C. 20005. Telephone, Area Code 202, 234-8400.

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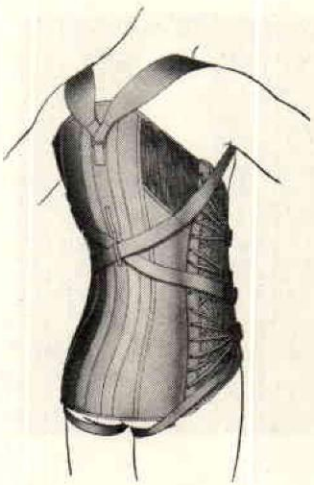

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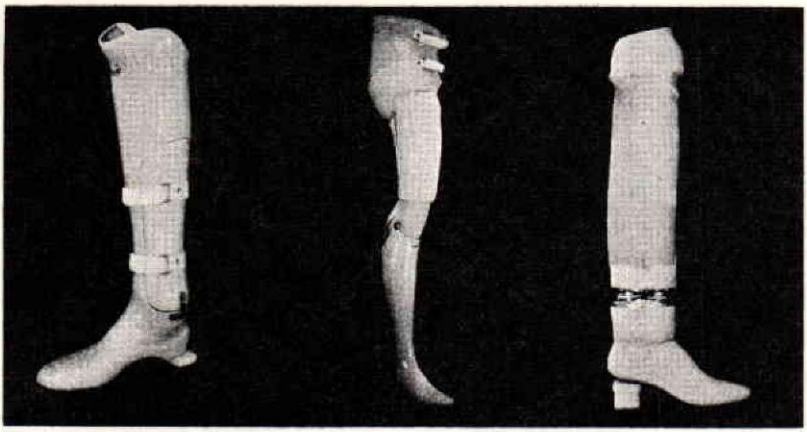

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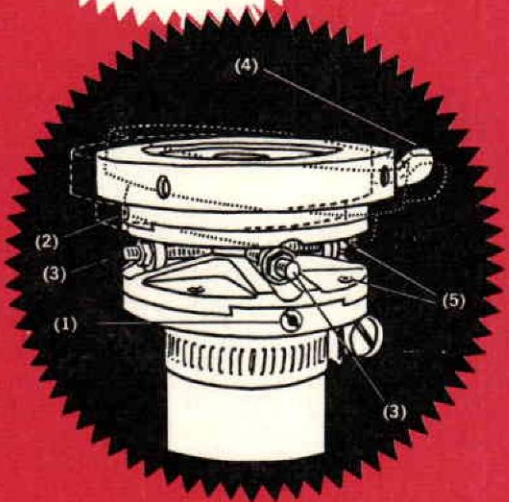

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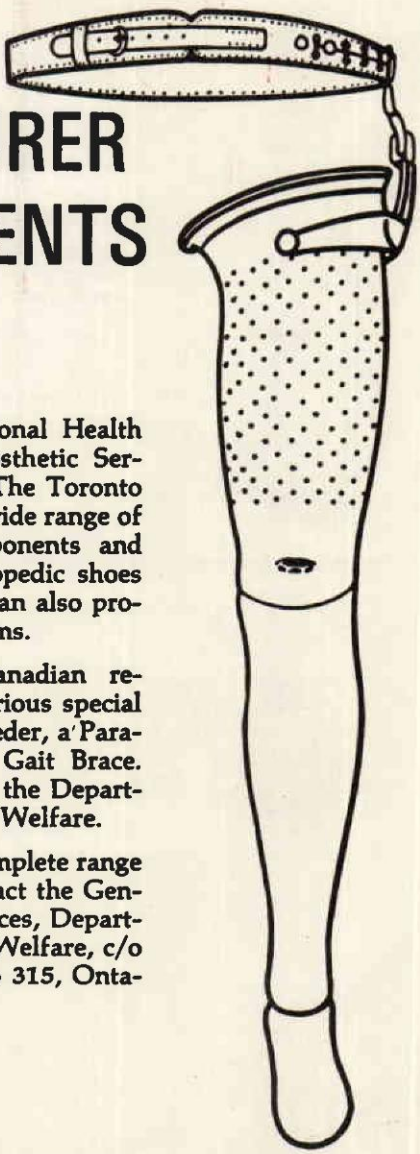

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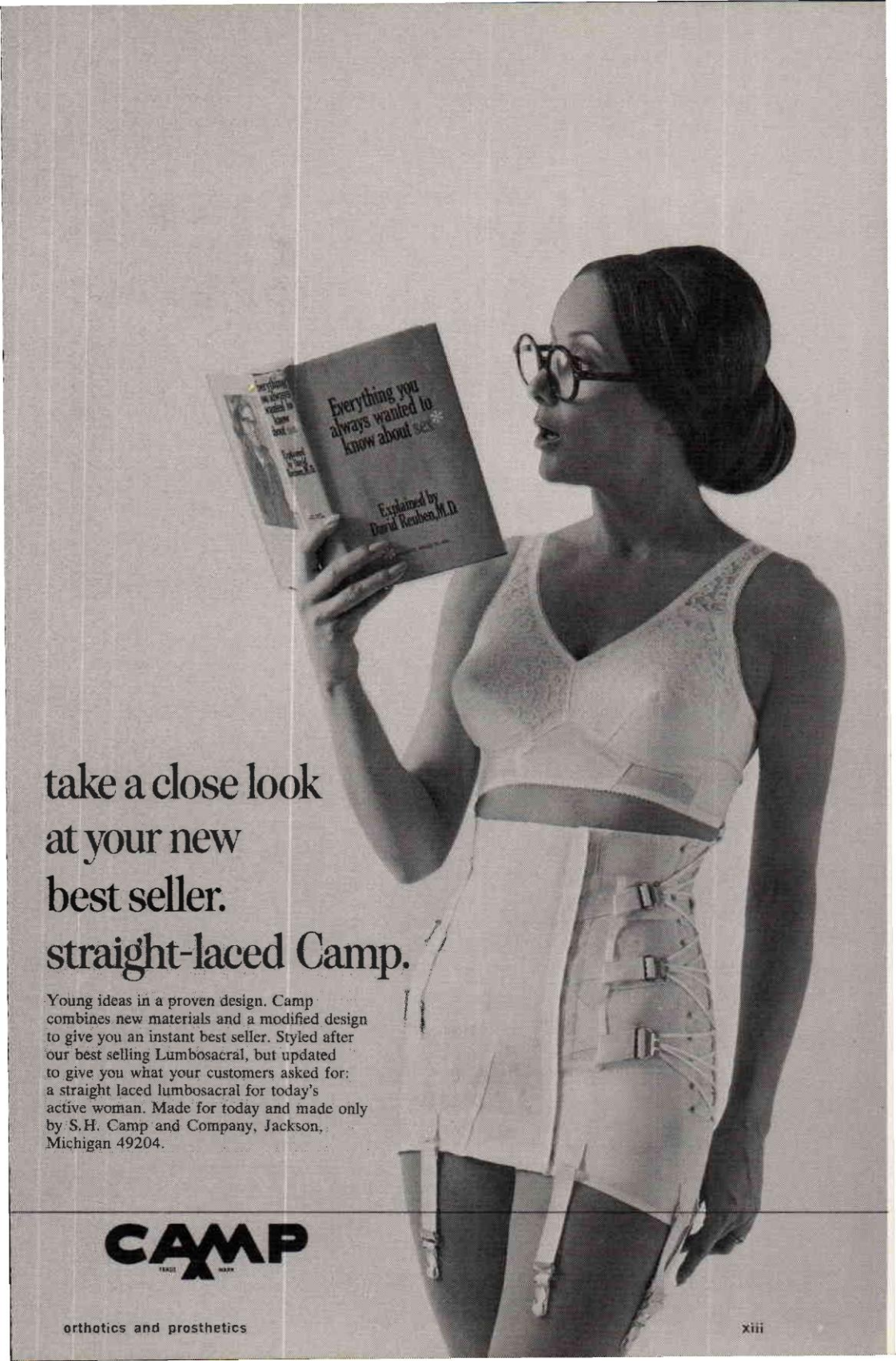

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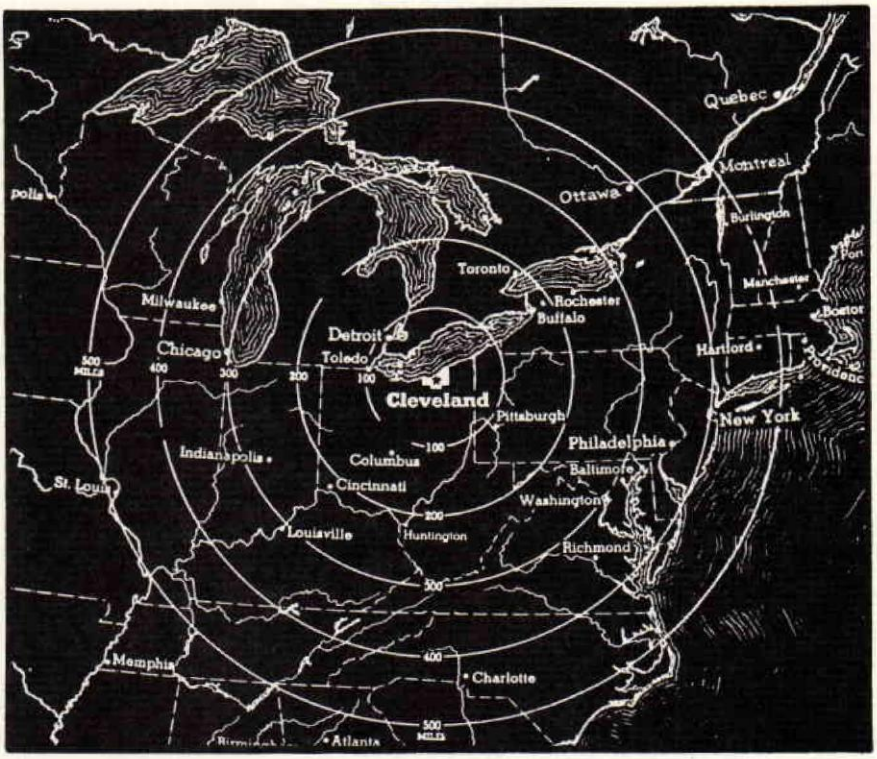

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Elastic Knee Control

by Robert E. Fannin, C.O.

Introduction

Most knee orthoses are designed to control medial and lateral instability, recurvatum, and some knee flexion weakness. One major problem that arises in knee braces is keeping them in a functional position. A waist belt with a suspension strap or an extension to the shoe can be added to help control this problem. If a severe knee problem is present, a knee brace alone is usually not sufficient, and an above-knee orthosis should be used.

A knee support that does not present the problem of staying up on most patients is the elastic type with reinforcements. A mistake made by most practitioners when designing this type of support is that they make the elastic too short and the reinforcements too soft and flexible. Another serious problem is that most elastic knee supports are taken off a shelf or out of a box and put on the patient; in nine cases out of ten a good fit is impossible because an exactly fitting support is not available, and what is at hand is considered to be "close enough." For a correctly fitting elastic knee support, the patient should be measured and then the elastic support made to fit those measurements if a stock model does not fit.

Many types of reinforcements are used with elastic knee supports. These may be plastic or metal stays, spiral stays, or jointed uprights. Most of the time, the stays are used to prevent the elastic from wrinkling or rolling down, and actually give very little support. The jointed uprights are designed to give good medio-lateral support, but they do little to restrict flexion extension motion. Most commercially available elastic knee supports with medio-lateral jointed uprights made today

Anterior View
Figure 1(A)

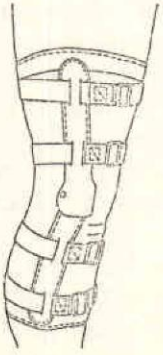
are too short and the uprights are too short and malleable. This would be a problem if a patient were going to wear this support while participating in sports. Two views of a properly designed elastic knee support are shown in Fig. 1(A) and (B).

Fabrication Procedures

An illustrated procedure, from measurement of the patient through application of the orthosis to the patient, follows.

Tracing and Measurement

1. Make a tracing of the affected knee in the same manner as for an above-knee orthosis except that the foot need not be included.



Lateral View
Figure 1(B)

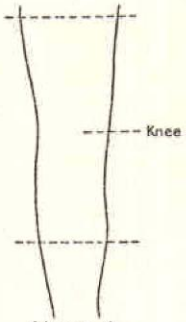


Figure 2

2. Place marks on the patient's leg at mid-thigh, ¾ inch superior to the medial tibial plateau, and at mid-calf. The upper and lower marks should be equidistant from the mark on the knee. Measure, and record length on tracing.

3. Take circumference measurements at (1) mid-thigh, (2) midway between mid-thigh and knee, (3) at the knee, (4) at the tibial protuberance, (5) at the widest part of the calf, and (6) just below the calf for the distal measurement. Record circumferences on the tracing.

Note: Record measurements on Order Chart, and order elastic. When it is received, start fabrication. (A typical order chart is shown here.)

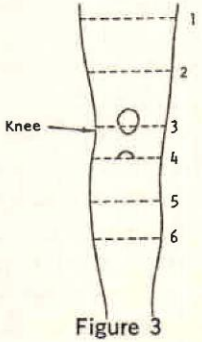
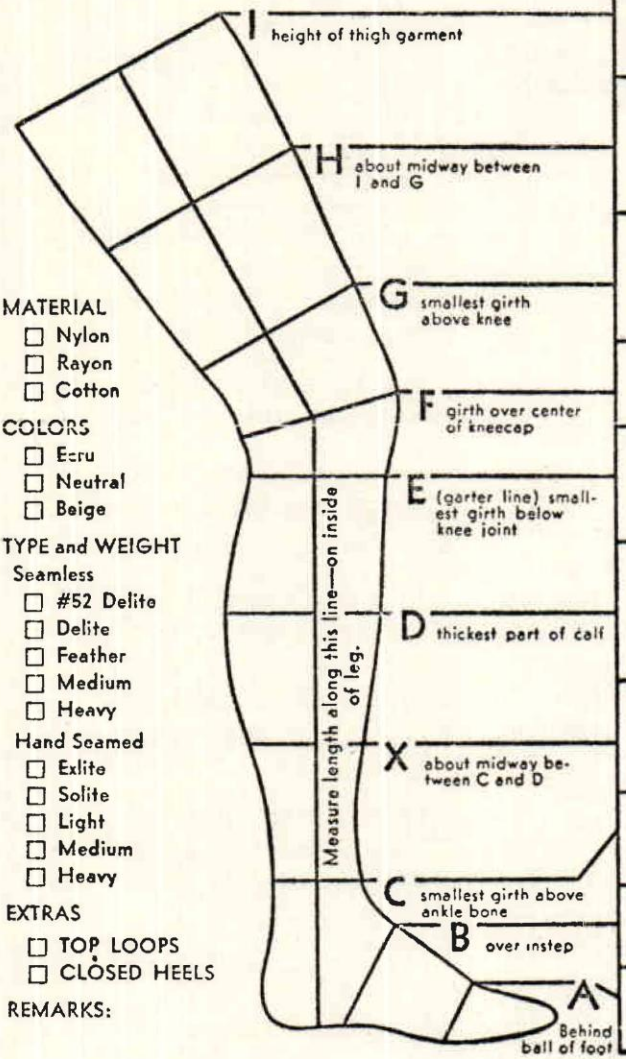


Figure 3

In taking measurements, check dimension at each point indicated on diagram, measuring not only circumference, but also length from base line to point at which each circumference is taken. On length measurements up to and including F, the floor is base line; on length measurements above F, center of knee-cap (point F) is base line. All length measurements are taken along INSIDE OF LEG; make sure that measurements for length and circumference are taken at exactly the same point. Accurate length is as important as accurate circumference.

MARK ALL DETAILS ON THIS SHEET Check type of garment desired. Weight; Color. Check Right or Left leg. Then measure leg at points indicated on diagram, taking measurements of both circumference and length.

MAKE YOUR MEASUREMENTS ACCURATE
We allow for normal compression
If extra compression is required note under "Remarks"



	CIRCUMFERENCE		
	RIGHT	LEFT	LENGTHS
I	I	I	F to I
H	H	H	F to H
G	G	G	F to G
F	F	F	Floor to F
E	E	E	Floor to E
D	D	D	Floor to D
X	X	X	Floor to X
C	C	C	Floor to C
B	B	B	A to B
A	A	A	

MATERIAL
- ☐ Nylon
- ☐ Rayon
- ☐ Cotton

COLORS
- ☐ Ecru
- ☐ Neutral
- ☐ Beige

TYPE and WEIGHT

Seamless
- ☐ #52 Delite
- ☐ Delite
- ☐ Feather
- ☐ Medium
- ☐ Heavy

Hand Seamed
- ☐ Exlite
- ☐ Solite
- ☐ Light
- ☐ Medium
- ☐ Heavy

EXTRAS
- ☐ TOP LOOPS
- ☐ CLOSED HEELS

REMARKS:

Ship to:..... Order No.....

Address..... Date.....

Figure 4

Fabrication of Jointed Uprights

4. Make a pattern of the upper and lower parts of the knee joints. (A permanent pattern of this joint may be kept on file for use when needed.) The total length of the uprights should be 1 inch less than the length of the elastic. They should be 1⅛ inches wide at the joint, tapering to 11/16 inch at the end.

Mark location of joint centers.

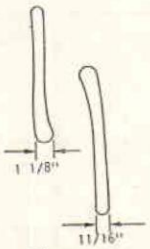


Figure 5

5. Cement the patterns to duraluminum sheeting of proper gauge, or trace around them if they are permanent patterns. For the average patient, the duraluminum should be of .100 thickness; use .125 for a large or very strong patient.

Cut out; finish edges.

6. Center-punch and drill ¼-inch holes for joint centers.

7. Rivet the joints together, using large-headed rivets. The heads should be as thin and smooth as possible. Put the heads of the rivets on the outside of the joint. Put thin brass or nylon washers between the two parts of the joint and under the rivet head.

Peen over the rivet at the inside of the joint to make it smooth as possible.

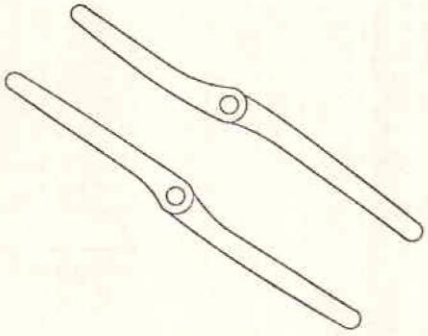


Figure 6

8. Shape the uprights to the tracing. Unlike those for a regular leg brace, these uprights should be fitted accurately to the tracing, allowing only for bony prominences, such as the head of the fibula.

9. Clean the parts and finish the metal (polish, sandblast, wirebrush, etc.).

Fabricating the Elastic Knee Control

10. Fold the elastic lengthwise, anterior to posterior, exposing one side.

11. Locate the center from top to bottom, and mark as shown in Fig. 7.

12. Center the uprights and joint on this center-mark and, using a pencil, draw lightly around both


Figure 7

Figure 8

ends of the upright to about 1½ inches above and below the joint center. (Fig. 8)

13. Repeat Step 12 on the opposite side of the elastic for the other joint. Then transfer the markings to the inside of the elastic to establish location of the padding.

The line can be transferred by inserting a sharp pencil or other sharp-pointed instrument through the elastic at intervals along the line, and marking the points where the instrument emerges on the inside. Then these points can be connected by a pencil line on the inside.

14. Using 3- or 4-ounce elk leather, cut a cover for the above-knee part of the upright, with a flap to cover the joint, as shown in the sketch. Allow enough extra width to sew a double row of stitching around the upright (see pattern shown in Fig. 9).

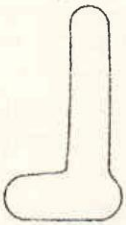


Figure 9

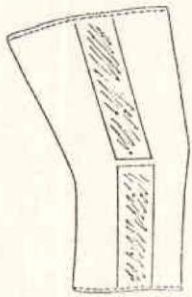


Figure 10

15. Make a leather cover for the below-knee part of the upright, again allowing enough leather to sew a double row of stitching around the upright.

16. Cut four pieces of white wool felt ⅛ inch thick. Two of these are to pad the above-knee uprights and two, the below-knee portions. Allow enough width to run a double row of stitching around the uprights.

Note: The felt serves two purposes. It reinforces the stitching, and also protects the patient's leg against pressure from the metal joints.

17. Apply rubber cement to one side of the felt pieces, and allow it to dry.

18. Turn the elastic inside out. Apply a coat of rubber cement to the areas marked in Step 13. When the cement is dry, stick the felt strips to the elastic. Then turn the elastic right-side out.

19. Apply a ¼-inch line of rubber cement around the joint markings on the elastic made in Step 12.

20. Apply rubber cement to a strip about ¼ inch wide around the edges of the unfinished side of the leather joint covers.

Figure 11

21. Hold the above-knee portion of the joint cover over the joint.

Fold the joint flap under as shown in Fig. 11. Stick the joint flap together and fasten it with a speedy rivet. Repeat for second upright.

22. When the cement is dry, stick the joint covers to the elastic with the joints in position.

23. Run two rows of stitching around the uprights. Sew as closely as possible to the uprights, for a snug fit.

Trim off excess leather if necessary. Also trim off excess length of white felt padding.

Note: No rivets are used to hold the joints in place. This permits joints to be removed so that the elastic can be laundered. Also, the patient can have two elastics and one pair of joints, permitting a change without duplicating the joints.

Elastic Straps

For greater stability, four 1-inch elastic straps can be added: two above-knee (one at the top of the upright and the other just above the knee) and two below the knee (one just below and the other at the bottom of the upright). Following is the procedure required:

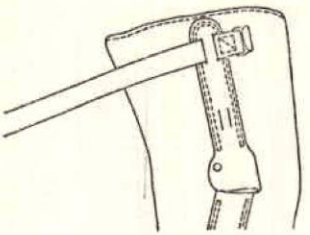


Figure 12

24. Cut four straps of heavy 1-inch elastic. The required length is the circumference at the level of each strap plus 5 inches.

25. Fold over the end of the strap twice, approximately 1 inch each time, with a buckle hook in place. Then stitch.

Note: Strap stays may be fabricated of lengths of plastic tubing cut to size.

26. Put a tip on the other end of each strap. The tips may be made of metal, plastic, or wax.

27. Cut slots in the upright covers at the level of each strap. The slots should be wide enough to accommodate a 1-inch strap. They should be paired at each upright, as shown in Step 28.

28. Insert finished straps in slots. Start from lateral anterior to posterior, passing around the back of the leg, through the medial posterior to the anterior, over the front of the leg, to the buckle and hook.

Apply support to patient.

The completed elastic knee control is shown in Fig. 13.

Figure 13

The CAPP Adjustable-Friction Wrist Unit

by
Carl Sumida, C.P.O. *
and
Julie Shaperman, M.A., O.T.R. **

Introduction

A plastic adjustable constant-friction wrist rotation unit has been developed at the Child Amputee Prosthetics Project, UCLA, under Grant #C-199 from the Department of Health, Education and Welfare, Children's Bureau. This wrist unit was designed by Carl Sumida, and has been tested at CAPP and fourteen other clinics. This is the final report on the development and testing of the unit.

* Research Prosthetist, Child Amputee Prosthetics Project, UCLA.
** Research Occupational Therapist, Child Amputee Prosthetics Project, UCLA.

DESIGN FEATURES

The design features of this wrist unit are illustrated in a diagram of a cross-section of the unit (see Figure 1) and the specifications as listed in Table I.

DESIGN REQUIREMENTS

One objective of the design was to provide smooth even friction around the entire circumference of the stud of the terminal device. To achieve this, two slots were designed into the threaded portion of the plastic. These slots extend approximately halfway through the thickness of the plastic, and provide the needed displacement to increase

CROSS SECTION OF THE WRIST UNIT

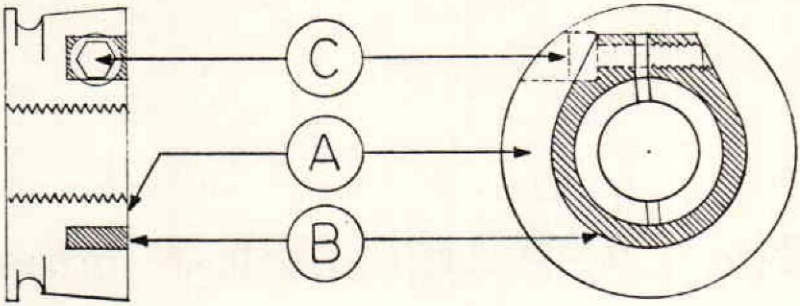


Figure 1

Side View End View

A. Main Body

B. Ring Clamp

C. Friction Adjustment Screw

TABLE I

Material	Delrin (natural color): product of E. I. DuPont de Nemours and Co., available from plastics distributors.		
Ring Clamp	Aluminum 356, heat-treated and anodized		
Adjustment Screw	Socket head screw, 6/32 x ½"		
Adjustment Wrench	Allen wrench, size 7/64"		
Sizes (diameter)	1½"	1¾"	2"
Weight (ounces)	0.78	1.16	1.48
Thickness	⅝" — all sizes		
Internal Thread	½ x 20		

or decrease the friction as the adjustment screw is turned to close or open the ring clamp. A relatively gross turning of the Allen screw changes the friction in small increments. Furthermore, these slight changes in friction are evenly distributed around the stud of the hook, allowing the amputee to easily and accurately select the precise amount of friction he desires.

Other design objectives were to provide a unit that would be low in cost, lightweight, and require minimal maintenance. The use of Delrin plastic and the simplicity of the de-

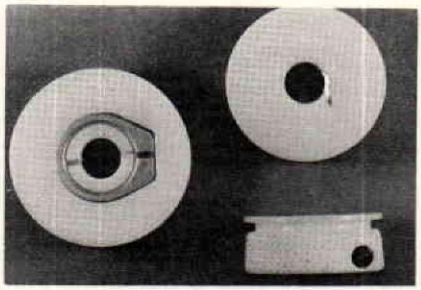


Figure 2

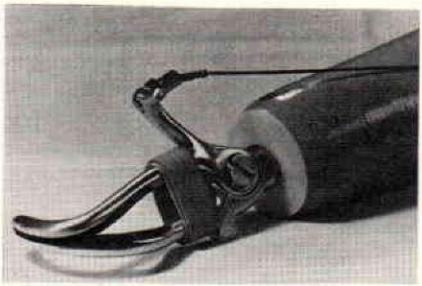


Figure 3

sign have resulted in a lightweight unit which can be easily and inexpensively produced and should pose minimal maintenance problems (see Figures 2 and 3). This unit can be fabricated into any prosthesis; however, because of its light weight it is especially useful for the amputee with a short stump — for whom weight at the distal end of the prosthesis is often a problem. Furthermore, the development of this unit is consistent with the shift toward more use of plastics in prosthesis design.

FABRICATION

A procedure for fabricating the plastic wrist unit into a prosthesis was developed during the test period. The major change from conventional fabrication technique is that the back of the wrist unit must be carefully protected from filling with laminate or plaster. At CAPP, the technique used is to cover both flat surfaces of the unit with two layers of masking tape, and to plug the adjustment screw hole with modeling clay, wax, or crepe foam. The unit is then easily adaptable to any individually preferred method of fabrication. The position of the adjustment screw must be well marked before pouring the plastic laminate. After lamination, the hole for the adjustment screw must be cut out.

Reports from several prosthetists who have used the plastic wrist unit reveal that each has developed his own method of protecting the back of the unit, adapting it to his own fabrication technique, and exposing the adjustment screw on the finished prosthesis.

CLINICAL EVALUATIONS

The Prosthetics and Orthotics Department of New York University has conducted a field test of the Delrin Wrist Unit, in which fourteen clinics fitted twenty-nine children between the ages of one and twenty-one years. The results of this test were published by Barbara Gehant [1] who states:

> "Therapists reported that ten of the children seldom or never pre-positioned their terminal devices, while nine children did so frequently. . . . In the units that were pre-positioned frequently, friction rarely or never required readjustment. Once the friction was adjusted for a particular terminal device, the unit maintained fine degrees of adjust-

ment. The only disadvantage mentioned was the need to release friction whenever one terminal device was interchanged with another.*

"All of the investigators praised the lightness of the unit; the Delrin units being approximately 50 percent lighter than the presently available wrist units of like size. Most respondents cited the smoothness and reliability of the friction and the superior cosmesis of the plastic wrist. The Delrin unit, when installed into the forearm, fits flush with the distal edge of the laminated forearm, leaving only the distal surface of the unit exposed."

The CAPP Evaluation. Over 150 of these wrist units have been fitted to patients at the Child Amputee Prosthetics Project at UCLA. All of these patients have been monitored for development of problems with this unit. Eighty-one patients (utilizing eighty-six units) participated in a very detailed evaluation program which included completing NYU data forms.

These eighty-one patients included thirty-seven males and forty-four females between nine months and twenty years of age. Three had bilateral prostheses requiring two wrist units; one child had two prostheses for the same extremity; one child had two wrist units on the same prosthesis (one was a shoulder unit), thus bringing the total number of units evaluated to eighty-six. The majority (fifty-eight) of the patients participating in the evaluation had unilateral below-elbow prostheses. All but twelve of the eighty-one patients wore their prosthesis full waking hours Thirty-three of the eighty-one patients prepositioned the terminal device frequently.

Results of the CAPP Evaluation

Problem: Of these 150 patients, very few had any problem with the wrist unit: all of the units remained functional for the life of the prosthesis, with only a few exceptions. Two minor problems were: 1) the need for cleaning or re-tapping (3 patients); and 2) the need to have the adjustment screw replaced because the slot in the screwhead was stripped (two patients). An additional problem occurred because eight units were damaged in central fabrication. Three of these required re-fabrication because plaster of paris had filled the back of the unit, freezing the adjustment mechanism. The other five could be cleaned enough to get adjustable friction, although they could not be tightened enough to lock out motion completely. If the back of the unit is filled with wax before sending it for central fabrication this can be avoided.

Only four other patients had problems with the unit, and these may have been due to negligence or extreme forces placed on the unit. One oiled the hook stud and then tried to forcefully tighten friction against it, causing the adjustment screw to break inside the unit. Two units were cross-threaded, and de-

* AUTHORS' NOTE: The requirement that friction be released when interchanging terminal devices was imposed by CAPP as a precaution against cross-threading, and was considered good practice for care and maintenance of any wrist unit.

veloped a crack across the face after one year. One other unit that was not cross-threaded developed a "wiggle" of the terminal device within the unit, and a slight crack after one year. A new hook reduced the wiggle somewhat, but could not eliminate it entirely.

Advantages: The Delrin wrist unit provides even pressure around the entire circumference of the stud of the terminal device, thus assuring smooth and even friction throughout the turning arc of the hook. The constant-friction wrist units formerly used produce friction by applying pressure at one point along the hook stud; this often results in a "bump" or uneven friction at some point in the turning arc. This unevenness disappears if the friction is tightened, but young children cannot turn their own hooks if this is done. At CAPP, this "bump" or uneven friction has often been traced to "out-of-round" hook studs. With the Delrin unit, even the flattened portions of the hook stud—although still perceptible—are less of a problem than with units that apply pressure only at one point.

Functional evaluation also confirmed an important design feature of this wrist unit: it permits fine degrees of friction adjustment. The child amputee often needs to achieve a balance between the amount of wrist friction small enough to allow him to turn the hook with his sound hand, but still great enough to prevent the hook from turning inadvertently from a pronated position when he places tension on the cable. Also, since the child ordinarily maintains minimal friction at the wrist, any variation in the amount of friction when the hook is in different positions is more noticeable.

Conclusions from the CAPP Evaluation. From an evaluation of 150 patients wearing this unit for periods of time ranging from three to eighteen months, it was concluded that the unit meets the design criteria and provides excellent function for the child amputee. This lightweight, simple design has been very well received by the patients and prosthetists in the Southern California area who have used it.

The smooth, constant friction around the full circumference of the terminal device stud was maintained at an optimum level over long periods of time. Few problems were encountered, and those related to fabrication were easily solved by minor changes in technique. The large size has been used as a friction shoulder joint for two children, with good results.

This wrist unit is now used routinely by CAPP patients.

SUMMARY AND RECOMMENDATIONS

A plastic constant-friction wrist rotation unit has been designed at the Child Amputee Prosthetics Project, UCLA, under a Department of Health, Education and Welfare grant. Results of field-testing at CAPP and fourteen other child amputee clinics demonstrate that the unit meets the need for which it was designed. Fine degrees of friction adjustment can be obtained by gross turning of the Allen screw, with exceptionally smooth and constant friction throughout the entire

turning arc. This adjustment is maintained well over a period of time without need for re-adjustment. Parents and children have stated that the unit is more appealing visually than the metallic, mechanical appearance of the conventional wrist unit.

This unit was discussed and evaluated by the Subcommittee on Child Prosthetics Problems of the Committee on Prosthetics Research and Development, at a meeting in Toronto, Canada, during June, 1970. The members of the subcommittee concluded that this unit is very acceptable and should be commercially available.[2] Arrangements with a manufacturer are now being concluded.

REFERENCES

1. Gehant, Barbara A., B.S., "Field Evaluation: Delrin Plastic Wrist Unit," a report prepared by the Department of Prosthetics and Orthotics, New York University, Post-Graduate Medical School, July, 1970.
2. Reported in "Abstract of Minutes of Meeting, Subcommittee on Child Prosthetics Problems, Committee on Prosthetics Research and Development, Division of Engineering, National Research Council, National Academy of Sciences, National Academy of Engineering; *Inter-Clinic Information Bulletin,* New York University; Volume IX, No. 12, September, 1970, p. 15.

Transparent Socket Fabrication

by Virgil Faulkner, C.P., C.O. (C) *

The desirability of seeing an amputation stump in the prosthetic socket has long been recognized. The transparent socket as a fitting aid would solve many problems such as pressure pain, etc. It can be used as a definitive socket or as a negative mold. Recognizing this problem and consulting with several colleagues at New York University who had devised a technique for fabrication of a transparent socket, the following fabrication method was developed.

Casting of the Below-Knee Stump

A negative cast is taken in the usual way, then removed from the amputation stump. An extension made from plaster of paris bandages is then added to the proximal end of the cast, approximately two (2) inches high. The cast is filled with plaster of paris using the slush method, or by forcing an eight-ounce paper cup as far as possible into the cast. This will make a thin wall mold. Select a length of pipe and prepare it for suction and insert it into the cast. After the plaster has hardened, remove the negative cast in the usual way.

Modification of the Positive Model

Modify the positive model, as necessary. After all modifications are made and the model is smooth, using a round surform blade, cut a groove ½ inch deep and ½ inch wide that extends completely around the mold approximately ½ inch from the proximal edge. At this point if time permits place the cast in an oven approximately 150° F for four (4) hours so it will be thoroughly dry.

Fabrication of the Transparent Socket

* Director, Division of Prosthetics and Orthotics, Department of Orthopedics, University of Virginia Medical School.

Materials required for fabrication are:

Parting lacquer
Vacuum pump
PVA sheet and bags
Clear cast resin[R]
Clear cast catalyst
Clear cast non-fracture additive
4134 laminac resin
Fiberglass roving
Fiberglass stockinette
Pressure sensitive tape
16 oz. cup
Tongue depressor
Cone for funnel
Lubricant
String

The step-by-step fabrication procedure is as follows:

(1) Coat the cast with lacquer and apply the suction base.

(2) Lubricate the socket and pull PVA over the cast. *Caution*—The shiny side of the PVA must be on the outside.

(3) Tie off and apply vacuum so that the PVA conforms to all irregular shapes of the cast.

(4) Saturate a towel with acetone and dry the PVA while the vacuum is running. It is important that the PVA not break because the lubricant will cause the resin to remain tacky after it has cured.

(5) Apply a roll of fiberglass roving starting on the lateral side leaving six (6) inches below the cast. Bring the roving up over the cast and down the medial aspect. Make one complete turn around the pipe and bring the roving up over the patella and the tibial crest. Approximately ½ inch from the distal end of the tibia start wrapping the roving around the cast taking care to keep it tight. Place the wraps approximately ¾ inch apart making certain the wrap crosses the head of the fibula, the tibial tubercle, the indention for the patellar tendon bar and the patella. Make the last wrap approximately ½ inch from the groove. On the proximal section, bring the roving down and tie it the six (6) inches that was left previously.

(6) If the socket is to be used for definitive purposes substitute fiberglass stockinette for the fiberglass roving. The stockinette can be applied in up to three (3) layers. Clarity is best when using roving only and decreases with each layer of stockinette applied, however, one layer of fiberglass stockinette provides considerable strength and good clarity.

(7) Take a PVA bag, pull it over the cast using the most convenient method. *Caution* — The PVA bag must not bind on the distal part of the cast. Also, because this bag will touch the inner bag, some difficulty may be experienced. Take care not to move the fiberglass roving.

(8) If air is available, inflate the bag and pull down.

(9) If no air is available, mix a small amount of resin using the formula given below and pour it in the bag making certain the cast is completely covered with the resin.

(10) After the bag is pulled down and tied, take a piece of sixteen pound twine long enough to encircle the cast three times. Place the string in the groove, pull it tight and tie.

(11) Cover the string with pres-

sure sensitive tape applying as much pressure as possible.

(12) Make a funnel, place it in the bag and attach the bag and funnel to an overhead pulley.

(13) The resin used to fabricate the socket is a mixture of 80% clear cast[R] resin and 20% 4134 laminac resin plus a clear cast non-fracture additive. For a medium size stump approximately 4½ inches long 500 grams of resin is sufficient. However, there must be enough resin to form a cast of minimum ¼ inch thickness with a distal extension of two (2) inches. Mix the resins adding the non-fracture additive according to manufacturer's instructions and using the catalyst supplied with the clear cast[R]. Add approximately four grams catalyst per 100 grams resin. (The resin will set in approximately 45 minutes.) Mix well and pour into the PVA bag.

(14) Massage the resin into the fiberglass. The fiberglass must be completely saturated with the resin; this point is reached when the strands of glass seem to disappear.

(15) Force the resin into the PVA bag so that there is a minimum of ¼ inch thickness all over the cast. There should be enough resin to have a two-inch extension on the distal end of the cast.

(16) After forcing the resin down, twist and tie the PVA bag so that constant pressure is maintained. The head of the fibula, patella, crest of the tibia and the belly of the gastrocnemius will present a problem if the PVA is stretched too tight.

(17) Careful watch must be maintained just as the resin starts to gel. There is a period of approximately one minute when the gelled resin can be moved en masse over thin areas. After this it must not be moved. The PVA should not be removed for a minimum of three (3) hours after the resin has set.

(18) If removing the socket is a problem it may be cut down each side with a cast cutter. The cuts are then filled with clear cast resin that is under catalysis.

(19) The socket is cut, trimmed and attached to an adjustable unit by drilling and tapping four (4) holes for 10-32 machine screws on the distal buildup.

(20) If material has to be removed for fitting, the clarity can be restored by spraying on one coat of clear lacquer, or by painting on a thin coat of clear cast resin that is under catalysis.

Conclusion

The advantages of a transparent socket are the ability to observe the stump during static and dynamic alignment and all phases of the walking cycle. It may, when correctly fitted, be incorporated into the definitive prosthesis. Total fabrication time is approximately two (2) hours.

Acknowledgments

This fabrication technique could not have been realized without the assistance of the New York University Prosthetic and Orthotic staff and the Department of Orthopedics of the University of Virginia.

Polyvinylchloride Gel in Orthotics and Prosthetics

Part I

Preparation and Application of Silicone Gel

by

Richard C. Koch, C.O.*

Henry J. Sturza **

The gel pads that have been used in orthotics and prosthetics for the past several years have brought considerable improvement in prosthetic and orthotics devices and in patient care for the prevention of decubitus ulcers. Because of the high cost of this material, however, many patients have had to do without these much-needed pads. One reason for the cost is that the gel formula has been based on silastic material which is very expensive. Now, however, a polyvinylchloride (P.V.C.) gel has been developed without silicone or silastic basics, and consequently, the cost has been significantly reduced. Moreover, this new material offers several advantages over the gel previously used.

P.V.C. gel has been in use at the University of Michigan Medical Center for about two years. We have found it very easy to work with, particularly since the "stickiness" inherent in such substances can readily be controlled by the

* Research Certified Orthotist, Department of Physical Medicine and Rehabilitation, University of Michigan Medical School.

** Coordinator of Orthotic and Prosthetic Facilities, University of Michigan Medical School.

Figure 1

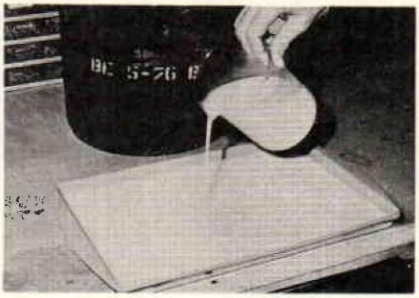


Figure 2

application of talcum powder after the gel has been processed and cooled. This simple factor greatly facilitates the covering of pads.

The key to the gel's effectiveness is its ability to displace pressures. One danger in being bedridden or confined to a wheelchair is that skin under constant pressure tends to break down, resulting in the bedsores called decubitus ulcers. At this Medical Center we have used P.V.C. gel in wheelchair pads for more than 50 patients. We have also designed and fitted breast prostheses, as well as pads of all shapes for assistive devices and artificial limbs. In our rehabilitation ward we have two gel mattresses, 36″ x 24″ x 1″, in constant use; this size covers the spinal area completely, and with separate pads for heels, elbows, and head, all pressure sites are adequately protected.

Directions for processing:

1. Mix thoroughly.

P.V.C. gel comes from the manufacturer with thick settlings at the bottom of the can. The gel must be mixed until the viscosity is uniform. Fig. 1.

2. Heat at 330°F.

In the first stages of heating, the viscosity is somewhat reduced. Fig. 2. Thereafter the gel thickens and becomes clear, and at the pouring stage the viscosity returns to approximately the same as before heating. Fig. 3. The time required is about 30 minutes at 330°F. for 2 ounces of gel, and about 3½ hours for a wheelchair pad 16″ x 16″ x 2″.

3. Pour into molds or pans.

The gel can be heated in a teflon-lined mold of the intended size and shape, or it can be heated in a larger container and poured into the proper molds. Fig. 4. It is important that the molds be lined with teflon for ease in removing the gel after it has cooled. If teflon is not available, the inside of the mold may be sprayed with silicone, which also helps to prevent sticking.

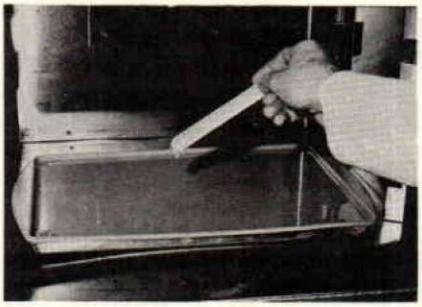


Figure 3

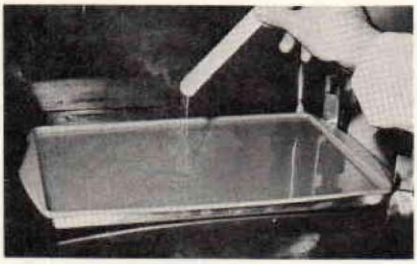


Figure 4

4. Cool to room temperature.

The gel should cool at room temperature before it is handled. The time required depends on the thickness of the pad—a ¼-inch sheet takes about 60 minutes, whereas a sheet the size of a wheelchair pad takes 6 to 8 hours. The time can be shortened by placing the molds in a cooler room.

5. Remove from molds.

Before handling the gel, sprinkle it with talcum powder Fig. 5. Then begin at one corner, using your fingertips, and carefully "peel" the gel from the mold Fig. 6. Apply talcum to the whole unit after it has been removed.

6. Apply a two-layer cover.

The pad must be covered to prevent the oil from penetrating

Figure 5

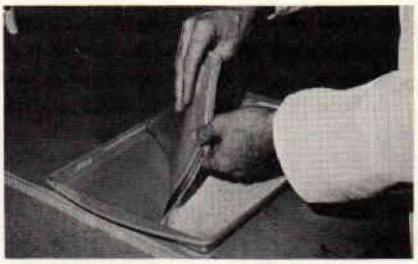


Figure 6

through the cloth cover. We have had good results by covering the pads with a polyethylene film (e.g., Tuftane)[1] before the outer cover is applied. The outer cover is usually a soft leather. Fig. 7, A, B, C. For wheelchair pads we use 12-inch cotton stockinette under the Tuftane film cover Fig. 8.

After the gel has been processed and cooled it can be reclaimed by reheating to a liquid form and used for a different application. Thus no material is wasted.

Equipment:

pyrex beaker
teflon pans
oven or bunsen burner or hot plate
tongue blades or paddle for stirring
tuftane film
cotton stockinette

Extended applications:

Very thin pads, or pads which will be exposed to rough treatment, can be reinforced with fabric. Our practice is to laminate a thin piece of cotton or nylon mesh material in the lower third of the pad thick-

1. Atco Surgical Inc.
450 Portage Trail
Cuyahoga Falls, Ohio

Figure 7A

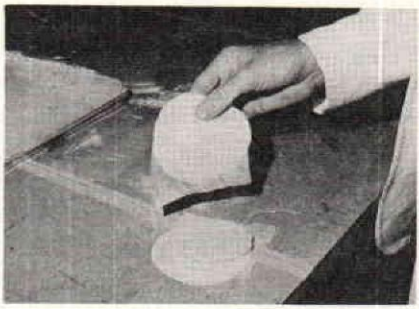


Figure 7B

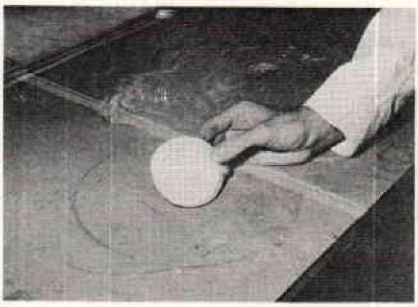


Figure 7C

ness. Cheesecloth works very well. Fig. 9.

Like the gel previously used, this new material is relatively heavy; a wheelchair pad, for example, weighs about 19 pounds. Patients who transfer such pads from chair to bed or to a car should be provided with a carrying case, for ease in handling as well as protection of the pad. Fig. 10. To help reduce the weight we have experimented with combinations of materials, for example pouring a layer of P.V.C. gel over a layer of polyester foam. In reducing the weight this also tends to reduce the efficiency of the pad; nevertheless the technique may be specifically useful for devices such as breast prostheses, where appearance and weight are more important than resistance to pressure.

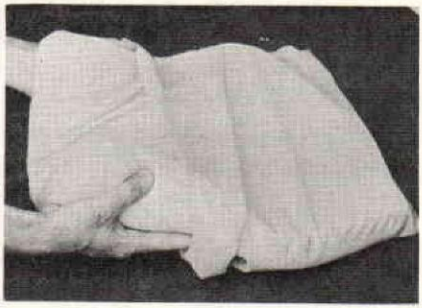


FIGURE 8

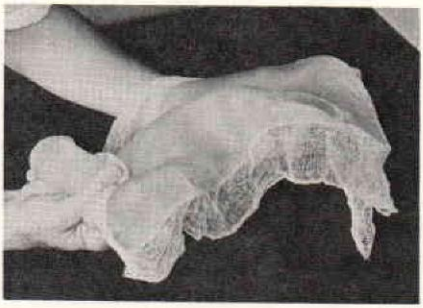


FIGURE 9

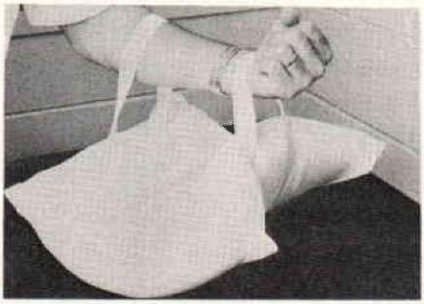


FIGURE 10

* The authors would like to acknowledge the Technicians in the Orthotic and Prosthetic Facilities, also Mr. Lewis Smith of Hull Smith Chemical, 1723 Marshal Road, Des Plaines, Illinois.

Polyvinylchloride Gel in Orthotics and Prosthetics

Part II

Silicone Gel Below-Knee Amputation Prostheses

by

George H. Koepke, M.D., Joseph P. Giacinto, C.P.,
and Richard A. McUmber, C.P.

Reprinted from
THE UNIVERSITY OF MICHIGAN MEDICAL CENTER JOURNAL
Ann Arbor, Michigan
Oct.-Dec. 1970, Vol. XXXVI, pp. 188-189

In cases of leg amputation, surgeons are increasingly aware of the need to spare the knee joint whenever possible, because of the great functional advantage for the patient. Ordinarily, a good surgical below-knee stump can be fitted successfully with one of the 22 kinds of modern prostheses. Following severe trauma, however, it is often difficult to salvage the knee and at the same time provide a stump that can be fitted to a prosthetic limb. Split-thickness grafts may be necessary to provide coverage for soft tissue deficits. Some stumps may have extensive scars or areas without sensation; others may be very short, offering little surface area in relation to the body weight that must be supported. In such cases the prosthesis may fit well initially, but within a short time the forces exerted at the stump-socket interface will induce further shrinkage of the stump area and may lead to problems such as pain in the stump, "choke syndrome," loss of skin, or ulceration.

In an attempt to insure optimal

distribution of pressures and lessen shear forces on the stump, a silicone gel envelope contoured to the stump was developed in the University of Michigan Prosthetic Shop (by Joseph P. Giacinto and Richard A. McUmber) as a modification of a total contact below-knee prosthesis. To reduce the customary sliding of the prosthesis on the stump, a rubber sleeve suspension can be provided as a substitute for a thigh corset, suprapatellar cuff, fork strap, waist belt, or other type of suspensory device.

As shown in Figure 1, the standard patellar-tendon-bearing prosthesis with SACH foot (solid ankle cushion heel) has been modified by substituting silicone gel in an envelope of lightweight horsehide for the conventional socket liner of rubber (Kem-Blo*) and Naugahyde.* Conventional cotton, wool, or nylon stump socks are applied to the stump before donning the prosthesis.

The new gel liner has been tested by 50 patients, 18 of whom had experienced serious stump disorders as the result of wearing one of several conventional sockets. In 6 of these 18 patients the stumps were shorter than 6 inches; 3 were partially insensitive; 3 had large adherent scars. In 1 patient the knee flexion was limited to 35°, and in 5 there was little muscle near the end of the stump and the distal portion of either the tibia or fibula was subcutaneous. In addition to these 18 patients who had previously worn artificial limbs, 32 new patients were fitted, 2 of whom had undergone below-knee amputation of both legs. The patients have been followed from four months to two years, and all have expressed their satisfaction with the new type of prosthetic socket. None have reported excessive perspiration.

Pressure transducer studies of the stump-socket interface, under the direction of Dr. James L. Cockrell, have shown that a silicone gel socket appears to distribute pressures more evenly than a hard socket made from an identical cast of the stump. The qualities of silicone gel may approach some of those found in liquids, and it is appropriate to speculate that shear forces or tangential pressures are less in a silicone gel than with other socket materials.

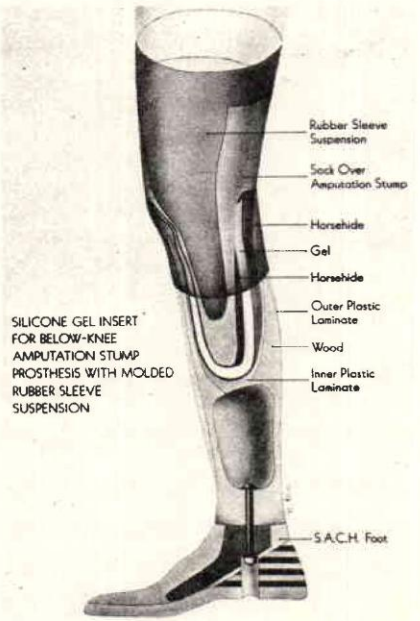


FIGURE 1—Silicone gel insert for below-knee amputation stump prosthesis with molded rubber sleeve suspension.

* Uniroyal, Inc., New York, New York.

Unfortunately, this prosthesis is somewhat more expensive than others and only a few prosthetists are experienced in its fabrication. However, silicone gel sheets† of the proper durometer, and molded rubber sleeves‡ of various sizes are now available to facilitate the construction of this device.

Summary

The addition of contoured silicone gel to the socket of a well fitted total contact below-knee prosthesis suspended with a molded rubber sleeve has proved to be superior to other kinds of prostheses. Pressure transducer studies have demonstrated more uniform distribution of pressures and suggest that shear forces are probably reduced at the stump-socket interface. For these reasons, below-knee amputation stumps considered as inadequate might be fitted successfully with this modified prosthesis.

† Atco Surgical Supports, Inc., Cuyahoga Falls, Ohio.
‡ Perry Rubber Co., Massillon, Ohio.

Dr. Edward T. Haslam, Vice President and Director of the American Board for Certification

Dr. Edward T. Haslam, who served two terms as Vice President and Director of the American Board for Certification, passed away on June 23.

Dr. Haslam, 55, professor of orthopedic surgery at Tulane University School of Medicine, received his M.D. degree from Harvard Medical College in 1939 and served his internship at Boston City Hospital. He began his residency at Westfield State Cancer Hospital in Westfield, Mass., in July of 1941, but was called to active duty with the U.S. Navy four months later. Dr. Haslam remained on active duty with the U.S. Navy Medical Corps until 1948 and rose from lieutenant junior grade to commander.

He resumed his advanced medical training in 1949 at the Shriners' Hospital for Crippled Children in Springfield, Mass., and received further training at the University of Kansas Hospital in 1950.

He was appointed an instructor in orthopedic surgery at the University of Kansas School of Medicine in 1950 and two years later an assistant professor of orthopedic surgery at the Tulane Medical School. He was appointed associate professor in 1957 and full professor in 1967.

Dr. Haslam became known for his work with the rehabilitation of amputees of all ages and especially of the juvenile amputee.

Dr. Haslam was a member of a number of professional organizations, including the American Academy of Orthopedic Surgeons, the American College of Surgeons, the American Congress of Rehabilitation Medicine, the American Medical Association, and the Louisiana State and Orleans Parish Medical Societies.

He served as a member of the rehabilitation committee of the American Academy of Orthopedic Surgeons, and as a consultant in orthopedic surgery to the U.S. Air Force Hospital at Kessler Field, to the U.S. Public Health Service and VA hospitals, as well as on the staff of four other local hospitals.

Among his innumerable contributions to the orthotic-prosthetic profession and to the advancement of the ABC Certification program, was his work in developing the Delgado Technician Program for training orthotic and prosthetic technicians. He also served as Medical Director of the Delgado Vocational Rehabilitation Center.

Dr. Haslam also served as Oral Examination Chairman for the 1967 and 1968 Certification Examinations and as an Examiner both prior and subsequent to those years.

He is survived by his wife, Alice L. Haslam who resides in New Orleans, and four children: Alice, Edward, Thomas, and Scott. He is also survived by his mother and sister in Manhattan, Kansas.

Private funeral services were conducted on June 24 in New Orleans and interment took place at Metairie Mausoleum.

FINAL 1971 ASSEMBLY PROGRAM

SUNDAY, OCTOBER 31

9:00 AM	Assembly Desk Opens	Mezzanine
	Women's Auxiliary Desk Opens	Mezzanine
	American Academy Desk Opens	Mezzanine
6:00 PM-9:00 PM	Cocktail Reception	Mezzanine and Exhibit Area

MONDAY, NOVEMBER 1

8:30 AM-10:00 AM	President's Breakfast	Room 2
9:00 AM	Assembly Desk Opens	Mezzanine
	Women's Auxiliary Desk Opens	Mezzanine
	American Academy Desk Opens	Mezzanine
	Insurance Desk Opens	Mezzanine
10:00 AM	Exhibits Open	Rooms 4, 5, 6, and 7
11:00 AM	Instructional Course— ANATOMY AND KINESIOLOGY OF THE LOWER LIMB—Part I Dr. Paul Meyer and Mr. Charles M. Fryer (By Reservation Only)	Room 3
12:00 Noon	Luncheon Period	
2:00 PM-3:00 PM	Technical Session Presentation by German Association	Room 3
3:15 PM-4:15 PM	Technical Session RESULTS OF EVALUATIONS OF NEW ORTHOTIC DEVICES Mr. Joseph Traub, C.P.	Room 3
5:00 PM	Exhibits Close	

TUESDAY, NOVEMBER 2

9:00 AM	Assembly Desk Opens	Mezzanine
	Women's Auxiliary Desk Opens	Mezzanine
	American Academy Desk Opens	Mezzanine
	Insurance Desk Opens	Mezzanine
	Exhibits Open	Rooms 4, 5, 6, and 7
10:00 AM	Women's Auxiliary Meeting	Rooms 9 and 10
10:00 AM	Instructional Course— ANATOMY AND KINESIOLOGY OF THE LOWER LIMB—Part II Dr. Paul Meyer and Mr. Charles M. Fryer (By Reservation Only)	Room 3
11:15 AM-12:15 PM	Technical Session CLINICAL EXPERIENCE WITH CONGENITAL ANOMALIES Dr. Raymond J. Pellicore	Room 3
12:15 PM-1:30 PM	Luncheon Period	
1:30 PM	Technical Session NEW DEVELOPMENTS By Suppliers	Room 3
1:30 PM	Voter Registration Desk Opens	Mezzanine
4:30 PM	Exhibits Close	
6:00 PM	Cocktail Party	Poolside
7:00 PM	Dinner and Show	Congo Room

WEDNESDAY, NOVEMBER 3

8:30 AM	Suppliers Breakfast	Room 11
9:00 AM	Assembly Desk Opens	Mezzanine
	Voter Registration Desk Opens	Mezzanine
	Women's Auxiliary Desk Opens	Mezzanine
	American Academy Desk Opens	Mezzanine
	Insurance Desk Opens	Mezzanine
	United Air Lines Desk Opens	Mezzanine
	Exhibits Open	Rooms 4, 5, 6, and 7

10:00 AM-12:15 PM	Technical Session PRINCIPLES OF PATIENT MANAGEMENT Part I—Interpersonal Relationships Dr. Vert Mooney and Mr. Roy Snelson, C.P.O. Part II—Records and Recordkeeping (To be announced)	Room 3
11:15 AM	Women's Auxiliary Tour	
12:00 Noon	Begin Exhibit Take-down	Rooms 4, 5, 6, and 7
12:15 PM-2:00 PM	ABC Certification Luncheon	Room 2
2:00 PM-4:00 PM	ABC Annual Meeting	Room 2
4:00 PM	ABC Directors Meeting	Room E, South Hall
	American Academy Meeting	Room 3

THURSDAY, NOVEMBER 4

9:00 AM	Assembly Desk Opens	Mezzanine
	Women's Auxiliary Desk Opens	Mezzanine
	American Academy Desk Opens	Mezzanine
	Insurance Desk Opens	Mezzanine
	UAL Desk Opens	Mezzanine
10:00 AM	Women's Auxiliary Breakfast	Rooms A and B, South Hall
10:30 AM-12:00 Noon	Technical Session ENDO-SKELETAL PROSTHESES Mr. Alvin L. Muilenburg, C.P.O.	Room 3
12:00 Noon-2:00 PM	Luncheon Period	
2:00 PM	AOPA Annual Meeting	Room 3
6:00 PM	Cocktail Reception	South Hall
7:30 PM	Concluding Banquet Dancing and Bar	South Hall

1971 ASSEMBLY EXHIBITORS

Booth	Exhibitors	Booth	Exhibitors
1–2	Kingsley Manufacturing Co.	26	Truform
3	Rolls Equipment Co.	27	Becker Mechanical Hand
4–5	Florida Brace Corp.	28–29	Atco Surgical Supports
6	Freeman Manufacturing Co.	30	Comfort Stump Socks
7	Tru-Mold Shoes, Inc.	31–32	Hosmer/Dorrance
8	Pel Supply Co.	33	Fiway Manufacturing Co.
9	Hersco Arch Products	35	Truform
10	Pope Brace Co.	36	Kellogg Corset Co.
11–12	Ohio Willow Wood Co.	37	Teltscher Corp.
13	Ace Orthopedic (Calcardine)	40	Southern Prosthetics
14	Scholastic Systems, Inc.	41	Apex Foot Products
15	S. H. Camp. Co.	42	Everest & Jennings, Inc.
16–17–18	Knit-Rite, Inc.	43	Polycadence, Inc.
19–20–21	U.S. Manufacturing Co.	44	Viennatone of America
22	Fillauer	47	Realastic Industries
24	Becker Orthopedic	49	C. H. Alden Shoe Co.
25	Irving Drew Corp.	50–51	Otto Bock Ortho. Industry

1971 Certification Examination Results

The 1971 Certification Examinations were held at Northwestern University, Chicago, Illinois from July 18 to 24 inclusive. The following candidates successfully completed the examinations and have been awarded certification status in the disciplines indicated:

Certified Orthotist

Applegit, Russell M., Jr.
Bain, Edward L.
Bangham, Robert A.
Beck, James E.
Becker, Otto K.
Bellman, Greg M.
Bendel, Allan B.
Bergoust, Howard A.
Brookshier, Jack L.
Brown, Russell D.
Buchanan, Robert R.
Buckner, Martin L.
Carlow, Warren A.
Cartaya, Ron A.
Cheney, Gary A.
Clark, Darrell R.
Cocco, Frank N.
Cooke, Everette E.
Eisler, Herbert
Estrello, Mario
Fields, Count
Frank, Robert A.
Guimond, Paul W.
Haines, Wilbur
Hartung, Gerhard O. K.
Hertzoff, Edwin F.
Irby, Kenneth L.
Janke, Elmer A.
Kearns, Richard L.
Keller, Hans-Peter
Kerr, James S.
Knight, Clarence E.
Kovacs, Edward A.
Krumenacker, Spencer L.
Lanquist, Ronald G.
Lappe, Bryan F.
Layton, Anthony W.
Loveless, Gary L.
McIntyre, Bernard
Miller, John K.
Molina, Roger H.
Mullen, Robert B.
Musick, Dennis C.
Pool, Richard W.
Rincon, Felix
Rolfes, Raymond H.
Schufletowski, Henry L., Jr.
Simko, Stephen T.
Spaw, Robert
Stuart, A. Bruce
Whited, Daniel W.
Wilkinson, Ather W.
Wilms, Alan F.
Wiseman, H. G.
Yochman, Johnnie L.

Certified Prosthetists

Anderson, Daniel E.
Beery, Lloyd O.
Botkin, Joseph P.
Brown, Robert A.
Coates, Michael F.
Collier, Milo S.
Conner, Roger D.
Crow, Plaze O.
Dix, Robert A.
Doyle, William
Ficociello, John N.
Flanary, Ronald E.
Fullerton, Jerry
Garcia, Manuel C.

Certified Prosthetists (Continued from Page XVII)

Grantham, Charles A.
Hakert, R. Douglas
Hall, George H.
Harrison, Rex E.
Hartson, Robert C.
Holmes, Donald W.
Johnson, Edward F.
Koncak, Frank A.
Lett, Gerald K.
Lewis, William C., Jr.
Luckett, Robert E.
McGrew, Dan, Jr.
McLain, George A.
Neumann, William C.
Pawlowski, Ronald
Press, Robert D.
Putzi, Robert
Provini, Albert V.
Quigley, Michael J.
Rice, H. Grant
Robinson, Kenneth G.
Rosenberg, Richard J.
Rosenqvist, Lennart A.
Roy, Richard A.
Schondorfer, Kurt
Shields, Earl V.
Taylor, Thomas C.
Trivett, Dan W.
Vaden, Don G.
Vanover, Garland
Vilminot, Jerry E.
Wells, Richard A.
Wildman, Louis E.

Certified Orthotists-Prosthetists

Benecke, Walter A., Jr.
Bodenstein, Norman
Caputo, Jack A.
Delaney, Peter C.
Dunn, Paul A., III
Enneberg, Harold
Forbes, David J.
Forbrich, Falko N. E.
Kessler, Jerome S.
McDougle, William R.
Payne, Woodrow W.
Reid, Robert B.
Schroeter, Werner P.
Snell, W. Clinton
Vogt, Jerry D.
Webb, Ronald L.

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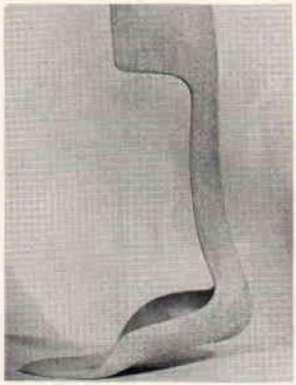

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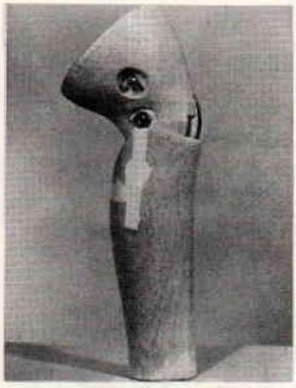

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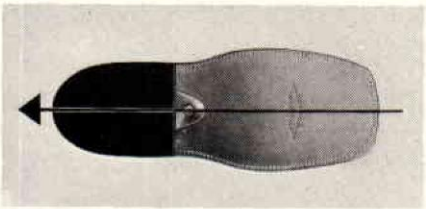

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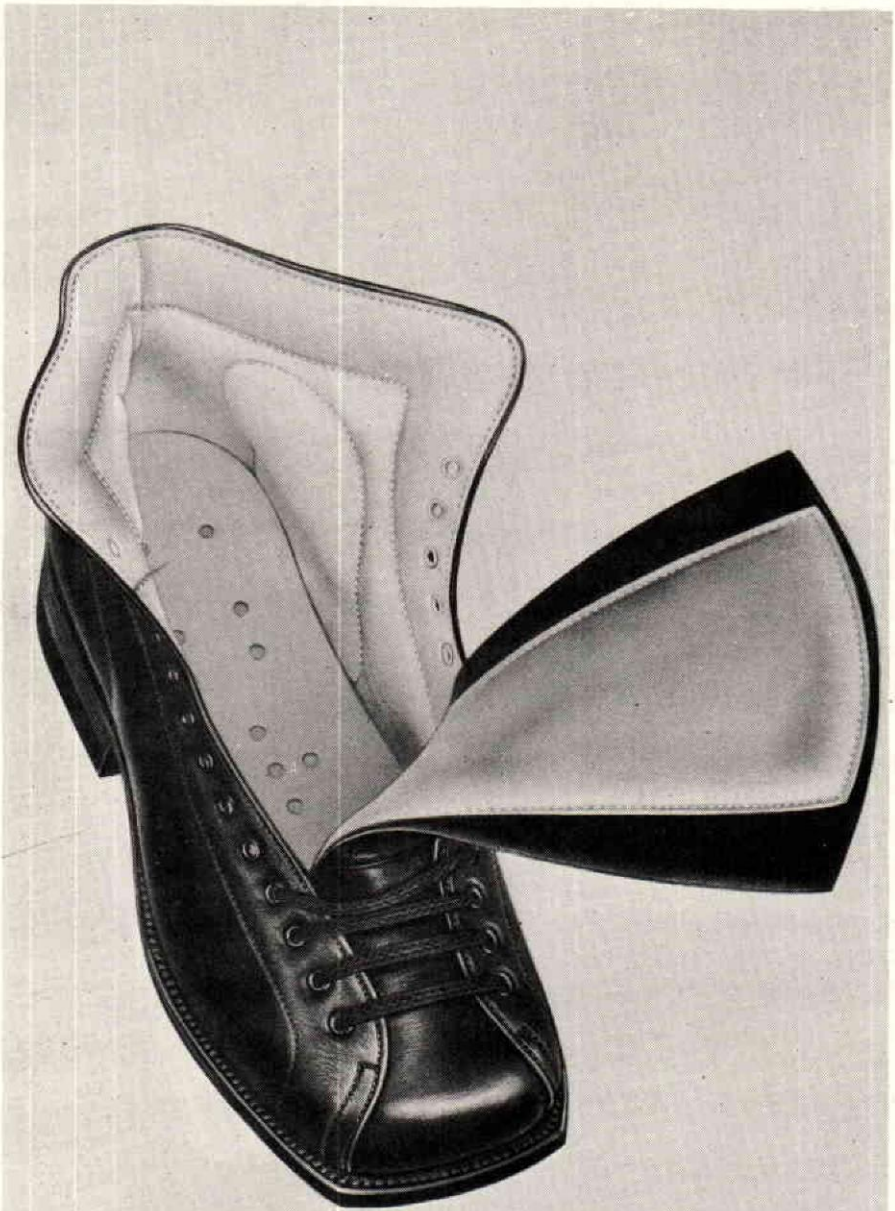

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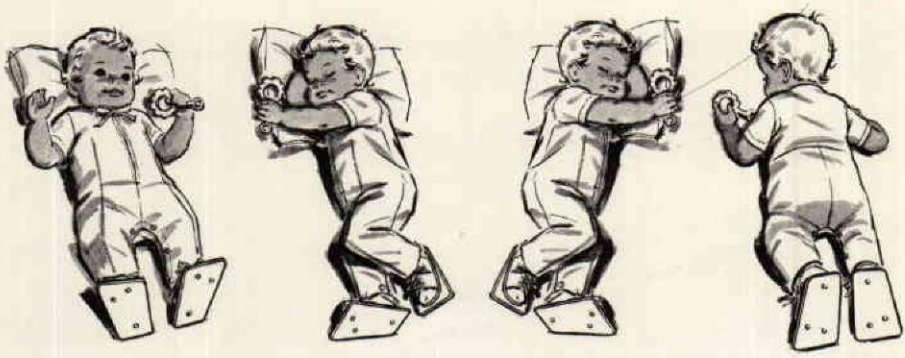

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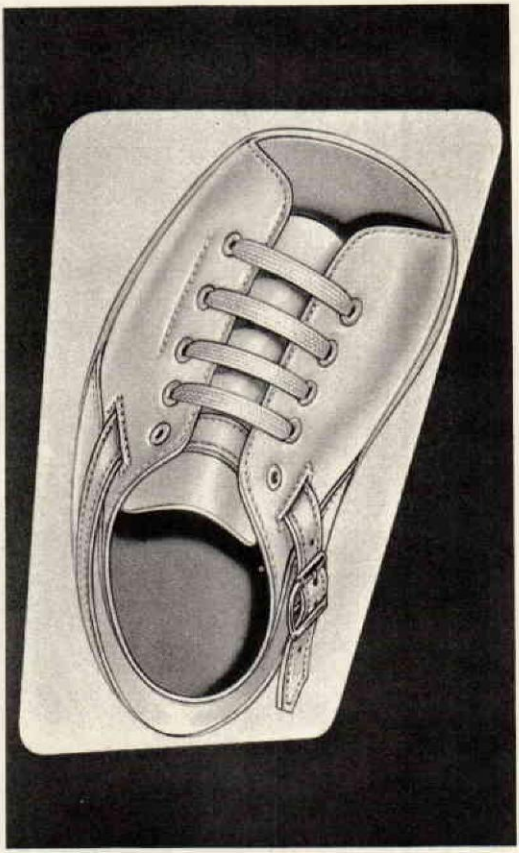
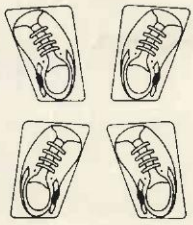


EXTERNAL ROTATION

INTERNAL ROTATION



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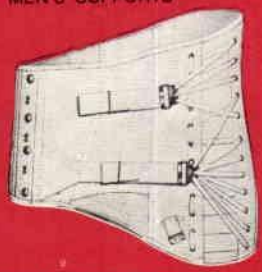

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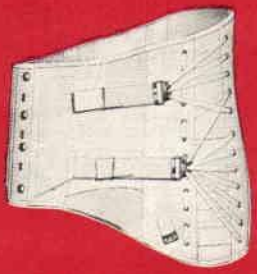

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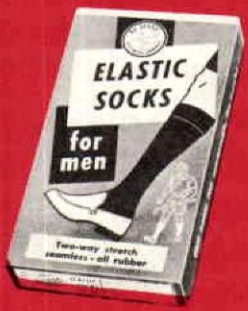

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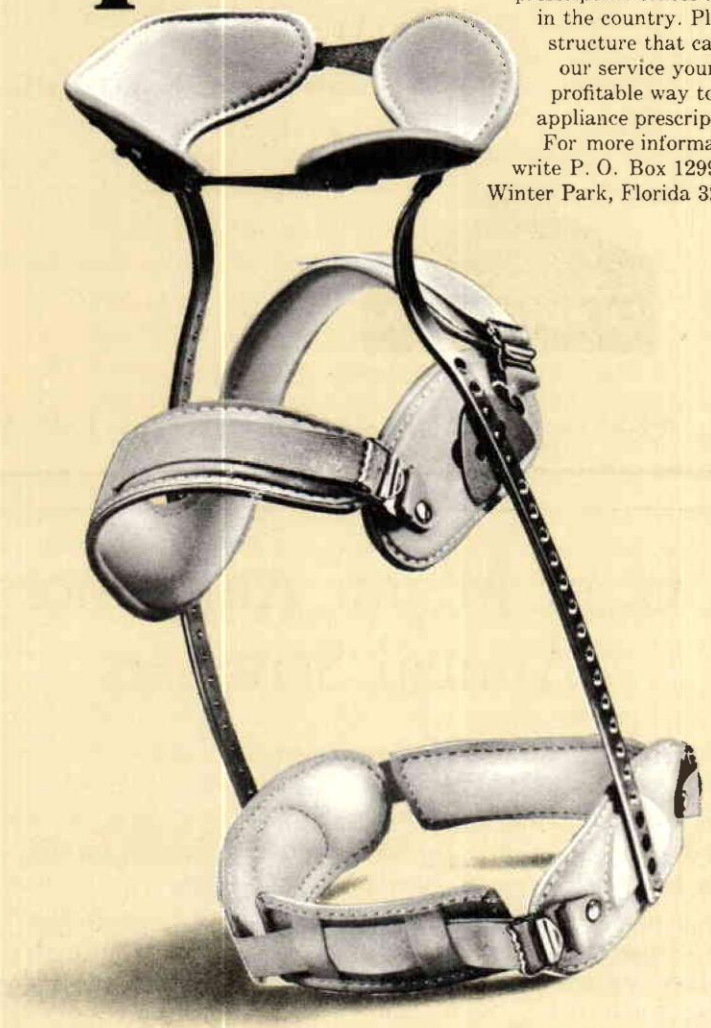

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For further information regarding the seminars, please contact: Augusto Sarmiento, M.D., Department of Orthopaedics and Rehabilitation, University of Miami School of Medicine, P.O. Box 875, Biscayne Annex, Miami, Florida 33152.

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