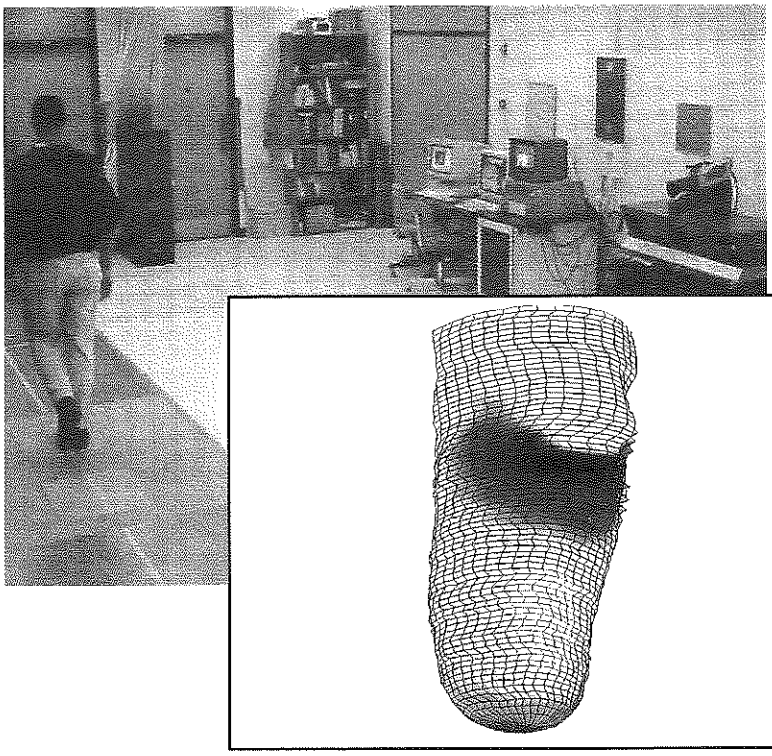
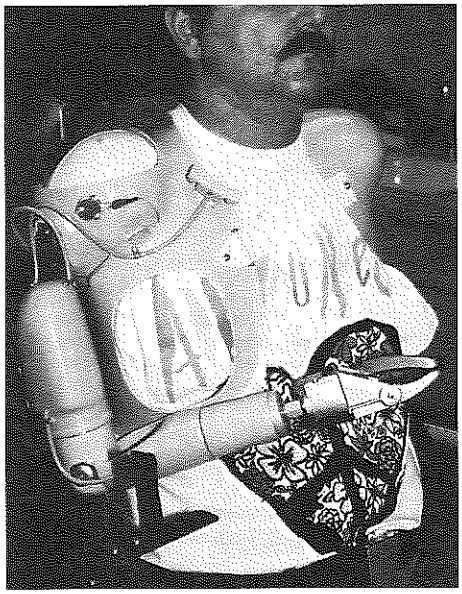
Capabilities

Communicating the Science of Prosthetics and Orthotics

Volume 5, Number 3, July 1996





The Northwestern University Prosthetics Research Laboratory and Rehabilitation Engineering Research Program focuses on the areas of Aided Ambulation, Upper-Limb Prostheses and Computer Aided Engineering of orthoses and prostheses.

How Northwestern University RERP Research Affects the Man and Woman on the Street

By Jan Little

You see them on the news breaking the international record for high jumping and as school kids engaged in spelling bees. You see them roller blading down the shore of Lake Michigan. One of the members of the U.S. Army's elite Golden Knights Parachute Team is one. Sometimes -- if you've ever watched *The Fugitive* -- you even see them as the villain. Who? The millions of people in the United States who use prosthetic limbs and orthoses.

Do research facilities such as Northwestern University Prosthetics Research Laboratory and Rehabilitation Engineering Research Program (NUPRL&RERP) have a role and an influence in the lives of people who use prostheses and orthoses? A visitor to our laboratories might find it difficult to make an immediate connection because they would mostly see men and women quietly tapping computer keyboards -- or repeatedly measuring the reaction of prosthetic feet or knees using specially designed apparatus and computer programs -- or pouring over articles in thick professional journals.

Continued on page 2

The Consumer Advisory Panel (CAP) and the Technical Advisory Panel (TAP) for Northwestern University Prosthetics Research Laboratory and Rehabilitation Engineering Research Program

Members of the CAP attending the meeting:

- Margaret C. Pfrommer, Chicago, 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
- Rose Wilson, Tinley Park, IL.

Guests: K. Martin Scott, Syracuse, NY
Frederick K. Miller, Elmhurst, IL

Members with previous commitments:

- Edward Eckenhoff, M.S., M.H.A., F.A.C.H.E., Washington, DC
- William Lintz, Fredrickstown, OH
- Johnnie P. Pearson, Winston-Salem, NC
- Wayne Vercellotti, Joliet, IL

Members of the TAP attending the meeting:

- 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 Instititute of Medical Engineering, Illinois Institute of Technology, Chicago, 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

Members with previous commitments:

- Michael J. Quigley, C.P.O., Oakbrook Orthopedic Services, Oakbrook Terrace, IL
- James A. Kaiser, B.S., C.P., Scheck & Siress Orthotics & Prosthetics, Inc., Oak Park, IL

Examining the question of whether -- and how much -- a research program such as NUPRL & RERP has an effect on the lives of individual amputees is important to the research program. By knowing whether and how a particular project is applicable to the lives of amputees, the researchers can either verify the direction of the project is correct of the project or redirect it. Entirely new topics or subtopics for research may result from this evaluation process.

Advisory panels assist in evaluation

To assist in such evaluation, two advisory panels have been created. The Consumer Advisory Panel (CAP) was selected in 1988 and is comprised of people who use a prosthesis or an orthosis. In 1993, a Technical Advisory Panel (TAP) was formed with members selected from research scientists in the field of biomedical engineering with an emphasis on prosthetics and orthotics. The panels met at NUPRL & RERP in Chicago on June 1 for a day of interaction between panel members and the staff and students of the Program. Although interaction continues throughout the year between panel members and staff members, perhaps the more important result is that the CAP/TAP meeting is a reminder that research cannot exist in a vacuum. The researcher must constantly re-examine his or her postulations and theories.

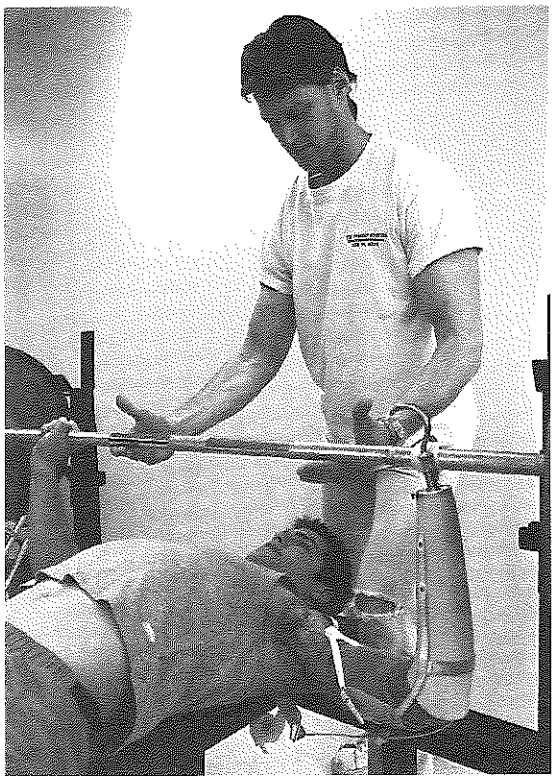
As one panel member pointed out, at Northwestern University, the people conducting research have an ongoing exchange of information with both the people who use and the people who fit prostheses and orthoses. Re-

Continued on page 6

Capabilities (ISSN 1055-7156) is published in April, July, October and January by Northwestern University's Rehabilitation Engineering Research Program. Program Director, Dudley S. Childress, Ph.D. Editor & Designer, Jan Little

Subscription is free to all individuals interested in prosthetics and orthotics. For contribution guidelines and advertising inquiries, write to the address below. Address subscription information, address changes and other correspondence to: *Capabilities,* Northwestern University RERP, 345 E. Superior St., Room 1441, Chicago, IL 60611.

For Many Amputees, Getting to the Paralympics is a Victory



Long, arduous hours of preparation lead up to winning a spot on the USA Paralympic Team. One of the many sports offering fierce competition for people with amputations is weight lifting.
(Photo courtesy of the Virginia Wirtz Sports Program, Rehabilitation Institute of Chicago)

If the name Bill Demby doesn't mean much to you, how about the TV commercial by DuPont Corporation in which a man, shooting baskets with friends, falls down and then we see that he has two prosthetic limbs? That's Bill Demby. Bill, who holds three national track and field records, will compete in Atlanta to add International records.

Sports can be the motivation to compete in life

Bill told his story in the Spring issue of the Institute for the Advancement of Prosthetics *Step Ahead.* Both of his legs were amputated below the knee after injury from Vietcong rocket attack in 1971. Demby returned to the United States to find that he wasn't a war hero. He had a high school education and had been told by his counselors that he wasn't college material. The combination of disability and lack of education may have been factors in Demby's drift into drug and alcohol abuse. He credits his wheelchair basketball and other sports as a significant influence on his life and his ability to overcome his addiction.

Bill Demby spends much time as a motivational speaker. His theme for speeches is: "Life is a game. In order to win, you have to play".

Bill Demby is only one of many athletes who has earned the right to represent the United States at the International Paralympics in Atlanta, August 6-15, 1996. For over two years, athletes with amputations have been competing in regional and national meets to win a berth on the Paralympic team. The competition in such sports as track, field and swimming has become so tough that a fraction of a second means the difference between being on the team and being a spectator.

Courtney Ratto's Paralympic journey

Courtney Ratto, the daughter of Linda Lee Ratto, member of the NUPRL &RERP Consumer Advisory Committee, will be cheering her U.S. Swim Team on from the sidelines. Although Courtney, who will be a high school senior this year, has won numerous medals in swimming, she missed placing on the team by a matter of seconds in the final competition for team berths in Boston, MA in May. (See October 1995 *Capabilities* for more on Courtney.)

Courtney's mother tells us that Courtney is excited about going to the Paralympics as an assistant to the swim

Continued on page 4

Paralympic Athletes
Continued from page 3

team and that Courtney has already decided that she will be a member of the U. S. Team in 2000.

For young people with disabilities, the experience of competition, the discipline required for training and the feeling of accomplishment may, in the long run, be more valuable than physical therapy. In athletic competition on the level of preparing for the Paralympics, there is no special consideration given. The playing field is level.

An aid to getting a life back together

For many athletes who were active in sports prior to their amputation, it is important to regain their self-image as a person with physical strength and prowess. Dennis Oehler, a transtibial amputee who specializes in track events including the long jump, has expressed the feeling that his competition in the Paralympics since 1988 has helped him get his life back together after his leg was amputated following a car accident. Oehler had a promising career as a soccer player at the time.

Medals won't be everything

Whatever the sport and whatever the results in Atlanta, the road leading to a spot on the U.S. Team has been marked by the highest level of competition for the amputees who will compete. Maybe as important as the medals they will win will be the experience of meeting athletes from 120 countries, the thrill of being part of the team and the knowledge that the Paralympics will convince a few more members of the public that people with disabilities come in all sizes, shapes and capabilities. ❖

Information Round-up: Books, Periodicals and Other Sources

Information Manuals for People with Lower Limb Amputations

Two informative manuals have been written to help people who have had lower limb amputation understand what the doctors and prosthetists are talking about. They are now available directly from the authors, A. Bennett Wilson, Jr. and Alvin L. Muilenburg. The manuals are:

A Manual for Below-Knee (Trans-Tibial) Amputees is a 16-page book that explains terminology, general information about amputation and the rationale behind how prostheses are fitted. It also gives tips on how prostheses are made and reviews several types of feet.

A Manual for Above-Knee (Trans-Femoral) Amputees offers discussions of the same topics covered in the manual for trans-tibial amputees but also outlines basic information about prosthetic knees. Like the previous manual, this one gives information on how to maintain a healthy residual limb and general overall health.

The manuals may be ordered from: A. Bennett Wilson, Jr., P. O. Box 380, Topping, VA 23169. One to four copies cost $3.00 each; 10-99, $2.00 each; 100 or more, $1.50 each. ❖

NIDRR Sponsored Information Programs Answer Many Questions

Another program in the continuing effort of the National Institute on Disability and Rehabilitation Research to forge strong information networks that can be used by people with disabilities, has resulted in a new Center. The program, the National Center for the Dissemination of Disability Research (NCDDR), is located in Austin, Texas.

NCDDR was funded in response to the need expressed by NIDRR-funded centers and projects for additional assistance to help those centers and projects reach more consumers. NCDDR offers technical assistance to NIDRR's 280 grantees on how to find consumers and determine what the needs of those consumers are. Consumers may also contact NCDDRR at 1-800-266-1832 or on the Internet at http://www.ncddr.org Another service to consumers sponsored by NIDRR is the National Rehabilitation Information Center, NARIC, which can be accessed at http://www.cais.net/naric//.

Statistics About Disabilities Available in New Report

An estimated 4.0 million children and adolescents in the United States have disabilities. This represents approximately 6.1% of all U.S. residents in that age range.

Information Round-up: Books, Periodicals and Other Sources...

...Continued

Eight out of every thousand persons in the U.S. experience a skull fracture or intracranial injury in any given year.

These and other statistics are reported by the Disability Statistics Rehabilitation Research and Training Center, University of California, San Francisco. This Center, sponsored by NIDRR, summarizes data from the National Health Interview Survey, a household survey of a random sample from the non-institutionalized U.S. population.

"Disability" is defined as limitation in one or more activities such as working, keeping house or attending school. In addition to establishing the presence and degree of disability, the NHIS identifies the chronic diseases, disorders or impairments that are associated with various categories of subjects.

Specific conditions are rather broadly defined. For example, our search of the reports failed to isolate expenditures for prosthetic and orthotic devices. While the report lists expenditures for visions aids and dental services, prosthetics and orthotics are probably included either under the categories of medical equipment or other professional services.

You may obtain the complete report or abstracts by contacting, Disability Statistics Rehabilitation Research and Training Center, Insitutue for Health and Aging, University of California, Box 0646, Laurel Heights, 3333 California St., San Francisco, CA 94143-0646. ❖

Northwestern University PRL & RERP staff and students in the news

Steven Gard's Research Featured in *Journal of Prosthetics and Orthotics*

"The Influence of Four-Bar Linkage Knees on Prosthetic Swing-Phase Floor Clearance", written by Steven A. Gard, Ph. D., Dudley S. Childress, Ph.D., and Jack E. Uellendahl, C.P.O., was the lead article in the Spring 1996 issue of the *Journal of Prosthetics and Orthotics*. The article discusses the study of eight models of four-bar linkage knees and the influence this type of knee has on floor clearance as compared to the single-axis knee. In addition to floor clearance, brief discussions of stance-phase stability and cosmesis of four-bar linkage knees are included. ❖

Laura Miller, NURERP's Paralympic Volunteer

When the over 3,500 athletes arrive in Atlanta for nearly two weeks of competition, there will be hundreds of jobs that need to be done. These jobs will range from retrieving javelins to coordinating transportation to helping an athlete find out where to buy an essential item -- right now! The jobs will be filled by the volunteers for the Paralympics.

One volunteer will be Laura Miller, a graduate student conducting research in the Northwestern University Prosthetics Reseach Laboratory and Rehabilitation Engineering Research Program.

"This (the Paralympics) is a great opportunity for me to meet a wide range of athletes with disabilities. I think it will help me be more informed in my work in studying ambulation. It's a different perspective than I could ever get in the lab or the clinic." Laura said, "I'll also get to know about more areas that deal with biomechanics. I grew up in Atlanta and my family still lives in a suburb -- so Mom will just drop me off at a MARTA station when she goes to work."

Laura, who won a Whitaker Scholarship to Northwestern University for doctoral studies in biomedical engineering, earned her Master's Degree in Biomedical Engineering from Northwestern in September 1994. Her thesis was titled "A Biomedical Analysis of a Vertical Compliance Shock Pylon for a Below-Knee Amputee System". Laura represented the Northwestern University Program at the 8th World Congress of the International Society of Prosthetic and Orthotics, April 2-7, 1995 in Melbourne, Australia. ❖

Continued on page 6

Northwestern Staff and Students in the News
Continued from page 5

Sanchez-Urrutia and Oslakovic earn advanced degrees

Northwestern University awarded a Doctoral Degree to Victor Sanchez-Urrutia and a Master's Degree to Keith E. Oslakovic in June. Both degrees were in biomedical engineering.

Sanchez-Urrutia's dissertation is titled "The Swing Phase of Hip Disarticulation Amputee Walking: An Analysis of Walking Constraints and Methodological Implications for Gait Analysis". Upon receiving his degree, Dr. Sanchez-Urrutia returned to his home country to teach in the mechanical engineering department of the University of Panama and to continue research in human ambulation.

Keith Oslakovic's dissertation is titled, "Finite Analsysis of the Donning of a Patellar Tendon Bearing (PTB) Prosthetic Socket". Oslakovic's research studied the stresses within the tissues due to deformations caused by simply putting on (donning) the socket. Previous research, with the exception of studies by Silver-Thorn in 1991, have tended to deal only with stress within the tissue which results from external forces such as standing or walking. Oslakovic is now a staff member at Northwestern University PRL & RERP. ❖

Does Research Effect the Amputee on the Street?
Continued from page 2

searchers work daily with the Prosthetic-Orthotic Clinical Service Department of the Rehabilitation Institute of Chicago (RIC), directed by Jack Uellendahl, C.P.O. and with the medical services for amputees, particularly Yeonchi Wu, M.D.

Because of the very close relationship with the clinical personnel, a researcher frequently meets the amputee at the time he or she is admitted to RIC. This provides an opportunity to know about how the user of the prosthesis lives. Is his goal to run a business? Sail in competition? Return to his farm? Each component of the life of the amputee may suggest subtle differences in the design of the prostheses he will use.

The teamwork between research and clinic has produced some experiences that would be rare for most researchers and practitioners. Although bilateral upper-limb amputation at levels above the elbow and higher is estimated to be less than 5% of all incidents of amputation, the RIC/Northwestern University RERP team works with several people with this condition each year because their reputation has spread nationally and internationally. The rare individual who experiences bilateral upper-limb amputation is often referred to RIC.

The work with this one specific condition is an example of how constant contact with the users and prescibers of prostheses has had an influence on the direction of research projects. For example, when working on the Prosthetic Arm Design and Stimulation System, described in the October 1995 issue of *Capabilities*, researchers benefited from their experience with bilateral amputees, who have the most complex problems and needs. Similarly, the fact that humeral rotation is essential to the bilateral upper-limb amputee has influenced the project to develop an electric humeral rotator.

Interaction with consumers heightens awareness

As a TAP panel member observed, the close contact with bilateral upper-limb amputees has led to early research into developing a feature that is very valuable to people with a single upper-limb amputations, but might not have been considered top priority for single upper-limb amputation. A bonus of the team approach is that the opportunity to test prototypes of new prosthetic devices has been enjoyed by a number of RIC patients.

The research and clinical components of services to prostheses and orthoses users are complemented and augmented by the Prosthetic-Orthotic Center (NUPOC) of the Northwestern University Medical School. NUPOC offers training leading to certification in prosthetics and orthotics and continuing education for practitioners, physicians, therapists and manufacturers. Students in NUPOC courses benefit from lectures by researchers which give insight to state-of-the-art development in the prosthetics-orthotics field. The researchers, in turn, benefit from input about what works or doesn't work in actual practice.

The CAP/TAP panel members were brought up to date on research projects by presentations in four topic areas: Prosthetic Upper Limb Research, moderated by Craig W. Heckathorne; Ambulation & Aided Ambulation, moderated by Dudley S. Childress, Ph. D.; the Hu-

man Mechanics Measurement Laboratory, demonstrated by Richmond Chan, Ph.D. and Computerized Methods in Prosthetics and Orthotics, moderated by Keith Oslakovic.

It is difficult to schedule interaction. However, panel members -- many of whom had been present at the CAP/TAP meeting in May 1995 -- gave pertinent comments as the presentations were made. For example, during the presentation of Prosthetic Upper Limb Research and in the summary session later in the day, members of the consumer panel pointed out that weight is a most important consideration for the person who uses an upper limb prostheses. Carol Scholar said that, as she gets older, she is more and more bothered by the fact that the harness for her prosthetic arm causes soreness.

New methods may be the answer to old problems

Discussion among panel and Northwestern University staff and students formulated the idea that research should be directed at this problem. Dr. Childress noted that one way to address the problems with harnesses for upper limb prostheses is to explore alternatives to traditional upper limb prostheses. Myoelectric upper limb prostheses can eliminate harnessing. Powered Extended Physiological Proprioception (E.P.P.) can be used to reduce cable and harness forces. Consumer requests for weight reduction in upper limb prostheses also confirms that the projects to find sources of motors and new battery technology to power lighter weight hands are research projects which address consumer needs.

Orthotics need to be evaluated

The Ambulation and Aided Ambulation research presentation was also well critiqued by the panel members. Rose Wilson, who has used crutches and braces for a significant portion of her life, urged research into orthoses that are lighter in weight and have better appearance. Crutches also, according to Mrs. Wilson, need to be evaluated and new thinking applied. This input may help form parts of the studies on crutch ambulation currently being conducted by the Program.

Fifteen models of prosthetic feet have been tested at Northwestern University RERP (see the article in July 1995 *Capabilities*). Panel members agreed that the properties of the feet tested in the study might not be the actual determining factor that a consumer uses to choose the foot he or she likes best. However, the NUPRL & RERP work allows a consumer to compare like properties of different feet. The study also provide manufacturers of feet with impartial data about their product. NUPRL & RERP does not endorse any product. The information, however, may be of use to prosthetists as they provide information to help individual amputees select the foot that best suits his or her needs.

Effects of research may not immediately be apparent

Similar exchanges of information continued through the sessions on Human Mechanics Measurement Laboratory, where panel members saw demonstrations of gait analysis, studies of events "around" standing and a reduced cost method of measurement of some aspects of gait using ultrasonic techniques. While it may take a number of years before the direct benefits to the consumer of the basic research done in this area become apparent, the research builds a scientific base for new theories and products applicable to ambulation.

As Dr. Foulds noted, the field of prosthetics and orthotics is a relatively old field. Frequently, the products and theories in the field have not been subjected to the scrutiny of scientific investigation. Such scrutiny may discover improvements which can be made.

The final conclusion of the CAP and TAP panel members seemed to be that research can and must touch the lives of consumers. Several kinds of "products" are developed by NUPRL & RERP. Some, such as the "Squirt Shape" method of shaping sockets demonstrated in the Computerized Methods in P & O session, are actual processes that perhaps will lower costs and improve the function for sockets. Other "products" are information, such as results of studies of four-bar knees. In this instance, the consumers of Northwestern University PRL & RERP are in three categories: the people who use prostheses, the prosthetists and orthotists who design and fit prosthetic systems and the manufacturers of prosthetic and orthotic devices. To assure that research significantly affects the lives of consumers, researchers need to communicate with consumers, practitioners and manufacturers.❖

If you would like to read more about the research projects conducted by the Northwestern University PRL & RERP, please request a copy of the *Activity Report* or visit our Web Site at http://www.nupoc.nwu.edu/

Capabilities
ISSN 1055-7156
Northwestern University Prosthetics Research Laboratory
and Rehabilitation Engineering Research Program

345 E. Superior Street, Room 1441
Chicago, Illinois 60611-4496
Phone Help Line: 312/908-6524
E-Mail: reiu@nwu.edu
web site =>http://www.repoc.nwu.edu/

Address Correction Requested

Non-Profit
U.S. Postage
PAID
Northwestern
University

Resource Unit Information Request

All information is free. *Check off what you need and mail this coupon back to:*

Northwestern University RERP/Resource Unit
345 E. Superior St., Room 1441
Chicago, IL 60611 USA

Allow two to three weeks for delivery

___ Send me more information on lab activities.
___ Start my subscription to *Capabilities.*
___ Send me one copy of *P&O Resource Directory.*
___ Send me the information packets checked below.

Information Packets (limit - one copy of each item)

___ Quick Info Sheet: Funding Ideas for Prosthetic-Orthotic Devices
___ ADA List of Publications
___ Above Knee Prosthetics
___ Amputation
___ Braces & Crutches
___ Below Knee Prosthetics
___ Children's P & O
___ Choosing a Prosthetist
___ Congenital Conditions Book List
___ Feet
___ Gait
___ Hands
___ Hip Disarticulation/Hemipelvectomy
___ Lower Limb Prosthetics (general)
___ Lower Limb Orthotics (general)
___ Myoelectric Packet
___ Publications for the New Amputee
___ O & P School
___ Orthotics (general)
___ Pain and Phantom Pain
___ P&O Research
___ Prosthetics (general)
___ Sockets
___ Sports/Recreation
___ P & O Statistics
___ Support Groups
___ Symes
___ Upper Limb O & P
___ Video List
___ What is P & O ?

Name_____

Address_____

_____