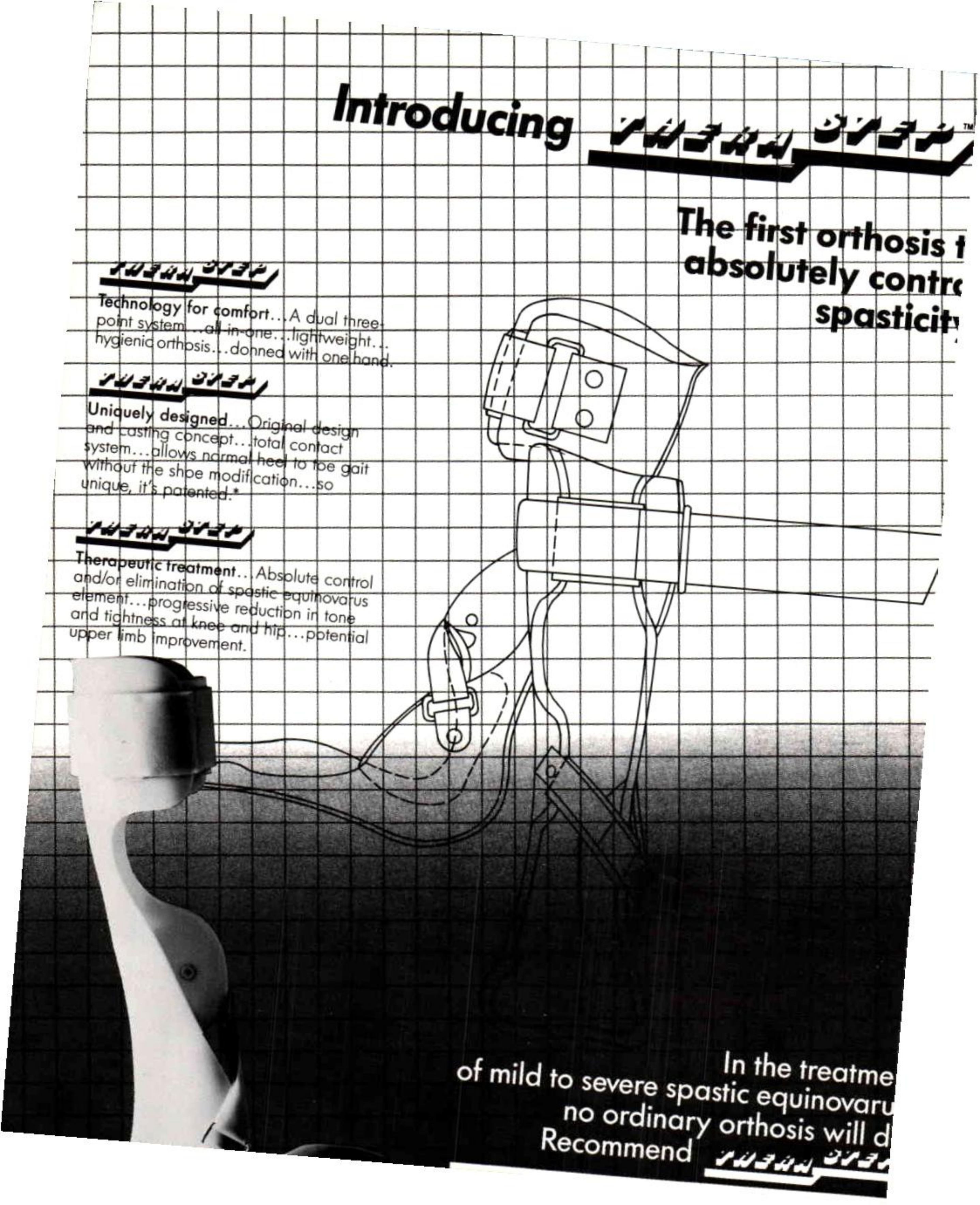
[redacted]

Spring 1986
Volume 40
Number 1

FOUNDED 1917

Orthotics and Prosthetics

Journal of the American Orthotic and Prosthetic Association


Introducing THERA STEP™
The first orthosis t
absolutely contr
spasticit
THERA STEP
Technology for comfort…A dual three-point system…all-in-one…lightweight…hygienic orthosis…donned with one hand.
THERA STEP
Uniquely designed…Original design and casting concept…total contact system…allows normal heel to toe gait without the shoe modification…so unique, it's patented.*
THERA STEP
Therapeutic treatment…Absolute control and/or elimination of spastic equinovarus element…progressive reduction in tone and tightness at knee and hip…potential upper limb improvement.
In the treatme
of mild to severe spastic equinovaru
no ordinary orthosis will d
Recommend THERA STE

Orthotics and Prosthetics

Editor
Lawrence R. Lange, C.P.O.
Consulting Editor
Joseph M. Cestaro, C.P.O.
Managing Editor
Christopher R. Colligan
Assistant Editor
Sharada Gilkey

Spring 1986 **Volume 40, Number 1**

CONTENTS

Second Class Postage Paid
at Alexandria, VA
and additional mailing offices
US ISSN 0030-5928

Subscriptions: $50 Domestic (U.S., Canada, Mexico)
$50 Foreign
$60 Foreign Airmail

THE AMERICAN ORTHOTIC AND PROSTHETIC ASSOCIATION

OFFICERS

President—**William B. Smith, C.O.**
Kansas City, Missouri

President-Elect—
Franklin M. Floyd, C.P.O.
Wilmington, North Carolina

Vice-President—
Bradley C. Rosenberger, C.P.O.
Lincoln, Nebraska

Secretary-Treasurer—
Larry R. Bradshaw
Denver, Colorado

Immediate Past-President—
Joseph M. Cestaro, C.P.O.
Washington, D.C.

THE AMERICAN ACADEMY OF ORTHOTISTS AND PROSTHETISTS

OFFICERS

President—**David C. Schultz, C.P.O.**
Milwaukee, Wisconsin

President-Elect—
Wm. C. Neumann, C.P.O.
Methuen, Massachusetts

Vice-President—
Alvin C. Pike, C.P.
Minneapolis, Minnesota

Secretary/Treasurer—
John W. Michael, C.P.O.
Durham, North Carolina

Immediate Past-President—
John N. Billock, C.P.O.
Warren, Ohio

THE AMERICAN BOARD FOR CERTIFICATION IN ORTHOTICS AND PROSTHETICS

OFFICERS

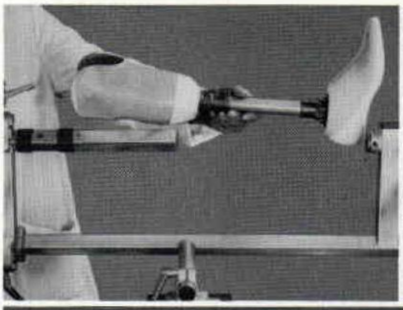
President—**Michael Lewis, C.P.O.**
Chicago, Illinois

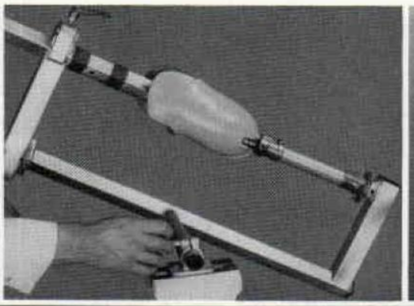
President-Elect—
Jon Leimkuehler, C.P.O.
Cleveland, Ohio

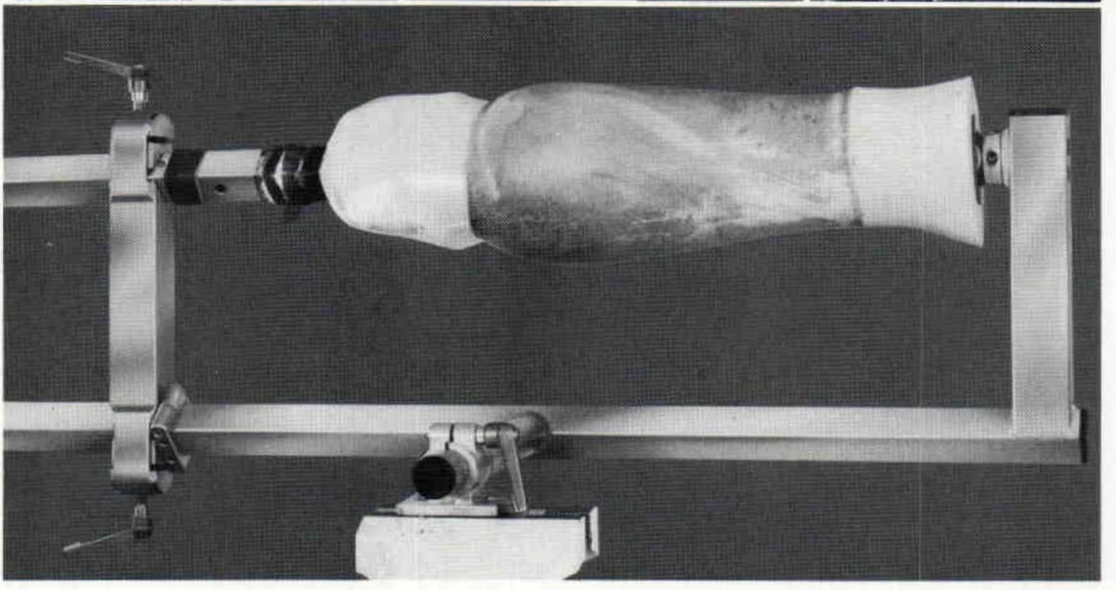
Secretary-Treasurer—
Frank Clippinger, M.D.
Durham, North Carolina

Vice-President—
Paul V. Murka, C.P.O.
Dayton, Ohio

Immediate Past-President—
Ronald F. Altman, C.P.O.
Newington, Connecticut







Lightweight Below-Knee Prosthesis using the OTTO BOCK Technique

You can fabricate a lightweight exoskeletal below-knee prosthesis using the proven OTTO BOCK techniques:

The adjustable modular components act as a dynamic alignment device.

These dynamic alignment values can then be accurately transferred to the final prosthesis by using the *743A16 OTTO BOCK Transfer Alignment Apparatus.*

For completion, utilize our PEDILEN and ORTHOCRYL Lamination Technique.

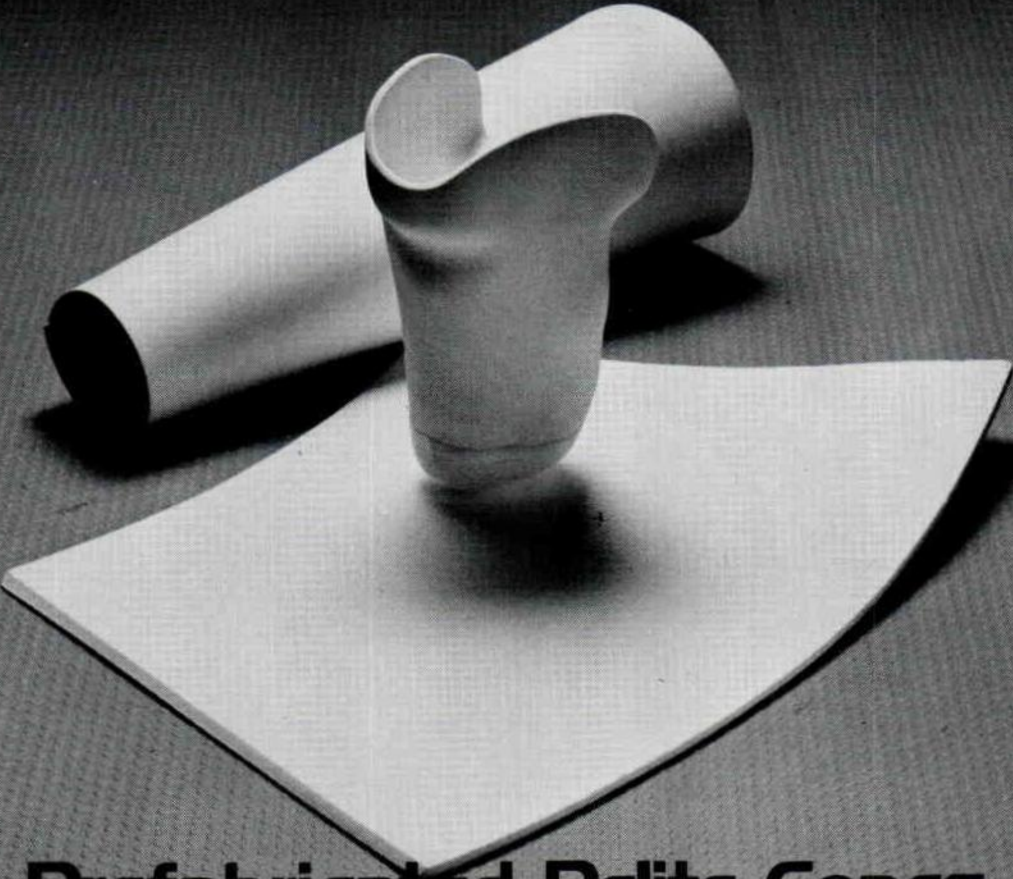
PEDILEN and ORTHOCRYL are registered trademarks of OTTO BOCK, Duderstadt.

Otto Bock
ORTHOPEDIC INDUSTRY INC.
UNITED STATES OF AMERICA

4130 Highway 55
MINNEAPOLIS/Minnesota 55422
Telephone (612) 521-3634
Telex 2 90 999

Ad Index and Hotline

Advertisers are encouraged to submit the name of a contact person within their organization for inclusion in the Ad Index.




DO
IT
NOW!

Reader's Forum

The authors of "Comparison of Three Prefabricated Collars," *Orthotics and Prosthetics*, Vol. 39, No. 4, pp. 21–28, asked that the following information be brought to the attention of our readers:

- The original title of the article is "Comparison of the Three Orthoses."
- On p. 22, the caption under the photograph for Figure 1 should read: "From left to right, Nec-Lock®, the Philadelphia Collar, and Soft-Foam Collar."
- On p. 25, Table 1, under Orthoses 2-4, the value for Ant./Post. should read 0.0000; under Orthoses 3-4, the Ant./Post. value should read 0.0106.
- On pp. 26–27, the paragraph beginning "The Philadelphia Collar" is repeated; the correct paragraph begins on p. 27.
- The following citations were inadvertently omitted from the references which begin on p. 27:

Buck, C.A., Dameran, F.B., Dow, M.J., "Study of Normal Range of Motion in the Neck Utilizing a Bubble Goniometer," *Arch. Phys. Med. Rehab.* 40, pp. 390–392, 1959.

Leighton, J.R., "An Instrument and Technique for the Measurement of the Range of Joint Motion," *Arch. Phys. Med. Rehab.* 36, pp. 571–578, 1955.

Leighton, J.R., "Flexibility Characteristics of Males Ten to Eighteen Years of Age," *Arch. Phys. Med. Rehab.* 37, pp. 494–499, 1956.

Fisher, S.V., Bowar, J.F., Essom, A.A., Gullickson, G., "Cervical Orthosis Effect on Cervical Spine Motion: Roentgenographic and Goniometric Method of Study," *Arch. Phys. Med. Rehab.* 50, pp. 709–715, March, 1977.

Stegner, B.L., Bostrom, A., Crunch Interactive Statistical Software, Crunch Software, 2547 22nd Avenue, San Francisco, California 94116.

The editors regret the errors.

Meetings and Events

Please notify the National Headquarters immediately concerning all meeting dates. It is important to submit meeting notices as early as possible. In the case of Regional Meetings, you must check with the National Headquarters prior to confirming date to avoid conflicts in scheduling.

1986

April 24–26, International Conference of the Menisci of the Knee, Hotel Libertas, Dubrovnik, Yugoslavia. Contact: Marko Pecina, President of the Organizing Committee, International Conference on the Menisci of the Knee, Zagreb, Yugoslavia.

April 26–29, AOPA Regions II and III Combined Annual Meeting, Resorts International Casino, Atlantic City, New Jersey. Contact: Mort Levy, CP, (201) 222-0366.

April 27–29, Rehabilitation International USA, International Conference, "Disability Prevention and Rehabilitation: A Global Challenge," Contact: Rehabilitation International USA, 1123 Broadway, New York 10010.

May 4–5, Northwest Chapter of the Academy Seminar, Portland, Oregon. Contact: Robert Lebold, CO, Salem Orthopedic & Prosthetic, Inc., 675 12th Street SE, Salem, Oregon 97301; tel. (503) 581-9191.

May 5–7, 1986 Annual Meeting of the National Association of Rehabilitation Research and Training Centers in cooperation with the National Rehabilitation Information Center, Hilton Plaza Inn on the Country Club Plaza, Kansas City, Missouri. Contact: Research and Training Center on Independent Living, AA-313 Bristol Terrace, Lawrence, Kansas 66044; tel. (913) 842-7694.

May 7–9, Second Annual Course on Practical Upper Extremity Prosthetics, East Meadow, New York. Contact: Daniel Shapiro, M.D., Program Director, Department of Physical Medicine & Rehabilitation, Nassau County Medical Center, 2201 Hempstead Turnpike, East Meadow, New York 11554.

May 7–10, Annual Meeting of the Association of Children's Prosthetic-Orthotic Clinics, Milwaukee, Wisconsin. Contact: Francis J. Trost, M.D., Program Chairman, 2545 Chicago Avenue S., Minneapolis, Minnesota 55404.

May 16–17, American Academy of Orthotists and Prosthetists Continuing Education Conference 2-86, "Lower Limb Prosthetics," Kansas City, Kansas. Contact: Academy National Headquarters, (703) 836-7118.

May 16–18, North Carolina Society of Orthotists and Prosthetists, Charlotte Marriott, Executive Park, Charlotte, North Carolina. Contact: Carl Tyndall, CPO, (919) 757-3058.

May 26–27, International Workshop on Hip Disarticulation and Hemipelvectomy Prostheses, Royal Ottawa Regional Rehabilitation Centre, Ottawa, Ontario, Canada. Contact: Education Department, Royal Ottawa Regional Rehabilitation Centre, 505 Smyth Road, Ottawa, Ontario K1H 8M2 Canada; tel. (613) 737-7350, ext. 602.

May 28–30, S.M. Dinsdale International Conference on Rehabilitation, "Towards the 21st Century," hosted by the Royal Ottawa Regional Rehabilitation Centre, 505 Smyth Road, Ottawa, Ontario K1H 8M2. Contact: Education Dept. tel. (613) 737-7350, ext. 602.

May 28–31, AOPA Region V Annual Meeting, Hyatt Regency, Cincinnati, Ohio.

May 29–June 2, InterMedica '86, 2nd International Exhibition of Biomedical and Hospital Equipment, Porte de Versailles Exhibition Park, Paris, France. Contact: Association INTERMEDICA, 10 Avenue Hoche, 75382 Paris, France.

May 31, Maryland, District of Columbia & Virginia Chapter of the Academy Meeting and Education Seminar, Bethesda, Maryland. Contact: Tim Evans, (301) 837-3750; Cindy Fox, (703) 698-5007.

June 2–6, Fitting Procedures for the Utah Artificial Arm, Northwestern University Post Graduate Medical School, Department of Prosthetics and Orthotics, Chicago, Illinois. Contact: Harold Sears, Ph.D., Motion Control, Inc., 95 S. Elliott Road, #105, Chapel Hill, North Carolina 27514; tel. (919) 968-8492.

June 6–8, AOPA Region IX, COPA, and the California Chapters of the Academy Combined Annual Meeting, Newport Beach Marriott, Newport Beach, California.

June 11–14, AOPA Regions VII, VIII, X, and XI Combined Annual Meeting, Four Seasons Hotel, Lake of the Ozarks, Missouri.

June 19–22, AOPA Region VI and Academy Midwest Chapter Combined Annual Meeting, Lakelawn Lodge, Delavan, Wisconsin.

June 23–27, RESNA 9th Annual Conference on Rehabilitation Technology, "Employing Technology," Radisson South Hotel, Minneapolis, Minnesota. Contact: RESNA, Suite 700, 1101 Connecticut Avenue, NW, Washington, D.C. 20036; tel. (202) 857-1199.

June 24–28, 6th National Veterans Wheelchair Games, University of Texas at Arlington, Arlington, Texas. Contact: Terrance J. Wickman, Games Coordinator, Dallas Veterans Administration Medical Center, Attn.: Recreation Service (11K), 4500 S. Lancaster Road, Dallas, Texas 75216; tel. (214) 372-7012.

June 26–28, Charleston Bending Brace Seminar for Scoliosis, Sir Francis Drake Hotel, San Francisco, California. Contact: Shannon Schwenn, Dobi-Symplex, Inc., (305) 645-0414.

June 29–July 4, International Society for Prosthetics and Orthotics World Congress, Copenhagen, Denmark. Contact: ISPO V, DIS Congress Service, Linde Alle 48, DK-2720 Vanlose, Copenhagen, Denmark.

July 18–19, American Academy of Orthotists and Prosthetists Continuing Education Conference 3-86, "Disarticulation Prosthetics," Milwaukee, Wisconsin. Contact: Academy National Headquarters, (703) 836-7118.

August 4, Canadian Chapter of ISPO Seminar, "State of the Art in Prosthetics and Orthotics," World Trade Center, Halifax, Nova Scotia, Canada. Contact: Guy Martel, Director, Prosthetics-Orthotics Department, Chedoke-McMaster Hospitals, Chedoke Hospital Division, P.O. Box 2000, Station 'A', Hamilton, Ontario L8N 3Z5 Canada; tel. (416) 521-2100, ext. 7572.

August 5–7, Canadian Association of Prosthetists and Orthotists Biennial National Convention, World Trade Centre, Halifax, Nova Scotia, Canada. Contact: Nova Scotia Rehabilitation Centre, Orthotics/Prosthetics Unit, 1341 Summer Street, Halifax, Nova Scotia B3H 4H4, Canada.

August 11–15, 1986 UNB Myoelectric Controls Course and Symposium, Fredericton, New Brunswick, Canada. Contact: Director, Bio-Engineering Institute, University of New Brunswick, Fredericton, New Brunswick, Canada E3B 5A3; tel. (506) 453-4966.

August 22–23, American Academy of Orthotists and Prosthetists Continuing Education Conference 4-86, "Pediatric Prosthetics," Newington, Connecticut. Contact: Academy National Headquarters, (703) 836-7118.

September 10–12, 6th Annual Advanced Course in Lower Extremity Prosthetics, East Meadow, New York. Contact: Daniel Shapiro, M.D., Department of Physical Medicine & Rehabilitation, Nassau County Medical Center, 2201 Hempstead Turnpike, East Meadow, New York 11554.

September 13–16, The 39th Annual Conference on Engineering in Medicine and Biology, Omni International Hotel, Baltimore, Maryland. Contact: The Alliance for Engineering in Medicine and Biology, Suite 700, 1101 Connecticut Avenue, NW, Washington, DC 20036.

October 22–31, UCLA Advanced Prosthetics Techniques, Los Angeles, California. Contact: Timothy B. Staats, MA, CP, UCLA POEP, Room 22-46, 1000 Veteran Avenue, Los Angeles, California 90024.

October 24–25, American Academy of Orthotists and Prosthetists Continuing

Education Conference 5-86, "Spina Bifida," Cincinnati, Ohio. Contact: Academy National Headquarters, (703) 836-7118.

November 4–8, USA Medical Advances Exhibitions in Europe, in conjunction with IFAS '86, Zurich, Switzerland. Contact: U.S. & Foreign Commercial Service, Mr. D. Schaubacher, Commercial Specialist, American Embassy, P.O. Box 1065, CH-3001 Bern, Switzerland; tel. 41/31/43 73 43, Telex 912 603.

November 4–9, AOPA Annual National Assembly, Marriott's Orlando World Center, Orlando, Florida. Contact: AOPA National Headquarters, (703) 836-7116.

1987

January 22–27, American Academy of Orthopaedic Surgeons Annual Meeting, San Francisco, California.

February 15–22, Academy Annual Meeting and Scientific Symposium, Hyatt Regency Tampa, Tampa, Florida. Contact: Academy National Headquarters, (703) 836-7118.

May 28–31, AOPA Region V Annual Meeting, Grand Traverse Hotel, Traverse City, Michigan.

June 5–7, AOPA Region IX, COPA, and the California Chapters of the Academy Combined Annual Meeting, Doubletree Inn, Monterey, California.

June 10–13, AOPA Regions VII, VIII, X, and XI Combined Annual Meeting, Dallas, Texas.

July 5–10, International Conference on Disability Education, Jerusalem, Israel. Contact: Israel Rehabilitation Society, 18 David Elazar Street, Tel Aviv 61901, Israel.

July 12–16, International Conference of Rehabilitation Journalists, Jerusalem, Israel. Contact: Israel Rehabilitation Society, 18 David Elazar Street, Tel Aviv 61901, Israel.

September 21–27, AOPA Annual National Assembly, Hyatt Regency Hotel, San Francisco, California. Contact: AOPA National Headquarters, (703) 836-7116.

1988

May 19–21, AOPA Region V Annual Meeting, Charleston, West Virginia.

September 5–9, 16th World Congress of Rehabilitation International, Keio Plaza Inter-Continental Hotel, Shinjuku, Tokyo, Japan. Contact: Secretary General, 16th World Congress of Rehabilitation International, c/o the Japanese Society for Rehabilitation of the Disabled, 3-13-15, Higashi/Kebukuro, Toshima-Ku, Tokyo 170, Japan.

October 25–30, AOPA Annual National Assembly, Sheraton Washington Hotel, Washington, D.C. Contact: AOPA National Headquarters, (703) 836-7116.

1989

October 2–8, AOPA Annual National Assembly, MGM Grand Hotel, Reno, Nevada. Contact: AOPA National Headquarters, (703) 836-7116.

1990

September 11–16, AOPA Annual National Assembly, Sheraton Boston Hotel, Boston, Massachusetts. Contact: AOPA National Headquarters, (703) 836-7116.

TO: PERSONS WORKING IN REHABILITATION

FROM: SIEGFRIED PAUL, CPO(E), SCIENTIFIC PROGRAM CHAIRMAN

RE: CALL FOR CONTRIBUTED PAPERS FOR THE 1986 ASSEMBLY SCIENTIFIC PROGRAM

The American Orthotic and Prosthetic Association's 900-plus membership consists of firms involved in the design, manufacture, and fitting of orthoses and prostheses. The primary objective of AOPA is to promote high levels of orthotic/prosthetic patient care services to the orthopedically handicapped. To aid in achieving this goal, each year the Association provides a forum, via its annual National Assembly, for orthotics and prosthetics professionals to share information on the many new ideas and/or concepts of or relating to orthotics/prosthetics. Nearly everyone working in orthotics and prosthetics in the United States attends the Assembly, along with many professionals from abroad. The 1986 Assembly will be held at Marriott's Orlando World Center, Orlando, Florida, November 4–9, 1986.

AOPA invites all interested persons to submit an abstract(s) for presentation during the Assembly's Scientific Program. The subject(s) for the abstract(s) should be new ideas, techniques, devices, and/or research that have a practical application in orthotics and prosthetics or a related field. Interested persons are invited to submit more than one abstract. Most presenters will be given 15 minutes for their presentation.

If you are interested in participating in the 1986 Assembly, please complete the abstact form on the reverse and return it to the AOPA National Headquarters no later than April 22, 1986.

Don't hesitate! Do it now and be a part of one of the major rehabilitation education meetings of the year!

Thank you.

AMERICAN ORTHOTIC AND PROSTHETIC ASSOCIATION ABSTRACT GUIDELINES

START THE ABSTRACT TITLE HERE USING *CAPITAL LETTERS.* Follow with authors' names, *Business Addresses, Zip codes.* Underline *Speakers'* Name.

Leave a space between heading and abstract proper. Indent as shown. Keep all lines as wide as possible without touching or going beyond the lines at either side. Keep the text in one paragraph. If literature citations are needed, insert them in parentheses and not as footnotes. Credits, if any, should be added at the end of the abstract, but not as a new paragraph. Before submitting your abstract, check format, nomenclature, and spelling.

AOPA National Headquarters
717 Pendleton Street
Alexandria, VA 22314
U.S.A.

American Orthotic and Prosthetic Association
ABSTRACT FORM

TITLE OF PAPER:

AUTHORS:
(Underline speaker)

ADDRESS (Include Zip Code):

PHONE:

OCCUPATION:

___ Orthotist
___ O.T.
___ Prosthetist
___ P.T.
___ C.P.O.
___ Engineer
___ M.D.
___ Other (Specify)

AUDIOVISUAL REQUIREMENTS:

___ 35mm slides
___ Overhead projector
___ 16mm sound movie
___ Other (Specify)

ABSTRACT: Maximum of 200 words or equivalent. Include Title of Paper, Authors' names, Addresses with zip code. Use single space typing. Use full width of ruled area.

MAIL ABSTRACT TO: AOPA National Headquarters
717 Pendleton Street
Alexandria, VA 22314
U.S.A.

INFORMATION FOR AUTHORS

ORTHOTICS AND PROSTHETICS

INVITES THE SUBMISSION OF ALL ARTICLES AND MANUSCRIPTS

WHICH CONTRIBUTE TO ORTHOTIC AND

PROSTHETIC PRACTICE, RESEARCH, AND

EDUCATION

All submitted manuscripts should include:

1. THE ORIGINAL MANUSCRIPT AND TWO COPIES. If possible, the duplicate manuscripts should be complete with illustrations to facilitate review and approval.
2. BIBLIOGRAPHY. This should be arranged alphabetically and cover only references made in the body of the text.
3. LEGENDS. List all illustration legends in order, and number to agree with illustrations.
4. ILLUSTRATIONS. Provide any or all of the following:
   a. Black and white glossy prints
   b. Original drawings or charts

   Do *not* submit:
   a. Slides (colored or black & white)
   b. Photocopies
5. A photo (black & white glossy) of each author listed on the manuscript, along with a short biographical sketch.

PREPARATION OF MANUSCRIPT

1. Manuscripts must be TYPEWRITTEN, DOUBLE-SPACED and have WIDE MARGINS.
2. Indicate FOOTNOTES by means of standard symbols (*).
3. Indicate BIBLIOGRAPHICAL REFERENCES by means of Arabic numerals in parentheses (6).
4. Write out numbers less than ten.
5. Do not number subheadings.

PREPARATION OF ILLUSTRATIONS

1. Number all illustrations.
2. On the back indicate the top of each photo or chart.
3. Write the author's name on the back of each illustration.
4. Do not mount prints except with rubber cement.
5. Use care with paper clips; identations can create marks.
6. Do not write on prints; indicate number, letters, or captions on an overlay.
7. If the illustration has been published previously, provide a credit line and indicate reprint permission granted.

NOTES:

—Manuscripts are accepted for exclusive publication in ORTHOTICS AND PROSTHETICS.

—Articles and illustrations accepted for publication become the property of ORTHOTICS AND PROSTHETICS.

—Publication of articles does not constitute endorsement of opinions and techniques.

—All materials published are copyrighted by the American Orthotic and Prosthetic Association.

—Permission to reprint is usually granted provided that appropriate credits are given.

—Authors will be supplied with 12 reprints.

Orthotics and Prosthetics, Vol. 40, No. 1, pp. 16–32.

A Report on Amputees in India

Dinesh Mohan

INTRODUCTION

A National Seminar on Rehabilitation Services and Reseach was held at the Medical College in Trivandrum in December, 1967. Speaking at the Seminar, Dr. P.K. Duraiswami, who was at that time the Additional Director General of Health Services, said that he was not surprised "that the problem of the Rehabilitation of the Handicapped has been given a low priority, in spite of its humanitarian aspect" because the central and state governments had to spend a large proportion of their limited funds on other health problems and population control.[1] In the same lecture he mentioned that according to plans, India will have six rehabilitation centres and 36 rehabilitation units in order to provide "effective rehabilitation service to the largest number of physically handicapped." Many of these centres and units have since seen established.

Almost 14 years later, Dr. P.K. Sethi, speaking at the Asian Meeting on Childhood Disability, confessed that "how utterly unrealistic my understanding was about this problem and I have increasingly a feeling of having wasted valuable years. I imagined, and I dare say most doctors and health administrators continue to so believe, that if we have a large number of well equipped rehabiltation centres with the latest facilities for sophisticated physiotherapy, occupational therapy and workshops for providing rehabilitation aids such as calipers, artificial limbs, and other sophisticated appliances we would be able to tackle the problem of childhood disability. We continue to lament the scarcity of such centres in our country and plead for financial assistance so that we may perform as well as the most advanced countries in the world. I am now convinced that if we continue to believe in the effectiveness of expensive institutional treatment, we shall never achieve our objectives. In fact, by diverting our limited manpower and financial resources towards building a few prestigious institutions, we shall deprive the millions of our disabled in the rural areas where the bulk of our people reside."[2]

The above two quotes show that though the problem of disabilities has been recognized in its extent and complexity for some time, there does not seem to be much agreement on how the problem should be tackled. Though Dr. Sethi feels that sophisticated institutions will not solve the problem, many other professionals in the field are convinced that without such institutions we will continue to be "backward" in our rehabilitation services. As the debate continues, so does the increase in the number of disabled in India. By the latest count, there are at least 12 million physically disabled persons in India.[3] Unless some realistic plans are formulated, these debates will not help us in the rehabilitation of these millions.

In this study, an attempt has been made to understand the issues involved by concentrating on a small section of the disabled—the amputees. The latter have been chosen because they are easily recognized and detected and so the associated statistics are more likely to be accurate. Secondly, a great deal of research and development work has been done on artificial limbs, and so it would be easier to discuss alternatives in rehabilitation. Issues and solutions in other areas of disability would be at least as complex, if not more. Therefore by examining one small area of disability in detail we would get a feel for the problems in others also.

This paper has been divided into three sections. The first section deals mainly with the epidemiology of amputees in India. Most of this information has been obtained from the National Sample Survey Organization's (NSSO) Report on Disabled Persons released in March, 1983.[3] This is probably the most accurate estimate of physically disabled persons in India based on NSSO's definitions of various disabilities.

The second section deals with the kind of aids and appliances that are being given to amputees in India. This section is based on information collected by the Centre for Biomedical Engineering, Indian Institute of Technology, New Delhi, and also by The Institute for the Physically Handicapped, New Delhi. In both cases, the information has been obtained by personal visits to the various rehabilitation centres around the country.

In the last section, an attempt has been made to propose guidelines for future work in the rehabilitation of amputees.

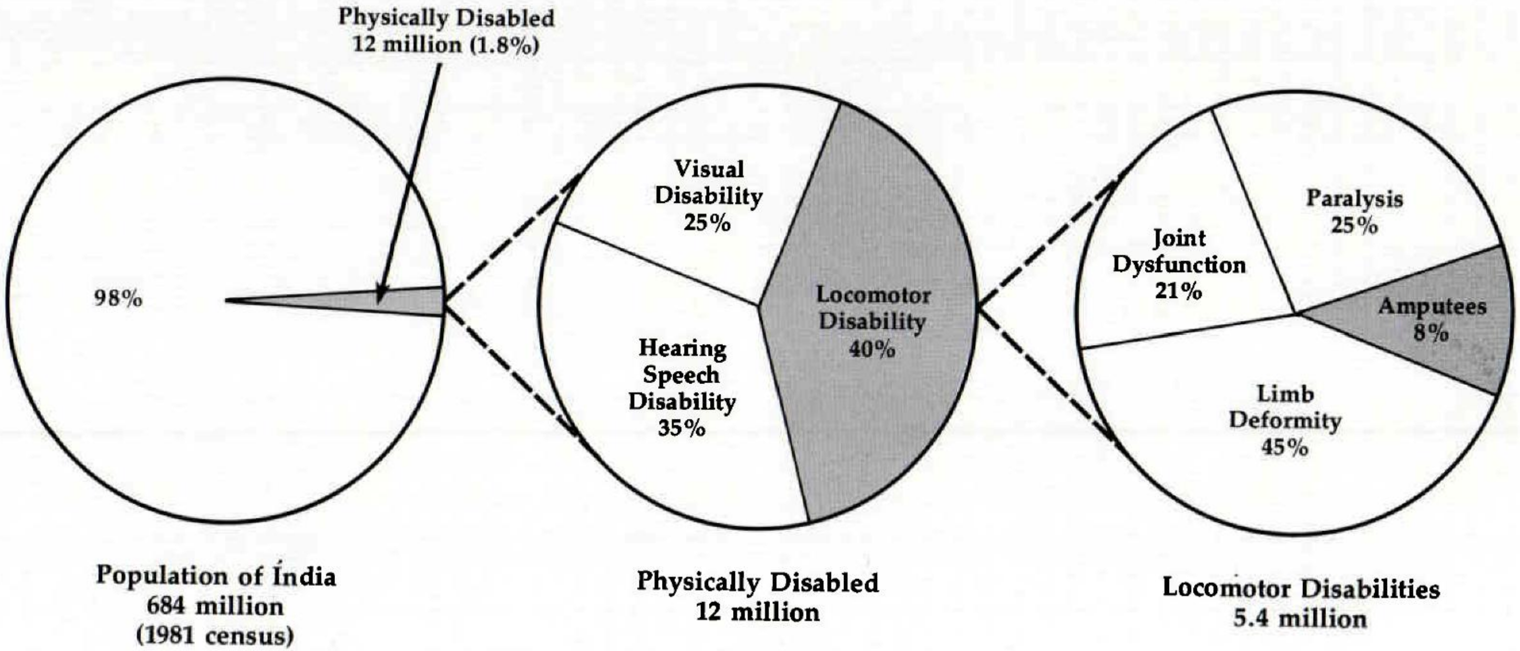
THE PROBLEM

The 1981 census[4] estimated India's population to be 683,810,051 of which 23.73 percent lived in urban areas and 76.27 percent in rural areas.[5] The National Sample Survey Organization conducted a survey of disabled persons in the period July-December, 1981, and the first report released in March, 1983 estimates that there were 12 million physically disabled persons in India. This is approximately 1.8 percent of the total population. Only acute disabilities were included in this survey since the detection was done by trained laymen and not medical experts (see text of reference for definitions of disabilities.)[3] The proportions of various disabilities are given in Figure 1. Locomotor disabilities constitute the largest proportion, and the number of amputees is estimated to be 424,000.

This is the first time that a comprehensive survey of the disabled has been carried out in India. The earlier surveys done by the NSSO in 1961 and 1974, and that done during the 1981 census, did not use clear definitions of disabilities and so their results are not comparable with the present NSSO results. Some spot studies have been carried out over the past three decades[6,7] but their definitions and estimates vary a great deal. For example, Babusenan[6] estimated a disability rate of 1.2 percent in Trivandrum including mental retardation, whereas Natarajan[7] reported a prevalence rate of 1.4 percent for the physically handicapped in Madras. Sahasrabudhe and Sancheti have reported[8] that in a recent survey of 22 villages in Pune district they discovered 1.96 percent of the population to be "handicapped," including "mental defects," but excluding cerebral palsy and leprosy. They further classified 36 percent of the "handicapped" as having "orthopaedic deformities." Because of these variations it was difficult to extrapolate for an all India figure. However, it is interesting that though Sahasrabudhe and Sancheti did not use the same definitions as NSSO, their estimates are of a similar order of magnitude as NSSO. This is probably because Sahasrabudhe and Sancheti also detected only those who were acutely disabled. Their study does not give any statistics on the number of amputees in their sample.

The prevalence rate of acutely physically disabled persons in India (1.8 percent) as estimated by the NSSO is, however, less than that reported for the severely disabled (2.8 percent) in the U.S.[9] It is not known whether this difference is owing to the different definitions of disabilities in the two studies or an actual difference in prevalence rates. In the U.S., locomotor disabilities constituted 60 percent of the

National Sample Survey Organization Estimates of the Physically Disabled Persons in India



Total number of amputees = 424,000 (0.62 per 1,000)

Figure 1.

physically disabled, whereas in India they constitute only 40 percent (Figure 1). It appears that paralysis and hemiplegia are much more prevalent in the U.S. than in India. This is probably because paraplegics and quadraplegics have a greater probability of surviving in the U.S. than in India. Amputees constitute eight percent of those with locomotor disabilities in both countries. But this is just a coincidence, because the prevalence rate of amputees in India works out to be 0.62 per 1,000 population, whereas in the U.S. and U.K. it is reported to be in the range of 1.2 to 1.6 per 1,000.[9, 10]

The proportions are higher in the U.S. and U.K. probably because more of them survive there, more congenital and other deformities are surgically operated upon for fitting prostheses, and the proportion of old persons is much higher in these countries. Amputations due to vascular and circulatory disorders and cancer are much more likely among older persons. Therefore, as the health conditions improve in India and people live longer, the prevalence of amputees in the Indian population is likely to increase further and may even become double the present rate.

Location and Sex of Amputees: Prevalence

Figure 2 shows the distribution of amputees by rural and urban areas in India. Though the urban areas in India house 24 percent of the population, only 21 percent of the amputees are located there.

The average prevalence rates in India for males and females are higher in rural areas than in urban areas. But there is a great deal of variation from state to state. In Bihar and Orissa the rates are higher in the urban areas both for males and females.[3] It is not clear why this is so, because higher rates in rural areas would appear to be due to the fact that more persons are involved in manual labor, where the risk of accidents may be higher, and also due to inadequate medical care. Females constitute only 20 percent of the total number of amputees, though they form 48.3 of the country's population.[4] In the absence of more detailed epidemiological data and information, it is not possible to understand why the ratios are so different for men and women. However, the ratios are not as different in Haryana and rural Rajasthan, where male amputees outnumber women amputees by less than a factor of two.[3] Again, it is not clear why this is so.

Figure 3 shows the distribution of amputees by state and also the prevalence rates by state. The prevalence rates vary quite a bit by state, but the total numbers in Rajasthan, Punjab, Haryana, Madhya Pradesh, Bihar, West Bengal, Maharashtra and Andhra Pradesh are around 30,000 each; Gujarat, Karnataka, Tamilnadu and Kerala around 15,000 each; Himachal Pradesh, Jammu and Kashmir, and Orissa around 3,000 each; and the most populous state, U.P., also has the maximum number of amputees, 91,000. Accurate figures for the North Eastern states are not available.

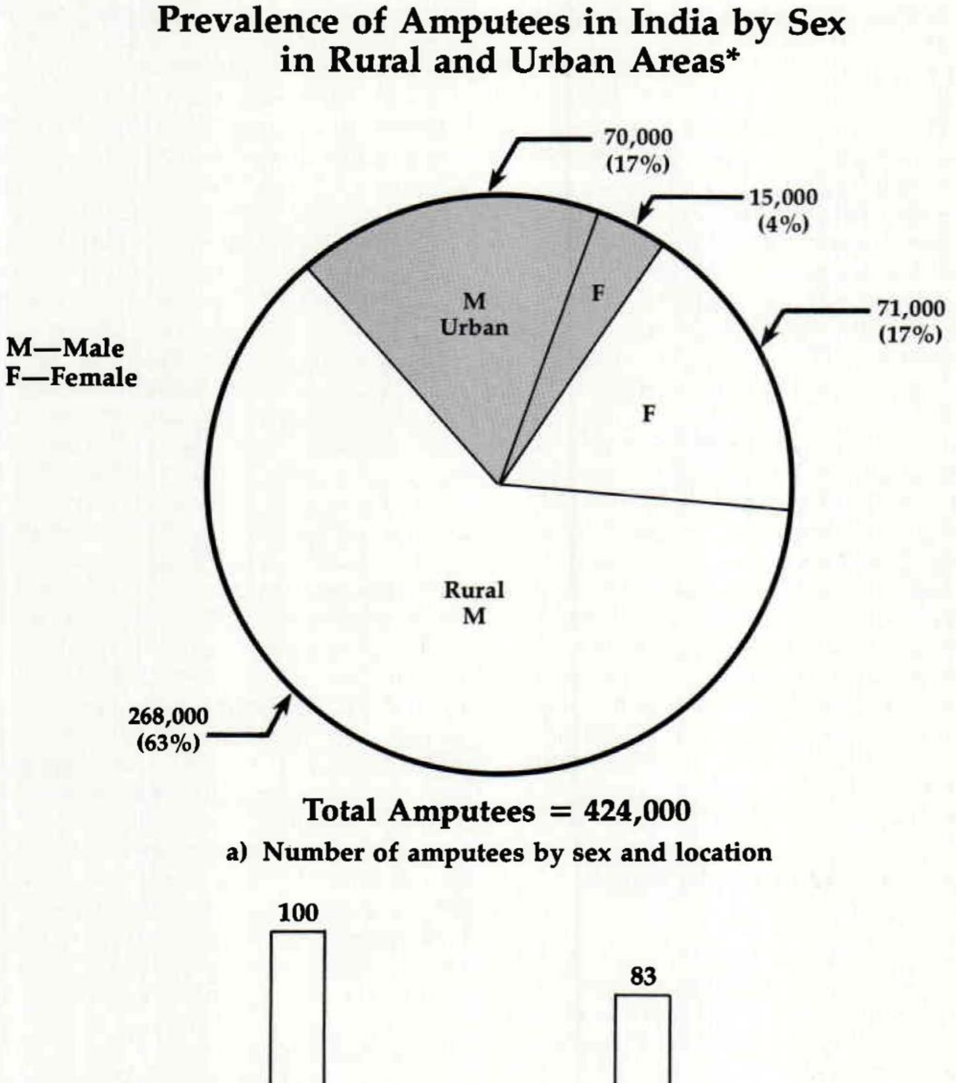
The prevalence rates in Punjab and Haryana are the highest: 182 and 244 per 100,000 persons respectively. This may be partly due to amputations caused by threshers and other agricultural machinery introduced in the last fifteen years or so.[11] But this does not seem to be an adequate explanation, as the incidence of paralysis and deformed limbs is also very high in these two states.[3] More epidemiological data are needed to understand why locomotor disabilities should have such a high prevalence rate in Punjab and Haryana.

Incidence rate

Figure 5 shows the incidence rate of amputees produced in India per year. These data indicate that the incidence rate is higher in rural areas, and there are five to six times as many male amputees as female amputees every year. Every year 23,500 amputees are added to the amputee population in India, of which 20,200 are males and 3,300 are females.

Age at Onset

Figure 5 also shows the distribution of amputees 60 years and older by the age at which they sustained the amputation. The pattern is different in rural and urban



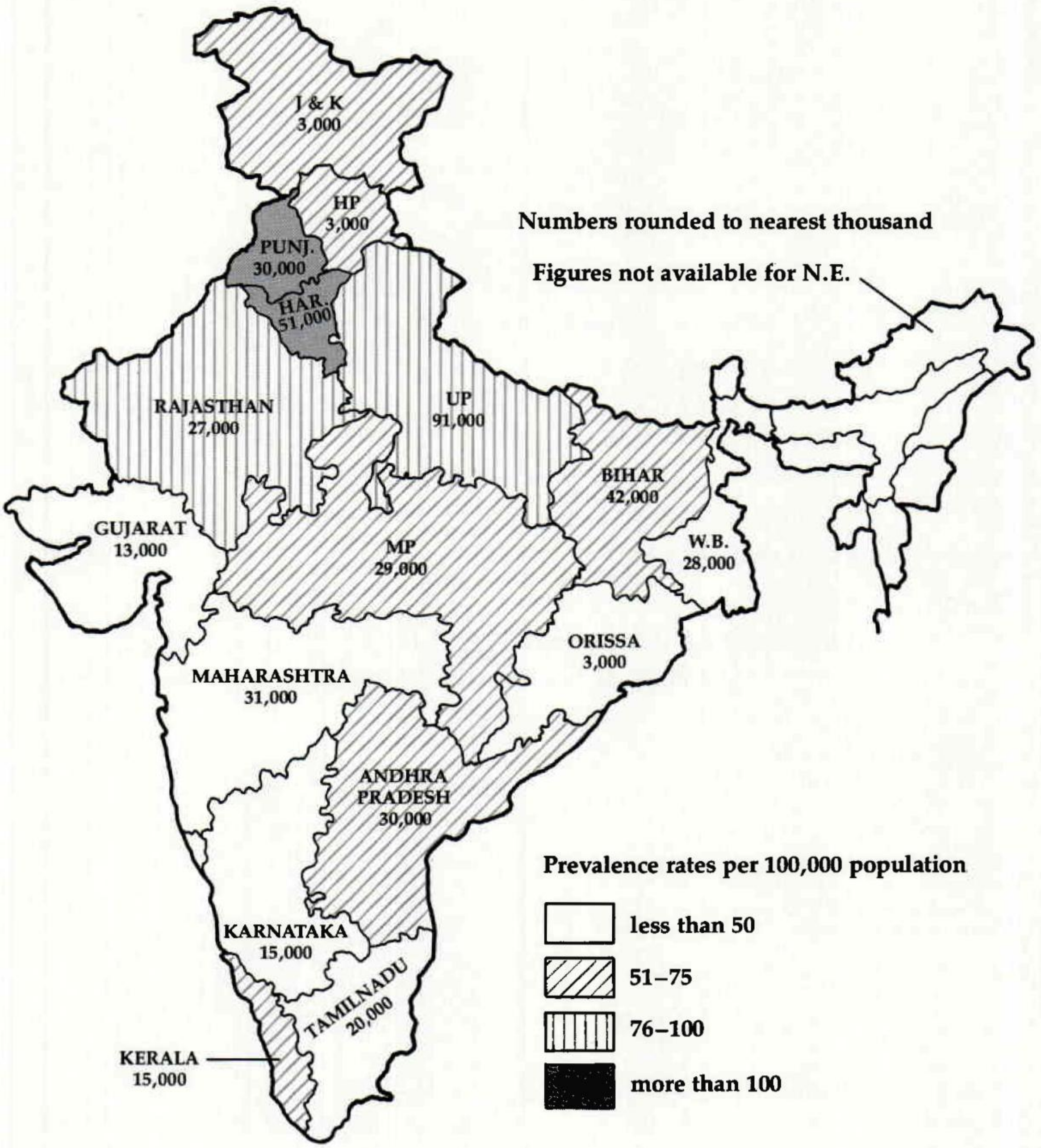
a) Number of amputees by sex and location

b) Prevalence rates per 100,000 population

(Source: NSSO, report on survey of disabled persons, 1983)

Figure 2.

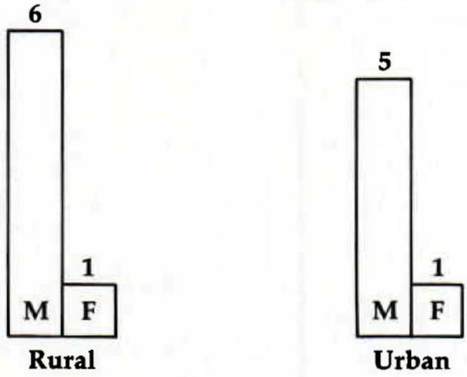
Number of Amputees and Prevalence Rates in Various States of India



(Source: NSSO, report on survey of disabled persons, 1983)

Figure 3.

Amputees Produced in One Year in India Grouped by Sex, and Geographic Location



Incidence rate per 100,000 population per year

	Male	Female
Rural	16,000	2,600
Urban	4,200	700

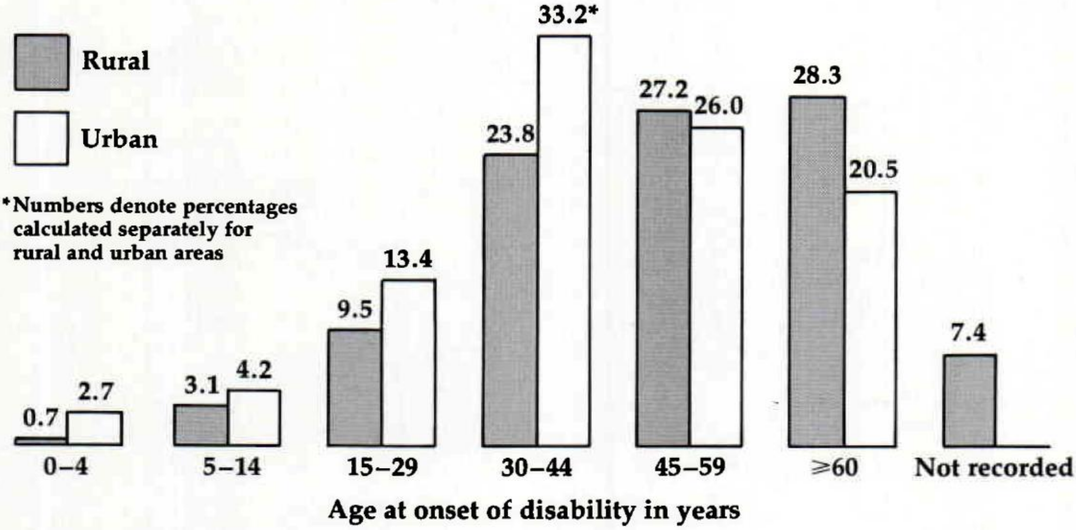
Total: 23,500

Total number of amputees produced per year

(Source: NSSO, report on survey of disabled persons, 1983)

Figure 4.

Distribution of Amputees Aged 60 Years and Above By Age at Onset of Disability



(Source: NSSO report on survey of disabled persons, 1983)

Figure 5.

areas. The number becoming disabled keeps increasing with age in rural areas, but in the urban areas the peak is reached between the ages of 30-44, and after that the proportion decreases again. In the high income countries, a large number of older people become amputees because of vascular problems and cancer,[10] but this is probably not the case here. If this were so, it would have been reflected in urban areas also where health conditions on an average may be better. The higher rate among the elderly in rural areas is probably because they may be continuing to do manual labor at older ages, and in addition they would not get good medical attention once they get injured. However, it is not necessary that the patterns are still the same as depicted by Figure 4, since these data are for persons 60 years and above, and disabilities for many of them were sustained a long time ago. To get some idea of the age of onset under current conditions, age-specific data for amputees would have to be obtained from the NSSO report, but the present information does indicate that old age amputations are not as serious a problem as in the high income countries, where impairment rates increase monotanically with age.[12]

Cause

Figure 6 shows the causes of amputation in rural and urban areas. Almost 60 percent of the amputees fall in the "other illness" and "other causes" category, and therefore these statistics do not give the complete picture of causation. It is not clear whether amputations due to infection following injury would be included in "other illness." For the country as a whole, only 11 percent of all amputations (47,000) are due to leprosy, and according to the NSSO data, 6.6 percent of those with deformed limbs (143,000) are due to leprosy.[3] Considering that the number of leprosy patients in India is in the millions, these appear to be low figures. Whether this is because of undercounting owing to a concentration of leprosy patients in specific living areas outside the enumeration blocks, or because many leprosy patients do not consider themselves disabled, is not known.

Injuries appear to be one of the major causes of disability accounting for at least 100,000 (23 percent) of the amputees. The number is probably larger, as it is possible that many of the amputations due to injury may be hidden under the "other illness" and "other causes" category.

At present, no statistics are available giving the details of the sources of injuries that result in amputations. Informal conversations with orthopaedists and managers of rehabilitation centres around the country indicate that road accidents in urban areas and agricultural and railway accidents in rural areas may be some of the more significant causes. While attention has been focused on road accidents and agricultural accidents for quite some time, the same is not true for railway accidents. This is partly because the railway statistics released to the public exclude more than 95 percent of the casualties on railway property.[13] This is because accidents are defined in such a manner by the railways that out of approximately 10,000 killed on railway property, only a few hundred fit the definitions. However, the Indian Railways does maintain an internal accounting system in which many of these casualties are acknowledged, but this report is not made public.[14]

Socio-Economic Background

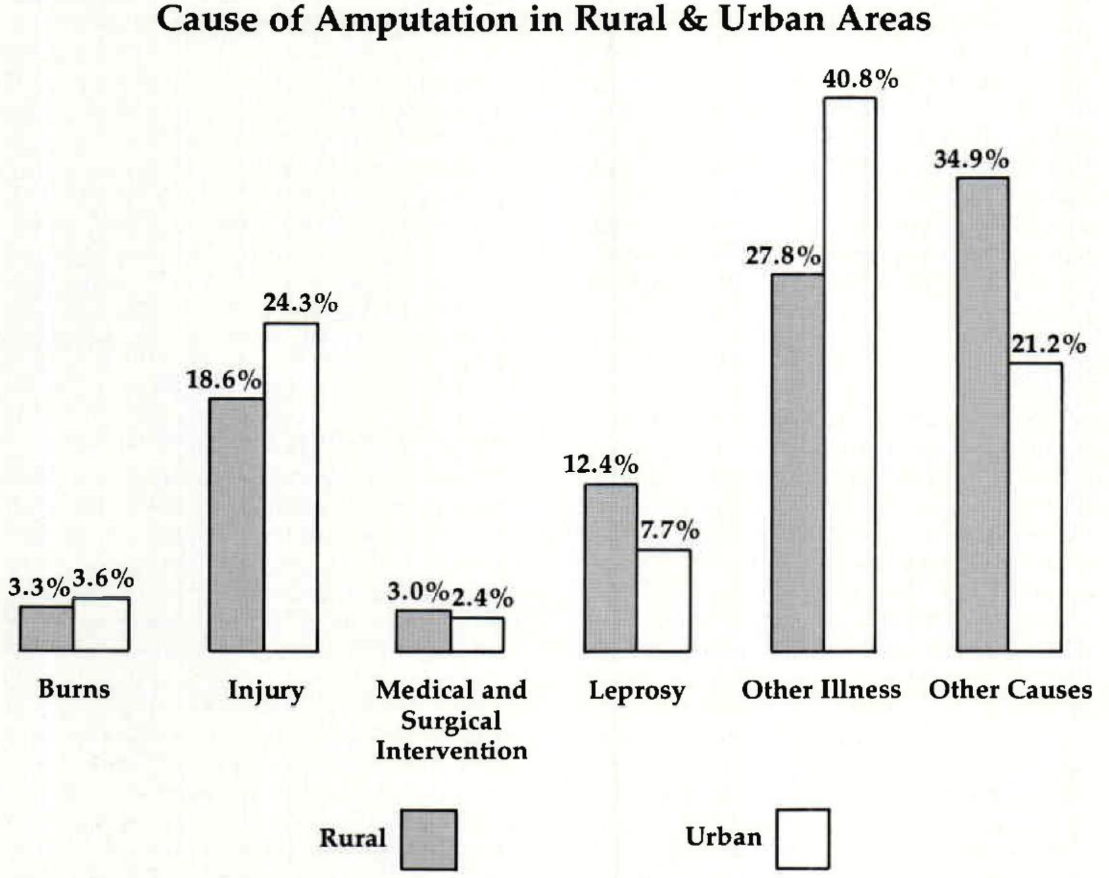
The NSSO data released until now does not give the socio-economic background of the disabled persons. However, professionals dealing with the disabled, especially the amputees, report that the vast majority of them come from very poor families. Statistics from The All India Institute of Physical Medicine and Rehabilitation, Bombay, indicate that at least 44 percent of the patients come from families with incomes less than 200 rupees* per month and another 44 percent with incomes between 400 and 600 rupees per month.[15] Similar results are reported by Sahasrabudhe and Sancheti.[8] In their sam-

*The exchange rate in March, 1986, was 12.5 Indian rupees to U.S. $1.00.

ple of the disabled from 22 villages in Pune district, 27 percent were unemployed and 87 percent were from families with per capita incomes less than 70 rupees per month. The difference in the two studies is probably due to the fact that on an average, patients in an urban hospital are likely to be richer than disabled persons identified in villages. There may be an element of under-reporting of incomes, but even if the given figures are doubled, it still does not make the disabled very rich.

Even in the high-income countries, the disabled tend to come from low-income families.[9] This is partly due to the fact that the disabled themselves may have low incomes or they may be very old. In India, however, since 80 percent of the amputees come from rural areas where average incomes are low, most of the families do not have the resources to help them financially.

In summary, India has about half a million amputees and 23,500 are added every year. Amputees in India are predominantly male, rural, poor, and in the working age group. A significant proportion of amputations are reported to be due to injuries sustained in railway and road accidents and due to agricultural equipment. There is a high variation in prevalence rates from state to state, with Haryana and Punjab being the highest, and Orissa the lowest.



(Source: NSSO, report on survey of disabled persons, 1983)

Figure 6.

THE PRESENT SITUATION

The first major limb fitting centre in India was established in Pune in 1944 by the Armed Forces, mainly for use by their own employees. I would estimate that there were approximately 50 private and public organizations in India which provide aids for amputees in 1983. Of these, six have been designated as Regional Limb Fitting Centres by the Artificial Limbs Manufacturing Corporation of India (ALIMCO), Kanpur, and 27 as Peripheral Limb Fitting Centres. The Regional Centres are located at Trivandrum, Nagpur, Jaipur, Madras, Calcutta, and Cuttack.[15]

Extent of Service

Until the late 1950's, very few limbs were available to civilians in India because the Artificial Limb Centre in Pune provided service mainly to the armed forces. Representatives from most of the main rehabilitation centres in India participated in a National Seminar on Rehabilitation Services and Research organized at the Medical College in Trivandrum in 1967. Judging from the reports submitted at that meeting,[16] it appears that in 1967 the number of amputees fitted with prostheses was not more than 100 in India (not including the Armed Forces Centre in Pune), and of these, over 90 percent were lower limb prostheses.

The situation has improved a great deal in the intervening years. The author estimates that approximately 6,000 prostheses were fitted to amputees in 1981. This estimate is based on a survey carried out by the Centre for Biomedical Engineering, IIT, Delhi, and another survey conducted by The Institute for the Physically Handicapped, Delhi. It appears that over 60 percent of the total number of limbs were fitted by two centres: Regional Limb Fitting Centre in Jaipur and the Artificial Limb Centre in Pune, each fitting approximately 2,000 limbs. The other Centres in India fitted anything from a very few to 400-500 limbs each. Even in 1981, over 90 percent of the prostheses fitted were for lower limbs.

The number of amputees fitted with limbs increased rapidly in the late 1970's mainly because of the expansion of a few centres. Taking this into account and the fact that the life of most prostheses is around five years at most, we can estimate that at most about 25,000 amputees are using prostheses today. This would be six percent of the total number of amputees in India. The actual number may be even less, as studies show that many amputees stop using their aids after some time either because the prosthesis really does not suit them or they need repairs.[17, 18] Considering that an estimated 23,500 amputees were added to the population in 1981, there is a net addition of over 17,000 amputees every year who do not receive any aids.

Quality of Prostheses

Because of the pioneering work done by the Centre in Pune, All India Institute of Physical Medicine and Rehabilitation in Bombay, and some of the Regional Centres, we are well versed with the technologies involved in traditional exoskeletal lower limb prostheses. The below-knee prosthesis with S.A.C.H.-foot is being manufactured in these Centres with a fair degree of competence and in some cases with quite ingenious forms of import substitution in materials and methods. However, the design is basically the same as adopted by the Veterans Administration in the U.S., a decade and a half back. Components for the same are being manufactured at ALIMCO, Kanpur. We, however, still do not have a good stabilized knee available in the country, and most users have complaints regarding the materials used and reliability of the products.

There has been very little real invention of or innovation in designs of prostheses in India. The only notable exception is the work done at the Regional limb fitting and Rehabilitation Research Centre in Jaipur.[17] Their outstanding success with a rubber vulcanized foot (Jaipur Foot) and an aluminum shank has helped them to provide prostheses to as many as 2,000 amputees in 1982. The innovation has cut down on fabrication time greatly, and this in turn helps in keeping overhead low, and allows fitting of a much larger number of amputees. There has been a great deal of debate regarding the biomechanical properties of the Jaipur foot, with many questioning its efficiency. However, according to tests done at our Centre and at the University of Strathclyde,[19] the Jaipur foot compares favorably with the S.A.C.H. foot in most biomechanical aspects. There are minor variations in the two, but the Strathclyde report claims that the patient in fact, "preferred the Sethi [Jaipur] foot." At present a few endoskeletal above-knee prostheses are also being tried out at Jaipur. These prostheses use a simple single-axis pin joint at the knee, an aluminum socket, the Jaipur foot, and electric conduit pipes (mild steel) as pylons. A preliminary report[20] indicates that such a sample design may function quite well on level ground at normal speeds of walking, provided the centre of gravity is adjusted optimally. The design is still a long way from widespread application.

There have been attempts at innovation at other centres also. The main preoccupation in India has been to develop a prosthesis which allows people to squat and also sit cross-legged. While the Jaipur foot allows squatting, there is no design of an above-knee prosthesis which can be considered optimal for sitting cross-legged. An above-knee prosthesis has been developed at the All India Institute of Medical Sciences which permits squatting and sitting cross-legged, but because it is of the exoskeletal type, it has a hard external surface. A number of these are in use, and its widespread applicability will depend on the acceptability by these patients, ease of maintenance, and cost of manufacture. It is still too early to tell.

Many other centres, including those in Bombay, Lucknow, Calcutta, ALIMCO, and Madras are experimenting with designs of prostheses more suited for Indian conditions, but no one design has been particularly successful. The Artificial Limb Centre in Pune has developed an indigenous design of a stabilized exoskeletal above-knee prosthesis, but it has not gained wide acceptance, owing to failures and maintenance problems. One of the main stumbling blocks faced by all the centres is the lack of availability of appropriate materials for use in prostheses, or their high cost when available. They also suffer from a lack of expertise in the use of the newer synthetic materials.

As far as the upper extremity is concerned, the situation is much worse. Even cosmetic hands are not easily available, and very few centres are able to deal with the upper limb amputee's needs. Innovation in this area is even more limited, with work having been done mainly in Pune, Navedac Centre in Chandigarh, and ALIMCO.

Therefore, the amputees in India, in general, still have to use prostheses which have not been specifically designed for local conditions and local habits. While a much needed service is being rendered by most centres, a great deal more could be done, both in terms of quality and quantity.

The Cost of Prostheses

It is almost impossible to get an actual account of what it costs any centre to provide a prosthesis to an amputee. In government, semi-government, and charitable institutions, the costs of overhead are not evaluated realistically, and therefore the cost of a limb basically represents material costs and some nominal labor costs. Even in private institutions, many of the professionals have multiple duties and functions, and so cost evaluation becomes difficult. However, it is clear that the cost of running most centres is reasonably high, except in Jaipur. The cost of a prosthesis, both upper and lower, is probably in the range of 1,000 rupees, depending on the complexity. It is not surprising then that amputees can avail themselves of these limbs only if they are donated or otherwise obtainable for free. The reasons given for not using an aid are given in Table I.[3]

Table 1
Reason Given by Amputees for not Acquiring an Aid/Device

Reason given	Percent of Amputees
Not available	3%
Too expensive	47%
Aid not necessary for economic independence	8%
Aid not necessary for personal independence	15%
Others	27%

It is interesting that only three percent claimed that the aid was not available. The belief that aids are in fact available is not really true, as most centres cannot handle any more patients. Some have waiting lists for as long as a year. The NSSO survey also reports that of those amputees who took treatment for their disability, only eight percent were advised to obtain an aid. It is not known why this number is so low.

Prosthetic aids are obviously too expensive for the overwhelming majority of the amputees, and in the absence of a universal insurance or government subsidy system, most of them could not afford them.

The Wait

There are long waiting lists of amputees at all centres in India. This is in spite of the fact that a vast majority of the amputees do not even attempt to obtain an aid. The waiting time can only be reduced if the limb fitting process is shortened and made more efficient. Most professionals believe that the time could be reduced by increasing facilities and staff. But this would hardly be a solution, as operating costs may increase. The fabricating and fitting time has been reduced drastically in Jaipur. It would be useful if a few other facilities were developed where the fabrication time was reduced.

THE FUTURE

Over the past three years, my colleagues and I visited a large number of rehabilitation centres and units in India. What I have seen and heard leaves me terribly confused. It is a paradox that while almost every unit has at least one dedicated and experienced professional prosthetist, and physician or surgeon who is excellent by any standards, it is a rare unit which excells in innovation and research. It is my impression that there is very little in-house engineering expertise in these centres, and engineers outside these institutions are not really concerned with the interests of the disabled. Research studies dealing with amputees and their needs is almost non-existent. Most of the studies taken up are of a sporadic nature, and long term in-depth studies are almost unknown.

Secondly, it appears that we really do not know what the amputees actually want. By and large we give them what we think they need, and this usually turns out to be what we can make. Barring some experiments in Jaipur[17] and in a few other centres, there has been no systematic effort made to determine what kind of help amputees from different income groups and geographical regions really want. This lack of communication has been alluded to frequently in studies that originate in high income countries.[21-23] A report from the Office of Technology Assessment of the Congress of the United States records that "the need for technology is most often based on needs of disabled persons as perceived by professionals or program administrators instead of a blend of the disabled person's needs, desires, and capabilities, as identified with the full participation of the disabled person or a representative."[21] This problem is probably much more acute in India as the cultural and socio-economic gap between professionals and amputees, who are generally very poor, is very large. Yet most managers of rehabilitation centres around India were not really willing to discuss this problem in depth.

Unless we have some feedback from amputees about their perceived needs, it will be difficult to state categorically what our future course of action should be. This feedback will not really mean much until the amputees have choices to make and preferences to show.

In general terms it can be stated that what the amputees need are rehabilitation aids and devices in much larger numbers, at much lower costs, and without a long wait. The devices should give functional mobility for vocational needs and independence for personal needs. These would vary from one end of the country to the other, and by income and occupation within a particular region. It could lead to a large number of design variations instead of a fixed design for everyone everywhere. However, this is easier said than done. Therefore, it would be useful to examine the problems and issues facing the amputees so that we can set some priorities for the future.

Economics of Rehabilitation of Amputees

Policy makers in India often express the view that amputees should be given the best prostheses available, but they hardly ever set out the details of how this is to be accomplished. An exception to this is a project report from ALIMCO which sets out the details of a limb fitting centre where 300-360 fittings could be done per year.[15] Of the 360 fittings, 200 were expected to be orthotic devices and 160 prosthetic devices. It is also stated that these centres would be established at medical centres where many facilities are already available.

According to the report, the unit would need a floor area of 250 square meters and a capital investment of 60,000 rupees. If we allocate 50 percent of this expenditure as directly beneficial to amputees, we can assume a floor area of approximately one square meter and an investment of approximately 200 rupees per amputee. In India there are at least 23,500 new amputees every year, and a backlog of almost 400,000 amputees who do not have any aids. Therefore, if we plan on fitting at least 50,000 amputees every year we might just about catch up by the year 2000. According to the above estimates, we would need an investment in 50,000 sq. meters of space and 10 million rupees in materials. At the present construction prices of more than 1,000 rupees per square meter, this turns out to be an investment of more than 50 million rupees for establishing facilities to handle 50,000 amputees per year.

According to the same report, recurring costs for amputees should be calculated on the basis of 945 rupees per amputee. Therefore, the recurring expenditure would be almost 50 million rupees per year. In my opinion, these are gross underestimates because physicians' and surgeons' salaries, and costs of operating rooms and awards are not included in the above estimates. Even these conservative figures are far in excess of what is allocated to the Ministry of Social Welfare and Ministry of Health for the welfare of the amputees. The total Sixth Plan outlay (central) for the welfare of the handicapped is 244 million rupees under the Ministry of Social Welfare, and this includes all programming (including training, research, scholarships, etc.) for all disabilities.[24] If we consider setting up the above mentioned facilities over a 10 year period, even then the capital and recurring expenditure over a five year period would be far more than 280 million rupees, or greater than the whole budget. Amputees, however, form only three percent of the disabled population in India.

The above not very sophisticated exercise shows that either the budget allocations are woefully inadequate, or that if present models of rehabilitation are used, there is not much hope of providing prostheses to a majority of the amputees. What is clear is that if present methods of rehabilitation are followed, it will not be possible to provide prostheses even to a fraction of the amputees in India, and the ALIMCO model will end up denying prostheses to a majority of them.

Obviously we will have to redefine what we mean by the "latest and the best" in prostheses, and also redesign our institutions. I would like to suggest that we take these words at their literal best. "Latest" should mean what we design now and in the future, and not necessarily what is being used currently in the high income countries. Similarly, "best" should be that device which actually gets used by the amputee. No matter how "sophisticated" an aid is, if the amputee does not get it, it is the worst for him.

These considerations set very tough guidelines for the professionals as far as design of limbs and rehabilitation centres are concerned. The designs have to be such that not only is the cost of the prosthesis very low, but also the recurring expenditure of rehabilitation centres have to be much lower than at present. Prosthesis fitting times would have to be reduced drastically so that the same facilities can serve many more people. Staying away from home also places a very difficult burden on poor families, and that in itself can be a disincentive for them to obtain prostheses.

Technology and the Amputee

Scientists and engineers love to design things which excite them the most. Unfortunately, in the area of rehabilitation, this has resulted in a great deal of wasted effort. Agerholm[22] states that the "exclusion from the benefits of technology is seen even more strikingly in relation to 'special' devices of use only to handicapped people, and often developed at great expense on their behalf by inventors, who naively expect that those whom they could benefit will actually receive them." Agerholm's understanding comes from his experience in the U.K., where there is much more money than in India. Unfortunately, we do not have many "inventors" in India. But even the copies suffer from the same naive beliefs as Agerholm's inventors in U.K.

This poses a serious dilemma for the designer/engineer. Should he equip his laboratory with the most expensive equipment that money can buy and use the most complex computer routines to solve the most horrendous mathematical models of human movement? Or should he only worry about solving problems so that the results actually benefit the amputee? These issues are not easy to resolve.

Though the author has long believed that the most expensive gait analysis laboratories around the world have not really contributed much to prosthesis design, it is hard to conceive that they are not really useful. There was a nagging suspicion that they may actually be doing work which may prove very useful in the future. Though the issue has not been resolved to the author's satisfaction, his experience in collaborating with the Regional Rehabilitation Centre in Jaipur has been very educational.

Some time back, we were approached with a problem that the pylons being used in a simple endoskeletal above-knee prosthesis were failing and the design needed change. We thought that the Centre in Jaipur was being naive in using electrical conduit pipes in the prosthesis when much better materials were available. But when we looked around for substitutes we discovered why it was wise to use them—they were cheap and available everywhere. So we tested them in our Strength of Materials Laboratory and discovered that their strength in buckling and bending was less than one-third of what would be predicted theoretically, and that is why they were failing. However, the next larger size was strong enough to take walking loads in spite of bad quality steel and manufacturing faults.

The next thing that intrigued us was that amputees could actually walk using a very simple single-axis hinge-type knee designed at Jaipur. The question was how they could walk on this simple above knee prosthesis, and what were the limitations of the prosthesis. So we put a young student to work modelling the leg motion during the swing phase of the gait cycle.[20] We assumed the shank to be a compound pendulum swinging about the knee, and did some sensitivity analyses. We discovered in quantitative terms what prosthetists have known for some time:

that the location of the centre of gravity makes quite a difference to the movement of the leg, the absolute mass of the shank is not as critical as is the moment of inertia,and that it is possible for a simple knee to function like a normal leg at particular walking speeds on level ground. These walking speeds turn out to be the average walking speeds for adults. We could also detect that the swing of the shank was very dependent on the exact moment in time when the toe left the ground. Therefore, with some training, the amputee could use this limb quite successfully.

The above exercise has not solved all the problems connected with an above knee prosthesis. It has however, helped us understand the mechanics of the swing phase of the leg and has also given us an idea on what parameters are important in design. More importantly, it helped us in providing a service without spending too much money, and gave us a basis for doing more work.

These experiences and visits to many centres around the country give the impression that when professionals and policy makers demand the "best and the latest" in the area of prostheses and devices for the amputees, they actually set us back. In fact they pose false choices and also justify not doing anything as long as their concept of the "best" is not available.

CONCLUSION

In summary, at present the research and development effort in India is marginal in the area of prosthetic devices for amputees, and the dominant models of institutions providing services are not likely to serve more than a few of the amputees. There has to be a drastic reordering of the priorities and accompanying changes in design of both prostheses and institutions. If we do not change our ways, we will add to our stock of amputees by tens of thousands every year. If we have any intentions of giving the amputees a chance of functioning as normal members of society, we have to do much more work. Some of the areas that need urgent attention are enumerated below.

- As longevity increases in India, it is possible that the number of older amputees will also increase. This will put an additional burden on the already grossly inadequate services. All out efforts should be made to control amputations caused by injuries due to road, rail, and agricultural accidents.
- Emergency care techniques that do not depend on capital intensive equipment have to be evolved so that serious injuries can be taken care of locally and quickly. Efficient ways of burn and hemorrhage management should be taught extensively.
- Micro-studies should be carried out in various parts of the country, to determine what kind of aids the amputees consider useful and adequate, e.g., will simple pylon type lower limb prostheses with good sockets and foot-pieces be acceptable?
- Until now we did not know the prevalence rates of amputees by location in India. Now we have this data (Figure 3). Plans for establishment of rehabilitation centres should be changed so that amputees around the country have equal access to help.
- Very little thought has been given to the architectural aspects of rehabilitation centres. There are no architects who specialize in designing such institutions. Can designs be evolved which are more suited to poor people who are not very mobile? Can space be used for multiple purposes so that capital costs are brought down?
- Upper extremity amputees have suffered gross neglect. Functional arms and hands which are easy to fabricate and fit have to be developed. In the case of unilateral amputees it may be possible to develop aids for the good hand so that it can perform many of the functions which normally require two hands.
- Much more work needs to be done to develop endoskeletal prostheses, since their fabrication times are much less than exoskeletal prostheses.

• Sockets used in temperate climates are not very suitable in India. We must develop our own designs which are more comfortable in hot and humid climates.

• Prostheses designed in India should be easy to fit and have as few moving parts as possible. This will reduce the probability of failure. Poor people find it very difficult to bring a prosthesis back for repairs.

• We appear to be very weak in materials research and much more attention needs to be paid to this subject. Many designs of prostheses have not succeeded because of the use of wrong or overly expensive materials.

• In the absence of technical expertise in rehabilitation centres, efforts should be made to use engineers and technicians in associated industries.

• As many aids as possible should be designed so that local mechanists can repair them. Manuals giving such details can be prepared in regional languages.

• It should be possible to make most parts for prostheses and appliances locally. Large factories like ALIMCO should make only those products that require high precision and quality control.

• Personal care aids usually involve simple technology. Such aids should be designed for our needs. Brochures containing fabrication guidelines for such aids should be widely available.

• Buildings and vehicles should be designed so that amputees have little difficulty in using them. Guidelines for design should be established as soon as possible.

The above are some of the more urgent concerns, and the answers to some of the issues raised above will not come easily. Newspapers and magazines report only those achievements which involve very complex designs and new sophisticated technology developed in foreign countries. This warps our thinking about what is important, because the vast majority of the amputees do not ever get to use those items which may function very well in the laboratory but are too delicate and expensive to be taken out. We must leave our pre-conceived notions about rehabilitation aids for the amputees.

Unless we reject the present dominant models of amputee care in India and come up with more efficient and humane models, the number of amputees without prostheses will keep increasing. At the present rate, this means adding about 20,000 every year to the half million that are already there. The choice is abundantly clear—do we want to move forward or backward?

AUTHOR

Dinesh Mohan is with the Centre for Biomedical Engineering, Indian Institute of Technology, New Delhi, India 110016.

REFERENCES

[1]Duraiswami, P.K., "Rehabilitation and the State," in *Proceedings National Seminar on Rehabilitation Services and Research*, Vol. II., Medical College Trivandrum, India, 1967.

[2]Sethi, P.K., Keynote Address, Asian Meeting on Childhood Disability, Family and Community Roles, UNICEF, New Delhi, November 2–5, 1981.

[3]National Sample Survey Organization, *Report on the Survey of Disabled Persons*, 36th Round, July–December 1981, No. 305, Department of Statistics, New Delhi, 1983.

[4]Padmanabha, P., *Provisional Population Totals*, Paper-1 of 1981, Series-1, India, Census of India, 1981.

[5]Padmanabha, P., *Provisional Population Totals Rural Urban Distribution*, Paper-2 of 1981, Series-1, India, Census of India, 1981.

[6]Babusenan, G., "Rehabilitation of the Disabled," in *Proceedings National Seminar on Rehabilitation Services and Research*, Vol. II, 38–42 Medical College, Trivandrum, India, 1967.

[7]Natarajan, M., "The Problems of Rehabilitation of the Orthopaedically Handicapped," in *Proceedings National Seminar on Rehabilitation Services and Research*, Vol. II, 45–47 Medical College, Trivandrum, India, 1967.

[8]Sahasrabudhe, B.G., and Sancheti, K.H., "Survey of the Handicapped," *Bulletin of Sancheti Hospital and Medical Research Centre*, 1:2, 25–29 Pune, 1979.

[9]Spencer, W.A., "Rehabilitation Concepts, Social and Economic Aspects of Assistive Devices," in *Disability*, Eds., R.M. Kenedi, J.P. Paul, and J. Hughes, 11–23 Macmillan Press, London, 1979.

[10]Wilson, A.B. Jr., *Limb Prosthetics*, p. 7, Robert E. Krieger, Huntington, N.Y., 1972.

[11]Chari, P.S., Kharshing, W., and Balakrishnan, C., "Wheat Thresher Hand Injuries," *Indian Journal of Medical Research*, 63:6, pp. 829–832, 1975.

[12]Taylor, D.G., "The Economics of Rehabilitation," in *Disability*, Eds., R.M. Kenedi, J.P. Paul, and J. Hughes, pp. 87–100, Macmillan, London, 1979.

[13]Mohan, D., "Statistical Jugglery by Railway," *Indian Express* 6, August 14, 1982.

[14]Accident Statistics of Indian Railways for 1980–81 Ministry of Railways (Railway Board), Government of India, Delhi, 1982.

[15]*Establishment of a Limb Fitting Center: 300–360 Fitments In A Year*, Project Report, Artificial Limbs Manufacturing Corporation of India, Kanpur, 1980.

[16]*Proceedings, National Seminar on Rehabilitation Services and Research*, December 4–6, 1967, Medical College, Trivandrum, India.

[17]Sethi, P.K., Udawat, M.P., Kasliwal, S.C. and Chandra, R., "Vulcanized Rubber Foot for Lower Limb Amputees," *Prosthetics and Orthotics International*, 2, pp. 125–136, 1978.

[18]Sant, M.V., "Rehabilitation in Medicine," in *Proceedings National Seminar on Rehabilitation Services and Research*, pp. 15–24, Medical College, Trivandrum, India, 1967.

[19]North, J.F., Jones D., Govan, N.A., and Hughes, J., Performance Measurement of the Jaipur Foot, Presented at the World Congress of ISPO, Interbor and APO, Montreaux, Switzerland, 1974.

[20]Mohan, D., Ravi, R., and Sethi, P.K., "Jaipur A.K. Prosthesis: Results of Mathematical Modelling and Field Trials," in *Proceedings RESNA 8th Annual Conference*, Memphis, Tennessee, 1985.

[21]Office of Technology Assessment, *Technology and Handicapped People*, U.S. Government Printing Office, Washington, D.C., 1982.

[22]Agerholm, M., "The Logistics of Technology for the Handicapped," in *Disability*, Eds., R.M. Kenedi, J.P. Paul, and J. Hughes, pp. 64–74, Macmillan, London, 1979.

[23]*Social Security and Disability: Issues in Policy Research*, Studies and Research No. 17, International Social Security Association, Geneva, 1981.

[24]*Sixth Five Year Plan 1980–85* Planning Commission, Government of India, New Delhi, 1981.

Orthotics and Prosthetics, Vol. 40, No. 1, pp. 33–37.

Floor Reaction Orthosis: Clinical Experience

Gai-Fu W. Yang, M.D., R.P.T.
Dong S. Chu, M.D.
Jung H. Ahn, M.D.
Hans R. Lehneis, Ph.D., C.P.O.
Richard M. Conceicao, B.A., C.P.O.

In clinical practice, the knee-ankle-foot orthosis (KAFO) with locked knee joint and limited ankle motion has been used for patients with paraplegia or paraparesis due to various etiologies. Patients who use such an orthosis walk with a rigid knee and an unphysiologic gait.

Several attempts were made to design an ankle-foot orthosis (AFO) which would stabilize the knee joint with weak quadriceps femoris muscles and facilitate a near normal gait. In 1969, a supracondylar knee-ankle orthosis[3] (SKO) and, in 1979, a Saltiel Brace[4] (SB) were introduced and were characterized by free knee flexion, limited knee extension, and a solid ankle. Both orthoses were difficult to don. In addition, the SB did not provide adequate mediolateral stability to the knee joint. In 1973, after many modifications, a Kumamoto University short leg brace[5] (KU-SLB) became available primarily for poliomyelitis patients who had residual paraparesis. The KU-SLB had a single plastic upright on the back of the leg and supracondylar support with a cut-out for the patella. All three of these orthoses described above were constructed with the ankle in the equinus position to increase mechanical stability of the knee joint. Thus, the stance phase of the gait cycle was initiated with toe touch or foot flat instead of heel strike. The patients who wore these three types of othorses had trouble sometimes with stumbling or had difficulties in descending slopes or stairs. We will illustrate here a floor reaction orthosis (FRO), with an attempt to improve the above described deficiencies, and its use in gait training for three paraparetic patients.

CASE REPORTS

E.J. is a 33-year-old male who sustained a fracture and dislocation of T11-12 in an airplane accident. He became immediately paraplegic below the level of T12 and first experienced slight voluntary movements of his left toes about two months after the accident. The muscle strength recovered gradually and two years later he was able to

Figure 1. Floor reaction orthosis. Note the neutral position of the subtalar joint.

walk with a right KAFO with an ischial seat/locked knee, a left conventional AFO and two forearm crutches.

Unfortunately, he developed contractures of both Achilles tendons, which had to be lengthened surgically. After the operations, his left lower limb became weaker so he began using bilateral KAFOs and forearm crutches for ambulation. Following intensive strengthening exercises, the strength of his quadriceps femoris muscles was fair minus on the left and poor plus on the right side, with manual muscle testing[1] (MMT). At this time, an FRO was prescribed for his left lower limb (Figure 1).

The second case is that of an 18-year-old male, D.W., who became paraplegic secondary to anterior spinal artery syndrome. One week after the onset of T10 paraplegia, he noted the return of muscular strength in the right lower limb. One month later, his M.M.T. showed poor minus for the right and trace for the left quadriceps femoris muscles, and he ambulated between parallel bars with bilateral Scott-Craig braces using a swing-to gait. When the strength of the right quadriceps femoris muscles improved to fair minus, a Zimmer splint or "handy standy" was applied to the right lower limb, along with a walker to assist the patient in ambulation. However, the patient was not satisfied with these devices. An FRO was then provided and was accepted by the patient (Figures 2, 3).

Figure 2. The second patient with a left floor reaction orthosis ascends the stairs.

A 56 year-old diabetic female, E.M., woke up one morning, got out of bed and fell because of weakness of the left lower limb. Soon she became paraplegic, and then quadriplegic for two weeks. Electromyographic studies revealed a severe demyelinating neuropathy consistent with Guillain-Barre syndrome.

She exhibited steady improvement in muscle strength, particularly in both upper limbs and the right lower limb. She began to ambulate between parallel bars in the pool, then outside the pool with bilateral "handy standies." Within two weeks, she

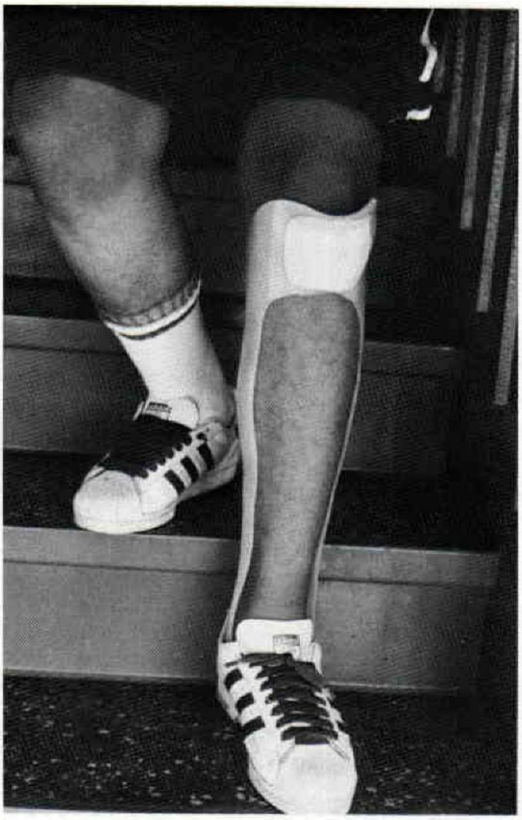


Figure 3. The second patient descends the stairs with a left floor reaction orthosis.

Figure 4. The third patient with a right floor reaction orthosis.

progressed to walking with a right Zimmer splint/posterior leaf spring AFO, left "handy standy"/toe strap, and rolling platform walker. As soon as the strength of the right quadriceps femoris muscles reached fair minus, an FRO was made for the right lower limb (Figure 4). A plastic KAFO with metal knee and ankle joints was prepared for the left lower limb.

All three patients described above were found to be excellent candidates for FROs. They were well motivated and the strength of their quadriceps femoris muscles was improving to at least a fair minus level. If they had one AFO, they met almost all of the requirements for functional community ambulation.[2] After a short period of rehabilitation training, they walked well with their FROs and accepted the FRO as an assistive functional device for ambulation.

CASTING AND FABRICATION

The patient is seated in a casting chair, and all bony prominences are identified with an indelible pencil. A latex rubber tube is run anteriorly over the dorsum of the foot along the tibial crest to the level of the fibular neck. The tube then winds medially to the mid anterior-posterior dimension of the knee. This allows the negative impression to be sectioned for removal, yet it can be properly "keyed in" for exact placement and orientation. A length of tubeguaze stockinette is placed over the limb to act as a cast separator, and the shank is then wrapped with elastic plastic bandage to the level of the fibular neck.

The foot is then placed on a footboard in neutral subtalar position with slight plantar flexion to accommodate the heel height of the patient's shoe. Care must be taken to position the foot in the correct amount of toe out, and to maintain the shank in proper orientation to mid-saggital alignment.

When the ankle-foot section has hardened, the knee is extended to approximately 15 degrees of flexion and wrapped with plaster bandage to the level of the proximal border of the patella. The patellar tendon is then outlined as a reaction point from the floor for knee extension by compressing with thumb and forefinger pressure in the same manner as with a below knee patellar tendon bearing (PTB) orthosis casting. Since weight bearing is not a consideration, the popliteal area and contour of the posterior calf need not be disturbed.

The negative impression is removed and filled in preparation for modification. Modification follows standard procedures with plaster buildups over all bony prominences for pressure relief. The footplate is fully modified for support of the medial and lateral longitudinal arches. In addition, a slightly more aggressive modification is made under the sustentaculum tali and transverse metatarsal arch to provide a stable base for the calcaneus in a slight plantar flexion position and comfortable distal reaction point under the metatarsal heads.

The patellar tendon is now isolated. Although not an area covered by the orthosis, the patella was included in the negative impression so that the tendon modification could be properly oriented with respect to natural toe out. If this is not done, the orthosis will tend to rotate medially or laterally and begin to impinge on the femoral condyles. The positive model is then smoothed, coated with a parting lacquer and covered with nylon hose in preparation for vacuum forming.

A $^{3}/_{16}$" thick sheet of copolymer (polyethylene-polypropylene composite) is drape vacuum-formed over the positive model from posterior to anterior, creating an anterior seam. In the area of the patellar tendon, the seam is pinched together tightly with Teflon sheeting to ensure good bonding at this point. When this technique is performed with the plastic material at the proper temperature, there is no need for plastic welding equipment or other bonding agents to maintain the structural integrity. The positive model is broken out, and the orthosis is trimmed and smoothed for fitting.

DISCUSSION

The major advantage of the FRO is that, besides stabilizing the ankle and subtalar joints, it assists the knee extension capabilities of the patient with fair minus strength in their quadriceps femoris muscles, and therefore helps prevent the knee joint from buckling. The KAFO can accomplish these functions, but its use frequently results in overbracing of the patient as well as increased energy consumption. The ankle of the FRO is almost in the neutral position, so that the patient can begin his gait cycle with heel strike and descend stairs more easily than if he were using the SKO, SB, or KU-SLB. The gait pattern with this orthosis is more physiologic, because it provides opportunity for the quadriceps femoris muscles with fair minus strength to work as the patient walks. Also, provided the patient feels reasonably secure, the FRO gives him a sense of freedom and control over external devices.

The FRO shares all the advantages of those orthoses made with plastic materials. Its weight is much less than that of a conventional KAFO (0.3 kgs. vs. 2.2 kgs. avg.). This device is molded to provide total contact, thus preventing pressure sores over bony prominences. The patients report that it is more comfortable, more cosmetically appealing than their old orthoses, and can fit into a regular shoe using normal trousers. It is cleaned easily with mild soap and water, and has no movable parts which would require maintenance.

However, the acceptance of the FRO has been hampered by a number of factors. The first factor is the cost. Older designs were fabricated from polyester and acrylic laminates. Not only are these materials relatively expensive but their use in fabrication is very time consuming. Vacuum forming techniques utilizing thermoplastic sheeting offer a quick, inexpensive alternative. The material cost is lower but, perhaps more importantly, the time required for fabrication is approximately one-third less.

A second main difficulty with this orthosis has been its lack of adjustability in the degree of ankle equinus, and consequently the amount of knee extension moment control force. As the principle goes, the more plantar flexion in the orthosis, the more extension force applied at the knee joint. The stability of the knee is enhanced, but so is the resistance to forward progression. Reducing the degree of plantar flexion allows more forward motion to occur in the gait cycle before the maximal extension force is generated.

This produces a smooth gait, but decreases the stability requiring more active control and strength in the quadriceps femoris. The optimum tibial-talar angle in this FRO then is at the proper balance between these two conflicting considerations, and provides maximal function. This angle is different for each individual and may vary over a period of time. Attaining and maintaining this optimum configuration prior to actual ambulation is exceedingly difficult, especially when the patient's clinical picture is changing.

By casting for the orthosis on a footboard higher than the intended heel height of the shoe, the entire device will be maximally plantar-flexed. From this starting point, the device can be selectively destabilized by filling the "space" between the orthosis heel height and that of the shoe. This maneuver changes the reaction dynamics of the orthosis. It gives an effect similar to dorsiflexing the entire component. In this sense the FRO is far more adjustable, and can be modified to either fine tune the gait or alter it as the individual condition changes. The orthosis can then be remade at a suitable angle or left in a readily adjustable state.

AUTHORS

The authors may be contacted through the Rusk Institute of Rehabilitation Medicine, New York University Medical Center, 400 East 34th Street, New York, NY 10016.

REFERENCES

[1]Daniels L., Worthingham, *Muscle Testing, Techniques of Manual Examination,* Fourth Edition, Philadelphia, London, Toronto, W.B. Saunders Co., 1980.

[2]Hussey R.W., Stauffer, E.S., "Spinal cord injury: Requirements for ambulation," *Archives of Physical Medicine and Rehabilitation,* 54, pp. 544–547, 1973.

[3]Lehneis, H.R.: "New concepts in lower extremity orthoses," *Medical Clinics of North America,* 53, pp. 585–592, 1969.

[4]Saltiel, J., "A one-piece laminated knee locking short leg brace," *Orthotics and Prosthetics* 23, 68–75, 1979.

[5]Watanabe H., Yonemitsu H., "Short leg brace for knee extensor weakness (KU short leg brace)," *Kumamoto Medical J.,* 26, pp. 90–95, 1973.

EDITOR'S NOTE

Another resource is: "Use of the Anterior Floor Reaction Orthosis in Patients with Cerebral Palsy," Edwin D. Harrington, M.D., Robert S. Lin, C.O., James R. Gage, M.D., *Orthotics and Prosthetics,* Vol. 37, #4, pp. 34–42, Winter, 1983–84.

Orthotics and Prosthetics, Vol. 40, No. 1, pp. 38–42.

Sexually Transmitted Diseases and Contact with the Orthotics-Prosthetics Professional

Steven D. Prock, C.P.O.

INTRODUCTION

Over the past few months the author has noted an alarming increase in the number of articles and stories published concerning sexually transmitted diseases. Each article describes these sexually transmitted diseases at epidemic levels and the medical field's growing concern about this. The author had never given these diseases much thought until he read an article which described a means of transmittal as "direct contact" other than "sexual contact." It was only then that the author started asking questions and doing research concerning these unmentionable diseases. While the author does not wish to cause alarm, this article is intended to create an awareness about sexually transmitted diseases.

DISCUSSION

A person has the greatest chance of contracting one of the more than 25 types of veneral disease through sexual contact, but there are very real possibilities that the prosthetist and orthotist could contract one of these diseases in his daily routine. Whether the orthotist is palpating for the symphysis pubis, or the prosthetist is palpating for the ischial tuberosity, they are in close proximity of the perineal area. Working in this area increases the chances of coming in contact with a veneral disease; however, infestation is not restricted to just the perineal area.

Transmission of a venereal disease can be made when one comes in direct contact with an infected person, or from freshly contaminated material.[1] Even innocently putting your hands near your nose or mouth after examining a patient has its hazards. There are many ways of contracting a sexually transmitted disease and work in the prosthetic-orthotic field increases your chances of acquiring these diseases.

Since we can now see that "direct contact" instead of just "sexual contact" can transmit these diseases, we should be aware of the signs and symptoms and other modes of transmission of these diseases. The following outline is a condensed version of the six most common types of sexually transmitted diseases and their signs and symptoms.[2] This is not a complete overview and is in no way designed to be used in self-diagnosis. It is only meant as a tool to help increase awareness of these diseases.

I. A.I.D.S. (Acquired Immune Deficiency Syndrome)

A. Signs & Symptoms

1. Weight loss, weakness, fever, generalized lymphadenopathy, and the appearance of a variety of opportunistic infections.
2. On physical examination, one could find white placques of candida in the mouth. Also, herpetic lesions on the genitals or the rectal area.
3. Early lesions may appear as asymptomatic, subtle, reddish-blue patches. Over a period of days to weeks, lesions become more nodular with deeper purple color and often yellowish-green "bruise-like" margins.
4. The person could have a history of hepatitis, gonorrhea, syphilis, or herpes. High risk groups include homosexuals, intravenous drug abusers, and recent Haitian immigrants.

B. Transmission

1. A.I.D.S. is likely to be contracted through an open sore by contact with blood or any secretions from the eyes, nose or mouth.[3]

(It is interesting at this point to note that the dental community is routinely taking precautions such as masks and gloves to prevent contact with blood and facial secretions.)

II. Syphilis

A. Signs & Symptoms (Primary stage)

1. Initial lesion appears two to four weeks after inoculation, changing from a small red papule to a small ulcer to a hard chancre, usually on prepuce or vulva.
2. Lymph nodes enlarge about two weeks after appearance of lesion.
3. Inflammation at mouth of Stenson's duct and enlargement of epitrochlear lymph nodes.

B. Signs & Symptoms (Secondary stage)

1. Lesions of the skin and mucus membrane.
2. Systematic symptoms such as headache, fever, and malaise are common, but may be absent.
3. Enlargement and induration of regional lymph nodes.
4. Eruptions of the skin, maculae (rosella) syphilide, reddish-brown coppery spots continuing for one to two weeks.

C. Transmission

1. Direct contact between humans.
2. Contact with freshly contaminated material.
3. Transfusion of infected blood or plasma.
4. Utero passage of organism from mother to fetus.
5. Through a broken place in the skin or mucus membrane.[4]

(Syphilis is more likely to be contracted in the secondary stage than in the primary.)

III. Herpes (Genital)

A. Signs & Symptoms

1. Vesicular lesions on vulva, perinum, vagina, and cervix in women, lesions on penile shaft, prepuce, glans penis, scrotum, and perinum in men.
2. Tender adenopathy, dysuria, and constitutional signs more common with primary infections than those recurring.[5]

B. Transmission

1. Direct contact between humans with an active infection.
2. Medical and dental professionals frequently develop herpes infections on their hands from contact with a patient who is shedding the virus at the time.
3. Sometimes a person with herpes may shed virus particles even though no sores or other signs of recurrence are present.[6]

(Herpes is easily contracted through an active lesion.)

IV. Venereal Warts

A. Signs & Symptoms

1. A pointed, reddish moist wart about the genitals or anus.
2. Develops near mucocutaneous junctions forming pointed, tufted, or pendulated pinkish or purplish projections of varying length and consistency.

B. Transmission

1. Direct contact between humans.[7]

V. Gonorrhea (Figure 5)

A. Signs & Symptoms

1. Males
   a. Yellow mucopurpulent discharge from penis due to inflammation of the uretha. May become deep-seated and affect the prostate.
   b. Slow, difficult, and painful urination.
   c. Sometimes painful induration of the penis.
2. Females
   a. Slight pain (not enough to seek medical help).
   b. Urethral or vaginal discharge.
   c. Frequent or painful urination.
   d. Lower abdominal pain.
   e. Tenderness in the area of Bartholin's and Skene's glands.[8]

B. Transmission

1. Direct and close contact with an infected person (not necessarily intercourse).[9]

(Contracting gonorrhea is less likely than the aforementioned diseases. Even with an open wound the risk is minimal.)

VI. Chlamydia

A. Signs & Symptoms

1. Females
   a. Vaginal discharge.
   b. Fever
   c. Stomach pain.
   d. Burning sensation during urination.
2. Males
   a. Whitish discharge from penis.
   b. Itching or burning during urination.

B. Transmission

1. Sexual intercourse.
2. Vaginal delivery of a baby.
3. Rarely by any other means.[10]

(Contracting Chlamydia is not likely in the prosthetic or orthotic line of work. There is a risk, but it is very minimal.)

VII. Other Potential Hazards

A. Hepatitis B

B. Strep

C. Staphylococci

D. Tuberculosis

PROPHYLAXIS

The following is a list of ideas which may help you protect yourself from possible contact with sexually transmitted diseases. If you do take precautions, I suggest that you have some type of "checks and balances" system due to the fact that one precaution may not be enough. Also, quite often, females honestly do not know they are infected.

- Sterilize any and/or all equipment (this may not always be feasible or practical).
- Ask specific questions on patient information forms (word these so that symptoms are described, i.e., "do you have painful urination?" not, "do you have, or have you had, a veneral disease?").
- Delay services until suspicious lesions are identified and treated.
- Begin personal and patient education.
- Use the following items and procedures as a guide for personal care:
  —gloves
  —gowns
  —masks
  —washing hands after each patient
  —bandaging and protecting open wounds
  —cleaning the suspected area of the device with strong cleaner before working.

In most cases, wearing gloves and routine cleanliness of the hands would be practical and adequate protection against these diseases.

CONCLUSION

Venereal disease can be transmitted by means other than "sexual contact," and the term sexually transmitted diseases is a misleading description for a potential health hazard to the prosthetic and orthotic field. The chances of someone in this field contracting a venereal disease are not remote, and because the untreated results can be devastating to our personal lives (i.e., embarrasment, deformity, and even death), a keen awareness must be developed and the necessary precautions taken.

For more information on this subject, I suggest you contact your personal physician, your county health department, or the National V.D. Hotline (1-800-227-8922).

AUTHOR

Steven D. Prock, C.P.O., is owner of the Texoma Health Care Center, Inc., 120 S. Crockett, Sherman, Texas 75090.

REFERENCES

[1,5,9]Bruner, Lillian Sholtis, R.M., et al., *The Lippencott Manual of Nursing Practice Third Edition*, pp. 802, 808.

[2]Seligmann, Jean, "A Nasty New Epidemic," *Newsweek*, February 1985, p. 73.

[3]Felman, Yehudi M., M.D., and Axel W. Hoke, M.D., *Wellcome Atlas of Sexually Transmitted Diseases*, p. 46.

[4,7,8]Thomas, Clayton L., M.D., *Tabor's Cyclopedic Medical Dictionary*, Edition 12, pp. S-148, 149, V-17, G-39.

[6,10]Gause, Ralph W., M.D., "Sexually Transmitted Diseases, Part II," *American Baby*, (January, February 1985), XLVII:22.

BIBLIOGRAPHY

Seligmann, Jean, "A Nasty New Epidemic," *Newsweek*, (February 1985).

Bruner, Lillian Sholtis, R.M., et al., *The Lippencott Manual of Nursing Practice Third Edition*, Philadelphia: J.B. Lippencott Co., 1982.

Gause, Ralph W., M.D, "Sexually Transmitted Diseases, Part I & II," *American Baby*, (January 1985, February 1985).

Thomas, Clayton, L., M.D., *Tabor's Cyclopedic Medical Dictionary*, Edition 12, Philadelphia: F.A. Davis Company.

Felman, Yehudi M., M.D., and Axel W. Hoke, M.D., *Wellcome Atlas of Sexually Transmitted Diseases*, Research Triangle Park: Burroughs Wellcome Co., 1985.

ACKNOWLEDGMENT

Many thanks to Minaxi Rathod, M.D., Infectious Diseases, for her aid, comments, and critique of this article.

Orthotics and Prosthetics, Vol. 40, No. 1, pp. 43-50.

Case Studies— Orthotic Management of the Adult Post Polio Patient

Darrell R. Clark, C.O.
Jacquelin Perry, M.D.
Thomas R. Lunsford, C.O.

In 1984, a conference on post polio was held in Warm Springs, Georgia, site of one of the original polio treatment centers. This conference was in response to the growing number of post polio patients being seen in clinics around the country with complaints of pain, increased weakness and loss of function. Since the conference, there have been a number of articles in the popular press with regard to what is being called the "Post Polio Syndrome."[1,2,3]

While several theories have been pro-osed regarding the cause of this phenomenon, the end result is that many of these post-polio patients are now seeking re-evaluation of their condition. These patients fall into one of two broad categories: those who have worn orthoses through the years, and those who have not.

The former group has continued to wear orthoses after their adolescent years because they had sufficient residual paralysis to require it. The latter group may have worn orthoses initially, but later discarded them because they were able to substitute for paralyzed musculature through altered posture or with their remaining, although weakened muscles.

Orthotic design for these patients is complex, and for it to be effective, the system must accommodate the patients' substitution mechanisms as well as their instability and deformity. This article will address some of the more common lower limb problems which may be improved with appropriate orthotic management.

BIOMECHANICAL DEFICITS

The probems to be reviewed include:

- Inadequate Dorsiflexion in Swing
- Dorsiflexion Collapse in Stance
- Genu Recurvatum
- Genu Valgum
- Medio-Lateral Ankle Instability

Each is discussed on the basis of cause, gait problems, substitution mechanisms, and orthotic management.

Inadequate Dorsiflexion

Weakness of the pre-tibial muscles will cause the foot to fall into plantarflexion during the swing phase of gait. This causes

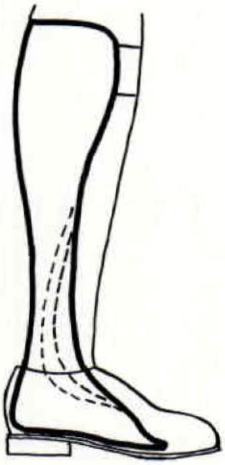


Figure 1. In this illustration, the dotted lines demonstrate removal of material to allow less resistance to plantar flexion at heel strike.

"toe-drag" during gait, and creates the potential for the patient to trip and fall. Patients with adequate residual strength may clear the foot by increasing hip and knee flexion. The result is a shortened step length, due to the inability to extend the heel forward, and a "toe first" contact.

Although this may be satisfactory for some patients, others, who lack the ability to substitute without fatigue, will want a more normal gait. There are several ankle-foot-orthoses (AFO), either metal or plastic, designed to overcome "drop foot" during swing by providing either passive plantarflexion restraint, or active dorsiflexion assist. A plastic AFO will passively prevent the foot from dropping, and a metal AFO with a spring assist will actively pick the toe up during swing.

Consideration must be given to the consequence of restrained motion at initial contact. In an orthosis that is too rigid, the force providing passive plantarflexion restraint in swing may, at heel strike, induce a knee flexion thrust. This would be intolerable in the presence of weak quadriceps. Since patients have shown a preference for the cosmesis and light weight of a plastic AFO, some degree of adjustment is needed. This can best be accomplished by modifying the trim lines at the ankle so there is maximum flexibility (Figure 1). Another means of reducing the knee flexion torque is to reduce the heel lever at initial contact. This can be accomplished with a cushion heel on the shoe or by undercutting the heel (Figure 2).

Dorsiflexion Collapse

In order for the leg to support body weight during stance, there must be stability of the hip, knee, and ankle. The patient with weak extensor strength at the hip and knee can substitute by positioning the center of gravity posterior to the hip and anterior to the knee (i.e., hyperextension) to adequately stabilize these joints. However, for the patient with a weak calf, the only substitution available at the ankle to

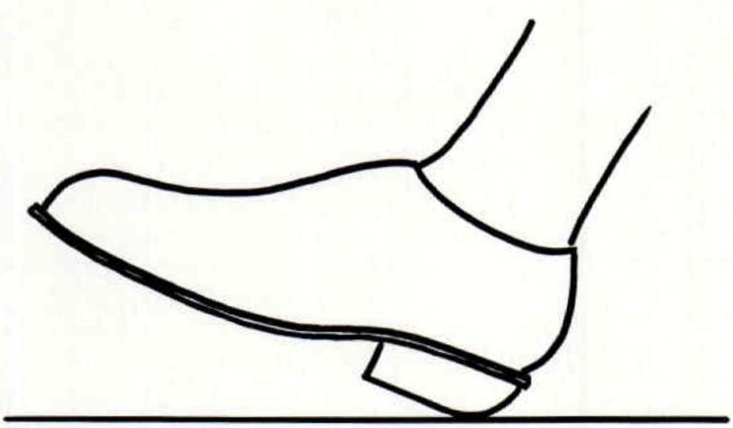


Figure 2. By rounding the heel of the shoe, you may also improve transition from heel to toe during the stance phase.

restrain uncontrolled anterior tibial motion in stance is a persistent plantarflexed posture. Without this, the result is instability in the second half of stance, and the danger of falling forward. If body weight is shifted behind the knee joint, it too will become unstable. Patients with unilateral involvement cope with this condition by reducing stance time on the affected side. Patients with bilateral movement must rely on canes or crutches to attain stance stability.

Stability is achieved orthotically by restraining dorsiflexion in stance and maintaining the tibia in a vertical position. This allows the patient to "lean into" the orthosis without fear of collapsing at the ankle. This reduces demand on the unaffected leg for the unilateral patient, and on the arms of the bilateral patient. Dorsiflexion restraint may be provided with either a conventional metal AFO, designed to restrict dorsiflexion range of motion, or a rigid plastic AFO. Because the torque created by body weight is high, the dorsiflexion stop must be rigid. Placing springs in the ankle joints of the orthosis in an effort to restrain dorsiflexion will be totally inadequate.

Genu Recurvatum

Patients with weak quadriceps will attempt to create stance stability by placing their body weight anterior to the knee joint, (i.e., hyperextension) to lock their knee. This places the soft tissues posterior to the knee in tension and may produce progressive recurvatum. As the amount of recurvatum increases, the rate of increase accelerates to the point of pain and decreased function.

This also has an adverse effect on gait. Individuals normally produce 60° of knee flexion in initial swing to clear the foot. If a patient is in 20° recurvatum in stance, an additional demand is created which is not easily met by the patient. They can not quickly flex through what is now 80°, and their energy expenditure increases. A neutral knee, in addition, is desirable in the second half of stance, so that the knee can be easily unlocked to prepare for swing.

The patient with weak knee extensors can not risk having his weight line fall behind his knee joint during stance, as the resulting flexion torque will cause the knee to buckle. The common orthotic answer is to provide a locked knee-ankle-foot orthosis (KAFO). This requires the patient to accommodate the locked knee joint by hiking the pelvis or utilizing other substitutions for the stiff-legged gait. In those patients who have adequate hip extensor strength, the need for hip hiking in swing can be avoided by providing a KAFO with a freely moving knee joint, that includes 10-15° hyperextension. An offset knee joint which places the mechanical axis posterior to the anatomical axis is used (Figure 3). This increases the extension lever in midstance and, coupled with the 10-15° hyperextension, allows the knee to assume a po-

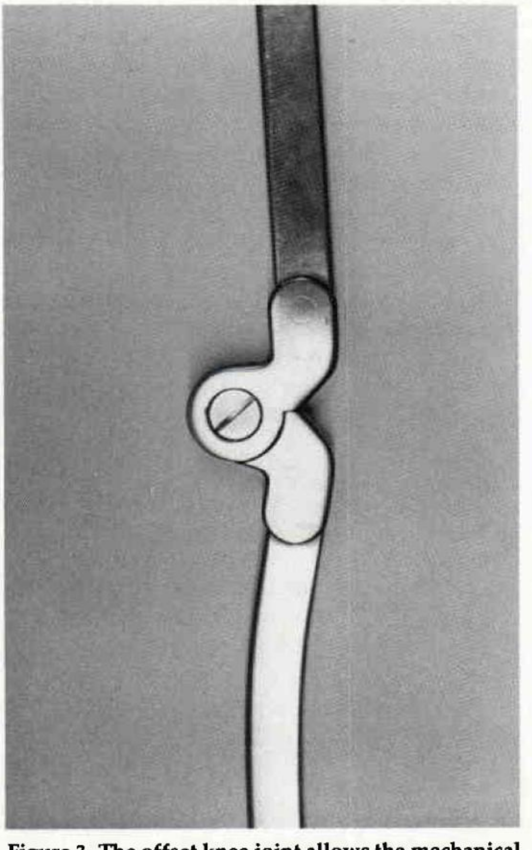


Figure 3. The offset knee joint allows the mechanical knee axis to be posterior to the anatomical axis, and thus improve stability.

sition of stability. The patient avoids the extreme position of pain or deformity, yet retains the ability to flex freely during swing.

Genu Valgum

Genu valgum is seen more often in the paralytic patient than genu varum because the presence of weak hip abductors causes the patient to lean laterally in stance to reduce the demand on these muscles. The change in body alignment produces a valgum stress at the knee. Over time, deformity occurs and these patients usually present with complaints of pain, decreased function, and increased energy expenditure.

Orthotic management may include a KAFO which obtains maximum correction of the deformity, within limits of patient tolerance and range of motion. Orthotic components which provide the corrective force are best applied to the proximal, medial tibia and femoral condyles. Pre-tibial shells are one of the most common components used. These are designed to support the knee anteriorly, with a proximal medial extension to support the medial surface of the knee. In cases of recurvatum, a posterior shell with a medial proximal extension can be used to support the posterior and medial surfaces at the knee. In mild cases of genu valgum, a femoral condyle pad may be sufficient. All components should be padded to protect the patient against skin breakdown.

Occasionally a patient will present with a knee flexion deformity and internal rotation of the leg. During gait this can give the appearance of a valgum deformity. Care must be taken during the evaluation to avoid this misinterpretation of the patient's problem.

Medio-Lateral Ankle and Subtalar Joint Instability

With weak or absent foot and ankle muscles, stability in stance is decreased in the medio-lateral dimension as well as in the antero-posterior dimension. These patients have no effective substitution available, and their ankle and subtalar joints tend to collapse.

A passive deformity will respond to a U.C.B.L. insert. The potential effectiveness of this treatment is demonstrated if the deformity can be controlled manually during weight-bearing, either by holding the heel with your fingers, or rotating the tibia with your hands (externally for valgus, internally for varus). If this is not adequate, and the U.C.B.L. collapses, the arch will have to be reinforced between the orthosis and the shoe.

If the deformity is active, due to increased muscle tone, some patients will not tolerate the force necessary to correct the deformity, and the U.C.B.L. will not be adequate. Sometimes a U.C.B.L. extended into a plastic A.F.O. will work, otherwise the deformity exceeds orthotic capabilities and other measures must be taken.

Traditionally, KAFO's have not accommodated rotation of the ankle joint. This rotation, usually external, places the foot in a "toe-out" position. Many KAFO's are designed to place the foot perpendicular to the knee axis, which forces the foot into a varus posture. To further complicate the situation, "T-straps" are sometimes added to counteract varus producing forces. To avoid this problem, the KAFO must be constructed to align the mechanical ankle joint with the patient's anatomy. This is accomplished by rotating the distal end of the orthosis, so that it will properly align with the anatomical ankle joints.

CASE STUDIES

Case #1

This patient is a 52 year old male, with left leg involvement, who had never worn an orthosis. He had 30 degrees of painful, hyperextension range at the knee and severe, although flexible, ankle varus (Figure 4-A). He also complained of discomfort and fatigue in his right leg, which had provided his primary stance support for many years.

In order to achieve stance stability on the left leg, the patient was fitted with a KAFO,

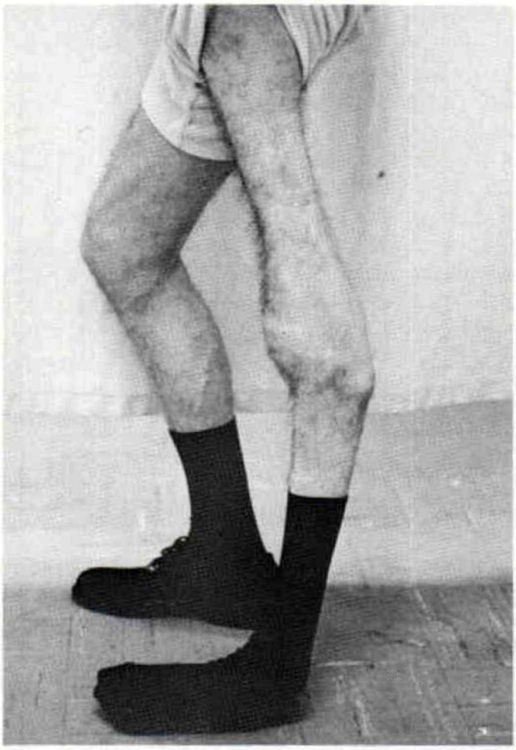


Figure 4-A. Genu recurvatum often results from years of force applied to bring the patient's center of gravity anterior to the anatomical knee joint, thereby replacing weak musculature.

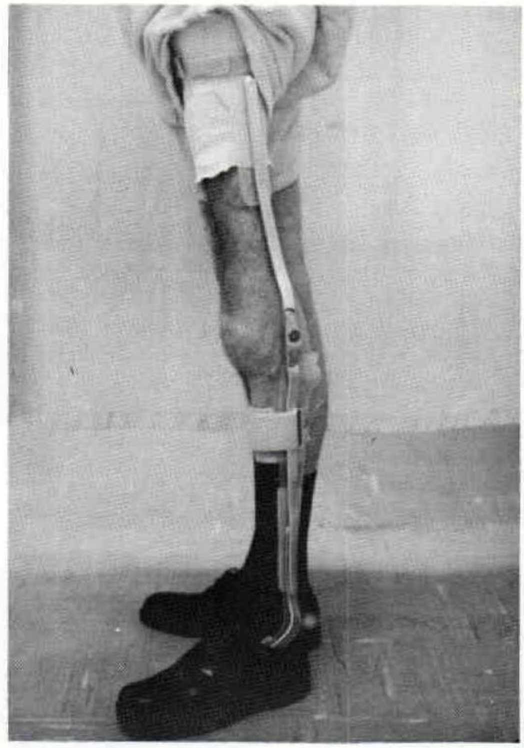


Figure 4-B. Orthotic correction designed to prevent painful, excessive genu recurvatum.

which provided knee and ankle control (Figure 4-B). The orthosis was designed with a plastic distal component, similar to a plastic AFO to maintain a neutral position at the ankle and foot.

A free-motion knee joint was utilized to allow swing phase flexion. This is possible due to the patient's recurvatum range. These patients, as previously mentioned, developed genu recurvatum by forcing their knee into extension to substitute for the lack of quadriceps force and provide weight-bearing stability. With his leg in a position of 0° flexion, the patient is not confident, because the slightest force would unlock the knee, causing it to buckle. To provide confident stance stability, the orthosis is positioned in 10-15° hyperextension. This creates an extension lever which locks the joint. When weight is transferred off the leg it is free to flex as it advances forward.

Case #2

A 54 year old male presented with 45° genu recurvatum, bilaterally (Figure 5-A). This patient had not been using orthoses and his deformity, while not painful, caused a very awkward and energy consuming gait.

He was fitted with bilateral plastic KAFO's (Figure 5-B). The offset knee joint, described earlier, was used. This positions the mechanical joint posterior to the anatomical joint, thereby creating an extension lever which locks the joint in stance, while retaining the ability to flex during swing. In addition, 10-15° of hyperextension is built-in for added stability, as in the previous case. Recurvatum was controlled by the use of plastic thigh and calf components. These provided broad contact areas to minimize pressure, and kept the overall weight of the orthosis to a minimum. Ten degrees of plantarflexion was allowed at initial contact to prevent knee flexion torque. Although the patient still requires crutches, stance phase stability is improved and fatigue is reduced.

Case #3

This was a 24 year old male with bilateral involvement. His right leg was flail, and he had combined genu recurvatum and valgum, as well as a fused ankle. His existing KAFO was ill-fitting and in need of repair (Figure 6-A). It supported his recurvatum only at the expense of excessive pressure on his calf.

Examination of the left leg revealed a weak calf, which resulted in dorsiflexion collapse in late stance. The patient wore high-top shoes in an attempt to increase ankle stability.

He was fit with a new KAFO on the right to control his genu recurvatum/valgum (Figure 6-B). Plastic was again used to minimize weight, provide better pressure distribution, and improve cosmesis. On the left he was fit with an AFO designed to restrain dorsiflexion and substitute for the weak calf in late stance. A standard metal system was also provided at the request of the patient in order to allow range of motion for driving.

Figure 5-A. This patient demonstrates bilateral excessive genu recurvatum.

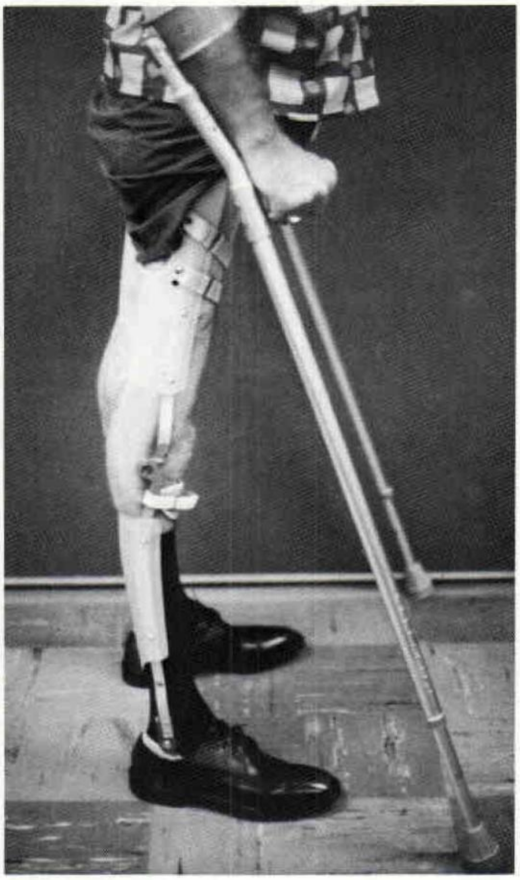


Figure 5-B. The same patient shown in Figure 5-A, with orthotic reduction of excessive genu recurvatum.

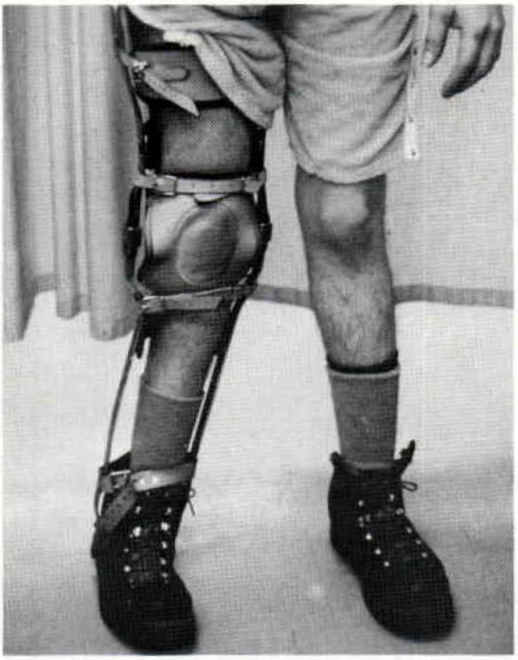


Figure 6-A. Patient #3, as presented at the clinic, prior to treatment.

Figure 6-B. Patient #3, following orthotic treatment with right knee ankle foot orthosis, and left knee ankle foot orthosis.

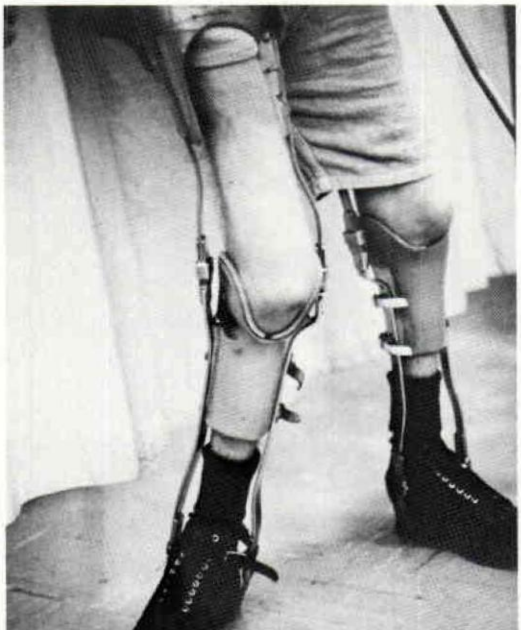


Figure 7-A. Case #4, as he presented to us with a recurrent history of broken medial uprights at the knee, due to excessive forces.

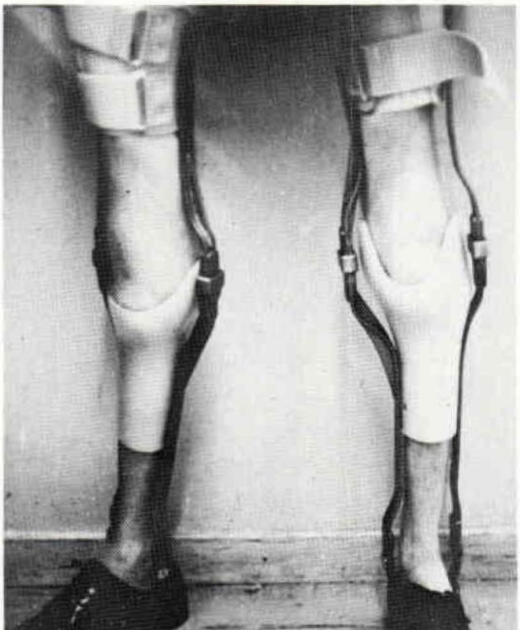


Figure 7-B. Following welded reinforcements to the uprights at the knee, breakage problems and instability have been corrected.

Case #4

A 30 year old male presented with flail legs bilaterally and genu valgum on the right. He wore KAFO's and used crutches, (Figure 7-A) and related a history of broken medial uprights on the right orthosis due to the force on the orthosis produced as a result of his deformity. Several attempts had been made to reinforce the system, with only limited success. To remedy this, reinforcements were welded onto the uprights near the knee.[4] The additional weight was not a problem, and significant increases in strength and stability were achieved (Figure 7-B).

SUMMARY

Many post-polio patients go on to experience a reduction in strength and function, and are seeking re-evaluation of their condition. Frequently these patients have managed without orthotic support by substituting with remaining muscles and posture "tricks," but now have increasing deformity and pain. Improved orthotic design can help meet these patient's needs, so that when they become dependent on an orthosis, they can have a functionally satisfying result. As a consequence, they will not have to wait until they reach an intolerable situation before accepting orthotic assistance.

AUTHORS

Darrell R. Clark, C.O., is Director of Orthotic Education at Rancho Los Amigos Medical Center, Downey, California, and California State University-Dominguez Hills, and senior orthotist in the Post-Polio Clinic at Rancho.

Jacquelin Perry, M.D. is Chief of the Pathokinesiology Lab and Director of the Post-Polio Clinic at Rancho Los Amigos Medical Center.

Thomas R. Lunsford, C.O. is Chief Orthotist at Rancho Los Amigos Medical Center and Cinical Director of the Orthotics-Prosthetics program at California State University-Dominguez Hills.

REFERENCES

[1]"A New Scare For Polio Victims," *Newsweek*, April 23, 1984.

[2]"The Polio Echo," *Time*, February 11, 1985.

[3]*Los Angeles Times*, December 9, 1984.

[4]Clark, D., Lunsford, T., "Reinforced Lower Limb Design Principles," *Orthotics and Prosthetics*, Vol. 32, No. 2, June 1978, pp. 35–45.

Orthotics and Prosthetics, Vol. 40, No. 1, pp. 51–54.

Microcomputers and the Small Orthotic/Prosthetic Firm

Thomas C.W. Chang, C.P.O.

During the past several years, the prices of microcomputers have steadily decreased, while their capabilities have dramatically increased. Thousands of software products have become available for microcomputers, and these products, many of them comparatively low in cost and easy to use, are being continually refined to take advantage of hardware improvements.[1] These developments have made computers available to small businesses that 10 years ago would have lacked the financial and technical resources to purchase and operate data processing hardware and software. Microcomputers, for the first time, thus have the capability to increase small business productivity and efficiency substantially and to fulfill the information needs of the small business owner or manager.[2]

As the owner and manager of a small orthotic and prosthetic firm, I have found manual recordkeeping, accounting, and generation of bills and correspondence to be increasingly cumbersome and time-consuming. Given the size of the business, its financial constraints, and the lack of technical computer expertise among my staff, purchase of a microcomputer appears to be the most intelligent way to begin computerizing these functions. In purchasing a microcomputer or any computer system, however, I am concerned with ensuring that the investment will be worthwhile, and that the computer, once purchased, will be productively used. Accordingly, this article will focus on guidelines for selecting personal computer hardware and software, and for initiating use of such a system in a small business environment.

PURCHASING THE SYSTEM

Computer experts agree that the most important step in purchasing a computer system is to begin by ascertaining user needs and constraints. For example, what functions or procedures does the business wish to computerize? Can standard software packages perform these functions? Is access to public data bases desirable? How much memory is necessary? Who will use the system? What special features are necessary? How much can the business afford to spend on a computer system?[3]

All of these factors should be considered before investigating specific hardware and software products. Many first-time personal computer purchasers fall into the trap of simply buying the most popular equipment and "hot" software packages and assuming that these will perform the required tasks.[4] Often, this assumption proves untrue, and the buyer is left with an expensive piece of equipment that is used little or not at all.

Next, the current micro-computer market should be thoroughly surveyed. In the case of hardware, features, costs, and available software for various models should be compared. In the case of software, "user friendliness" and thoroughness and clarity of documentation should also be evaluated. Many prospective buyers spend too little time on this step, perhaps because they are intimidated by the size of the market, the rapid changes occurring in it, and their ignorance of the technical terminology used by computer salesmen.[5] Nevertheless, a "consistent step-by-step evaluation of alternative offerings" is necessary if one is to avoid "acquisition of an ineffectual . . . system."[6]

Once appropriate hardware models and software packages have been identified, availability of technical services and advice from manufacturers and vendors should be ascertained. Many vendors and manufacturers provide assistance with needs assessment, help with selection of hardware and software, and user training and advice.[7] Such services may be critical to successful installation and continued use of the system, particularly for the small business that lacks in-house computer expertise.

A final and related consideration for the personal computer buyer is the viability of the company that manufactures the equipment.[8] Today's computer market, while huge, is relatively new, with numerous large and small companies competing for dominance. Most analysts predict that many of these companies will fail or drop out of the market during the next few years. The business that has purchased a computer from such a company may be left without technical follow-up or without the ability to upgrade a system or to purchase compatible software. In this situation, it may be worthwhile to spend a bit more on a system manufactured by a company that appears likely to survive the fierce competition of the next few years.

USING THE SYSTEM

How the small orthotic and prosthetic business manager sets up and begins using a personal computer is an important factor in determining the computer's ultimate contribution to business productivity and effectiveness. The most common problem leading to failure of a microcomputer to perform effectively is unrealistic user expectations. Too often, users expect a computer to be a "cure-all" that will solve all of their business problems, an expectation that is reinforced by much of the advertising for microcomputers. As Richard Byrne points out in the June, 1985 issue of *Personal Computing*, however, business problems can be solved only by effective business planning and management: "computerizing a sloppy situation will likely result in nothing more than a sloppy, computerized situation."[9] The computer is only a tool to enable the user to augment his own skills. It cannot substitute for the ability and effort to make intelligent business decisions, to recognize and react to changes in the business environment, or to perceive and take advantage of new opportunities, although it can help in all of these areas.

Another common mistake related to unrealistic user expectations is to attempt to do too much too soon with the new system. Often, overly eager computer novices purchase expensive and sophisticated equipment and software and attempt to put all of the system's capabilities to work immediately. Such users—and their employees—may become quickly discouraged when problems are encountered, with the result that the computer is underutilized.[10] This type of situation can be forestalled by careful planning and needs assessment in the pre-purchase stage.

The key to successful implementation of a microcomputer system is to progress one step at a time. Managers and employees should begin with a program that is comparatively easy to learn, such as a simple and user-friendly word processing or spreadsheet package, and then work their way up.[11] Once users have become familiar and comfortable with the computer, more important business activities or "critical success factors" should be identified and computerized, one at a time.[12] Byrne suggests that managers use a personal computer to "leverage" what they do best, not to compensate for areas of weakness: "to take something that you are doing poorly and begin doing it with a computer may only intensify the problem."[13]

Finally, if lower-level employees, such as secretaries, are to be primary users of the system, they should be involved, as far as possible, in the needs assessment, evaluation, and selection processes. Such involvement can help employees to understand how the personal computer will benefit them, and can ease any fears they may have about learning new procedures, or about being "replaced" by a computer. If feasible, training should be made available to employees.[14] Further, in choosing the system, physical features such as key size, screen angle, flickering of screen image, and character size and color should be evaluated for comfort and attractiveness. Once installed, a more comfortable system will help to improve employee morale and reduce error.[15] It is also important for the employer to understand that use of the new system may disrupt routines and decrease productivity temporarily.[16]

Once users—whether managment or staff—are introduced in this gradual fashion to working with the computer, they will begin to see how computerization can facilitate basic business functions, such as accounting and inventory control, and will "inevitably find other ways for the computer to make life at work easier or more productive."[17] At this point, the stage is set for the computer to develop naturally into a tool with many more uses than originally imagined.

SUMMARY

Today's microcomputer is a powerful business tool with numerous applications beneficial to the small business firm. It can be used to handle billing, accounting, and tax planning, to maintain and update records on inventory and clients, to generate mailing lists, and for word processing. Increasing the efficiency and accuracy of these essential functions can contribute greatly to business effectiveness and success.

Despite these impressive capabilities, however, personal computer purchases must be planned and products evaluated thoroughly and intelligently. Expectations for computer functions should be realistic; a microcomputer is not a "cure-all" for business problems, nor a substitute for good management.

Finally, users with little computer background should acquaint themselves gradually with the computer's operations and capabilities, working up from simpler to more sophiticated programs. In this manner, the small orthotic and prosthetic facility can derive maximum returns in efficiency and productivity from its microcomputer investment.

AUTHOR

Thomas C.W. Chang, C.P.O. owns Madison Prosthetic-Orthotic, Inc., 7817 Mineral Point Road, Madison, Wisconsin 53717.

REFERENCES

[1]Adam, Robert G., and Robert P. Stanojev, "15 Indispensable Guidelines to Buying Software and Service," *ICP Interface*, Special Edition, pp. 66–67.

[2]Hussain, Donna, & K.M., *Information Processing Systems for Management*, Richard D. Irwin, Inc., Homewood, Illinois, 1981 and 1985, p. 555.

[3]Ibid., pp. 542–544.

[4]Byrne, Richard B., "Leveraging Productivity," *Personal Computing*, June 1985, p. 43.

[5]Hussain, p. 542.

[6]Adam and Stanojev, p. 68.

[7]Hussain, pp. 544–545.

[8]Adam and Stanojev, p. 68.

[9]Byrne, p. 43.

[10]Ibid., p. 43.

[11]"Making a Computer a Cost-Effective Tool," *Computer: Buyer's Guide and Handbook*, July, 1985, Vol. 3, Issue #4, p. 41.

[12]Byrne, p. 45.

[13]Ibid., p. 45.

[14]Giannoti, Gene C., "Getting Their 'Act' Together," *Data Management*, June 1980, pp. 47–49.

[15]Hussain, p. 371.
[16]Op. cit., p. 49.
[17]"Making a Computer," p. 37.

BIBLIOGRAPHY

Adam, Robert G. and Robert P. Stanojev, "15 Indispensable Guidelines to Buying Software and Services," *ICP Interface*, Special Edition, pp. 66–73.
Byrne, Richard B., "Leveraging Productivity," *Personal Computing*, June 1985, pp. 41–45.
Giannotti, Gene C., "Getting Their 'Act' Together," *Data Management*, June 1980, pp. 47–50.
Hussain, Donna and K.M., *Information Processing Systems for Management*, Richard D. Irwin, Inc., Homewood, Illinois, 1981 and 1985.
"Making a Computer a Cost-Effective Tool," *Computer: Buyer's Guide and Handbook*, July, 1985, Vol. 3, Issue #4, pp. 37–42.

Orthotics and Prosthetics, Vol. 40, No. 1, pp. 55–57.

Technical Note: A Simple Boot to Prevent Pressure Sores

Albert L. Howe, C.P.O.

INTRODUCTION

Pressure sores on the heels and bony foot prominences are an unfortunate and frequent occurence in the elderly patient confined to bed. While many padded foot protectors are commercially available, none has proven entirely effective in our experience. We have, therefore, designed our own foam boot. It is maximally effective in preventing pressure sores and can be made in minutes from materials available in any hospital-based orthotics laboratory.

FABRICATION

Materials required are an "eggcrate" foam mattress, Masters® cement, Velcro® and canvas webbing. Masters® cement is first applied to one border of an 18" square piece of eggcrate mattress. Folding the square in the middle so that the knobby surface is to the inside, the edges of the cemented border are pressed together so that they adhere (Figure 1). A second 18" square piece of eggcrate foam is then applied to the outside smooth surface of the first square and its border glued together in a similar manner (Figure 2). Two webbing straps with Velcro® closures are then fashioned to hold the anterior opening of the boot closed.

The completed boot (Figure 3) encompasses the distal lower extremity to the mid-calf, protecting not only the foot and ankle prominences but also the Achilles' tendon area. Because the foam padding completely envelops the leg, it is impossible for the closure straps to chafe the skin. The double layer of foam not only provides double padding but also increases the surface area of the boot, thus distributing forces more evenly between the foot and the bed. Because the contoured surface of the eggcrate is next to the skin, there is ventilation between the skin and the foam rubber, thus preventing temperature build-up. Since the projections of the eggcrate foam move with the patient, there is no friction on the skin.

The material cost of the boot as described is less than $10.00. Four boots can be made from one eggcrate mattress.

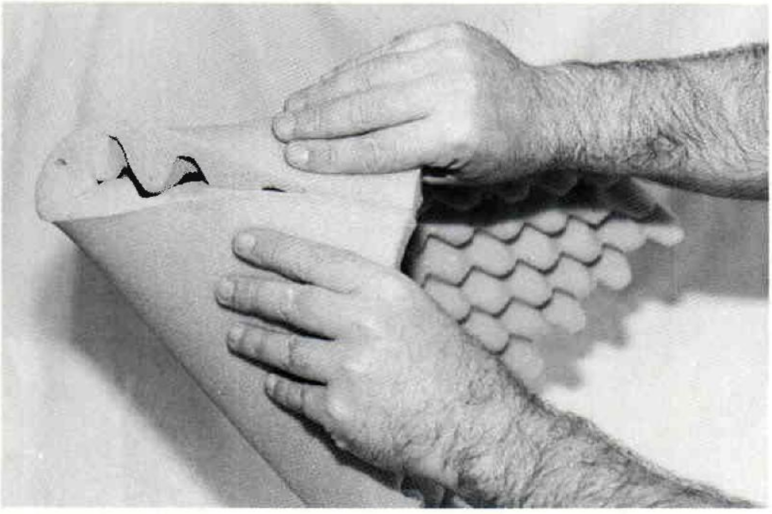


Figure 1. The border of the eggcrate mattress is adhered with the projections facing in.

Figure 2. The second layer is prepared in a fashion similar to the first, and the one layer is placed inside the other.

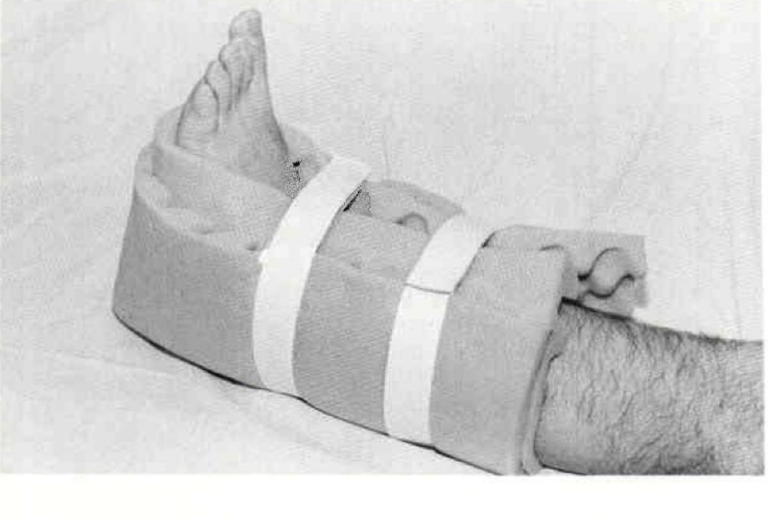


Figure 3. The completed boot, shown positioned on the patient, with closures in place.

SUMMARY

Over the past eight years, we have used the above-described double layer eggcrate boot to prevent pressure-induced skin lesions in elderly bedridden patients. No pressure sores have developed while the boots were in use. We recommend our design as an acceptable alternative to commercial foot padding for the prevention of pressure sores.

AUTHOR

Albert L. Howe, C.P.O., is with the Veterans Administration Medical Center, 1310-24th Avenue South, Nashville, Tennessee 37203.

ACKNOWLEDGMENTS

H.J. Bugel, M.D., for consultation; Cynthia Schneider, M.D., for assistance in preparation of manuscript; David L. Norris, orthotist, for photographs.

BOOK REVIEWS

Charles H. Pritham, C.P.O.

Lower Extremity Amputation, Linda A. Karacoloff, M.S., P.T., Aspen Systems Corporation, Box 6018, Gaithersburg, Maryland, 176 pages and index.

As explained in the forward, this book is an outgrowth of experience at the Rehabilitation Institute of Chicago and is a companion piece to a similar book concerning spinal cord injury, reviewed earlier. The objective of the book is to provide a clinical therapist with a practical method for planning the treatment of an amputee.

It includes chapters on evaluation, the pre-prosthetic program, above knee and below knee prostheses, prosthetic training, gait evaluation, and other topics. The book is quite thorough and well laid out. Of particular interest are the use of charts and graphs throughout to summarize and organize material.

The book would seem to be a useful addition to the professional library of any prosthetist wishing to gain insight into the therapist's role, and who wishes to have it available as a resource for therapists with whom he works.

Atlas of Orthotics, 2nd Edition, American Academy of Orthopaedic Surgeons, The C.V. Mosby Company, 11830 Westline Industrial Drive, St. Louis, Missouri 63146, 541 pages and index.

In their introduction, the editors state that it was their intent in this volume to steer a middle course between the disease specific "cookbook" approach of the original *Orthopaedic Appliance Atlas* and the rigorous biomechanical analytical approach of the first edition. To this end, the book is divided into three sections.

The first is concerned with basic information—including materials, gait, and biomechanics. The second section is about components and available orthoses, and the last is about the application of information in the first two sections to specific disease categories and situations. There is also a fourth section about living aids, including seating.

As always, the *Atlas* is an invaluable component of any orthotist's professional library, especially if one is preparing for certification. Two things should be borne in mind, however. It is written, quite correctly under the circumstances, by orthopaedic surgeons for orthopaedic surgeons, and not primarily for orthotists. Because of the breadth of material to be covered, it is rather general. An orthotist looking for a cookbook approach and all the answers will surely be disappointed.

Classified Ads

In order to properly calculate the number of words in (and the cost of) a classified advertisement according to the method used by AOPA, the advertiser should do the following. Add up every character in the ad, including commas, hyphens, etc. Divide the sum by five (we consider a word to consist of 5 characters) to find the total number of words. Then figure the cost based on these rates: MEMBERS—first 30 words $32.00. Each addiitonal word $1.50. NON-MEMBERS—first 30 words $78.00. Each additional word $4.00. Responses to AOPA Box numbers are forwarded unopened free of charge. Advertisements are to be paid in advance. Checks should be made payable to AOPA. Send to AOPA, 717 Pendleton Street, Alexandria, VA 22314. No classified ads will be taken by phone.

Orthotist, Certified or Board Eligible—Good salary and benefits, permanent position, requires some experience in bracing scoliosis and post operative spinal fusion. Contact: Isidore Zamosky, Inc., 608 S. Main Street, Spring Valley, NY 10977; (914) 352-2148 or 352-2397.

Prosthetic Technician

Immediate opening available. Salary commensurate with experience. Benefits include full health plan for employee. Profit sharing available.

Dorsch Prosthetic and Orthotics
109 East 29th Street
New York, NY 10016
(212) 683-2485

Contact: Mrs. Marita Dorsch Carozza

CERTIFIED PROSTHETIST: progressive office in Midwest town with population of 100,000. Competitive salary and additional benefits. Interested applicants send resume to AOPA, Box 110385, 717 Pendleton Street, Alexandria, VA 22314.

Experienced Prosthetist—Need not be certified. Experienced in patient care and fabrication. Immediate opening. Send resume to: Valley Orthopedic Brace & Limb Co., 3016 West Main, Russellville, AR 72801; or call collect to (501) 968-3249 and speak with Denton Lee or Bob Swank.

CPO Wanted for Management and Patient Care. Replies confidential to:

Fred J. Karg
Karg Prosthetics Co.
1319 W. Carson Street
Torrance, CA 90501
(213) 328-4573

ORTHOTISTS AND PROSTHETISTS

(certified, board eligible or skilled technicians)

J.E. HANGER, INC. has experienced growth in several of its east coast branch offices opening up new positions for qualified practitioners and technicians. We are a highly successful and well known corporation with 125 years of experience and can offer outstanding advancement opportunities. Relocation assistance, excellent fringe benefits including retirement plan, and continuing education are all part of our package.

Positions available in the following locations:

J.E. Hanger, Inc. of NY, Buffalo, NY
J.E. Hanger of Phila., Inc., Philadelphia, PA
J.E. Hanger, Inc. of VA, Richmond, VA

If you are qualified, there is an outstanding opportunity to join a progressive team and grow with a leader in the profession.

For further information contact:

J.M. Cestaro, C.P.O.
c/o Washington Prosthetic Supplies
(a division of J.E. Hanger, Inc.)
40 Patterson Street, NE
Washington, DC 20002
tel. (202) 789-0052

PROGRESSIVE CENTRAL FAB FACILITY—needs experienced plastics technician (3 yrs. min.), knowledgeable in all aspects of plastic fabrication. Beautiful Central Florida location for the outdoors oriented. Excellent pay & benefits for the right person. Super growth opportunity. Send resume to: AOPA Box 20386, 717 Pendleton Street, Alexandria, VA 22314.

Immediate opening for experienced CPO for modern facility to manage or for possible partnership. Reply to Pete Allen, Birmingham Limb & Brace Co., 3020 4th Avenue South, Birmingham, AL 35233.

Small P&O Facility for Sale in desirable college town. Will consider partnership offer from CPO. Gallatin Prosthetics, 103 Commercial Drive, Bozeman, MT 59715; (406) 586-8386.

CP or CPO needed immediately, **Certified or Board Eligible** to work with a new company in Northwestern Pennsylvania. Duties would include clinical work, measuring and fitting patients at the office and in the field, and manufacturing and designing orthotic and prosthetic products.

An excellent opportunity for those who want to grow and help with the many opportunities of a new and rapidly expanding Orthotics and Prosthetics company. Competitive salary and benefits.

Please call for more information or send your resume to the following address.

Carter Orthopedics, Ltd.
202 Union Street
Titusville, PA 16354
1-814-827-9691

The VA Medical Center, Long Beach, CA, is recruiting for a Research Prosthetist who is Board Eligible or CP to work with medical doctors and engineers in an amputation and prosthetics clinical/research program. This exciting position provides the individual with time and resources for prosthetics/orthotics research and application of state-of-art techniques to clinical problems. Salary appropriate to training and experience, excellent government benefits. Contact: Kay Patterson, Personnel Service, VA Medical Center, Long Beach, CA 90822. Phone: (213) 494-5651. The VA is an equal opportunity employer.

CERTIFIED ORTHOTIST—The University of Kansas Medical Center has a position available July 1986 for Certified Orthotist. Position offers/requires participation in a variety of specialty clinics: Muscular Dystrophy, Spina Bifida, Cerebral Palsy as well as treating patients requiring a broad spectrum of orthoses. Position also offers excellent working professional relationship with physicians and other allied health team members, a neat and clean working environment and excellent fringe benefits. Send resume to Paul Trautman, CPO; University of Kansas Medical Center, 39th & Rainbow Boulevard, Kansas City, KS 66103; (913) 588-6548. *An Equal Opportunity Affirmative Action Employer.*

Orthotist/Orthotist Prosthetist, Board Eligible—Rapid growth company in midwest needs a responsible person to grow with us. We want someone interested in staying with us to become a partner in the group. Great benefits, wonderful city, fun work and a future. Send resume to AOPA Box 30286, 717 Pendleton Street, Alexandria, VA 22314.

CERTIFIED PROSTHETIST-ORTHOTIST: Needed with clinical and fabrication experience. Competitive salary and benefits. Send resume and salary requirements. All replies considered confidential.

Texoma Health Care Center
120 S. Crockett
Sherman, TX 75090

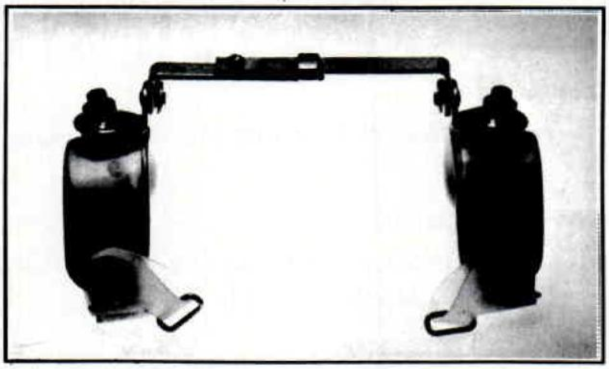
CO or CPO

Immediate opening with dynamic multidisciplinary practice in Southern Maine. Excellent company/opportunity. Close to Boston. Send resume to: AOPA Box 20786, 717 Pendleton Street, Alexandria, VA 22314.

CERTIFIED PROSTHETIST-ORTHOTIST: 23 years experience, 15 years experience as a chief of an orthotics lab. Experienced in spinal cord injury care, amputation surgery, IPOP, temp. prostheses, clinical practices. Accepting offers of employment and/or partnership. Prefer No. NJ, So. NY, So. Conn. area. Contact: CPO, Box 171, Beacon, NY 12508.

ILFELD

HIP ABDUCTION SPLINT



The Ilfeld Hip Abduction Splint is ideal for treating congenital dysplasia of the hip, with or without dislocation of the femoral head, before and after the walking age.

- **The Ilfeld splint consists of two aluminum thigh bands, with washable cloth and felt covers, fastened to a chrome plated cross bar by universal joints. The Thigh bands are also available Plastisol-dipped.**
- **The thigh bands are adjustable and are locked in place with a 3/16" hexagon wrench.**
- **Skin irritation is eliminated.**
- **The splint is adjustable for growth and progressive relaxation of abductor spasm.**
- **It is cool and comfortable; having no bibs or harnesses.**
- **The perineum is free for diaper hygiene.**
- **The child can crawl, walk, or climb in the splint.**

ADVANTAGES OF USING ILFELD HIP ABDUCTION SPLINT

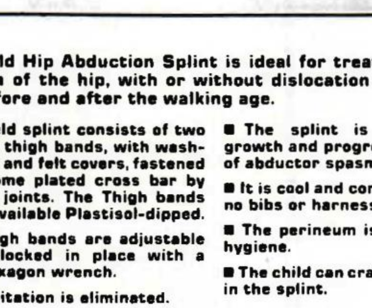
- Splinting allows treatment of congenital hip disease in infants without the use of cast, anesthesia, or hospitalization. In older patients it eliminates long months of imprisonment in the plaster body cast. The care of the patient at home is made easy by facilitating daily bathing, diaper changing, and perineal hygiene. The child is mobile and need not be carried. In addition to the physiological advantages of the Ilfeld splint, it is a method that is convenient for the mother and comfortable for the patient.

MATERIAL SPECIFICATIONS

- All steel parts chrome plated.
- Aluminum thigh bands are malleable enough to be shaped by hand.
- Interchangeable cloth covers are augmented by felt lining.
- Aluminum cuffs are available in Plastisol covering instead of cloth.

FITTING THE ILFELD SPLINT

- The splint is applied at first in easy maximal abduction. The mother is generally instructed to remove the splint twice daily for bathing and abduction-rotation exercises. The child returns weekly for adjustment of the splint into further abduction. The splint is adjusted without difficulty by the physician or a certified technician. Metal bands should be bent and shaped to fit patient's thigh and cloth covers should be washed by hand. (Extra cuffs for easy perineal care can be purchased.) When the splint is on, with the child on its back, be sure the cross bar folds up toward the navel so that the child may sit up. A waist band is generally used to prevent slipping of the splint and in cases where super abduction is desired.



DISTANCE BETWEEN KNEES ABDUCTED

APPROXIMATE SIZES FOR AVERAGE CHILD

SIZE	CIRCUMFERENCE	SPREAD	AGE
Extra Small	5" - 6"	6"	1 day to 1 month
Small	7" - 8"	7"	1 - 4 months
Medium	8" - 10"	9"	4 - 12 months
Large	10" - 12"	11"	1 - 3 years
Extra Large	12" - 15"	16"	Over 3 years

ORDERING INFORMATION

Measuring Sheet must include:

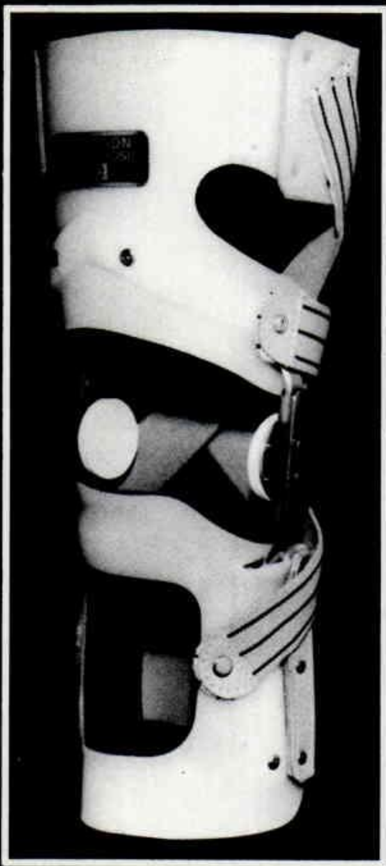
- Age of child — hip condition, which one.
- The four (4) designated circumferences shown with illustration.
- Approximate degree of abduction.
- If unusually chubby or below normal size, quote same.
- Please specify "Cloth" or "Plastisol" when ordering.

Serving the Prosthetic and Orthotic Profession.

NPI

NORTHEAST PARAMEDICAL INDUSTRIES

156 EAST 116TH STREET, NEW YORK, NEW YORK 10029
(212) 348-1900 (800) 223-0555



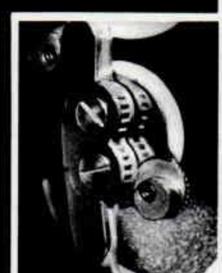
INTRODUCING... THE POLYACTION™ KNEE ORTHOSIS

BECKER ORTHOPEDIC is proud to distribute the POLYACTION™ KNEE ORTHOSIS manufactured by the Scott Orthotic Labs. The orthosis is prefabricated in four stock sizes for the right and left leg. Four models are available to accommodate all flexion and extension control needs.

- **Becker stainless steel polycentric knee joints**
- **Modular flexion-extension controls may be easily interchanged**
- **Lightweight - 1½ pounds**
- **Unique thigh trim for greater seating comfort**

Model P.A. 400
Free Motion

ALL of the POLYACTION™ KNEE ORTHOSES have a slide adjustment to ensure proper fit.



Model P.A. 403 - Adjustable Flexion-Extension Stops

The new Scott stop allows adjustable flexion-extension control.

To order specify model number, size, and right or left leg.

DESCRIPTION	MODEL NUMBER
Free motion with full extension stop	P.A. 400
Free motion with 10° extension stop	P.A. 401
Free motion with 20° extension stop	P.A. 402
Free motion with adjustable flexion-extension stops	P.A. 403
Sports covers	P.A. 410

SIZE	CALF CIRCUMFERENCE AT LARGEST POINT	THIGH CIRCUMFERENCE 7" PROXIMAL TO KNEE CENTER
Small	13-13 3/4"	17-18"
Medium	14-14 3/4"	19-20"
Large	15-15 3/4"	21-22"
Extra Large	16-16 3/4"	23-24"

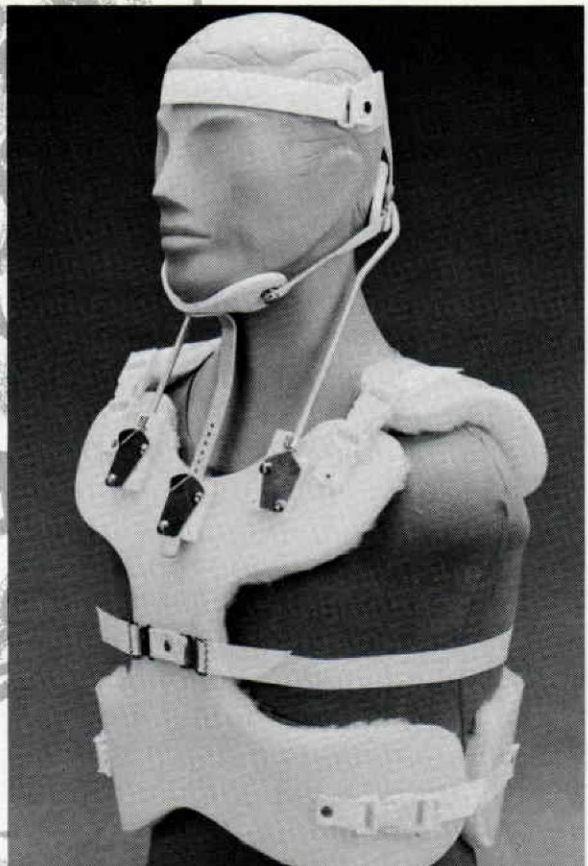
Manufactured by

SCOTT ORTHOTIC LABS
5300 West 44th Avenue
Denver, Colorado 80212
TOLL FREE (800) 821-5795
(In Colorado) 1-423-8510

Distributed by

Becker ORTHOPEDIC APPLIANCE COMPANY
635 Executive Drive Troy, Michigan 48083
TOLL FREE (800) 521-2192 • (313) 588-7480
Telex 810-232-4111

S.O.M.I.® VEST—C.T.O.



The patented S.O.M.I.® Brace has been used for a number of years to provide stability and support for a variety of injuries associated with the cervical spine. Now, the respected S.O.M.I. suspension system is available with a halo type body jacket to provide even more support for a variety of post-surgical applications as well as acute sprains, strains and subluxations.

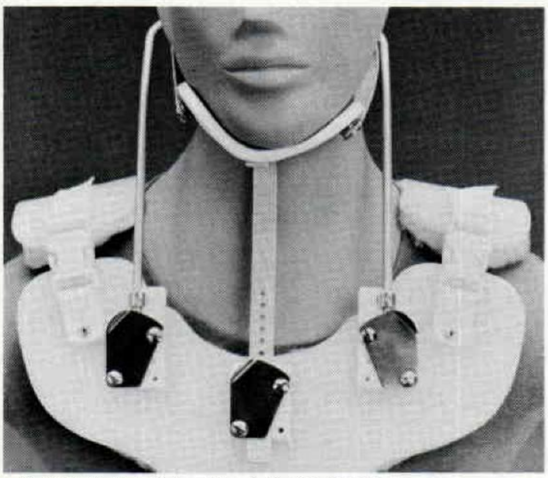
Introducing the S.O.M.I.® Vest—C.T.O.
Stabilization of the cervical spine is achieved by immobilizing the skull relative to the chest with a S.O.M.I. type superstructure connected to a halo type body jacket. Occipital and mandible pads are completely adjustable to provide maximum support and control anterior/posterior motion, lateral flexion and axial rotation. In addition, an improved over-the-shoulder suspension system is used for positive body jacket support and positioning.

S.O.M.I.® Vest—C.T.O. for long term rehabilitation.
For comfort the S.O.M.I. Vest—C.T.O. body jacket is thermoformed from flexible polyethylene and covered, on the inside, with a soft Kodel liner. The liner is attached to the body jacket with Velcro® and may be easily removed, washed or replaced for patient hygiene.

The lightweight body jacket is also ventilated to help in the prevention of pressure sores.

As rehabilitation proceeds a S.O.M.I. head band may be used to allow removal of the chin plate enabling the patient to eat, wash or shave while maintaining a stable cervical spine.

Three sizes to correctly fit adults and children.
The S.O.M.I. Vest—C.T.O. is designed to provide cervical immobilization for patients ranging in weight from 75 to 200 pounds. Fully adjustable and easy to apply, the S.O.M.I. Vest C.T.O. may be fitted while the patient is in a horizontal position, such as a hospital bed or Stryker type frame.



Product Numbers:

Size	Chest Circumference	Patient Weight	Product Number
Small	26"–30"	75–100 lbs.	**A30-200-0001**
Medium	30"–36"	100–140 lbs.	**A30-200-0002**
Large	36"–44"	140–200 lbs.	**A30-200-0003**

U.S. Patent Number 3,724,452

United States Manufacturing Company
180 North San Gabriel Boulevard, Post Office Box 5030
Pasadena, California 91107 U.S.A. (818) 796-0477
Cable: LIMBRACE, TWX No.: 910-588-1973, Telex: 466-302

Reprinted below is the application required by ABC for those wishing accreditation for their education programs. Please use this form when applying for credits.

American Board for Certification in Orthotics and Prosthetics

Application for Continuing Education Activities

Group A—Accredited Instruction

Educational Activity: ______________________________

Date(s) of Program: ______________________________

Institution and Location: ______________________________

Sponsor: ______________________________

Number of credit units applied for: ______________________________

Prerequisite

A. SUBMISSION 60 DAYS PRIOR TO PRESENTATION. (If presenters or subject matter changes within the sixty days notify ABC directly.)

B. Time frames must be presented: *example—9:00 to 9:45* (in & out)

C. Brief description of subject matter.

D. Along side of, or under the presenters, his or her credentials.

E. What categories they are applying for Continuing Education Units in: *example—Scientific, Business, etc.*

Comments

____

____

____

____

For Official Use Only

Course received late: Yes ☐ Date Received ______________________________ No ☐
Course Approved: Yes ☐ Date Received ______________________________ No ☐

If Disapproved or Number of Credit Units Reduced, Please State Reason(s).

____

____

____

Received in National Office: ______________________________.

Sent Committee: ______________________________.

Final Committee Action: ______________________________.

______________________________ Signature

______________________________ Date

American Orthotic and Prosthetic Association
717 Pendleton Street
Alexandria, VA 22314