MARCH 1978

Orthotics and Prosthetics

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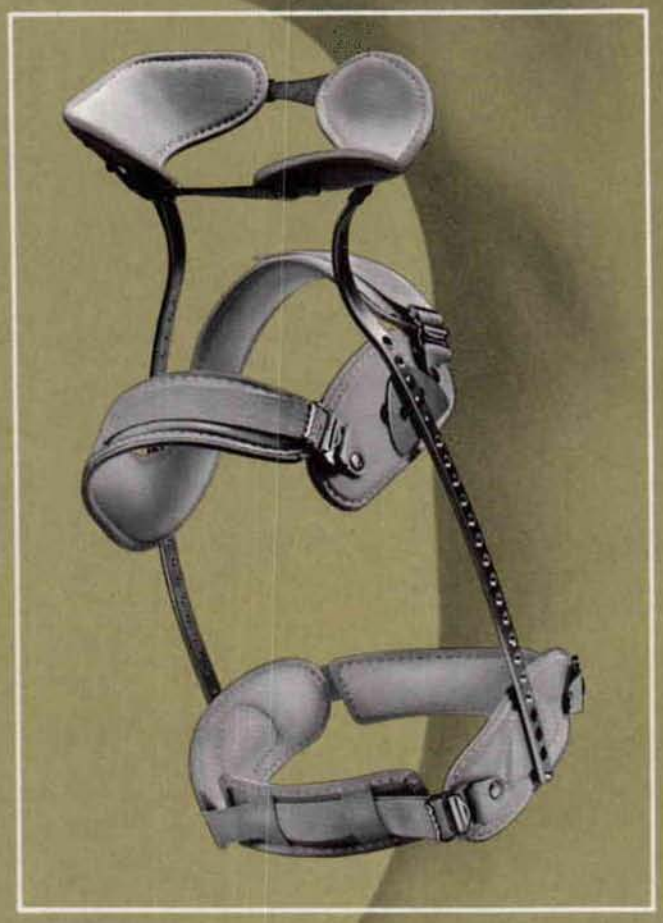

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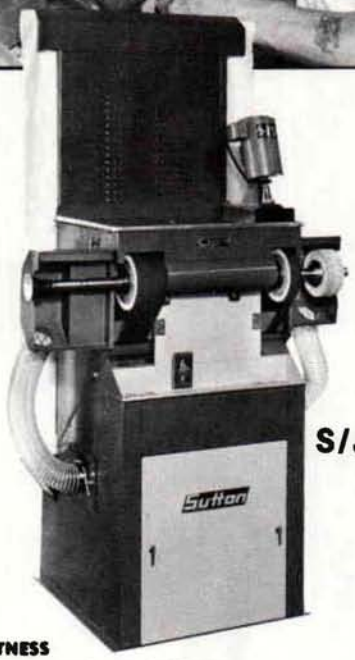

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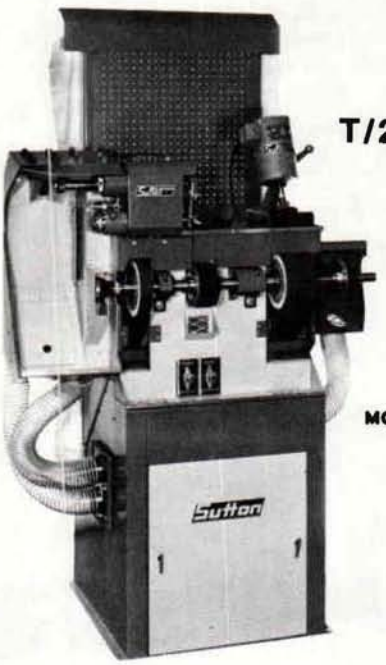

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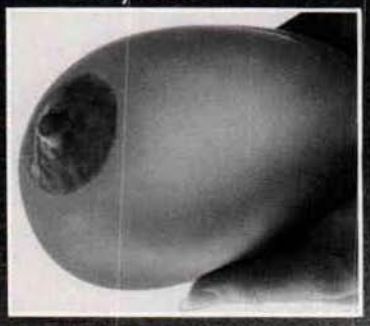

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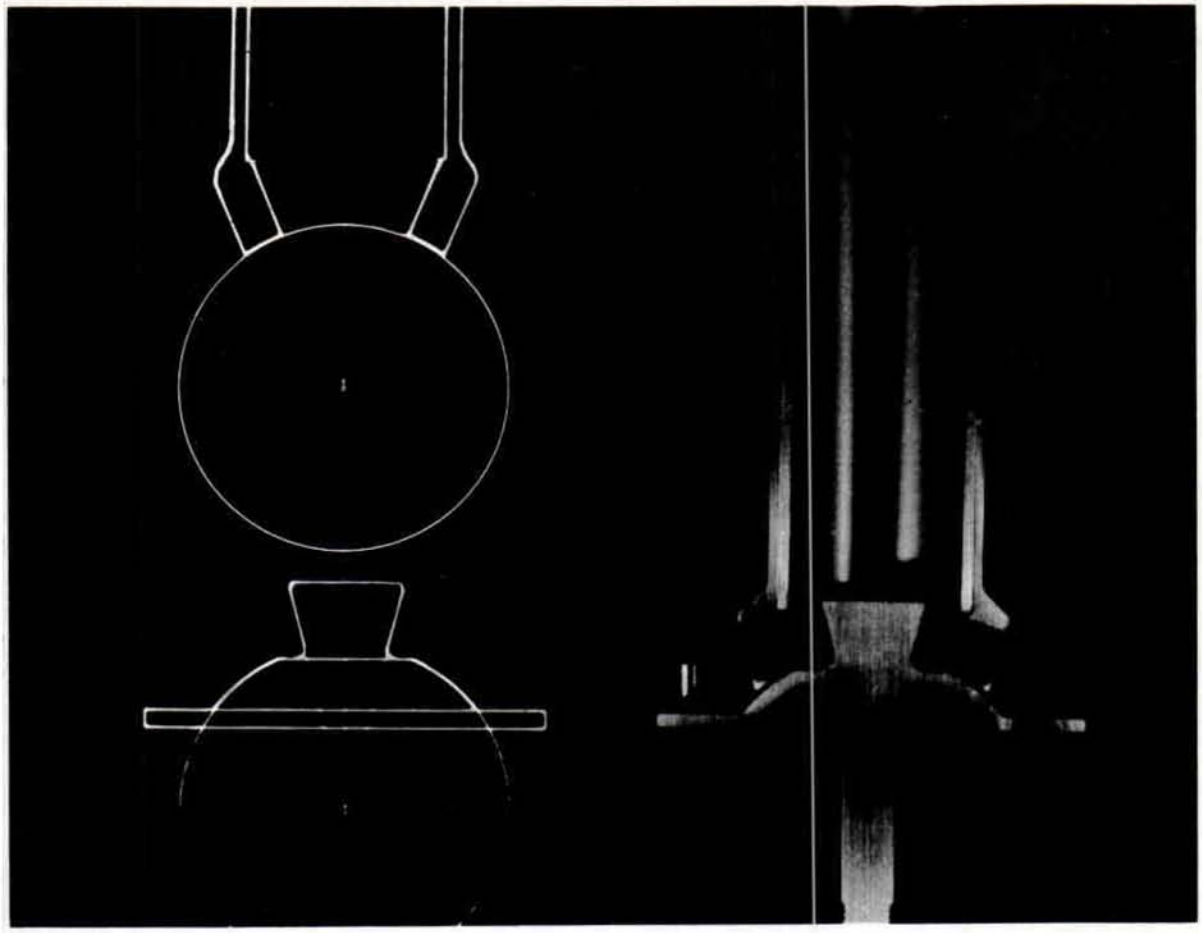

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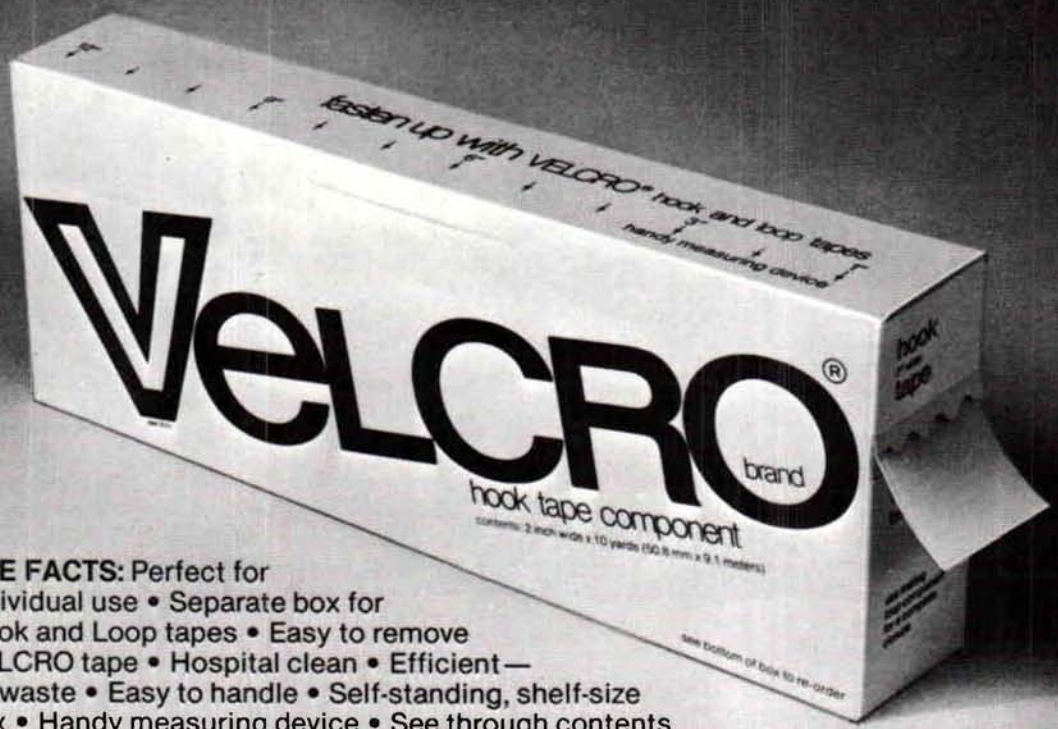

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These cassettes are not tape-slide presentations, as it proved impractical to develop such a program at the seminar. An attempt will be made to have tape slide presentations available from future seminars.

The above cassettes will however be accompanied by a limited number of pictures and/or illustrations which the speaker believes necessary for the understanding of the presentation.

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A NOTE

Unbelievable as it may seem to many of us, I have served as editor of "Orthotics and Prosthetics" for eight years, and since the guest editorial for this issue has been delayed, this seems to be an appropriate time to thank the many authors and at the same time, those individuals who have served on the Editorial Board during these years for their gracious assistance in production of "the Journal".

If the comments we have received over these eight years are taken literally, the readers of "Orthotics and Prosthetics" feel that our efforts have been useful. This is rewarding because at the outset of my association with "Orthotics and Prosthetics", the Editorial Board elected to place emphasis on clinically useful articles, leaving papers dealing directly with research to be published in The Bulletin of Prosthetics Research and other journals.

The fact that we feel that we have been successful in meeting the primary goal of the Journal does not give us license to "rest on our oars", and we are constantly striving to improve the usefulness of "Orthotics and Prosthetics". For this reason, we continue to solicit articles, by you, the practitioners, and, in addition, request that you send us your comments and suggestions for improvement.

A. Bennett Wilson, Jr.

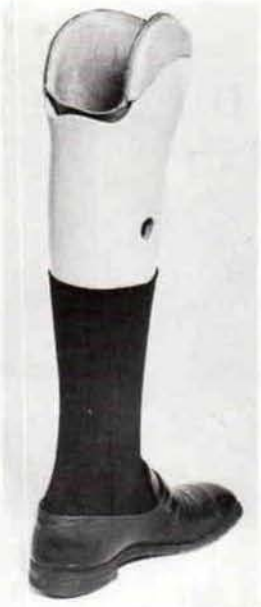

Fig. 3. Posterior-medial view of a below-knee prosthesis with latest version of the VAPC porous soft-socket liner.

On December 27, 1976 the stump was reported to be in good condition and no longer macerated. The patient pointed out that when the socket was originally fabricated without a vent hole it allowed the accumulation of fluid. However, as indicated by the Clinic Team note, "when the vent hole was added, the combination provided him with a dry distal stump and comfort."

The patient, who is available for frequent observation since his office is in the same building as that of the VAPC, has had no further difficulty with the BK stump as of this date, June 17, 1977. The technique has since been employed for other patients.

Summary

A modification of the VAPC open-mesh distal-end soft socket insert has been presented. This is useful for the patient who experiences an extreme degree of stump hyperhidrosis because it permits ventilation of a total contact socket as well as removal of perspiration fluid from the stump-socket interface.

Fig. 4. Anterior-lateral view of a below-knee prosthesis with latest version of the VAPC porous soft-socket liner.

Reference Cited

(1) Rubin, G., and Byers, J.L., *A porous, flexible insert for the below-knee prosthesis.* Orthotics and Prosthetics, Vol. 21, No. 3, Sept. 1973, pp 19-26.

Footnotes

[1]Prosthetist, Veterans Administration Prosthetics Center, 252 Seventh Avenue, New York City 10001.

[2]Orthopedic Consultant, Veterans Administration Prosthetics Center, 252 Seventh Avenue, New York City 10001.

Orthotics and Prosthetics, Vol. 32, No. 1, pp. 6-9, March 1978

MODIFICATIONS OF A MACLAREN BUGGY MAJOR FOR ORTHOPAEDIC SEAT INSERTS

Edward Barber[1]

The MacLaren Buggy Major[2] has been used for some time now at the Rehabilitation Engineering Center of Children's Hospital at Stanford. It offers an attractive, lightweight, folding stroller base to which an individually fitted orthopedic seat insert can be attached (Figs. 1, 2, 3, 4).

Fig. 1. The MacLaren Buggy Major base in upright position.

The main disadvantage that we have found is that when the stroller is open for use its seat is fixed in 90 deg. of hip flexion and the seat-back is reclined 60 deg. above the horizontal, thus offering no freedom for variation.

Most of the children seen here need at least two positions of reclination in order to maximize hand control, and for resting. Pictured in Figures 3 and 4 is a twelve-year old boy with cerebral palsy with tension athetosis, who requires positioning at 90 deg. above the horizontal for hand function and school activities, and positioning at 70 deg. above the horizontal for feeding and resting.

The two position feature was provided by shearing off the aluminum rod cap and re-

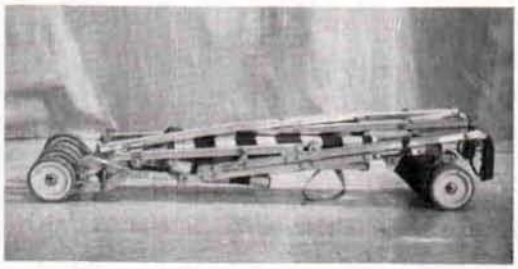

Fig. 2. The MacLaren Buggy Major base in folded position.

Fig. 3. The MacLaren Buggy Major and patient in orthopedic seat insert in upright position.

Fig. 4. The MacLaren Buggy Major and patient in orthopedic seat insert in reclined position.

moving the "U"-bracket and aluminum rod (Fig. 5) from the seat bottom and filling the holes formerly occupied by the rod with two pop-rivets so as to reattach the remaining bracket on the seat bottom, as shown in Figure 6. The seat bottom is now free to be positioned in any degree of hip flexion, or, as in this case, be folded flat against the seat back (Figs. 3 and 4). Attachment of the seating insert is made possible by the aluminum bracket shown in Figure 7.

The seat insert is made of half-inch thick ash plywood. It is padded to meet the therapeutic requirements of each patient. A steel rod bolted through the lower back, also shown in Figure 7, serves as the point of articulation. A cold-rolled square steel tube is used for the upper strut, which fixes the angles of reclination. Pivoted on the insert, the tube is notched where it crosses the aluminum arm of the Buggy at the required angles of reclination and is held in place by Velcro straps.

Footrests for this application must be adjustable to two positions to complement the two-position insert. It is constructed of half-

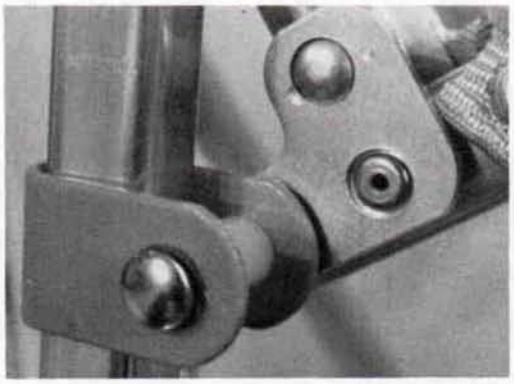

Fig. 5. "U"-bracket and aluminum rod that are removed to allow use of the orthopedic seat insert.

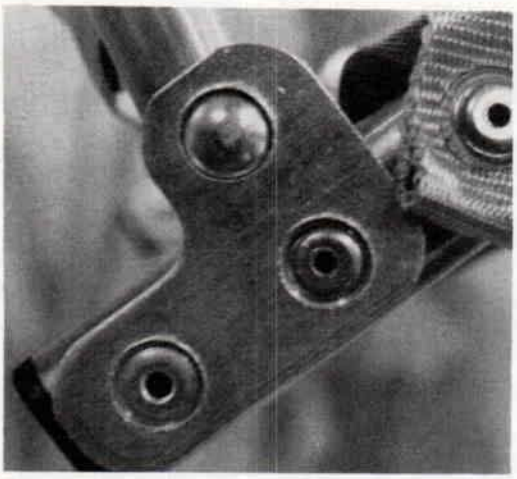

Fig. 6. The remaining bracket is reattached to the seat bottom with pop-rivets.

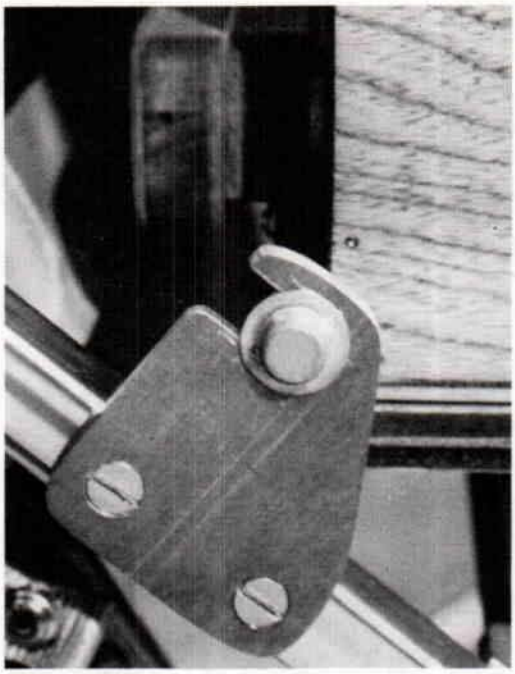

Fig. 7. Aluminum bracket used to provide attachment of seat insert.

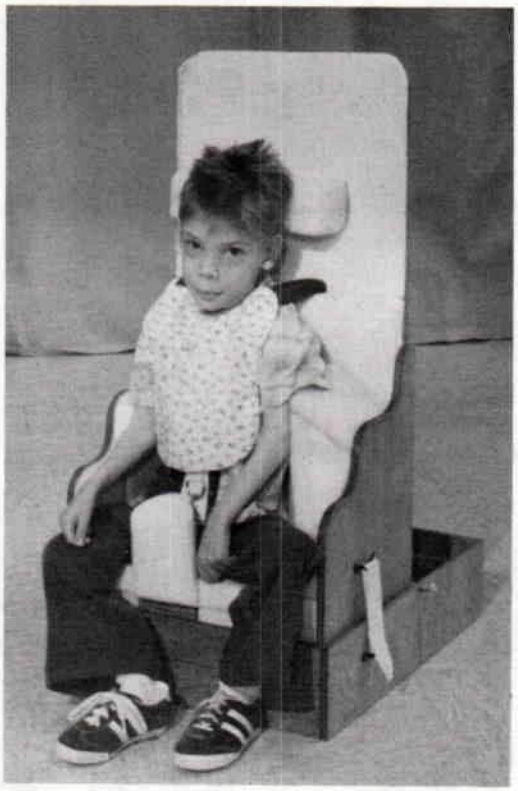

Fig. 8. View showing floor base to receive the orthopedic seat insert.

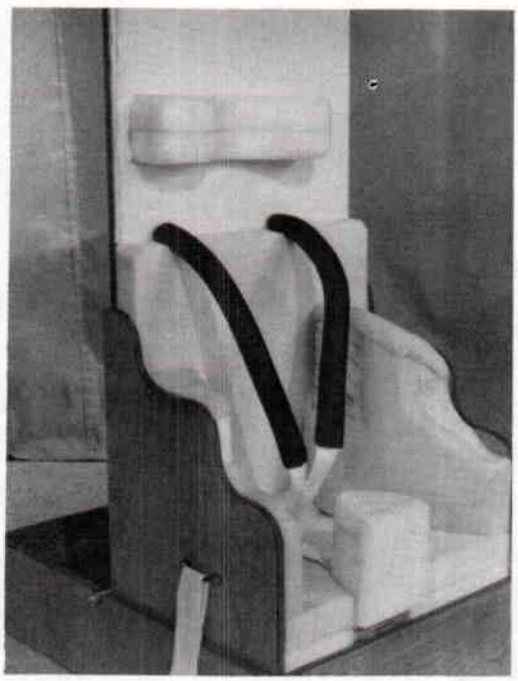

Fig. 9. Another view of the orthopedic seat insert and floor base.

Fig. 10. View of the system incorporating a Lexan tray.

Fig. 11. Another view of the system incorporating a Lexan tray.

inch ash plywood also, and is hung over the lower front aluminum cross member. It is removable. The main foot rest is fitted when the chair is in its more upright position. To accommodate the reclined position, a hinged piece of plywood with Ethylfoam of a thickness to achieve proper foot support is constructed, as shown in Figures 3 and 4.

To allow the child to participate in floor activities, a floor base is constructed to receive the insert. This base places the child at the proper height for his legs and is constructed strong enough to withstand the child's contractures (Figs. 8 and 9).

Most children require trays. These can be attached either directly to the seat insert or to the Buggy itself. While no tray has been constructed for the child shown here, Figures 10 and 11 show two units constructed at this center for other children. The trays can be constructed of ash plywood and sealed, or of polycarbonate (Lexan). Lexan, although more expensive, is preferred for durability, cleanliness, and the transparency that permits the child to look through the tray, thereby not blocking part of his world from view.

In all of the modifications made to the MacLaren Buggy and the devices which are attached to it, the original themes must remain. The Buggy and orthopedic seat system must be attractive, as lightweight as practical, and still allow the Buggy to fold flat.

Footnotes

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[2]MacLaren Buggy Major made in England by Andrew MacLaren, Ltd., Barby nr Rugby, England. Imported into the U.S. and distributed by MED-Medical and Hospital Equipment, 1215 S. Harlem, Forest Park, Ill. 60130; and Robin Aids, 3353 Broadway, Vallejo, California 94590.

Orthotics and Prosthetics, Vol. 32, No. 1, pp. 10-15, March 1978

NEW DIMENSIONS FOR PROSTHETIC SOCKS

Martha Field, M. S.[1]

Although the basic designs and fitting procedures for prosthetic socks have been standardized for many years(2), Knit-Rite, Inc.(5) and others(3) have become increasingly aware that correct fitting of standard socks is sometimes complicated by "irregular contours of the stump, the presence of skin grafts, or the lack of sensation in some areas"(4). Furthermore, improved socket designs have made it more desirable in some cases to have more contoured socks rather than additional layers of socks for more padding.

Knitting Standard Socks

Historically the contour or shape of a standard prosthetic sock has been achieved by increasing or decreasing the stitches (wales for width, courses for length). Since each wale is controlled by a single needle on a knitting machine, increasing or decreasing wales means increasing or decreasing needles. This can only be done on the side edges of the sock and is called fashioning. A sock is knitted beginning at the "toe" and widened (fashioned) one needle each side, each row to achieve the desired "toe" width (Fig. 1). The sock may then be knitted straight and widened at evenly spaced intervals often enough to achieve the necessary width desired for the top. When the sock comes off the knitting machine, the "toe" is the shape of a squared-off semicircle, and the fashionings are on the sides (Fig. 2A). After the sock has been processed, blocked, and fleeced, it is soft and fulled, and most often the fashionings are positioned in the center rather

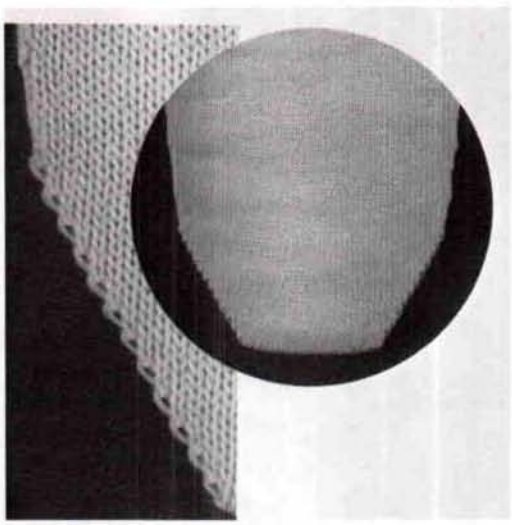

Fig. 1. "Toe" section of sock as it comes from the knitting machine. Each stitch (wale) across the "toe" end was made by one needle. Loops (fashionings) on the sides indicate where needles were added to increase the width of the sock. Needles may also be deleted gradually to narrow the sock for special contours as socks for Syme's amputation.

than on the sides to make the "toe" rounded rather than squared-off (Fig. 2B).

Sizing Standard Socks

Prosthetists usually determine "toe" and top by taking circumference measurements. For socks "toe" and top are expressed in flat measurements which are equivalent to one half the circumference or slightly less. The "toe" width of a sock may be measured in several ways. One way is to measure the width two inches from the tip of the sock(6). If measures are taken at the top of the widenings, the standard "toe" will approximate a semicircle. The top width of a sock is almost uniformly measured at the very top of the sock. "Toe" and top widths are scaled to each other in seven size ranges, two for up-

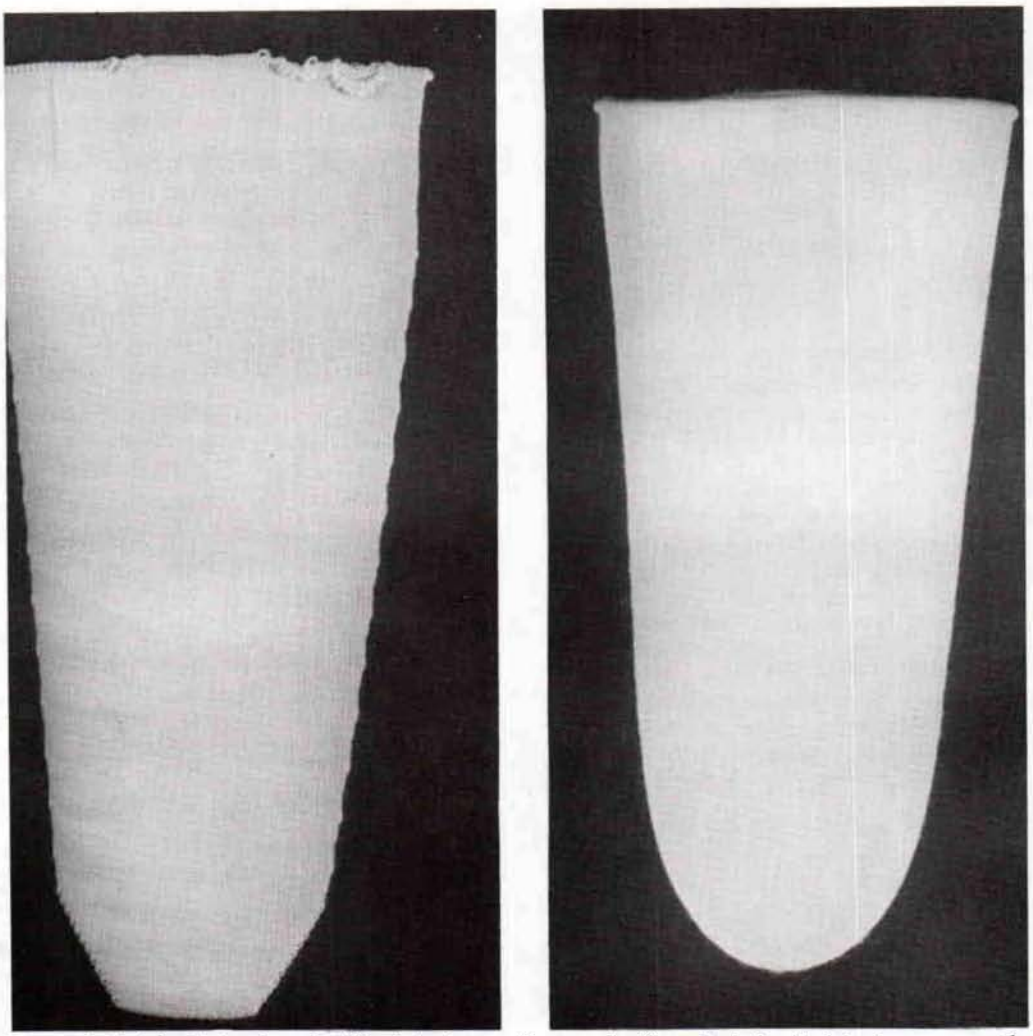

Fig. 2. **Left,** The knitted sock. "Toe" is shape of squared-off semi-circle. Fashionings are on the sides. **Right,** Sock ready to be delivered to the amputee. It is the same size as sock shown on the left, but has been processed, blocked and fleeced. Fashionings are now in the center of the sock and the "toe" has a rounded contour.

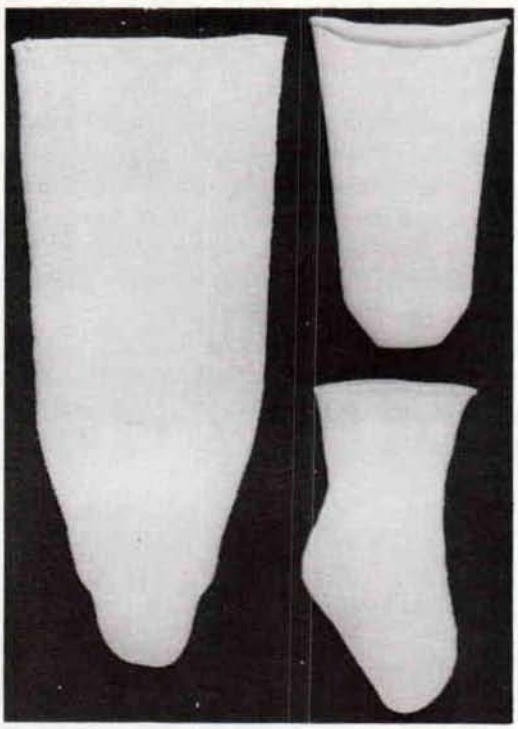

Fig. 3. Two amputees were originally fitted in a standard sock such as the 3-ply Orlon/Lycra® one at upper right. Amputee "A" had a narrowing at the distal end. Although the actual stump contour was not symmetrically narrowed, the sock (left) was made symmetrical, and in this case the stretch of the fabric conformed to the actual curvatures without the wrinkling that occurred with the standard sock. When a symmetrical configuration can give equal comfort, it is preferred because the amputee can then turn the sock and get more wear from it. Amputee "B" had an uneven side. The standard sock did not stretch enough to prevent wear in the protruding area. A sock, lower right, which followed the contour exactly gave superior wear and comfort.

per-limb amputees and five for lower-limb amputees[5]. In each size range, standard lengths are available in increments of two inches from 10 to 32 inches. PTB sizes are a separate range as are the Syme's sock sizes which require an additional measurement across the narrowed part. Measurements for all socks are expressed traditionally with the length first and other measurements in order from top to "toe".

Evaluating Fit

The ranges of sizes available and the knit construction of the standard sock does allow a good fit and an adequate amount of stretch and shaping for most, but not enough for all, amputees. Indications that socks are not fitting correctly have been related to wrinkling of the "toe" caused by irregular contours of the stump (Fig. 3A), inadequate wear from a sock because of pulling to stretch over a protruding area (Fig. 3B), and discomfort. There are many variations of these and other irregularities, any of which may indicate the need for a special prosthetic sock. Some special socks merely require knitting a wider "toe" called a box "toe", whereas, others may require much more complicated patterning to give proper fit and comfort. Making socks for some of these variations on a knitting machine is extremely difficult and sometimes impossible, but a way has been found to tailor a sock to the specific measurements of any amputee—in fact, even to a scale drawing or a pinned up sample (Fig. 4).

Tailoring Special Socks

Tailoring is achieved by a seam which flattens to the extent that it is impossible for the average wearer to feel and is less distinctive than the widenings created by fashioning a sock on a knitting machine. The seam is made on a modified serger. Many seaming yarns were tried before the specific stretch yarns were finally selected. They allow wool, silkoline (mercerized cotton) and Orlon/Lycra® knitted fabrics to be seamed

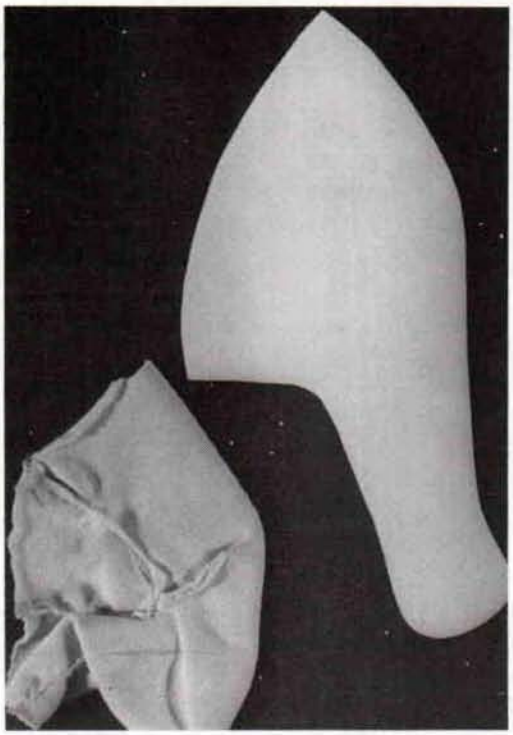

Fig. 4. At right is a scale drawing. No measurements were needed. Drawing was followed exactly for 100 percent wool and decreased 10 percent for Orlon/Lycra.® Fitting sock was sent.

At left is pinned-up sample. This was to fit a shoulder amputation and some measurements were also given.

and the seam to be stretched so that it is absolutely flat. This seam does not deteriorate in laundering. It does give a new dimension to prosthetic socks. The limitations of widenings and narrowings imposed by the knitting machine do not have to be adhered to anymore, and socks may be made now to fit unusual shapes smoothly and snugly. The squared-off "toe" can now be rounded and narrowed as gradually or abruptly as needed.

When a prosthetist is ordering a special sock for a new patient, he may find that the fitting sock is tailored since this is a faster process than setting up a knitting machine for one sock, and results in a sock to which alterations can easily be made if necessary. Once the dimensions have been established, the prosthetics facility may specify "knitted" or "tailored" when ordering and the sock will be made as closely to specifications as each method allows (Fig. 5).

Another new dimension has been the tailoring and knitting of 2- and 3-ply Orlon/Lycra® socks. This material was originally developed for fitting amputees immediately postoperative(1) and is relatively new in conventional prosthetic socks. Because of its increased elasticity, it is particularly suitable to certain amputations (Fig. 6), and the stretch seaming yarn is very compatible with the stretch fabric when a sock is tailored.

Tailoring seams were originally used on hip-disarticulation socks for the purpose of inserting a soft, pad-like wool panel into a supportive, elastic, snug-fitting Orlon/Lycra® body (Fig. 7). At first only 2-ply Orlon/Lycra® was used with 3- and 5-ply wool panels. Now 3-ply Orlon/Lycra® has been developed and is especially compatible with the 5-ply wool panel. Tailoring also allows 100 percent wool hip-disarticulation socks to be made in widths up to 26 inches and with many variations such as smaller waists, a tighter fit for a smaller area on one side of a bi-lateral and added protection down the thigh of the contralateral leg (Fig. 8).

Washing Orlon/Lycra® Socks

Hip-disarticulation socks of 100 percent Orlon/Lycra® both 2- and 3-ply have been found to be beneficial in immediate postsurgical prosthetic fittings[1] and can be supplied in plastic bags to accommodate sterilization. They are also being recommended by prosthetists for daily wear because the superior elasticity allows for a really supportive snug fit and the ease of laundering is especially important in this type of sock. Mild detergents and warm rather than hot water temperatures are recommended—cool dryer or air drying—no chlorine bleach—and the am-

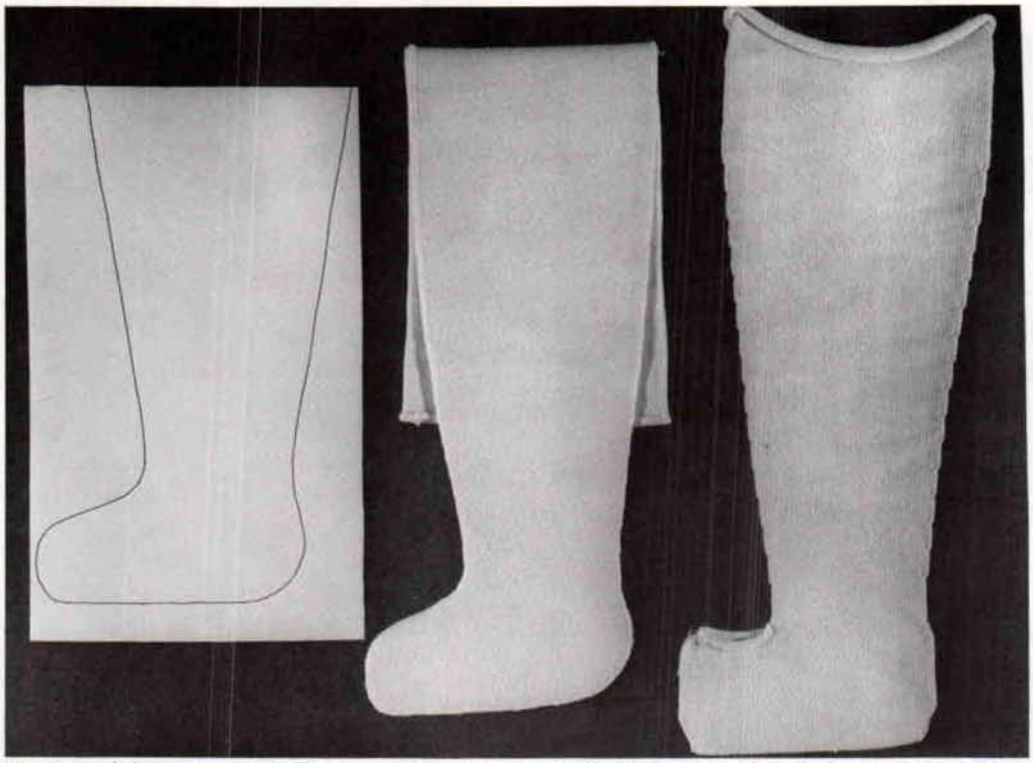

Fig. 5. At left is pattern made from measurements supplied by prosthetist. In the center is the tailored sock sent for a fitting. At right is knitted sock, requested by the amputee, as it looked after being knitted. When narrowing is so abrupt, stitches must be connected by hand.

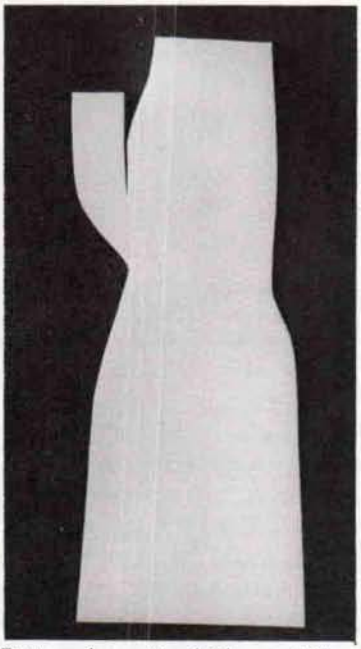

Fig. 6. Pattern for mitt which was tailored in 2-ply Orlon/Lycra® . In this case the elasticity of the fabric is imperative.

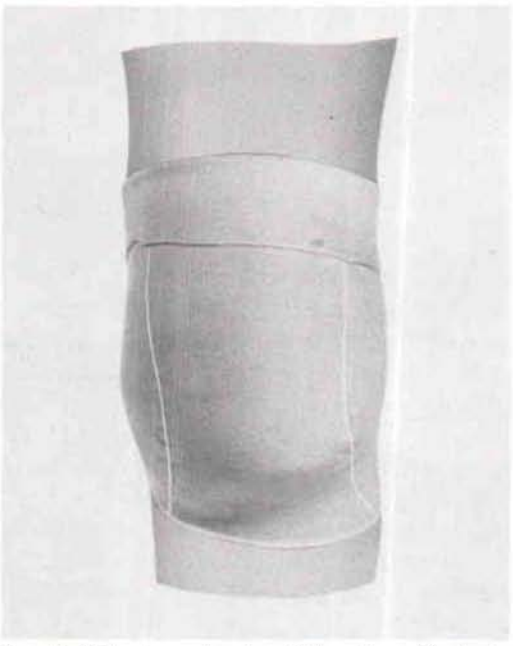

Fig. 7. Side view showing Orlon/Lycra® body seamed to wool panel to pad and protect sensitive areas.

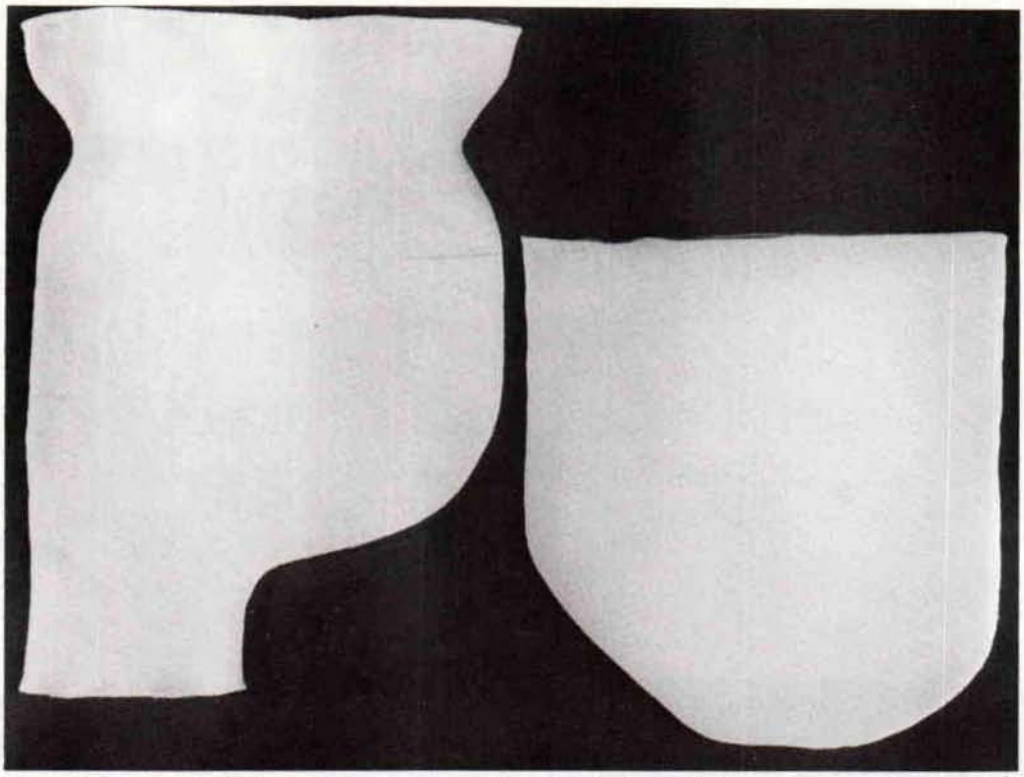

Fig. 8. Hip disarticulation sock (left) was tailored with a smaller waist and added protection for the unimpaired leg. Bilateral sock (right) was made smaller on one side for a snugger, wrinkle-free fit.

putee will find that the elasticity is retained for the life of the sock. Orlon/Lycra hip-disarticulation socks and regular socks are ordered in regular wool sizes but will measure up to 10 percent less than the same sized sock to assure proper fit considering the elasticity of the yar as well as of the knit. Orlon/Lycra® socks with the wool panel should be washed like a wool sock.

Main Conclusion

Prosthetists should now feel that all amputations can be correctly fitted with wool or Orlon/Lycra® socks to give comfort and protection to the amputee. They should also be aware that socks knitted or tailored of 2- or 3-ply Orlon/Lycra® yarns allow for snugger, smoother fittings and easier maintenance by the amputee.

Acknowledgments

I wish to express sincere thanks and appreciation to William B. Smith, Larry Pierce, and the entire Production Dept. of Knit-Rite, Inc. for their guidance and cooperation in developing these new techniques and adapting them to the specific needs of amputees.

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4. Smith, Wm. B., *Stump socks and amputee comfort. Orthop.* and *Pros. Appl. J.*, March 1965.

5. The Knit-Rite Story, Knit-Rite, September 1970.

6. VA Marketing Division for Medical Equipment; Cotton, wool and Orlon acrylic-Lycra spandex stump socks. Veterans Administration, 1st floor, Bldg. 50, Hines, Ill. 12, August 1972.

Footnotes

[1]Research & Development Co-ordinator, Knit-Rite, Inc., 2020 Grand Ave., P.O. Box 208, Kansas City, Mo. 64141.

Orthotics and Prosthetics, Vol. 32, No. 1, pp. 16-19

A NEW NON-INVASIVE HALO ORTHOSIS FOR IMMOBILIZATION OF THE CERVICAL SPINE[1]

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A. G. Hadjipavlou, M.D., F.R.C.S. (C)[3]
G. Berretta, C.O. (C)[4]

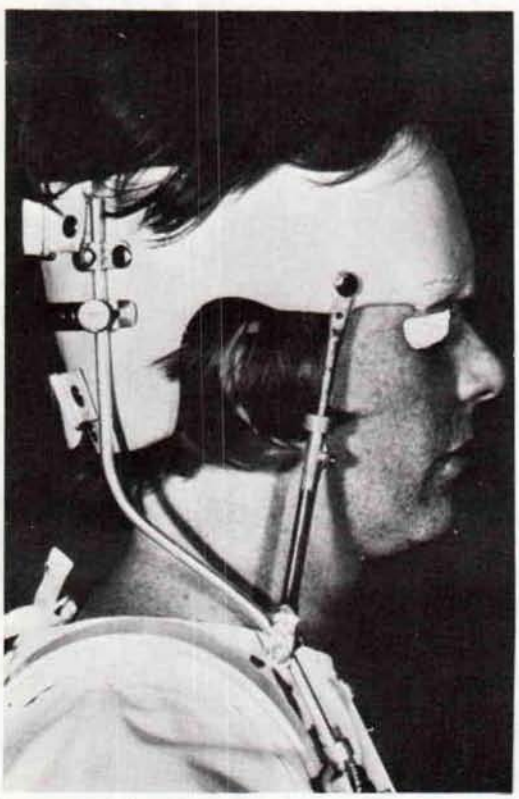

Fig. 1. The head component is moulded on the patient's head and attached to the sternal component by two posterior bars and two anterior uprights. Note that the chin is free and the orthosis does not interfere with opening of the mouth.

Because of the failure of the previous orthoses, except for the "halo" device, to immobilize the cervical spine and the disadvantage caused by the continued wearing of the mandibular immobilizing component, a new non-invasive halo orthosis has been designed.

Biomechanically, this orthosis is a total-motion control device. However, the chin is free, and thus undesirable movement from the temporomandibular joint is not imparted through the head to the cervical spine during the act of chewing and talking (Fig. 1). A special feature of this orthosis is that there are no undesirable forces applied over the temporomandibular articulation. Cineradiographic studies have shown that the spine remains almost immobile. The cervical spine is also partially unloaded from the weight of the head.

It is our opinion that this orthosis is almost the treatment of choice whenever rigid immobilization of the cervical spine is indicated. We have used this orthosis for conservative treatment of fracture of the cervical spine as an immobilizer following cervical spine surgery. We treated 20 cases (1), who had extremely unstable cervical spines with excellent results regarding healing and stability.

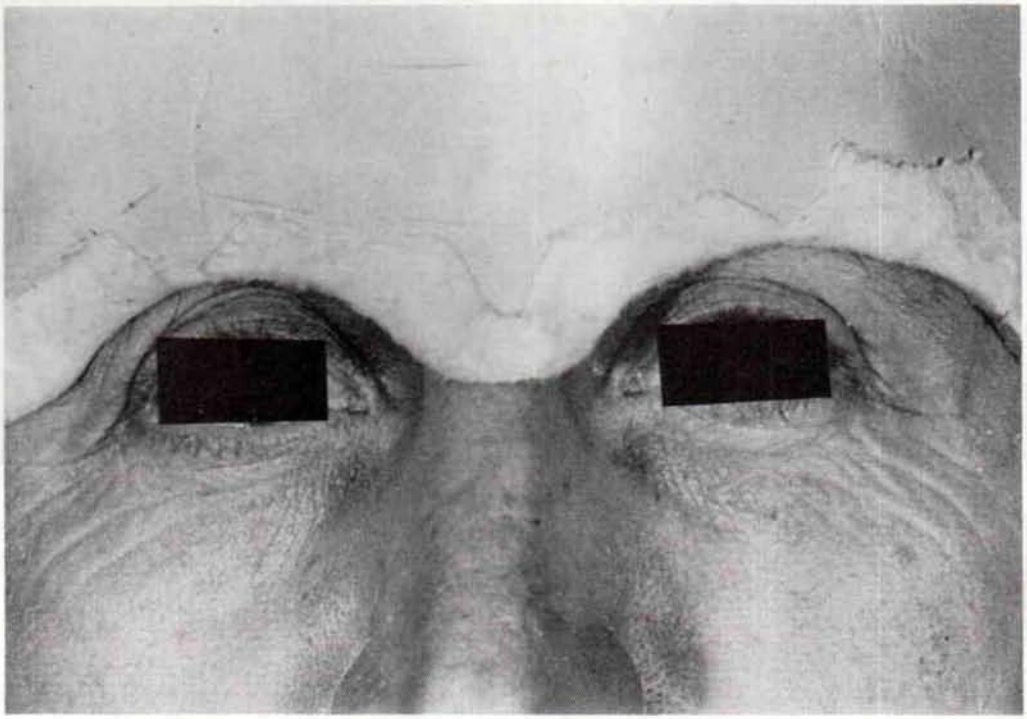

Fig. 2. the proper contour of the head component of the non-invasive halo orthosis.

Design and Fabrication

Construction materials include San-splint, steels (pre-moulded), Velcro straps, aluminum rods, iron rods, shoulder straps, foam, and felt. San-splint is a thermoplastic material that becomes pliable when heated in water at 120 deg. F., and thus can be moulded directly over the patient's head (Fig. 2).

A pre-moulded thoracic appliance with shoulder extensions, forming the thoracic component, is then applied to the patient's chest. When the head mould and thoracic mould are in the proper place, the orthosis is aligned with posterior bars which are fitted just in front of the occiput and curve anteriorly to be connected to the thoracic piece (Fig. 1).

An additional pair of uprights that are adjustable for height are attached to the temples and to sternal outriggers. The chest piece is held over the base of the neck by shoulder rests which are strapped to the lower end of the chest piece by axillary straps. The shoulder rests are placed close to the neck so that motion at the shoulder does not impart movement to the head component of the orthosis.

Finally, a Velcro strap to close the head piece is used on the back of the head (Fig. 3). The orthosis can be adjusted to position the head as required. If pressure areas are found directly over the bony prominences, the shape of the head mould should be readjusted. Because it is made from a thermoplastic material the contour can be changed by heating it and remoulding (Fig. 4).

In order to prevent the head from shifting and take the pressure from the head piece

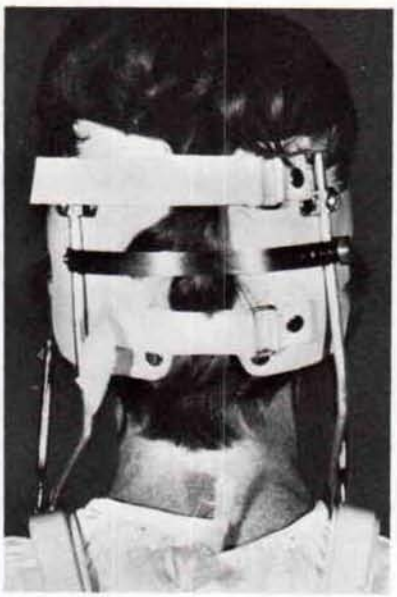

Fig. 3. The head piece is closed posteriorly by a Velcro strap. Tension can be adjusted by the patient.

when the patient is in a recumbent position, a chin plate can be fitted at the chest component.

This mandibular immobilizer is needed mostly at night (Fig. 5) and is seldom, if ever, necessary during the daytime. The chin plate can be removed easily for eating, shaving, etc. and also can be attached to the sternal component before the halo in order to prevent motion while immobilizing an unstable spine or fitting the orthosis to a patient under traction.

Summary

A new non-invasive halo orthosis was presented. It is a versatile total-motion control device that has been used for fractures of the cervical spine and as an immobilizer following cervical spine surgery.

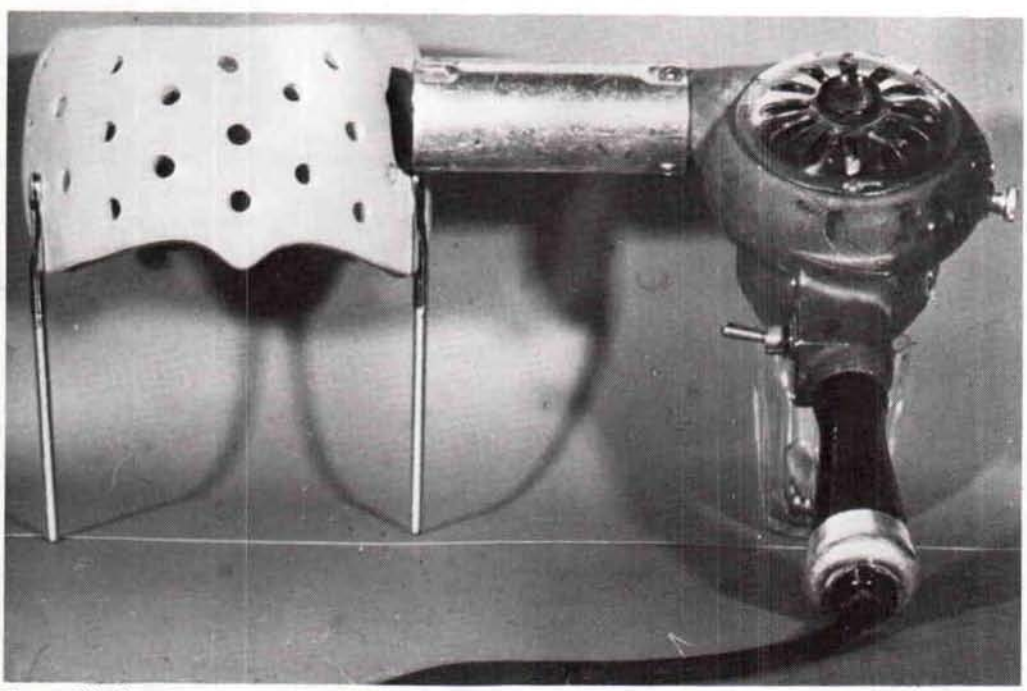

Fig. 4. The head component of the prosthesis is a thermoplastic material and thus can be easily remoulded by heating with a heat gun.

Fig. 5. Anterior view of the Wilson Orthosis properly made and fitted. Note that the chin piece can be removed easily and fitted by the patient. The orthosis is needed mostly at night.

Sommaire

Dû aux échecs des orthèses précédentes et de leurs inefficacités d'immobiliser correctement la colonne cervicale (excepté le halo device) ainsi que l'enorme désavantage de la pièce mentonnière, une nouvelle orthèse a été inventée avec succès.

Cette attache, du point de vue mécanique, est un dispositif de contrôle total des mouvements. Ceci est un type d'immobilisation halo "non-invasive." La pièce mentonnière, ne se porte que la nuit.

Dans cet appareil, le menton est libre et par conséquent aucun mouvement n'est transmis (quand le patient parle, mange etc. . .) à travers l'articulation temporo-mandibulaire pour atteindre le crane et la colonne cervicale.

Cette attache serait presque le traitement de choix pour une indication d'immobilisation rigide de la colonne cervicale.

Footnotes

[1]This work was carried out from the Department of Orthopaedics, Reddy Memorial Hospital, Montreal, Quebec and the Laboratory of J. E. Hanger of Montreal.

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[4]Certified Orthotist (C) President, J. E. Hanger of Montreal. Address reprint requests, J. E. Hanger, Ltd., 4259 St. Catherine Street West, Westmount (Montreal), Quebec H3Z 1P7

Orthotics and Prosthetics, Vol. 32, No. 1, pp. 20-24, March 1978

THE IOWA KNEE ORTHOSIS

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John Albright, M.D.[3]
Harley Feldick, M.D.[4]

The Iowa Knee Orthosis (Fig. 1) is a custom made device that provides maximum collateral ligament support while allowing a relatively normal amount of flexion about the lax knee joint. It uses either metal or plastic polycentric joints to provide the necessary support medially and laterally and polypropylene cuffs molded to the contours of the leg and thigh. A medial supracondylar indentation, similar to the medial wedge so well known to students of below-knee prosthetics, makes the orthosis self-suspending. The orthosis weighs between 1½ and 2½ kilograms, depending on the type of joint used. It is indicated for medial-lateral knee instability and for prevention of anterior-medial "giving way."

A review of the literature reveals at least twelve devices that have been designed to improve knee stability (Fig. 2). Undoubtedly, many more have never been described. An analysis of these orthoses delineates certain common purported goals:

1. Control of support or recurvatum
2. Control or support of medial-lateral instability
3. Rotational control
4. Prevention of knee instability in the weight-bearing, and often painful, stance phase of gait (Fig. 2)

To accomplish these objectives, many designs of materials have been utilized, leaving the observer to wonder what the more per-

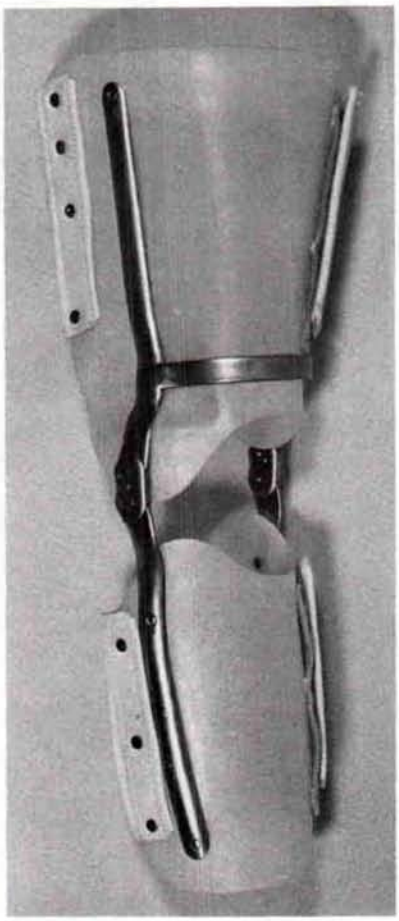

Fig. 1. Anterior view of Iowa knee orthosis. Metal polycentric knee joints are used in the version shown here.

KNEE ORTHOTICS (KO)

Name	Indication(s)	Credit	Date
Extension KO	Extend Knee, Prevent Flexion	H.H. Sinclair	1879
Molded Plastic Hinged KO	Mild Recurvatum	Sinclair	1967
Romer-Willen Knee Guiding Brace	M-L Instability	W. Nyga	1968
Molded Plastic KO (PTS)	Mild Recurvatum	Nitschke, Marschall	1968 1972
Swedish Knee Cage	Mild Recurvatum	Lehneis	1968
Michigan Brace	Recurvatum & M-L Instability	Smith Cook	1969
Supracondylar Orthosis (SK)	Recurvatum & M-L Instability	Lehneis	1972
Lenox Hill KO	M-L Instability	Castiglia	1972
Hinged KO	M-L Instability	Palumbo, Dixon	1975
External Cruciate Ligament Orthosis	M-L Instability AP Instability	Martin	1975
CARS-UBC KO Varus-Valgus	M-L Instability	Cousins, Foort	1975
Iowa KO	M-L Instability	Miller, Albright	1977

Fig. 2. Table showing most of the knee orthoses designed through the years to improve knee stability.

fect orthosis should contain. A list of the minimum requirements would include:

1. Light weight
2. Cosmetic appearance
3. Self-suspending
4. Anatomically accurate, to allow near normal knee motion
5. Durable
6. Capable of withstanding the deforming forces consistent with the disease process
7. Ease of doning and doffing

The Iowa Knee Orthosis meets many of these requirements:

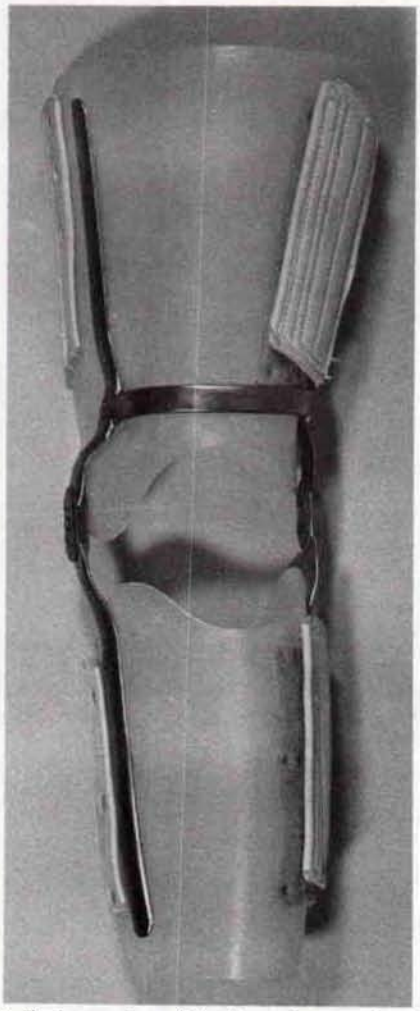

Fig. 3. Early version of the Iowa knee orthosis using stainless steel polycentric knee joints.

1. Its light weight derives from the form-fitted polypropylene molded from a plaster model of the patient's leg. Great care during the casting procedure insures an exacting interface. Two peices of welded 1/8-in. polypropylene form the cuffs.
2. Experience with the more conventional types of knee orthoses revealed that cosmesis ranks high on any patient's list of priorities. In the absence of any waist strap or support to the shoe, the Iowa Knee Orthosis fits well under pants or skirt and does not require special shoes or shoe modification. Only with the extremely obese patient where medial supracondylar suspension is technically difficult and inadequate is it necessary to incorporate a waist strap.
3. By virtue of the self-suspending design, the Iowa Knee Orthosis does not dislocate in flexion as do many other orthoses. The suspension demands that the patient become accustomed to moderate medial femoral pressure caused by the wedge-type suspension, similar to that caused by the medial wedges when used in PTB prostheses.
4. The design of the polycentric knee hinges allows nearly normal knee motion. Although the first generation orthoses were constructed with stainless steel polycentric joints (Fig. 3), the new orthosis incorporates a nylon polycentric joint that to date appears to function well (Fig. 4).
5. Durability has been remarkable. An offensive tackle of the Iowa football team played in all ten games of the 1976 season with one of our orthoses with stainless steel joints. (The conference officials do allow this type of equipment with only minor modification.)
6. In addition to being durable, the orthosis must endure the stress induced by various diseases. In our experience,

the orthosis is capable of withstanding forces both from within and without while allowing the patient freedom of knee motion in the desired planes. Additionally, patients are protected during sleep in the early postoperative period, when repairs may be vulnerable.

7. The patient is able to easily don and doff the Iowa Knee Orthosis, which is not always the case with other KO's. It relies on two 15 cm-wide posterior elastic straps which yield sufficiently to prevent hamstring tendon impairment, yet the cuffs remain in proper location. Closure is easily accomplished with one hand, making it ideal for any aged patient.

Of the first 123 cases fitted with the Iowa Knee Orthosis, the most common indication was postoperative protection for surgically repaired ligaments. The orthosis is fitted as soon as the edema has subsided and the patient is ready to begin the postoperative exercise program. Most patients complete isometric exercises with or without crutches while wearing the brace 24 hours each day to provide control of the knee without needless immobilization, which has been shown in dogs and monkeys to weaken knee ligaments. A regular rehabilitation program is then begun in an effort to return the patient to the performance test level (PTL) recorded by the University Department of Athletics before competition began.

The orthosis is worn routinely 24 hours per day until the patient reaches 80 percent of that performance test level (PTL), after which the orthosis is worn only during exercise, provided there is full knee ROM and a noncontact life style.

The other large group of patients who have benefitted from the orthosis are those with instability, secondary to chronic knee laxity. As the figures indicate, the Iowa Knee Orthosis has been used as an alternative to surgery, or without further surgery. Other uses include: 1) a preoperative trial to determine if further surgery is necessary; and 2) as an adjunct to total knee replacement.

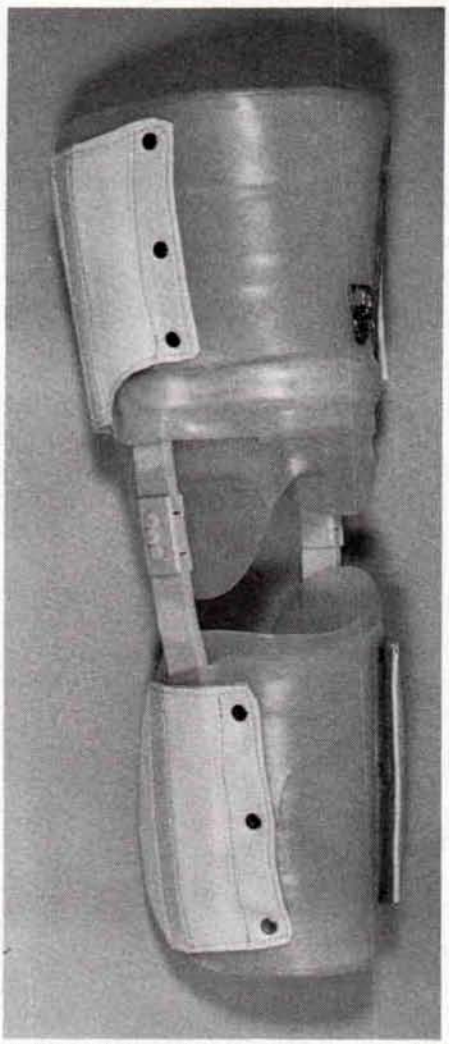

Fig. 4. Later design of the Iowa knee orthosis that uses a nylon polycentric knee joint.

In 20 patients after total knee replacement, the knee instability made walking difficult and painful. In these 20 cases, mostly with rheumatoid disease, the Iowa Knee Orthosis has been helpful in making walking easier. The patients have accepted a self-suspending, plastic KO, and have rejected ones attached to the shoe. In other cases of soft or loose ligaments, the orthosis acts as a useful support allowing those ligaments to heal,

with resultant increased knee stability.

The Iowa Knee Orthosis represents a combination of successful conventional ideas combined in an all-plastic orthosis. The most critical component in its production is the absolute attention to detail required in taking an accurate negative cast. The success of fabrication demands a perfect mold.

Prior knowledge of PTB-wedge casting techniques is extremely helpful. Proper pressure and positioning of the medial suspensory indentation determines the success or failure of the fit.

In conclusion, a description of 123 fittings of the Iowa Knee Orthosis has been presented. Material type, design, and use of the orthosis have been described as part of the total postoperative care of the patient with an unstable knee.

It appears by a review of the uses of the Iowa Knee orthosis:

1. A contour fit provides marginal knees with good M-L stability;
2. Rigid support may afford protection from injury during competition;
3. Polycentric joints allow excellent motion while maintaining a constant fit of the brace;
4. Protection of post-surgical knee is most common indication and added stability may prevent rotational "giving way" when primarily due to medial-anterior-medial/lateral laxity.

Footnotes

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[2]American Prosthetics, 2203 Muscatine Ave., Iowa City, Iowa 52242

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[4]Department of Intercollegiate Athletics, University of Iowa, Iowa City, Iowa 52242

Orthotics and Prosthetics, Vol. 32, No. 1, pp. 25-31, March 1978

PLASTICS IN LOWER-LIMB ORTHOTICS

Warren A. Carlow, Jr., C.O.[1]
Manuel J. Almeida, O.[2]

This article is not designed to introduce any new orthotic devices into the field, but rather to show variations of some previously described orthoses and to demonstrate the unlimited possibilities of plastics in orthotics.

It is our intent to encourage orthotists to consider application for plastics to a greater range of patients, and to exchange ideas and techniques with the hope that more such devices will be prescribed by physicians and clinic teams throughout the country.

Details of fabrication will not be covered since each orthotics facility has its own equipment and techniques.

In fabricating thermoplastic orthoses the orthotist must first evaluate each patient very carefully and plan exactly what is to be done. He can then proceed to measure and cast the patient, modify the cast accordingly, and fabricate an orthosis with a minimum of error, and expense. It is recommended that each orthosis be trimmed as little as possible until the initial fitting, when it is cut down just enough to facilitate donning. The shoe is fitted, the patient walks, and further trimming and adjustments are made to fit each individual patient's requirements.

Follow-up is the most important part in the orthotic management of these patients. Depending on the patient, we usually follow them from three weeks to six months. Some are followed for years as their needs change as they grow older or their condition changes. During this period more alterations are made, such as straps, SACH heel and other shoe modifications, more trimming, padding, etc. to correct and/or support a deformity and eliminate any unnecessary gait deviations. The accompanying photographs show just a few variations of knee-ankle-foot orthoses, ankle-foot orthoses, and plastic insert orthoses.

Valgus of the ankle has always been a problem to control. By using an AFO with a valgus correction strap (Fig. 1) in older patients, especially C.V.A., this system provides a very comfortable and effective means of control. The strap is 2-in.-wide Velcro attached to the inside medial wall at or above the malleolus and extending to the outside lateral wall around the posterior aspect of the orthosis. For static control the medial wall is trimmed more anteriorly and is padded. This system of rigid ankle AFO's and KAFO's is used quite frequently in our area for younger patients with Multiple Sclerosis, Muscular Dystrophy, Cerebral Palsy, and Spina Bifida.

There are so many versions of AFO's that it would take a book to show them all. Again we would like to emphasize individu-

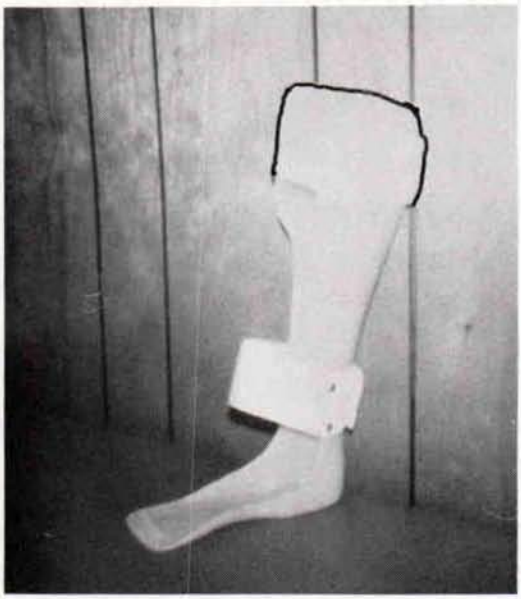

Fig. 1. AFO with valgus correction strap.

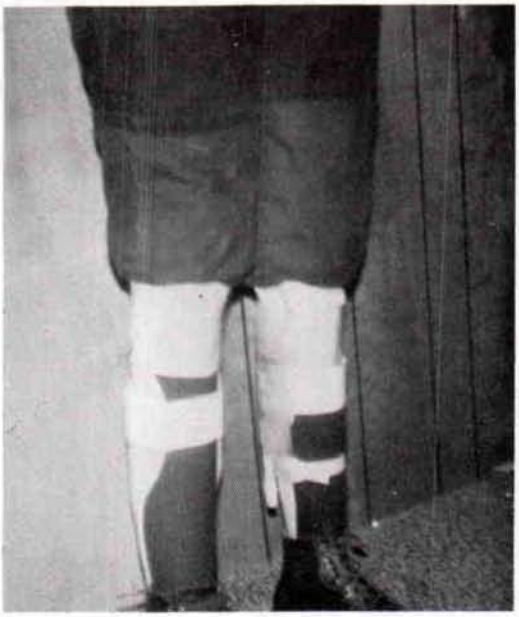

Fig. 2. Bilateral AFO's for spinal-cord-injury patient.

alization of each orthosis, and the need for an extensive evaluation of each patient to determine the characteristics of the orthosis that will best meet his needs.

Figure 2 shows a 23-year-old veteran who had a spinal-cord injury L2 and L3 and who also suffered the loss of the great toe bilaterally. Attempts with conventional bracing were unsuccessful and the devices were discarded by the patient. He was fitted with bilateral AFO's with a rigid ankle which supported his ankles and knees quite well. A full steel shank was applied to the shoes to eliminate toe break which caused irritation to his toes and amputation sites. This patient walks with one forearm crutch and is completely self sufficient.

Figures 3A and B show a similar case, but with a different diagnosis. This Muscular Dystrophy patient's needs were just the opposite of those of the patient shown in Figure 2. Rather than a knee flexion problem he had hyperextension of the knee and a very spastic dropfoot. He was also fitted with bilateral AFO's with a rigid ankle. Neither patient could stand or walk for any length of time. The MD patient was content to use a wheelchair most of the time because it took too much effort to walk. He now uses Canadian crutches and ambulates quite well. This method of rigid ankle AFO's in these type of cases are in reality KAFO's because they are supporting the knee as well as the ankle foot complex.

Figures 4A-C show KAFO's with hinged anterior section. This type of orthosis is used when anterior and posterior control are needed as in a Multiple Sclerosis or Muscular Dystrophy patient. Note high posterior wall and rigid ankle. The angle of the foot and heel height are very critical as these patients are very unstable and can only control about a 5 deg. zone before the knee buckles either forward or back.

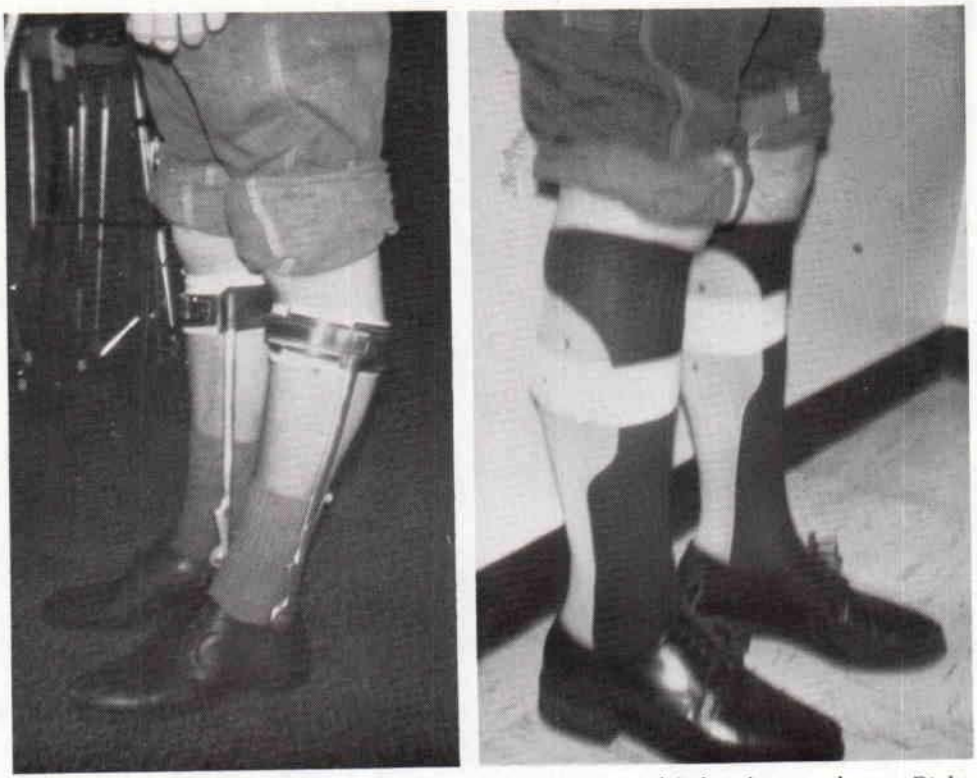

Fig. 3. Left, Muscular Dystrophy patient with conventional below-knee orthoses; Right, same patient wearing AFO's with rigid ankle section.

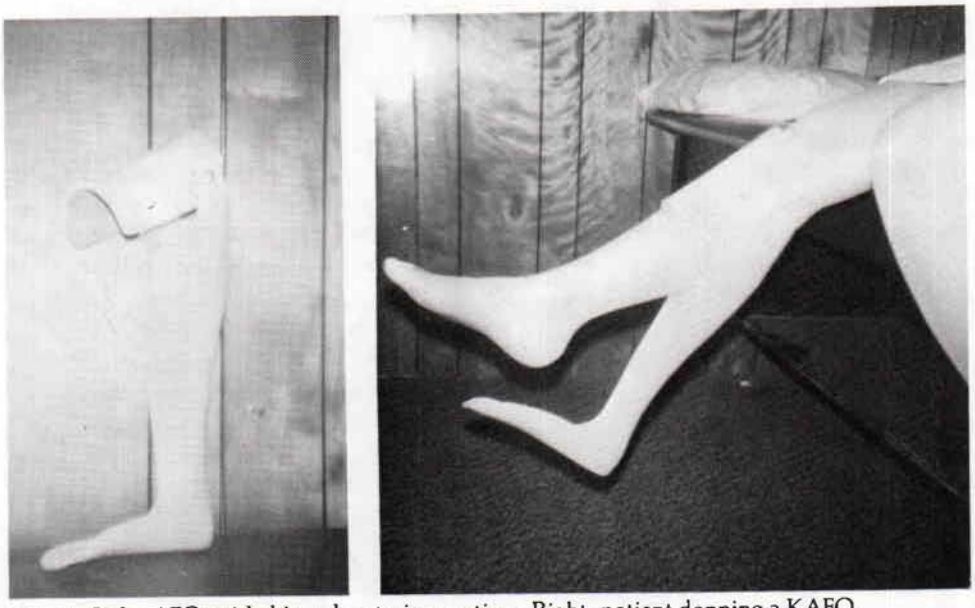

Fig. 4. Left, AFO with hinged anterior section; Right, patient donning a KAFO.

Fig. 5. Spina Bifida patient with bilateral KAFO's.

Figure 5 shows a young Spina Bifida patient wearing bilateral KAFO's with semi-rigid ankles. The medial wall is trimmed more anteriorly to support a valgus condition of the ankles while the lateral wall is trimmed more anteriorly to support a valgus condition of the ankles while the lateral wall is trimmed more posteriorly to let the ankle correct itself. These types of orthoses are also used on Cerebral Palsy and Muscular Dystrophy patients and patients with various below-knee deformities. This particular patient had bilateral knee flexion contractures also.

Figure 6 shows a polypropylene Patella-Tendon-Bearing AFO for use in below-knee fractures or severe foot or ankle deformities or burns where little or no weight can be put on the foot. When using this orthosis with fractures we recommend starting with a rigid ankle and grinding away material to provide more flexibility as the healing takes place. By hinging the anterior section we can leave the posterior aspect more proximal to

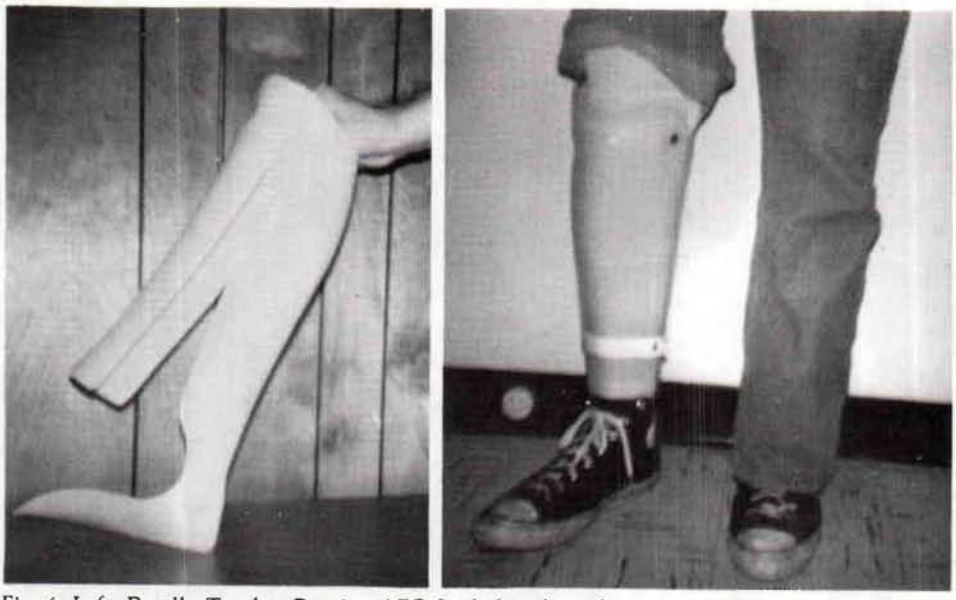

Fig. 6. Left, Patella-Tendon-Bearing AFO for below-knee fractures; Right, patient with distal one-third fracture of tibia and fibula wearing Patella-Tendon-Bearing AFO.

the knee, thus providing more support and elimination of the need for any straps, as in Figure 7.

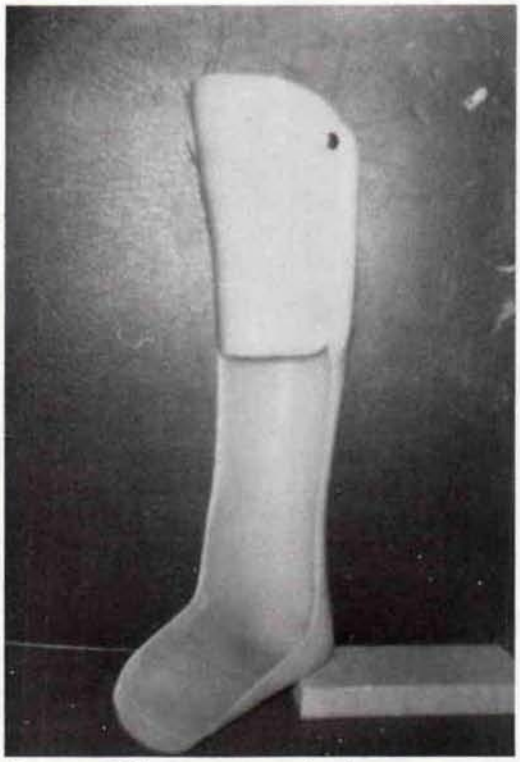

Fig. 7. AFO for Meningomyelocele patient.

Figure 8 shows just one of the many different types of orthoses for the patient who requires an above-knee orthosis. This particular device combines the AFO concept with a quadrilateral socket, below-knee prosthetic knee joints, and an elastic knee extension assist.

Figure 9 shows a conventional above-knee orthosis, with a quadrilateral socket, that we use when a locked knee is required for ambulation, as in above-knee fractures.

Figure 10 represents five years of orthotic treatment of a unilateral postpolio patient.

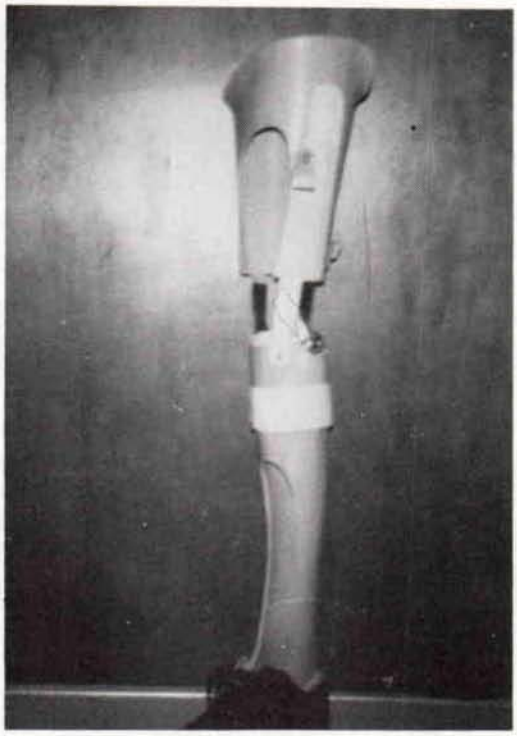

Fig. 8. Laminated HKAFO for bilateral polio patient.

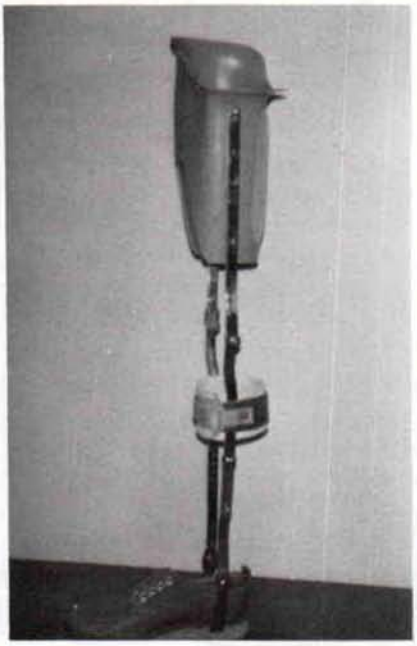

Fig. 9. AK orthosis with laminated quadrilateral socket.

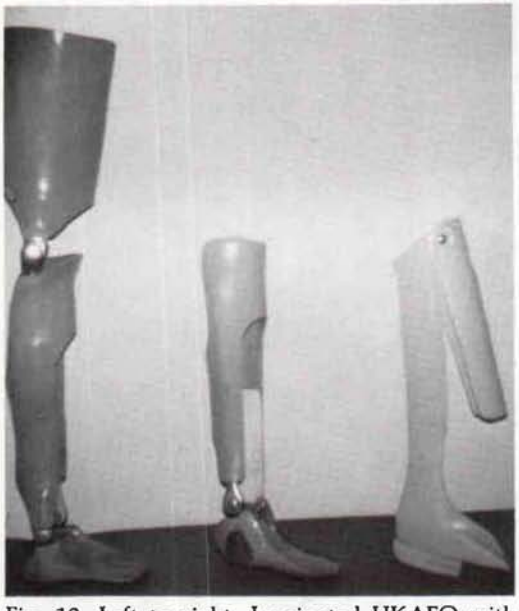

Fig. 10. Left to right: Laminated HKAFO with 180 deg. stop at knee and 90 deg. anterior stop at ankle; laminated AFO with 90 deg. anterior stop at ankle; polypropylene AFO with hinged anterior section, rigid ankle, and SACH heel.

Fig. 11. Polio patient wearing laminated AFO with 90 deg. anterior stop at ankle.

He was first seen with a conventional "long leg brace." He is an exceptional patient, and was determined to walk with as normal an appearance as possible. Because his affected side was the right, he wanted ankle motion so he could drive an automobile, and he was provided with an above-knee laminated orthosis with a 90 deg. anterior stop at the ankle and a 180 deg. stop at the knee using below-knee prosthetic side joints and the AFO concept (Figure 10, left). He wore this for approximately two years, after which it was decided he could do without the proximal portion of the orthosis. A below-knee orthosis was made of similar design which he wore for another two years (Figure 11). He still wanted something better and a polypropylene AFO with SACH heel was made (Figure 10, center). We decided to use an anterior hinged high back AFO (Figure 10, right), because he didn't like the slapping at the knee of his previous orthosis and could not tolerate a posterior strap. The patient walks very well with this orthosis, but we are still working on an orthosis which combines the advantages of the rigid ankle and the movable ankle KAFO.

The KAFO and AFO concept is a very effective means of treating patients with leg-length discrepancies, especially those as a result of polio.

Figure 12 shows a 10-year-old boy with a congenital absence of the femur that resulted in a 10½ in. leg-length discrepancy. This orthosis can be considered a HAFO since the

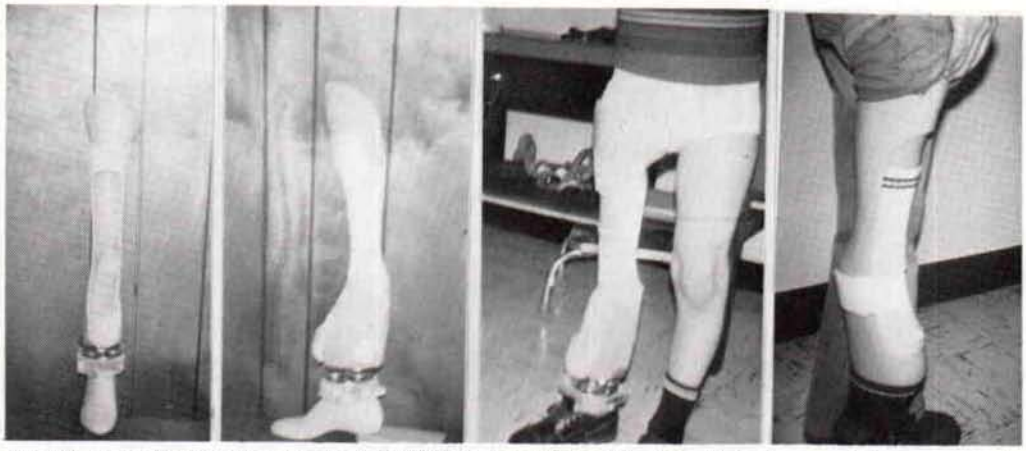

Fig. 12. From left to right: laminated HAFO for patient with congenital absence of femur—anterior view; medical view showing alignment jig and SACH foot; patient at time of fitting; finished orthosis on patient.

proximal anterior portion contains the hip, which is dislocated. Figures 12 shows the orthosis ready for fitting anterior and lateral views with a foam filler, alignment jig, ankle block, and prosthetic foot. A dynamic walking alignment was achieved with the initial fitting (Fig. 12) and the orthosis was completed in the same manner as a conventional below-knee prosthesis. This is the second orthosis of this type for this patient. His first one lasted more than two years before he outgrew it. The only thing he cannot seem to do is ride a bicycle. We will try to overcome this problem with a knee unit in his next orthosis since his right heel should be level with the left knee at that time.

Summary

We have found that as thermoplastics have become more popular in orthotics, especially since the introduction of polypropylene, we have been able to use plastics in an estimated 65 percent of our patients who would normally require a "long leg" or an "above-knee double upright brace." About 80 percent of these patients have been converted to a below-knee plastic orthosis. It is our hope that some new orthotic devices will be developed as a result of this and future articles of this nature. Also it is hoped that orthotists will be encouraged to customize each orthosis to meet each patient's particular needs, rather than provide them with a "standard" model.

Footnotes

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Orthotics and Prosthetics, Vol. 32, No. 1, pp. 32-35, March 1978

A QUICK-CHANGE ANKLE DISCONNECT FOR A BELOW-KNEE AMPUTATION

Ernest Baehr, CPO[1]
John Simek, Orthotic-Prosthetic Assistant[1]

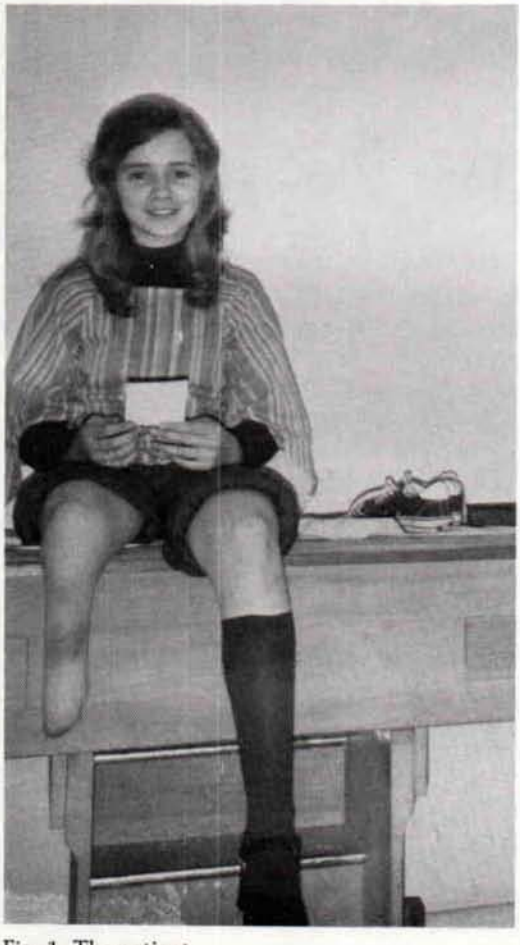

Fig. 1. The patient.

The subject of this study is a 12-year-old, healthy, female with a long below-knee amputation (Fig. 1). She was first seen by us at nine years of age, with the diagnosis of congenital absence of the fibula. She had had a deformed ankle joint, and a shortening of the tibia, but a foot of normal size.

Until her eighth year, when the foot was amputated, she was fitted about every two years with a molded plastic device that provided end-bearing. PTB supracondylar strap type of suspension was used with a posterior opening. Her foot was gradually drawn into equinus to accommodate the increasing shortage of the extremity. She walked very well with these prostheses, but had the discomfort and inconveniences caused by breakages and adjustments that can be expected of an active growing child with her deformity. However, the cosmesis was not good. After amputation of her foot, which gave her a good conical end-bearing stump, whe was fitted with a conventional PTB SACH foot prosthesis. She walked very well, had good cosmetic appearance, and suffered very few discomforts through this growing stage.

When she attained the age of twelve, it again became necessary to replace the prosthesis. When the measurements and the cast-

ing had been performed the mother was asked to bring in a shoe in the style that the girl would like to wear with the stipulation that the heel must not measure more than one inch in height.

Fig. 2. Exploded view of the unit.

A problem became evident when the mother, in a pleading approach and the daughter in a sullen mood, presented me with a pair of tennis shoes, such as all active, athletic girls wear, and a pair of shoes with two-inch high heels, such as every young lady has as her heart's desire. Something had to be done to satisfy the desires of a young lady and a girl and in that way maintain a happy mother-daughter relationship.

Obviously, the solution had to be in providing interchangeable feet. From having watched her over the years and seeing her, to her mother's displeasure, sacrifice good gait for convenience when making the change from shoes to sneakers, I could not impose the inconvenience and lack of control that would result if the bolt had to be removed from the foot every time she wished to change shoes. Costs also had to be justified.

A quick change coupling at the ankle seemed to be the best approach, and it appeared to present the least problem if a tubular pylon construction could be used. Because there was only 2½ in. available for the coupling, I discussed this with Paul Leimkuehler of Cleveland and had to agree with him that the available quick-change wrist

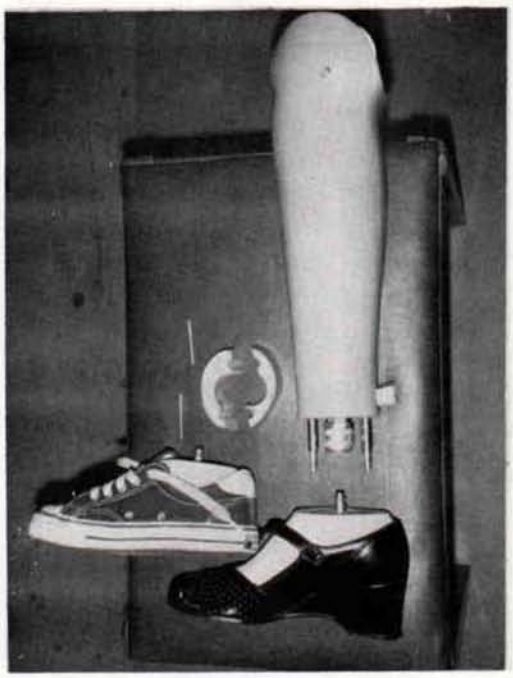

Fig. 3. Partial assembly of the unit.

units would not be strong enough to be used in a below-knee prosthesis for a twelve-year-old girl.

However an air hose coupling (Lincoln Flex-O-Matic automatic air coupling) seemed as though it might be satisfactory. After removing the air seal from the socket

Fig. 4. The unit assembled completely.

Fig. 5. Patient in high heels

part of the coupling, an attachment plate was screwed onto the stud and it was attached to the distal end of the socket block. The nipple stud was then threaded inside to receive the SACH-foot bolt and by attaching a plate to the stem, the nipple unit was inserted and secured in the foot. To control rotation, and to act as locating pins, two ¾-in. rods were threaded and screwed into the distal end of the socket block, anteriorly and posteriorly of the coupling. Corresponding holes to receive the pins were then set into the foot. Sleeves are slipped over the pins to prevent any possible motion. A space-filling block is then made that divides into two

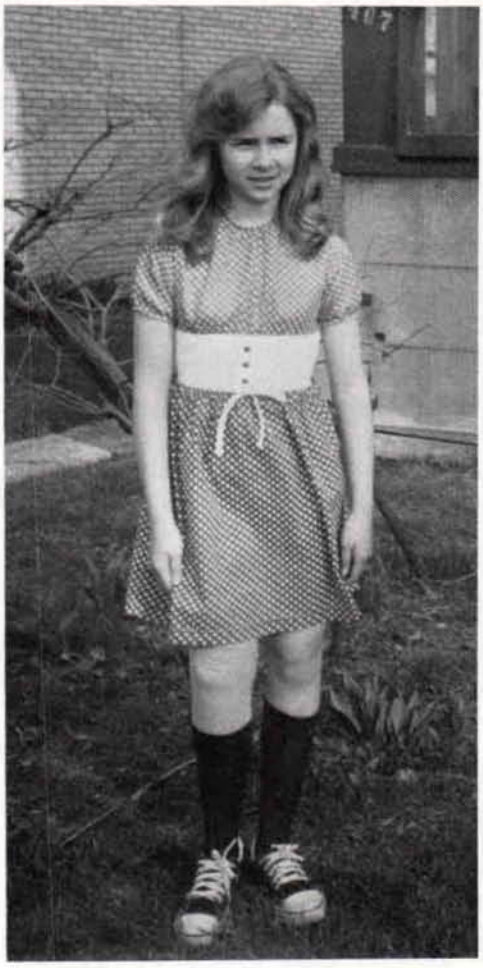

Fig. 6. Patient in tennis shoes

parts so that when a foot is locked into position the blocks are removed easily and an easy upward lift of the slip collar releases the connection. All the parts can be disassembled and disconnected to aid in the finish lamination process, to make adjustments, and for servicing.

The patient has now used this prosthesis for more than three months, and has really enjoyed the function provided by the quick-change coupling. She returned to us once to have an adjustment because an attachment plate had made a ¼-turn off of the bolt. Because the unit is set up on very close tolerances, to function properly all threaded connections must be very secure.

Footnote

[1]Flint Limb and Brace Co., 409 West Third Avenue, Flint, Michigan 48503.

NEW PUBLICATIONS

"PROSTHETICS AND ORTHOTICS INTERNATIONAL"

The International Society for Prosthetics and Orthotics announces the publication of an official professional journal entitled "Prosthetics and Orthotics International."

The core of each issue of the Journal will be scientific, clinical and practical papers on all aspects of prosthetics, orthotics, rehabilitation engineering and related orthopaedic surgery. Although no firm decisions have been made as to the balance of the articles which will appear in each issue regarding disciplines or specialty, they hope to ensure that each individual member will find a large proportion of the material of interest. The first two issues are being devoted to the presentation of up-dated version of papers originally presented at the World Congress in Montreux in 1974. Future issues will be a blend of papers based on ISPO congresses, invited papers and, in particular, papers submitted by the ISPO membership.

Prosthetics and Orthotics International is published three times yearly by the International Society for Prosthetics and Orthotics (ISPO), PO Box 42, DK-2900, Hellerup, Denmark. Subscription rate is $14 (U.S.) per annum, single numbers $5 (U.S.). The journal is provided free to Members of ISPO. The subscription rate for Associate Members is $7 (U.S.) per annum. Remittances should be made payable to ISPO.

Editorial correspondence, advertisement bookings and enquiries should be directed to Prosthetics and Orthotics International, National Centre for Training and Education in Prosthetics and Orthotics, University of Strathclyde, 73 Rottenrow, Glasgow G4 ONG (Tel.: 041-552 4049).

LETTER TO THE EDITOR

Dear Sir:

I would like to call your attention to the omission of part of a chart from the article titled "VAPC Prescription Procedures for Knee Orthoses and Knee-Ankle-Foot Orthoses" published in "Orthotics and Prosthetics" for September 1977.

A chart titled "Lower Limb System" is on page 13 of that issue. The second half of that chart is missing. I would suggest that if your readers are interested in the complete chart, they will find it in the June, 1976 issue of "Orthotics and Prosthetics", pp. 22 and 23.

Gustav Rubin, M.D.
Orthopedic Consultant
Veterans Administration—
Prosthetics Center
New York, New York

ANNOUNCEMENT

The abstracts of all papers presented at the 1977 ISPO-AOPA World Congress along with the names and addresses of all authors are now available from the National Office of AOPA-ABC-AAOP for $7.00. Both of the documents were contained in the package distributed to registrants at the Congress, but there has been a demand for copies for individuals who could not attend and by libraries.

To order *Abstracts* and *Adress List* fill out below and send with $7.00 for each set to cover handling and mailing costs to:

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CERTIFIED PROSTHETIST/ORTHOTIST-The University of Kansas Medical Center College of Health Sciences and Hospital is looking for a certified prosthetist/orthotist to serve as the Director of the Department of Orthotics and Prosthetics.

Applicants should have a B.S. or Associate degree, certification in both prosthetics and orthotics and five years of management experience. Salary is negotiable.

As a result of the expansion of our hospital facilities, we will be increasing the scope of our services. We plan to develop teaching and research activities within our large medical school and allied health professional training program. The latest equipment and applications in Orthotics and Prosthetics are presently being used with the support and cooperation of an active Orthopedic and Plastic Surgery and Rehabilitation Medicine Service.

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CERTIFIED PROSTHETIST-CERTIFIED ORTHOTIST—Large Canadian Firm seeking prosthetist and orthotist to take over complete managerial duties, fringe benefits, health insurance, very good salary, retirement plan. All replies will be handled in strict confidence. Send resume and salary requirements to: Gino Berretta, J.E. Hanger Ltd., 4259 St. Catherine West, Westmount, (Montreal), Quebec, Canada.

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RESOLUTION CONCERNING THE METRIC SYSTEM

The following resolution was adopted by the Board of Directors of the American Orthotic and Prosthetic Association at its meeting in San Diego October 3, 1973:

WHEREAS by Act of Congress it has been determined that the United States should proceed towards adoption of the metric system as used almost universally throughout the rest of the world, and

WHEREAS the technological professions and many segments of the health professions have commonly used the metric system over an extended period of time, and

WHEREAS it is important for members of the orthotic/prosthetic professions to interact with their colleagues in the medical and technological communities for optimum patient service be it hereby

RESOLVED that the American Orthotic and Prosthetic Association endorses the use of the metric system by its members and other orthotic and prosthetic practitioners in the United States, and in witness of this endorsement and Association urges the editors of its journal *Orthotics and Prosthetics* to commence the dual reporting of weights and measurements in both the English and metric systems at the earliest possible date with the objective of employing the metric system solely by the time of the 29th Volume in 1975.

METRIC SYSTEM
Conversion Factors

LENGTH

Equivalencies

angstrom	= 1 x 10^{-10} meter (0.0 000 000 001 m)
millimicron*	= 1 x 10^{-9} meter (0.000 000 001 m)
micron (micrometer)	= 1 x 10^{-6} meter (0.000 001 m)

To Convert from	To	Multiply by
inches	meters	0.0254†
feet	meters	0.30480†
yards	meters	0.91440†
miles	kilometers	1.6093

AREA

To convert from		
square inches	square meters	0.000636†6†
square feet	square meters	.092903

VOLUME

Definition

1 liter = 0.001† cubic meter or one cubic decimeter (dm^3)
(1 milliliter = 1† cubic centimeter)

To convert from	To	Multiply by
cubic inches	cubic centimeters	16.387
ounces (U.S. fluid)	cubic centimeters	29.574
ounces (Brit. fluid)	cubic centimeters	28.413
pints (U.S. fluid)	cubic centimeters	473.18
pints (Brit. fluid)	cubic centimeters	568.26
cubic feet	cubic meters	0.028317

MASS

To convert from	To	Multiply by
pounds (avdp.)	kilograms	0.45359
slugs‡	kilograms	14.594

FORCE

To convert from	To	Multiply by
ounces-force (ozf)	newtons	0.27802
ounces-force (ozf)	kilogram-force	0.028350
pounds-force (lbf)	newtons	4.4732
pounds-force (lbf)	kilogram-force	0.45359

*This double-prefix usage is not desirable. This unit is actually a nanometer (10^{-9} meter = 10^{-7} centimeter).
†For practical purposes all subsequent digits are zeros.

STRESS (OR PRESSURE)

To convert from	To	Multiply by
pounds-force/square inch (psi)	newton/square meter	6894.8
pounds-force/square inch (psi)	newton/square centimeter	0.68948
pounds-force/square inch (psi)	kilogram-force/square centimeter	0.070307

TORQUE (OR MOMENT)

To convert from	To	Multiply by
pound-force-feet	newton meter	1.3559
pound-force-feet	kilogram-force meters	0.13826

ENERGY (OR WORK)

Definition

One joule (J) is the work done by a one-newton force moving through a displacement of one meter in the direction of the force.

1 cal (gm) = 4.1840 joules

To convert from	To	Multiply by
foot-pounds-force	joules	1.3559
foot-pounds-force	meter-kilogram-force	0.13826
ergs	joules	1×10^{-7} †
b.t.u.	cal (gm)	252.00
foot-pounds-force	cal (gm)	0.32405

TEMPERATURE CONVERSION TABLE

To convert °F to °C $\quad °C = \dfrac{°F - 32}{1.8}$

°F	°C
98.6	37
99	37.2
99.5	37.5
100	37.8
100.5	38.1
101	38.3
101.5	38.6
102	38.9
102.5	39.2
103	39.4
103.5	39.7
104	40.0

* A slug is a unit of mass which if acted on by a force of one pound will have an acceleration of one foot per second per second.

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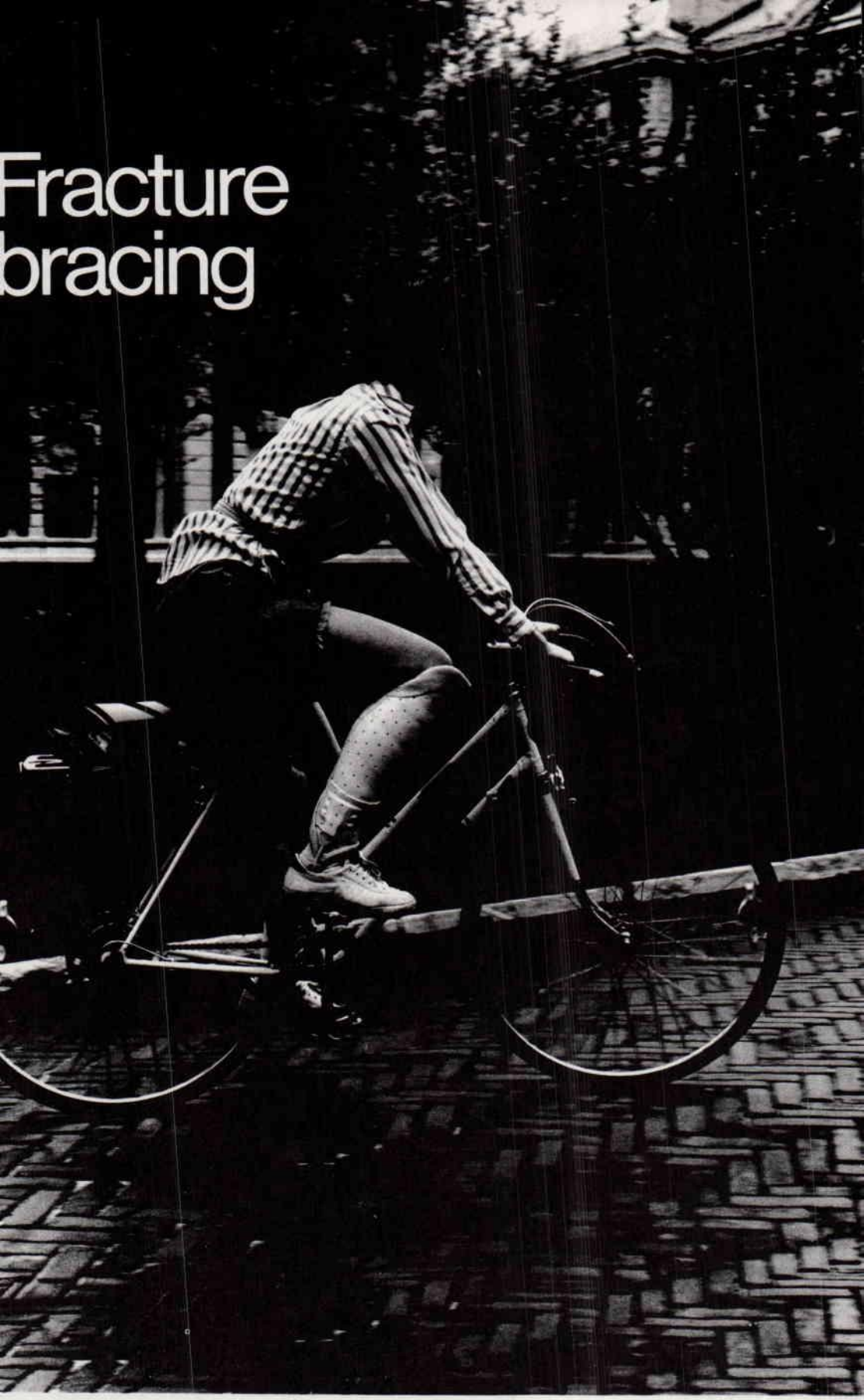
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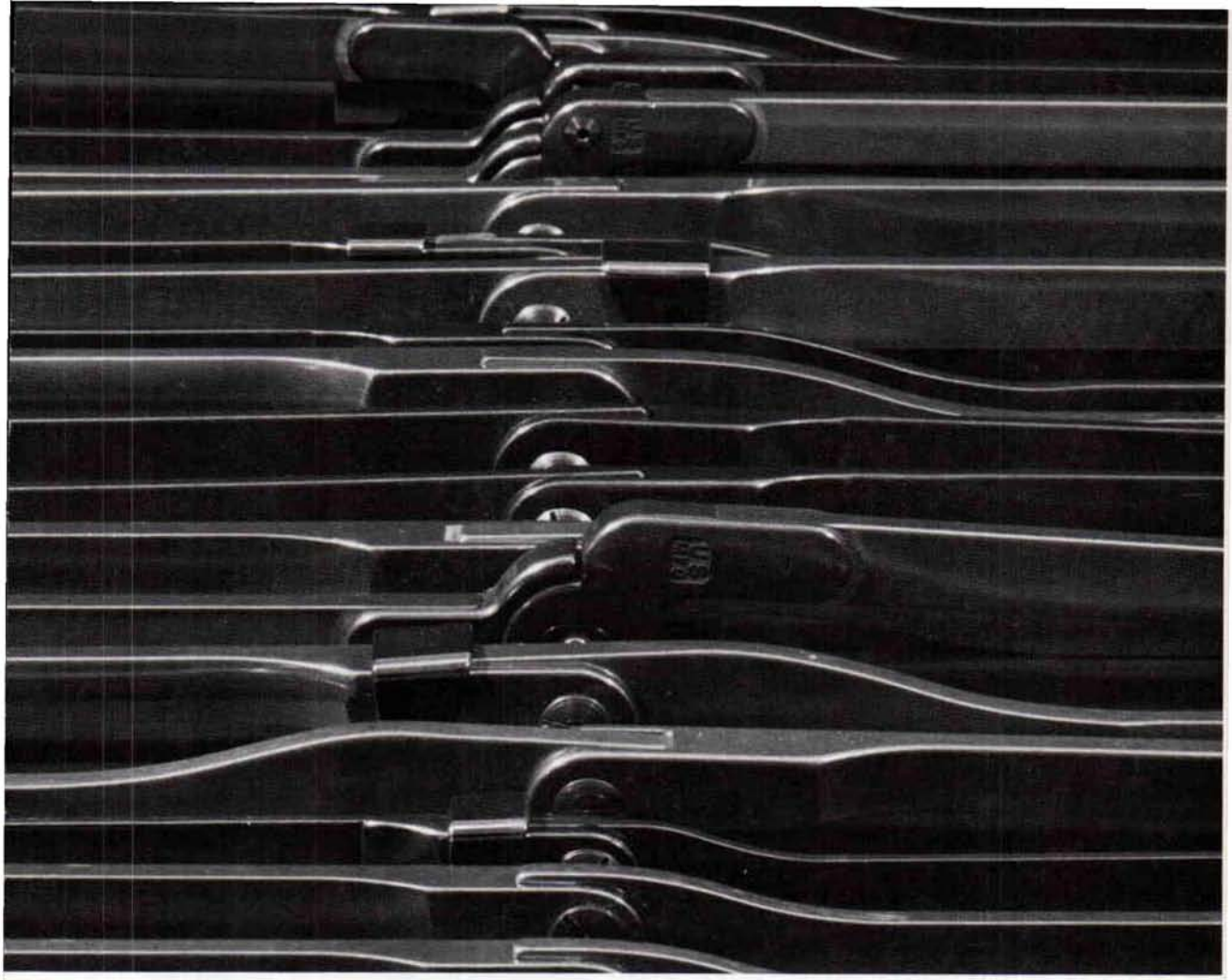

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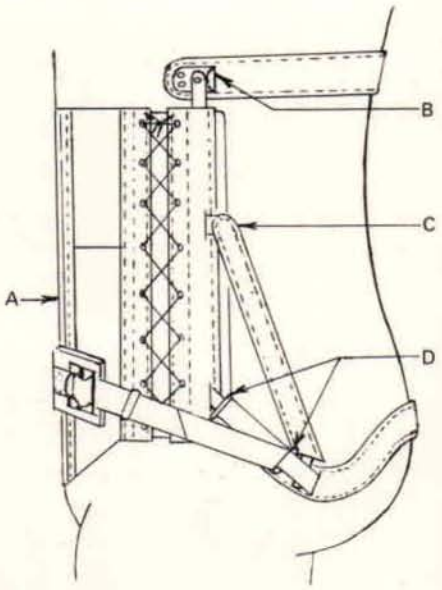

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