

September 1970



orthotics
and
prosthetics

COPYRIGHT © 1970 BY THE AMERICAN ORTHOTIC AND PROSTHETIC
ASSOCIATION, PRINTED IN THE UNITED STATES OF AMERICA,
ALL RIGHTS RESERVED

american
orthotic &



prosthetic
association

VOLUME 24

NUMBER 3

SEPTEMBER 1970

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.

orthotics and prosthetics

THE JOURNAL OF THE
ORTHOTIC AND PROSTHETIC PROFESSION

Contents

- 1 **Flexible Below Knee Socket With Supracondylar Suspension**
James Breakey, B.P.T.
- 11 **The Design of A New Style Ischial Weight-Bearing Brace For Use In The Treatment of Legg-Perthes Disease**
Eric L. Radin, M.D.
Michael M. Amrich, C.P.
- 21 **Brace-To-Body Dynamics**
John Glancy, C.O.

second class postage paid
at Washington, D.C. and at
additional mailing offices

S
Southern **PS** **PROSTHETIC SUPPLY CO.**
CO

Telephone: 875-0066
Area Code 404
POST OFFICE BOX 7428
947 Juniper St., N.E. • Atlanta, Ga 30309

WE WILL BUILD YOUR LIMBS

ANY TYPE – ANY STYLE

SHIPMENT IN 10 DAYS OR LESS

IF YOU NEED PRODUCTION

CALL

Charles White – 404-875-0066

COLLECT

Satisfaction Guaranteed

“Everything for the Prosthetic & Orthotic Manufacturer”

THE AMERICAN ORTHOTIC AND PROSTHETIC ASSOCIATION

OFFICERS

President—**William L. Bartels, C.O.**
Portland, Oregon

President-Elect—**Roy Snelson, C.P.O.**
Downey, California

Vice President—**Mary S. Dorsch, C.P.O.**
New York, New York

Secretary-Treasurer—**Durward R. Coon, C.P.O.**
Detroit, Michigan

Immediate Past President—**Michael P. Cestaro**
Washington, D.C.

REGIONAL DIRECTORS

Region I—**Alfred Schnell, C.P.O.**
Hartford, Connecticut

Region II—**John C. Gallo, C.P.**
New York, New York

Region III—**Phillip N. Pulizzi, C.P.**
Williamsport, Pennsylvania

Region IV—**J. D. Ferguson, C.P.O.**
Chapel Hill, North Carolina

Region V—**Joseph L. Gaskins, C.P.**
Pontiac, Michigan

Region VI—**Walter A. Pawlowski, C.O.**
Gary, Indiana

Region VII—**William M. Brady, C.O.**
Kansas City, Missouri

Region VIII—**Robert V. Bush, C.P.O.**
Albuquerque, New Mexico

Region IX—**Patrick J. Marer, C.P.O.**
Escondido, California

Region XI—**Dale O. Butler**
Portland, Oregon

AMERICAN BOARD FOR CERTIFICATION IN ORTHOTICS AND PROSTHETICS, INC.

President—**Samuel E. Hamontree, C.P.**
Downey, California

President-Elect—**Robert E. Fannin, C.O.**
Columbus, Ohio

Vice President—**Raymond J. Pellicore, M.D.**
Chicago, Illinois

Secretary-Treasurer—**Fred J. Eschen, C.P.O.**
New York, New York

Immediate Past President—**Ralph R. Snell, C.P.**
Memphis, Tennessee

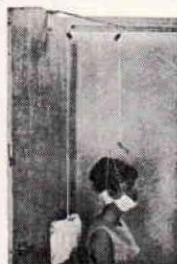
Augusto Sarmiento, M.D.
Miami, Florida

Allan G. Smith, M.D.
Brooklyn, New York

Herbert B. Warburton, Executive Director
Audrey J. Calomino, Asst. Executive Director

TRU-EZE

QUALITY AND DEPENDABILITY
AT COMPETITIVE PRICES



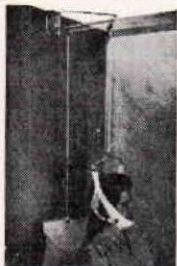
OD-4

"LOW-BUDGET" TRACTION SETS

TRU-EZE (over-door) Traction Support with Spreader Bar, "Diskard" Head Halter and Weight Bag. See HH-53 Head Halter Page 22 in TRU-EZE Catalog.

LIST PRICE **\$5.75**

Write for Quantity Discounts.



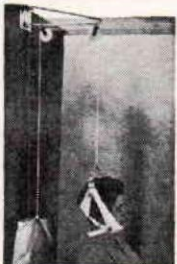
OD-3

"ECONOMY" TRACTION SETS

TRU-EZE (over-door) Traction Support with Spreader Bar, "Economy" Head Halter (med.) and Weight Bag. See HH-52 Head Halter Page 22 in TRU-EZE Catalog.

LIST PRICE **\$7.00**

Write for Quantity Discounts.



OD-5a

DELUXE SETS (NYLON PULLEYS)

TRU-EZE (over-door) Traction Support with 12" Spreader Bar, "TRU-TRAC" Deluxe Head Halter HH-51 (S-M-L) and Weight Bag. See HH-51 Head Halter Page 22 in TRU-EZE Catalog.

LIST PRICE **\$11.25**

Write for Quantity Discounts.

For complete details and specifications, write . . .



TRU-EZE

TRU-EZE manufacturing co., inc.

Traction Specialties

P. O. BOX 855 • BURBANK, CALIFORNIA

Index to Advertisers

September 1970

C. H. Alden Shoe Co.	Inside Back Cover
Atco	XXIV
Becker Orthopedic Appliance Co.	XXVIII
S. H. Camp and Co.	XVIII, XIX
C. D. Denison	XXII
The Irving Drew Corp.	IX
Fillauer Surgical Supplies, Inc.	VII
Florida Brace Corporation	V
Freeman Manufacturing Co.	VI
Herbst Shoe Manufacturing Co.	XXVI
Hosmer, Inc.	XV
The Joseph Jones Co.	IX
James R. Kendrick Co., Inc.	XIV
Kingsley Manufacturing Co.	XXI
The Knit-Rite Company	XX
L. Laufer & Company	XXVII
Markell Shoe Company, Inc.	XXIII
The Ohio Willow Wood Co.	IV
Pel Supply Co.	XVI
Robert O. Porzelt	XVII
Realastic Industries	XXVII
Roden Leather Co.	XXVIII
Sabel Division, C. H. Alden Co.	XIII
Sabel Co., Potvin	XXIX
Southern Prosthetic Supply Co.	II
Sutton Shoe Manufacturing Co.	VIII
Trautman	XII
Tru-eze Manufacturing Co., Inc.	IV, VIII
Truform Anatomical Supports	X, XI
United States Manufacturing Co.	XXV
C. N. Waterhouse Co.	XVII

EVERYTHING

for the

Prosthetic Industry

The Ohio Willow Wood Co.

79-85 Chestnut Street

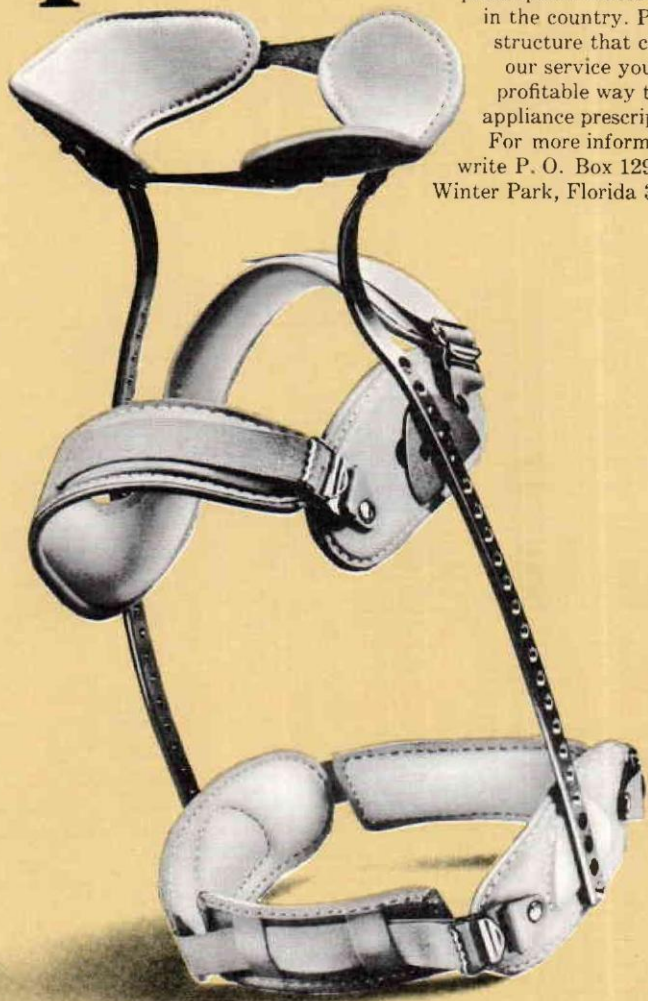
Mount Sterling, Ohio 43143

Rigidly spinal

Spinal appliances are our only product. They're sold only through ethical dispensing orthotists. So we try to make each of our collars and braces the best of its kind - like our new Two-Post Cervical Brace - for maximum acceptance by your doctors and patients. And we back them up with service to you.

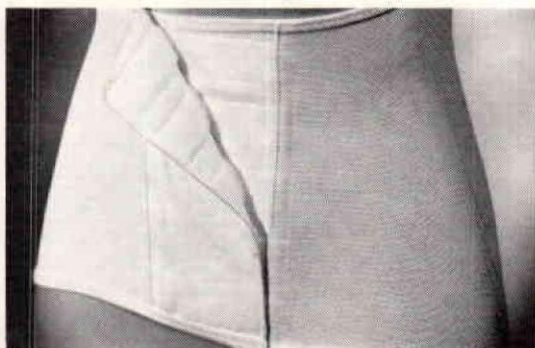
Service like 24-hour delivery of prescription braces anywhere in the country. Plus a price structure that can make our service your most profitable way to fill spinal appliance prescriptions.

For more information, write P. O. Box 1299, Winter Park, Florida 32789.



Florida Brace Corporation

no hooks
no snaps
no buckles
no straps



introducing an
exclusive, new perfectly
contoured all-elastic
support from Freeman
that's easy on... easy off!

Now, an orthopedic support
that's as simple to put on and
take off as it can be. Thanks to
the easy adjustment Velcro™
front. This makes it a natural for
older patients. Available in

men's and women's Dorso-
Lumbar and Sacro-Lumbar mod-
els with steel brace stays. These
all-elastic supports are cut over
tried and proven Freeman pat-
terns. Write for full information.

Freeman

FREEMAN MANUFACTURING CO.
Box J, Sturgis, Michigan 49091

THESE TOO (2)

WILL BE IMITATED

1. RUHRSTERN ELASTIK PLASTER BANDAGE

Sizes 3, 4 and 5 inch. Edges are finished to provide neater appearance. NOT stretched therefore handles easier. Fillauer — first with elastik plaster.

2. NEW Low PROFILE DETACHABLE DENIS BROWNE NIGHT SPLINT

Free, exclusive locking wrench and protractor. Offset Bar permits child to stand without danger. Lengths 4 to 36 inches. Fillauer — first with this new detachable splint.



Fillauer

Surgical Supplies, Inc.

Box 1678

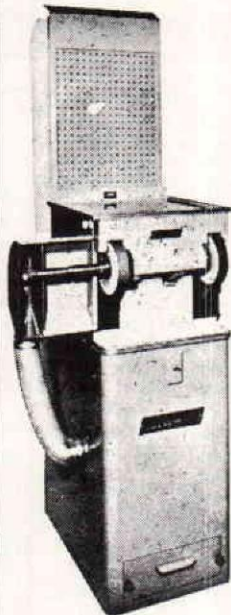
Established 1914

Chattanooga, Tenn.

SUTTON SANDER SPEEDS CUTTING TIME BY 40%!

BELTS LAST FOR MONTHS

Designed especially for the limb and brace profession. Compact, fast-cutting sander uses 60-inch belts with 12-second change feature. Powerful exhaust collects dust in a drawer. Quick change fitting accommodates flap emery wheel, naumkeag sander, or metal cone shaped cutter. Oiled for life. Only 51" high, 19" wide, 27" deep. In daily use by orthotists all over America. Send coupon today!



Sutton Shoe Machinery Co.

8053 Litzsinger Rd., St. Louis, Mo. 63144 Mission 7-0050

Offices in Principal Cities

Please send complete information on Sutton's SJ 2-0.

Name.....

Firm.....

Address.....

City..... State..... Zip.....

AT LAST!

AN ADJUSTABLE DISPOSABLE HEAD HALTER!

- Maximum flexion angle guaranteed.
- Exclusive 5 position adjustment.
- One Universal size—fits all heads.
- Priced in the disposable field.

DISK·A·FLEX®

WRITE FOR SPECIFIC INFORMATION TO:

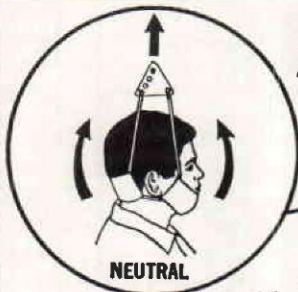
TRU·EZE manufacturing co., inc.

Traction Specialties

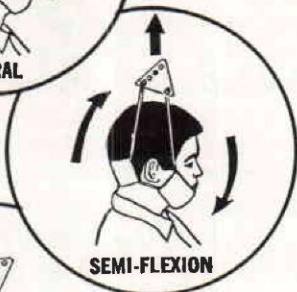
P. O. BOX 855 • BURBANK, CALIFORNIA



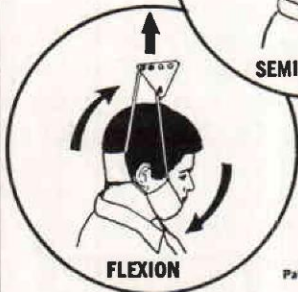
Patent No. 3046980



NEUTRAL



SEMI-FLEXION



FLEXION

Specially Designed For Brace Work



Look at some of the features of our famous
"Brace Shoe."

- Leather Sole
- Long Counter
- Extra Strong Steel Shank

YOU CAN USE THIS SHOE
WITH COMPLETE CONFIDENCE.

Sizes 5 - 13 in varying widths. Extra
large size range also available.

Colors: Black, Smoke, White, Sage
Green Gluv and Antique Brown
Crushed Kid. Mismatch Service
on Black Only.

Write For Free Catalog



The Irving Drew Corporation

Lancaster, Ohio 43130

DREW - DR. HISS - CANTILEVER GROUND GRIPPER

NO LEATHER LIKE JONES LEATHER

For Appliances and Artificial Limbs



**Specially Tanned So Color Will Not
Fade Off and Soil Under Garments**

**Buckles, Rivets, Plastics, Webbing
and other items**

WRITE FOR SAMPLE CARDS AND PRICES

THE JOSEPH JONES COMPANY

225 LAFAYETTE STREET

NEW YORK, N. Y. 10012

What every dealer should know... about **TRUFORM** orthopedic appliances

Truform has furnished the best possible orthopedic appliances since its inception in 1893. Furthermore, the company has the fundamental policy to make orthopedic appliances of greater quality than has yet been known, and it accepts this responsibility continuously as a customer trust.

Whatever your orthopedic appliance needs . . . from splints to cervical braces . . . Truform stands ready to help with their complete line of traction, splinting and bracing. Besides this, they have a full selection of surgical and orthopedic corsets.



Model #947 WP



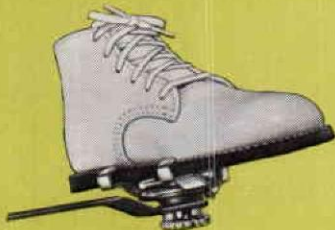
Model #782 Cock-Up Wrist Splint

A very unique appliance that is capable of delivering support to immobilize the wrist area. It is made of soft, yet durable leather and comes in 6 sizes, either left or right. #771 is exactly the same, but the material is heavy canvas.



Model #907
 Denis Browne Splint —
 Rivet Type

This splint aids the correction of club-feet, positional and tibial deformities and congenital hip dislocations. The rotating protractor has clear markings every ten degrees enabling the setting to be extremely accurate. A solid one-piece rivet type plate comes in two standard sizes, 3" and 4". The extension bar is available in lengths from 6" to 16" in one inch increments.



Model #908
 Denis Browne Splint — Clamp-On Type

This model is similar to the #907, but it differs only in its adaptability to the shoe. The clamp will accept variable sole thickness without slippage.



Model 997 Cervical Brace

It provides fixation and extension to the cervical spine. Separate adjustment of the chin and occipital pieces give proper angulation. It has four separately adjustable uprights that permit a more positive degree of fixation and extension.

For congenital hip dislocations, it extends only the width of the crotch area, and is very lightweight. Soft leather inner straps combine to make this appliance most comfortable. The closure is by Velcro straps in front which facilitate easy nursing care. Two sets of snaps, one upper and one lower, allow each size to adjust 3".

Model 911 Hip Abduction Splint — Plastic



Model 904 Two Piece Shoulder Brace

This brace crisscrosses in the back, and a webbing strap with a buckle anchors the front. It has multiple uses, i.e. use only one side or incorporate with a dorsal extension brace.

To control motion of a fractured clavicle, the #902 effects a fixation of the shoulder joint. The shoulder section is stockinette covered for softness. Completely adjustable.

Model 902 Clavical Splint



Truform Anatomical Supports sold only by Ethical Appliance Dealers.

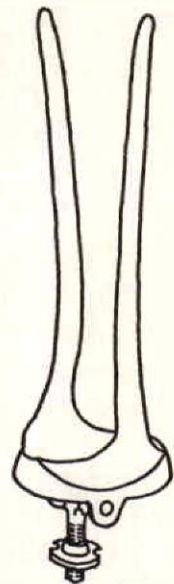
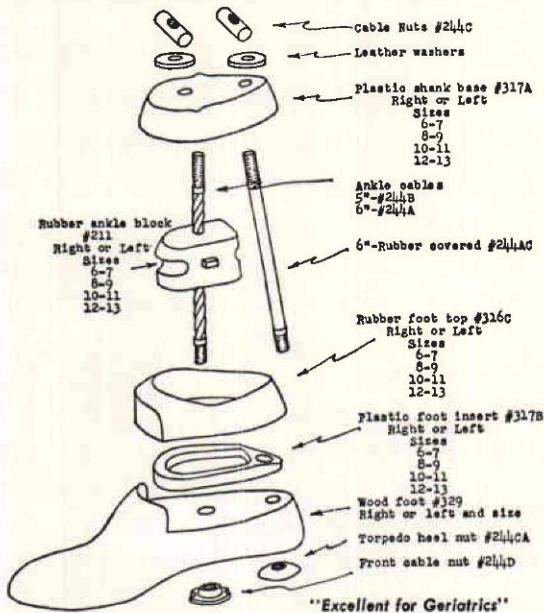
TRUFORM

anatomical supports

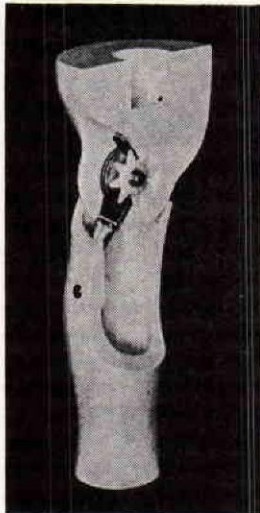
3960 Rosslyn Drive • Cincinnati, Ohio 45209
New York • San Francisco • Texarkana

236T

PARTS FOR RUBBER ANKLE ASSEMBLY



Symes Frame #270A with ankle joint, shaped to cast and measurements.



The new A.K. Friction Unit shown above is a product of the U. S. Manufacturing Co. The unit is based on research at Northwestern University Prosthetic Research Center by Colin McLaurin and the Center's staff.

The Friction Unit provides for three stages in both flexion and extension. One adjustment easily accessible to the amputee provides for the selection of the overall level of friction.

This simple mechanical unit is installed in a specially designed single axis wood knee-shin set-up in standard sizes ready for use by prosthetists.

We are distributors for the above unit, the Hydra-Knee, Hydra-Cadence and all items manufactured by the U. S. Manufacturing Co.

Distributors for U. S. Manufacturing Co.

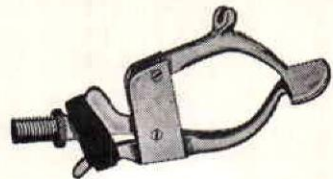


Minneapolis Artificial Limb Co.

Wholesale Division

410 Portland Ave., Minneapolis, Minn. 55415

Trautman Terminal Devices



No. 114 Standard Locktite—Length 4 $\frac{1}{8}$ "
 #114S length 4 $\frac{1}{2}$ "—#114L length 5 $\frac{1}{2}$ ".
 Voluntary opening, automatic closing. Grips firmly, locks when closed, forming ring for holding pitchfork, shovel and various tools. Connection fits ball terminal on cable.

**BRACE JOINTS
 FRENCH LOCK
 DROP-LOCK
 FREE
 ALUMINUM STEEL**



TRAUTMAN Supplies

A NEW PRODUCT OF MODERN RESEARCH

Sabel gets all the breaks . . .



Sloping, padded no-chafe top line. Extra wide, 7" padded tongue accommodates swellings and bandaging.

with the new all-purpose AM-BOOT!

The most versatile and accommodating boot ever designed, through clinical experiences and medical requirements.

Helps put a post surgical patient back on his feet . . . makes him ambulatory by providing custom features that anticipate practically all post-surgical problems.

Sabel gets all the breaks . . . because they make their own!

SABEL'S

AM-BOOT

E. J. Sabel Co., Benson—East
Box 644 Jenkintown, Pa. 19046

orthotics and prosthetics



Neutral last with full, squared-off toe. Neither right nor left. Notice elongated heel.



Heavy foam interlining with soft, glove leather lining throughout. Pre-drilled holes in steel shank are marked and located on leather insole.



Steel shank is pre-drilled for easy brace attachment. Heel is extra long to accept angular bracework.

DEMAND THE FINEST FOR YOUR CUSTOMERS

KENDRICK'S

Duo Flex

two-way stretch surgical elastic stockings



Duo Flex is available in garter length, over-knee length and full thigh length.

PRESCRIBED BY PHYSICIANS... SOLD WITH CONFIDENCE

For your customers there should be no substitute for the finest.

The Kendrick Duo Flex Surgical Elastic Stocking is Kendrick's "custom fit" stocking for the more severe varicose conditions. Duo Flex features a uniquely balanced two-way construction: circular pressure for more efficient holding power, PLUS the longitudinal stretch of two-way stretch hose for greater comfort.

A perfect fit Duo Flex is available from stock consisting of 5 sizes in garter length, over-knee length and full thigh length styles. This complete fitting service eliminates the need for special made-to-measure orders.

The seamless contoured heel of the Duo Flex prevents irritation and there is no creasing over the instep. For added customer satisfaction the Duo Flex has soft, absorbent material on the inside for greater comfort and a smooth, nylon exterior for appearance and durability.

Specify surgically correct Kendrick products for your customers. Their confidence in you will result in more frequent repeat sales and higher profits.

You can recommend Kendrick with Confidence

JAMES R. KENDRICK COMPANY, INC.
Philadelphia, Pa. 19144 New York, N. Y. 10016

Kendrick
S I N C E 1 8 5 3

NEW

HOSMER LOWER-EXTREMITY PROSTHETIC COMPONENTS...

NEW

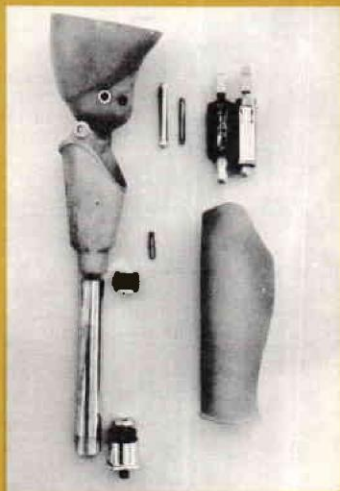
TEMPORARY ADJUSTABLE A/K PYLON



- designed for early post-op use
- easily adjusted up to $1\frac{5}{16}$ " in M-L and A-P planes and 4° tilt in both planes.
- finger adjustments lock in
- spring-loaded knee-lock

NEW

PROSMETIC®/ALLOY KNEE-SHIN ASSEMBLY



- rugged durability and superior cosmesis
- pneumatic or hydraulic swing phase controls
- Prosmetic soft covers (rigid foam neuter blanks available)

NEW

PNEUMATIC SWING PHASE CONTROL



Rugged, easily adjusted, lower cost variable gait swing phase control; serviceable by prosthetist.

HYDRAULIC SWING PHASE CONTROL



Durable, easily adjusted, moderately priced variable gait swing phase control; smooth hydraulic action.

ALSO**NEW**

Adjustable BK pylon for early post-op use, transferable to definitive prosthesis with soft cover; soft covers in range of sizes; compact, versatile new hip joint.



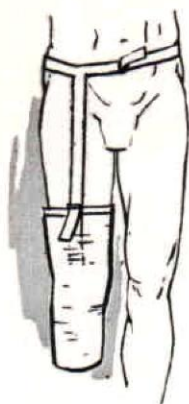
Pioneers and Leaders in Modern Prosthetics

Hosmer, Inc.

... Now a leader in lower-extremity prostheses also

HOSMER,® INC. • 561 Division St. (P. O. Box 37), Campbell, Calif. 95008 • (408) 379-5151 • Cable "HOSMER"

POST-SURGICAL SUPPLIES



BELOW-KNEE SUSPENSION BELT (LEFT AND RIGHT)

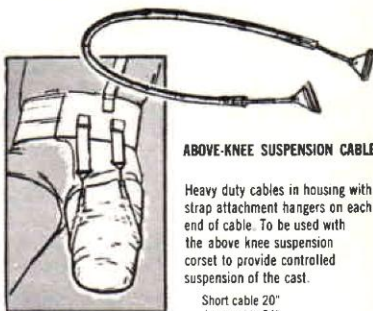
Light weight webbing waist belt, with elastic suspension strap, and cast attachment strap with buckle.



ABOVE-KNEE SUSPENSION CORSET

Heavy canvas belt with suspension and shoulder straps used to suspend above-knee cast in the immediate post surgical routine. May be used as right or left, with full felt apron. Small, medium and large sizes.

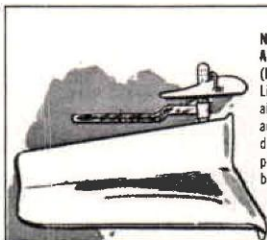
Small 27" to 32" circumference
Medium 31" to 39" circumference
Large 40" to 46" circumference



ABOVE-KNEE SUSPENSION CABLES

Heavy duty cables in housing with strap attachment hangers on each end of cable. To be used with the above knee suspension corset to provide controlled suspension of the cast.

Short cable 20"
Long cable 24"



No. 21-480 ABOVE-KNEE CASTING FIXTURE (LEFT AND RIGHT)

Light weight plastic casting fixture for above knee amputations features an adjustable anterior-posterior dimension, flexible plastic "SCARPA'S" plastic posterior and medial contoured brim and extension.



S.A.C.H. FEET
all sizes



No. 2L-245 ADJUSTABLE B/K PROSTHETIC UNIT

Supplied with anterior and posterior tilt adjustments and quick disconnect. Tubing cut to length at time of fitting.



No. 2L-241 ADJUSTABLE A/K PROSTHETIC UNIT

Features all the alignment adjustability of the B/K, plus selective manual knee lock and adjustable knee frictions.



SPLIT QUADRILATERAL SOCKETS



RUHRSTERN ELASTIC PLASTER BANDAGE

3", 4", 5" Widths



DOW CORNING MEDICAL ADHESIVE TYPE B

6 oz. spray can



LAMB'S WOOL

1/4 oz. package



STUMP SOCKS (SPANDEX)

Especially woven for immediate P/S prostheses. Rolled top to toe for ease of application.

Len.	Top Width	Toe Width
14"	5"	3 1/2"
18"	5"	4"
18"	6"	5"
18"	8"	6"
18"	9"	7"



BELOW-KNEE FELT PADS

Felt pads for relief of pressure-sensitive areas in immediate post-surgical casting of B/K stumps. In sets of three.

1. Pre-patella pad
2. Medial tibial crest.
3. Lateral tibial crest.

PEL SUPPLY COMPANY

4623 DETROIT AVE., CLEVELAND, OHIO 44102—PHONE: 216-651-7791

PAUL E. LEIMKUEHLER, PRESIDENT

Flexible Below Knee Socket With Supracondylar Suspension

by James Breakey*, B.P.T.

with an Introduction by James Foort**, M.A.Sc.

Semi-flexible plastic laminate sockets have been used in the prostheses of fifty BK amputees during the past two years at the Manitoba Rehabilitation Hospital in Winnipeg. These sockets were designed to permit more intimate fit of the socket against bony prominences without damage to the skin, and to permit adjustment of pressure between stump and socket by the insertion of liners between the flexible socket and the supporting structure. We had noticed that no amputee ever complained about discomfort against bony prominences, and seldom complained of discomfort at the end of the stump while standing in the sock during suspension casting of the stump. Also, experience with air cushion sockets

indicated the merit of flexibility in the socket against soft tissue areas of the stump which are compressed by the socket during weight bearing. It has frequently been proposed that bony structures now protected from pressure by relief pockets in the sockets might better be used to increase further support and stabilizing areas between stump and socket.

The present system used in conjunction with the semi-flexible sockets includes a supporting receptacle, a wedge-disc alignment unit pylon and a SACH foot. Cosmesis is obtained either with a custom made plastic laminate shell (semi-flexible), or a sponge polyurethane cover which is prefabricated in standard sizes. Many of these prostheses have been suspended from the medial femoral condyle, and a few with additional suspension from the top edge of the patella.

The receptacle supports the flexible socket so that weight bearing and stabilizing forces are resisted, and stability of the supracondylar

* Director, Prosthetic-Orthotic Division, Kingston General Hospital, Kingston, Ontario. Formerly Clinical Prosthetist at Manitoba Rehabilitation Hospital when the technique described in the article was developed.

** Technical Director, Prosthetic-Orthotic Research and Development Unit, Manitoba Rehabilitation Hospital, 800 Sherbrook St., Winnipeg 2, Manitoba.

suspension hook is ensured. The receptacle can also be fashioned so that extra relief space external to the flexible socket is provided over any vulnerable area. Further, since the socket can be pulled out of the receptacle, just as the kemblo liner was removable, adjustments can be made to socket fit by bonding in liners without spoiling the inner surface of the socket. When entry into the socket is difficult, because of inward projection of the supracondylar hook, the socket can be donned and inserted into the receptacle with the stump in place as a means of protecting the stump during its insertion into the prosthesis.

The socket referred to here might well be described as a two-piece socket, as a socket with flexible liner, or as a flexible socket with supporting receptacle. In any event, as far as the stump is concerned, the socket is rigid in areas of support and stabilization, semi-flexible in distal areas, over bony areas, and in any other areas which might require it, and is in total contact. It will be referred to as a flexible plastic laminate socket supported by a plastic laminate receptacle.

The outline that follows indicates the method used to fit and fabricate the flexible socket, and the preparation of the supporting receptacle. All procedures omitted are those which are common knowledge and which are not changed with reference to the particular procedures used.

FITTING THE AMPUTEE

Data Recorded

1. Antero-posterior stump knee

width at the mid-patellar tendon level—knee relaxed.

2. Medio-lateral stump knee width at the tibial plateau level.
3. Distance between extreme outer edges of the tensed hamstring tendons.
4. Supracondylar measurement from above the adductor magnus tendon insertion medially to the tensor fasciae lata laterally.



Fig. 1

Finger Positions During Cast Taking (Medial View).

5. Supracondylar height measured from the mid-point of the medial knee joint line to a point superior to the adductor tubercle of the medial femoral condyle (Insertion of adductor magnus tendon).

MAKING THE IMPRESSION

The Northwestern University's suspension casting technique is used to make the stump impression. The plaster is wrapped as described in the report, "A Pylon Prosthesis System for Shank (B/K) Amputee" by J. Foort (1).



Fig. 2

Finger Positions During Cast Taking (Posterior View).

1. Define the patellar tendon by impressing the thumb tips on either side of it.
2. Exert light counter-pressure across the back of the stump with the fingers of the hand, which is on the lateral side of the stump.
3. The fingers on the medially placed hand are used to define the contour of the medial femoral condyle (Fig. 1). The index and middle fingers are placed anterior to the adductor magnus tendon and the 4th and 5th digits are placed posterior to it. The 5th digit superimposes the medial hamstring tendons (Fig. 2).

Plaster Stump Model Modification

The model is modified in the same manner as described in "*A Pylon Prosthesis System for Shank (B/K) Amputees*," with the following additional features:

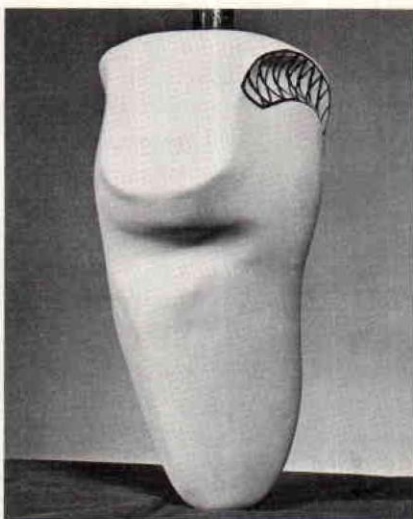


Fig. 3

Antero-medial View of Supracondylar Shelf.

1. The finger indentations outlining the contour of the medial femoral condyle and the condylar height measurement serve as guide in defining the condylar indentation in the plaster model.

The medial supracondylar shelf is approximately $\frac{3}{4}$ " wide from top to bottom. It is approximately $\frac{1}{2}$ " deep at most. It is contoured from the medial epicondylar surface of the femur to encompass the adductor tubercle area toward the femoral shaft to blend with these areas. On reaching the deepest point of the shelf, this smooth radii gradually reverses its direction following the shape of the soft tissue of the thigh (Fig. 3). The suspension hook should be at approximately the superior patella level, so that there is a tissue cushion between the hook and the bony surface of the femoral condyle. The medial patellar area and the medial hamstrings area are fitted intimate-

ly; however, the shelf is flared and contoured in order to prevent interference with their movement or to produce any discomfort (Fig. 4).

2. The model is reduced to $\frac{1}{4}$ " greater than the supracondylar measurement to allow

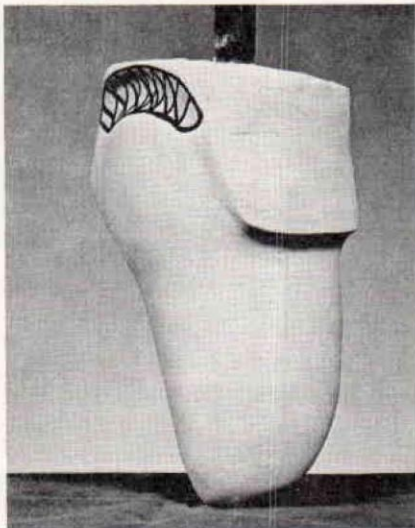


Fig. 4

Posterior-medial View of Supracondylar Shelf.

for wearing a wool stump sock. The lateral aspect of the model is trimmed down in a flaring fashion above the lateral femoral condyle until the desired distance is obtained.

Laminating the Flexible Socket

The vacuum draw technique is always used. The resin combination consists of 75% flexible No. 4134, and 25% rigid No. 4110.

The following procedure is used:

1. Pull a moistened PVA sheet over the plaster cast. A heat gun can be used to aid in removing any wrinkles.

2. Tailor three nylon tricot bags to fit the model.
3. With the vacuum acting on the PVA, put on the first of the tailored tricot bags. Place on three layers of 181 glass cloth in order to give strength



Fig. 5

Medial View of Plaster Model.

to the PTB area, posterior brim area and the medial and

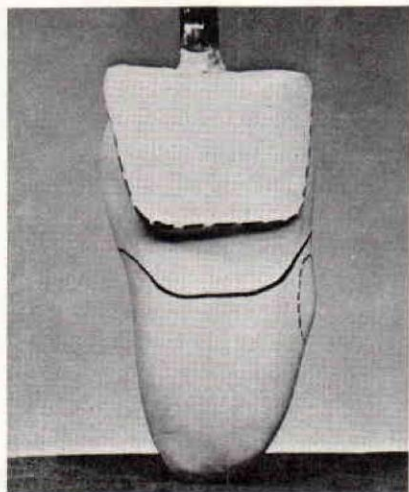


Fig. 6

Posterior View of Plaster Model.

lateral ears of the socket. The glass should include the patellar tendon bar area, but should not exceed the top of the tibial tubercle area. On the medial side it extends from the medial flare region of the tibia inferiorly to the summit of the medial supracondylar shelf superiorly. Posteriorly, it extends 1" below the posterior brim line. Laterally, the glass is so tailored to extend from above the protuberance of the lateral tibial condyle, and from above the head of the fibula to the top of the lateral ear of the socket. The socket must be free from glass in these bony areas to ensure flexibility (Fig. 5, 6, & 7).

4. Put on the other two tricot bags. The seams of the bags are criss-crossed over the inferior aspect of model for strength.

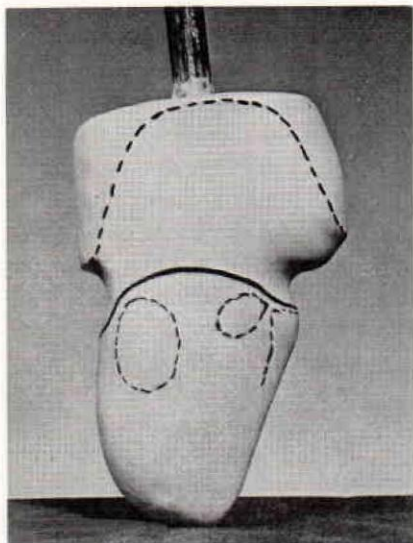


Fig. 7
Lateral View of Plaster Model.

5. Pull a talcum powdered PVA sleeve over model.
6. Add the mixture of flexible and rigid resin and begin

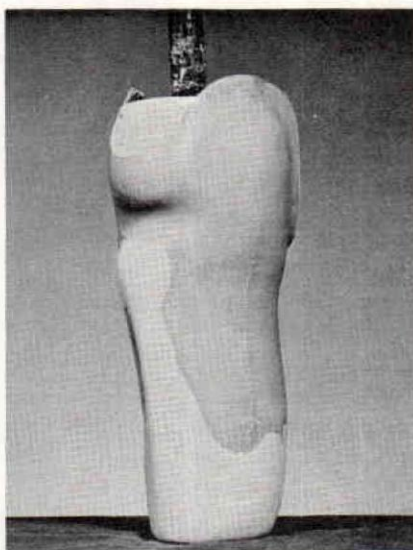


Fig. 8
Medial View of Plaster Build-ups on Socket.

plastic laminating in the usual way. Be sure that any excess resin is removed from the socket, as excess resin reduces the socket flexibility.

Receptacle Construction

The receptacle is custom-built to transmit weight through areas which tolerate weight bearing, and to afford stump stability. Relief areas (spaces) are left between the flexible socket and receptacle in areas which do not tolerate high pressures; mainly, the crest of the tibia and fibular head. The flexible socket is able to distend in these areas of low pressure tolerance, thus cushioning forces against the stump.

To construct the receptacle, proceed as follows:

1. Remove the PVA bag. Place the socket model in a vise and add approximately $\frac{1}{4}$ " plaster extension over the tibia of the plastic socket from the tibial tubercle to the distal end of the tibia. The

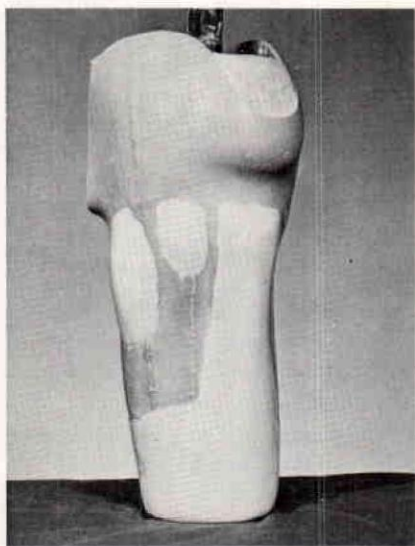


Fig. 9

Lateral View of Plaster Build-ups on Socket.

- plaster is to be feathered from its summit to its junction with the socket (Fig. 8).
2. Add the same amount of plaster over the head of fibula and feather it in. If there are any sensitive areas or if flexibility is desired in any other places, spaces can be made by plaster build ups in a similar manner (Fig 9).
 3. Place the socket model in a vise and adjust it until, with reference to the floor, there is about five to ten degrees of flexion in the socket and about five degrees of lateral tilt.
 4. Add a paper extension which

will allow about $\frac{1}{2}$ to 1 inch of plaster to be poured into it.

5. When the plaster has set, a $2\frac{1}{2}$ -inch circle is scribed with the center as far posterior and lateral as possible.
6. The plaster extending beyond this circle is removed to make the bottom of the socket cup-shaped around the edges.
7. Any excess plaster that has set in areas where contact between socket and receptacle for stump support is desired can be removed by rasp and screen.

NOTE:— It is important that the transition between the plaster build-ups and the flexible socket be smooth and gradual to eliminate areas of high force concentration.

8. Glue $\frac{1}{8}$ -inch aluminum disc to the bottom of the plaster receptacle and pull on the PVA sleeve.
9. Start the lay-up of fabric with a tailored felt bag made of one-ounce felt.
10. Lay on six squares of 181 glass cloth which slightly overlap the base of the plaster. Six strips wide enough to cover the base, and long enough to reach down the PTB bar level are laid on in a rosette fashion.
11. Complete the layups with two thicknesses of nylon stockinette.
12. Add plastic (90 percent rigid and 10 percent flexible) in the usual manner. After the

plastic has been added, a second disc with a hole for the PVA extension is forced against the base and strapped down with tape to form a flat surface on the outside.

After the resin has cured, plaster is removed from the socket and the socket and plaster are removed from the receptacle. The base of the receptacle is flattened on a disc sander, a 1/2-inch hole is drilled in the center and a wrench slot is cut on the side. Excess plastic is trimmed and the edges sanded. The socket with supporting receptacle is ready for assembly with the wedge disc alignment unit and sach foot. (Fig. 10).

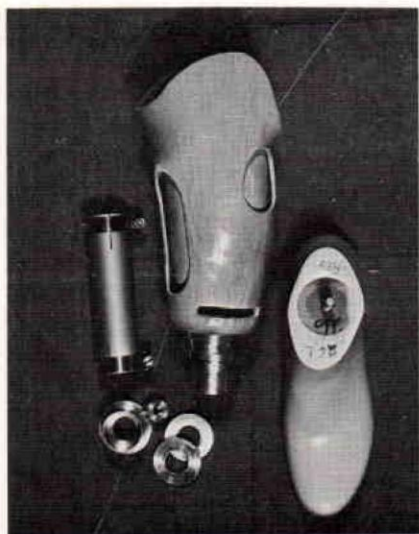


Fig. 10
Components Making Up the Prosthesis.

If small adjustments have to be made, such as allowing a little more relief area or snugging up in an area of the stump, the following can be done:

a. *To relieve an area*—The inside of the receptacle being made of felt

can be ground slightly to allow a relief space for the flexible socket to distend or a hole may be cut in the receptacle.

b. *To snug up in an area*—A patch of leather, felt, or rubber can be placed between the socket and receptacle. The flexible socket will bulge inward in that area giving the stump more support.

NOTE:—The relief areas built into the receptacle may be cut out, making the receptacle frame-like.

FABRICATION NOTE: To allow slight adjustability in the medial supracondylar shelf area, patella tendon bar area, or posterior brim region, a layer of one-ounce dacron felt can be included next to the PVA sheet before placing on the first tricot bag in the lay-up procedure. The felt would be tailored and include the same area as the glass cloth.

In cases where greater than normal distal stump weight bearing is desired, it is advisable to include a patch or two of tricot over the distal end of the socket during the lay-up, to reinforce the crossed seams of the tricot bags.

As an alternate to tricot in the socket fabrication, three layers of nylon stockinette can be used if additional flexible resin is added.

Methods of Donning Prosthesis

1. Remove the socket from the receptacle of the prosthesis.

Put it on the stump. Pop the socket back into the receptacle of the prosthesis (Fig. 11).

2. Leave the socket insert in the prosthesis. With the stump flexed to about 90 degrees approach socket with stump almost 30 to 45 degrees internally rotated to the patellar tendon bar of the socket. Insert the stump as deeply as possible into socket, then rotate the prosthesis medially and rotate the stump laterally as the stump is pushed into the socket (Fig. 12).

Advantages of the Supracondylar Suspension

1. Freedom from straps. (But if auxillary suspension is desirable at times, a fork strap with snap fasteners and waist belt suspension can be added).
2. Improved M/L knee stability.
3. Reduced pistoning of the stump in the socket.
4. Improved knee mobility during sitting.
5. Improved cosmetic effect at the knee both in standing and sitting.

CLINICAL EXPERIENCE

Chart 1 illustrates the number of patients fitted with flexible sockets at the Manitoba Rehabilitation Hospital during the past two years and at Kingston General Hospital during the past six months. The chart indicates whether the patient fitted was a new or old amputee; previous prosthesis and socket type; and present socket type.



Fig. 11
Wearing Socket During Donning of Prosthesis.

The majority of the amputees who were previous prosthetic wearers fitted with flexible sockets commented on the following:

1. More comfortable than previous hard or soft sockets.
2. Could wear the prosthesis



Fig. 12
Donning of Prosthesis.

INFORMATION ON PREVIOUS PROSTHETIC WEARERS

No. of Patients Fitted	Hospital	Present Socket Type***			Previous Prosthesis Type		Previous Socket Type			Previous Socket Material		
		PTB With Cuff Suspension	PTSC*	PTSPC**	With Side Joints & Thigh Corset	Without	PTB	Plug Fit	Other (Specify)	Hard Plastic	Soft (Kembol Liner)	Other (Specify)
23	Manitoba Rehabilitation	8	9 Incl. One Bilat. B/K	8 Incl. One Bilat. B/K	4	21 Incl. Two Bilat.	21 Incl. Two Bilat.	4	—	17 Incl. Two Bilat.	4	4 Molded Leather
7	Kingston General Hospital	1	5	1	4	3	3	3	1 slip	—	5	2 Molded Leather
A Sub-Total		30	9	14	9							

NEW AMPUTEES

No. Fitted	Hospital	Socket Type		
		PTB With Cuff	PTSC	PTSPC
27	Man. Hosp.	7	18	2
8	King. Hosp.	4	3	1
B Sub-Total		35	11	21

Total A & B	Pt's Fitted	PTB Cuff Susp.	PTSC	PTSPC
		65	20	35 Incl. One Bilat. B/K

LEGEND

- *PTSC—Patella tendon bearing socket with supracondylar suspension. (Medial femoral condyle)
- **PTSPC—PTB socket with supracondylar plus supra patella suspension
- ***All sockets made of flexible plastic laminate as described in article.

longer daily, before the stump became sore, than with previous prosthesis.

3. Liked this socket type because it had "give" to it.
4. A few commented that they believed the socket was cooler than previous types worn.

Conclusion

A technique has been presented for the fabrication of a flexible socket with a supporting receptacle.

A method of obtaining supracondylar suspension has been outlined. Clinical experience has shown the users of this technique significant advantages for continuing to use this method of socket design.

REFERENCES

1. Foort, J., and D. A. Hobson, A pylon prosthesis system for shank (BK) amputees, Prosthetics and Orthotics Research and Development Unit, Manitoba Rehabilitation Hospital, Winnipeg, November, 1965.

The Design of a New Style Ischial Weight-Bearing Brace for Use in the Treatment of Legg-Perthes Disease

Melvin J. Glimcher, M.D.,* Eric L. Radin, M.D.**
and Michael M. Amrich, C.P.***

Orthopedic Research Laboratories, Harvard Medical School, at the Massachusetts General Hospital, and the Rehabilitation Clinic Liberty Mutual Medical Service Center, Boston, Massachusetts

This work was supported by the Liberty Mutual Insurance Company

Purpose

The principal of protection of the femoral head during avascular necrosis (Legg-Perthes Disease) results from the observation that the natural end stage of this disease, if untreated, is flattened, enlarged femoral head. The late osteo-arthritis changes that these patients frequently develop are probably the result of a loss of congruity between the fem-

oral head and acetabulum. While in the process of healing, the bone in the femoral head is porotic and not able to take the usual stresses of weight-bearing. Furthermore, this disease affects children in a period of relatively rapid growth. The synovial effusion that accompanies the disease usually causes some subluxation of the femoral head, removing it from the acetabulum, allowing the

* Edith Ashley, Professor of Orthopedic Surgery, Harvard Medical School; Senior Lecturer, Department of Mechanical Engineering, Massachusetts Institute of Technology; Consultant, Rehabilitation Clinic, Liberty Mutual Medical Service Center, Boston, Massachusetts.

Surgery, Harvard Medical School, Lecturer, Department of Mechanical Engineering, Massachusetts Institute of Technology; Consultant, Rehabilitation Clinic, Liberty Mutual Medical Service Center, Boston Massachusetts.

*** Chief Prosthetist, Rehabilitation Clinic, Liberty Mutual Medical Service Center, Boston, Massachusetts.

** Assistant Professor of Orthopedic

head to grow in an incongruous fashion. Concomitant x-rays and photographs taken of cadaver specimens demonstrate that the articular surface of the femoral head is well-covered by the acetabulum in all positions.¹ The advantage of abduction is not better coverage but rather allowing the seating of the femoral head more securely within the acetabulum in the presence of effusion, permitting its growth to be moulded by the socket.

Muscular forces about the hip contribute a much greater share of the load borne by the joint than does body weight. Inman² was probably the first to suggest that the abductor muscle group contributed the major share. He theorized that the forces acting through the hip joint approximate two and a half times body weight. More recently Paul,³ calculating the intra-articular force by analyzing displacement of legs in gait films, and Rydell,⁴ by measuring pressures transmitted through a specially instrumented femoral head prosthesis, clearly substantiated that hip intra-articular pressures are far in excess of body weight. Their figures, in fact, tend to suggest that Inman's values were on the low side.

The multiplicity of methods now in use in the treatment of Legg-Perthes Disease bespeaks the lack of any truly satisfactory means. Strict bed rest, while removing body weight from the hip, still allows muscular contractions as the patient moves around in bed. The Snyder Sling again gives the patient something to fix against. Furthermore, it is an extremely easy device for a child to overcome. He merely needs

to flex the opposite knee in order to get the affected side foot on the ground for full-bearing.

The classical patten-bottom brace, developed empirically, consists of a full-ring Thomas splint, thigh and calf straps, and a rubber patten at the bottom of the brace. The foot is elevated above the patten by building the other shoe up from two and a half to three and a half inches with a lift. Weight is borne through the ring of the splint, from the ischium directly to the patten, bypassing the hip joint. In order to keep the foot within the brace and out of equinus a strap goes from the heel of the shoe to the top of the patten. The circumferential supports as well as the strap gave the child many points upon which to fix the leg in order to contract the muscles about his hip.

It has been our clinical observation that the old style patten-bottom brace was inadequate because it did nothing to eliminate the muscular forces about the hip (Fig. 1). The good results probably derive

NORMAL HIP

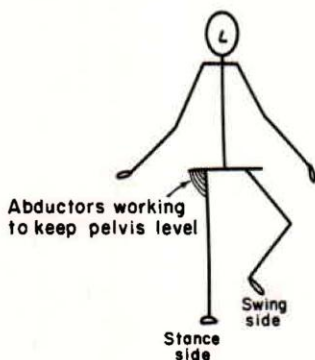


Figure 1A

Diagram of normal abductor muscle function. The stance side abductors contract to maintain the pelvis level.

OLD STYLE BRACE

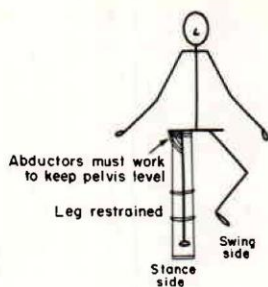


Figure 1B

In the "old style" patten-bottom brace the abductors can still function normally as the leg is restrained.

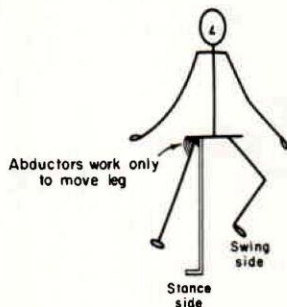
from the encumbrance of the child with the apparatus. It is clear that to prevent muscular forces acting about the hip joint either the abductor muscles must be fixed in length or the affected leg be completely free.

We have approached the problem of redesigning this brace from an experimental point of view. An attempt was made to record direct inter-articular pressures from the hip joint of a chimpanzee which had been taught to walk upright and fitted with braces. However, it became apparent that the chimpan-

zee's gait pattern was so different from man's that valid conclusions applicable to the human situation could not be drawn.⁵ We have thus been forced to rely on EMG recordings of muscle activity during gait to substantiate our design changes.

Our first major change was an attempt to support the opposite pelvis so that the affected-side abductor would not be triggered into firing. It is the slight drop of the pelvis on the opposite side which stretches the muscle and triggers its contraction. Substituting a laminated plastic quadrilateral socket for the Thomas ring for better support, we were able to successfully support the pelvis with a second quadrilateral socket held by a strap cinched over the shoulder. We found, however, that the tension on the strap and the pressures applied to the ischial tuberosity by the support socket were really so great that only very small children could tolerate it. We also did away with the strap from the heel of the shoe to

POGO STICK BRACE



POGO STICK BRACE



Figures 2A & 2B

In the Pogo Stick Brace, although the abductors can contract they can no longer function to level the pelvis. Patients rapidly adjust to the fact that contracting their abductors is no advantage in braced gait. The abductors quickly become silent after their effectiveness has been lost. Balance is achieved by shifting the body weight over the braced side.

the patten and replaced it with a dorsiflexion spring brace, eliminating this point of possible leg fixation.

We then changed our principal attack to focus on attempting to keep the affected leg completely free (Fig. 2). If the leg is free there can be no way to stabilize it and fire the abductors. We accomplished this with a single medial upright, eliminating the calf or thigh straps and adding an extremely loose calf ring (Fig. 3). The superior brim of the lateral wall of the quadrilateral socket was extended to the iliac crest, and an oblong cut-out made distal to the greater trochanter (Fig. 4).

Balanced on the end of a single medial upright without anything to fix the leg on made it difficult to forcefully contract the abductors. EMG studies bore this out. We found, however, that putting pants on over the brace provided the male patients with a means of stabilizing the leg (Fig. 5). It was thus necessary to insist on extremely wide legged pants ("bell bottom trousers") in order to prevent the leg from being fixed. The efficacy of this model has been borne out both in adult tests where the adult volunteer has felt a sense of freeness of his leg which disappeared when the leg was fixed to the upright with straps (Fig. 6).

This brace was first made for a juvenile patient in March of 1964. Since that time 24 children ranging in age from 4 to 12 (Figs. 7 and 8) have been provided with the device. Although it is much too early to draw any conclusions relative to the treatment of Legg-Perthes Dis-

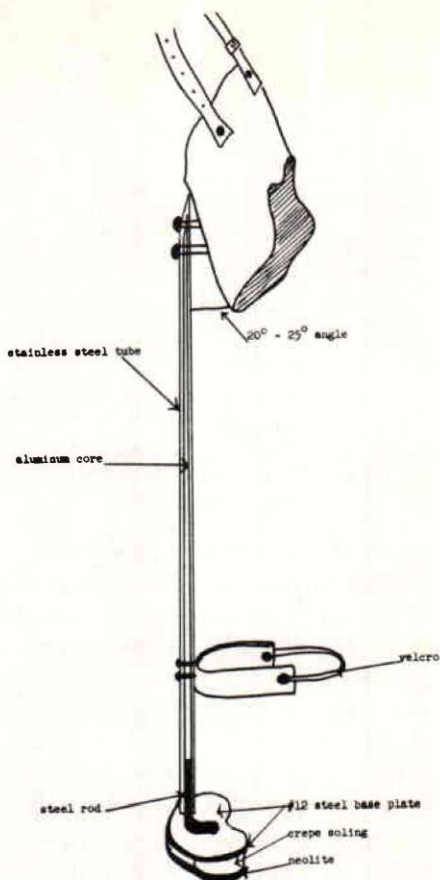


Figure 3

Diagram of the Pogo Stick Brace. Note the large loop to allow free leg motion and the abduction of the socket.

case on the basis of our experience so far, the study is continually expanding. Plans to utilize the brace for adults with hip fractures are also under consideration.

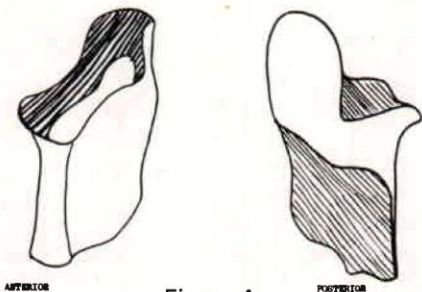


Figure 4

Diagram of the quadrilateral socket. Note the lateral wall cut-out.

TIGHT PANTS

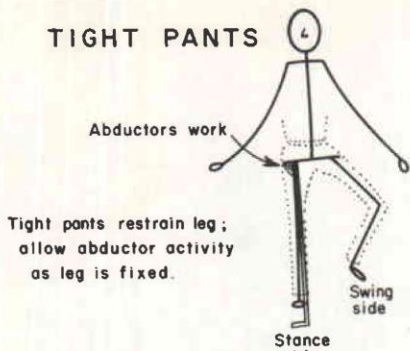


Figure 5

Tight pants over the Pogo Stick Brace act to restrain the leg abolishing the muscle silencing action of the brace.

Since the brace was first introduced there have been a few attempts to imitate it. We have been impressed that the imitators have not fully grasped the significance of the free-hanging leg and have concentrated only on the cut-out lateral wall of the socket and a single upright. We hope that this communi-

cation will clarify these important points for all. The following information is provided as a step-by-step procedure for measurement, fabrication, and fitting of the brace.

BRACE FABRICATION AND FITTING

Measurements

Normal brace tracings, lengths, widths, and circumferences are taken of the affected extremity.

Additional Measurements

- Anterior - posterior measurement taken from the adductor longus tendon to the ischial tuberosity.
- Medial-lateral measurement taken from the adductor longus tendon to the greater trochanter.
- Mid-calf height for band of spring toe pickup splint.

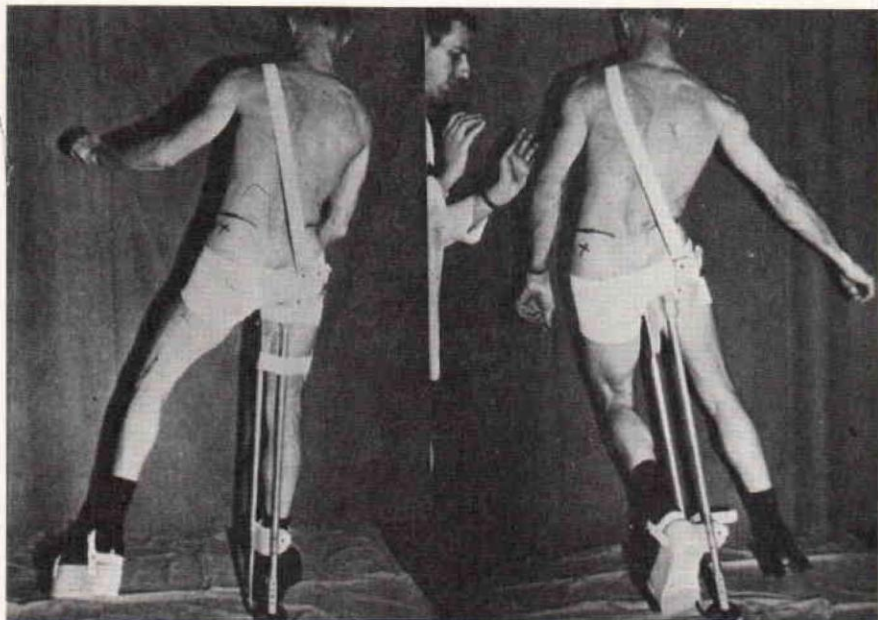
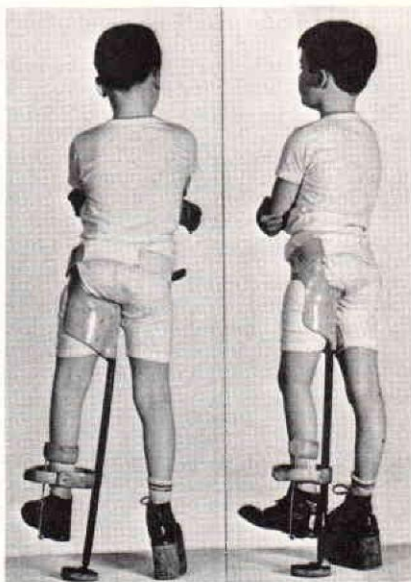
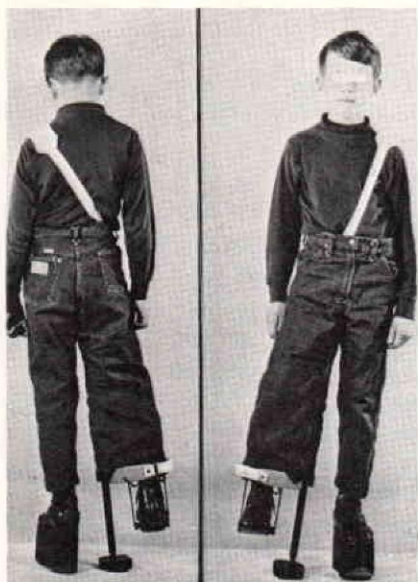


Figure 6

With a strap around the upper leg, it is relatively easy to balance on the brace.

With the strap removed, and the leg free, it is no longer possible.



Figures 7A & 7B

Patient fitted with a Pogo Stick Brace on the right. Note the bell-bottom pants in Figure 7A.

d) Top of shoe height for ankle retainer band position. Normal shoe extension height must be added to this for proper attachment of brace.

e) Shoulder loop suspension length is taken from the anterior perineum level over the opposite shoulder and back to the greater trochanter.

f) Ischium to bottom of shoe plus height of shoe extension for brace length.

Casting

a) Small children may be casted by hand moulding technique. Brims and/or brim stands can be used, if sizing can accommodate thigh circumference.

b) Procedure:

1. Patient stands with normal foot on 4" block and affected extremity abducted 25°-30°. Assistance may be necessary for balance.

2. Cast sock is applied to include the complete pelvic area of the af-

fected side. For small children it is better to fashion a pair of briefs from 8"-10" stockinette.

3. Indelible markings are made on the sock at the greater trochanter, ischial tuberosity, crest of the ilium and distal brim line.

4. Using 4"-6" elastic or fast setting plaster of Paris bandage, wrap extremity laterally up to iliac crest, and distally from the ramus about 8". If a casting brim is used, the plaster wrap must be carried above the brim to the iliac crest.

5. If hand casting, thumb and flat of hand are used respectively to shape the scarpas to ischial tuberosity level. Right hand is used for right casts with opposite hand used to mould cast into the iliac fossa area.

6. The negative cast is closed on the end, and extensions are made anteriorly, medially, and posteriorly in preparation for vacuum lamination.



Figures 8A & 8B

Patient with bilateral Legg-Perthes Disease fitted with Pogo Stick Braces bilaterally.

Cast Modifications

- a) Cast is altered in usual manner according to measurements.
- b) AP shaping to measurements is critical. Ischial seat must be altered to accommodate the degrees of abduction and should be perpendicular to the floor in stance position.
- c) Superior lateral modification of cast is done by making cast concave in iliac fossa area.
- d) Cast is prepared for vacuum lamination.

Lamination

- a) Material set-up:
 1. One layer of 1/2 ounce dacron felt.
 2. Four 2" strips of fibreglas reinforcement around complete upper portion of brim. Add several layers of 4" width fibreglas to medial wall of lay-up.



FIG. 8B

3. Three or four layers of nylon stockinette.

b) 90% rigid-10% flexible resin mixture. 600-800 grams will be needed for child-size brims. Epoxy resin is suitable for heavy weight use.

Trim Line of Brim

a) Medial Wall—Extends about 6"-8" distally for attachment to medial upright.

b) Anterior Wall—Trimmed similarly to AK socket with adequate flare to maintain ischial tuberosity on seat.

c) Posterior Wall — Trimmed 1½"-2" below ischial seat and flared into medial wall.

d) Lateral Wall—Proximal trim line is distal to iliac crest and anterior superior iliac spine and blended into anterior and posterior superior brim. Lateral wall is removed in inverted U shape from level of greater trochanter distally and blended into the anterior and posterior walls.

Components and Assembly of Brace

a) Brim with abduction cut-out

b) Medial support:

1. Stainless steel tube (T304, ¾" OD, .035-20GA wall.

2. Aluminum tube (⅝" OD-⅜" ID).

a) Fits into steel tube for added strength .

3. Tube and insert extend from superior medial wall distally to base plate attachment.

a) Tube and insert are flattened at proximal attachment to brim to avoid bulk.

b) Brim is temporarily attached with two #8 copper belt rivets at 5° flexion and 25° ab-

duction angle. Wooden wedge is used to maintain angle.

4. Steel rod attachment to base plate (⅜" x 10"):

a) Distally a 1½" right angle bend is welded or silver soldered to steel base plate—medial to mid-line.

b) Upper part inserted into tube assembly and attached with four SS screws 8/32" x 7/16" ½" apart for height adjustment.

5. Steel base plate #12 gauge spring steel:

a) Cut about 2½" x 4" and corners rounded.

b) After attachment to steel rod, leather is glued and riveted for base of soling.

c) ½" crepe soling is glued to leather.

1. Crepe is sanded medially to tilt plate an additional 5°.

d) Neolite or some hard wearing sole is glued to crepe.

6.) Ankle band retainer 2" x 10-12" #16 gauge spring steel):

1. Bend in J shape:

a) Posterior part of band approximately 2½".

b) Medial part of band approximately 3".

c) Anterior part of band approximately 6".

2. Laterally, a loose velcro closure about 12" long is made through a rectangular bar.

3. Band is dipped in plastisol or leather covered.

4. Retainer is attached with two steel rivets at pre-measured height about 8"-10" from floor.

Brim is permanently attached to medial upright at correct angle.

a) Epoxy filler is used for firm attachment.

b) Buckles are riveted to brim for shoulder loop.

1. Anterior attachment at mid-brim level of seat and lateral attachment midway between superior trim line and greater trochanter.

2. Foam rubber shoulder pad should be made for loop.

Spring Wire Pickup Splint

a) Standard type used to maintain foot in moderate dorsiflexion. Since non-weight bearing, tension of spring may have to be lessened to avoid heel riding out of shoe.

Normal Shoe Extension

a) Recommend 3½"-4" buildup of lightweight material.

b) Bottom of extension sanded on medial aspect to place foot into

c) ¼" crepe soling and hard rubber sole are glued to extension. slight eversion.

d) Extension can be stained and water-proofed.

Wearing Apparel

a) Loose clothing should be worn over brace.

1. For female patients, a dress or skirt would be better to avoid restriction of movement of the involved extremity.

2. For male patients, trousers must be altered in an exaggerated bell-bottom fashion. The outside seam of the trouser leg is opened from top to bottom. An appropriate triangular shaped piece of material is then sewn to this seam to allow free motion of the extremity. Trousers or slacks should not extend below the ankle band.

Fitting, Checkout, and Ambulation

a) Application of brace:

1. Protective sock or stockinette must be worn.

2. Brace is applied by putting foot through brim and pulling brim up to perineal level.

3. Shoe with spring splint is put on and positioned into retainer band with loose velcro closure.

4. Normal shoe and shoulder loop suspension are put on.

b) Check-points:

1. In stance position, check for level iliac crests. Also check for height of affected shoe from floor. Should be about same height as shoe extension.

2. Location of greater trochanter—should allow free abduction of extremity.

3. Retention of foot in retainer band.

a) Loose velcro closure so that foot is free and only light contact is made with velcro.

4. Shoulder loop suspension should be snug to support brace and maintain ischial tuberosity on seat.

Initial Ambulation

a) Patient should use two crutches for balance.

1. Children will usually regain balance with brace in about two weeks and discard crutches.

b) Patient should ambulate with broad base and concentrate on abducted gait with brace.

c) Bilateral brace wearers should use two crutches at all times, however, some children may develop good balance and discard crutches indoors.

REFERENCES

1. Hammon, B. T. and Charnely, J. The Sphericity of the Femoral Head. *Med. & Bio. Ergng.* 5:445-453, 1967.
2. Inman, V. T. *Functional Aspects of*

- the Abductor Muscles of the Hip. *J. Bone Joint Surg.* 29A:607-619, 1947.
3. Paul, I. P., Bio-engineering Studies of Forces Transmitted by Joints, in *Bio-mechanics and Related Bioengineering Topics*. R. M. Kenedi (ed.). Pergamon, London, 1965, pp. 359-368.
 4. Rydell, N. W. Forces Acting on the Femoral Head Prosthesis. *Acta Orthop. Scand. Suppl.* 88, 1966.
 5. Radin, E. L. and Amrich, M. M. Limitations of Chimpanzees as Subjects in Brace Design Experiments. *Bull. Prost. Res.*: 12-10:205-212, 1969.

Brace-to-Body Dynamics

John Glancy, C.O.*

For over twenty years the results of the studies done on human locomotion at the Biomechanics Laboratory, University of California at Berkeley, have been available to the orthotics profession. Perhaps the fact that these studies were oriented toward prosthetics is the explanation as to why their findings have not been applied more aggressively to orthotic problems. Traditionally, orthotics and prosthetics have been practiced as separate professions, and although the two have become more closely associated in recent years, it appears that orthotics may still be in the grip of past traditions.

While there is no question that intensive orthotic research is the ultimate to sound future progress, it is questionable as to whether orthotics is making as imaginative a use of current biomechanical infor-

mation as it might in the present. What follows is a suggested method of analyzing the interactions which take place between a brace and the human body, i.e., the effects which a mechanical system (a brace) has upon a biomechanical system (the human body) and vice versa. For the lack of a better term these interactions will be referred to as—**brace-to-body dynamics**. The proposed method permits control of brace-to-body dynamics, by 'programming' the control of motion. 'Programmed' motion control being here defined as 'planned' or 'allowed' motion within a given brace system versus static control of every movable segment that a brace system may encompass.

With the armamentarium presently available to the orthotist, much can be done in several areas to improve brace-to-body dynamics, and in so doing improve the patient's functional performance. The adult patient can be braced more satisfactorily than a child, as the

*Chairman, Division of Orthotics (Division of the Department of Orthopedics), Indiana University Medical Center.

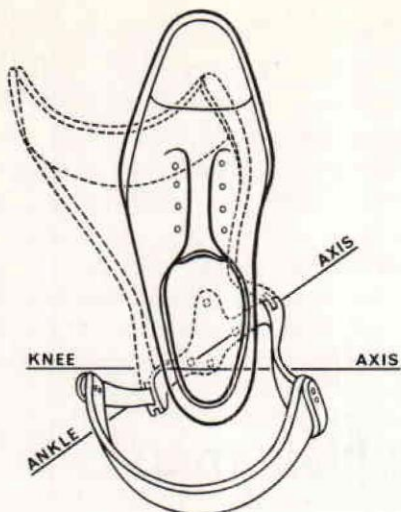


Fig. 1A

BK brace for an adult with accommodation for external tibial torsion and anatomical alignment of the foot to the knee and ankle axes. Brace with posterior calf band is illustrated to give a clearer view.

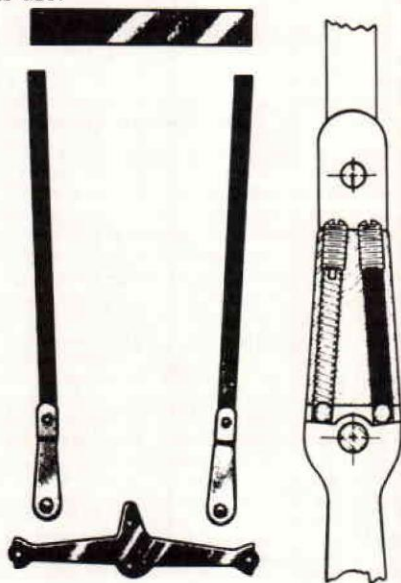
maximum degree of his external tibial torsion is fixed; therefore some accommodation can be built into the brace (Figure 1). However, a brace is not presently available which can provide necessary motion controls, and yet accommodate the normal development of external tibial torsion in the child who must wear a brace during his growing years.

Two examples of the 'programmed' brace-to-body dynamics analysis technique are presented to demonstrate its functional application. The rationale for the designs is based on two primary premises: 1.) The complex sequence of motions which enable man to walk in an upright position are dictated by the laws of motion. Man's obedience is not an act of will—however, his locomotor system must practice absolute obedience. 2.) A brace has but one function—that is, to

control body motion. Its design is therefore subject to the same laws of motion as the body it serves.

The following is a design of a BK brace for a hemiplegia patient with the common pathological condition of a varus foot due to a spastic tibialis anterior (the only dorsiflexor functioning). The patient's plantar flexors are not spastic. The knee is unstable due to weak quadriceps.

Each component of the design is listed, followed by the rationale for its use.



DOUBLE UPRIGHT BK BRACE
Spring Dorsiflexion and/or Plantar Flexion
(Note replacement of one spring with solid rod.)

FIG. 2

1. Bilateral Pope double spring-action ankle joints and uprights. The anterior springs are to be replaced with steel rods, thereby converting the joints to rigid (slightly less than 90°) anterior stops. The posterior portion should permit 15° of plantar flexion against the spring's resistance. (Figure 2.)

RATIONALE:

The anterior stops check the forward progress of the tibia in the sagittal plane as it rotates over the foot. Its forward rotation is checked at 2° to 3° forward of a 90° relationship to the fixed foot. This setting will maintain the knee in its normal, slightly fixed position during mid-stance. This setting also prevents any tendency for the anterior metal band (see #2) to cause genu recurvatum. The posterior setting of the ankle joints permits the normal range of plantar flexion to occur between heel-strike and foot-flat. The springs resist the force of gravity as well as the resultant force from the floor, thereby mechanically producing the function normally required of the pretibial muscles. Thus a mechanical supplement or substitute, for the function of the pretibials during this period is possible. As to which is the actuality, supplement or substitute, would seem to depend upon the severity of the spasticity present.

The result is either a partial or a total by-pass of the pretibial muscles. Stimuli to regional proprioceptors are kept to a minimum, if not eliminated, thereby reducing further excitation to the spastic tibialis anterior. The fact that the normally inactive plantar flexors have not been interfered with throughout this period, is most significant. The posterior springs also hold the foot in 2° to 3° of dorsiflexion throughout the swing phase. The force of the springs eliminates the need for the pretibials to sustain a position of dorsiflexion, so important to maintaining clearance between the foot and floor during swing phase.

2. The metal band is to be attached anterior to the uprights instead of the usual posterior calf band.

RATIONALE:

The purpose of the band is to stabilize the knee, from mid-stance to toe-off, by supplementing the weak quadriceps muscles. This band and the anterior stops in the ankle joints work in unison to check the tibia's forward progress beyond the mid-stance period. As the tibia presses against the band a counter force builds which prevents flexion of the knee. During the mid-stance period the gastrocnemius muscle is kept in an eccentric contraction by preventing the heel from raising while simultaneously extending the knee. By mechanically producing what is normal position, at its normal time, in the overall sequence of motions within the stance phase, further protection against the occurrence of genu recurvatum is provided.

3. The ankle joints are to be set in 22° of external rotation. The Lehneis-New York University Measuring Board is used to determine the amount of tibial torsion and toe-out the patient presents.

RATIONALE:

The mechanical ankle axis of the brace will then be congruent to the patient's anatomical ankle axis, i.e., 22° of external tibial torsion. This will ensure against any impingement of the normal transverse rotary motions of the tibia, caused by the wearing of the brace. This setting prevents the brace from introducing abnormal torque forces to the ankle and foot, with all that

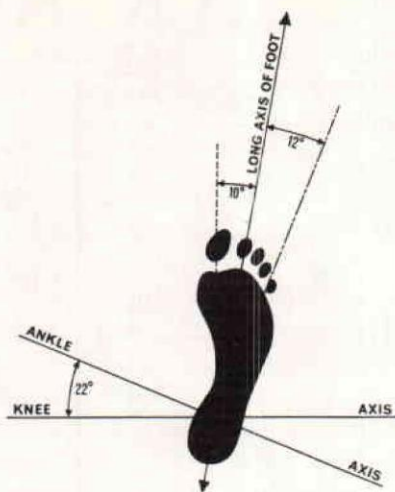


Fig. 3A

Transverse plane—(right foot—viewed from above)
Example of the anatomical alignment of the long axis of the foot (toe-out) to the knee and ankle axes.

such torque forces imply to propriceptors in both regions.

4. The brace attachment (whether it be a solid stirrup or a receptacle for a split stirrup) is to be set at 22° of **toe-in** on the shoe.

RATIONALE:

This setting of the brace attachment to the shoe will duplicate the patient's anatomical relationship of the long axis of the foot (toe-out) to both his knee and ankle axes. (Figure 3A.)

The uprights are bent in a manner which places the ankle joint axis in a fixed 22° of external rotation. With the ankle joints thus aligned, were the brace attachments fixed to the shoe at the patient's anatomical toe-out of 10°, the result, when assembled, would be a shoe setting of 32° of toe-out to the patient's knee joint, as viewed in the transverse plane. (Figure 3B.)

In order to match nature's align-

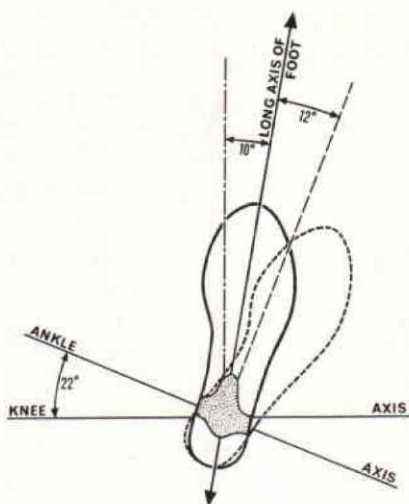


Fig. 3B

Transverse plane (left foot—viewed from below)

Duplicating nature's alignment — brace attachment set at 12° toe-in to ankle axis and 10° toe-out to knee axis. The dotted outline indicates the position in which the shoe, would be, in relation to the knee axis, were the 22° of tibial torsion put into the brace with the attachment fixed to the shoe in the patient's 10° of toe-out.

ment, the following procedure is used:

PATIENT

- A. 22° external tibial torsion
- B. —10° toe-out.

—
12° (equals degree of toe-in to ankle axis)

BRACE AND SHOE

- A. Brace must duplicate the full 22°.
- B. Brace attachment is set in 12° of toe-in on the shoe

When the shoe is attached to the brace it will be in proper alignment, i.e., 10° of toe-out to the knee and 12° of toe-in to the ankle, as viewed in the transverse plane.

5. A rigid metal strip is inserted between the welt and the sole, throughout the length of the shoe.

Before insertion, its distal end is to be preshaped to set the forefoot in approximately 15°-20° of flexion as in the toe-off position.

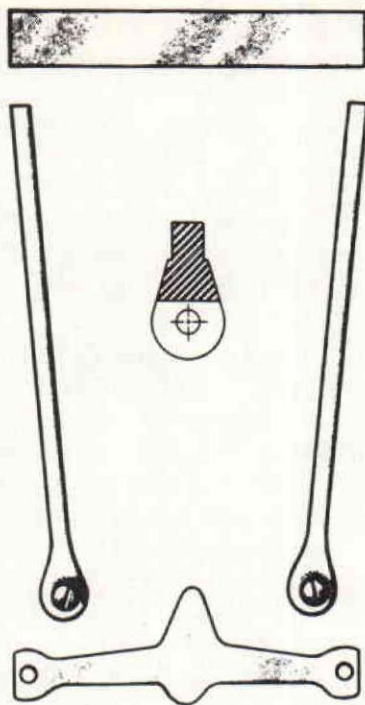
RATIONALE:

The purpose is threefold: 1) To utilize the entire length of the shoe as a more efficient resistance arm; 2) To reinforce the shoe; 3) to bypass the spastic tibialis anterior muscle by mechanically placing the forefoot in the toe-off position, thereby alleviating its need to be active at this time in the walking cycle. The posterior springs, at toe-off, provide some push-off force to start the leg into its forward acceleration during the swing phase.

6. A $\frac{3}{16}$ " to $\frac{1}{4}$ " 'rocker' bar is to be attached to the bottom of the sole of the shoe. The apex of the rounded rocker bar is to be placed immediately proximal to the metatarsal heads.

RATIONALE:

The rocker bar acts in conjunction with the anterior metal band and the anterior stops in the ankle joints. As the tibia's forward progress is checked at the mid-stance position by the anterior stops, a counter force is produced by the anterior metal band which prevents the knee from buckling. At this time in the walking cycle, the body weight is just beginning to rotate, in the transverse plane, forward of the lateral mid-line, having received its impetus from the push-off of the opposite limb. This same impetus is also rotating the body forward, in the sagittal plane and serves to 'trip' the body over the rocker bar, raising the heel and automatically placing the braced leg in the pre-set toe-off position. Thus the action



DOUBLE UPRIGHT BK BRACE
Limited Motion

FIG. 4

of raising the heel and the placement of the foot in the toe-off position are produced mechanically, without using the musculature which would normally be required to accomplish these movements.

7. A cushion heel is used to replace the hard rubber heel.

RATIONALE:

The cushion heel's function is to reduce the sudden jolt (exceeding the body weight by 15-20 percent), which the limb receives at heel-strike, thereby reducing excitation to whatever spasticity may be present.

The design of a BK brace for a cerebral palsy patient who presents the common problem of a spastic gastrocnemius and accompanying

knee flexion, would consist of the following available components:

1. Bilateral limited motion ankle joints and uprights. The anterior portion of the joints are to be rigid stops set slightly less than 90° , the same as the previous design. The posterior portion is to permit 15° of plantar flexion. (Figure 4.)

RATIONALE:

In the normal sequence of events during stance phase, the gastrocnemius is not involved in achieving foot-flat, i.e., the 15° of plantar flexion. Any attempt to prevent foot-flat from occurring, will force the gastrocnemius and all other plantar flexor muscles to go into an isotonic contracture following heel-strike, to overcome the resistance of placing the foot in the normal position to receive the weight of the body. In those cases where a plantar flexion stop is used and the calcaneus is successfully prevented from raising in the shoe when the gastrocnemius is spastic—the result is a force which will act to flex the knee. Again, the contradiction of the use of a plantar flexion stop to prevent equinus becomes evident. Posterior springs are not used because the patient possesses the full compliment of functional pretibials (though weakened due to constant overpowering by their spastic antagonist).

2. Anterior metal band.

RATIONALE:

Again, this band and the anterior stops in the ankle joints work in unison to check the tibia's forward progress beyond the mid-stance position. The previous rationale for the use of this band is still valid, although this patient has functional

quardiceps. It should be noted that because of the tendency of a spastic muscle to lose its normal length, it seems practical to permit the gastrocnemius to perform the eccentric contraction which occurs between the foot-flat and mid-stance positions. (Figure 5.)

3. The ankle joints are to be set in external rotation equal to the external tibial torsion which the patient presents.

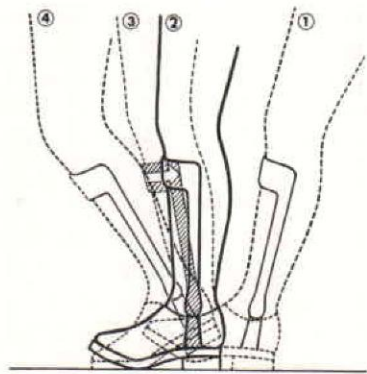
RATIONALE:

The previous rationale is still valid. However, as previously mentioned, no brace is presently available which will accommodate to the gradual 'developmental' increase of external tibial torsion in the growing child. The restriction of this aspect of growth which present-day braces impose, hopefully will be alleviated before too long.

a. Foot is plantar flexing toward the foot-flat position following heel-strike. Note the impact absorption through the compressed posterior portion of the cushion heel.

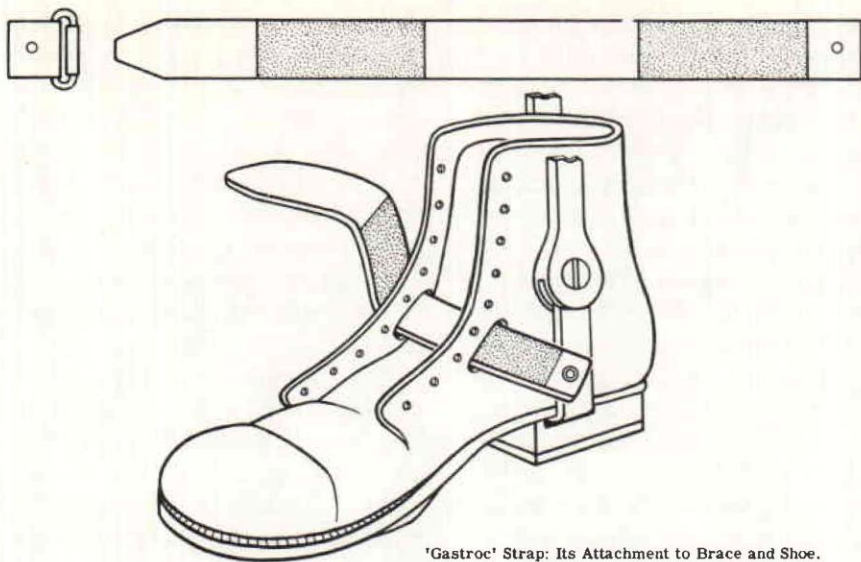
b. Mid-stance position: The limb in swing phase, along with the

A SCHEMATIC ILLUSTRATION OF "PROGRAMMED" BRACE-TO-BODY DYNAMICS



DOUBLE UPRIGHT BK BRACE with Cushioned Sole and heel and "Buckler" Bar and Rigid Metal Sole Plate

FIG. 5



'Gastroc' Strap: Its Attachment to Brace and Shoe.

FIG. 6

body, has rotated in the transverse plane to the lateral midline. Note the stability of the knee at this period when the magnitude of downward vertical force is high. The preset toe-off positioning of the metal sole plate is evident.

c. Just before heel-rise: The body's center of gravity has now rotated in the transverse plane forward of the lateral midline. Note the stabilizing of the knee by the counter pressure of the anterior metal band. 2° - 3° of forward motion allowed to the tibia by the anterior stops in the ankle joints permits normal knee flexion during this period.

d. The forward rotation of the body has 'tripped' over the rocker bar and placed the foot in the toe-off position in preparation for push-off.

4. The brace is to be fixed to the shoe to match the patient's anatomical requirements, as per the previously described procedure.

RATIONALE:

The previous rationale still applies and also relates to the remarks added to #3 immediately above, as the toe-out relationship would appear to be subject to change also.

5. A rigid metal plate is inserted between the welt and the sole, throughout the length of the shoe. Its distal end is to be preshaped as in the toe-off position of 15° of forefoot flexion.

RATIONALE:

The purpose remains threefold. The first two reasons presented in the previous rationale still apply. However, the reasons for placing the forefoot in a pre-set toe-off position are somewhat different: 1) Since normal heel-rise following the mid-stance position is prevented by the combined blockage of the anterior band and the anterior stops in the ankle joints, it appears reasonable to expect the patient's functioning pretibials will attempt to

raise the heel. 2) The rigid plate stiffens the flexible sole of the shoe and resists both muscular and resultant forces. Therefore, the forced inactivity of the plantar flexors is not challenged by excessive activity of the pretibials at an unnatural time in a normal walking cycle. 3) The pre-set toe-off contouring of the shoe limits the efforts of the pretibials to a push-off force only, as the 'rocker bar' (see #6) serves as a mechanical substitute for their toe-off positioning activities.

6. A rocker bar is added to the sole of the shoe in the same placement as for the hemiplegic patient.

RATIONALE:

The same as the previous #6.

7. The hard rubber heel is replaced with a cushion heel.

RATIONALE:

The same as the previous #6. When additional 'shock absorption' is desirable, a $\frac{3}{8}$ " cushion sole is applied throughout the length of the shoe, and the cushion heel and rocker bar are added to it. When a cushioned sole is used, an equal thickness must be placed on the other shoe. When reduction of unwanted stimuli to the skin of the sole and heel, which is related to contact with the floor is desired, a $\frac{1}{8}$ " to $\frac{3}{16}$ " cushion inner-sole may be placed inside the shoe. Whenever a cushion inner-sole is used a size larger shoe is necessary to ensure patient comfort.

8. A gastroc' restraining strap.

RATIONALE:

This velcro strap is pivotably attached on the solid, or split stirrup, below the ankle joint. It passes over the instep, through two slots cut below the eyelets on either side of

the tongue, and passing through a metal loop (also pivotably attached on the opposite side, below the ankle joint) to fasten onto itself, either side of the instep (Figure 6). A $\frac{3}{16}$ " x $\frac{1}{4}$ " felt pad is cemented to the inner-sole of the tongue to prevent the velcro strap from cutting into the instep. A size wider shoe will allow room for the tongue pad.

The patient's foot is placed in the shoe while the brace is attached. The knee is flexed and the heel is checked to be sure it is in contact with the bottom of the shoe. The velcro strap is then passed through the metal loop attached below the ankle joint. A firm downward pressure is applied to the instep with one hand while the slack is drawn out of the strap. When the foot is firmly set against the bottom of the shoe, the velcro strap is fixed to itself on the metal loop side of the tongue. The shoe is then laced and tied and the loose end of the velcro strap is drawn over the laced instep and fixed to itself at the originating end of the strap.

The purpose of this strap is to insure that the gastrocnemius muscle cannot go into isotonic contracture as the tibia moves forward over the foot in the sagittal plane. The combined effect of this strap and the anterior metal band attached to the uprights force the gastrocnemius to stretch, thus limiting its action to an eccentric, or more clearly descriptive, an isometric contraction—the tibia's forward progress having been checked well short of its normal maximum range.

Although the preceding examples are confined to two specific biome-

chanical dysfunctions, the functional analysis approach is suggested as a means of analyzing orthotic problems in general, regardless of etiology, as they relate to walking. The technique appears to hold promise as a means of realizing the full potential of current knowledge, and in so doing, help to identify the areas in which future orthotic research would be most fruitful. It is hoped that the publishing of the preceding ideas will serve to excite the interest of those who are dedicated to improving the well-being of the handicapped.

REFERENCES

- Journal of Bone and Joint Surgery, 30-A: 859-872, 1948. Levens, A. S., Inman, Verne T., and Blosser, J. A.
- Human Limbs and Their Substitutes, 15 and 16: 437-480, 1954. Eberhart, Howard D., Inman, Verne T., and Bresler, Boris.
- Braces Today, "Human Locomotion," February and March, 1967. Inman, Verne T.
- Human Limbs and Their Substitutes, 14: 411-435, 1954. Elftman, Herbert.
- Orthopaedic and Prosthetic Appliance Journal, 18: 110-114, June, 1964. Lehneis, Hans R.
- Orthopaedic and Prosthetic Appliance Journal, 19: 209-214, September, 1965. Lehneis, Hans R.
- Orthopaedic and Prosthetic Appliance Journal, 13: 37-40, December 1959. McMurray, Wm., and Greenbaum, Werner.
- Orthopaedic and Prosthetic Appliance Journal, 18: 273-280, December, 1964. Anderson, Miles H.
- Orthotics—Et cetera, 9: 32-61, 1966.
- Smith, Edwin M. and Juvinal, Robert C.
- Orthotics Et Cetera, 9: 365-382, 1966. Cailliet, Rene.
- Braces Today, "Orthopaedic Management of the Lower Extremity in the Hemiplegic Patient," May, June, and July, 1967. Perry, Jacquelin.
- Orthopaedics for the General Practitioner, 111-124 and 145-164, 1957. Kenney, Wm. E. and Larson, Carroll B.
- Atlas of Human Anatomy, 411-464, 1950. Anson, Barry J.
- Human Anatomy and Physiology, 4th Ed., 218-238 and 261-281, 1960. Millard, N. D., King B. G. and Showers, M. J.
- Orthotics Et Cetera, 9: 249-273, 1966. Deaver, George G.
- Orthotics Et Cetera, 9: 1-31, 1966. Hines, Thomas F.
- Orthotics and Prosthetics, 22: 28-33, September, 1968. Viel, Eric.
- Orthopaedic and Prosthetic Appliance Journal, 19: 304-313, December, 1965. Habermann, Helmut.
- Orthopaedic and Prosthetic Appliance Journal, 13: 44-46, December, 1959. Tosberg, Wm. A.
- Orthopaedic and Prosthetic Appliance Journal, 13: 79-82, March, 1959. Rosenberger, Josef.
- Orthopaedic and Prosthetic Appliance Journal, 17: 354-371, December, 1963. Stamp, Warren G.
- Orthopaedic and Prosthetic Appliance Journal, 15: 341-344, December, 1961. Keiser, Robert P.
- Orthopaedic and Prosthetic Appliance Journal, 20: 127-143, June, 1966. Tosberg, Wm. A.
- Orthopaedic and Prosthetic Appliance Journal, 16: 111-115, June, 1962. Howard, James A., Warren, Harold B., and Titus, Robert.
- Orthopaedic and Prosthetic Appliance Journal, 19: 294-297, December, 1965. Larrick, Robert B.
- Lower Extremities—Orthotic Course, New York University, Post-Graduate Medical School, Prosthetics and Orthotics.

**The 1970 NATIONAL ASSEMBLY of the
AMERICAN ORTHOTIC AND PROSTHETIC ASSOCIATION**

will be held

SEPTEMBER 30 to OCTOBER 3, 1970

at the

**PORTLAND HILTON HOTEL
PORTLAND, OREGON**

For Program Details and Registration Information
write to

**The American Orthotic and Prosthetic Association
1440 N Street, N.W.
Washington, D. C. 20005**

The Assembly is open to all who are interested in the
rehabilitation of the orthopedically disabled

MADE TO ORDER

Special Orthopedic Shoes

ANY TYPE — ANY STYLE

Send us the negative casts, we make the Shoes
to your or your Doctor's specifications.

WE SPECIALIZE IN EXTREME CASES.

For information and price list, also free measuring
charts, write to:

ROBERT O. PORZELT

3457 LINCOLN AVENUE • CHICAGO 13, ILLINOIS

Telephone: BI 8-0343

C. N. Waterhouse Leather Co.

For the **BEST**
in all
ORTHOPEDIC and PROSTHETIC
LEATHERS



146 Summer Street • Boston, Massachusetts 02110 • 617/542-4112



And the word is Camp. That's because Camp has a really complete product line from orthotic supports—to braces—to rehab aids. It creates a lot of problems for us, but it eliminates a lot of problems for you. And it keeps doctors and customers from using a four letter word when the fit's not right. And with Camp you deal with a single source, the leader in the orthotic support and appliance industry. In a word—it's Camp. S. H. Camp and Company, Jackson, Michigan 49204.

the next time
it doesn't fit right
use a four letter
word

CAMP
1940 1980



SUPPLIERS TO PROSTHETIC & ORTHOTIC FACILITIES

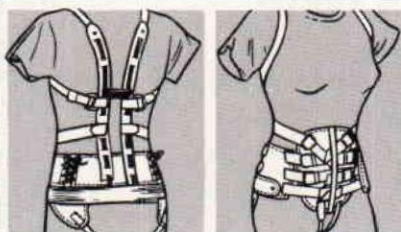
U. S. MANUFACTURING CO.



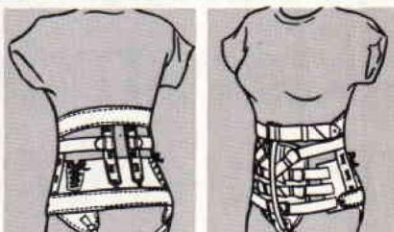
A/K & B/K Postsurgical Pylons



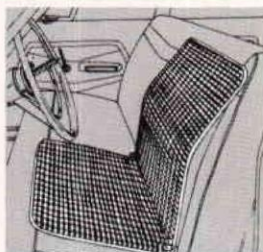
PILLOW & SPLINTS
FOR HIP ABDUCTION



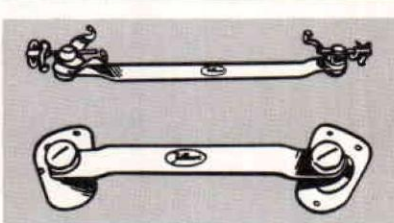
TAYLOR SPINAL BRACE
WITH SHOULDER STRAPS



CHAIR BACK SPINAL BRACE



SACRO-EASE CAR SEATS



DENIS BROWNE
NIGHT SPLINTS

KNIT-RITE



**FINEST WOOL
STUMP SOCKS
SOFT
DURABLE
COMFORTABLE**

THE SOURCE FOR ALL YOUR SHOP NEEDS

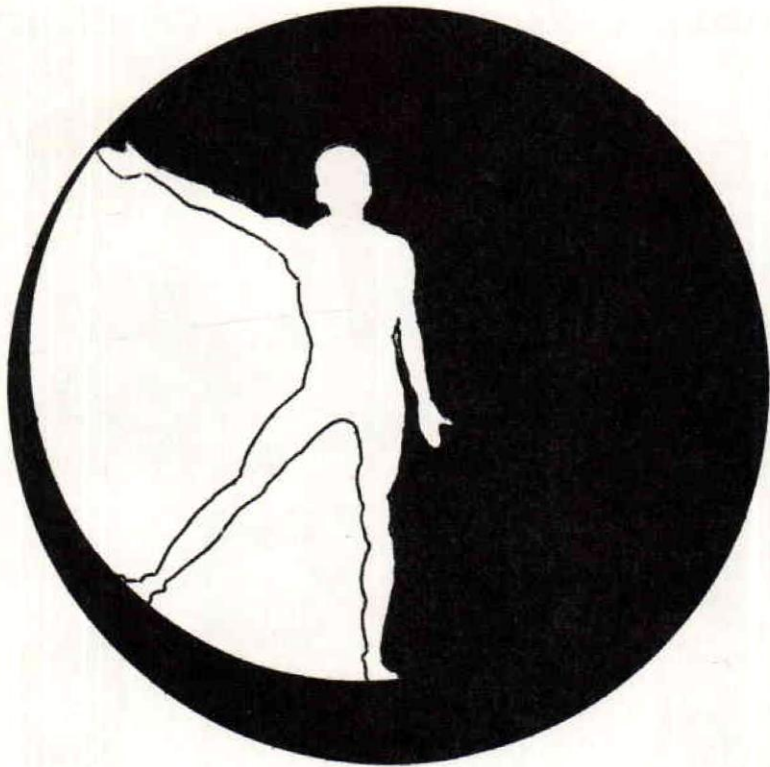
STUMP SOCKS—BRACES—CORSETS
HOSIERY—TRACTION EQUIPMENT
PROSTHETIC & ORTHOTIC
PARTS—SUPPLIES COMPONENTS
ABRASIVES—BUCKLES—RIVETS—VELCRO
CHEMICALS—PLASTICS—PLASTER
TOOLS—FOAMS—LEATHER—STOCKINETTE
WEBBING—WOOD—FABRICS

KNIT-RITE, INC.

1121 GRAND AVENUE • KANSAS CITY, MISSOURI 64106
PHONE: 816-221-0206



Kingsley mfg. co.



complete prosthetics

1984 PLACENTIA AVENUE • COSTA MESA, CALIFORNIA 92627

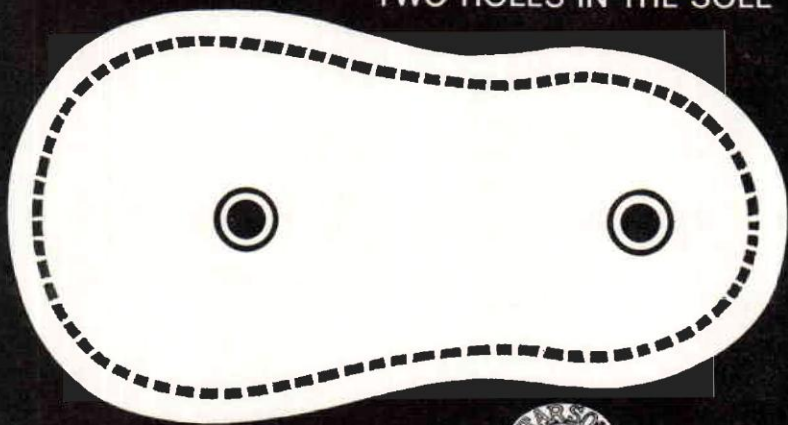
READY TO FIT HAND, WRIST AND FINGER BRACES, CERVICAL BRACES, TRAINING AIDS AND SPECIAL APPLIANCES – PLUS A COMPLETE LINE OF SPINAL AND LEG BRACES CUSTOM MANUFACTURED TO YOUR MEASUREMENTS.


COMPLETE CATALOG AVAILABLE ON REQUEST



C. D. DENISON ORTHOPEDIC APPLIANCE CORP.
220 W. 28th Street – Baltimore, Md. 21211

this is the **TARSO® SPLINT ADAPTOR**
TWO HOLES IN THE SOLE



SPLINTS SIMPLY SCREW  ON

Recessed in these two holes are steel screw receptacles. They are standard equipment in every Tarso Pronator® and Tarso Medius® open toe boot.

No need for clamps or rivets with the Splint Adaptor. Just four screws and a key, supplied free. Plus the low cost Tarso Splint, with foot plates perforated to fit the Splint Adaptor, in any bar length.

Attachment is simple. Mother can remove and replace the splint morning and night, in minutes, if required.

Tarso open toe boots are beautifully made of natural grain leather. All have firm Goodyear welted soles. Soft seamless glove leather linings. Semi-detached tongues for smooth fit. Flexible counters. And a sloping top line.

For children big enough to walk, we suggest closed toe Tarso Pronator® and Tarso Medius® styles. The same versatile Tarso Splint can be attached with rivets or sheet metal screws. Or use our excellent clamp splint.

Available from dealers throughout the U.S. and Canada. Write for Catalog and ingenious new TARSO STICKER KIT.



MARKELL SHOE COMPANY, INC.

504 SAW MILL RIVER ROAD,

YONKERS, N. Y. 10702

for Orthotists and Prosthetists



atco-gel

now available in SHEETS

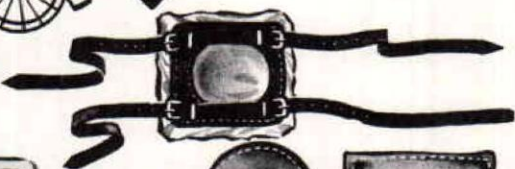
PROVEN thru research and evaluation by the
University of Michigan Medical Center

- 16" x 16" sheets in thicknesses 1/4", 3/16", 3/8"
—plus others upon request.
- Atco-Gel is a resilient material, ideally suited for
pressure-reduction and padding. Permits professional
application where critical fit is vital.
- Sheet is strengthened by
impregnated gauze.
- Liquid form is also available—easily
fabricated through heat and forming.

Suitable for pressure pads,
wheelchair cushions, etc.



DEVELOPED BY
HULL-SMITH CHEMICALS, INC.



ATCO Surgical Supports Co.

450 Portage Trail
Cuyahoga Falls, Ohio 44222
Call (216) 928-2153

**UNITED STATES
MANUFACTURING CO.**

B * S * K
*fully
stabilized
knee*

Fully stabilized at all times up to 25° of flexion.

The stabilizing effect of this knee virtually eliminates falls, increases confidence and reduces general fatigue.

Prevents collapse of the knee when bearing weight. The mechanism is a sturdy mechanical unit located entirely within the knee.

The B.S.K. is designed to accommodate the Staros-Gardner Alignment Coupling.

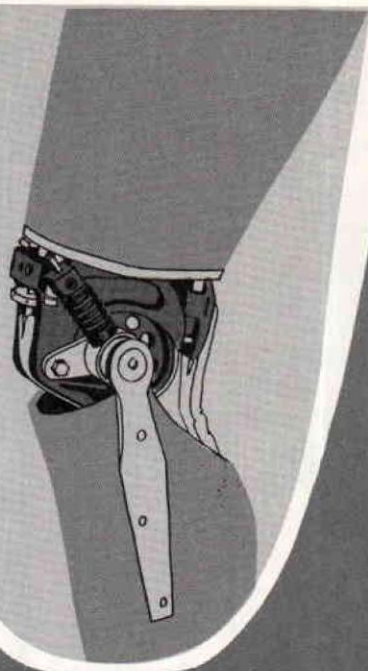
Accepted for general issue by the Ministry of Health of England in January, 1963.

Sold on prescription only



**UNITED STATES
MANUFACTURING CO.**

P.O. Box 110, 623 South Central Avenue,
Glendale, California 91209, U.S.A.



10/69

61 62 63 64 65 66 67 68 69

Child Life
has been the best
selling and most
prescribed brand
of children's
prescription foot-
wear since 1961.



HERBST SHOE MANUFACTURING CO.
P.O. BOX 2005
Milwaukee, Wisconsin 53201

Realastic[®] The largest, most complete line of
cosmetic restorations available anywhere in the world.

- COSMETIC GLOVES
- PASSIVE & PARTIAL HANDS
- BODY BUILD-UPS and RESTORATION
 - LEG & FOOT COVERS
 - ATROPHIED LEG BUILD-UPS
 - BOW LEG PADS
 - NOSE, EAR, EYE and FACIAL RESTORATIONS
 - PARTIAL FEET
 - COSMETIC FINGERS & ARMS
 - EYEBROWS
 - BREAST RESTORATIONS
 - MASKING and STRETCH HOSE
 - SUPPLIES

Realastic Industries 1000 - 42nd Street Oakland, Calif. 94608

**All Your Needs For
ORTHOPEDIC AND PROSTHETIC APPLIANCES
SUPPLIES**

Under One Roof

*Coutils · Moleskins · Brocades · Elastics
Non-Elastics · Nylon Lacings · Buckles
Tools · Air Foam · Steels · Vibretta*

PRENYL[®]

"The Most Versatile Material for Splinting"

VELCRO[®]

New concept in fastening

distributed to the
Orthopedic and Prosthetic Professions

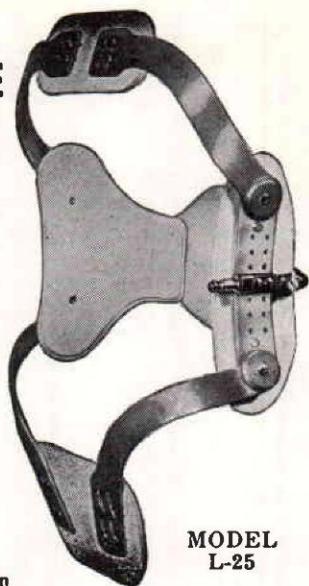
by

L. Laufer & Co.

50 West 29th Street • New York 1, N. Y.

Becker ADJUSTABLE HYPEREXTENSION BRACE

- Quick release, snap-out attachment
- Adjustable, self aligning posterior pad
- Rotating adjustment for sternal and pubic pads
- Vertical and horizontal sliding adjustments
- Bi-lateral worm gear traction bands
- Plastic water resistant pad covers
- Constructed of 24 ST aluminum



MODEL
L-25

1776 South Woodward • Birmingham, Michigan

MANUFACTURERS OF PRECISION-MADE BRACE PARTS

BECKER ORTHOPEDIC APPLIANCE COMPANY

24 Hour Service



**SERVICE
OUR
BYWORD**

—Exclusively—

LEATHERS FOR THE
ORTHOPEDIC and PROSTHETIC TRADE

LIMB & BRACE LEATHERS:

- Orthopedic Horsehide
- Orthopedic Cowhide
- Orthopedic Elkhide
- Glazed & Molding Cowhide
- Calf—Kip—Sheep—Pigskin

HOSPITAL LEATHERS:

- Shearlings for Pads
- Carving & Tooling
- Molding
- Russet Strap

Satisfied Customers Throughout the United States Since 1924

**ORDERS SHIPPED
THE SAME DAY**

RODEN LEATHER CO., INC.
1725 CROOKS ROAD
ROYAL OAK, MICH. 48068
Area Code 313-542-7064

the **BIG ONE**

Sabel

EQUINO-VARUS

Announcing a new extended size range on the big one . . . to meet hundreds of requests from doctors at the medical conventions. Now, a patient can be kept in night or day corrections longer because sizes 5 and 6 will do it. With or without splints, these added sizes allow the doctor to follow up castings with a holding shoe for the older infant.



**E. J. Sabel Co., Benson-East, P.O. Box 644
Jenkintown, Pennsylvania, 19046**

ORDER FROM SABEL DIVISION,
R. J. POTVIN SHOE CO.
BROCKTON, MASS. 02402

**NOW in sizes
000 to 4**

NARROW AND WIDE

5 and 6

NARROW ONLY

1970 NATIONAL ASSEMBLY PROGRAM

Saturday, September 26

National Office Staff arrives

Sunday, September 27

Set up on-site assembly office

Final run-through of physical arrangements and program
Hotel Staff Orientation of Convention Bureau help.

Monday, September 28

8:00 A.M. Assembly Office opens.
9:00 A.M. ABC Board of Directors

Tuesday, September 29

8:00 A.M. Assembly Office opens.
9:00 A.M. AOPA Board of Directors
12:00 Noon Begin Exhibit Set-up
6:00 P.M. Reception
TS Moderators Meeting

Wednesday, September 30

8:00 A.M. Assembly Office opens.
Women's Auxiliary Desk opens
8:30 A.M. The President's Breakfast
10:00 A.M. Formal Opening of Exhibits
10:30 A.M. Women's Auxiliary Hospitality Room
10:30 A.M. Coffee Service
10:30 A.M. TECHNICAL SESSION
"Upper Extremity Orthotics"
11:00 A.M. Women's Auxiliary Meeting
12:00 Noon Joint Executive Council Meeting
1:30 P.M. TECHNICAL SESSION
"New Products"
3:30 P.M. TECHNICAL SESSION
"Plastic Materials in
Orthotics and Prosthetics"

Thursday, October 1

8:00 A.M. Assembly Office opens.
Women's Auxiliary Desk opens
Exhibits open
Coffee Service
8:30 A.M. TECHNICAL SESSION
"Spinal Anatomy"
10:30 A.M. CONCURRENT TECHNICAL SESSIONS

I. "Spinal Bracing"

II. "Cosmetic Finishing of Skeletal Systems"

12:30 P.M. Lunch
2:00 P.M. Insurance Committee
2:00 P.M. TECHNICAL SESSION
"Legal Liability in Orthotics & Prosthetics"
4:00 P.M. Exhibits close
Free Time - Weather permitting, it is planned to have a swim party with beer and soft drinks at the hotel's outside pool and patio.
6:30 P.M. Barbecue with entertainment and cash bar at the hotel's pool and patio

Friday, October 2

8:00 A.M. Assembly Office opens.
Women's Auxiliary Desk opens
United Airlines Desk opens
Exhibits open
Coffee Service begins
8:30 A.M. CONCURRENT TECHNICAL SESSIONS
I. "Hand Splinting"
II. "Status of Fitting Symes, Knee and Hip Amputees"
10:30 A.M. Break
11:00 A.M. TECHNICAL SESSION
"Orthotic and Prosthetic Knee Mechanisms"
12:30 P.M. ABC LUNCHEON
2:30 P.M. ABC ANNUAL MEETING
ABC BOARD OF DIRECTORS MEETING

Saturday, October 3

7:30 A.M. Suppliers Breakfast
9:00 A.M. Women's Auxiliary Breakfast
9:00 A.M. TECHNICAL SESSION
"Evaluation Criteria for Immediate Post-Operative and Fracture Bracing Techniques"
11:00 A.M. Lunch
12:30 P.M. Begin Exhibit Take-down
12:30 P.M. TECHNICAL SESSION
"Stress and Strain on Skin and Soft Tissues"
2:45 P.M. AOPA ANNUAL MEETING
6:30 P.M. CONCLUDING RECEPTION
7:30 P.M. CONCLUDING BANQUET

Sunday, October 4

8:30 A.M. AOPA Board of Directors (new)

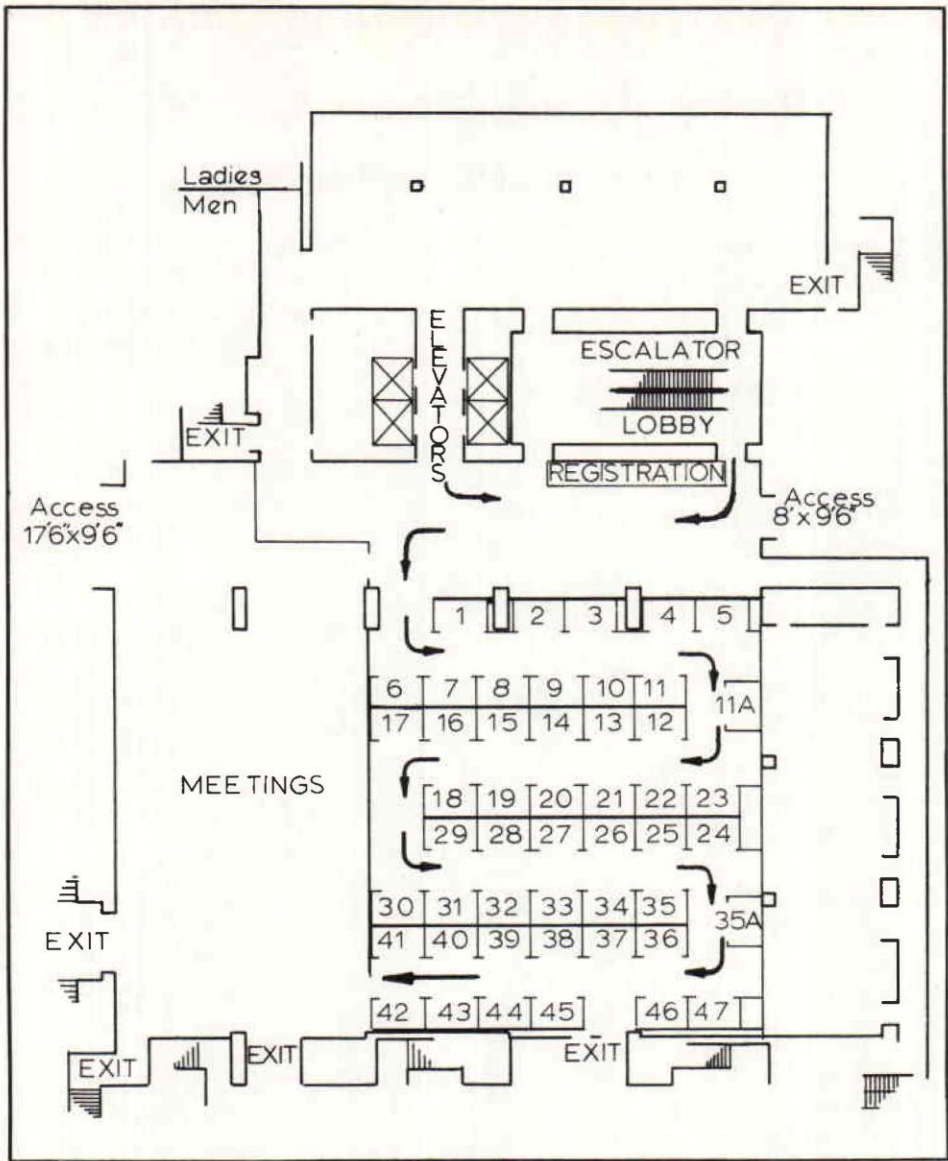


EXHIBIT FLOOR PLAN

Northwestern University Prosthetic-Orthotic Center Announces Courses

Prosthetics 601

Above-Knee Prosthetics for Prosthetists

Three-week course will cover functional anatomy, biomechanics, measurement and lay-out techniques, adjustable leg, transferring with alignment duplication jig, auxiliary suspension, plastic laminate reinforcing, and checkout. Instruction will include fluid-controlled mechanisms; analysis of a variety of fitting problems. Only total contact plastic sockets will be taught in this session. One of the prostheses fitted will be on a hydraulic unit. This course is open to certified prosthetists and to those preparing for certification.

Tuition:

Prosthetists	\$300.00 plus
Laboratory Fee	200.00
Total Tuition:	\$500.00

Date: October 5-23, 1970

Prosthetics 611

Below-Knee Prosthetics for Prosthetists

Three-week course will include functional anatomy and locomotion of the below-knee amputee, measurement and casting techniques, fabrication of plastic sockets; fabrication and fitting of special prostheses including the PTB supracondylar wedge suspension, PTB supracondylar, supra-patellar prosthesis (PTS), and air-cushion

sockets; location of knee joints, alignment analysis, application of these to the use of the new below-knee adjustable leg. During practical laboratory sessions students will fit four below-knee amputees. Time will be devoted to seminar discussions of problems encountered by students. The course is open to certified prosthetists or to those preparing for certification.

Tuition:

Prosthetists	\$250.00 plus
Laboratory Fee	150.00
Total Tuition:	\$400.00

Date: April 12-30, 1971

Prosthetics 621

Advanced Below-Knee Prosthetics for Prosthetists

Five-day laboratory course offering instruction and laboratory practice in the fabrication and fitting techniques of special below-knee prostheses. This will include the patellar tendon bearing supracondylar wedge suspension prosthesis; patellar tendon bearing supracondylar, suprapatellar prosthesis (PTS); air-cushion socket and Polysar socket. This course is open to certified prosthetists and to those preparing for certification.

Pre-requisite: Completion of a B/K course at N.Y.U., U.C.L.A. or N.U.

Tuition:

Prosthetists	\$100.00 plus
--------------	---------------

Laboratory Fee 175.00
Total Tuition: \$275.00

Dates:

Section A February 1-5, 1971

Section B May 24-28, 1971

Section C June 14-18, 1971

Section D July 12-16, 1971

Section E July 19-23, 1971

Prosthetics 661

Upper-Extremity Prosthetics for Prosthetists

Three-week course will include measuring, fabricating, fitting and harnessing the upper-extremity amputee. Functional anatomy will also be covered. The students will make two below-elbow prostheses including a Muenster type; two above-elbow prostheses; and measurement and check socket fitting of shoulder disarticulation amputee will be taught. This course is open to certified prosthetists and to those preparing for certification.

Tuition:

Prosthetists \$250.00 plus
Laboratory Fee 150.00
Total Tuition: \$400.00

Date: February 22-March 12, 1971

Prosthetics 671

Review of Fluid Control Mechanisms for Prosthetists

A seminar in fluid-controlled mechanisms will be offered for qualified prosthetists. Enrollment is limited to those who have successfully completed a course in above-knee prosthetics.

Tuition:

Prosthetists \$100.00

Date: January 11-13, 1971

Orthotics 701

Spinal Orthotics for Orthotists

Two-week laboratory instruction in this course will include practice in the measurement, tracing, fabrication and fitting of spinal orthoses (lumbo-sacral; thoraco-lumbar; anterior hyperextension and cervical appliances) with special instruction in corsetry. Milwaukee Brace construction will not be offered in this course. In addition, lectures in anatomy, kinesiology, pathology and components will be given. This course is open to certified orthotists and to those preparing for certification.

Tuition:

Orthotists \$200.00 plus
Laboratory Fee 100.00
Total Tuition: \$300.00

Date: March 22-April 2, 1971

Orthotics 711

Lower-Extremity Orthotics for Orthotists

Two-week laboratory course will include instruction and practice in measurement, tracing, fabrication and fitting of lower-extremity orthoses (below-knee orthosis; above-knee orthosis) with emphasis on mechanical joint location and tibial torsion. In addition, lectures in anatomy, kinesiology, pathology, components and shoe modifications will be given. This course is open to certified orthotists and to those preparing for certification.

Tuition:

Orthotists \$200.00 plus
Laboratory Fee 100.00
Total Tuition: \$300.00

Date: November 2-13, 1970

Orthotics 721

Upper-Extremity

Orthotics for Orthotists

Two-week laboratory course includes instruction and practice in measurement, tracing, fabrication and fitting of short opponens, long opponens, tenodesis and externally powered hand splints. In addition, lectures in anatomy, kinesiology, pathology and components will be offered. This course is open to certified orthotists and to those preparing for certification.

Tuition:

Orthotists	\$200.00 plus
Laboratory Fee	100.00
Total Tuition:	\$300.00

Date: May 3-14, 1971

Orthotics 741

Basic Plaster and

Plastic Orthotic Techniques

Five-day course offers lectures, demonstrations and laboratory instruction in plaster and plastic techniques. Included will be casting of patients, modification of molds,

plastic resin lamination and thermoplastic application. The students will fabricate a PTB weight-bearing socket for a B/K orthosis; plastic shoe insert for correction of flexible foot deformities with application as distal attachment for B/K and A/K orthoses; thermoplastic hand-positioning splint. This course is open to certified orthotists and to those preparing for certification.

Tuition:

Orthotists	\$125.00 plus
Laboratory Fee	100.00
Total Tuition:	\$225.00

Dates:

Section A February 1-5, 1971

Section B March 15-19, 1971


Please address inquiries and requests for Application for Admission to:

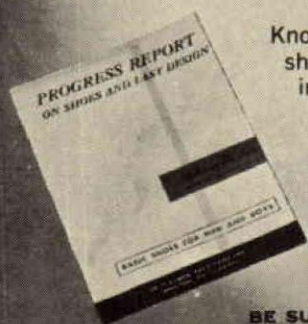
Charles M. Fryer, M.A., Director
Prosthetic-Orthotic Center
Northwestern University Medical
School
401 East Ohio Street
Chicago, Illinois 60611

foot problems?
fitting problems?

prescribe



**ALDEN  PEDICS®...THE ONLY SHOES
WITH LASTS FOR EVERY FOOT TYPE**



Know that your corrections will be made best in shoes uniquely designed to accommodate them... in a stable, controlled, superior quality foundation.

Alden-Pedic's superior accommodation of prescribed corrections is achieved not only with unique last selection. Long inside counters; right and left ortho heels, long inside; heavy gauge right and left ribbed steel shanks; and premium leathers combine to provide the finest foundation made for your corrections.

**BE SURE. WRITE FOR YOUR FREE PROGRESS REPORT
ON SHOE & LAST DESIGN & ILLUSTRATED BROCHURE**

C. H. ALDEN SHOE COMPANY • MIDDLEBOROUGH • MASS. 02346

**AMERICAN ORTHOTIC AND PROSTHETIC ASSOCIATION
1440 N STREET, N.W.
WASHINGTON, D.C. 20005**