



**The Journal of the International Society  
for Prosthetics and Orthotics**

# **Prosthetics and Orthotics International**

**April 1980, Vol. 4, No. 1**



*OTTO BOCK*

ORTHOPÄDISCHE INDUSTRIE KG  
3428 DUDERSTADT W-GERMANY

The best has gained world-wide reputation:

## Over 1 million OTTO BOCK SACH-Feet in 22 years

During this time OTTO BOCK SACH-feet were often copied but never surpassed in function, quality and cosmesis.

We produce 416 different models:

Forms for ladies, men and children, sizes from 12 up to 30 cm, heel wedges with three different shore densities and 5 heel heights (12, 18, 25, 35 and 45 mm).

Our PEDILAN foam, which was developed 25 years ago especially for these feet guarantees low specific weight, non-ageing and continuous flexibility.

# Prosthetics and Orthotics International

*Co-editors:* JOHN HUGHES  
NORMAN JACOBS

*Production Editor:* RONALD G. DONOVAN

*Editorial Board:* ANDRÉ BÄHLER  
RONALD G. DONOVAN  
JOHN HUGHES  
NORMAN JACOBS  
KNUD JANSEN  
GEORGE MURDOCH  
GEORGE VERES

Prosthetics and Orthotics International is published three times yearly by the International Society for Prosthetics and Orthotics (ISPO), PO Box 42, DK-2900, Hellerup, Denmark (Tel. (01) 658144). Subscription rate is \$28 (U.S.) per annum, single numbers \$10 (U.S.). The journal is provided free to Members of ISPO. The subscription rate for Associate Members is \$14 (U.S.) per annum. Remittances should be made payable to ISPO.

Editorial correspondence, advertisement bookings and enquiries should be directed to Prosthetics and Orthotics International, National Centre for Training and Education in Prosthetics and Orthotics, University of Strathclyde, 73 Rottenrow East, Glasgow G4 0NG, Scotland (Tel: 041-552 4049).

ISSN 0309-3646

Produced by the National Centre for Training and Education in Prosthetics and Orthotics, Glasgow.

Printed by David J. Clark Limited, Glasgow

# 1890—1980

We are proud to announce

## 90 YEARS

continuous

## Service to Patients

and

## Prosthetic Development

The world has been an eventful and turbulent place over the last 90 years. The world of prosthetics and orthotics, although fortunately less turbulent, has been just as eventful in its own small way. It gives us great pleasure and satisfaction to have been associated with these exciting events over this period. Future developments promise to be even more stimulating. We look forward to continuing service to our patients and to improving their comfort and activity by continuously developing the devices they need.

### CHAS. A. BLATCHFORD & SONS LTD

Lister Road, Basingstoke, England.



# The Journal of the International Society for Prosthetics and Orthotics

**April 1980, Vol. 4, No. 1**

## **Contents**

Editorial	1
I.S.P.O. Third World Congress	3
Controlled environment treatment I. M. TROUP	15
Toileting self-care methods for bilateral high level upper limb amputees L. FRIEDMANN	29
Skin problems of the leg amputee S. W. LEVY	37
Standards for modular prostheses A. STAROS	45
A simple and versatile driving appliance for upper limb amputees T. E. SENSKY	47
Medizinisch-Orthopadische-Technik, 2/80; abstracts	50
Volume 3, No. 3-abstract translations	51
Index to Volume 3	58
Calendar of events	62

## Executive board of ISPO

### *Elected Members:*

G. Murdoch (President)	United Kingdom
A. Staros (President Elect)	United States
E. Marquardt (Vice-President)	Germany
B. Klasson	Sweden
H. Ogishima	Japan
J. A. Pentland	Canada
H. Schmidl	Italy
J. Hughes (Hon. Secretary)	United Kingdom
E. Lyquist (Hon. Treasurer)	Denmark

### *Immediate Past President:*

K. Jansen	Denmark
-----------	---------

### *Standing Committee Chairmen:*

To be appointed (Membership)	
S. Fishman (Education)	United States
A. B. Wilson (Evaluation)	United States
J. Kjolbye (Finance)	Denmark
G. Veres (Publications)	Norway
B. M. Persson (Research)	Sweden
E. Peizer (Resources)	United States
E. Lyquist (Design and Layout)	Denmark
K. Jansen (Protocol)	Denmark
R. Baumgartner (Conference)	Switzerland

### *Regional Consultants:*

T. Keokarn	South East Asia
B. Sankaran	India
V. E. Angliss	Australasia
N. Kondrashin	Eastern Europe
H. Ginko	Central Europe
P. Prim	Southern Europe
To be appointed	
J. E. Traub	Middle East
S. Sawamura	Pan America
G. Holmgren	Pan Pacific
F. A. O. Owosina	Scandinavia
	Africa

### *Interbor Consultant:*

A. Bähler	Switzerland
-----------	-------------

### *Rehabilitation International Consultant:*

P. Dollfus	France
------------	--------

### *Consumer Consultants:*

C. Dunham	United Kingdom
H. C. Chadderton	Canada

### *Secretary*

Aase Larsson	Denmark
--------------	---------

## **Editorial**

We are pleased to introduce with this edition of the journal an expansion of our service to the membership—translations of summaries of the articles which appeared in the last number. This at least is a first step in helping those of the membership who do not have English as a first language to identify those papers which they might wish to have translated in full. Eventually we would hope to have the translated summaries appear in the same number of the journal, but meantime, for technical reasons, this is not possible.

This is but one of the decisions made at the last meeting of the Executive Board held in Copenhagen in December of last year. The meeting was, of course, dominated by detailed consideration of the many aspects of the preparations for the Third World Congress in Bologna. Reports were considered on the planning and arrangements for the scientific sessions, the instructional courses, the symposia, the scientific and commercial exhibits, the social events and the thousand and one things which go to make a successful Congress. This involves an enormous amount of work by a relatively small band of workers, each of whom accepts responsibility for a particular facet of the organisation and by the Congress Committee itself which has the coordinating role.

Following the Board Meeting, an advisory document outlining the requirements for those intending to host future World Congresses was sent to all National Member Societies with the invitation to make a bid for 1983, 1986 or 1989. We hope for a good response at Bologna!

The Executive Board heard reports from various Standing Committees on their activities so far in the triennium.

The Protocol Committee is now preparing proposals for amendments to the Constitution for consideration by the Executive Board, the International Committee and the membership at large. In a new society the constitution is, to some extent, produced "in a vacuum" and the proposed amendments reflect the experience in operation of the last six years. The committee is also developing guide lines to facilitate the work of the various people and groups who go to make up the Society—Officers, Standing Committees, National Member Societies and others. This committee is, in a sense, a drafting body for the Executive Board.

The Evaluation Committee has been pursuing the proposal, previously reported, for the establishment of an International Evaluation Agency, operating under the aegis of ISPO. A meeting convened by the Rehabilitation Services Agency of the USA, under the ISPO banner, was held in Poland last July, where representatives of about fourteen nations considered our proposal. The consensus was that we should pursue this project and various proposals were made on obtaining funding. The follow-up, however, has not so far resulted in any fiscal support.

The main activity of the Publications Committee continues to be the production of the journal. The decision reported above to publish foreign language summaries for a trial period followed the Executive Board's consideration of this Committee's activities.

The Education Committee were hoping to foster further collaborative meetings on prosthetist/orthotist education, course content, method, etc., to maintain the Society's initiative and influence in this field. Again, the stumbling block was obtaining the necessary funding. A number of possibilities were identified and discussed to be pursued by the Chairman.

The Finance Committee presented the current state of the Society's accounts. It had been necessary to increase membership fees and subscriptions because of continuing inflation and fluctuation of exchange rates. The general situation, however, remained fairly stable. The President reported that The War Amputations of Canada had once more generously made a large donation to the Society. He was joined by the Board and, we are sure, by the membership, in expressing the Society's thanks to our Canadian colleagues.

The President was also able to report that, following negotiations with the Society and Home for the Disabled in Denmark, they had agreed to provide accommodation and other facilities for the ISPO secretariat in their headquarters in the Orthopaedic Hospital, Copenhagen, and to give financial support for a period of three years. This is an enormous contribution to our Society and the Board expressed their gratitude to the Society for the Disabled and to Erik Lyquist, our Honorary Treasurer, who was the prime mover in the negotiations. It is, of course, also for the Society something of a home-coming, for as many members will know, the Orthopaedic Hospital was for many happy years the headquarters of our predecessor, ICPO, and was the starting point of ISPO. The move should take place in the Spring of 1980. We must also register our grateful thanks to the County Hospital, Gentofte, which through the good offices of our Past President, Dr. Knud Jansen, has housed us for the last 8 years. This represents real funding without which the Society could not have survived its fledgeling years. We hope that we may repay these bodies in our service to their disabled and the disabled of the world.

Just about the time this journal reaches you, Dr. Knud Jansen will be receiving, in the University of Strathclyde here in Glasgow, Scotland, the Honorary degree of Doctor of Science. This is the highest honour the University can bestow in recognition of the man and his work. It is impossible to attempt to define the contribution which Knud Jansen has made in this field. His name is a by-word; his energy boundless; his dedication total. We offer him our congratulations, our admiration and the hope that he will continue to enrich our professional lives for many years.

John Hughes  
*Honorary Secretary.*

## 1980 World Congress

28 September—4 October, 1980 Bologna, Italy

### Congress Sponsorship:

I.S.P.O.—International Society for Prosthetics and Orthotics, P.O. Box 42, DK 2900 Hellerup, Denmark.

**INTERBOR**—International Association of Orthotists and Prosthetists, c/o Bundesinnungsverband für Orthopaedie Technik, Reinaldistrasse 7-9, D-4600, I Dortmund, Germ. Fed. Rep.

### Congress Secretariat:

Studio B. C.  
via Ugo Bassi, 10  
40123 Bologna  
Italy

### Scientific Programme Committee:

André Bähler (Switzerland)  
René Baumgartner (Switzerland)—ex officio  
Silvano Boccardi (Italy)  
Pier-Guido Bondente (Italy)  
Ronald Donovan (Scotland)  
Sidney Fishman (USA)  
John Hughes (Scotland)  
Norman Jacobs (Scotland)  
George Murdoch (Scotland)—ex officio  
Antonio Pedotti (Italy)  
Hannes Schmidl (Italy)—ex officio  
Anthony Staros (USA)—Programme Chairman  
Jacques Van Rollegem (Belgium)  
A. Bennett Wilson (USA)  
Franco Zarotti (Italy)

---

## Final call for Papers, Films and Scientific Exhibits

### PAPERS

The final date for submission of papers is April 28. Abstracts should be sent to:

Norman Jacobs  
National Centre for Training and Education  
in Prosthetics and Orthotics  
University of Strathclyde  
73 Rottenrow  
Glasgow G4 ONG  
Scotland

Each abstract should be typed on A-4 paper (210 mm×297 mm or 8½ inches×11 inches will be acceptable) using double spacing and leaving a 3 cm. margin all around, and should include in the following order.

1. The *title* of the presentation as it should appear in the Programme.
2. A *summary* of approximately 150 words covering the main points of the paper.
3. The *name(s)*, affiliation(s), professional discipline(s), and title(s) of the author(s) with the name of the *presenting author* underlined.

If successfully reviewed, a typescript of the paper will be required by June 30, 1980 in order to give the interpreters the required time for translations.

### FILMS

Please send details of any film or videotape you wish to include in the film programme to Ronald Donovan at the above address.

Information should include, running time, language of presentation and a summary of content (approximately 100 words).

### SCIENTIFIC EXHIBITS

Proposals for scientific exhibits should include information on content, space requirements and any special technical services and should be sent to:

Studio B. C.  
Via Ugo Bassi 10  
40/23 Bologna  
Italy

## Congress

SATURDAY SEPTEMBER 27	SUNDAY SEPTEMBER 28	MONDAY SEPTEMBER 29	TUESDAY SEPTEMBER 30
07.30-17.00 REGISTRATION	08.00-16.00 REGISTRATION	08.00-16.00 REGISTRATION	08.00-16.00 REGISTRATION
		09.00-18.00 EXHIBITS OPEN	09.00-18.00 EXHIBITS OPEN
MORNING	MORNING	MORNING	MORNING
08.00-12.00 Course BK Below-Knee & Syme Prosthetics	08.00-10.00 Course SU Amputation Surgery	08.00-10.00 Film & Video Tape Programme	08.00-10.00 Film & Video Tape Programme
Course ULO Upper-Limb Orthotics	08.00-12.00 Course BK Below-Knee & Syme Prosthetics	08.00-10.00 Course AK Above-Knee & Knee Disarticulation Prosthetics	08.00-10.00 Course AK Above-Knee & Knee Disarticulation Prosthetics
Course SE Seating for the Severely Disabled	Course ST Management of Stroke Patients	Course SU Amputation Surgery	Course SU Amputation Surgery
Course CH Management of Congenital Limb Deformities	Course FB Fracture Bracing	Course GA Gait Analysis Techniques	Course GA Gait Analysis Techniques
	Course ULO Upper-Limb Orthotics	Course LLO Lower-Limb Orthotics	Course LLO Lower-Limb Orthotics
	Course SE Seating for the Severely Disabled	Course ULP Upper-Limb Prosthetics	
	10.00-12.00 Course CH Management of Congenital Limb Deformities	Course FB Fracture Bracing	
		10.30-12.30 Plenary Session Amputations	10.30-12.30 Plenary Session Spinal Problems
	AFTERNOON	AFTERNOON	AFTERNOON
VISIT THE EXHIBITS	15.00-16.00 Opening Ceremony	14.00-17.00 Discussion Panel and Open Papers	14.00-17.00 Discussion Panel and Open Papers
Open 09.00-18.00 Monday through Friday	16.00 Opening of Exhibition	Film & Video Tape Programme	Film & Video Tape Programme
	Exhibition open till 18.00	Symposium S-1 Management of Low Back Pain	Symposium S-4 Conventional vs Plastic Orthoses
		Symposium S-2 Hip and Knee Orthoses	Symposium S-5 Stump Management & Classification
		Symposium S-3 Point of view of the Disabled	Symposium S-6 Orthotics in Cerebral Palsy
	EVENING		
	20.00 Welcoming Reception		

# Programme

WEDNESDAY OCTOBER 1	THURSDAY OCTOBER 2	FRIDAY OCTOBER 3	SATURDAY OCTOBER 4
08.00-16.00 REGISTRATION	08.00-16.00 REGISTRATION	08.00-16.00 REGISTRATION	
09.00-18.00 EXHIBITS OPEN	09.00-18.00 EXHIBITS OPEN	09.00-18.00 EXHIBITS OPEN	
MORNING	MORNING	MORNING	MORNING
08.00-10.00 Film & Video Tape Programme	08.00-10.00 Film & Video Tape Programme	08.00-10.00 Film & Video Tape Programme	<p>08.30-11.45 Plenary Session Prosthetics and Orthotics in the Developing Countries</p> <p>Promise of Rehabilitation Engineering</p>
08.00-10.00 Course AK Above-Knee & Knee Disarticulation Prosthetics	08.00-10.00 Course AK Above-Knee & Knee Disarticulation Prosthetics	08.00-10.00 Course HD Hip-Disarticulation Prosthetics Course GT Gait Training	
Course LLO Lower-Limb Orthotics	Course LLO Lower-Limb Orthotics	Course ULP Upper-Limb Prosthetics	
Course ULP Upper-Limb Prosthetics	Course ULP Upper-Limb Prosthetics	Course SC Orthotic Management in Scoliosis	
Course SC Orthotic Management in Scoliosis	Course SC Orthotic Management in Scoliosis	Course WP Wheelchair Prescription	
Course WP Wheelchair Prescription	Course WP Wheelchair Prescription	Course WP Wheelchair Prescription	
10.30-12.30 Plenary Session Congenital Limb Deficiencies	10.30-12.30 Plenary Session Lower Limb Disorders	10.30-12.30 Plenary Session Orthopaedic Problems-Foot	11.45-12.30 Closing Ceremony
AFTERNOON	AFTERNOON	AFTERNOON	
	14.00-17.00 Discussion Panel and Open Papers	14.00-17.00 Discussion Panel and Open Papers	
	Film & Video Tape Programme	Film & Video Tape Programme	
	Symposium S-7 Above Knee Fitting & Alignment Symposium S-8 Prostheses for Amputation Through the Foot Symposium S-9 Prosthetics/Orthotics Ed.	Symposium S-10 Prosthetics & Orthotics in Developing Countries Symposium S-11 Evaluation, Philosophy and Practices	
	EVENING		
	20.00 Congress Dinner		

**Pre-Congress Instructional Courses  
September 25–September 27, 1980.**

Code	Subject	Total Hours	Thursday September 25	Friday September 26	Saturday September 27
OS	Construction Techniques for Orthopaedic Shoes Location: Officine Ortopediche dell'Istituto Ortopedico Rizzoli, Bologna	16		9.00–18.00	9.00–18.00
MY	Construction Techniques for Myoelectric and Electronic Protheses for Amputations and Congenital Deformities Location: Centro Protesi I.N.A.I.L., Budrio (Bo.)	24	9.00–18.00	9.00–18.00	9.00–18.00

**Congress Instructional Courses  
September 27–October 3, 1980**

Code	Subject & Organizer	Total Hours	Sat. Sept. 27	Sun. Sept. 28	Mon. Sept. 29	Tues. Sept. 30	Wed. Oct. 1	Thurs. Oct. 2	Fri. Oct. 3
BK	Below-Knee & Syme Prosthetics J. Hughes (Scotland)	8	8–12	8–12					
AK	Above-Knee & Knee Disarticulation Prosthetics E. Lyquist (Denmark)	8			8–10	8–10	8–10	8–10	
HD	Hip-Disarticulation Prosthetics G. Holmgren (Sweden)	2							8–10
SU	Amputation Surgery (*Monday and Tuesday only) B. Persson (Sweden)	6		8–10	8–10	8–10			
GA	Gait Analysis Techniques S. Simon (U.S.A.)	4			8–10	8–10			
GT	Gait Training J. Van Rollegem (Belgium)	2							8–10
CH	Management of Congenital Limb Deformities L. Kruger (U.S.A.)	6	8–12	10–12					
ST	Management of Stroke Patients R. Waters (U.S.A.)	4		8–12					
LLO	Lower-Limb Orthotics D. Condie (Scotland)	8			8–10	8–10	8–10	8–10	
FB	Fracture Bracing V. Mooney (U.S.A.)	6		8–12	8–10				
SC	Orthotic Management of Scoliosis A. Bähler (Switzerland)	6					8–10	8–10	8–10
ULO	Upper-Limb Orthotics J. Edelstein (U.S.A.)	8	8–12	8–12					
SE	Seating for the Severely Disabled* N. Ring (England)	8	8–12	8–12					
WP	Wheelchair Prescription* L. Simon (Germ. Fed. Rep.)	6					8–10	8–10	8–10
ULP	Upper-Limb Prosthetics D. Childress (U.S.A.)	8				8–10	8–10	8–10	8–10

\*English only, at present.

Plenary Sessions	Symposia
<p>Monday, September 29 10.30-12.30</p> <p><b>Amputations</b></p> <ul style="list-style-type: none"> <li>—Amputation Surgery, An Overview</li> <li>—The Dysvascular Patient</li> <li>—Amputation Surgery in the Dysvascular Patient</li> <li>—Prosthetic Management</li> <li>—Total Patient Management</li> </ul> <p>Co-Chairmen: H. Ginko (Germ. Fed. Rep.); F. Zarotti (Italy).</p>	<p>Monday, September 29 14.00-17.00</p> <p>Management of Low Back Pain (S1) Organizer: J. Kjolbe (Denmark)</p> <ul style="list-style-type: none"> <li>—Hip and Knee Orthoses (S2) Organizer: H. De Brunner (Switzerland)</li> <li>—Point of View of the Disabled (S3) Organizer: A. Fishman (USA)</li> </ul>
<p>Tuesday, September 30 10.30-12.30</p> <p><b>Spinal Problems</b></p> <ul style="list-style-type: none"> <li>—<i>Vittorio Putti Lecture: Surgical Management</i> Presented by: R. Savini, Istituto Rizzoli</li> <li>—Surgery in Scoliosis</li> <li>—Non-Surgical Management of Scoliosis</li> </ul> <p>Co-Chairmen: M. Campanacci (Italy); G. Pierron (France).</p>	<p>Tuesday, September 30 14.00-17.00</p> <p>Conventional vs. Plastic Orthoses (S4) Organizer: G. K. Rose (England)</p> <ul style="list-style-type: none"> <li>—Stump Management and Classification (S5) Organizer: B. Persson (Sweden)</li> <li>—Orthotics in Cerebral Palsy (S6) Organizer: D. Mazoyer (France)</li> </ul>
<p>Wednesday, October 1 10.30-12.30</p> <p><b>Congenital Limb Deficiencies</b></p> <ul style="list-style-type: none"> <li>—<i>Knud Jansen Lecture: Surgery</i> Presented by: E. Marquardt (Germ. Fed. Rep.)</li> <li>—Total Patient Management</li> <li>—Prosthetic &amp; Orthotic Management</li> </ul> <p>Co-Chairmen: G. Murdoch (Scotland); L. Kruger USA).</p>	<p>Wednesday, October 1</p> <p>AFTERNOON FREE</p>
<p>Thursday, October 2 10.30-12.30</p> <p><b>Lower-Limb Disorders</b></p> <ul style="list-style-type: none"> <li>—Pathological Gait</li> <li>—Prescription Principles</li> <li>—Orthotic Management</li> </ul> <p>Co-Chairmen: S. Fishman (USA); E. Lyquist (Denmark).</p>	<p>Thursday, October 2 14.00-17.00</p> <ul style="list-style-type: none"> <li>—Above-Knee Fitting and Alignment (S7) Organizer: J. Fischer (Denmark)</li> <li>—Prostheses for Amputations Through the Foot (S8). Organizer: W. Kreiger (Germ. Fed. Rep.)</li> <li>—Prosthetics/Orthotics Education (S9) Organizer: S. Fishman (USA)</li> </ul>
<p>Friday, October 3 10.30-12.30</p> <p><b>The Foot Orthopaedic Problems</b></p> <ul style="list-style-type: none"> <li>—Biomechanics, Static and Dynamic</li> <li>—Surgical Intervention</li> <li>—Orthotic Management</li> </ul> <p>Co-Chairmen: R. Baumgartner (Switzerland); B. Klasson (Sweden).</p>	<p>Friday, October 3 14.00-17.00</p> <ul style="list-style-type: none"> <li>—Prosthetics &amp; Orthotics in Developing Countries (S10). Organizer: S. Heim (Germ. Fed. Rep.)</li> <li>—Evaluation, Philosophy &amp; Practices (S11) Organizer: A. B. Wilson (USA).</li> </ul>
<p>Saturday, October 4 08.30-11.45</p> <ul style="list-style-type: none"> <li>—<i>Prosthetics and Orthotics in the Developing Countries: Moderator: S. Heim (Germ. Fed. Rep.)</i></li> <li>—<i>The Promise of Rehabilitation Engineering</i> Moderator: C. McLaurin (USA).</li> </ul> <p>Co-Chairmen: A. Staros (USA); J. Hughes (Scotland).</p>	

## General Information

The 1980 World Congress of the International Society for Prosthetics and Orthotics and Interbor will present a number of forums giving registrants information extremely useful in the delivery of services to disabled people. We invite you to participate in this World Congress.

The *plenary sessions* will have a select list of invited speakers to provide status reports on the technologies and procedures associated with prosthetics and orthotics, the underlying surgery, and other aspects of rehabilitation engineering. The *discussion periods*, to be held following the plenary sessions, will permit all participants to offer comments and address queries to these speakers.

Taking the example of the prior ISPO World Congress held in New York in 1977, the 1980 Congress will present a series of *instructional courses* offering very specific details in the wide range of subjects shown in this announcement. These courses were selected as currently meaningful to clinicians seeking immediate aid for their patients.

At the *open paper sessions* in the afternoons, registrants will hear what is new, what is forthcoming, and what the more distant future holds.

A visit to the *exhibits* will be a valuable educational experience. In these primarily commercial displays, the registrant will find on show the latest available aids and devices which have been developed for the benefit of patients the world over.

The *symposia* will provide stimulating forums for detailed discussions on the prosthetic and orthotic topics shown in this announcement. Here, individuals in roundtable discussion can express their concerns and learn of potential solutions. The scientific and management directions taken by the sponsoring societies can also be reviewed in these sessions.

The *films and video tapes* will supplement the proceedings by allowing registrants to see particular products and processes offered by various people and organizations.

Bologna, the site of the Congress, will provide the registrants with many interesting cultural and culinary experiences. The area has an interesting history particularly in the medical and orthopaedic disciplines. Italy, and particularly Bologna, offers to the sponsoring societies an ideal location for accessing interest from all over the world.

The city of Bologna, the social programme planned by the Congress Committee, the comfortable hotels, and the excellent scientific programme should guarantee the registrant a very productive and pleasant stay. For the first time at an ISPO or INTERBOR Congress all sessions will be simultaneously translated into four languages (English, Italian, French, and German) allowing participants understanding any one of these to obtain the maximum amount of information possible.

We invite you to come to Bologna, enjoy all these things, and attend some very valuable and instructive technical sessions.

Flavio Orlandi  
Congress President

Hannes Schmidl  
Secretary General

**Congress Secretariat:**

Studio B.C.  
via Ugo Bassi, 10  
40123 Bologna  
Italy  
Telephone: 051/268877

**Place of Congress:**

Palazzo della cultura e Dei Congressi  
40128 Bologna—Piazza della Costituzione, 5c  
Bologna, Italy

**Congress Registration:** All copies of the enclosed registration form should be returned to STUDIO B.C. together with the fees for registration, hotel deposit, and for any instructional courses selected. Participants will receive a confirmation card and hotel voucher as acknowledgment of registration by return mail. Upon presentation of the confirmation card at the registration desk in the Congress Centre, the registrant will receive an official Congress Programme and badge. The registration desk will open at 07.30 and remain open until 17.00 on September 27 and will be open every Congress day from 08.00 until 16.00.

**Congress Registration Fees:** Advance Registration (Received at STUDIO B.C. prior to July 31, 1980).

Member of ISPO/INTERBOR	L. 175,000
Non-Member	L. 200,000
Student*	L. 75,000
Accompanying person	L. 50,000

**ON—SITE REGISTRATION** (and registrations received after July 31)

Member of ISPO/INTERBOR	L. 200,000
Non-Member	L. 225,000
Student	L. 100,000
Accompanying person	L. 60,000

\*Students must be registered full time. A letter certifying that status must accompany registration form for student fees to be honored.

**Hotel Reservations:** Hotel reservations can be made by completing the appropriate part of the registration form. The official travel agency for the Congress will be KUONI—C. A. B. (via Montebello 8—Bologna; Telephone: 051/551501—551756; Telex 211571 Kuobo). KUONI will assist with hotel reservations and transportation. Their offices around the world will be ready to serve all participants.

Hotel	single/bath	double/bath
Luxury Class	L. 55,000	L. 80,000
A Class	L. 42,000	L. 61,000
B Class	L. 23,850	L. 38,250
C Class	L. 19,500	L. 30,500

Rates include continental breakfast, service charge and value added tax. If your requested hotel is not available, you will be assigned to the next class according to hotel rate.

Reservation and confirmation can only be effected after receipt of the hotel deposit of L. 50,000 per person which should be transferred via bank draft together with the registration fee before July 31, 1980. (NO CABLE OR TELEX REQUESTS WILL BE ACCEPTED). A hotel voucher will be sent at the same time as the Congress registration receipt. The hotel voucher should be presented to the hotel upon arrival, and the deposit therein mentioned will be deducted from the final hotel bill.

**Payments:** Payment of fees for registration and hotel deposit should be made by bank transfers in Italian Lire in favour of: Studio B.C. ISPO/INTERBOR 1980, CONGRESS, account No. 2560 with CREDITO ROMAGNOLO, Agenzia 4, via IV Novembre, Bologna, Italy. Please mention *full name and address* on all bank transfers.

**NO PERSONAL CHEQUES ACCEPTED**

Enclose copy of Bank Draft and Registration Form and mail to:

Studio B.C.  
via Ugo Bassi  
40123 Bologna, Italy.

**Cancellations:** if cancellations reach the Congress Secretariat before August 15, 1980, all fees paid, with the exception of a 15% administrative charge, will be refunded. Refunds CANNOT be made to participants who cancel after August 15, 1980.

**Transportation:**

**By air:** There are direct connections to Bologna with Paris (four times a week). Non-stop Flights from London (three times a week). There are daily flights to Milan with trains to Bologna.

**By train:** There are direct railway connections with almost all places in Central Europe.

**By car:** To reach the Congress Centre, leave the motorway by following the sign "Bologna Tangenziale" and then use the "Bologna Fiera" exit.

**City bus:** From the centre of Bologna and from the Central Station N 28 of the bus network goes to the Congress Centre.

**Preliminary Programme:** The entire Congress Programme is presented on pages 4 and 5 of this announcement.

**Pre-Congress Instructional Courses:** Pre-Congress Courses will be held on Thursday, Friday, and Saturday, September 25, 26, 27, 1980. Location and time of these courses can be found on page 6 of this announcement. All participants will receive additional information upon receipt of the advance registration form and all fees.

**Instructional Course Programme:** The courses being presented during the Congress are shown on page 6. Fees for the courses are shown on the registration form. When completing the registration form enclosed, please show the courses selected, making sure to avoid schedule conflicts and include proper payment.

**Submission of Papers:** Information on submission of papers is shown on page 3. Abstracts should be submitted as soon as possible and no later than April 28.

**Film & Video Tape Programme:** Submitted films and video tapes will be shown from 08.00-10.00 and from 14.00 to 17.00 on Monday, September 29 through Friday, October 3. No films will be shown on Wednesday, October 1, 1980, a free afternoon for Congress registrants.

**Exhibits:** The exhibit area will be officially opened immediately after the Opening Ceremony on Sunday September 28, 1980. The exhibits will be open Monday, September 29, through Friday, October 3, from 09.00 to 18.00.

## Social Programme

### Opening Reception

(Included in Registration Fee)

Sunday, September 28 20.00 hrs

We invite you to attend the Opening Reception in the Foyer of the Conference Centre on Sunday. Enjoy a hot and cold Hors D'oeuvre buffet, your favourite drinks, and the opportunity to meet your colleagues.

Wednesday, October 1 Bologna Tour No. 1

(included in the accompanying person's fee).

Enjoy a 3-hour tour of the city. During this tour you will visit the Piazza Maggiore, Piazza Re Enzo, the Church of San Domenico and the Church of Santo Stefano.

### Congress Dinner

Thursday, October 3 20.00 hrs.

Tickets for the Congress Dinner may be reserved now by means of the registration form attached. Tickets may be purchased for L. 40,000 per person and will be sent to you together with the hotel voucher.

### Congress and Post-Congress Tours

#### Tour 1

Date: 1 October

**Half-day Bologna sightseeing (3 hours) by private coach, English speaking guide—entrance fees**

#### Programme:

Piazza Maggiore:

Palazzo d'Accursio (Town-hall 13th-14th century), Palazzo dei Banchi (built by Vignola), Basilica San Petronio (famous sun-line meridian), Palazzo del Poestà (fifteenth century).

Piazza Re Enzo:

Palazzo Re Enzo (where the King was imprisoned for 22 years), Fontana del Nettuno (masterpiece by Gianbologna).

Palazzo dell' Archiginnasio (anatomic theatre)  
Church of San Domenico (statues by Michelangelo)  
Church of Santo Stefano (group of seven churches—10th-11th-12th century).

Two Towers (12th century).

Price L. 7,000.

#### Tour 2

Date: 28 September

#### Full day excursion to FERRARA

(A magnificent example of renaissance urbanization) and **POMPOSA** (8th-9th century abbey), by coach with hostess aboard—lunch included.

Price L. 34,900.

#### Tour 3

Date: 28 September

#### Full day excursion to SAN MARINO

(The most ancient republic of the world) and **RIMINI** (famous beach and Roman remains), by coach with hostess aboard—lunch included.

Price L. 37,900.

#### Tour 4

Date: 29 September

#### Full day excursion to RAVENNA

(The capital of Byzantine mosaics) and **DOZZA** (little village nesting among the hills overlooking Bologna, twinned with Montmartre (Paris) because of its festival of "The painted walls"), by coach with hostess aboard—local guide in Ravenna—lunch included.

Price L. 34,900.

#### Tour 5

Date: 1 October

#### Full day excursion to FIRENZE

By coach with hostess aboard, local guide—lunch included.

Price L. 39,800.

#### Tour 6

Date: 30 September

#### Full day excursion to VENICE

By coach with hostess aboard, local guide—lunch included.

Price L. 51,000.

N.B: Above excursion prices are based on a minimum of 30 participants.

**Tour 7**

Date: 3 October

**Two Days Excursion—By Train—To Venice**

1st day—08.17 a.m.

Departure from Bologna by 1st class train to Venice. Seat reservations. Arrival in Venice at 10.35 a.m.

Transfer by private launches from the railway station to hotel. Accommodation at the hotel. Afternoon sightseeing of Venice on foot. Dinner and overnight at the hotel.

2nd day

Continental breakfast at the hotel. Morning free. Optional excursion by regular means to Isles (Murano, Burano, Torcello). Afternoon free.

5.05 p.m.

Transfer to the rail station. Arrive in Bologna at 7.17 p.m.

Price L. 83,500.

(supplement for single room L. 7,500)

**Price, based on a minimum of 30 participants, includes;**

- First class railway ticket with seat reserved Bologna/Venice and return.
- Assistance and transfer by private launches from Venice rail station to hotel and back.
- Two hours sightseeing on foot with English speaking guide and entrance fees.
- Half board at a good second class hotel in twins and singles with private facilities.
- English speaking hostess along with the group for the whole trip.
- Taxes and services.

**Tour 8**

Date: 3 October

**Two Days Excursion—By Coach—To Florence**

1st day:

a.m. sightseeing Florence with guide

p.m. free

Dinner, overnight at hotel (2nd class with bath)

2nd day:

Morning excursion to Pisa. Balance of afternoon free in Florence.

5.30 p.m. leave for Bologna

Price L. 84,000. (suppl. for single room L. 6,500).

**Price, based on a minimum of 30 participants, includes:**

- Deluxe coach from Bologna to Bologna for the whole programme.
- English speaking hostess along with the group for the whole trip.
- Local guide in Florence and Pisa. Entrance fees included.
- Half board (one) at a good second class hotel, in twins and singles with private facilities.

**Tour 9**

Date: 3 October

**Two Days Excursion—By Coach—To Venice****Programme:**

1st day:

At 08.00 by coach to Padua (stop) Venice. Transfer to hotel by private motor launch.

Afternoon sightseeing on foot.

Dinner at hotel. Overnight.

2nd day:

Morning free.

Early in the afternoon transfer to Piazza le Roma and leave by coach to Vicenza.

Visit to town and its surroundings where one finds some of the most celebrated Venetian Villas. Then proceed to Bologna, late afternoon.

Price L. 104,000. (suppl. for single room L. 7,500).

**Price, based on a minimum of 30 participants includes:**

- Deluxe coach from Bologna to Bologna for the whole programme.
- Hostess (English speaking) at group's disposal for the whole trip.
- Sightseeing on foot (two hours) with English speaking guide and entrance fee.
- Transfer, including assistance and portage of one piece per person, by private launches from Piazza le Roma to hotel and back.
- One day half board at a good second class hotel in town, in twins and singles with bath.

**Tour 10**

Date: 5-11 October

**Six Days Post-Congress Tour—By Deluxe Coach—To FLORENCE—PISA—AREZZO—PERUGIA—ASSISI—ORVIETO—ROME****1st day BOLOGNA—FLORENCE**

09.00 a.m. Leave Bologna for Florence via Autostrada del Sole. In Florence meet your guide for two hours city sightseeing ending at your hotel. Balance of afternoon free. Dinner and overnight at the hotel.

**2nd day PISA**

Half board at hotel in Florence. Half day morning excursion to Pisa (leaning tower). Afternoon free in Florence.

**3rd day AREZZO—PERUGIA**

After continental breakfast, leave for Perugia along the Autostrada del Sole. Stop in Arezzo for a short visit, then proceed to Trasimeno Lake. Lunch on its banks. Proceed to Perugia arriving directly at the hotel. Dinner and overnight.

**4th day ASSISI ORVIETO ROME**

Continental breakfast. Visit to Assisi for two hours and then proceed to Orvieto (old famous Gothic cathedral). Lunch in town. Short visit, then continue to Rome. Dinner and overnight.

**5th day ROME**

Half board at the hotel. Morning city sightseeing  
Afternoon free.

**6th day ROME**

Continental breakfast. Morning city sightseeing.  
3.00 p.m. Leave Rome by coach for Bologna.  
Arrive in Bologna around 8/9.00 p.m.

For those who wish to leave the tour in Rome; end of  
our services after morning city sightseeing on 6th day.

Price L. 350,000.

(suppl. for single room L. 38,000 for the whole trip).

**Price, based on a minimum of 30 participants includes:**

- a) Deluxe coach for the whole programme—  
itinerary from Bologna to Bologna.
- b) English speaking hostess along with the group for  
the whole trip.
- c) Half board at a good second class hotel, in twins  
and singles with private facilities.
- d) Local guides in Florence, Pisa, Assisi, Rome.  
Entrance fees included.
- e) Taxes and services.

Advance Registration  
Closes  
July 31, 1980

**1980 World Congress**  
**September 28–October 4, 1980**  
**Bologna, Italy**

Return All Copies To:  
Studio B.C.  
40123  
Via Ugo Bassi 10  
Bologna, Italy

**Advance Registration Form:** *Please Type or Print*

Family Name \_\_\_\_\_ Initials \_\_\_\_\_ Institute \_\_\_\_\_

Street Address \_\_\_\_\_ Town \_\_\_\_\_

Country \_\_\_\_\_ Preferred Language:  English  French  
 Italian  German

**Advance Registration Fees:** By July 31, 1980

Member of ISPO/INTERBOR (*membership No.*) . . . . . L. 175,000 \_\_\_\_\_ Total Lire

Non-Member . . . . . L. 200,000 \_\_\_\_\_

Student . . . . . L. 75,000 \_\_\_\_\_

Students must be registered full time. A letter certifying that status must accompany registration form.

Accompanying person(s) . . . . . L. 50,000 \_\_\_\_\_

Name(s) \_\_\_\_\_

Registration fee includes Opening Reception, Bologna Tour,  
Concert.

**On-Site Registration Fees:** Member—L. 200,000 Student—L. 100,000  
Non-Member—L. 225,000 Accompanying Person—L. 60,000

**Pre-Congress Instructional Courses:** Refer to page of Announcement.

—OS Construction Techniques for Orthopaedic Shoes . . . . . L. 50,000 \_\_\_\_\_  
September 26 & 27—Bologna

—MY Construction Techniques for Myoelectric and Electric prostheses  
for Amputations and Congenital Deformities . . . . . L. 70,000 \_\_\_\_\_  
September 25, 26, & 27—Budrio

**Congress Instructional Courses:** When making selections refer  
to page of Announcement to  
avoid scheduling conflicts.

*Course Fee:*  
L. 5,000 per hour.



Eight-Hour Courses		Six-Hour Courses		Four-Hour Courses		Two-Hour Courses	
_____ BK	8 hrs.	_____ SU	6 hrs.	_____ GA	4 hrs.	_____ HD	2 hrs.
_____ AK	8 hrs.	_____ CH	6 hrs.	_____ ST	4 hrs.	_____ GT	2 hrs.
_____ LLO	8 hrs.	_____ FB	6 hrs.				
_____ ULO	8 hrs.	_____ SC	6 hrs.				
_____ SE	8 hrs.	_____ WP	6 hrs.				
_____ ULP	8 hrs.						

L. 5,000  
per Hour \_\_\_\_\_

To calculate cost of Instructional Courses add total number of hours and multiply by L. 5,000.

### Social Programme:

Congress Dinner . . . . . L. 40,000 per person \_\_\_\_\_

Optional Tours (see page . . .)

- |  |   |  |
|--|---|--|
| <input type="checkbox"/> No. 1 (L. 7,000);   | <input type="checkbox"/> No. 2 (L. 34,900); | <input type="checkbox"/> No. 3 (L. 37,900);  |
| <input type="checkbox"/> No. 4 (L. 34,900);  | <input type="checkbox"/> No. 5 (L. 39,800); | <input type="checkbox"/> No. 6 (L. 51,000);  |
| <input type="checkbox"/> No. 7 (L. 83,500);  | <input type="checkbox"/> No. 8 (L. 84,000); | <input type="checkbox"/> No. 9 (L. 104,000); |
| <input type="checkbox"/> No. 10 (L. 350,000) |   |  |

### Hotel Accommodation:

	Hotel Rates	Single/Bath	Double/Bath
Please reserve in category: _____	Luxury	55,000	80,000
Arrival Date: _____	A	42,000	61,000
Departure Date: _____	B	23,850	38,250
No. of Single Rooms: _____	C	19,500	30,600
No. of Double Rooms: _____			

If you have arranged to share a room with another participant please indicate the name here:

\_\_\_\_\_

Deposit . . . . . L. 50,000 per person \_\_\_\_\_

**Total Remittance Enclosed . . . . . L.** \_\_\_\_\_

### Payment:

Transfer the total by bank draft in ITALIAN LIRE payable to:  
Studio B.C. ISPO/INTERBOR Congress 1980  
Account No. 2560  
Credit Romagnolo—Agenzia 4, via iv Novembre  
BOLOGNA, ITALY

Please mention *full name and address* on all bank drafts.

## Controlled environment treatment (CET)

The use of a new concept of wound environment in amputation surgery and other conditions of the extremities.

I. M. TROUP

*Limb Fitting Centre, Dundee.*

### Abstract

The use of a new method of improving certain physical aspects of the environment imposed on the extremity is discussed. This follows the use of Controlled Environment Treatment in amputation surgery and other specific conditions within a controlled trial in several Centres in the United Kingdom and United States of America.

The protocol did not attempt to establish any system of controls, the results being based on observation and clinical impression. In other words it is an extension of CET use in an attempt to obtain a wider experience of its application.

One hundred cases involving 128 treatments are listed over a wide variety of clinical presentations. Recordings were made of the presence or absence of oedema, infection, ischaemia and pain, amongst other relevant data. Certain conclusions proved possible and staff acceptance of the system was obtained.

The evidence suggests that the continued use of CET is justified in certain carefully selected clinical conditions. Further, it appears necessary to set up controlled scientific assessments of the system particularly within vascular laboratories where many relevant investigative procedures are carried out on a routine basis.

### Introduction

Normally a clinical trial is expected to present a control element against which comparisons are made. Further, the control is expected to bear comparison in certain respects with the trial case. Both trial and control cases should have a potential for objective description allowing accurate data input thus producing a valid statistical result.

CET is such that there is much to hamper a survey based on statistical analysis. The type of

case presented, the degree of pre-surgical investigation directed at level determination with its relative uncertainty in amputation surgery, the desirability in terms of rehabilitation of retaining the knee joint and the type of surgical technique used, all introduce variables likely to make comparison impossible. Further, post-operative management varies from the specialised unit to those primarily concerned with general surgery. Finally, the relative limitation in numbers presents a randomisation problem and all of those factors dictate against any statistically significant feedback. Thus, it seems clear that the quality and quantity of evidence must weigh heavily in favour of other methods of clinical evaluation.

A report on a new method of treatment such as CET can, it is submitted, be presented using the basis of a clinical impression. This implies a freedom of clinical judgement and selection of cases, far from being randomised, is made on personal assessment within a relatively narrow field in which experience has been gained of other more conventional methods of management. It is on these cases that the report is presented, with, if required, one further justification, namely a wider experience than most in the application of CET.

Wound healing has generated much thought for many years and basically it depends on well known physiological principles. This applies to wounds following trauma, disease and surgery. Optimum criteria have been recognised and much effort has been expended in attempting to apply these criteria. A great variety of dressings for wounds has been used and much care, particularly by nursing staff, has been directed at the application of these dressings using sterile techniques. However, all these efforts fail to recognise the physical environment imposed on the wound by the method of treatment used. For over half a century it has been known that pressure on tissues can, and does, have a

---

All correspondence to be addressed to Dr. I. M. Troup, Dundee Limb Fitting Centre, 133 Queen Street, Broughty Ferry, Dundee, Scotland.

significant effect on healing potential. Further, it is known that the degree of pressure, and its variation in level and time, is equally significant.

The temperature of the environment imposed by a conventional dressing is, to say the least, variably harmful. The snug, comfortable bandage must present bacteria with an ideal opportunity to thrive. Equally the moistness imposed by a bandage adds to this unsatisfactory environment. Finally, the absolute sterility of a dressing can never be assured since it must be applied and in so doing contamination is possible.

CET (Fig. 1) is entirely associated with these problems. It imposes certain, quite precise physical factors on the environment, each being variable as the occasion demands.



Fig. 1. Top, Controlled Environment Treatment (CET) applied to an amputee patient. Bottom, control console.

The dressing (Fig. 2, top) is simply sterile air or gas delivered from, and controlled by, a console to a treatment bag, fabricated in polyvinyl chloride.

The bag, or sterishield to use the commercial term, (Fig. 2, bottom) has an internal proximal apron which forms a partial seal allowing pressures to be generated within the bag, this being suspended by an appropriate shoulder harness and hemipelvic band.

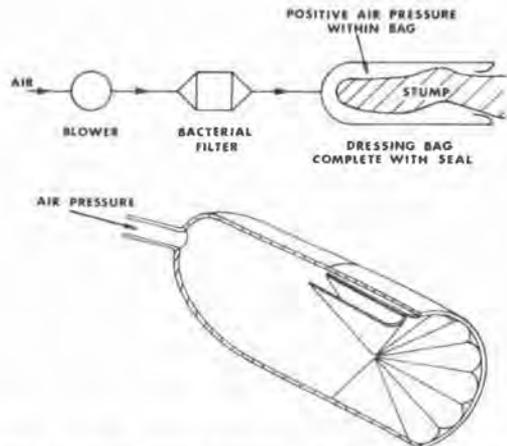


Fig. 2. Top, basic scheme for pressurisation of amputation stump. Bottom, dressing bag showing formation of pleated seal.

The pressures can be varied in level and time, automatic cycling imposing what might be seen as a vascular pump effect on the extremity, promoting lymphatic and venous return. Significantly, every part of the extremity enclosed within the sterishield has imposed upon it equal and consistent pressures, there being no high loading or tourniquet effect. Finally, the temperature of the air or gas, and thereby to some extent the humidity, can be controlled.

This method of treatment was used within an international trial with a very precise protocol from May 1976. This followed its development by the Biomechanical Research and Development Unit, Department of Health and Social Security, Roehampton, England (Redhead 1973; Redhead et al. 1974, 1977). During this phase all the treatment at the Dundee Centre was devoted to the amputee in the immediate post-operative period. A system of controls was devised and recordings were made of such things as oedema, pain and status of wound healing at specific periods during the post-operative phase. Very early it became apparent that there were great difficulties in making these assessments and in

particular the assessment of pain proved an insuperable hurdle. Even if one assesses the amount of analgesic drugs administered this is by no means an accurate index of the degree of pain. Oedema, of course, is difficult to assess with accuracy and clinical judgement was the only means of arriving at the necessary data. Other recordings were involved in the trial, such as the degree of infection of the wound and bacteriological control was widely used. During this phase only one machine was available.

The number of cases treated with CET was nineteen and the controls totalled fifty-one.

It would appear in retrospect that this international programme must be regarded mainly as a learning process which terminated in November 1976 and may be the subject of an independent report. At this time two further machines, Mark II's became available, and the entire nature of the trial was changed. It was no longer necessary to follow the previous trial protocol because of its termination and thought was therefore given to the means of assessment for future application.

So far, preliminary reports have been published by Burgess and Pedegana, Seattle (1977) on the use of CET for limb surgery and trauma and Redhead and Snowdon, Roehampton (1978) on CET and its derivatives, PET (Pressure Environment Treatment) and CPC (Controlled Pressure Casting). It was considered that the widest application of CET in clinical practice required further evaluation and this paper gives an experience in Dundee of 100 such cases:

Total number of cases treated 100, of which:

- 17 required 2 periods of CET
- 2 required 3 periods of CET
- 1 required 4 periods of CET
- 1 required 5 periods of CET

In all there was a total of 128 events.

Consideration at this stage was given to the recording of results and a very simple form was devised which graded such things as general clinical status, oedema, infection, ischaemia, pain, the administration of drugs and the status of healing, along with patient activity and the settings determined for CET during the period of treatment (Table 1). The grading of oedema, infection, ischaemia and pain is basic, making no attempt to show anything other than the clinical

presentation as seen on a day to day basis. It could be argued that the recordings are such that no statistical proof could be available finally, but the intention is to establish a clinical feeling or impression following the trial of the machine in a variety of situations. This trial of CET is set against the normal management of the amputee, that is, rigid dressings or pressure bandaging and in non-amputee cases it is obviously a new experience. Criteria had to be established for the necessary coding (Table 2) and these were divided into three specific areas:

- 1 The type of event
- 2 The status of healing
- 3 The general clinical impression

It should be said that the general clinical impression is in itself ambiguous. It is patently obvious that a person subjected to amputation for a gangrenous foot has "improved" if he exhibits a healing stump and for this reason the word "improved" is open to question. It might seem more appropriate to call it "satisfactory" but this, in effect, would not cover other situations. In any event no results were looked at in any way whatsoever until the end of the period in question, and the figures presented are a truthful clinical impression of the results following the use of CET. For the sake of clarity each type of event will be described and the individual results pertaining will be given. Certain specific conclusions or deductions within each group of events may be given but general conclusions regarding CET are presented later.

#### **Event 1 Pre-surgical-amputation**

Ten cases were treated, the average age being 62.5 years. The main indication, if not the only one, was the presence of pre-operative oedema, but in some cases the degree of oedema was such that level determination was difficult, if not impossible.

Treatment was continued for varying periods (three to nine days) and oedema was completely eradicated in eight cases and diminished in two cases. The subsequent surgical treatment was undoubtedly eased by an oedema free operating field and, if amputation level was in doubt, there was clinical clarification rather more rapidly than one would normally expect. Infection and pain were relatively unchanged.

TABLE 1

## CONTROLLED ENVIRONMENT TREATMENT

DLFC Trial No.

Name \_\_\_\_\_ Hospital \_\_\_\_\_ Hospital \_\_\_\_\_

Age \_\_\_\_\_ Unit No. \_\_\_\_\_ Unit No. \_\_\_\_\_

Diagnosis \_\_\_\_\_

*Type of event:**Dates:**General clinical status:* 1—Good; 2—Average; 3—Poor*Oedema:* 1—None; 2—Mild; 3—Moderate; 4—Severe*Infection:* 1—None; 2—Cellulitis; 3—Serous; 4—Purulent*Ischaemia:* 1—None; 2—Possible; 3—Clinically evident*Pain:* 1—None; 2—Mild; 3—Moderate; 4—Severe*Drugs:* 1—None; 2—Antibiotics; 3—Vasodilators*Status of healing:*

1—Wound complete

5—Wound  $\frac{3}{4}$  incomplete

2—Wound satisfactory

6—Wound total breakdown

3—Wound  $\frac{1}{4}$  incomplete

7—N.A.—non surgical

4—Wound  $\frac{1}{2}$  incomplete*Patient activity:* 1—Bed; 2—Seated; 3—Standing; 4—Ambulant  
(maximum to be recorded)*CET Programme:*

HP \_\_\_\_\_ mm Hg Time \_\_\_\_\_ sec

LP \_\_\_\_\_ mm Hg Time \_\_\_\_\_ sec

HP (seated) \_\_\_\_\_ mm Hg

HP (standing) \_\_\_\_\_ mm Hg

Temperature \_\_\_\_\_ °C

*Change in pressures/timing/temperature:*

Date \_\_\_\_\_

Date \_\_\_\_\_

*Clinical assessment of result of CET:*

\_\_\_\_\_ 1—Much improved

\_\_\_\_\_ 2—Improved

\_\_\_\_\_ 3—ISQ

\_\_\_\_\_ 4—Deteriorated

\_\_\_\_\_ 5—Clinical clarification

TABLE 2

**Coding**

<i>Type of event:</i>	1—Pre-surgical, amputation
	2—Routine post-surgical, amputation
	3—Non routine post-surgical, amputation
	4—Unhealed stump
	5—Post operative—general
	6—Extremity—trauma, diabetic
	7—Extremity—trauma, non diabetic
	8—Extremity—oedema
	9—Extremity—ulceration
	10—Extremity—diabetic
	11—Extremity—infected, non-diabetic
<i>Status of Healing:</i>	1—Wound—complete
	2—Wound—satisfactory
	3—Wound— $\frac{1}{4}$ incomplete
	4—Wound— $\frac{1}{2}$ incomplete
	5—Wound— $\frac{3}{4}$ incomplete
	6—Wound—total breakdown
	7—N.A.—non surgical
<i>General Clinical Impression: (G.C.I.)</i>	1—Much improved
	2—Improved
	3—ISQ
	4—Deteriorated
	5—Clinical clarification

**Event 2 Routine post-operative—amputation**

Forty-seven cases were treated and it is entirely significant that most were vascular in origin. Constantly, in a desire to maximise rehabilitation, retention of the knee joint was a desirable feature in level determination. Further, the relevance of pre-surgical clinical assessment of level must be considered and in particular its nature and accuracy.

Ages ranged from thirty-seven to eighty-seven, the average being 65.3 years.

**Oedema**

There is little doubt that post-operative stump oedema is controlled by CET. In only two cases oedema was noted as persisting following treatment. The first was a clinically doubtful below-knee level which apparently exhibited free bleeding at operation. There was early clinical clarification of non-viability and the

oedema was very likely due to the degree of ischaemia. The second case presenting with persisting oedema was a through-knee level complicated by a deep intra-condylar haematoma.

**Infection**

Infection is difficult to assess since it is frequently associated with ischaemia and the dominance of one or other is a matter of clinical judgement. Many pre-operative assessments revealed infection (68%) and of these 28% presented with post-operative stump infections. Bacteriological control proved impossible since it was common to have no growth of pathogens reported despite what appeared to be obvious infection. Of the cases (32%) presenting with no evidence of pre-operative infection, nine (60%) had some evidence of stump infection later. It is of interest to note that of these nine cases, three

proceeded to complete stump breakdown and five to quarter incomplete wound healing. A number of these failures had an acceptable clinical explanation and perhaps were a reflection of level assessment.

### *Pain*

Pain is impossible to assess with accuracy and the recording simply indicated whether or not the pain was a marked feature of post-operative management. In eighteen cases (38%) patient reaction appeared to indicate the presence of a relevant pain level. It is significant that of these eighteen cases, eight proceeded to healing, three to quarter incomplete wound healing, one to half incomplete wound healing and four to complete breakdown.

Of the forty-seven cases, thirty (64%) showed either complete healing or a satisfactory wound at the termination of CET. Twelve cases (25.5%) showed quarter incomplete healing, one case showed half incomplete healing and four cases showed total wound breakdown. It is of interest to note the remarks recorded in these cases where breakdown occurred, i.e.

1. Pre-operative oedema (untreated by CET)
2. Clinically doubtful below-knee level, bleeding at operation seemed to indicate below-knee level
3. Wrong clinical assessment
4. Multiple pathology—rheumatoid arthritis, systemic lupus erythematosus, vasculitis and steroid administration.

The 25.5% of cases showing quarter incomplete healing were nearly all infected but ischaemia may have been playing a significant role.

### *Number of days under treatment*

Less than five days—3

Five to ten days—11

Ten to fifteen days—15

Fifteen to twenty days—12

Twenty to twenty-five days—6

Three cases where treatment ceased early were—a sudden death on the fourth post-operative day, a confusional state and one most appropriately called a machine phobia.

Of the eleven cases treated for five to ten days three were terminated early because of machine phobia, one died on the sixth post-operative day, one was of multiple pathology including colostomy management and one was

discontinued for technical reasons (unsuitable sterishield size). To some degree the length of treatment was dictated by the varying numbers of cases presenting and limited equipment. However, patient need was always considered and priorities decided.

### *General Clinical Impression*

Of the forty-seven cases, forty-three (91.5%) were judged to be either improved or much improved and in this context must be interpreted as satisfactory. This group included a percentage of cases which did not show primary healing but generally the stumps were viable, allowing local wound revision. Only four cases broke down completely (mentioned above under status of healing) and one of these was interpreted as clinical clarification since the level was very doubtful.

### *Conclusion*

The conclusion is based on a comparison with the normal type of stump management at these levels, practised over many years. This was by rigid dressings, mostly without mobility but some with mobility, that is, the application of an immediate or delayed post-operative fitting (IPOF). There is little doubt that CET controls the oedema of surgical trauma better than a rigid dressing which, of course, is entirely passive, simply containing a specific stump volume. The control of pain perhaps favours rigid dressings but it is submitted, since the assessment is open to question, that the value of any opinion is equally suspect. The status of healing is encouraging but again it must be set against other factors, e.g. the desire to save the knee, the adequacy of pre-operative assessment of level and the surgery. In the absence of any acceptable control system, largely due to the complexity of the problem, and the difficulty with randomisation, it is believed that the results are better than those achieved by the use of rigid dressings. It should be said that rigid dressings in this context are applied by the author with utmost care, in the knowledge that the stump environment problems are quite as relevant as the preceding surgery.

### **Event 3 Non-routine post-surgical—amputation**

Twenty-two cases fell within this category (Table 3). Almost half (nine cases) were being treated with other types of post-operative

## Event 3

TABLE 3

Age	Oedema after treatment		Pain after treatment:			Treatment No. of days	G. C. I.	Remarks
	Present	Absent	Similar	Absent	Reduced			
57		✓	✓			10	5	Initial below-knee in doubt, CET used for viability. Finally achieved local below-knee revision.
44		✓		✓		8	5	Initial clinical assessment below-knee level. Finally transmetatarsal level achieved.
76		✓	✓			5	5	First rigid dressing change at 8 days post-operatively. Ischaemic stump. CET resulted in rapid clarification non-viability.
34		✓		✓		9	1	Delayed below-knee healing. IPOF with oedema. Healed.
74		✓		✓		6	1	Post-rigid dressing oedema.
19		✓		✓		5	2	Pre-fitting oedema.
57	✓		Pain increased			1	3	Discontinued because of pain.
68		✓		✓		6	5	Clarification—non viable below-knee level.
68		✓			✓	7	2	Revision after 9 days. CET to optimise environment. Healed.
68	None before			✓		9	2	Local wedge revision.
67		✓	✓			5	5	Post rigid dressing 15th post-operative day. Doubtful viability.
47	Reduced		✓			16	2	Trauma leading to below-knee. Gross oedema when first seen. CET followed by local below-knee revision. Healed.
47		✓		✓		7	2	Below-knee revision treated by delayed rigid dressing. Marked oedema necessitated CET.
58		✓	✓			8	5	Clarification prior to local below-knee revision.
32	None before			✓		12	1	Below-knee revision treated with routine CET.
66	None before		✓			7	3	Below-knee revision—treated CET—early cessation of treatment—wrong choice of patient.
64	None before		✓			10	5	Previous amputation toes—failed—below knee level treated CET.
62		✓			✓	8	5	Delayed CET post below-knee amputation—clarification.
69		✓			✓	10	2	Post below-knee rigid dressing (9 days)—oedema—treated CET.
48		✓			✓	4	2	Oedema 14th post-operative day—treated CET.
58	✓ ↓			✓		5	2	Diabetic foot.
52		✓			✓	8	2	Frostbite—late post-operative amputation toes with grafting—oedema.

environment and were exhibiting some clinical indication of doubtful level viability. Of the remaining cases eight presented with post-operative oedema, perhaps due to the initial pathology of trauma, perhaps in association with the rigid dressing or for varying other reasons.

Thus, non-routine post-surgical amputation cases consist of a number of varied conditions. They probably reflect the wide use of CET and offer little of statistical interest. The number of days CET was applied tends to be less.

Less than five days—2

Five to ten days—16

Ten to fifteen days—3

Fifteen to twenty days—1

This would seem rational in as much as it was being applied for a fairly specific purpose.

General clinical impression was favourable, twelve cases being improved, two cases unchanged and eight exhibiting evidence of rapid clinical clarification.

#### Event 4 Unhealed stump

Five cases were treated in this category. CET was used for a variety of reasons:

1. Following trauma to a healing below-knee stump. Oedema was reduced but infection and non-viability necessitated higher

revision, the latter probably preceding the trauma.

2. Sloughing, unhealed, below-knee suture line, eight weeks post-operative. Both oedema and infection subsided and the stump healed.
3. Post-rigid dressing—unhealed, oedematous stump which healed following CET.
4. Unhealed stump with oedema—pre-IPOF. Later required revision.
5. Post-IPOF—granulating clean wound with oedema. Finally healed following nine days CET.

#### Event 5 Post-operative—general

Five cases were treated including one double treatment (six events). (Table 4).

#### Event 6 Extremity—trauma—diabetic

Only one case was treated in this group—a man aged 61 years with a history of diabetes who presented following an injury to his forefoot. Clinically either a Syme's or a below-knee amputation seemed necessary but following CET for ten days with reduction of oedema and pain he required only amputation of the hallux. Primary healing was achieved. CET was used pre- and post-operatively. The potential of CET in this type of case warrants full evaluation.

TABLE 4

#### Event 5

Age	Oedema after treatment:		No. of days	G. C. I.	Remarks
	Present	Absent			
67		✓	7	4	Infected foot—non-diabetic. Debridement—CET on 5th post-operative day. Technical failure of machine—below-knee amputation.
18	✓		8	2	Fracture bases 2,3, 4 metacarpals—open reduction with wiring—delayed CET—improved hand function but only partial reduction of oedema.
62	None before		15	2	Infection following excision of head of 1st metatarsal and base of proximal phalanx. Infection much reduced.
58		✓	8	2	Tuberculous ankle involving tendon sheaths with contra lateral below-knee amputation—post operative and pre-plaster immobilisation—oedema much reduced—finally settled and mobilised.
58		✓	7	2	Paronychia hallux in diabetic—surgery followed by CET.
58		✓	10	2	Recurrence infection and oedema in last case—below-knee amputation following reduction of oedema.

### Event 7 Extremity—trauma—non-diabetic (Table 5).

#### Conclusion

The elimination or reduction of post-traumatic oedema has undoubted benefits not only with regard to healing but also in achieving improved function. Failure to eliminate the oedema in three of the severe cases is ascribed to delay in CET application. The use of CET in this type of case, as in event 6, requires evaluation.



Fig. 3. Left, elephantiasis with "cauliflower" foot. Right, considerable reduction of oedema following CET. The excessive skin fold is clearly shown (see Table 6).



Fig. 4. Left, reduction of calf oedema from 73 to 44cm. Right, following plastic surgery—removal of skin fold, reduction of cauliflower foot with grafting and amputation of toes. Calf circumference now 33cm (see Table 6).

### Event 8 Extremity oedema

Fourteen cases were treated in this group, including one double and one triple treatment (Table 6).

There is little doubt that the extremity oedema can be reduced or diminished with resulting increased function and improved cosmesis. As a pre-fitting measure CET is most successful and pre-surgical benefit can also be recognised.

TABLE 5

### Event 7

Age	Oedema after treatment:		No. of days	G. C. I.	Remarks
	Absent	Reduced			
18		✓	7	2	Fracture bases 2, 3, 4 metacarpals—gross oedema leading to circulatory deficit—marked benefit.
53		✓	9	2	Degloving injury forearm—delayed treatment but still resulting in improved function of the hand.
30		✓	9	2	Injury forearm and hand—delayed CET—incomplete resolution of oedema.
68	✓		7	2	Fracture medial malleolus—late treatment on 18th day—gross oedema much improved.
59	✓		11	2	Fracture tibia and fibula treated with internal fixation—reduction of oedema achieved.
47		✓	4	1	Fracture humerus, radius and ulna—severe oedema markedly reduced.
32	✓		13	1	Injury of arm with amputation distal phalanx thumb—grafting—oedema completely resolved.

TABLE 6

## Event 8

Age	Oedema after treatment:		No. of days	G. C. I.	Remarks
	Absent	Reduced			
47		✓	5	2	Lymphoedema arm—unknown aetiology—fibrosis tissues—limited improvement.
67		✓	15	1	Elephantoid limb of unknown aetiology. Reduction circumference calf from 74 to 42 cm. (see Figures 3 & 4).
67	✓		13	2	Post-operative recurrence oedema—plastic surgery to remove excessive skin folds—inadequate support from normal compression bandaging.
67	✓		5	1	Recurrence mild oedema at fitting stage of calf boots—CET reduced calf by 5 cm.
17	✓		13	2	Lymphoedema leg for 10 years—unknown aetiology—reduction mid calf by 6 cm and above ankle circumference by 5½ cm.
21	✓		6	2	Lymphoedema calf of unknown aetiology—oedema eliminated.
84	✓		5	2	Bilateral lower limb lymphoedema—probably postural. Completely eliminated
84	✓		6	2	(see Figure 5).
67		✓	7	2	Post-radiation oedema—tissues indurated—oedema is completely eliminated.
80		✓	3	2	Post-radiation oedema arm—pathological fracture humerus—abandoned due to pain caused by impaction of fracture with opposing sterishield and suspension pressures.
72		✓	7	2	Elephantiasis nostras—much improved.
73	✓		7	2	CVA and hemiplegia—using conventional apparatus with much oedema—oedema eliminated prior to contemporary orthotic fitting.
70	✓		2	2	Pre-orthotic fitting.
59		✓	5	2	Pre-tendo-Achilles tenotomy.
57		✓	4	1	Brachial plexus lesion leading to oedema of hand with reduced function—much improved following reduction of oedema.
41		✓	1	2	Friedreichs ataxia with oedema lower limbs—pre-orthotic fitting—CET not tolerated.
59	✓		6	1	Post-mastectomy oedema arm—delayed treatment—upper arm reduced by 6 cm and forearm by 4 cm.

TABLE 7

## Event 9

Age	Oedema after treatment:		Infection	No. of days	G. C. I.	Remarks
	Absent	Reduced				
77	✓		Unchanged	13	1	Varicose ulceration much improved by CET—early termination due to technical failure.
68	✓		Unchanged	9	2	Varicose ulceration vastly improved—CET combined with plastic surgery.
84		✓	Unchanged	6	2	Varicose ulceration—treatment abandoned due to general status.



Fig. 5. Bilateral lymphoedema. Left, before treatment. Right, after treatment (see Table 6).

### Event 9 Extremity ulceration

Three cases in this group (Table 7) form a very small experience of the use of CET in varicose ulceration but it clearly indicates the necessity to expand application in this type of condition to allow adequate evaluation. Initial impressions are favourable as might be expected where an environmental situation favours healing by encouraging venous and lymphatic return and reducing distal stasis.

### Event 10 Extremity diabetic

The results of treatment of the diabetic foot deserve consideration (Table 8). CET is clearly one of the measures likely to offer benefit in the future. There is little doubt, that correctly applied to the appropriate case, CET is a valuable form of treatment.



Fig. 6. Top, diabetic foot with ulceration related to first metatarsal head—wide surgical drainage. Bottom, foot healed after treatment (see Table 8).

### Event 10

TABLE 8

Age	Oedema after treatment:		Infection:		Pain after treatment:			No. of days	G. C. I.	Remarks
	Absent	Reduced	Reduced	Unchanged	Reduced	Absent	Unchanged			
37	✓			✓		✓		9	1	Ulceration related to first metatarsal head—treatment repeated after six months—finally wide surgical drainage—foot healed (see Figure 6).
37	✓			✓		✓	7	2		
37	✓		✓			✓	52	1		
62	✓			✓		✓		22	2	Improved but infection remained due to underlying bony involvement.
57	None before			✓		✓		11	2	Infection hallux—desloughing and removal infected bone—healing failure but no initial oedema.
58	✓			✓	✓			11	2	Paronychia hallux—improved.
65	✓		✓			✓		15	2	Infection related to first metatarsal head which was excised—wound healed.

### Event 11 Extremity infected non-diabetic (Table 9).

#### Pressures/temperatures used

Generally speaking, the console settings for pressure, cycling times and temperature were those originally suggested within the international protocol. It is believed that pressures tended to be higher in the later stages of trials in other Centres in the United Kingdom. The whole question of pressures requires further thought. The majority of amputation cases are vascular in origin and the pressures require to be related to such things as skin blood pressure and blood flow. Other cases simply presenting with oedema appeared to respond to the pressures used in the Dundee trial and this evidence would support the use of lower pressures. In effect, if one believes that the elimination of oedema is mandatory in all cases on the assumption that peripheral circulation becomes less embarrassed, the use of lower pressures would appear to be adequate.

Temperature is related to two factors;

- (a) comfort
- (b) a level which would limit bacterial growth and resulting infection

This appears to be achieved within the range of 28°C to 31°C the variation being entirely due to the element of patient comfort. Patients were specifically asked whether the limb appeared to be uncomfortably hot or cold and the temperature was adjusted accordingly.

### Conclusions

It could be argued this paper simply lists observations over a wide selection of cases. There is no intention to do otherwise and it is simply a necessary preamble offering impressions on the use of CET. Ideally comparisons would allow an indication of performance and how it differed from more conventional treatments. However this was not the stated approach and rigid control systems, even if possible, are not an essential element of this type of evaluation. Perhaps the data presented at length in the paper will allow the reader to draw his own conclusions.

Before considering the clinical evidence there are several areas of major interest if CET application is to be efficiently managed.

### 1 Staff acceptance

#### a) Medical

There are three major ways in which the doctor is involved. Firstly, in the assessment of case suitability, and this is critical. Secondly, in day to day treatment observation, to allow personal evaluation and perhaps criticism of selection. Thirdly, in the instruction of paramedical staffing in the use and application of CET.

#### b) Nursing

Nursing staff familiarise rapidly given the essential initial instruction. Management of the

TABLE 9

### Event 11

Age	Oedema after treatment		Infection		Pain:			No. of days	G. C. I.	Remarks
	Absent	Reduced	Reduced	Unchanged	Reduced	Absent	Unchanged			
58		↙		↙	↙			8	2	Tuberculous disease involving tendon sheath, ankle with abscess formation—pre-operative measure.
24		↙	↙			↙		19	2	Abscess ankle in chronic myeloid leukaemia—grafting thought necessary but healed.
77		↙		↙		↙		8	2	Sinus associated with fourth metatarso-phalangeal joint which was dislocated. CET after curettage.

patient is found to be fairly easy although the necessity of moving patient and machine within a unit in the course of any rehabilitation programme causes some inconvenience. In this respect it is staff dependent.

### c) *Physiotherapy*

Essentially CET demands a fresh approach by the physiotherapist. Mobilisation is still possible in the amputee, but within a limited area. An advantage recognised by the physiotherapist is the facility of early joint mobilisation within the sterishield. Any stated disadvantage tends to be negated through time, and with the recognition of the advantages of CET.

## 2 Management of equipment and reliability

The CET apparatus has been found through experience to be self managing, as indeed the designers intended. Servicing is minimal, involving the change of an air filter after one month's use and the bacterial filter after one year. As with any machine faults can develop but they have been infrequent and relatively simple. Temperature control depends to some degree on the ambient conditions and unless recognised this can be a difficulty. Related to the management of the equipment is the harness used for upper limb treatment. The design of this harness is open to considerable criticism and this is mainly due to the inability of the design features to accommodate the very varied, desired range of function at the shoulder joint, as opposed to the hip.

There are certain conclusions regarding the advantages and disadvantages of CET which can be stated unequivocally.

### *CET advantages*

1. No skill of application is required
2. Adequate control of pressures
3. Adequate control of temperature
4. Sterility
5. Observation of stump or extremity under treatment

### **Specific staff defined advantages/disadvantages**

#### *Nursing—*

- Stump visible
- Management of device easy
- Saving of nurse/hours—dressings, bandaging

*but*

Unwieldy environmental hazard

#### *Physiotherapist—*

Knee can be exercised,

*but*

Limited assisted function by physiotherapist

Patient less mobile

Frustration of seeing others more mobile using other methods of stump environment

Walking bars mobility—excessively staff dependent

### **CET conclusions**

Oedema controlled

Improved venous/lymphatic return

Peripheral stasis reduced

Pain controlled adequately

Early joint mobilisation

No high loading or tourniquet effect

### **Observation of wound**

#### *Sterility*

Advantages and disadvantages must be set against conventional dressings of whatever type are normally favoured. CET after all is simply an air dressing which is not only sterile but exerts the influence of cycling evenly distributed pressure on the extremity as a whole and, if applicable, the wound in particular. The effect of cycling pressure is to reduce or, more often, to eliminate oedema and this can only come about by increasing the vascular and lymphatic return from the limb. If this is correct there must be an elimination or reduction of peripheral vascular stasis, an element well known to be detrimental to wound healing.

The elimination or reduction of oedema is seen repeatedly in the use of CET and evidence of improved healing is noted in many cases. Improved function can also result and there are clear applications in the orthotic field.

Two specific conditions deserve much wider exposure to CET, the diabetic foot and chronic varicose ulceration. Both these conditions present frequently seen clinical problems often treated too lightly by those responsible for their care. It is believed that CET forms the ideal environment to encourage healing but it must be said, particularly in the diabetic foot, that surgery should be radical, since without this facility CET will fail.

Finally it is believed that the evidence presented in this series is sufficient to justify the continued application of this form of treatment even to a degree excluding other more commonly used forms of wound environment management. Evaluation of CET must proceed and this, it is believed, must be based and quantified against known methods of assessment and investigation in vascular disease. CET is a valuable addition to the equipment available to

the clinician in the treatment of certain disease categories.

#### Acknowledgement

The assistance of clinical and para-medical colleagues at Dundee Limb Fitting Centre and Kings Cross Hospital, Dundee is gratefully acknowledged, as is the assistance of Miss Marilyn Anderson, Dundee Limb Fitting Centre.

#### REFERENCES

- BURGESS, E. M. and PEDEGANA, L. R. (1977). CET for limb surgery and trauma. (A preliminary report). *Bull. Pros. Res.* **10:28**, 16-57.
- REDHEAD, R. G. (1973). The problems of the post-operative and stump/environment interface. 1st International Congress on Prosthetic Techniques and Functional Rehabilitation, 65-73, Egermann, Vienna.
- REDHEAD, R. G., SNOWDON, C., BURGESS, E. M. and VITALI, M. (1974). Controlled environment treatment for the post-operative management of wounds of the upper and lower limbs including amputation stump. 1st World Congress, ISPO, Montreux.
- REDHEAD, R. G. and SNOWDON, C. (1977). A new approach to the management of wounds of the extremities; controlled environment treatment and its derivatives. Scientific Symposium, British Trade Fair, Tokyo. Copies from BRADU Library, Roehampton, London.
- REDHEAD, R. G. and SNOWDON, C. (1978). A new approach to the management of wounds of the extremities. CET and its derivatives. *Pros. & Orth. Int.* **2:3**, 148-156.

## Toileting self-care methods for bilateral high level upper limb amputees

L. FRIEDMANN

*Paediatric Occupational Therapy Department, Institute of Rehabilitation Medicine, New York*

### Abstract

One of the most important problems for the bilateral upper limb deficient patient is the inability to manage toileting activities. Dependence in this area precludes schooling or work. This paper surveys available clothing types and adaptations to facilitate doffing and donning clothing and devices for genital cleansing and menstrual care. The devices are analyzed for suitability for different types and levels of high deficiency and purposes. Independence requires intense motivation of the patient and elimination of overprotection by the parents.

### Introduction

The problem which is of greatest concern for the bilateral high level upper limb amputee is the ability to take care of himself in toileting. The inability to cleanse oneself after defecation, urination, and menstruation, eliminates the possibility of attending school, independent travel, or employment. While it is occasionally acceptable to consent to being fed by someone else, it is degrading and destructive of self-confidence for an individual to have to be cared for in the most intimate of activities, toileting. This aspect is frequently ignored by members of the rehabilitation team because toileting activities are considered "dirty". Rehabilitation requires that the rehabilitation team be concerned with successful function in this as in other abilities.

The problem exists mainly in congenital limb deficiency, although an occasional acquired amputee will have a similar problem. The principles are the same, except that in the adult the range of motion of the lower limbs will generally be more restricted.

These persons must be assessed individually. The precise length of the residual limbs, the range of motion of each joint, the muscle strength and agility remaining are crucial. For that reason, only general classifications can be given, and a series of trial methods and devices may be required in an individual case. The purpose of this article is to attempt to disseminate the information that the author has gathered over a prolonged period of time from many sources, so that the therapist working anywhere will have the combined experience of many rehabilitation facilities.

In the rehabilitation of the high bilateral upper limb amputee, the success achieved is directly related to the motivation. The motivation of the child is to a great extent a reflection of the motivation of the parents. If the parents wish the child to attend school, then as a rule the child will be motivated to attend school and to learn those things which are required in order for him to do so. One of these is the ability to take care of himself in the toilet. The patient who is strongly motivated towards independence will usually succeed in being independent despite very severe handicaps. If the parents want to keep the child dependent, they will generally succeed in so doing, often for life. This precludes independence in the activities of daily living, in schooling and in vocational training and placement.

### Preparation for toileting activities

Before toileting can be started, the clothing and underclothing must be removed. For the young child clothing adaptations are almost always required. When the child reaches adolescence and starts to consider social activities, clothing adaptations are frequently rejected because of their unsightly appearance. Clothing adaptations should be as inconspicuous as possible. Required loops should be made from

---

All correspondence to be addressed to Ms. L. Friedmann, Clinical Supervisor, Paediatric Occupational Therapy Department, Institute of Rehabilitation Medicine, 400 East 34th Street, New York, N.Y. 10016, U.S.A.

the material of the clothing so as to be inconspicuous; Velcro closures should be the same colour. As few special devices as possible should be used, so that they do not have to be carried to school, to work, or while travelling. Loose clothing without elastic is desirable, to make doffing and donning easier.

In the male who needs to urinate, if the zipper cannot be opened by the extremities, either without or with a loop on the zipper pull, the trousers may be left partially open. Provided the upper part of the trousers is covered by an exterior shirt or jacket, the fly of the trousers may be left two-thirds open to allow a boy without arms to urinate independently. The individual will generally not wear underpants. The pants are suspended by means of suspenders rather than a belt. The cross of the suspenders in the back must be quite high to prevent sliding off, usually just below the seventh cervical vertebra. The tension must be just appropriate to suspend the trousers. The trousers are pulled down by having the individual slip off one shoe and grasp the pants leg on the contralateral side with the toes and pull down the trousers, exposing the penis in the already open fly.

In patients with partially functional upper limbs, the fly of the trousers may be entirely closed, to be opened by the upper limbs with or without a limb extender. This is generally facilitated by use of a small key ring in the zipper tab.

For defecation the pants will have to be removed completely. The pants can be closed with Velcro at the waistline, usually with a counter-pull through a D-ring or overlapping. Belt loops and occasionally other loops may be required for donning the pants either with the residual limbs or with a limb extender. Because this is difficult, it is preferable for the individual to be trained to have a bowel movement either in the morning before leaving the house or in the evening after returning, rather than during the school or work day. The pants are generally donned by placing them on the floor or mattress. The patient inserts the feet into the trousers and raises his legs. Gravity and shaking cause the pants to slide proximally while the patient lies supine. When the pants are at the level of the hips, the patient utilizes friction between the mattress or floor and the trousers to hold them in place while wiggling the buttocks into the upper part of the trousers. If suspenders are used to

hold up the trousers, one shoulder is inserted at a time under each suspender strap. This may be assisted by means of the contralateral foot and/or use of the teeth or occasionally the chin. Sometimes the pants are pulled over the hips while standing, pulling up the suspenders with the teeth while rotating the hips with the legs in maximal abduction.

Occasionally a boy wishes to wear his shirt inside his pants. This increases the difficulty in dressing. Long elastic straps should be sewn to the shirt at the hemline. These loops are held with the toes while the trousers are donned.



Fig. 1. Devices from the Rehabilitation Institute of Montreal. Left, clothing hook attached to mirror. Right, device for patients with short upper limbs (see text).

### Devices

Devices may be utilized to facilitate doffing and donning of clothing. The simplest one that will do the job is best. The most useful is a clothing hook on the wall at the appropriate level for the individual. The hook may be of any shape. It may be plain, roughened or have rubber tubing. Monique Audet at the Rehabilitation Institute of Montreal, Canada, applies the hook to a mirror with a suction cup so that the individual can see where the hook is in relation to the clothing. (Fig. 1 left). They also developed a device for patients with short upper limbs, especially phocomelia. It is a forked rod to push the trousers down. (Fig. 1 right). One side of the fork has a hook on it to be used for pulling. The other end of the rod has a cup which the patient applies to his chin forcing the cup and rod down to lower the clothing. In addition, there are

dowels through the rod which are manipulated by the phocomelic extremity and assist in pulling or pushing. A modification was described by Ring (1972) which is a rod connected to an S-shaped curved hook with the S being on its side to push and pull.

M. A. Mendez at Queen Mary's Hospital, Roehampton, London, England, has developed many devices and methods for these patients. Patients with upper limb phocomelia and normal lower limbs use a dressing stick with a hook, S-shaped as described by Ring, but retractable and lockable, or round. Patients with amelia who do not have an upper extremity with prehension use wall hooks and a dressing stick with a biting tip. She adapts the clothing using Velcro usually with counterpull, but occasionally overlap. She occasionally uses Velcro with two loops and a split ring. She illustrates a German wall hook for dressing and undressing which is attached to a wall. This is a flat disc on a rod which is attached to the wall for raising and lowering the clothing (Fig 2).

Ann G. Fisher, Area Child Centre, Grand Rapids, Michigan, has used various shaped plastic limb extenders with a split at the distal end for pushing pants up and down.

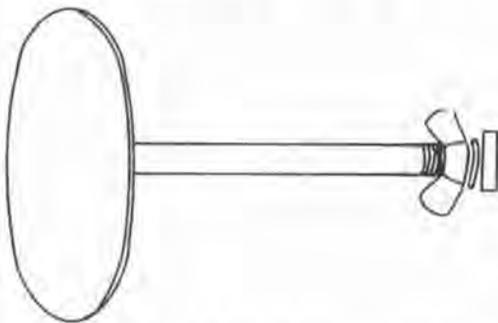


Fig. 2. Wall mounted disc for dressing and undressing used at St. Mary's Hospital, London.

### Toileting

There are three categories of patients who have toileting problems. The first is (A) children who have short upper limbs, sometimes with true phocomelia, with adequate grasp and release, but who lack the limb length and reach to cleanse after defecation. The second category (B) is children who have inadequate grasp and release in the upper limbs, who have limited range of

motion of the hips and/or severe shortening of the femur or of the tibia. The third category (C) is children who have no upper limb function with normal lower limbs and with well developed foot function. Any child who can manage to cleanse the groin area without devices should do so. Foot usage is usually adequate, with trunk motion where needed.

#### (A) Short arms with grasp

One may have to extend the length of the upper limbs artificially using some type of limb extender for pushing clothing down and pulling it up with an individually designed device for holding the toilet paper.

If the devices cannot be collapsed for carrying, two sets are required, one for home and one for school. Simple ones may be made from  $\frac{1}{2}$ " (1 cm) diameter dowel with an L-shaped hook, covered with rubber tubing, or with a coat-hook bent at an appropriate angle depending on the configuration of the patient.

Useful suggestions for wiping devices have been received from many sources. Bridget Duckworth at the G. F. Strong Rehabilitation Centre, in Vancouver, Canada, has found useful a limb extender made of stainless steel welding rod inserted into a plastic or wooden handle. (Fig. 3). A J-cloth (Handi or Easy Wipe) is inserted into the end and wrapped around the prongs. The patient wipes with one part of the cloth, flips the end over and uses a clean part. M. A. Mendez uses a dowel handled extender which has a similar spring metal coil for inserting toilet



Fig. 3. Stainless steel limb extender from the G. F. Strong Rehabilitation Centre, Vancouver (see text).

paper. Black Notley Hospital, Braintree, England, use a toilet paper holder made out of a stainless steel knitting needle set in an aluminium tubing handle (Lowman & Klinger, 1970). Y. Cupid at the University of Saskatchewan University Hospital in Saskatoon, Canada, recommends a long-handled holder made of coat hanger wire with a coil into which toilet paper is placed, also similar to the preceding two. A second device which has been used by them is a pair of long-handled tongs bent to the desired shape. This is sometimes difficult to control if the patient uses a prosthetic terminal device.

For travelling, Duckworth has used a washing aid consisting of a long towelling washcloth with one end hooked to the shower head at the top and the lower end attached to two large suction cups which are fixed about half the length of the bathtub. With this, every area can be washed, including the perineal area. It is generally fixed in place by the feet or prostheses. As with most centres, they find wrist flexion units helpful in manipulating trouser zippers if prostheses are used. The zipper tabs are fitted with a small split ring or loop for additional assistance. The wrist flexion units are also helpful for extracting the penis. Some patients are agile enough to use the prosthetic hook for wiping.

All wiping of the anus should be done from the rear in females to avoid vaginitis.

M. Audet uses a portable plastic stick or spatula with a slit or hole at the functional end, into which toilet tissue is inserted. The limb extender is modified according to each child's special needs in length, shape, material, size, etc. As with most centres, they find that collaboration between the therapist, the parents and the child is required for success with these devices, because many types need to be tried before appropriate ones are finally developed. They produce devices that are simple, usable in most situations and easy to transport in a purse or schoolbag so that multiple devices are not required.

Helen J. Scott of Princess Margaret Rose Orthopaedic Hospital in Edinburgh, Scotland, uses a metal folding extender which has a metal ring attached to its end. Stitched to this is a rubber or plastic material which has a central hole with eight or more slits radiating out towards the metal ring. The toilet paper is pressed into the central hole, where it is gripped by the plastic. The child utilizing this device can

reach from the rear for anal cleansing. The toilet paper can be removed by the phocomelic digits and thrown away and a clean piece inserted for further cleansing. The device can be folded for carrying in the schoolbag or purse. Proximal rings or assistive holding devices can be utilized where there is inadequate grasp.

Granstrom (1976) has described two reaching devices. The first is essentially a bent plastic tube with a wooden handle with a narrow slit at the end for holding the toilet tissue. The toilet paper is removed after use by pulling the plastic holder against the rim of the toilet bowl forcing the paper into the bowl. The second device is similar, but the ends of the slit are held close together by means of a sliding plastic ring, securing the toilet tissue during the wiping process. When the toilet tissue is to be disposed, the plastic ring is pushed proximally and the tissue is removed by use of a spike within the removable wooden handle.

Adenia Spencer of the Texas Scottish Rite Hospital for Crippled Children, Dallas, Texas, has tried a jointed rod held together by a wing nut for adjustment of the angle which has a foam covered rectangular plate attached to the end. The foam rubber is covered by a terry cloth cover with a draw string which is used for wiping (Fig. 4).

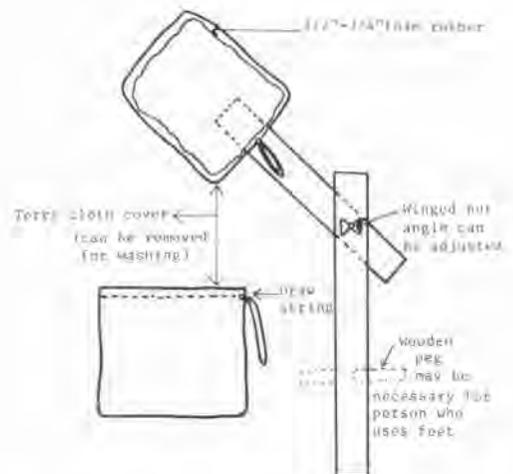


Fig. 4. Adjustable toilet device used at the Texas Scottish Rite Hospital for Crippled Children, Dallas. The size may be adjusted to suit the patient.

Marion Shaw of the Ontario Crippled Children's Centre, Toronto, Canada, has developed a folding rod with a cup and cover similar to the device described from the Princess Margaret Rose Hospital. This device is hinged for portability and is held in the extended position by means of a sliding cylindrical lock. A removable probe for removing the toilet tissue from the cup is inserted into a flat rectangular handle (Fig. 5).



Fig. 5. Ontario Crippled Children's Centre folding rod device.

The Therafin Corporation, Crete, Illinois, has developed a toileting assist they call a Hygiene-Aid, cat. #A131. (Fig. 6, top). It is a rod which has two polyethelene hand straps to assist the patient with limited hand function in grasping the rod. The distal end has a gripping device with plastisol covered jaws which are held together by means of a rubber band. After wiping, the patient taps the release lever on the inside of the toilet bowl to release the paper.

This device is listed in the catalogue of the Fred Sammons Co., Springfield, Illinois. A second toilet limb extender is shown "Short toilet aide" cat.#BK 6014, which is a pair of curved handled tongs covered with plastisol, a positive grip device (Fig. 6, bottom).

Kuhn (1970) of the University of Muenster, illustrates a reaching device which has a pincer to hold the toilet tissue. A button on the proximal end controls the pincer to lock or unlock the toilet paper. It is used from the front.

M. Zimmerman, Institute of Rehabilitation Medicine, New York City, uses a limb extender made of two plastic rods, with smooth edged inter-locking teeth. The handles are squeezed to open, a small spring under the expansile tension closes and holds the paper (Fig. 7, top).

The author made an extension device for an elbow disarticulation stump out of an E-Z band

applicator with elongated handles and rubber tubing covering the curved tips for better prehension (Fig. 7, bottom).



Fig. 6. Top, Therafin Corporation Hygiene-Aid (see text). Bottom, short toilet aid from Fred Sammons Co.



Fig. 7. Top, limb extender used at the Institute of Rehabilitation Medicine, New York. Bottom, the author's device for elbow disarticulation stump.

Elaine Treffer at the University of Tennessee Centre for the Health Sciences in Memphis, Tennessee, uses a modified version of the O.C.C.C. toileting aid. It is made of metal rather than plastic and utilizes a telescoping device rather than a folding one. She finds that this is lighter, smaller and more useful for transporting the device. The proximal side has push and pull hooks for manipulating the pants. She asserts that attempting to train children earlier than the teens in self care is unrewarding because most children younger than the early teens are not adequately motivated for independent toileting. In the author's experience there are some children younger than 13 who are very interested in toileting independence and an attempt to train the child should be made.

*(B) Hands with inadequate grasp*

The next category of patients are those with upper extremities with inadequate grasp and release with, in addition, limited range of motion at the hips, knees and/or severe shortening of the femur. The best solution is to place the toilet tissue with the hand or the foot on the edge of the toilet bowl and rock the pelvis back and forth against the toilet paper for cleansing the groin. The best type of toilet is of horseshoe shape, preferably with the seat open in front. Some therapists have used the toilet seat rather than the top of the bowl; in the author's experience the top of the bowl is better because it is narrower and it is easier for anal cleaning to take place.

If the above option is not feasible, a stationary device may be required, where ever the child needs to use the toilet.

Prof. E. Marquardt of the University of Heidelberg, Germany, utilizes a plastic device which may be attached to the toilet bowl by means of a spring-clip or to a wall (Fig. 8, top) so that it can swing out for use. A spring plate holds the toilet tissue in a location which the patient can reach with the perineal area. The paper is inserted and removed either by a phocomelic extremity or by use of the feet while the child sits on the toilet nearby (Fig. 8, bottom).

Evelyn Bloch of the Thoms Rehabilitation Hospital, Inc., of Asheville, North Carolina, has described the use of a large diameter dowel fixed to the wall at groin height. The dowel is wrapped with toilet paper using the toes. The toilet paper is sat on to rub the appropriate area. A small



Fig. 8. Wall mounted plastic device from the University of Heidelberg; the device may also be attached to the toilet bowl by spring clips.

enlargement may be added to the dowel near the wall to provide better contact in the anal area.

M. A. Mendez describes two types of split hooks which are attached to a wall either by a suction cup or screws. Essentially they are two flat plates of plastic or metal between which the toilet paper is placed.

The author has described a toilet attachment which hooks on to the edge of a bathtub (Friedmann, 1975). This was modified later by Wright (1976) for use with a floor stand.

Prof. G. G. Kuhn, from the Orthopaedic Hospital of the University of Muenster, Germany, employs a bidet of the WC-O-Matic type. In Scandinavia and in Scotland, the Clos-O-Mat automatic bidet is utilized. (Orthopaedic Hospital, Copenhagen, Denmark, found this unsatisfactory; it can only be used in the home).

*(C) No hand function*

For patients with little or no upper extremity function on either side with normal lower limbs with well developed foot function, the best

solutions are holding the toilet paper between the toes and wiping the groin with foot and ankle motion while sitting on the floor or the toilet bowl, rocking the pelvis back and forth if needed. Another method requiring less agility is to place the toilet paper over the heel and squat down so that the anal area rests on the paper on the heel. The patient then rocks, cleansing the anal area.

#### Urinary devices for boys

Boys with phocomelic extremities have the problem of removing the penis from the trousers for urination. Ann G. Fisher suggests the use of a rod with a loop to fish the penis from the trousers after the fly has been opened.

The author's modification involves attaching a Nyloplex cylindrical loop by means of an extension to two or more sections of a folding ruler (Fig. 9). The resulting device is portable and inexpensive.

Ring (1972) shows rods with rings or a gutter trough for holding the penis.

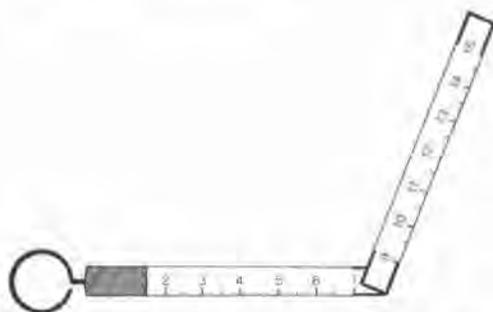


Fig. 9. Simple, inexpensive urinary device modified by the author from the loop and rod aid suggested by the Area Child Centre, Grand Rapids, Michigan.

#### Menstrual care

A very serious problem for the girl after puberty is cleanliness during the menstrual period. A number of commercial devices may be utilized such as adhesive sanitary napkins inside the panties. A second solution is to use the standard sanitary napkin held inside the panties by means of two elastic strips or pockets (Fig. 10). In an active girl, if there is a problem of shifting, the use of sanitary panties or panties with a plastic crotch may be advisable. Helen J. Scott at the Princess Margaret Rose Orthopaedic Hospital in

Edinburgh, Scotland, suggests that sanitary napkins or towels with loops be held in the panties by means of a cloth strip with a plastic ring on one end. The cloth strip is folded upon itself with two pieces of Velcro to enclose the loop on each side of the napkin. It is held fast to the panty by the stitched on plastic ring. Exact positioning of the sewn straps is important to ensure that the napkin is not displaced during activity.



Fig. 10. Sanitary napkin attached to panties by elastic strips.

One useful measure is to use pre-prepared paper panties and adhesive sanitary napkins. The entire panty is thrown away after use.

Some girls prefer the use of a tampon. Where this is desired a mirror should be attached in front of the toilet bowl to assist insertion and removal. Kuhn (1977) illustrated a device he developed for insertion of a tampon into the vagina (Fig. 11, top). It is operated by foot pumping which compresses air which is driven through a tube. The compressed air inserts the tampon rapidly. For this reason there is some potential danger because of the possibility of damage to the skin or to the vaginal tissues. A simpler modification which is portable (Fig. 11, bottom), has been developed by Prof. E. Marquardt which is an additional tube attached to the portable toilet device described earlier for use by phocomelics, with a metal loop for removal. The tampon string is elongated and at its end has a glass bead or metal ring to hook onto the metal loop of the tampon-aid.

Evelyn Bloch sent an idea which she has not tried, which might prove useful. She recommends that for removal of a tampon, which has a double string with a knot dangling, a

small metal hook covered with polyurethane could be attached to a wooden platform which is held down by the feet. The patient could squat over it and catch the hook in the loop and then slowly stand, pulling the tampon out of the vagina. She suggests that perhaps a tube covered with plastisol could be attached to the same board at an angle which is proper for vaginal insertion. This is merely an idea which would need further development.

The Hygiene-Aid made by the Therafin Corporation is claimed to be successful for inserting and removing vaginal tampons (see Fig. 6, top).



Fig. 11. Top, tampon insertion device developed in Muenster. Bottom, portable modification from the University of Heidelberg (see text).

### Bilateral upper and lower limb involvement

Patients with quadrimemberal involvement have extreme difficulty in toileting. These patients need various devices for dressing and undressing, such as dressing sticks, wall hooks, etc. For perineal cleansing the bidet type of device is generally required. It is unfortunately not portable, and one must be obtained for each location that the child needs to do toileting.

The above survey of available aids is intended to serve as a working guide for therapists. These cases are fortunately rare, so no one has extensive experience and a continuing collection and dissemination of information on these devices would be of benefit to these patients.

### Acknowledgements

The author is very grateful for the help that the sources mentioned have given in sharing their experiences and hope that anyone having a new device or method which proves successful will communicate with her for follow-up articles on the same subject.

### REFERENCES

- FRIEDMANN, L. (1975). Toileting device for high level upper limb amputees. *Int. Clin. Inf. Bull.*, **14**: 7-8, 25-27.
- GRANSTROM, M. (1976). toilet paper holder. Information sheet A2.23-9, ICTA Information Centre, Bromma, Sweden.
- KUHN, G. G. (1970). Treatment of the child with severe limb deficiency. *Int. Clin. Inf. Bull.*, **10**: 3s, 2-32.
- KUHN, G. G. (1977). Vaginal tampon applicator. *Int. Clin. Inf. Bull.*, **16**: 5-6, 13-15.
- LOWMAN, E. and KLINGER, J. L. (1970). Aids to independent living: Self-help for the handicapped. McGraw-Hill, New York.
- RING, N. D. (1972). Miscellaneous aids for physically handicapped children. *Int. Clin. Inf. Bull.*, **12**: 3, 1-12.
- WRIGHT, B. (1976). Independence in toileting for a patient having bilateral hemimelia. *Int. Clin. Inf. Bull.*, **15**: 5-6, 21-24.

## **Skin problems of the leg amputee**

S. William LEVY

*Department of Dermatology and Biomechanics Laboratory, University of California, San Francisco*

### **Introduction**

Lower-extremity amputees, the group with which this paper is concerned, include persons who have been subjected to gross anatomic loss of the lower limbs at widely varying levels, such as partial foot amputation, below-knee and above-knee amputations, knee or hip disarticulation, and hemipelvectomy. Amputation at each level is attended by distinctive problems of functional loss, fitting and alignment of the prosthesis, and medical difficulties, such as skin disorders, that are secondary to the use of the limb. These amputees require the continued care of prosthetists who construct the artificial limbs on which the amputees must depend for locomotion—and indeed, to a large degree, for social and economic rehabilitation—for the rest of their lives.

But the problems facing leg amputees are not wholly prosthetic. Many are clearly medical; for example, pain, circulatory problems, and skeletal changes. Many amputees also require the care of the dermatologist more or less frequently throughout their lives. The dermatologist is capable of rendering invaluable aid to the other members of the rehabilitation team, since he is in a position to be familiar with the problems of the skin that may result from wearing an artificial limb.

The skin of an amputee who wears a prosthesis is subject to many abuses. Most leg prostheses have a snugly fitting socket in which air cannot circulate freely and perspiration is trapped. The socket provides for weight-bearing; uneven loading may cause stress on localized areas of the stump skin. Examples of such stress are

intermittent stretching of the skin and friction from rubbing against the socket edge and interior surface. With certain types of prostheses, stump socks are worn for reduction of friction. In the above-knee amputee, pressure may be exerted on the adductor region of the thigh, the groin, and the ischial tuberosity—points of contact with the socket rim. If a suction socket is used for suspension, the stump is subjected to negative pressure as well. In the below-knee amputee, who usually still has the upper third of the tibia, pressures occur over the anterior tibial area and the sides and, sometimes, the end of the stump. In the conventional below-knee prosthesis, constriction of soft tissues of the thigh by the thigh corset may cause significant obstruction to venous and lymphatic drainage of the leg. In addition to the effects of pressure and friction, the amputee's skin is vulnerable to the possible irritant or allergenic action of the materials used in the manufacture of his prosthesis.

The state of the stump skin is of utmost importance in the amputee's ability to use a prosthesis. If good skin condition cannot be maintained despite daily wear and tear, the prosthesis cannot be worn, no matter how accurate the fit of the socket may be.

Since continued use of the prosthesis is so important in the amputee's rehabilitation, it is of vital concern to the physician and the prosthetist to prevent any disorder which may return him to crutches or bed rest. Some amputees may have no disorder of the stump skin for months or years, while others, whose skin has less tolerance for trauma, experience frequent difficulties. Even minute lesions are of great importance, since they may be the beginning of an extensive skin disorder which can bring mental, social, and economic disaster to an amputee.

---

All correspondence to be addressed to Dr. S. W. Levy, University of California, 450 Sutter Street, Suite 2001, San Francisco, California 94108, U.S.A.

This article deals with the common skin problems associated with the wearing of a lower-extremity prosthesis. Twenty-five years ago the Biomechanics Laboratory, in conjunction with the Department of Dermatology at the University of California School of Medicine, in San Francisco, organized a group to investigate the cutaneous problems of the lower-extremity amputee. Amputees were referred to us by physicians and prosthetists for the study and treatment of unusual and persistent conditions that had not responded to conventional therapeutic measures. Approximately the same number of above-knee and below-knee amputees have been seen. Much of our experience was gained with amputees using suction-socket suspension, but the same or similar problems have been found in patients using conventional types of suspension.

The cutaneous disorders peculiar to lower-extremity amputees have been classified, as well as evaluated and treated in individual cases. Out of this study improved methods of treatment have evolved. These are summarized in this paper, after a brief discussion of the methods of stump hygiene that have been found most beneficial.

### Stump hygiene

We have found that poor hygiene is an important factor in producing some pathological conditions of the stump skin. Poor hygiene is largely responsible for bacterial and fungus infections, nonspecific eczematization, intertriginous dermatitis, and persistence of epidermoid cysts. Some patients fail to wash adequately either the stump or the socket, and maceration and malodour result. There has been no unanimity of opinion as to exactly what measures should be used routinely, and amputees have come to us with varied and often strange ideas about stump hygiene.

A simple hygienic programme with use of a bland soap or sudsing detergent has often had a preventive or a therapeutic effect on a cutaneous disorder. For example, this treatment has been found to be curative for some persistent eczematoid eruptions of the stump. Soaps or detergents that contain chlorhexidene or hexachlorophene have bacteriostatic, in addition to cleansing action and thus help reduce the possibility of infection. Amputees should be advised to purchase a plastic squeeze bottle of

liquid detergent containing an antimicrobial which is relatively inexpensive and available in drugstores without a prescription. Some amputees prefer to use cake soap containing an antibacterial substance. They should be instructed in the use of such agents.

The cleansing routine should be followed nightly or every other night, depending on the rate of perspiration, the degree of malodour, and the bathing habits of the person. The stump should not be washed in the morning unless a stump sock is worn, because the damp skin may swell, stick to the socket, and be irritated by friction during walking. For the same reason the best time to cleanse the socket is also at night. If a stump sock is worn, it should be changed every day and should be washed as soon as it is taken off, before perspiration is allowed to dry in it. If the sock dries with a "dog ear", a rubber ball can be inserted to give it shape.

### Stump oedema syndrome

When an amputee first starts to wear a suction-socket prosthesis, his skin must adapt to an entirely new environment. He can expect oedema, reactive hyperemia, reddish-brown pigmentation resulting from capillary hemorrhage and, occasionally, serous exudation and crusting of the skin of the terminal portion of the stump. These changes are the almost inevitable result of the altered conditions forced on the skin and the subcutaneous tissues. They are relatively innocuous, do not usually require therapy, and can be partially prevented by gradual compression of the stump tissues with an elastic bandage or "shrinker" sock prior to use of the prosthesis. An incorrectly fitted socket may predispose the leg amputee to this disorder by imposing a pressure distribution that disturbs circulation. Oedematous portions of the skin of the distal part of the stump may become pinched and strangulated within the socket (Fig. 1, left) and may ulcerate or become gangrenous as a result of the impaired blood supply.

Biopsies have shown that the brown pigmentary changes so often seen on the distal portion of the stump are due to hemosiderin deposited within the tissue (Fig. 1, right). It is thought this disorder is vascular in origin, a venous and lymphatic congestion producing the oedema and hemorrhage. Superficial erosion of the distal stump skin is not uncommon, and, in



Fig. 1. Left, stump oedema seen through the socket valve. Right, hyperpigmentation of stump skin secondary to chronic stasis.

rare instances, deep ulcers can result from the poor cutaneous nutrition.

Therapy by the dermatologist requires teamwork with the orthopaedic surgeon and prosthetist. This includes elimination of all mechanical factors contributing to the oedema, such as choking by the socket and poor fit and alignment. Excessive negative pressure in a suction-socket prosthesis will also contribute to circulatory congestion and oedema. Treatment should be directed toward better support of the distal soft tissues.

#### Cutaneous problems

**Contact dermatitis.** We have seen a number of patients with contact dermatitis of the amputation stump (Fig. 2, left). In these amputees this disorder was usually caused by contact of the skin with chemical substances that acted either as primary irritants or as specific allergic sensitizers. Varnishes, lacquers, plastics, or resins may be used in finishing the sockets of leg prostheses. We have had to learn about the materials used in different types of prostheses in order to understand and treat the problem adequately. We have also had to analyze the different conditions of heat, humidity, and friction in the socket, since these are related to the intensity of the reaction.

Epoxy resins are frequently used to improve the appearance of a socket and to render it impervious to external agents. These resins, if incompletely cured in their manufacture, may produce a primary irritant dermatitis, as well as cause a specific allergic reaction. Some amputees use a foam-rubber cushion, others a plastic-covered pad, on the bottom of the socket. A number of the cements and volatile substances used to repair prostheses are also capable of

producing either an irritant reaction or allergic sensitization. Any of these agents is capable of producing a contact dermatitis of the stump skin after weeks, months, or even years of use. In some instances we found only by a carefully taken history that the use of a new cream, lubricant, or cleansing agent coincided with the onset of the dermatitis.



Fig. 2. Left, contact dermatitis of distal stump skin due to Naugahyde pad in bottom of socket. Right, positive patch test (B) on arm from pad. (A) is negative control.

When contact dermatitis is suspected, every attempt should be made to determine the contactant. Patch tests are most informative in pinpointing specific substances as the cause of dermatitis of the stump (Fig. 2, right). Because patch testing with strong concentrations of known primary irritants will result in reactions on any skin, solutions of such substances are first diluted according to published lists in order to prevent a false-positive reaction and possible injury to the skin.

The following sources of contact dermatitis have been proved in a number of our patients:

Ambroid	Platon
C-8 epoxy resin	rayon
polyethylene	sizing in new stump sock
foam-rubber pads	T-161 cement
McCloskey's trans-	Fuller Synalac No. 7790
parent lacquer	Saran (auto seat cover)
tincture of Merthiolate	Aerowax
adhesive tape	Naugahyde

Removal of the suspected contactant resulted in a cure, and subsequent patch testing identified the offending agent.

In those instances of contact dermatitis where the irritant has not been obvious and patch tests have been inconclusive, temporary symptomatic therapy has alleviated the symptoms. Cool compresses, bland antipruritic lotions, and the

topical use of hydrocortisone or similar corticosteroid preparations have been beneficial.

#### *Nonspecific eczematization*

Nonspecific eczematization of the stump skin has been seen in a number of instances as a persistent, weeping, itching area of dermatitis over the distal portion of the stump. The lesions at times are dry and scaly and at other times become moist without apparent reason. The condition often fluctuates over a period of months or years and may be a source of much anxiety to the amputee.

We have tried to find the cause of this dermatitis through a complete study of the patient—history, physical examination, laboratory tests, and subsequent observation of the clinical course of the condition. We have been able at times to elicit a significant history of recurrent allergic eczema and in some cases to demonstrate active eczematous lesions on other portions of the body to account for the eruption on the stump. In other instances the eczema has been secondary to poor fit or alignment of the prosthesis or to oedema and congestion of the terminal portion of the stump, so that only with the alleviation of these problems has the condition cleared. Temporary symptomatic topical treatment with hydrocortisone or other corticosteroid preparations is effective, but the condition frequently recurs unless its cause can be eliminated.

#### *Epidermoid cysts*

A number of authors have described the appearance of multiple cysts, commonly called post-traumatic epidermoid cysts, in the skin of amputees' stumps in association with the wearing of an artificial limb. They occur most frequently in above-knee amputees in the areas covered by the upper medial margins of the prosthesis (Fig. 3, left), but they have also been seen in other areas and in below-knee amputees (Fig. 3, right). Usually the cysts do not appear until the patient has worn a prosthesis for months or years.

Characteristically, in the above-knee amputee small follicular keratin plugs develop in the skin of the inguinal fold and of the adductor region of the thigh along the upper edge of the prosthesis.

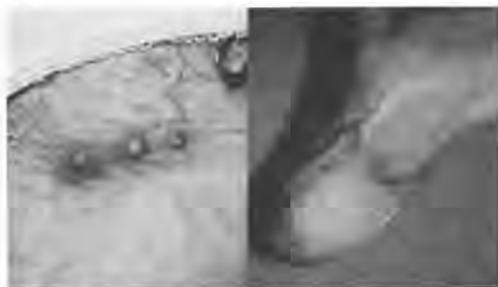


Fig. 3. Left, adductor cysts on thigh of above-knee amputee. Right, below-knee amputee with epidermoid cyst (outlined).

Similar plugs may appear over the inferior portion of the buttock where the posterior brim, or ischial seat, of the prosthesis rubs. Through the process outlined below, some of these plugs may become deeply implanted and develop into cysts (Fig. 4, left). These lesions may become as large as 5 cm in diameter. They are seen as round or oval swellings deep within the skin, and with gradual enlargement become sensitive to touch. The skin may break down and erode or ulcerate. If irritation by the prosthesis is allowed to continue, the nodular swelling may suddenly burst and discharge a purulent or serosanguinous fluid. The sinus discharge may become chronic and thus make it impossible for the patient to use his prosthesis. Frequently, scars remain after the cysts have healed. If the break takes place within the deeper portion of the skin, subcutaneous intercommunicating sinuses may develop.

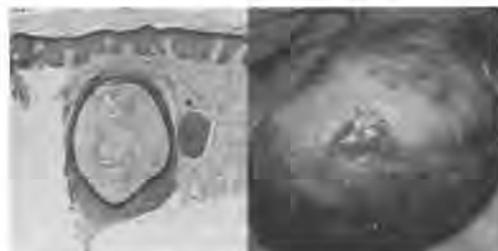


Fig. 4. Left, low-power photomicrograph of early epidermoid cyst. Right, distal stump ulcer.

Some investigators regard the cysts as sebaceous adenomata and speak of sebaceous adenitis as being of frequent occurrence in the adductor region of the thigh. These and similar lesions have also been described in the hands and fingers after trauma.

It appears that the condition is one in which the surface keratin and epidermis become invaginated, acting as a "foreign body". Under the influence of friction and pressure from the prosthesis the keratin plug and its underlying epidermis are displaced into the corium. The result is a production of nonspecific inflammation and implanted epidermoid cysts. These cysts can remain quiescent for a long period of time or can, with secondary bacterial invasion by *Micrococcus* (*Staphylococcus*) *pyogenes* var. *aureus* or other skin pathogens, become abscessed and produce the characteristic clinical picture.

Either surgical incision and drainage or excision of the chronic, isolated, noninfected nodule may give temporary relief, but there is no completely satisfactory method of treatment. In the acutely infected phase, hot compresses and antibiotics (selected through bacterial studies and sensitivity tests of the cystic fluid) are indicated. As the process localizes, incision and drainage may be temporarily beneficial. The chronic problem can, in some instances, be improved or successfully eliminated by proper fit and alignment of the prosthesis.

At the present time we are applying various topical agents in an effort to prevent or retard the inflammation that follows the formation of the keratin plug, which may be the precursor of the epidermoid cyst. We have attempted to develop a stump sock or adductor rim sock for use with the suction-socket prosthesis to prevent cyst formation. Various substances have been tried as socket liners for reduction of friction over pressure areas. Polytetrafluoroethylene film (Teflon) has been found to be the most satisfactory for this purpose. Hydrocortisone or its derivatives have been injected into the cysts and their channels. Inunction of hydrocortisone preparations in areas of maximum friction has also been tried. This was found to reduce inflammation, as anticipated, and to provide symptomatic relief though only temporarily. In our experience, there is still no completely satisfactory method of treatment, and each case is a therapeutic challenge.

#### *Pyodermas*

Folliculitis and furuncles are often encountered in amputees with hairy, oily skin, since the condition is aggravated by the use of an artificial leg. It is usually worse in summer, when

increased warmth and moisture from perspiration promote maceration of the skin in the socket, which in turn, favors invasion of the hair follicle by bacteria. Ordinarily, this process is not serious, but sometimes it progresses to formation of furuncles, cellulitis, or an eczematous, weeping, and encrusted superficial pyoderma.

Folliculitis and furuncles may be the result of poor hygiene of the stump or the socket. In 10 lower-extremity amputees, the bacterial flora of the skin of the stump was compared with the flora of the skin of the opposite, normal limb. All subjects wore prostheses and followed a satisfactory routine of stump hygiene. The stump skin was found to harbour a bacterial flora considerably more abundant than that of the skin of the contralateral leg.

In several patients chronic recurrent folliculitis was essentially cured by having the amputee adhere to the routine hygienic programme previously described. In other instances therapy may need to include wet dressings, incision and drainage of boils after localization, oral or parenteral use of antibacterial substances, or local application of bactericides.

Some manufacturers of plastics and resins for use in artificial limbs are now experimentally incorporating bacteriostatic substances into their products to aid in preventing bacterial infection by reducing the total bacterial count. Porous laminates with bacteriostatic additives are being investigated; such agents, by allowing more air about the stump skin, may help to reduce excessive perspiration and resultant bacterial and/or fungus infection.

#### *Fungus infections*

Superficial fungus infections of the stump skin may be difficult to eradicate completely because of continued moisture, warmth, and maceration in the prosthetic socket. *Tinea corporis* and *tinea cruris* usually appear only on the part of the stump or thigh enclosed by the socket. The diagnosis may be confirmed by culture and microscopic demonstration of the fungus filaments in scales or vesicles removed from a lesion. Therapy consists of the application of fungistatic creams and powders for an extended period of time. The oral antifungal antibiotic, griseofulvin, may be of benefit in recurrent

*Trichophyton rubrum* infections which have not responded to topical therapy.

#### *Intertriginous dermatitis*

Intertriginous dermatitis is an irritation of those skin surfaces which are in constant apposition and between which there is hypersecretion and retention of sweat. This condition usually occurs in the inguinal or crural areas, but on occasion it occurs in the folds of the end of the stump where two surfaces of the skin rub each other and where the protective layer of keratin is removed by the friction. Continued friction and pressure from the socket may result in lichenified and pigmented skin. A chronic disorder may develop, with deep, painful fissures and secondary infection and eczematization. Hygienic measures to cleanse the apposing folds and the use of drying powders or lotions are beneficial. Often these problems may be corrected by proper prosthetic fit and alignment.

#### *Chronic ulcers*

Chronic ulcers of the stump may result from bacterial infection or from poor cutaneous nutrition secondary to an underlying vascular disorder or to localized pressure from a poorly fitting prosthesis (Fig. 4, right). Malignant ulcers can develop within old, persistent stump ulcerations; therefore, every effort should be made to treat the condition before it becomes chronic. With repeated infection and ulceration of the skin the amputation scar may become adherent to the underlying subcutaneous tissues, a condition which invites further erosion and ulceration. Continued wear and tear from the use of a prosthesis may necessitate surgical revision in order to free the scar in the bound area.

#### *Tumours*

Tumours of the stump skin may be benign or malignant. We have seen benign hyperkeratoses and have removed viral verrucae from the stump skin. Simple cutaneous papillomas are easily removed. A cutaneous horn on the amputation stump has been reported by others, and we have removed one from a below-knee amputee wearing a conventional prosthesis.

#### *Verrucose hyperplasia*

A verrucose condition of the skin of the entire distal portion of the stump has been seen in a

number of instances (Fig. 5). This disorder has been described as *verruca vulgaris*, but in biopsies taken by us the pathological picture of viral verrucae has not been seen. The condition has been thought by some to be associated with malignancy. Among patients with verrucose hyperplasia, we have found only one such instance. In a 40-year-old male patient with extensive ulceration and infection of the stump skin and verrucose hyperplasia of long duration, a squamous cell carcinoma developed in the skin and extended into the bone.



Fig. 5. Top, terminal lymphatic stasis of distal stump skin of above-knee amputee; this may precede verrucose hyperplasia. Bottom, verrucose hyperplasia of distal stump skin in a below-knee amputee.

A number of our patients had had verrucose hyperplasia for months or years. Many had made the rounds of general physicians, dermatologists, prosthetists, and orthopaedic surgeons. They had been treated with topical preparations and by various types of radiotherapy without effect. Systemic antibiotics and other oral medications had been of only temporary benefit.

It was only through trial and error that we found external compression to be the best method of treatment, in combination with adequate control of bacterial infection. In the below-knee amputees seen by us who had this

condition, the distal part of the stump was oedematous; the stump dangled freely in the socket. When support of the stump end was provided in the socket by means of a temporary platform built up with foam-rubber cushions, the verrucose condition was reduced. The greater the compression on the distal stump, the more immediate and lasting was the improvement.

It was as a result of this investigation that the engineers and prosthetists of the Biomechanics laboratory modified the prosthetic design to provide back pressure for the tissues at the end of the stump. After several weeks' use of the modified prosthesis, the verrucose condition of these patients disappeared and did not recur. The hyperplastic condition appeared to have been secondary to an underlying vascular disorder, poor prosthetic fit and alignment, and, possibly, bacterial infection.

The successful treatment of this disorder serves as yet another example of the need for interdisciplinary cooperation to provide the maximum benefit to the individual amputee.

#### Other disorders

Over a period of time numerous cases have been observed of chronic dermatoses which were localized on the stump. We have seen patients with acne vulgaris of the face and back develop acne lesions of the stump. We have seen similar localizations in patients with seborrheic dermatitis, folliculitis, and eczema. We have seen and there are recorded instances of psoriasis (Fig. 6) and lichen planus developing on the stump skin with few lesions present elsewhere on the body. Here it is important to treat the generalized cutaneous disorder in order to improve the stump condition.

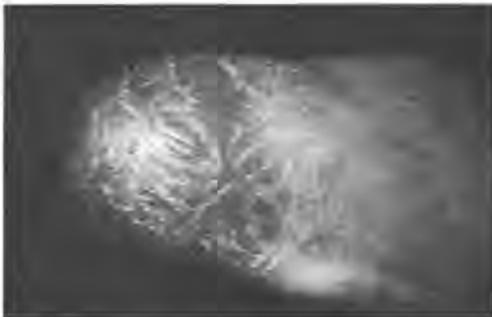


Fig. 6. Psoriasis of distal stump skin.

#### Summary

The importance of early recognition and treatment of skin lesions on the stumps of amputees cannot be overemphasized. Heavy demands are placed on the stump skin by the artificial limb. Even a minor skin eruption may, through neglect or mistreatment, become an extensive disorder that will seriously threaten the amputee's mental, social, and economic rehabilitation. Contact dermatitis, eczemas, epidermoid cysts, bacterial and fungus infections, chronic ulcers, and verrucose hyperplasia are among the disorders to which the stump skin is subject. Proper stump hygiene is often effective in alleviating or averting some of these conditions.

Since skin disorders in amputees are essentially "environmental" dermatoses, their treatment often involves change of the environment through adjustment or redesign of the artificial limb. For example, verrucose hyperplasia was treated successfully by a change in prosthetic design. Thus, the skills of engineers and prosthetists must be combined with the contributions of dermatologists and other medical specialists in the solution of skin problems of the amputee.

#### BIBLIOGRAPHY

- ALLENDE, M. F., BARNES, G. H., LEVY, S. W. and O'REILLY, W. J. (1961). The bacterial flora of the skin of amputation stumps. *J. Invest. Derm.*, **36**, 165-166.
- ALLENDE, M. F., LEVY, S. W. and BARNES, G. H. (1963). Epidermoid cysts in amputees. *Acta Derm Venereol. (Stockh.)*, **43**, 56-67.
- BARD, G. and RALSTON, H. J. (1959). Measurement of energy expenditure during ambulation, with special reference to evaluation of assistive devices. *Arch. Phys. Med. Rehab.*, **40**, 415-120.
- BARNES, G. H.: Skin health and stump hygiene. (1956). *Art. Limbs*, **3**, 4-19.
- BARNES, G. H. and LEVY, S. W. (1964). *Problems of the amputee-stump oedema*. Illustrated pamphlet. Biomechanics Laboratory, University of California, 17 pp. + index.
- BURGESS, E. M. (1978). Wound healing after amputation: Effect of controlled environment treatment. A preliminary study. *J. Bone Jt. Surg.*, **60-A**, 245-246.
- FAULKNER, V. and PRITHAM, C. (1973). A below-knee prosthesis with a porous socket. *Orth. Pros.* **27**:1, 1-5.

- LEVY, S. W. (1956). The skin problems of the lower-extremity amputee. *Art. Limbs*, 3, 20-35.
- LEVY, S. W., ALLENDE, M. F. and BARNES, G. H. (1962). Skin problems of the leg amputee. *Arch. Derm.* 85, 65-81.
- LEVY, S. W. and BARNES, G. H. (1961). Problems of the amputee: Stump Hygiene. Illustrated pamphlet. Biomechanics Laboratory, University of California, Berkeley and San Francisco, and the Division of Dermatology, University of California School of Medicine, San Francisco.
- SULZBERGER, M. B., CORTESE, T. A., FISHMAN, L., and WILEY, H. S. (1966). Studies on blisters produced by friction: I. Results of linear rubbing and twisting techniques. *J. Invest. Derm.*, 47, 456-465.

## **Standards for modular prostheses\***

A. STAROS

*Veterans Administration Prosthetics Center, New York*

### **Introduction**

Inefficiency in administration and denigration of product or process quality can result from a purchasing agency (such as a Government) becoming too specific in issuing its requirements for a product or process. Inefficiency is associated with long, overly complex statements of specifications; these produce time-consuming efforts to comply and will, for compliance checking, require heavy investment by the purchaser.

Quality may be affected by the detail of a specification restricting innovation and change.

In limb prosthetics it should be acceptable to limit the standard to overall performance and durability requirements for hardware but to include the most important standards of all, those which establish the function of the assembled product and cover the people performing the service to the patient.

### **Specifications on hardware**

The United States Department of Defence has for many years used detailed specifications for nearly all of its purchases; only recently it considered some change in its philosophy on some standards. The Wall Street Journal of New York, in an article of September 22, 1978 pointed out that the Pentagon is trying to eliminate as nearly as possible all its very bulky statements of requirements for products and instead proceeding to buy items available in the commercial market. One example cited was Worcestershire sauce, for which a 20-page document was set down to cover acidity, colour and spice. Difficulty resulted in achieving

conformance; prices as a result were higher than when the Pentagon elected to suspend its specifications and purchase sauces that had demonstrated commercial market acceptability.

In another example the Wall Street Journal article points out that selling mouse traps to the military would require compliance with about 500 pages of specifications. When the military realized the problems associated with this particular acquisition, the standard for the mouse trap was reduced to less than a page; the requirement for the mouse trap was simply put in terms of the performance required, that of catching a mouse.

These examples (and there are many others) illustrate how over-zealous some government procurement agencies can become in trying to control the purchasing of hardware. The U.S. Veterans Administration some time ago learned that excessive restrictions on detailed prosthesis design would be inappropriate and that innovation would be impeded. Although the Veterans Administration has performance and durability specifications covering very common mass-produced hardware such as artificial hands, elbows, some knee mechanisms, and foot-ankle systems, it will not issue detailed specifications to cover the prosthesis. It is recognized that the quality and performance of the prosthesis (sometimes in spite of the hardware) are most dependent on the persons performing the fabrication and fitting.

### **Specifications on people**

Thus the quality of the prosthesis is related directly to the quality of the service, and the service provided in the delivery of artificial limbs is most dependent on the people providing that

---

All correspondence to be addressed to Mr. A. Staros, Director, Veterans Administration Prosthetics Center, 252 Seventh Avenue, New York, N.Y. 1001 U.S.A.

---

\*Based on a paper presented at the ISPO International Course on Above-knee Prosthetics, Rungsted, November, 1978.

service. Specifics about their quality are based on knowledge and experience as determined by and as judged by their peers. The quality that should be required by purchasing organizations (such as the U.S. Veterans Administration) is that these people meet the highest standards of their profession and that their product meet the highest standards of their industry. Compliance with these are determined primarily in the VA clinics rather than in VA test laboratories where the minor aspects of compliance are determined only on components.

The requirements in the current Veterans Administration contract for procurement of prosthetic services reads as follows:

"The services provided under this contract should represent the highest quality standards of the industry in performing fabrication and

fitting. Prosthetic components purchased under the contract should meet VA's standards for quality and performance, wherever such standards exist. Enforcement of these standards, the compliance testing required, and the dissemination of results will be the responsibility of the VA. Materials and sundry hardware will be of the highest quality used by the industry and profession."

To go much beyond the above would require an extraordinary and expensive capability for compliance testing. Standards which are detailed in terms of design would require persons to be employed to do quality checks to see if every detail of the specification was being met. Controlling the quality of people who supervise fabrications and perform the fittings is a much more sensible (and less expensive) approach.

## A simple and versatile driving appliance for upper-limb amputees

T. E. SENSKY

*Department of Surgery, Stoke Mandeville Hospital, Aylesbury.*

### Abstract

A simple fixed-hook driving appliance is described, suitable for upper-limb amputees, and its function compared with that of the commonly available ball-and-cup device. The hook is reliable, safe and inexpensive. An attachment is also described which fits on to gear levers, allowing the use of the driving appliance to change gears manually.

### Introduction

The ideal driving appliance for upper-limb amputees should be simple, inexpensive, reliable and capable of being used in unmodified cars. The standard ball-and-cup device (motoring appliance AE44, manufactured by Hugh Steeper (Roehampton) Ltd.) partly fulfils these criteria, but is not completely safe, and requires the attachment of the ball device to the steering wheel of every vehicle used. An alternative device is described here, particularly suitable for right-hand amputees driving right-hand-drive vehicles.

### Design

The appliance (Fig. 1) is a fixed V-shaped stainless-steel hook on a short stem. The two forks of the 'V' are covered with tubing rubber or a similar material with a high coefficient of friction. The hook is fitted to a standard adaptor, domed with holes (Steeper catalogue No. 16J) which allows free circumrotation of the hook in the prosthesis.

This design is particularly applicable to below-elbow amputees, but it is unlikely that any modification would be required for above-elbow prostheses.

---

All correspondence to be addressed to, Dr. T. E. Sensky, Department of Surgery, Stoke Mandeville Hospital, Mandeville Road, Aylesbury, Bucks HP21 8AL.



Fig. 1 The fixed-hook driving appliance. The forks of the 'V' are covered by rubber tubing.

### Operation

This is most conveniently considered by comparing the hook with the standard ball-and-cup device.

The hook is able to grip the wheel at any point along its circumference, whereas with the ball and cup device grip is only possible at the point on the wheel to which the ball is attached. The hook offers two advantages in this respect. Firstly, turning the wheel can be executed by small arcs of movement using each arm alternately, which is the exact movement recommended to two-handed drivers. Secondly, because wide swinging movements of the prosthesis are therefore unnecessary, the prosthesis can be maintained in a position of optimum comfort and safety whatever the position of the wheel.

In the ball-and-cup device, the angle subtended by the prosthesis on the axis of rotation of the wheel,  $\alpha$ , (Fig. 2, left) is critical.

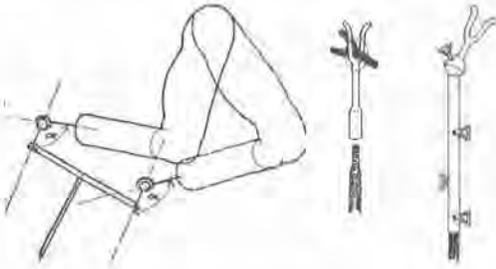


Fig. 2 Left, the use of the ball-and-cup driving appliance. The angle  $\alpha$  changes depending upon the position of the wheel. Right, gear lever attachments for use with the driving hook. The simple attachment is shown on the left, the adjustable appliance on the right (see text).

Upon it depends the ability of the cup to cover the ball and thus effectively to control the wheel. Furthermore, since the ball remains fixed on the wheel, the angle  $\alpha$  changes depending on the position of the wheel. In practice, the driver must be positioned so as to maintain the angle  $\alpha$  as close as possible to  $90^\circ$  whatever the position of the wheel. Such optimum positioning can sometimes be difficult, for example in a sports car with low seats and a nearly vertical steering wheel. Here either the appliance or the vehicle must be modified if control of the wheel is to be adequate.

By contrast, with the hook, the angle  $\alpha$  is unimportant, the V shape allowing a firm grip of most steering wheels whatever this angle. Whatever the vehicle, the driver's only consideration in positioning himself is his comfort.

With the hook, force can be applied in a plane approximately perpendicular to the axis of rotation of the wheel; force applied in this way not only grips the wheel but is effective in turning it. Little muscular effort is required in maintaining this grip, controlled shoulder extension with the elbow fixed in a position of comfortable flexion allowing the hook to wedge against the steering wheel. By contrast, in the ball-and-cup device, the force with which the cup grips the ball must be exerted in the axis of rotation of the wheel, and thus cannot contribute towards turning the wheel; in addition, this force requires continual active elbow extension (in below-elbow amputees). The continual

attention necessary to keep the cup covering the ball detracts from that paid to the road.

The same problems arise with both appliances in operating controls on the steering column. In practice, it is usually possible to stabilize the wheel with the prosthesis and use the other hand to cross over to reach the necessary controls. Alternatively, the controls may be modified or repositioned to make them more easily accessible.

Use of the hook also obviates two other problems sometimes reported with the ball-and-cup appliance, namely a tendency for the ball to work loose (potentially very dangerous) and cracking or other damage to the steering wheel due to fixation of the ball.

### Manual Gear Changes

Here it is necessary to fix an attachment to the gear lever. In principle, as shown in Figure 2 right, the stem of the driving hook fits snugly into the fork of the gearstick attachment, the latter positioned to allow traction in all directions in the horizontal (or other appropriate) plane.

In its simplest form, the gearstick attachment is screwed directly on to the gearstick in place of the gear knob, the attachment being bent permanently to the required shape appropriate to the motorist and his particular vehicle. A more versatile device has a hollow metal tube which slips over the upper part of the gear lever, to which it is attached with screws; such attachment also allows the height of the device to be adjusted. The final adjustment of the angle of the fork utilizes a ball-and-socket joint. A joint allowing movement on one plane only would add to the stability of fixation of the forks, but make the attachment slightly less versatile in its use in different vehicles, the chief advantage of the more complex of the two gearstick attachments.

The principles above can be applied equally well to devices suitable for vehicles with automatic gearboxes and those with column gear levers.

One advantage of the ball-and-cup appliance is that the cup can control a manual gearchange without any modification of the gear lever, although occasionally adjustment is necessary to make the gear lever optimally accessible, usually by permanent bending or replacement of the gear lever. However, this advantage is more than countered by the evident superiority of the fixed-hook appliance in controlling steering,

**Discussion**

The simple fixed hook appliance described has been used for the past 14 years by the author, a congenital below-elbow right-hand amputee, to drive a wide variety of vehicles, including high-performance cars (Fig. 3) and heavy four-wheel-



Fig. 3 The driving hook in use.

drive vehicles. It has shown itself to be easy to use, very safe, and completely reliable. Its manufacture is simple and inexpensive. It allows the mechanism of driving for amputees to approximate closely to that used by two-handed drivers. The hook appliance itself is compact enough to be kept in the glove compartment of a car. In overcoming some of the problems encountered with the ball-and-cup appliance, this hook deserves to be considered as a safer and more versatile alternative.

**Acknowledgement**

The author is very grateful to Ms H. Scrimgoeur, Occupational Therapist, Arm Training School, Queen Mary's Hospital, Roehampton, London S.W. 15, for her valuable comments and for sharing her wide experience in the use of the ball-and-cup appliance.

## **Medizinisch-Orthopädische-Technik, 2/80**

The above volume was dedicated to below-knee prosthetics. As a service to our membership we offer English language abstracts of the contents. We are grateful to Medizinisch-Orthopädische-Technik, for permission to publish these.

### **Editorial**

**R. F. Baumgartner**

#### **Abstract**

The below-knee stump proves to be far superior to the stumps produced by above-knee amputation and even knee disarticulation. Therefore, the orthopaedic surgeon must make every effort to save the knee joint including the insertions of its extensor and flexor muscles. This is particularly important in vascular patients who all are candidates for bilateral leg amputation. Modern below-knee prostheses with total surface contact and without knee hinges or thigh corset have now been available for almost 20 years. The PTB-principle has been improved and now definitely offers much better function and cosmesis for the amputee. Late complications, particularly circulation problems can be avoided. Still, too many prosthetists prefer to fit their patients with conventional below-knee prostheses. This issue tries to encourage surgeons to prescribe and prosthetists to use this modern technique, the age of the steam engine also being over for at least a couple of years. Temporary and final fitting practices are presented with all the details useful to prevent failure.

### **Die Unterschenkel-Kurzprothese The short below-knee prosthesis**

**P. Botta and R. F. Baumgartner**

#### **Abstract**

Report on results with 1180 PTB prostheses. Over 90% of new amputees and 75% of old amputees are fitted with this modified type of PTB below-knee prosthesis. Details of construction and results even in extremely short or long stumps are discussed.

### **Uebungsprothesen mit Kunststoffschäften Temporary prosthesis with plastic socket**

**G. Neff**

#### **Abstract**

Temporary prostheses with sockets made from low pressure polyethylene give excellent results in early and even final fitting of amputees. The material is easy to handle and can be combined with polyethylene closed-cell foam products. Cosmesis, comfort and weight are most acceptable compared to other types of temporary sockets.

### **Frühversorgung Unterschenkelamputierter Early fitting of below-knee amputees**

**F. Rexing and J. Eichler**

#### **Abstract**

A method of temporary prosthetic fitting of below-knee amputees is presented. It permits constant supervision of the wound, total immobilisation of the stump, easy adaptation to changes of volume and early gait training. The prosthesis is light-weight and easy to handle. 17 patients have been fitted so far.

### **Ein Frühversorgungskonzept für Unterschenkel- Amputierte Early fitting of below-knee amputees**

**W. Winkler and G. Fitzlaff**

#### **Abstract**

Early fitting of below-knee amputees is particularly difficult if stump conditions are not ideal. The paper presents a temporary prosthesis which provides total contact and full stability and thus accelerates stump maturation.

# Prosthetics and Orthotics International

## December 1979, Vol. 3, No. 3

### Deutsch

#### Der Aufbau der Oberschenkel-Prothese

**J. Foort**

*Pros. Orth. Int.*, 3:3, 137-139

##### Zusammenfassung

Der Aufbau von Oberschenkel-Prothesen wird diskutiert, im Sinne von besonderen Veränderungen der relativen Prothesen-Stellung und deren Auswirkung für den Oberschenkel-Amputierten.

Die Wirkung einer Veränderung der Länge, der Fussposition (vorwärts, rückwärts, medial und lateral), und des Fusswinkels (Spitzfuss, Hackenfuss, Einwärtsstellung, Auswärtsstellung), werden für die verschiedenen Gangphasen in Betracht gezogen:

- a) Schwungphase, unbelastet
- b) Standphase, belastet
- c) bewusste Kontrolle
- d) Umstände unter welchen wenig oder keine Kontrolle angewandt werden kann.

#### Gedanken zur Rohrskellettprothese

**J. Foort**

*Pros. Orth. Int.*, 3:3, 140-143

##### Zusammenfassung

Der Autor definiert das Modular-Rohrskellett-System und schildert die Entwicklung, die mit Versuchsmodellen in den Fünfzigerjahren begonnen hat. Möglichkeiten dieser Modularprothesen werden vom Standpunkt des Konstrukteurs, des Orthopädietechnikers, des Amputierten, des Rehabilitationszentrums, der zahlenden Stelle und des Staatsbürgers her erleuchtet.

#### Gehschulung für Unterschenkel-Amputierte

**C. van Griethuysen**

*Pros. Orth. Int.*, 3:3, 163-165

##### Zusammenfassung

Ein Gehschul-Programm für Unterschenkel-Amputierte wird vorgestellt, wobei auch die prä- und postoperative Behandlung kurz erwähnt wird. Weiter werden Gehübungen für

Anfänger und Fortgeschrittene gezeigt. Einige Abweichungen vom Gangbild werden diskutiert, da dieses Wissen für den Physiotherapeuten Voraussetzung ist, um optimale Ergebnisse zu erzielen.

Ganz besonders wird die Zusammenarbeit zwischen den Mitgliedern des klinischen Teams hervorgehoben, die dem Patienten erst die Voraussetzung schafft; ein optimaler Gang zu erzielen.

#### Die Errichtung von orthopädietechnischen Versorgungszentren in Afrika

**S. Heim**

*Pros. Orth. Int.*, 3:3, 152-154

##### Zusammenfassung

Die Orthopädiewerkstatt von Tunis wurde 1973 einer einheimischen Leitung übertragen. Bei einem Besuch 5 Jahre später stellte man fest, die Versorgung der Amputierten auf gleichem Niveau gehalten werden konnte, jedoch nicht ausgebaut wurde. Besonders eine Anpassung des technischen Wissens an die lokalen Gegebenheiten hat nicht stattgefunden. Ausserdem hat sich die soziale Betreuung verschlechtert. Daraus folgt, dass ständige Kontrollbesuche wesentlich sind, nachdem das Zentrum einmal in einheimische Hände übergegangen ist.

Trotzdem ist Tunesien das auf diesem Gebiet am weitesten entwickelte Land in Afrika. Die meisten Länder Schwarzafrikas haben für die Patienten Versorgungsmöglichkeiten nur in der Hauptstadt. Diese vermögen jedoch den Bedarf der übrigen Bevölkerung niemals zu decken. Die gezeigten Schwierigkeiten erfordern besser ausgebildetes technisches Personal als in den Industrieländern, einen hohen technischen Standard und eine umfassende Ausbildung. Die Zeit für die Planung und Durchführung solcher Projekte war bisher zu kurz bemessen. Die Bedürfnisse der Bevölkerung, von der 90% auf dem Lande lebt, werden geschildert, die

Anforderungen festgelegt in der Meinung, sie sollten gleich hoch sein, wie in den Industriestaaten.

### **Gedanken zur sensiblen Rückinformation bei Handprothesen**

**P. Herberts and L. Körner**

*Pros. Orth. Int.*, 3:3, 157-162

#### **Zusammenfassung**

Die Entwicklung von neuen Empfindungs-Rückkoppelungssystemen (sensory feedback) für die Handprothetik ist nicht so erfolgreich wie die modernen Systeme der Prothesenkontrolle. Dieser Unterschied wird verursacht durch eine ungenügende Analyse des Begriffes der Empfindungsrückmeldung und dem Mangel an Wissen der Bewegungsphysiologie. In diesem Artikel werden moderne Theorien der physiologischen Bewegung kurz zusammengefasst und die Verbindung dieser Theorien mit der Entwicklung der Empfindungsrückmeldung werden diskutiert.

Die Schlussfolgerung zeigt, dass in Zukunft, das System der Empfindungsrückmeldung für Handprothesen in dem Sinne geleitet werden sollte, dass die physiologischen Bewegungsergebnisse, die man von den Prothesen Kontrollsystemen gewonnen hat, verwendet werden. Dies kann durch die Weiterentwicklung des Kontrollsystems gewonnen werden. Ein Versprechen bildet in dieser Hinsicht die proportionalen Kontrollsignale, welche durch die Unterscheidung von den mioelektrischen Signalen gewonnen werden. Die Entwicklung von künstlichen Systemen für die Rückmeldung sollte auf die Fälle beschränkt werden, bei welchen die Rückmeldung von der Prothesenkontrolle ungenügend ist.

Die Wichtigkeit der Einfachheit und Zuverlässigkeit der Rückmeldungssysteme wird betont, als auch die Notwendigkeit nach dem Einbau eines Rückmeldesystems die prothetische Unabhängigkeit aufrecht zu erhalten.

### **Orthopädiertechnik in Lateinamerika**

**E. Jensen**

*Pros. Orth. Int.*, 3:3, 155-156

#### **Zusammenfassung**

Lateinamerika ist ein Gebiet mit sehr unterschiedlichen Kulturen und Geisteshaltungen. Der Amputierte wird je nach seinem

Einkommen von privaten, von staatlich unterstützten oder vom Staat betriebenen Werkstätten versorgt. Auf die Schwierigkeit, Patienten der unteren Einkommensgruppe eine gute Versorgung zu bieten, wird hingewiesen wie auf die Notwendigkeit, die Qualität und Raschheit der Versorgung zu verbessern, und zwar mit einheimischen Material und Arbeitskräften. Finanzielle und Statusprobleme bilden eine Schranke gegen die Fortbildung und Anerkennung des Orthopädietechnikers. Aus diesem Grund ist unser Berufsstand wenig attraktiv. Eine bessere Aus- und Weiterbildung ist dringend notwendig.

### **Selbsthaftender Totalkontaktschaft für Oberschaft für Oberschenkelstümpfe**

**R. G. Redhead**

*Pros. Orth. Int.*, 3:3, 126-136

#### **Zusammenfassung**

Ein neuer Oberschenkelköcher wurde entwickelt, der durch seinen Totalkontakt wenigstens teilweise auf den Tubersitz verzichten kann. Die Grundlage dieses Köchers basiert auf der Annahme, dass die Weichteile in einem gut geformten Oberschenkelköcher voll belastet werden können und sich unter Druck wie ein elastischer fester Körper mit wenig Festigkeit verhalten. Für die Modellnahme wurde eine neue Methode entwickelt, indem ein elastischer Strumpf zusätzlich als nachgiebiger Köcher angewendet wird. Der Halt des elastischen Strumpfes und die Benützung eines Extensionszuges bringt die Weichteile des Stumpfes in die gewünschte Form, während das Gipsnegativ abbildet. Die Ergebnisse, die im Laboratorium von den unter Belastung im Köcher gemessenen Druckwerten gewonnen wurden, entsprechen unseren theoretischen Berechnungen. Dieser neue Typ ist nun in einigen Zentren in England erhältlich.

### **Die Wirtschaftlichkeit der Modularprothese**

**A. Staros**

*Pros. Orth. Int.*, 3:3, 147-149

#### **Zusammenfassung**

Die Bedeutung des Ausdruckes 'Modular' in der Prothetik wird untersucht. Die Zeit, in welcher individuelle Bestandteile, an laufenden, gängigen Modellen ausgewechselt werden können, wird besprochen. Die ökonomische Seite der Versorgung von Patienten mit

Modularprothesen wird besprochen und die Schlussfolgerung gezogen, dass mit dieser Technik keine speziellen Einsparungen zu erzielen sind, sondern die Zeiteinsparung für den Orthopädie Techniker durch die höheren Materialkosten ausgeglichen werden.

Die Vorteile der Austauschbarkeit der Bestandteile in Bezug auf die Verordnung, werden untersucht. Am Schluss wird die Anwendung von neuen Materialien beschrieben wie Grafit, Epoxy-Harz, um damit das Gewicht der Bestandteile zu verkleinern.

### **Rohrskelett-Prothesen für die untere Extremität** **J. S. Taylor**

*Pros. Orth. Int.*, 3:3, 144-146

#### **Zusammenfassung**

Die Bedingungen für eine gute Unterschenkel-Rohrskelett-Prothese werden aufgezeigt. Zwei bestehenden Rohrskelett-Prothesen Systeme werden miteinander verglichen:

Das eine wird nach der Anprobe, bei der Fertigstellung weiterverwendet, das andere wird nach der Anprobe ausgewechselt.

Das nicht auszuwechselnde System wird als leichter und in der Herstellung als kürzer beschrieben. Bei der Oberschenkel-Rohrskelett-Prothese werden noch weitere Gesichtspunkte in Erwägung gezogen, wie Präzision des Aufbaus, Einbaumöglichkeiten der verschiedenen Knie-systeme und Auswechselbarkeit der einzelnen Bestandteile, sowie kosmetische Probleme.

Schliesslich wird über das Lagern von Bestandteilen und über die Anforderungen welche an die Mitarbeiter gestellt werden, Ueberlegungen angestellt.

### **Ultraleichte Prothesen**

**A. B. Wilson, Jr.**

*Pros. Orth. Int.*, 3:3, 150-151

#### **Zusammenfassung**

Das Orthopädie-Technische Forschungsprogramm in den USA war, bedingt durch den 2. Weltkrieg, speziell auf junge, gesunde Amputierte ausgerichtet. Aus diesem Grunde wurde dem Gewicht der Prothese wenig Aufmerksamkeit geschenkt. Seit ungefähr 1960, erfordert der nun zu versorgende geriatrische Patient eine leicht Prothese. Die sehr leichte Unterschenkel-Prothese aus Polypropylen welche vom Moss-Rehabilitations-Zentrum

entwickelt wurde wird vorgestellt. Diese befindet sich in klinischer Beurteilung.

Der nächste Schritt der Weiterentwicklung wird diskutiert. Dieses Studium wird über die Wirkung von Gewicht und die Verteilung desselben in der Oberschenkel-Prothese Auskunft gegeben. Man hofft damit, eine gute und leichte Prothese für den geriatrischen Amputierten zu erhalten.

## **Español**

### **Alineamiento de las prótesis por encima de la rodilla**

**J. Foort**

*Pros. Orth. Int.*, 3:3, 137-139

#### **Resumen**

Se describe el alineamiento en términos de los resultados de determinados cambios en la posición relativa de las partes en la marcha de los amputados por encima de la rodilla.

Se estudian los efectos de los cambios en longitud, posición del pie (hacia adelante, hacia atrás, medial y lateral) y el ángulo del pie (dedos hacia arriba, hacia abajo, hacia adentro, hacia afuera), para las siguientes condiciones del ciclo de la marcha.

a) fase de balanceo, es decir, sin carga.

b) fase de apoyo, es decir, con carga.

c) control voluntario, y

d) los momentos en que no se puede ejercer más que muy poco control e incluso ninguno.

### **Prótesis modular—un punto de vista filosófico**

**J. Foort**

*Pros. Orth. Int.*, 3:3, 140-143

#### **Resumen**

El autor proporciona una definición de los sistemas modulares y sigue su desarrollo desde los diseños experimentales de los años 50. Se examina y discute la aplicación de sistemas protésicos modulares desde el punto de vista del diseñador, el protésico, el amputado, el centro, el organismo asegurador y el ciudadano.

### **Entrenamiento en la marcha para amputados por debajo de la rodilla**

**C. van Griethuysen**

*Pros. Orth. Int.*, 3:3, 163-165

#### **Resumen**

Se describe un procedimiento de entrenamiento

para la marcha para los amputados pre debsajo de la rodilla, que incluye un resumen del tratamiento pre y post-operatorio y los ejercicios para el entrenamiento de la marcha. Se discuten algunas desviaciones de la marcha, ya que su conocimiento es fundamental para un fisioterapeuta, si quiere conseguir unos óptimos resultados.

Se insiste en que cada miembro del equipo clínico debe de estar en comunicación con los demás, con objeto de que el paciente pueda conseguir una marcha óptima.

### **La creación de servicios protésicos en los países Africanos**

**S. Heim**

*Pros. Orth. Int.*, 3:3, 152-154

#### **Resumen**

En 1.973 la dirección del taller ortopedico de Tunez, se traspasó a un director tunecino. Se describe la visita realizada cinco años más tarde. Se observó que se habría mantenido el servicio, pero que no se habría desarrollado no se habría realizado una adaptación de los conocimientos técnicos a las necesidades del país y el servicio social había sufrido un deterioro. Se llegó a la conclusión que después de un traspaso de este tipo de servicios, es esencial realizar visitas regulares.

Tunez, sin embasrgo, es el país más desarrollado de Africa en este campo. La mayoría de los países africanos tienen alguna clase de servicios en la capital, pero no hacen frente a las necesidades de toda la población. Las dificultades son más perentorias en lo referente al personal técnico que en los países desarrollados, siendo necesario una formación completa y de alto nivel. Esto, a su vez, lleva consigo que el periodo de planificación y puesta en marcha de tales proyectos haya sido hasta ahora demasiado corto.

Se discuten las necesidades de la población, el 90% de la cual vive en zonas rurales, y los requisitos para un mismo nivel de asistencia ortopedica que en los países desarrollados son así mismo detallados.

### **Ideas sobre información sensorial en la prótesis de mano**

**P. Herberts and L. Körner**

*Pros. Orth. Int.*, 3:3, 157-162

#### **Resumen**

El desarroll de sistemas para una información

sensorial en las prótesis de mano no ha tenido el éxito de los sistemas modernos de control de prótesis. Esta discrepancia es debida en parte a un análisis insuficiente de los conceptos de información sensorial y por negligencia en el conocimiento de la fisiología de la cinestesis. Se sumarizan las teorías modernas sobre la cinestesia fisiológica y se discuten la implicación de estas teorías en el desarrollo de los sistemas de información sensorial de las prótesis. Se lleaga a la conclusión de que el futuro desarrollo de sistema de información sensorial de la prótesis de mano, debería estar dirigido hacia un aumento del uso de la cinestesis fisiológica como resultado de la función de los sistemas de control de la prótesis. Todo puede conseguirse con un mayor desarrollo de los sistemas de control. Un paso prometedor en esta dirección es el uso de una señal de control proporcional basada en la recepción de una señal a través del reconocimiento de señales mioeléctricas multiples. El desarrollo de sistemas artificiales para la recepción de sensaciones deberían restringirse a las situaciones en las que sea insuficiente la información resultante del control de la prótesis. Se acentúa la importancia de la sencillez y seguridad del sistema de información, así como la necesidad de poder incluirlo en la prótesis, incluso después de aplicar un sistema de información.

### **Protésica y Ortésica en America Latina**

**E. Jensen**

*Pros. Orth. Int.*, 3:3, 155-156

#### **Resumen**

Latino América es una zona de amplias variedades de cultura y actitudes. El amputado se suministra de teindas privadas, laboratorios subvencionados por el Estado y de Laboratorios controlados por el Gobierno, de los que podrá valerse de acuerdo con sus posibilidades. Se analiza la dificultad para proporcionar el servicio en particular para el grupo con unos ingresos más bajos y se subrayan la necesidad de mejorar la calidad y la rapidez del tratamiento y el uso de materiales indígenas y de artesanía local. Los problemas de los Presupuestos son una barrera para mejorar los servieios, así como el fallo en reconocer al protésico profesional en un nivel social y con un salario apropiado, lo que lleva a una falta de personal. Se subraya también la importancial de los avances en la educación y for-mación profesional.

### Encajes de contacto total autosuspendido para amputación por encima de rodilla

R. G. Redhead

*Pros. Orth. Int.*, 3:3, 126-136

#### Resumen

Se ha diseñado un nuevo tipo de encaje por encima de la rodilla que da un apoyo en toda la superficie y que evita que el apoyo isquiático sea la principal área de apoyo. El encaje se basa en la hipótesis de que si los tejidos blandos del muñón están adecuadamente apoyados en un contenedor con la debida forma, reaccionarán a la carga como un cuerpo sólido elástico relativamente blando.

Se ha desarrollado un método para hacer el molde del nuevo tipo de encaje, usando una funda elástica como un 'encaje docil'. La sujeción de la funda elástica y el uso de tracción deforma los tejidos del muñón para que tomen la forma adecuada mientras se seca el molde. El resultado de las medidas de laboratorio de las presiones entre las superficies con estos encajes bajo carga axial, han resultado muy similares a lo que se había previsto. El nuevo encaje se suministra a los pacientes en bastantes centros de Inglaterra.

### Economía de la prótesis modular

A. Staros

*Pros. Orth. Int.*, 3:3, 147-149

#### Resumen

Se examina el significado del término 'Modular' en prótesis. La característica de los diseños actuales, es la velocidad por la que se pueden intercambiar los componentes individuales. Se discuten los aspectos económicos al proporcionar prótesis modulares y se llega a la conclusión de que no hay ahorro en el tiempo del protésico y el ahorro del tiempo del técnico desaparece por los altos costes de los componentes. Se examinan las ventajas del intercambio en el proceso de prescripción y finalmente se describen las ventajas en el uso de componentes de grafito y fibra sepoxy para lograr una reducción del peso en ciertos componentes protésicos.

### Montaje modular para prótesis por encima de la rodilla

J. S. Taylor

*Pros. Orth. Int.*, 3:3, 144-146

### Resumen

Se especifican las necesidades para un montaje modular ideal de prótesis de miembro inferior. Se comparan los sistemas modulares que mantienen el aparato de alineación como parte de la estructura final, de aquellos que requieren retirarlo después de la alineación dinámica. El primero se describe como teniendo las ventajas de menor peso y un tiempo más corto de fabricación.

Otros aspectos de la prótesis modular por encima de la rodilla que se consideran, son la exactitud de la alineación, posibilidad de los diferentes mecanismos de rodilla e intercambio de los componentes y de la restauración cosmética. Finalmente, se consideran las ventajas en el almacenaje y las necesidades de personal.

### Prótesis ligeras

A. B. Wilson, Jr.

*Pros. Orth. Int.*, 3:3, 150-151

#### Resumen

El programa de investigación protésica en Estados Unidos, iniciado después de la 2. guerra Mundial, estaba dirigido principalmente a los amputados jóvenes y sanos. En consecuencia, se prestó poca atención a la reducción del peso. Con la identificación de los problemas de la 3.ª edad, alrededor de 1.960, se creó la necesidad de unas prótesis más ligeras. Se describe la prótesis por debajo de la rodilla ultraligera de polipropileno, desarrollada en el Centro de Rehabilitación Moss. Actualmente está siendo sometida a evaluación clínica.

Se discute el siguiente paso del desarrollo. Esto implicará el estudio de los efectos del peso y su distribución en las prótesis por encima de la rodilla, lo que se espera, conducirá a un diseño útil para los amputados geriátricos.

## Français

### L'alignement des prothèses fémorales

J. Foort

*Pros. Orth. Int.*, 3:3, 137-139

#### Résumé

L'alignement des prothèses fémorales est présenté avec ses effets sur la marche des amputés. Sont discutées plus particulièrement les conséquences d'une modification de la

longueur, de la position du pied (en avant, en arrière, en dedans ou en dehors) et de l'angle du pied (équin, talus, en rotation interne ou externe) sont examinés par rapport aux différents stades de la marche;

- a) phase d'oscillation, sans charge
- b) phase d'appui
- c) conduite volontaire
- d) conditions dans lesquelles la conduite ne peut que peu ou pas être appliquée.

#### **Quelques réflexions sur les prothèses tubulaires**

**J. Foort**

*Pros. Orth. Int.*, 3:3, 140-143

##### **Résumé**

L'auteur présente une définition des prothèses tubulaires et décrit leur évolution dès les modèles d'essai des années cinquante. Les possibilités de prothèses tubulaires sont décrites du point de vue de l'ingénieur, du technicien en orthopédie, de l'amputé, du centre de rééducation, du tiers payant et de la société.

#### **Entraînement à la marche pur amputés tibiaux**

**C. van Griethuysen**

*Pros. Orth. Int.*, 3:3, 163-165

##### **Résumé**

Un programme d'école de marche pour amputés tibiaux est présenté avec quelques aspects du traitement pré-et postopératoire. Sont décrits les exercices au stade initial et avancé. Quelques boîtiers sont discutés, car le kinésithérapeute doit les connaître pour obtenir des résultats satisfaisants.

La collaboration et l'information mutuelle entre tous les membres de l'équipe de rééducation est particulièrement importante pour obtenir de bons résultats.

#### **L'installation des services d'appareillage en Afrique**

**S. Heim**

*Pros. Orth. Int.*, 3:3, 152-154

##### **Résumé**

Depuis 1973, le centre d'appareillage à Tunis établi par nos soins, est dirigé par un technicien du pays. Nous avons visité ce centre cinq ans plus tard. Nous avons constaté que le niveau de l'appareillage des amputés était maintenu mais n'avait pas été développé. Il n'y avait surtout pas eu d'adaptation des connaissances techniques aux données locales. A part cela, la qualité du

service social a baissé. Il s'en suit que des visites plus fréquentes s'imposent lorsque la direction du centre est transférée aux indigènes.

Néanmoins, la Tunisie est le pays le plus développé de l'Afrique dans le domaine de la technique orthopédique. Dans la plupart des pays africains, les possibilités d'appareillage sont limitées à la capitale, mais celle-ci n'est pas en mesure de satisfaire les besoins de la population entière.

Les difficultés rencontrées exigent une équipe mieux formée que dans les pays industrialisés, un niveau technique très poussé et une formation professionnelle aussi complète que possible. Le temps à disposition pour la préparation et l'exécution de tels projets était trop court. Les besoins de la population dont les 90% vivent à la campagne sont discutés. Il nous paraît évident que les exigences de l'orthopédie technique doivent être aussi sévères que dans les pays industrialisés.

#### **Quelques réflexions sur la sensibilité des mains artificielles**

**P. Herberth and L. Körner**

*Pros. Orth. Int.*, 3:3, 157-162

##### **Résumé**

Dans les prothèses de main, la construction d'un système d'information sensorielle (sensory feedback) n'a pas abouti à des résultats aussi satisfaisants que pour les autres dispositifs de direction de la prothèse. Il manque notamment une analyse profonde de la conception de cette information et les connaissances de la physiologie du mouvement sont négligées. Dans cet article, les théories modernes de la physiologie du mouvement sont résumées. Les conséquences de l'application de cette théorie sur le développement des systèmes d'information sensorielle sont discutées.

#### **L'orthopédie technique en Amérique latine**

**E. Jensen**

*Pros. Orth. Int.*, 3:3, 155-156

##### **Résumé**

L'Amérique latine représente une région de niveaux de vie et de caractères individuels très variés. L'amputé est appareillé selon ses moyens soit par des entreprises privées soit par des ateliers subventionnés par l'Etat ou lui appartenant. Les difficultés d'appareiller les patients pauvres sont énormes. Il sera nécessaire

d'améliorer la qualité et la rapidité d'appareillage en se servant du matériel et de la main-d'oeuvre indigène. Le travail du technicien en orthopédie n'est que peu apprécié et peu rémunéré. C'est pourquoi le métier du technicien en orthopédie n'est pas très recherché. La formation professionnelle continue doit être améliorée.

#### **Emboîtement auto-adhérent à contact total pour moignons fémoraux**

**R. G. Redhead**

*Pros. Orth. Int.*, 3:3, 126-136

##### **Résumé**

Notre nouvel emboîtement à contact total renonce en grande partie à l'appui ischiatique. L'idée de cet emboîtement est basé sur l'hypothèse que si les tissus mous supportent toute la charge, ils se comportent sous pression comme un corps rigide et élastique. Pour la prise du négatif plâtré, un bas élastique entoure le moignon qui est mis sous traction. Les pressions mesurées dans l'emboîtement pendant la phase d'appui correspondent à nos calculs théoriques. Ce nouvel emboîtement est actuellement appliqué aux malades dans différents centres anglais.

#### **Les aspects économiques de la prothèse tubulaire**

**A. Staros**

*Pros. Orth. Int.*, 3:3, 147-149

##### **Résumé**

Le terme technique 'tubulaire' dans l'appareillage est défini. On a mesuré le temps nécessaire pour changer une pièce dans un des modèles courantes et l'on a constaté que les prothèses tubulaires ne sont pas plus économiques que les prothèses conventionnelles. Les économies de temps sont anéanties par le prix plus élevé des pièces détachées. On a également examiné l'interchangeabilité des pièces détachées pour l'alignement de la prothèse. Avec des matériaux

nouveaux tels que les fibres de carbone ou la résine époxy, on essaie de réduire le poids de ces pièces.

#### **Les prothèses modulaires pour les membres inférieurs**

**J. S. Taylor**

*Pros. Orth. Int.*, 3:3, 144-146

##### **Résumé**

Les critères pour une prothèse tubulaire idéale du membre inférieur sont énumérés. Deux types de prothèses tubulaires sont comparés. L'un reste dans la prothèse définitive, l'autre est enlevé après alignement. Le système qui reste en place a la réputation d'être plus léger et de demander moins de travail. D'autres aspects sont considérés, notamment la précision de l'alignement, les différents types d'articulation du genou et l'interchangeabilité des pièces ainsi que des aspects esthétiques. Enfin, quelques idées sur le stockage des pièces détachées et sur la formation professionnelle des prothésistes sont présentées.

#### **Prothèses ultra-légères**

**A. B. Wilson, Jr.**

*Pros. Orth. Int.*, 3:3, 150-151

##### **Résumé**

Après la deuxième guerre mondiale, les travaux de recherche en technique orthopédique aux Etats-Unis furent destinés à l'appareillage d'amputés jeunes et en bon état général. C'est pour cette raison que le poids de la prothèse fut plus ou moins négligé. Dès les années 1960, une prothèse plus légère s'avéra nécessaire pour les amputés gériatriques. Au centre de rééducation Moss, une prothèse tibiale ultralégère en polypropylène a été développée. Elle se trouve actuellement au stade des essais cliniques. Le stade suivant étudiera une prothèse fémorale dans ses effets de charge et de distribution des forces dans le but de créer une prothèse plus adaptée aux amputés gériatriques.

# Prosthetics and Orthotics International

## Index to Volume 3, 1979

### Author Index

- Abe, M., Iwakura, H., Fujinaga, H., Kakurai, S. and Yano, H.** (see Iwakura, H.)
- Ahlgren, S-A., Olsson, T. and Wingstrand, H.** Technical note—a thoracobrachial synthetic resin orthosis 88
- Arthur, M.** Technical note—cervical traction 115
- Bar, A., Seliktar, R. and Yekutieli, M.** (see Seliktar, R.)
- Baumgartner, R. F.** Above-knee amputation in children 26
- Baumgartner, R. F.** Book review 48
- Baumgartner, R. F.** Knee disarticulation versus above-knee amputation 15
- Bertelee, X. and Van Rollegem, J.** (see Van Rollegem)
- Boontje, A. H.** Revascularization or amputation 20
- Cook, T., Wilson, A. B. Jr. and Pritham, C.** (see Wilson, A. B. Jr.)
- Fernie, G. R., Holden, J. and Soto, M.** (see Holden, J.)
- Field, A., Platts, R. G. S. and Knight, S.** (see Platts, R. G. S.)
- Foort, J.** Alignment of the above-knee prosthesis 137
- Foort, J.** Modular prosthetics—a philosophical view 140
- Foort, J.** Socket design for the above-knee amputee 73
- Fujinaga, H., Iwakura, H., Abe, M., Kakurai, S. and Yano, H.** (see Iwakura, H.)
- Griethuysen, C. van.** Gait training for the below-knee amputee 163
- Heim, S.** The establishment of prosthetic services in African countries 152
- Herberts, P. and Körner, L.** Ideas on sensory feedback in hand prostheses 157
- Holden, J., Fernie, G. R. and Soto, M.** An assessment of a system to monitor the activity of patients in a rehabilitation programme 99
- Holmgren, G.** The interface between the body and the above-knee prosthesis 31
- Hughes, J. and Jacobs, N.** Normal human locomotion 4
- Iwakura, H., Abe, M., Fujinaga, H., Kakurai, S. and Yano, H.** Locomotion of the hemipelvectomy amputee 111
- Jacobs, N. and Hughes, J.** (see Hughes, J.)
- Jensen, E.** Prosthetics and orthotics in Latin America 155
- Kakurai, S., Iwakura, H., Abe, M., Fujinaga, H. and Yano, H.** (see Iwakura, H.)
- Knight, S., Platts, R. G. S. and Field, A.** (see Platts, R. G. S.)
- Körner, L. and Herberts, P.** (see Herberts, P.)
- Manley, M. T. and Solomon, E.** The clinical assessment of the normal and abnormal foot during locomotion 103

<b>Murdoch, G.</b> Above-knee amputation—an 'ideal' situation	13
<b>Murdoch, G.</b> Editorial	1
<b>Murdoch, G.</b> Editorial	119
<b>Olsson, T., Ahlgren, S-A. and Wingstrand</b> (see Ahlgren, S-A.)	
<b>Paul, J. P.</b> Book review	166
<b>Platts, R. G. S., Field, A. and Knight, S.</b> Orthoses to fit shoes	89
<b>Pritham, C., Wilson, A. B. Jr. and Cook, T.</b> (see Wilson, A. B. Jr.)	
<b>Redhead, R. G.</b> Total surface bearing self suspending above-knee sockets	126
<b>Rolleghem, J. Van and Bertelee, X.</b> Socket fabrication	68
<b>Rose, G. K.</b> The principles and practice of hip guidance articulations	37
<b>Seliktar, R., Yekutieli, M. and Bar, A.</b> Gait consistency test based on the impulse— momentum theory	
	91
<b>Solomon, E. and Manley, M. T.</b> (see Manley, M. T.)	
<b>Soto, M., Holden, J. and Fernie, G. R.</b> (see Holden, J.)	
<b>Staros, A.</b> Economics of modular prostheses	147
<b>Staros, A.</b> Editorial	61
<b>Taylor, J. S.</b> Above-knee prosthetic alignment	82
<b>Taylor, J. S.</b> Modular assembly above-knee prostheses	144
<b>Wilson, A. B. Jr., Pritham, C. and Cook, T.</b> A force-line visualization system	85
<b>Wilson, A. B. Jr.</b> Lightweight prostheses	150
<b>Wilson, A. B. Jr.</b> Standards for lower limb prostheses	44
<b>Wingstrand, H., Ahlgren, S-A. and Olsson, T.</b> (see Ahlgren, S-A.)	
<b>Yekutieli, M., Seliktar, R. and Bar, A.</b> (see Seliktar, R.)	
<b>Yano, H., Iwakura, H., Abe, M., Fujinaga, H., Kakurai, S.</b> (see Iwakura, H.)	

**Subject Index****Amputation**

- Above-knee amputation—an 'ideal' situation, G. Murdoch 13  
 Above-knee amputation in children. R. F. Baumgartner 26  
 Knee disarticulation versus above-knee amputation, R. F. Baumgartner 15  
 Revascularization or amputation. A. H. Boontje 20

**Biomechanics**

- Gait consistency test based on the impulse-momentum theory. R. Seliktar, M. Yekutieli and A. Bar 91  
 Locomotion of the hemipelvectomy amputee. H. Iwakura, M. Abe, H. Fujinaga, S. Kakurai and H. Yano 111  
 Normal human locomotion. J. Hughes and N. Jacobs 4

**Book reviews**

- Amputation and prostheses 48  
 Orthopaedic engineering 166

**Calendar of events**

49, 116, 169

**Editorial**

- G. Murdoch 1  
 A. Staros 61  
 G. Murdoch 119

**Foot**

- The clinical assessment of the normal and abnormal foot during locomotion. M. T. Manley and E. Solomon 103

**Instrumentation**

- A force-line visualization system. A. B. Wilson Jr., C. Pritham and T. Cook 85  
 An assessment of a system to monitor the activity of patients in a rehabilitation programme. J. Holden, G. R. Fernie and M. Soto 99  
 Gait consistency test based on the impulse-momentum theory. R. Seliktar, M. Yekutieli and A. Bar 91  
 The clinical assessment of the normal and abnormal foot during locomotion. M. T. Manley and E. Solomon 103

**Letters to the editor**

168

**Lower limb**

- A force-line visualization system. A. B. Wilson Jr., C. Pritham and T. Cook 85  
 An assessment of a system to monitor the activity of patients in a rehabilitation programme. J. Holden, G. R. Fernie and M. Soto 99  
 Normal human locomotion. J. Hughes and N. Jacobs 4

**Mobility aids**

- The principles and practice of hip guidance articulations. G. K. Rose 37

**Orthotics***Lower limb*

- Orthoses to fit shoes. R. G. S. Platts, A. Field and S. Knight 89  
The principles and practice of hip guidance articulations. G. K. Rose 37

*Spine*

- Technical note—cervical traction. M Arthur 115

*Upper limb*

- Technical note—a thoracobrachial synthetic resin orthosis. S-A. Ahlgren, T. Olsson and H. Wingstrand 88

**Paediatrics**

- Above-knee amputation in children. R. F. Baumgartner 26

**Prosthetics***Lower limb*

- Above-knee prosthetic alignment. J. S. Taylor 82  
Alignment of the above-knee prosthesis. J. Foort 137  
Economics of modular prostheses. A. Staros 147  
Gait training for the below-knee amputee. C. van Griethuysen 163  
Lightweight prostheses. A. B. Wilson Jr. 150  
Locomotion of the hemipelvectomy amputee. H. Iwakura, M. Abe, H. Fujinaga, S. Kakurai and H. Yano 111  
Modular assembly above-knee prostheses. J. S. Taylor 144  
Modular prosthetics—a philosophical view. J. Foort 140  
Socket design for the above-knee amputee. J. Foort 73  
Socket fabrication. J. Van Rollegem and X. Bertecele 68  
Standards for lower limb prostheses. A. Bennett Wilson 44  
The interface between the body and the above-knee prosthesis. G. Holmgren 31  
Total surface bearing self suspending above-knee sockets. R. G. Redhead 126

*Upper limb*

- Ideas on sensory feedback in hand prostheses. P. Herberts and L. Körner 157

**Prosthetics and orthotics programmes**

- Prosthetics and orthotics in Latin America. E. Jensen 155  
The establishment of prosthetic services in African countries. S. Heim 152

**Therapy**

- Gait training for the below-knee amputee. C. van Griethuysen 163

## **Calendar of events**

### **New York University Post-Graduate Medical School**

#### **Short Term Courses**

##### **Courses for Physicians and Surgeons**

751 C Lower Limb and Spinal Orthotics; 5-10 May, 1980.

##### **Courses for Therapists**

752 C Lower Limb and Spinal Orthotics; 5-10 May, 1980.

745 B Upper Limb Prosthetics; 2-6 June, 1980.

757 B Upper Limb Orthotics; 9-13 June, 1980.

##### **Courses for Orthotists**

756 Spinal Orthotics; 27 May-6 June, 1980.

753 Lower Limb Orthotics; 7-25 July, 1980.

##### **Courses for Prosthetists**

743 Above Knee Prosthetics; 9-27 June, 1980.

##### **Course for Rehabilitation Counsellors**

750 B Prosthetics and Orthotics; 23-27 June, 1980.

Requests for further information should be addressed to Prof. S. Fishman, Prosthetics and Orthotics, New York University Post-Graduate Medical School, 550 First Avenue, New York, NY 10016, U.S.A.

### **Northwestern University Medical School**

#### **Short Term Courses**

##### **Courses for Physicians, Surgeons and Therapists**

602 E, 603 E Prosthetics: Lower and Upper Limb; 5-9 May, 1980.

631, 632, 633 Management of the Juvenile Amputee; 12-15 May, 1980.

602 F, 603 F Prosthetics: Lower and Upper Limb; 9-13 June, 1980.

602 G, 603 G Prosthetics: Lower and Upper Limb; 23-27 June, 1980.

##### **Courses for Orthotists**

731 Review Course in Orthotics for Orthotists.

751 Fitting and Fabrication of the C.T.L.S.O.; 16-20 June, 1980.

Further information may be obtained by contacting Mr. C. M. Fryer, Director, Prosthetic-Orthotic Center, Northwestern University Medical School, 345 East Superior Street, Room 1723, Chicago, Illinois 60611, U.S.A.

**May, 1980**

World Congress on Accident Prevention, Amsterdam, Netherlands.

Information: International Social Security Association, Case Postale 1, Geneva 22, Switzerland.

**7-9 May, 1980**

Engineering Aspects of the Spine, London.

Information: Institution of Mechanical Engineers, 1 Birdcage Walk, London SW1, U.K.

**19 May, 1980**

Practical Management of Handicapped Children.

Information: Castle Priory College, Thames Street, Wallingford, Oxford, OX10 0HE, U.K.

**23-27 May, 1980**

Physical Medicine and Rehabilitation Stockholm.

Information: Dr. W. Moritz, Sydsvenska Sjukgymnast Institutet 5-220 05 Lund 5 Sweden.

**29 May-2 June, 1980**

Stress and Performance in Children with Cerebral Dysfunction.

Information: Castle Priory College, Thames Street, Wallingford, Oxford OX10 0HE, U.K.

**June, 1980**

24th Annual National Rehabilitation Conference, Arlington, Texas.

Information: D. Hall, 912 Rosevale Drive, Hewitt, Texas, U.S.A.

**15-20 June, 1980**

3rd Annual Interagency Conference on Rehabilitation Engineering, Toronto, Canada.

Information: Joseph E. Traub, Rehabilitation Services Administration, HEW, 220 C St. S.W., Washington, DC 20201, U.S.A.

**20-27 June, 1980**

International Conference on Rehabilitation Engineering, Sheraton Centre, Toronto, Canada.

Information: CMC, Inc., 5401 Kirkman Road, Suite 550, Orlando, Florida 32805, U.S.A.

**21-22 June, 1980**

Plastics in Medicine and Surgery, Enschede Netherlands.

Information: J. N. Ratcliffe, Plastics and Rubber Institute, 11 Hobart Place, London S.W.1.

**22-27 June, 1980**

Rehabilitation International 14th World Congress, Winnipeg, Canada.

Information: Mr. Jack Sarney, Canadian Rehabilitation Council for the Disabled, Suite 2110, Yonge Street, Toronto, Ontario M5E 1E8, Canada.

**23-28 June, 1980**

Helen Keller Congress, Boston, Massachusetts.

"Blueprint for the Future".

Information: American Foundation for the Blind, Inc., 15 West 16th St., New York, NY 10011.

**July, 1980**

Helen Keller Centennial World Conference on Deaf-Blindness, Hannover, West Germany.

Information: World Council for the Welfare of the Blind, 58 Avenue Bosquet, 75007 Paris, France.

**August, 1980**

National Multiple Sclerosis Society Conference, Denver Colorado, U.S.A.

Information: Sylvia Lawrie, 205 East 42nd Street, New York, NY 10017, U.S.A.

**17-22 August, 1980**

8th International Congress of Physical Medicine and Rehabilitation on the theme "Disability-Prevention and Management by Rehabilitation Medicine" Stockholm, Sweden.

Information: Secretary, Dr. I. Swedborg, Avd. for Fys. Med. och Rehab., Karolinska Sjukhuset S-104 01, Stockholm, Sweden.

**Change of dates: 25-29 August, 1980**

Physical Medicine/Rehabilitation: 8th Congress of the International Federation of Physical Medicine, Stockholm, Sweden.

Information: Physical Medicine, c/o Stockholm Convention Bureau, Jacobs Torg 3, S-111 52, Stockholm, Sweden.

**September, 1980**

Mediterranean Conference on Medical and Biological Engineering, Marseilles, France.

Information: Prof. G. Kapham, Faculté de Médecine (Nord), Boulevard P-Drummond, 13326 Marseilles Cedex III, France.

**Mid-September, 1980**

American Orthotic and Prosthetic Association Meeting, New Orleans, U.S.A.

Information: M/s. S. I. McCamley, American Orthotic and Prosthetic Association, 1444 N. Street NW, Washington, DC 20005, U.S.A.

**27 September-1 October, 1980**

33rd Annual Conference on Engineering in Medicine and Biology, Washington DC, U.S.A.

Information: M/s. P. I. Horner, Administrative Director, Alliance for Engineering in Medicine and Biology, 4405 East-West Highway, Suite 404, Bethesda, Maryland 20014, U.S.A.

**28 September-4 October, 1980**

ISPO 3rd World Congress, Bologna, Italy.

Information: Studio B.C., via Ugo Bassi 10, 40123 Bologna, Italy.

**17 October, 1980**

B.E.S. Scientific Meeting and A.G.M.

Information: K. Copeland, R.C.S. L.I.F., London W.C.2.

**16-21 November, 1980**

First International Convention on Medico-Legal Aspects of Disability, Tel Aviv, Israel.

Information: Convention Secretariat, P.O. Box 3059, Tel Aviv, Israel.

**21-23 November, 1980**

Fundamentals of Gait, Orthotics and Prosthetics, The Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry, Salop.

Information: Mr. G. K. Rose, F.R.C.S., Orthotic Research and Locomotor Assessment Unit, The Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry, Salop, SY10 7AG, U.K.

**11-13 June, 1981**

5th Nordic Meeting on Medical and Biological Engineering, Linköping, Sweden.

Information: Prof. Ake Oberg, Dept. of Biomedical Engineering, Regional Hospital, S-58185 Linköping, Sweden.

**18-24 June, 1981**

International Technical Aids Exhibition and Forum, Dusseldorf, Federal Republic of Germany.

Information: Deutsche Vereinigung für die Rehabilitation Behinderter, 6900 Heidelberg 1, Friedrich-Ebert-Anlage 9, Federal Republic of Germany.

**August, 1981**

5th International Conference on Electrical Bio-Impedance, Tokyo, Japan.

Information: Prof. K. Nakayama, Dept. of Electrical Engineering, Sophia University, Kioi-cho 7, Chiyoda-ku, Tokyo 102, Japan.

## **SPONSORING MEMBERS**

We are pleased to announce that the following companies were Sponsoring Members of ISPO for the year 1979.

**Lindemann Orthopedic,  
Ostre Stationsvej 44,  
5000 Odense C,  
Denmark.**

**Camp Scandinavia AS,  
Kastanie Alle 22,  
2720 Kobenhavn,  
Denmark.**

## Moulded feet. New from Hanger.



SACH and UNIAXIAL moulded feet with optional attachments for wood, light metal and modular legs.

Type tested for 1 million walking cycles and available in either Melanic or Caucasian Syncell foam.



**JUZO**  
**MEDICAL ELASTIC**  
**STOCKINGS**  
**OF WORLD RENOWN**



Julius Zorn GmbH · D-8890 Aichach · Telephone 082 51/30 61 · Telex 539 405

“Following amputation of the lower leg, firm controlled bandaging was required to ensure the correct stump contour would be formed.”



Formation of a correctly shaped stump offers the patient much greater comfort when a prosthesis is fitted.

The bandage considered most suitable for this purpose is Elset 'S'—the specially developed supportive bandage for amputation stumps. A lightweight bandage, manufactured from bright viscose rayon and elastic yarns, the special slip properties of Elset 'S' allow it to accommodate itself to the limb and so achieve the desired compression.



The bandage is manufactured in 10cm and 15cm widths (12 metres stretched). Two leaflets, illustrating application of Elset 'S', entitled "Above or through knee stump bandaging" and "Below knee stump bandaging" are available on request.

The standard Elset bandage (6m stretched) is available in 5cm, 7.5cm, 10cm and 15cm widths.

Detailed information on all Seton products is included in the full colour catalogue.

For your free copy, write to: Seton Products Limited, Tubiton House, Medlock Street, Oldham OL1 3HS. Tel: 061-652 2222. Telex: 669956.

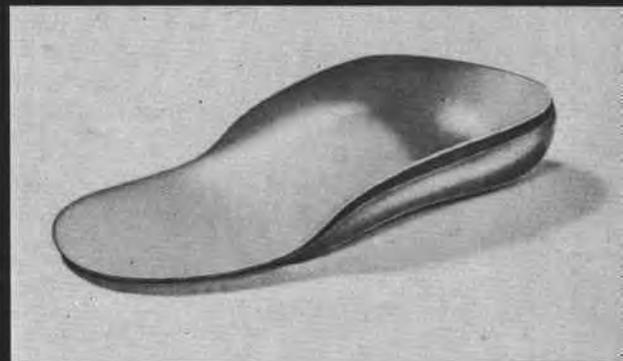
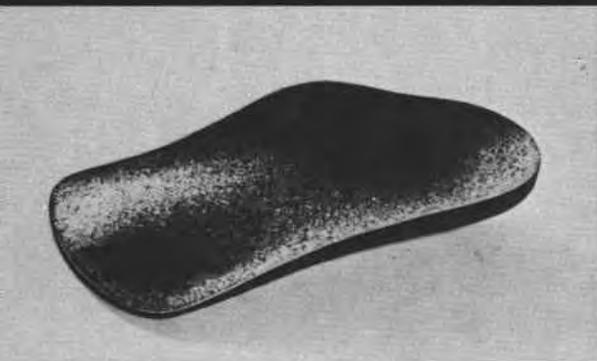
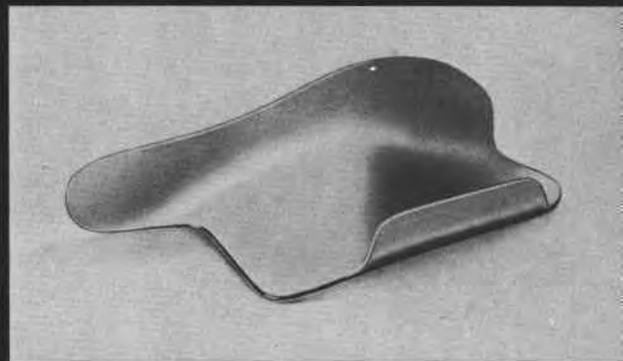
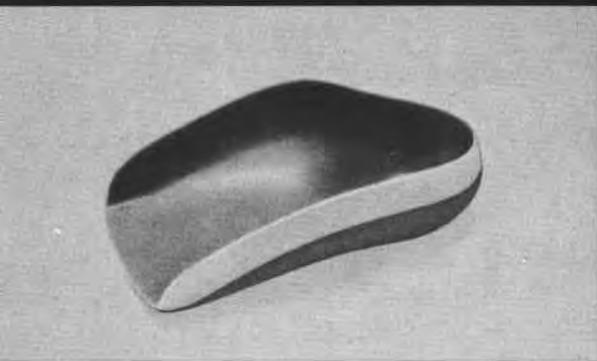
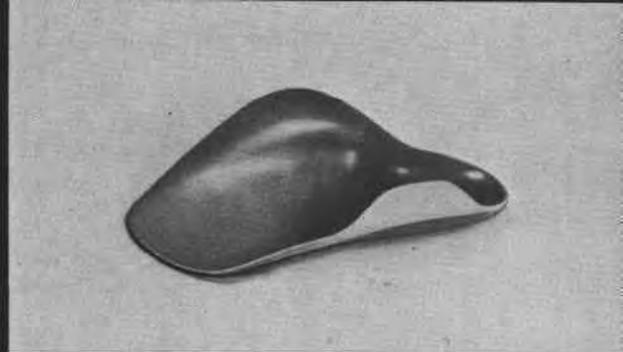
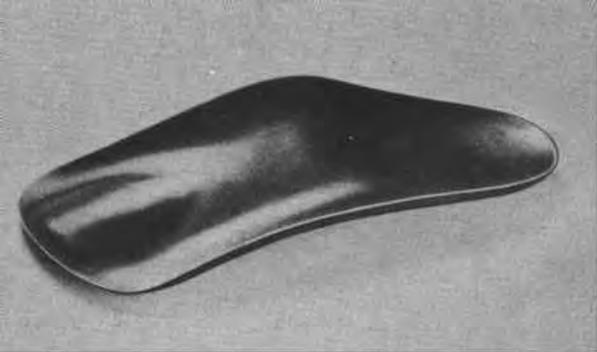


THE BRITISH HOSPITAL  
EQUIPMENT  
DISPLAY CENTRE

Exhibitors at Western Centre and BHEC in London.

Elset 'S' bandages from

**Seton**  
THE 'TUBIGRIP' PEOPLE



**We make them.**

schein

**orthopädie  
service**

Schein Orthopädie Service KG D-5630 Remscheid 1  
P. O. Box 110609 (02191) 6017  
Manufacturers and Distributors of Schein-arch-support



# MASCHINEN-SCHMID

*A long and successful  
tradition in machinery for  
Orthopaedic Supplies*

- ROBUST
- STEADILY IMPROVED
- DUST EXTRACTING

*Machinery and tools  
made in Germany  
by specialists for specialists*



**NEW!**  
**SOCKET ROUTER**  
**TITAN 120E**

- PROVEN IN PRINCIPLE
- IMPROVED DESIGN

*Please ask for more  
information*

*For detailed information please write to:*

**Maschinen-Schmid, Morenastr 3, D8000 Munich Germany**  
Telephone 089/832510



## JOINTS AND BRACES

Leg and hip joints, braces and  
shoe stirrups

## SPARE PARTS

Feet, knees, socket blocks, hooks,  
hands, wrist and elbow units

## MATERIAL

Fabricating supplies, tools

## LEATHER AND FABRICS

## TOOLS AND MACHINES

### 'MIRA'

Abduction pillow splints

**E. LINK & CO.**

P.O. Box 4459

**D-7200 TUTTLINGEN**

TELEPHONE (07461) 5018

an outstanding tool  
in biomechanics:  
**THE NEW** quartz multicomponent  
measuring platform for

sports



orthopedics



neurology



**NEW!**

Quartz Multicomponent Measuring Platform for Biomechanics – this unique instrument determines together with a special electronic unit the following 6 measurands:

- the 3 components  $F_x$ ,  $F_y$  and  $F_z$  of any force acting on it
- the coordinates  $a_x$  and  $a_y$  of the instantaneous point of force application
- the free moment  $M'_z$  about an axis normal to the platform

This system is an indispensable tool in various fields such as

- sports: reaction forces in broad and high jump, shot put, running etc.
  - orthopedics: gait analysis, evaluating prosthesis, monitoring rehabilitation etc.
  - physiology of work: stress on workers, human engineering etc.
  - neurology: "Romberg" test, psychomotor phenomena.
  - posturography: more than a simple statokinesimeter, as the horizontal forces (in 2 components!) exerted in maintaining equilibrium are measured, too.
- Over 110 systems are successfully used all over the world! Special version with glass top plate available on request.

The outstanding features are:

- amazingly simple operation
- factory calibrated
- extremely wide measuring range,
- very low cross talk (typically < 1%)
- linear and free of hysteresis
- natural frequency over 1 kHz
- interchangeable top plates
- simplified mounting.

We offer a complete line of piezo-electric transducers for pressure, force and torque, multicomponent force, acceleration and charge amplifiers, also in miniature versions, and other electronic equipment.



Piezo-Messtechnik

**KISTLER**

Kistler Instrumente AG  
CH-8408 Winterthur/Switzerland  
Phone: (052) 25 28 21  
Telex: 76 458

# HSR HSR

a new addition to a wide range  
of prefabricated hand and  
forearm splints.

literature available on request



#### HUGH STEEPER (ROEHAMPTON) LTD

237-239 Roehampton Lane,  
London, S.W.15, 4LB, England.  
Telephone: 01 788 8165  
Telex: 261787

Manufacturers of Prostheses Orthoses  
and Aids for the Handicapped



## R<sub>x</sub> : Restraint

### the EXO-STATIC Collar with Chin Piece

When the prescription is for positive stabilization and maximum restraint...rely on the EXO-STATIC Collar with Chin Piece. This collar provides restraint, prevents movement back against the neck, controls lateral motion and gives maximum patient comfort with no tendency to chafe under the chin.

FlaManCo's line of EXO-STATIC collars are designed to physicians' specifications, engineered for reliable operation, and manufactured to the highest standards of quality...with competitive pricing. Whatever the prescription, there's an EXO-STATIC collar that will fill it.

#### OTHER FlaManCo Products...

- EXO-STATIC COLLAR WITHOUT CHINPIECE
- EXO-FOAM SOFT CERVICAL COLLAR
- EXO-OVERHEAD DOOR TRACTION UNIT
- DISKARDS DISPOSABLE HEAD HALTER
- EXO-PELVIC TRACTION SLING

FOR INFORMATION AND CATALOGUE ...



EXO-BED Traction Unit



CERV-EASE Soft Collar  
with Stiffener

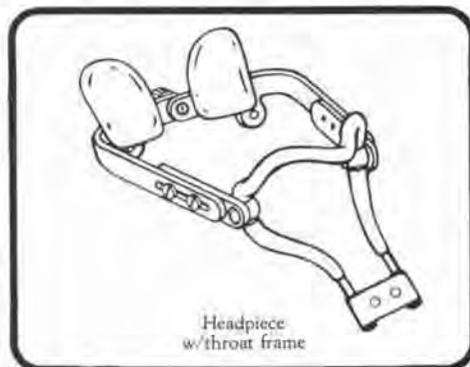
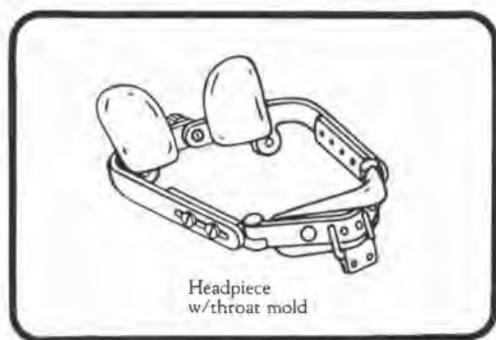
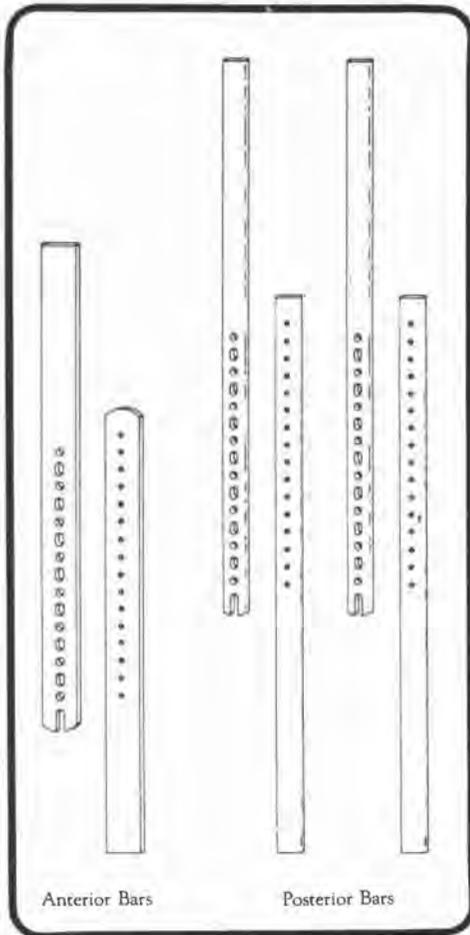
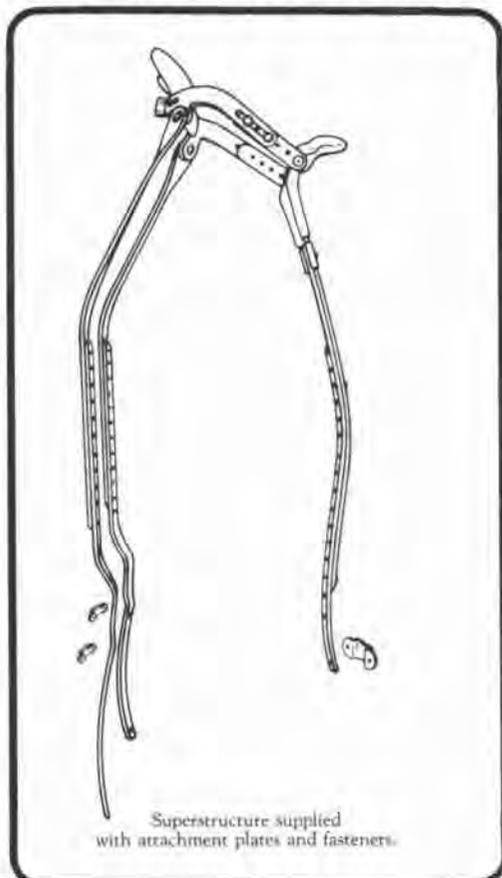
**FlaManCo**  
FLORIDA MANUFACTURING  
CORPORATION

P. O. Box 2324 - Daytona Beach, Fla 32015  
(904) 767-2372

U.S.A.



# Milwaukee Kits



## Durr-Fillauer Orthopedic... "The Source"

All Milwaukee components are now in stock for immediate shipment. Choice of inch or metric screw threads. Let Durr-Fillauer supply all your orthopedic needs and help you increase your patient services. Remember Durr-Fillauer... "The Source."

 **DURR-FILLAUER MEDICAL, INC.**  
Orthopedic Division  
P.O. Box 1678 • Chattanooga, Tennessee 37401

The touch  
of velvet...

the grip  
of iron.

## Prosthetic Limb Vise

Now from OPE, a manual vise that gives delicate compression control. Helps avoid damaging valuable prosthesis.

Rugged, solid hard maple construction assures strength and holding power.

Rubber serrated jaw pads enhance the non-slip grip and prevent surface disfiguration of the component.

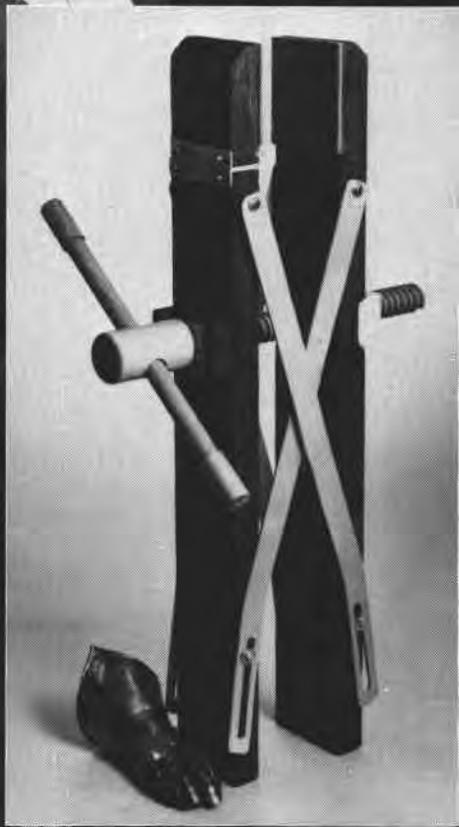
Swivel jaw provides the flexibility of holding at a variety of angles.



**Orthotic Prosthetic Enterprises, Inc.**

1215 Washington Avenue, Wilmette, Illinois 60091

Telephone: (312) 251-1987



## List of advertisers

Charles A. Blatchford and Sons Ltd.	ii
Otto Bock Orthopädische	IFC
Durr-Fillauer Medical Inc.	xii
Florida Manufacturing Corporation	xi
J. E. Hanger and Co. Ltd.	v
Kistler Instruments AG	x
Knit-Rite Inc.	IBC
E. Link and Co.	ix
Maschinen-Schmid	ix
Orthotic Prosthetic Enterprises Inc.	xiii
Schein Orthopädie Service KG	viii
Seton Products Ltd.	vii
Hugh Steeper (Roehampton) Ltd.	xi
United States Manufacturing Co.	OBC
Julius Zorn GmbH	vi

---

## RESEARCH ORTHOTIST

A vacancy exists for the post of Research Orthotist in the Orthotic Research and Locomotor Assessment Unit at the Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry, Shropshire. The successful candidate will work with a multi-disciplinary team under the direction of a senior consultant orthopaedic surgeon and be involved in the development of orthotic devices for severely handicapped patients, the application of modern materials to specific orthotic problems and in evolving more effective means of information transfer.

The salary and conditions will be those of a Grade 2 Medical Physics Technician (the salary is £5,547 to £6,918 in eight increments) and applicants would normally be expected to have the following qualifications:

- 1) L.B.I.S.T. or diploma in Orthotics from the Training Council for Orthotists, or equivalent.
- 2) Relevant orthotic experience. Previous research experience would be an advantage but is not essential.

Applications, outlining qualifications, experience and giving the names and addresses of two referees should be sent to:

Mr. G. K. Rose, F.R.C.S.  
Director  
O.R.L.A.U.,  
Robert Jones and Agnes Hunt Orthopaedic Hospital,  
OSWESTRY,  
Shropshire,  
SY10 7AG.

### **Information for Contributors**

Contributions should be sent to Prosthetics and Orthotics International, National Centre for Training and Education in Prosthetics and Orthotics, University of Strathclyde, 73 Rottenrow, Glasgow G4 0NG. In the meantime considerable difficulty and delay is entailed in processing contributions in languages other than English. Authors are asked to provide three copies of text, tables and figures. Papers are accepted on the understanding that they may be subject to editorial revision and that no substantial part has been, or will be published elsewhere. Subsequent permission to reproduce articles must be obtained from the publishers. Manuscripts should be typewritten in double line spacing on one side of paper only with margins of 25 mm. **Papers must commence with an abstract not exceeding 250 words.** On a separate sheet must be:

- (1) Title and short title. The short title should appear at the head of each page and should not exceed forty-five characters including spaces.
- (2) Authors' names, initials and titles. The present address of any author if different from the place where the work was done, may be shown as a footnote.
- (3) Department(s) in which the work was done.
- (4) The name and full postal address of the author to whom correspondence and requests for reprints should be directed. This will appear as a footnote.

### **Illustrations**

All illustrative material should be lightly marked on the back in pencil with the figure number in arabic numerals, title of paper, authors' name and a clear indication of the top of the figure. The approximate location in the text should be marked. Figure captions should be typed on a separate sheet. Tables should be used only when necessary to clarify important points. Each table should be typed on a separate sheet and numbered consecutively in arabic numerals.

### **References**

References in the text should follow the author/date system for example: Peizer (1971). If there are more than two authors—Solomonidis *et al.* (1974). References at the end of articles should be listed on a separate sheet in alphabetical order of (first) authors' name, as follows: Marx, H. W. (1974). Lower limb orthotic designs for the spastic hemiplegic patient. *Orthotics and Prosthetics*, 28(2), 14–20. Journal titles must be given in full.

References to articles in books should include author, year of publication, article title, book title edition, editor (if different from author) first and last pages, publisher and place of publication. For example, Hughes, J. (1975). Recent developments in prosthetics and orthotics. *Recent Advances in Orthopaedics* (2) Ed. McKibbin, B., 196–216, Churchill Livingstone, Edinburgh.

### **Reprints**

Ten reprints will be supplied free of charge to the first named author. Additional reprints will be available at cost if they are ordered when the proofs are returned.

# WE COULD MAKE A CHEAPER PROSTHETIC SOCK



... but we don't!

The person who wears  
**KNIT-RITE**  
knows why!

QUALITY and SERVICE  
FOR OVER 50 YEARS

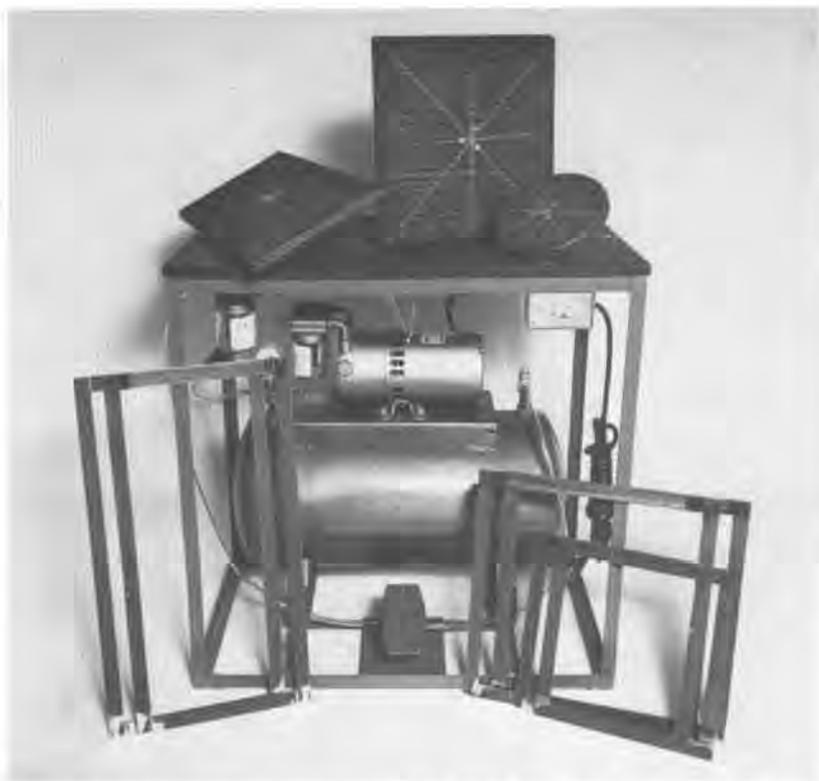


Call Toll Free:  
**1-800-821-3094**

AS CLOSE AS YOUR TELEPHONE

## KNIT-RITE, INC.

2020 GRAND AVENUE • P. O. BOX 208 • KANSAS CITY, MISSOURI 64141  
PHONE: 816-221-0206



## **Fabricate your own custom orthotic and prosthetic devices with our new vacuum forming machine.**

Improvements in the design of United States Manufacturing Company's vacuum forming machine make it both faster and easier to use.

Any one of four mounting tables is quickly removed or repositioned by simply twisting a thumb screw which clamps the mounting table to the base. This type of connector is an improvement over platens that screw into the base connector because threaded connectors have a tendency to twist and block vacuum tubes

with continued use.

The second new feature, a treddle foot pedal, sets and maintains a constant vacuum even if the operator must remove his foot from the pedal and leave the machine for a period of time.

Other features include: Four mounting tables (8" round, 9½" round, 9½" x 21" rectangle and 13½" square); 8 gallon holding tank; compact 31" x 20" x 31" size; ¼ HP motor to produce 26 inches of mercury vacuum.

# **USMC**

**United States Manufacturing Company**

180 North San Gabriel Blvd., P.O. Box 5030,  
Pasadena, California 91107 U.S.A. (213) 796-0477  
Cable: LIMBRACE, TWX No.: 910-588-1973

110 Volt, 60 Hertz AC, single phase — **T15-501-0600**

220 Volt, 50 Hertz AC, single phase — **T15-502-0500**

United States Manufacturing Company will also supply your plastic needs - including Thermo-Vac Clear Plastic, an extremely strong completely clear thermoplastic polymer that is excellent for fabricating a wide variety of orthotic and prosthetic devices.