

Figure 1: (left) Layers of elastic stockinette of various lengths and widths provide gradient pressure for limb edema control, and shrinkage of residual limbs. Figure 2: (right) Removable Rigid Dressing used for transtibial and Symes amputation.

## Postoperative and Preprosthetic Management for Lower Extremity Amputations

By Yeongchi Wu, M.D.

Postoperative and preprosthetic management of residual limbs have a critical influence on both the functional performance of the residual limb as it interacts with the prosthesis and the amount of pain and edema experienced by the patient following surgery. Postoperative complications, discomfort and trauma can be minimized or prevented by proper immobilization of the surgical wound.

### Traditional methods of treatment

Many methods have been used for postoperative and preprosthetic management of residual limbs. Most methods involve soft dressings<sup>(1)</sup>, elastic bandages<sup>(2,3)</sup>, elastic shrinkers<sup>(2)</sup>, pneumatic shrinkers<sup>(4)</sup> and removable rigid dressings<sup>(1,5-13)</sup>. At the Rehabilitation Institute of Chicago within the Northwestern-McGaw Medical Center, we have routinely used elastic stockinettes<sup>(13)</sup> (Figure 1) and removable rigid dressings<sup>(9-11,13)</sup> (Figure 2) for control of limb edema and for shrinkage. This article will deal with these two techniques, which have proven clinically effective. Staff and patients find them simple to learn and to apply.

The choice of these two methods as our preferred treatments was also influenced by negative characteristics of other traditional methods. Elastic bandages, although still used by many surgeons, require frequent re-application and, when applied inappropriately may cause edema from proximal constriction or ulceration over the bony prominences because of excessive pressure.

### Commercially available shrinkers have draw-backs

Commercially available elastic shrinkers, although successful in a number of applications, are not stocked in a range of sizes adequate for use with specific patients. Other problems that have arisen with elastic shrinkers is that sizes are not available for obese patients, pediatric patients or patients with very short or very long residual limbs. Elastic shrinkers may also be too tight to put on or too loose to provide the necessary compression on the stump.

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## Management for Lower Extremity Amputations

Continued from page 1

We have used elastic stockinette to replace the conventional elastic bandage and stump shrinkers for control of edema and shaping of the residual limb. This elastic stockinette is commercially available in rolls of various widths and is much less expensive than the conventional elastic bandages and stump shrinkers. It can easily be stretched onto the residual limbs. Gradient pressure of the desired degree can be achieved by applying as many layers as needed with careful monitoring of distal circulation and pressure over bony prominences (Figure 3).

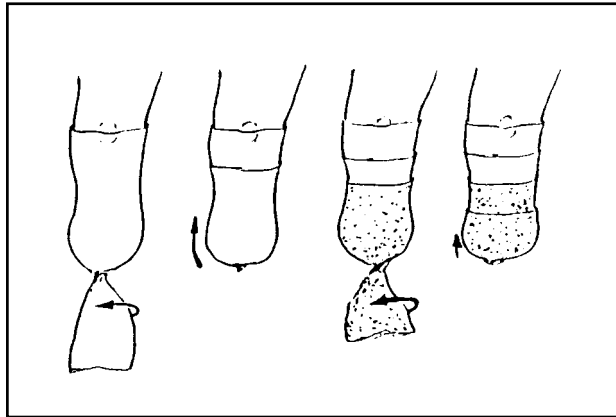


Figure 3: Elastic stockinette for control of distal edema.

### Rigid dressing are used in modified ISPF

In the 1960s, immediate postsurgical fitting (IPSF) of amputees was introduced in France<sup>(5)</sup> by Berlement, in Poland by Weiss<sup>(6)</sup> and by Burgess in the United States<sup>(6-8)</sup>. The practice led to major advances in the rehabilitation of amputees, but the need for removal and reapplication of the IPSF device by trained clinicians limited its routine application. In addition, the immediate postoperative prosthetic fitting with weight bearing was noted to sometimes interfere with wound healing. To avoid these problems, we have used a modified approach, using rigid dressing alone (without weight bearing) following the transtibial amputation and weight bearing only after the surgical wound has healed.

Our management of the residual limb after amputation includes prevention of wound infection, immobilization of soft tissue to facilitate healing and provision of constant compression to control edema and shrinkage. The treatment should also prevent accidental trauma to the residual limb and be easy for staff or patient to reapply. Details of rigid removeable dressings follow.

## Management of specific levels of lower limb amputation

- **Hip Disarticulation** - The surgical wound following hip disarticulation or hemipelvectomy is wrapped with elastic stockinette, 10" or 12" wide, around the stump and the waist. The distal end is then twisted and folded upward to the waist, leaving two layers over the surgical area. Another layer can be added for more compression. (Figure 4). A gradient pressure over the operated area using this technique is far more effective than that of elastic bandaging. Our clinical experience is that support of the soft tissue promotes healing and lessens the intensity of stump pain.

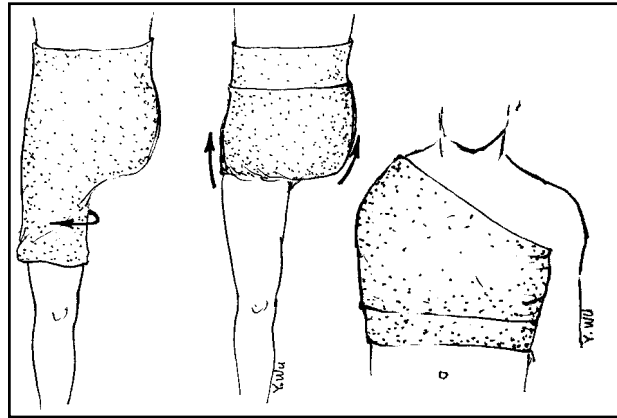


Figure 4: Elastic stockinette for hip disarticulation or shoulder disarticulation.

- **Transfemoral Amputation** - The complexity of stump wrapping with elastic bandage and the need for re-application at regular intervals is not possible for many geriatric patients to accomplish because they often lack fine motor control and have difficulty learning new skills. Most of our geriatric patients can manage the simpler method of using elastic stockinette.

An 8" wide elastic stockinette with a 6" longitudinal cut medially is pulled to waist height. The upper corners are tied with straps around the waist. Once the proximal

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Historically, designers of prosthetic prehension devices have used studies of the dominant physiological hand as a basis for rationalizing the choice of prehension patterns to be incorporated prosthetically. This rationale has persisted in spite of the generally accepted observation that a person with a unilateral arm amputation preferentially uses the physiological hand while the prosthetic prehension device is used in a non-dominant assistive capacity. In an effort to disprove or validate the empirically based assumptions, researchers at NURERP have been studying the division of function between the dominant and non-dominant physiological hands to gain insight into the differences in the functional roles of the two hands.

### Familiar activities were used to avoid bias

Subjects, without upper-limb amputations, have been videotaped performing a set of activities involving a variety of actions that typically incorporate both hands. The activities were selected as representing common and familiar actions which would require a minimum of direction to the subject and thus reduce the possibility of the subject self-consciously using the hands in unnatural ways. The activities contained specific features of interest, such as handling objects of different sizes and surface features, transfer of objects from place to place and from hand to hand, inter-hand and intra-hand manipulation of objects, repetitive and single-event actions, and reaching outward from the body and inward to the body.

Analysis of the videotaped sequences reveals that the number of prehension acts performed by the non-dominant hand was 80% of the number performed by the dominant hand. It, therefore, appears that the non-dominant hand is used for holding an object almost as frequently as the dominant hand in the activities studied.

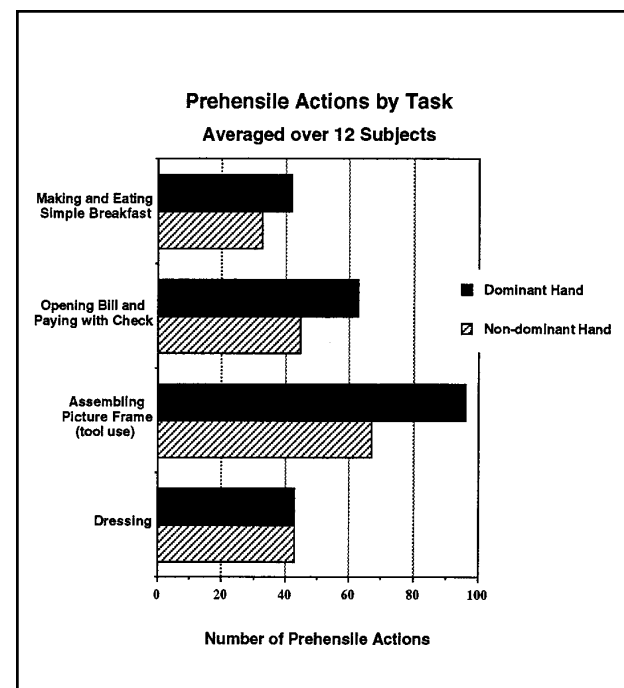
It was also observed that a grasp pattern similar to palmar prehension (the palmar pad of the thumb in opposition to the palmar pads of the index and middle fingers) was used most often for both hands. Grasp patterns secondary to palmar prehension were observed to be task specific for the non-dominant hand.

### Study supports empirically-based assumptions

The quantitative data provided by this study stresses the importance of the grasp function in a prosthetic prehension device. The study also supports the empirically-based emphasis on palmar prehension in the design of hand-like prosthetic prehensors. Prior studies of the dominant hand in highly-directed activities have been used to justify incorporation of this prehension pattern in prosthetic hands. Our study shows that this pattern is also primarily used by the non-dominant hand in common activities—a situation more closely resembling functional use of a prosthetic prehension device.

## NURERP Study Investigates Hand Functions in Common Tasks

*One of the goals of the research at Northwestern University PRL & RERP is to verify assumptions upon which choices in prosthetics are based*



*Average number of prehensile actions performed by the dominant and non-dominant hands in the four activities.*

**This research was sponsored by the National Institute on Disability and Rehabilitation Research and was included the Northwestern University PRL & RERP Activity Report**

### References Resulting From This Research

- Toth, P.J., (1991)** "Hand Function Differentiation," M. Sc. Thesis, Northwestern University, Evanston, IL, 1991.
- Heckathorne, C.W., Toth, P.J., Childress, D.S. (1995)** "The Role of the Non-Dominant Hand in Manipulative Tasks", Abstracts of the Eighth World Congress of the International Society for Prosthetics and Orthotics, p. 146❖

# Education in Orthotics & Prosthetics: NAPOE Offers a Detailed Guide

For students who are looking at a career in prosthetics and orthotics or for individuals seeking a new career, the National Association of Prosthetic-Orthotic Educators (NAPOE) offers a comprehensive guide to educational programs. These programs offer degrees and certifications at various levels.

## Baccalaureate level

NAPOE give details of three programs leading to Bachelor of Science or Bachelor of Health Science degrees. All three universities offer two year programs concentrating on prosthetics and orthotics. Prerequisite courses, which must be completed before admission to the P & O courses, also require two years. The programs are designed to produce professional level graduates who be qualified to sit for the certification examination given by the American Board (ABC) for Certification in Orthotics and Prosthetics.

The NAPOE publication lists both prerequisite courses and courses which must be taken to achieve the bachelor's degree. The three universities that offer bachelor's degrees are:

**California State University Dominguez Hills  
Orthotics & Prosthetics Program  
Health Sciences Department SHC-A141  
1000 E. Victoria Street  
Carson, CA 90747**

**University of Texas  
Southwestern Medical Center at Dallas  
Southwestern Allied Health Sciences School  
Prosthetics-Orthotics Program  
5323 Harry Hines Blvd., Suite V5.400  
Dallas, TX 75235-9091**

**University of Washington  
School of Medicine  
Division of Prosthetics and Orthotics  
Department of Rehabilitation Medicine  
1959 N.E. Pacific Avenue, Box 356490  
Seattle, WA 98195**

## Programs leading to Certification

Certification programs offered by five institutions are reviewed in the NAPOE guide. A bachelor's degree

is a prerequisite for acceptance in the certification programs. The length of each program ranges from nine months to one year with the goal of each program being to provide professional-level practitioners with the knowledge and skills needed to sit for the ABC certification exams. Institutions offering certification programs are:

**California State University Dominguez Hills  
(Same address as the bachelor's degree program)**

**Newington Certificate Program in  
Orthotics & Prosthetics  
181 E. Cedar Street  
Newington, CT 06111  
(in cooperation with the  
University of Connecticut)**

**Northeast Metro Technical College  
University of Minnesota  
3300 Century Ave., N  
White Bear Lake, MN 55110**

**Northwestern University Medical School  
Prosthetic-Orthotic Center  
345 E. Superior Street, Room 1723  
Chicago, IL 60611**

**Rancho Los Amigos Medical Center  
7450 Leeds Street  
Downey, CA 90242**

## Programs for Technicians

NAPOE lists two institutions offering courses of approximately one year in length for technicians in orthotics and prosthetics. These programs are designed to train technicians to be knowledgeable in general laboratory procedures, familiarity with handling the materials used in prosthetics and orthotics, and safe use of tools to produce prosthetic and orthotic devices. Graduate of both programs are awarded an Associate degree and are prepared to work as skilled P & O technicians. The institutions offering technicians programs are:

**Northeast Metro Technical College  
(same address as the Certification Program)**

**Spokane Falls Community College  
3410 W. Fort George Wright Drive  
Spokane, WA 99204**

The *NAPCE O & P Education Guide* is an essential tool for any person interested in learning more about educational opportunities in the field. The information in the Guide will save a significant amount of time and money

by providing all the details on courses, prerequisites, potential financial aid, application deadlines and other topics.

The NAPCE O & P Guide is available free of charge from: National Association of Prosthetic-Orthotic Educators, 1650 King Street, Suite 500, Alexandria, VA 22314❖

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### **Northwestern University PRL & RERP staff and advisors in the News**

## **Margaret Pfrommer Named to Joint Commission's PTAC**



Margaret C. Pfrommer, Research Associate and Consumer Advocate, NUPRL & RERP, has been named the first Public Member of the Professional and Technical Advisory Committee (PTAC) for the Joint Commission on Accreditation. Ms. Pfrommer will provide insight to the Committee from several points of view including that of a consumer of health care, advisor to disability organizations and participant in the development of assistive technology.

The Joint Commission provides accreditation programs and other services to improve quality and support performance improvement in a number of areas of health care. The organization originally developed standards of performance for hospitals and was for a number of years known as the Joint Commission on Accreditation of Hospitals (JCAH). The reputation and expertise of JCAH led to requests by private and public organizations for the development of performance standards for many other areas of health care including long term care and mental health

facilities. In 1988, the Joint Commission became the first organization to address standards of excellence and uniform quality of service in the home care area.

The Home Care sector of the Joint Commission addresses five types of home health care organizations. These organizations provide services in: medical equipment; home nursing, therapy and social work; personal care and support; preparing, dispensing, and monitoring of pharmaceuticals in the home and respiratory care.

For over 20 years, Ms. Pfrommer has been actively involved in a spectrum of organizations related to the needs and rights of people with disabilities. Her experiences include heading the Illinois delegation to the White House Conference on Handicapped Individuals in 1977. She has also served in a number of capacities in organizations for people with disabilities in Chicago and the State of Illinois. ❖

## **AAOP Names Mark Edwards Educator of the Year**



*Mark Edwards, C.P.*

Mark Edwards, C.P., Director of Prosthetics Education at the Northwestern University Prosthetic-Orthotic Center (NUPOC), was named Educator of the Year by the American Academy of Orthotics and Prosthetics (AAOP),

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## Northwestern University PRL & RERP staff and advisors in the News

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the scientific body which represents orthotists and prosthetists.

At the Annual Meeting of the AAOP in Orlando, FL March 5-9, 1996, the Academy recognized Edwards for his distinguished career devoted to prosthetics and orthotics education which spans over 10 years of services at NUPOC. Edwards and his staff have coordinated with the AAOP to develop the Exam Preparation Seminar.

Edwards, who received his B. S. degree in Kinesiotherapy from the University of Illinois at Chicago, has been director of the Prosthetic Education at Northwestern University Medical School, Chicago, IL since 1992. In addition to his position at NUPOC, he is Chair of the National Association of Prosthetic & Orthotic Educators, Past President, Midwest Chapter of the American Academy of Orthotics & Prosthetics, and Chair of the Exam Preparation Committee.

Under his direction, NUPOC trains individuals in post-graduate education leading to careers as certified prosthetists and orthotists. NUPOC's educational programs also include training for physicians, surgeons, therapists and other allied health professionals. ❖

### **John Steege Moves Up at Northwestern**

The January issue of *Capabilities* featured an article about the application of computer technology to the field of prosthetics and orthotics authored by John Steege, research engineer with NUPRL & RERP. In pioneering in the use of computers in development the biomechanics of the mechanical interactions between the below-knee amputees and their prostheses, Steege has gained such an advanced knowledge of computer technology that Northwestern University has asked him to join the staff at the University Computing Center.

In addition to work in internal joint replacement, Steege conducted biomechanical investigations and finite element modeling of human/prosthesis interaction that were extremely advanced and will according to NUPRL&RERP Director, Dudley Childress, have significant impact on the future direction of fitting prostheses and orthoses and will improve clinical services. In addition, Steege developed the highly effective computer network that links the research projects, administration and

day-to-day communications in the laboratory. Almost in his "spare time", John developed the NUPRL&RERP site on the World Wide Web.

A graduate of Northwestern University with his B.S. in Biomechanical Engineering and his M.S. in Theoretical and Applied Engineering, Steege has been with the NUPRL & RERP for nearly 15 years. Reactions of his colleagues at the laboratory are mixed. Everyone is happy for the success of their friend -- but apprehensive about life at the labs without him. ❖

### **Michael Quigley Aids Victims of Landmines**

Even after truces are signed and wars are theoretically over, amputation by landmine explosion continues at a high rate in many countries. Michael Quigley, C.P.O., member of the NUPRL & RERP Technical Advisory Panel, leaves his orthotic/prosthetic practice in Chicago's western suburbs and travels to those countries. A member of a medical team directed by United States Agency for International Development (USAID), Quigley participates in in-depth reviews of the needs of the victims of landmine explosions. The results are programs that address the need for prostheses, fitting and on-going care and maintenance.

Numbers of amputees in countries with recent histories of warfare are staggering. United Nations reports list statistics such as: Cambodia - 36,000; Angola - 70,000; and Viet Nam - 200,000. Most of these countries also lack extensive medical treatment facilities, particularly in rural areas where landmines are most prevalent.

Quigley has served two rotations as Director of Orthotics on SS Hope Ship and has also served with Project Hope in South America. In the U.S., he has served as President of the American Academy of Orthotists and Prosthetists and numerous other positions with professional societies.

### **Childress Keynote Speaker at National Rural Rehab Meeting**

Dudley S. Childress, Ph.D., told attendees at the National Conference on Rural Assistive Technology that farmers have played an important role in the development

of engineering over the years. Childress, who has used his experience as a rural youth to become a widely recognized biomedical engineer, opened the conference which addressed using rehabilitation engineering to help farmers, migrant and seasonal workers who have experienced disabilities remain active in the agricultural area.

The conference, held March 10-13, 1996 in Indianapolis, IN was coordinated by the Indiana Tech Act Project (ATTAIN) and Breaking New Ground Resource Center at Purdue University.

## **John Billock Named President of AAOP**

John Billock, C.P.O., was named president of the American Academy of Orthotists and Prosthetists for the second time in December 1995. Billock was Research Prosthetist at the Northwestern University Prosthetics Laboratory in the early 1970s. He participated in the early work with myoelectric prostheses and contributed significantly to the development of myoelectric socket designs.

Billock addressed the challenges facing the orthotic and prosthetic field in the March issue of *O & P Business News*. In the interview, he outlined the AAOP's program for advancement of professional practice through education, credentialing and heightened awareness of the current health care climate. Billock also served as President of AAOP in 1985/86.

## **NURERP Advisory Panels Will Meet in May**

The Consumer Advisory Panel and the Technical Advisory Panel for the Northwestern University Rehabilitation Engineering Research Program will meet May 31 and June 1, 1996 at the NURERP offices and laboratories in Chicago. The panels will review progress on research projects over the past year and make recommendations for continuation of research during the next year.

The Consumer Advisory Panel (CAP) was formed to assure that research is relevant to the lives of people who use prosthetics and orthotics. CAP is also instrumental in making sure that results of research done at the Northwestern University program are disseminated to groups and organizations to which consumers turn for up-to-date information. Members of the CAP are: Edward Eckenhoff, M.S., M.H.A., F.A.C.H.E., Washington, DC; William Lintz, Fredrickstown, OH; Johnnie P. Pearson, Winston-Salem, NC 27155; Margaret C. Pfrommer, Chi-

cago, IL; Linda Lee Ratto, B.S., M.S., Atlanta, GA; Carol Young Scholar, R.N., M.S., C.R.C., Liverpool, NY; Hector Torres, Memphis, TN; Wayne Vercellotti, Joliet, IL and Rose Wilson, Tinley Park, IL. Members of the CAP were chosen based on the fact that they were engaged in delivery of health care services to people who use prosthetics and orthotics and that they personally use prosthetic or orthotic devices.

The Technical Advisory Panel (TAP) is made up of individuals who are active in research or service delivery in orthotics and prosthetics. The TAP was formed to review the NURERP research and how it relates to other research in orthotics and prosthetics nationally and internationally. Members of the TAP are: Lawrence E. Carlson, D.Eng., University of Colorado, Boulder, CO; Richard A. Foulds, Ph.D., Center for Applied Science & Engineering, A. I. duPont Institute, Wilmington, DE; Robert J. Jaeger, Ph.D., Pritzker Institute of Medical Engineering, Illinois Institute of Technology, Chicago, IL; James A. Kaiser, B.S., C.P.; Scheck & Siress Orthotics & Prosthetics, Inc., Oak Park, IL; Maurice LeBlanc, M.S.M.E., C.P., Rehabilitation Engineering Center, Lucile Packard Children's Hospital, Palo Alto, CA; Lawrence R. Quigley, C.P.O., Lakeshore Orthotic & Prosthetic Services, Ltd., Chicago, IL and Michael J. Quigley, C.P.O., Oakbrook Orthopedic Services, Oakbrook Terrace, IL.

The CAP and TAP will issue a report of their observations, comments and recommendation after the meeting in Chicago. This report and other news from the meeting will be published in a future issue of *Capabilities*. ❖

## **Visiting Surgeons Present Technical Orthopaedics**

The highlight of a week-long visit to NUPRL & RERP by four Travelling Fellows from Germany was the presentation of special topics in technical orthopaedics, in the Magnuson Auditorium of the Rehabilitation Institute of Chicago on March 21, 1996.

Bernard Greitemann, M.D., Medical Director of the Munsterland Clinic for Orthopaedics, Rheumatology, Oncology and Diabetes in Bad Rothenfelde, presented "The Diabetic Foot: Surgical Management and Prosthetic Fitting". "Symes Amputation in Diabetics: Obsolete or Still Up-to-date?" was the topic of the lecture by Rainer Eckhardt, M.D., Department of Orthopaedics, University of Ulm. Mathias Axt, M.D., Department of Orthopaedics, University of Heidelberg, spoke on "Hip Disarticulation and Gait Analysis". The presentation of "Adolescent Idiopathic Scoliosis: Effectiveness of Treatment with Cheneau Brace", by Franz Landauer, M.D., C.P.O., University of Innsbruck, Austria, completed the program. ❖

# Bits 'n' Pieces

## .....information round-up from disability interest organizations

**The Amputee Coalition of America will hold their Annual Meeting** in Atlanta, Georgia in conjunction with the 1996 Paralympic Games. The Meeting will take place at the Renaissance Atlanta Hotel Concourse **August 16-18, 1996**. In addition to appearances by Paralympic athletes and attendance at the opening ceremonies of the Games, the ACA meeting is packed with other events. Classes, seminars and presentation topics include consumer education in prostheses, support group development, research, consumer advocacy, recreation and fitness, gait analysis and improvement and much more. To obtain all the details needed to register, please call the ACA office at 423/524-8772. With registration for ACA members at only \$150, double rooms at \$99 and special discounts on airfare, this has to be the most economical way to share Atlanta's Olympic/Paralympic summer of excitement. Early registration deadline -- which assures you of the low costs listed above -- is **July 25, 1996**.

**Want a list of amputee golf tournaments and teaching clinics** across the country? Just call National Amputee Golf Association (NAGA) at 1-800-633-NAGA (633-6242). Disabled Sports USA has a list of sports for amputees including track & field, cycling, lawn bowls, skiing, swimming and volleyball. Call Disabled Sports USA at 1-301-217-0960.

**Kaleidoscope TV is by and for people with disabilities.** Launched on July 26, 1990, Kaleidoscope TV (KTV) has grown to reach 15 million households on over 200 cable systems in 34 states with 24-hour broadcasting. Programs, 90% of which are original with KTV, feature actors and actresses with disabilities and focus on topics including living with disabilities, health care information, technological advances and research. To locate KTV in your area, call your local cable television provider.

**The contributions of Jacquelin Perry, M.D., a leader in physical medicine and rehabilitation** were recognized by Rancho Los Amigos Medical Center in Downey, CA on January 24, 1996. Dedication ceremonies were held on that day for the Jacquelin Perry Neuro-Trauma Institute and Rehabilitation Center. Dr. Perry has made significant contributions to the field of prosthetics and orthotics.

**If you're a Washington Watcher, you can now access government documents** including the *Federal Register* and the *Congressional Record* on the World Wide Web. The web site address is <http://www.access.gpo.gov/supdocs/> If you have the time and patience to sort through the information, this is a good way to keep up on pending

legislation that will have an effect on people with disabilities.

## Books and Periodicals

**John Hockenberry's book *Moving Violations: War Zones, Wheelchairs, and Declarations of Independence***, hasn't crossed our desk yet, but should be a highly entertaining read. John has covered news as a broadcast journalist in nations that were at war and nations where people with disabilities were probably kept in back sheds. John uses a wheelchair in addition to his microphone and is a clever fellow with words. The book is published by Hyperion, 371 pages, \$24.95 and available in bookstores.

**Two comprehensive resources on how to find information about disability** are offered by National Rehabilitation Information Center (NARIC).

*Directory of National Information Sources on Disabilities, Sixth Edition.* The two-volume set lists over 700 organizations for information on disabilities and includes lists of databases and resource directories. Price: \$15.00.

*NARIC Guide to Disability and Rehabilitation Periodicals.* This volume includes information on nearly 500 periodicals pertaining to various disabilities and concerns related to disability. Price:\$15.00.

Both publications are available from: NARIC, 8455 Colesville Road, Suite 935, Silver Springs, MD 20910-3319. Telephone: 800-346-2742 V/TT 301-587-1967.

### Do you use braces -- and have questions?

Several times a month, our phone rings or our E-Mail crows and a person who is a user of braces -- the lower limb orthoses, not the product of orthodontistry-- is calling to express frustration. "Is anyone doing any research on improving braces?" "Aren't there new materials that could make braces lighter and stronger?" "Couldn't braces be made more attractive -- maybe invisible?"

There are new materials and methods of which you may not be aware and we'll be happy to forward that information from the Northwestern University Prosthetic-Orthotic Center (NUPOC). We'll also be happy to collect experiences of brace users and put them in an article in the future. ❖



## Management of Lower Extremity Amputations

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end of the elastic stockinette is secured in place, the distal end is cut to proper length, twisted, and rolled back up to the thigh proximally. Additional layers of shorter elastic stockinette can be applied if more distal pressure is needed. (Figure 5 )

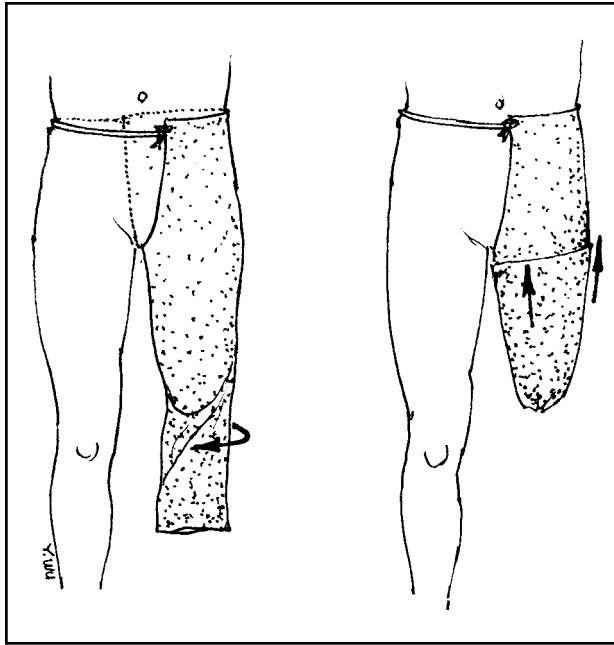


Figure 5: Elastic stockinette for transfemoral amputation.

• **Through-the-Knee Amputation** - The residual limb following through-knee amputation can be managed initially with a nonremovable plaster cast and followed either by a removable rigid dressing as used in the transtibial amputations or by elastic stockinette. Rigid dressing, either removable or nonremovable, is preferred for stump protection.

• **Trans-tibial Amputation** - The wide-spread use of elastic bandaging after removal of the thigh-high rigid dressing to achieve further shrinkage of the residual limb has had some disadvantages. Inconsistent wrapping techniques by the staff or patient often causes either pretibial sores or distal edema. To remedy this problem, Removable Rigid Dressing (RRD) was developed in 1977 at the Veterans Administration Lakeside Medical Center, an affiliate of the Northwestern-McGaw Medical Center. This is a modification of the casting and suspension methods of the IPSF concept. The principles that have made the RRD procedure effective are 1) use of nonexpandable plaster cast to prevent edema, 2) use of supracondylar suspension to make the cast removable, 3) ability to inspect the wound condition, 4) ability to add stump socks to facilitate shrinkage,

5) immobilization of soft tissue to secure wound healing and control residual limb pain, 6) prevention of further trauma, 7) use of cotton spacer in casting procedure to avoid excessive pressure over bony areas thereby preventing skin breakdown, and 8) possibility of graded weight bearing.

Our clinical experience using the RRD has shown improved rehabilitation of trans-tibial amputees since we initiated the procedure in 1977. We attribute this to elimination of skin breakdown and fast stump shrinkage.

### Components of the RRD (Figure 6)

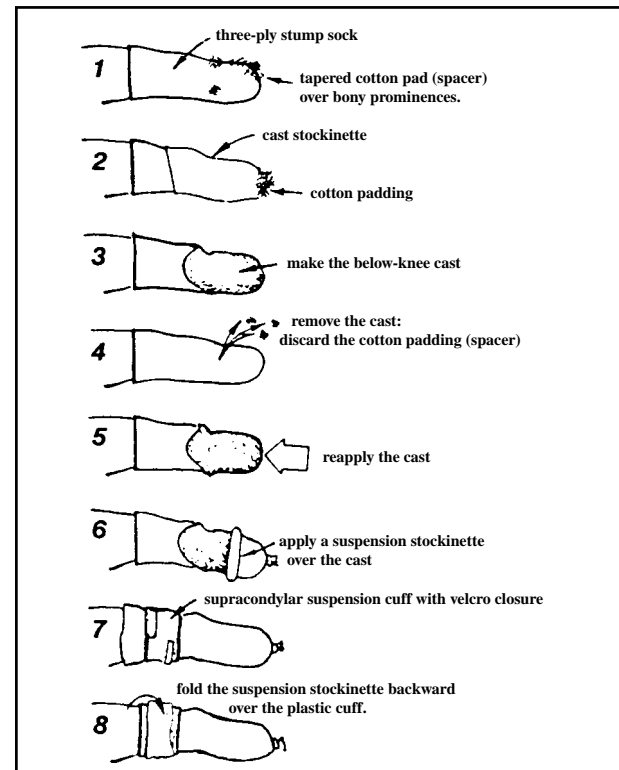


Figure 6: Making and application of a Removable Rigid Dressing.

There are four components used in the RRD: (1) stump socks; (2) plaster cast; (3) suspension stockinette, and, (4) supracondylar suspension cuff. The fabrication and application of the RRD are detailed in the article published in *Clinical Prosthetics and Orthotics*, 1987 (Reference #11).

### Application of the RRD

Only five steps are necessary to reapply the RRD:

1. Apply the proper layers of tube or stump socks over the wound dressing;
2. Apply the plaster cast;
3. Pull the suspension stockinette upward to cover the plaster cast;

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4. Put the supracondylar cuff in place and fasten the Velcro closure;

5. Pull the suspension stockinette tight, fold it downward and anchor it to the Velcro hooks on the suspension cuff.

Several methods can be used to assure that the RRD is put on in the proper orientation. A mark on the plaster cast and a similar mark on the supracondylar cuff are matched next to the patella. A smiling face drawn on the front surface of the cast makes it easier for the patient to apply the cast properly. If excessive pressure with localized redness is noticed, the cast can be softened or hammered from outside and then pushed from inside to reduce the compression.

### RRD Used Routinely with Transtibial Amputations

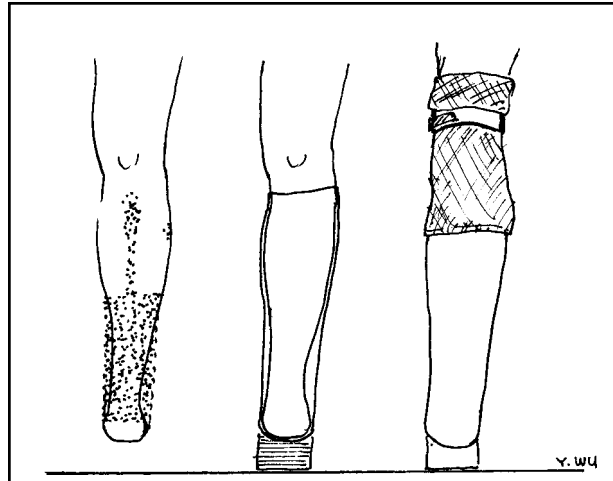
At the Northwestern-McGaw Medical Center, a thigh-high plaster cast is routinely applied upon completion of a transtibial amputation. This first cast is removed for wound inspection or when it becomes too loose and is replaced by the RRD. The RRD is then used for stump shrinkage and for prevention of trauma to the residual limb. It is worn continuously except for wound inspection, hygiene and monitoring of skin condition.

The RRD is also used for initial weight bearing on the residual limb. Mild pressure can be applied to the residual limb soon after surgery against a strap tied to the wheelchair armrests and positioned over the end of the RRD. After the wound is healed adequately, usually 14 days post surgery, standing on a padded car jack is sometimes used for weight bearing. Bilateral amputees practice weight bearing using a tilt table with the degree of weight stress controlled by the inclination of the table and the duration of standing. The RRD can be easily removed to monitor the skin's response to weight bearing. Tube socks can easily be added to accommodate stump shrinkage. It is advantageous to have maximal shrinkage achieved before the first prosthesis is made.

### Syme Amputation

In either the one-stage or two-stage procedures used in Syme amputation, the entire surgical area must be protected in a non-weight-bearing plaster cast for six weeks to permit the blood supply to become established. The same principles as those used for transtibial amputation RRD can be used about three to four weeks after Syme amputation. Proper casting technique is applied to assure that moderate weight is borne at the proximal portion of the residual limb, similar to that of a walking cast.

The procedure for making a Syme RRD is as follows: (Figure 7)



*Figure 7: Removable Rigid Dressing for Symes amputation.*

1. Measure the maximal circumference of the heel and determine the level where the calf has a similar circumference.
2. Pad the concave portion between the calf and heel with cotton padding (used as a spacer for casting).
3. Use cotton padding as a spacer for casting over the bony prominences, including tibial crest, tibial tubercle, fibular head, and malleoli for pressure relief between the cast and the residual limb.
4. Make a total contact cast, as for a fracture walking cast, and attach a rubber heel for weight bearing as needed.
5. Remove the cast when it is set and discard the cotton padding (spacers).
6. Tape the suspension stockinette on the proximal portion of the cast and anchor to the suspension cuff as needed.

Application of the Syme RRD is similar to that of the RRD system for transtibial amputation: apply proper layers of stump or tube socks; apply the cast; apply suspension stockinette and supracondylar cuff and secure the suspension stockinette to the cuff. Some degree of edema above the ankle can be controlled by a short elastic stockinette. Progressive shrinkage of the residual limb before the patient is fitted with a prosthesis is achieved by adding

stump socks.

### Advantages of RRD

- RRD offers protection from trauma resulting from falls or weight bearing exercise.
- Combined use of elastic stockinette and RRD can be very effective in certain cases when the residual limb is very bulbous.
- RRD is a useful means to facilitate wound healing because the reduction of edema and tissue immobilization. ❖

Two video tapes, *1. Managing the Residual Limbs After Amputation* and *2. Removable Rigid Dressing for the Transtibial and Syme Amputation*, are available from Don Olson, Ph.D., Education and Training Department, Rehabilitation Institute of Chicago, 345 E. Superior Street, Chicago, IL 60611.

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