Capabilities

Communicating the Science of Prosthetics and Orthotics

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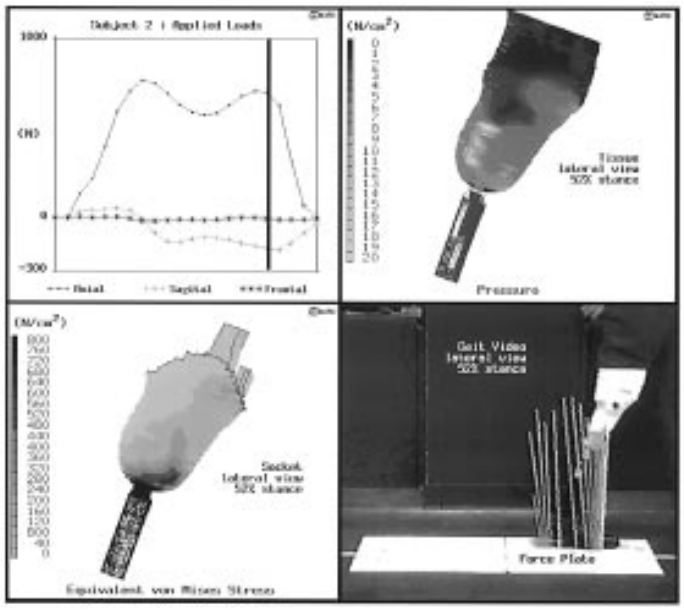

Figure 1.
One frame of a computer generated movie depicting load state (upper left), computer tissue pressure (upper right), socket stress (lower left) and actual video.

Computer Aided Design and Computer Aided Engineering Promises New Methods of Suiting Prostheses to Users

By John Steege & Keith Oslakovic

Computers no longer affect the lives of only a relatively small segment of the population these days. Not too many years ago, only researchers, airline reservation personnel, engineers and a limited number of hobbyists dwelt upon how many megabytes of RAM they needed. A limited number of homes had computers and the Internet was a mysterious "thing" that linked universities and some hospitals together. Getting onto the Internet required learning a new language.

Now, twenty dollars of software sends even the computer illiterate speeding from Web Site to Web Site. And bankers are concerned that software programs will force total change of the banking industry, eliminating many of their services.

Northwestern University's Prosthetics Research Laboratory and Rehabilitation Engineering Research Program are using the many capabilities of computers to increase the knowledge of how prostheses function and how to more closely match prostheses to the anatomy and needs of the person who will use the prosthesis.

Finite Element Analysis of Prosthetic Sockets

The design of a prosthetic socket largely determines the overall comfort and function of a below-knee (BK) prosthesis. The shape of this socket is not an exact replica of the residual limb, but includes modifications (rectifications) such that effective load transfer between the prosthesis and the residual limb is attained. The principles and techniques used by the prosthetist in performing such shape modifications are largely based on experience, and involve trial and error.

We have embarked on a series of new projects whose aim is to design socket shapes from fundamental principles

Continued on page 2

CAD/CAE may change socket design

Continued from page 1

of mechanics. Our approach is to model the limb/prosthesis interface through computerized finite element analysis (FEA) methods.

Initially, our use of the FEA investigated its ability to describe the pressures that develop between the prosthetic socket and the limb of an amputee. Computer models were generated from Computer Aided Tomography (CAT) scans of the amputee's limb. (Shown in Figure 2)

The very involved process of creating individual Finite Element Mesh (FEM) models of limbs has now been automated to the point where a detailed model can be generated in a few days. This is accomplished by implementing software previously developed for the design of total joint replacements to digitize the CAT scan data. This information is then fed into software which creates a FEM model representing both bone and tissue.

Prosthetic Design

The objective of our current work is to make the computer based engineering tool of finite element stress analysis clinically applicable to the design of prosthetic sockets. Using FEA, a stress pattern is applied to the surface of the computer limb model. The computer then solves for the shape that the limb must be in order for this stress pattern to occur. This new or "rectified" shape is then created using computer aided machining (CAM) techniques. The resulting socket is then fit to the amputee and evaluated by instrumenting it with pressure transducers to check that the "designed in" pressures are occurring. The socket fit is evaluated by prosthetists.

To date, we have designed a socket using the above methods and a uniform stress pattern of 10 KPa across the surface of the limb as our design pressure. A check socket has been produced from this design and qualitatively fit quite well. If we can accomplish our objective, there would be for the first time an objective, scientifically based method to design prosthetic sockets. Additionally, this work could then easily be extended to include the design of orthotic devices.

Finite Element Analysis of Below-Knee Prosthetic Gait

We are using FEA to examine stress patterns for trans-tibial amputees during gait. These analyses permit the development of realistic, three-dimensional, colored renderings that reveal stress distributions during various dynamic and static aspects of prosthesis usage. These graphical constructs will enhance understanding of biomechanical principles of amputee gait and be helpful in the development of better socket designs. The results will

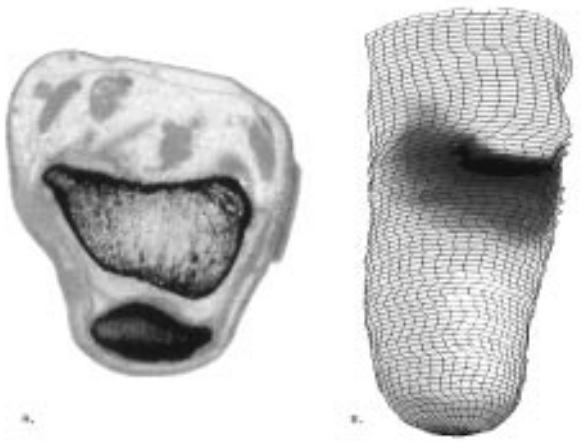

Figure 2. A) CT scan of a BK amputee limb showing the distal femur and patella. B) Finite element model generated from CT data showing pressures predicted to occur between the limb and the socket.

be suitable for usage in prosthetic manuals, for slide and video presentations, and for networked computer-aided demonstrations and interactive instructional programs.

Dynamic load information for three trans-tibial amputees was taken from the literature by digitizing load and moment curves with a tablet. These curves were broken into 21 steps and incrementally applied to a CT-scan-based finite element model of a trans-tibial amputee limb and socket. Analysis was carried out on a SPARCstation IPX with its processor upgraded to 80 MHz. The finite element code MARC™ was used in all analyses. The solution for each increment or load step would occur in under two hours. With 21 load steps, the entire stance phase could thus be modeled in under two days.

Continued on page 6

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Dudley Childress, Ph.D. elected to the Institute of Medicine of the National Academy of Sciences

Dudley S. Childress, Ph.D.

The Institute of Medicine of the National Academy of Sciences, announced on September 29, 1995 that Dudley S. Childress, Ph.D., Professor of Biomedical Engineering and Orthopaedic Surgery and Director of the Northwestern University Prosthetics Research Laboratory and Rehabilitation Engineering Research Program and Executive Director of the Northwestern University Prosthetics and Orthotics Education Center, had been elected to that Institute. Dr. Childress joins a select group of scientists honored by election to the Institute.

The Institute of Medicine was established in 1970 for the purpose of addressing protection and advancement of health professions and sciences, the promotion of research and development pertinent to health and the improvement of health care. Members are chosen for exceptional leadership in their field of medicine and for their career accomplishments.

Members of the Institute contribute significant amounts of time working with advisory, steering or governing committees to formulate recommendations pertaining to a wide range of health care concerns. Most of these recommendations are bases for formulation of public health care policy. Among topics being addressed by the Institute at this time are maternal and child health, infectious disease control and health in emerging nations.

Dr. Childress was elected to the Institute based on his contributions not only in the field of prosthetics and orthotics, but in rehabilitation and assistive technology as well. Dr. Childress, serving as President, was responsible for much of the early development of the Rehabilitation Engineering Society of North America (RESNA). Evidence of his contributions to other professional societies is the fact that he has been honored with Fellow status in the American Institute of Medical and Biological Engineering, RESNA and the International Society of Prosthetics and Orthotics. He has also been honored with Distinguished Service Awards from many consumer groups including the Congress of Organizations for the Physically Handicapped and United Cerebral Palsy Association.

In addition to his direction of research and education in prosthetics and orthotics at Northwestern University, Dr. Childress lectures widely and teaches in the Biomedical Engineering Department at Northwestern. Childress works both to record and honor the efforts of the people who developed the prosthetics and orthotics professions and to build upon their achievements to continuously improve the scientific base of the prosthetics and orthotics field. The following is an example of his work in this endeavor.

Address to the Institute of Electrical and Electronic Engineers 12th Annual Media Briefing, October 18, 1995, New York City, New York.

The October 1994 cover of *IEEE Spectrum* proclaimed “Coming Assault on Disabilities”. A new and powerful assault is coming; however, it should be noted that a strong beachhead has already been established. This beachhead is one of the unsung accomplishments of the last 30 years. In the 1960s, people with high-level quadriplegia, severe cerebral palsy, and other significant disabling conditions were often regarded as non-educable or as being impossible to habilitate or to rehabilitate. Many of these people were placed in nursing homes where they stagnated and lost opportunities to live fully and contribute to society. Today, just a generation later, people with the same kinds of disabilities, or worse, use technology (e.g. computers) to live in their own homes, to work and to participate in society in meaningful ways. They are ordinary people for the most part, but some are widely known, people like scientist Stephen Hawking, actor Christopher Reeve and jounalist John Hockenberry. They have been enabled by technology, by medicine, by their families, by community, and by laws of the society, but most of all they are enabled by their own will. They mostly can’t be cured, but they are often healed. Today, I want to talk about some of the technologies that enable these people. Rehabilitation technology and rehabilitation engineering are only a part of a much larger rehabilitation process. Nevertheless, it is an important part and the developments of this part of rehabilitation since about 1965 have been spectacular.

Continued on page 4

Childress elected to Institute of Medicine
Continued from page 3

The story actually began 50 years ago, after World War II. At that time there were 20,000 amputees from combat and about 60,000 American civilians who had received amputations in the war industry. The Surgeon General called for a united effort to assist these people and that was the beginning of research and development in the USA with respect to handicapping conditions. The now Department of Veterans Affairs and the now National Institute on Disability and Rehabilitation Research (NIDRR) have been the agencies that have been responsible for pressing forward with R & D efforts for disabled persons. With limited funding, they have achieved extraordinary results.

In the 1960s the activities expanded from limb prosthetics to disabling conditions in general. As a result, computers and other electronic devices have had great impact on the lives of people with disabilities. I'm delighted to show what has been accomplished and to discuss what is to come. I believe the results will be fine indeed. ❖

How to Locate a Support Group through NURERP

When an individual faces amputation or trauma that will leave his or a family member's life permanently changed, there are many crises. Will the individual be able to work? To assume family responsibilities? To enjoy life through activities, sports and recreation? Where does he or she find an orthotist or prothetist that will best fit his or her needs? How have other people handled similar problems? How have they dealt with these highly emotional situations?

One of the services offered by the Northwestern University Rehabilitation Engineering Research Program in Orthotics and Prosthetics is a national listing of over 200 support groups for amputees. These groups are listed by state and include mailing address and, usually, phone number.

The amputee support groups listed by NURERP offer services ranging from peer counseling to social activities. Many have data bases of resources for prosthetic and orthotic services, sports groups and specialty services in that specific area which enables the user to more quickly find the solutions for various needs.

The support group listing has just been updated. Assisting the Northwestern University staff in this effort were the **American Amputee Foundation**, the **Amputee Coalition of America, the National Amputee Foundation** and the **California coalition of amputee support groups.** If you would like a listing of amputee support groups, please contact *Capabilities* at the numbers listed on page 12. ❖

World Wide Web is a Source of Information for People with Disabilities

Judging from our e-mail box, more and more people are "surfing the net" to find information useful to them. Some are using home computers with a program -- such as Prodigy, America On Line or Netscape -- which gives access to the Internet and consequently the World Wide Web (WWW). Many others have learned that they can gain access through a school or university they attend or at their local library.

Pages on the WWW that may be of interest to people involved with the topic of amputation range from research-oriented pages, such as REPOC, NUPRL&RERP's page,**http://www.repoc.nwu.edu/,** to "a home shopping network for people with disabilities", by **EKA Communications**. This web site can be reached at: **http://www.disability.com/cool.html. "Enable"** is the Rehabilitation Technology Association's listing of communications and information sources and can be found at: **http://www.icdi.wvu.edu/Enable.html**. **Rick and Joni's Amputee Home Page** is under construction and will include Prosthetic Research, Physical Therapy and Funding at: **http://www.access.digex.net~ vandyke/amputee.html. Ian's Amputee Page,** originating in Burnaby, British Columbia, includes sports, international news and other topics at: **http://vanbc.wimsey.com/~igregson/index.html.** ❖

NUPOC Plays Vital Role in Assuring the Quality of Delivery of Prosthetics and Orthotics

By Mark Edwards, C.P. *Director of Prosthetics Education, Northwestern University Prosthetic-Orthotic Center*

As the area of prosthetics and orthotics becomes more complex and incorporates more and more state-of-the art technology, it becomes increasingly critical that the results of research in the laboratories and the development in private industry are transferred to the people who depend on prosthetics and orthotics to live fuller, more comfortable lives. A vital link in this transfer of technology are the prosthetists and orthotists practicing across the country. They provide the final step in assuring that the prosthetic or orthotic device exactly fits the needs of the user and is the latest in technology.

Northwestern University Prosthetics Orthotics Center (NUPOC), is the oldest educational facility in prosthetics and orthotics in the country. NUPOC offers courses ranging from preparation of candidates for certification examinations to courses to teach practicing prosthetists and orthotists updated products and procedures.

Exam Preparation Seminar

NUPOC and the American Academy of Orthotists and Prosthetists have combined to offer the Exam Preparation Seminar (EPS) for the past two years. This seminar is planned with the certification examination in mind. Prospective graduates of National Commision on Orthotics and Prosthetics Education (NCOPE) accredited programs can sit for the American Board of Certification (ABC) certification examination after completion of a year long structured residency or 1900 hours of supervised training.

The EPS gives future prosthetists and orthotists a structured and comprehensive review of the material they might be tested on. The subjects covered include test taking, mock written exam, clinical case studies, component recommendations, normal and pathological gait analysis, mock written simulation exam and theory and rationale for fittings at various levels of disability. NUPOC's faculty participate as the lead instructors and lecturers in the course.

The EPS is offered two times per year before the ABC written examination in the fall and spring. Feedback from attendees has been very positive. Future practitioners appreciate the intensity and knowledge that the Northwestern faculty offer during this two day session.

Participants also interact with other exam candidates and discuss regional differences in patient management and philosophies of fitting. This combination seems to help ease test anxiety and improve performance on the certification examination. Practitioners from other educational programs express enjoyment of the opportunity to see NUPOC's facilities and meet faculty members. NUPOC hopes to continue to offer this review and may assist in the development of the EPS at other accredited programs in the future.

Professional Continuing Education Courses

Management of Foot Disorders: Pedorthics 801-A & B (offered May 28-June 7, 1996 & July 8-19, 1996)

This is an intense two-week comprehensive course combining clinical management with fabrication theory and practice of skills. Anatomy and normal human locomotion will be reviewed. Pathophysiology of forefoot, hindfoot and midfoot will be discussed. Specific attention will be given to the etiology and pathomechanics of the Charcot, diabetic, arthritic and partial foot. The choice of materials in the design of foot orthoses to achieve biomechanical objectives will be addressed. Participants will present the rationale for treatment of selected case studies following lectures on pedorthic managment of adult and juvenile foot disorders.

Prosthetics and Orthotics for Suppliers and Manufacturers: Prosthetics 661 (offered May 29-31, 1996)

This course is designed specifically for manufacturers, suppliers and sales representatives to help them better communicate with practitioners. The course includes a Functional Review of Anatomy, Normal Human Locomotion, Theories and Design of all orthoses and prostheses and basic medical and allied health terminology. The course is beginning level and requires little or no experience in orthotics and prosthetics.

NU-RIC Ischial Containment: Prosthetics 611-B (offered May 22-24, 1996)

This course, which is taught by a combination of faculty from NUPOC and the Rehabilitation Institute of

Continued on page 7

CAD/CAE may change socket design

Continued from page 2

The incrementally calculated stresses in tissue, socket, and pylon were then displayed on the color computer monitor in an animated fashion (Figure 1). For visualization purposes, rotations were imposed upon the displayed results to simulate limb angle during the gait cycle. These animations were presented in tandem with displays of the load and moment values used as input into the FEA, as well as with displays of trans-tibial prosthetic gait from digitized video obtained in-house.

The work to this point has been a demonstration of the ability and utility of computer analysis and graphics when applied to prosthetics. We believe that this technology has shown great promise as a tool to quickly and efficiently perform parametric studies; studies which are impractical if not impossible to perform in the clinical research setting.

Contact Analysis

An approximation made previously in our FEA modeling was that the limb and socket interface was fixed, where no slippage or loss of contact may occur. We have begun work to more accurately model this interface using the contact problem capabilities of the MARC™ FEA code (Figure 3).

In addition to accounting for slippage at the interface during the gait cycle, contact problem modeling will also be suited to more accurately model donning of the socket. This will provide a means of quantifying the stresses produced by wearing the socket independent of weight bearing.

Contact problem formulation was applied to an existing simple problem to verify the accuracy of the solution. The axisymmetric stump/socket approximation built and modeled by Reynolds (1988) was reformulated as a contact problem using the MARC ™ finite element code.

Initial Results Provide Confidence In FEA Capabilites

Initial results showed similar stress distribution to both Reynolds' predicted and experimentally determined values. In addition, some variation of the surface friction coefficient was investigated and the expected result of increasing shear with increasing friction was evident. These initial models provided confidence in the contact capabilities of FEA code.

FEM from Ultrasonic Imaging

Investigation into the use of geometry data obtained via an ultrasonic digitizer developed by Doctors Ping He and Kefu Xue, Wright State University, is proceeding with encouraging results. The data obtained from ultrasonic scans includes both bone and tissue boundaries and is thus well suited for finite element model generation. The Wright State group has provided us with their first ultrasonic scan of an amputee containing 50 sections at five millimeter intervals. Using this work, we were able to incorporate the ultrasonic scan data of the amputee limb directly into our procedure for creating finite element models.

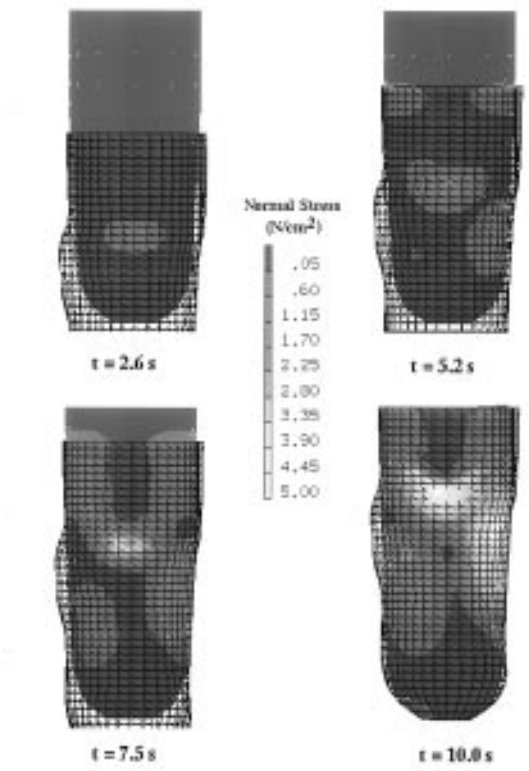

Figure 3. Normal Stress (pressure) resulting from donning of a prosthetic socket as predicted by finite element contact analysis for four different instances.

In another application of the power of computer technology to the field of prosthetics, the Northwestern University program is using a quick prototyping method to design and fabricate a socket. The process, named Squirt Shape, will be reported in detail in future issues of *Capabilities.* ❖

This Research is funded by the Department of Veterans Affairs Rehabilitation Research and Development Service and the National Institute on Disability and Rehabilitation Research.

NUPOC (continued)

Chicago offers the ABC certified practitioner a structured "hands-on" educational experience in up-to-date transfemoral prosthetics management. Theory, rationale, biomechanics, modification, static and dynamic alignment, patient fittings and trouble-shooting are among the topics taught in the three-day course. Practitioners will be able to identify the critical design features of the ischial containment shape as well as understand the principles of alignment and component selection.

For more information about NUPOC educational courses, contact Mark Edwards, C.P., Director of Prosthetics Education or Bryan Malas, C.O., C. Ped, Acting Director of Orthotics Education. (312-908-8006) NUPOC also offers a selection of text books and other guides to prosthetics and orthotics. ❖

NUPRL&RERP Staff Share Research and Project Progress in Many Activities

Dudley S. Childress, Ph.D., Director of the Northwestern University Prosthetics Research Laboratory and Rehabilitation Engineering Research Program, presented the Svetz Lectureship in Biomedical Engineering on November 15, 1995. The lecture was presented at the University of Pittsburgh in cooperation with that University's School of Health and Rehabilitation Sciences.

Three members of the NUPRL&RERP staff gave presentations at the meeting held by The Children's Memorial Medical Center, Chicago, October 19, to honor David Winter, Ph.D., who established the first clinical gait laboratory in 1974 at the Shriners Hospital in Winnipeg, Canada. Dr. Winter is Distiguished Professor Emeritus at the University of Waterloo, Canada and known internationally for his contributions to the study of normal and pathological human gait, a field in which he has published over 140 research articles. Northwestern University staff members presenting were: Dudley S. Childress, Ph.D., *Aspects of Gait and Anthropometry as Revealed in Scupture and Art,* and Richard F. ff. Weir, Ph.D., and Richmond B. Chan, Ph.D., *Real Time Gait Laboratory Instrumentation.*

A team from Metropolitan Tokyo Rehabilitation Hospital, Tokyo, Japan, consisting of an administrator, a medical doctor, a nurse, and physical therapist and an occupational therapist spent a portion of their visit to the Rehabilitation Institute of Chicago on October19 observing the research activities of the Northwestern University Prosthetic Research Laboratory and Rehabilitation Engineering Reseach Program. The team visited the U.S. to learn how rehabilitation services are delivered in this country, observe the system of community based rehabilitation and explore the latest information available on prosthetics and orthotics. ❖

What Do YOU Want To See in *Capabilities*?

Capabilities is published to serve people with interests in not only Prosthetic & Orthotic Research, but the general interest areas of living productively and -- by the way -- having a disability. Whether you're a person with an amputation, have a family member or friend with an amputation or are a practitioner in some phase of prosthetics and orthotics, we'd like to publish your ideas, success stories -- and your complaints, if you have them. Drop us a line in e-mail or U.S. Postal Service.

Bits 'n' Pieces ...

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

A significant percentage of amputations are the result of agricultural accidents. Farmers work in dangerous situations involving machinery, unstable footing from weather conditions, and large, sometimes unfriendly animals, etc. To help farmers who have lost a limb or portion of a limb continue to operate their farm, the Program ***Breaking New Ground*** has been established at Purdue University. The program offers assistance in finding the appropriate prosthetic, orthotic or assistive device ranging from an adaptation to make steering a tractor easier with a hook prosthesis to making a milking parlor accessible for a farmer who uses a wheelchair. The *Breaking New Ground Newsletter* includes a wide range of stories about how farmers with all types of disabilities have solved their problems. The "Plowshares" column gives details and the latest technology. If you'd like to learn more, call or write: Breaking New Ground, 1146 Agricultural Engineering Building, West Lafayette, IN 47907-1146, 800/825-4264.

Do you fly on commercial airlines while using a wheelchair, crutches or other prostheses or orthoses? If you do and you'd like to share your experiences -- good or bad -- in a way that counts, contact: ***Access to the Skies***, a program of the Paralysis Society of America The group is conducting a survey to determine how well airlines and airports are complying with the Air Carrier Access Act. To be included in the survey, call 1/800/643-8285 between 8 a.m and 4:40 p.m. Central time or on the Internet at: http://computek.net:80/access95.

SUPERKIDS is full of ideas for children with amputations. The SUPERKIDS newsletter contains stories about kids who, either through an anomaly at birth or trauma, are growing up without the usual number of hands, feet, arms or legs. They play sports and musical instruments, share adventures with siblings and do everything other kids do. The newsletter also has excellent tips on finding books about famous people -- like Jim Abbott, the one-handed New York Yankee baseball star -- who have dealt with amputation. If you would like to receive the newsletter, contact: SUPERKIDS: 60 Clyde Street, Newton, MA 02160.

Windows 95® has Sticky Keys. For those who use a computer with one hand or by using a mouthstick, Sticky Keys increase input speed and enable some operations that could not be performed using a single point input. For example, try to hit "Ctrl", "Alt", "Delete" to restart your system using only one hand. Windows 95® , Microsoft's new operating system for PC's, includes a latching system as one of the basic utilities. Once opened and activated, the latching system lets you use the keypad as a mouse, dampen down the keys to avoid repeats if you stay too long on them and delay typing if you tend to hit the wrong key on the way to the one you want. The latching systems also activates "Sticky Keys", which tricks the computer into thinking that the "Shift" key, for example, is still being held down after it's touched. The next letter typed will be a capital. For further information, contact your local Microsoft dealer, who, of course, is listed in your phone book or call Microsoft Sales at: 800 426-9400.

Some of the women attending the United Nations World Conference on Women didn't get to go to the sessions. It seems that about 350 women attending the Conference had mobility impairments and found that the meeting venue in Beijing, China was not only cold and lacking in amenities, it had steps leading from everywhere to everywhere else. Disability rights groups had worked for over a year to mobilize a network known as Women's International Linkage on Disability (WILD). According to a report in ***Paraplegia News,*** December 1995, when the women demonstrated against the inaccessibility, the host Chinese "lost" the one lift-equipped bus, leaving the women stranded far from their housing. The official U.S. delegation included one woman with a disability, Judy Heumann, assistant secretary of the Office of Special Education and Rehabilitation Services, but most of the attendees with disabilities were there on their own. For more details on this story, contact: Paraplegia News, 2111E. Highland Ave., Suite 180, Phoenix, AZ 85016-4702.

You can be sure of a front-row place at the 1996 Paralympic Games -- for free. Of course, this offer is only available to people who wish to serve as Envoys during the Games and will commit their time from August 10 to August 28, 1996. Highly trained delegates will assist athletes in many ways including translation, arrivals, accreditation, accomodation, transportation and departure. Your chances of being chosen as an Envoy are better if you speak foreign languages, but it's not mandatory. To apply, call the Paralympic Envoy Hotline, 404/724-2832. You'll make new life-long friends. **The Editor**

Information Round-Up: Books, Videos and Periodicals

Videos Show the Abilities of Amputees

Each year, a significant number of people with double amputation of the upper limbs come to use the combined programs of the Rehabilitation Institute of Chicago and the Northwestern University Prosthetic Research Laboratory and Rehabilitation Engineering Research Program. Certainly, the problems facing bilateral, high-level upper limb amputees can be many. However, most of the people who are treated in this combined program leave with impressive ability to live productive lives. Three videos have been produced about how bilateral upper-limb amputees resume their lives. They offer ideas and confidence to any upper-limb amputee and the people who are involved with them.

Bilateral Shoulder Disarticulation: Self-Care and Use of Complementary Hybrid Prostheses, Uellendahl, J., Heckathorne, C., Krick, H., McCauley, J., Meredith, J. and Wu, Y, M.D. 1993 1/2" VHS video, 30 minutes, puchase price, $60.00.

It probably doesn't occur to most people that a person with bilateral shoulder disarticulation, who wears two upper-limb prostheses will be found shaving himself, mowing the lawn, driving his van and pursuing his favorite activities. This video shows all of these activities. In addition to using his prostheses, the person featured in the video has also adapted various devices to help him go about his life. For example, he uses special controls on his van and his riding lawnmower. He shaves using a stand to hold the shaver. The viewer will gain ideas on how to use adaptations for activities of daily living.

Prosthetic Fitting and Self Care Skills in a Bilateral Above-Elbow Traumatic Amputee, Uellendahl, J., Meredith, J. and Wu, Y., M.D. 1992, 1/2" VHS, 30 minutes, purchase $60.00.

The amputee in this video demonstrates how he uses bilateral above-elbow body-powered prostheses incorporating four function cable control to achieve improved limb placement and prehensor dexterity. He is shown in daily activities using a variety of assistive techniques and devices.

Child Care with Bilateral Trans-Radial Amputation, Uellendahl, J., Meredith, J. and Wu, Y., M.D., 1995, 15 minutes, $30.00 purchase.

When the subject of this film incurred bilateral trans-radial amputations, one of his strongest desires was to be able to handle much of the care of his infant son because his wife was pregnant with their second child. He began care activities including changing diapers, dressing and feeding the child and positioning the child in the auto safety seat while using mechanical hook prostheses. He later moved on to using myoelectric prostheses.

The above videos may be ordered from: Education and Training Dissemination, Rehabilitation Institute of Chicago, 345 E. Superior St., Room 1671, Chicago, IL 60611. All orders must be prepaid with a check payable to Rehabilitation Institute of Chicago. Please add $3.00 per video for shipping and handling.

Book With a Wealth of Detail

THE HANDBOOK: Information for New Upper-Extremity Amputees, Their Families and Friends, by Richard L. Mooney, Mutual Amputee Aid Foundation, P.O. Box 4218, Carson City, CA 90231-4218. $14.95 (Inquire about special rates for Groups and Facilities).

In wonderfully clear, easy to read style, this book covers any area necessary to the new amputee: pre-surgical considerations, descriptions of prostheses, phantom pain, emotional pain, learning how to do things and much more. Eight people relate their personal experiences with upper-limb amputation in frank and humerous terms. The stories range from that of a child who crawled under a train, with amputation of both arms resulting, to that of a geologist who was mauled by a bear. Perhaps the best quote is from John Donlou, a rock climber and psychiatrist, who says, "what a person can do has more to do with what's going on in their head than what's left of their arm". The book also contains a wealth of sources for support groups, prostheses, funding, sports and recreation and other topics.

Quarterly Periodical Returns

Courage, a quarterly magazine published by the Indiana Amputee Foundation, Inc., 4525 Mayfield-Metropolis Rd., Paducah, KY 42001. $18.00 per year.

Published over 50 years ago by the Fraternity of the Wooden Leg, *Courage* has long been out of print. It's now back and filled with articles about people with amputations as they pursue jobs, sports and live their lives to the fullest. Articles about professionals in prosthetics and orthotics are also included. ❖

Will Managed Care Affect Your Future Choice of Orthosis or Prosthesis?

By Jan Little *Project Director, Resource Unit on Information and Education*

For the past decade, one of the most critical concerns in the U. S. has been the rising cost of health care. Although much ado was made about a National Health Care Program in 1993 and 1994, Congress failed to even agree on the type of plan to pursue. Health care is a multi-billion dollar business in this country. The parties who share those dollars include a variety of layers in the health care system ranging from the practitioner, who delivers care or equipment, through the doctors, nurses and medical technicians, to hospitals and on up to the insurance companies or "carriers", who pay for treatment and devices. The mere threat that the U.S. could have a single payer health care system -- similar to Canada -- presented a danger to the multitude of carriers. If there was only one entity paying for health care, the other hundreds of carriers would be out of business.

The system of free enterprise encourages creativity. Carriers and hospitals particularly began to explore options that would slow the growth of health care costs and provide acceptable coverage for the maximum number of people. One method of accomplishing this is managed care, a concept that apparently is gaining favor with many companies who provide health care coverage to their employees. Managed care is also being initiated for recipients of public health care coverage, such as Medicare and Medicaid, in a number of states.

What is Managed Care?

The simplest description of the very complex managed care method of health care delivery is that a company which offers coverage to their employees receives bids from a company which will provide medical treatment to all employees. This company may be an HMO (Health Maintenance Organization), a PPO (Preferred Provider Organization) or a combination of both with some traditional commercial insurance included. For the employer, insurance premiums are set for the period of the contract, relieving the employer of the uncertainty that formerly resulted from one employee having a catastrophic claim which caused huge increases in premiums. For the person covered by the contract, participating in an HMO will mean low-cost access to routine exams and other medical treatment. He or she must, however, use the doctor, the laboratories and the hospital determined by the HMO. With a PPO, the person covered may be able to have more choice of physicians, hospitals, etc. -- if their preferred medical group chooses to participate in the PPO.

The carrier providing health care -- whether an HMO or PPO -- is in a position of wagering that the premiums collected for the entire group of patients covered will exceed the cost to the carrier for provided health care. Actually, this is not as risky as it may sound. In the group covered, many participants will either require minimal or no health care during a year. To contain their costs of health care provision, the carrier solicits bids for services. For example, a group of physicians or a hospital will bid to treat all patients for a set amount for each procedure. Or, in the case of prosthetic and orthotics, the Prosthetic/Orthotic company will agree to provide services and devices at a set price. One term often heard in relationship to this system is "capitation". Under capitation, the carrier agrees to pay a set amount -- $100 per month, for example -- to the service provider to take any and all patients needing the provider's service whether or not those patients need service.

So What's Causing the Problems We Hear About?

If you read newspapers, watch TV or hang around professional meetings, social events or any place other than a cave in the ground, you're hearing horror stories about health care as delivered under managed care. Your co-worker's wife had a baby and was ejected from the hospital 24 hours to the minute after the baby took its first breath. Someone's Aunt Mildred, who has diabetes, was only able to see the podiatrist about her decreasing circulation in her feet on an every eight weeks schedule. Joe was forced to go to a prosthetist other than the one who had been his saving grace for 10 years. Chasing fraud and abuse of the system by health care providers has nearly replaced chasing organized crime for the FBI.

How much of the horror of managed care is real? How much is industry and media hype? Well, a story about HMO physicians moving big chunks of bureacracy around to provide treatment for a patient isn't nearly the enticement to get people to watch the 10:00 p.m. news as the story of a patient woefully wronged, is it? On the other hand, there are potential problems of which you should be aware if you're covered by a managed care program.

Potential Problems -- and What You Can Do

Based on interviews with prosthetists, orthotists, physicians and managed care providers, it seems that there

are some things you should be aware of as a person requiring provision of evaulation, fabrication, fitting and maintenance of a prosthesis or orthosis. Knowing the system may help avoid having problems with it.

• A few carriers using managed care are still making price the only deciding factor for services and products. However, the term "outcomes" is being used more each week. If cost-containment can be proven to result in increased medical or other costs down the line, those carriers will not be players in the market. If you miss work because your health care insurer does not allow adequate visits for maintenance of your prosthesis or orthosis, whoever contracted with your insurer -- employer, state agency, etc. -- will need documentation of your experiences.

• Your choice of practitioner may be limited. What does it mean to you that you have to wait weeks or travel more miles to see the approved practitioner? Document it.

• A very real potential exists that nation-wide companies will be able to contract for managed care provision of prostheses and orthoses, thus reducing the business of the local, independent practitioner that's always given you such good service. They may not be able to survive if forced to discount their services as much as large companies can and may have to close their doors before the managed care situation stabilizes.

• The practitioner may not have adequate time to thoroughly evaluate your needs, fabricate and fit your prosthesis or orthosis because hospitals are being forced to decrease the number of days a patient may stay in the facility. Hospitals are only reimbursed through managed care for the allowable number of days established for specific conditions.

• You may more frequently be treated by a technician or assistant, rather than a certified prosthetist or orthotist, because the larger companies may contain their costs by having certified practioners supervise people with less training in P & O.

Despite the above concerns, the prosthetists, orthotists and doctors interviewed were optimistic about the future. They based this optimism on the premise that people who need P & O service will not meekly accept whatever is chosen for them. We're already seeing a new phenomenon. Managed care companies are aggressively seeking patients to cover. This indicates that health care may be influenced more and more by consumer demand and choice. It's now more important than ever to be an informed -- and vocal -- consumer of health care services. ❖

NIDRR Funds Research to Aid Children with Amputations

A newly funded research program is focused on children with amputations and their families. The National Institute on Disability and Rehabilitation Research (NIDRR) has awarded a five year, $2.5 million grant to the Rehabilitation Engineering Research Program at Rancho Los Amigos Medical Center in Downey, California. This grant provides continued funding for the RERC which has focused on the development and provision of technology for children with orthopedic disabilities.

The grant award provides support for five separate research and development projects.

• design, evaluation and use of body-powered hands by young children with below-elbow amputations;

• development of an improved mobile arm support for children with flaccid paralysis of the shoulder and elbow flexor muscles;

• two studies on the orthotic needs of children with lower-limb impairment.

• solicitation of input from children and family members about attitudes toward prosthetic and orthotic equipment, current systems of service delivery, and the cultural, ethnic and socioeconomic factors that affect acceptance and use of assistive devices.

While the research addressing orthotic needs of children with lower-limb impairment will focus on children with myelomeningocele (resulting from Spina Bifida) because of the inherent difficulties in bracing this population, innovations in orthotic design which result from these projects will have wide application to children with spinal cord injury, muscular dystrophy, Guillain-Barre syndrome and other conditions resulting in paresis or paralysis of the lower extremities.

Co-Directors of the Rehabilitation Engineering Research Center are Donald R. McNeal, Ph. D. and Yoshio Setoguchi, M.D. Dr. McNeal has headed the RERC at Rancho Los Amigos for a number of years. Dr. Setoguchi is Medical Director of the Child Amputee Prosthetics Project at Shriner's Hospital, Los Angeles.

For further information, contact the program at Bonita Hall, 7505 Bonita St., Downey, CA 90242. ❖

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