Capabilities
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Experimental Research and Modeling in Lower Limb Prostheses

By Dudley S. Childress, PhD, Director, NUPRL&RERP, NUPOC

Many workers in modern prosthetics believe that scientifically-based models, tempered with experimental results, can enhance our understanding of prosthetics and greatly improve human-prosthesis performance. Models of this kind have been enormously successful in engineering and physics. A.V. Hill said that progress comes through experiment and theory acting and reacting on one another. It is the author's belief that the interaction between modeling (theory), experimentation, and empirical results (experience) are key to prosthetics science and to the rational advancement of the field.

Introduction

We all have models within our minds concerning how the world around us works and how we fit into it. These models are partial; nevertheless, we use them daily. In prosthetics, we use models as a guide to our decision making. Our mental models concerning prosthetics vary depending upon our professional discipline, our educational and cultural backgrounds, etc. Those with better "thought models" may be able to obtain superior clinical results. Although empirically-based models are indispensable, scientifically-determined models are needed to guide our mental model development and to provide us with new understanding about prosthesis function. With them we can conduct "parametric studies" without building new prostheses, conduct "what if" studies that might be impossible to do with human subjects, and facilitate the teaching of prosthetics principles. Models have many uses.

Einstein said, "everything should be as simple as possible but not simpler". Simple models work best for conceptualization. The difficulty of ultra-complex models is illustrated by a story called "On Rigors in Science" in the book *Dreamtigers,* by Jorge Luis Borges. The story describes zealous map makers who made a map that was the same size as their whole country. The map was highly accurate, but it was obviously useless as a map (model).

Experiments and Modeling

Human walking models that can incorporate prostheses and prosthesis components within them would be of

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Dr. Childress presented this paper to Plenary Session 5 at the IXthISPO World Congress, June 28-July 3, 1998, Amsterdam, The Netherlands. The study of Human Walking is one of the core areas of research at NUPRL&RERP. We wish to thank ISPO for permission to reprint this article, first printed in the Conference Book of the World Congress.

Experimental Research and Modeling

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great value. Studies could be carried out on these models to quickly evaluate the influence on walking performance of different prosthesis designs. At present, we have no good models of this kind. In fact, we do not even have a good understanding of standard walking. Though walking has been studied for many years, Kuo has observed, "We don't know much about human walking." For this reason, engineers such as McGeer[2], Garcia et al[3], Fowble & Kuo[4] and others have been building physical and computational models that exhibit self-walking properties. McGeer's passive dynamic walking machines suggest that the substrate for the human neuromuscular system may be a simple mechanism that is highly efficient, requiring little energy or control effort. Robotic walking, exemplified by the Honda robot, is also of interest.

A four-pronged approach to understanding walking is emerging, represented by physical models (including robots and toys), by computational models, by studies of nonstandard walking using prostheses or other aids, and by studies of standard healthy walking. Multifaceted exploration of walking principles seems more likely to succeed than single-faceted approaches.

Using the inverted pendulum as a simple model of gait

Alexander[5] uses the inverted pendulum as a simple model of gait. This is a good model for "thinking" purposes and is predictive of several attributes of walking. This model has also been used in studies of balance and in gait initiation investigations. The "inverted pendulum" concept, while incomplete of itself, is a powerful backdrop for slightly more complex models that remain dominated by the inverted pendulum theme. When shock absorption properties of musculotendinous tissues of the foot, shank, thigh and pelvis are considered along with inverted pendular properties, a number of measurable walking parameters can be predicted and understood. The ballistic model of walking by Mochon and McMahon[6,7] have been very influential, suggesting that walking itself may require low muscular effort.

Our own experiments concerning the effect of pelvic obliquity and stance-phase knee flexion (Gard & Childress[8], Gard & Childress[9]) have brought into question the second and third determinants of gait as defined by Saunders, et al.[10] Knee flexion and pelvic obliquity are not timed so as to reduce vertical peak to peak displacement of the body's torso. Therefore, they cannot be energy savers in the way Inman and his followers have described in many articles and texts written about walking. The impact of four-bar linkage knee design on prosthetic foot clearance has been studied in computer models by Gard, et al[11]. Studies of amputee gait show that hip hiking is prevalent and one likely source of increased energy expenditure.

One of the most successful mathematical and computer studies of human walking was performed by Koopman[12]. He developed an inverse dynamics model that used only kinematic data as input and an optimization procedure that reduced numerical errors of differentiation. His 8-segment model was predictive. Of special note for prosthetics was his result when four different foot shapes were used.

As it turns out, the shape of the foot in the model has a profound influence on analysis results. These results concerning foot shape presage results obtained in prosthetic foot studies that were conducted in my own laboratory.

Modeling enables understanding of the prosthetic foot

Foot Modeling by van Jaarsveld et al[13] characterized various prosthetic feet with mechanical representations. The experiments and the models developed enable us to understand prosthetic foot function in new ways. Knox[14] and Childress et al[15] have found that a prosthetic foot's shape during roll-over is of much importance in understanding the influence of the foot on walking performance. The experimental shape can be approximated by foot deformation data and center of pressure data for constant loads near body weight.

The way in which shoes influence foot prosthesis mechanics has been a practical outcome of the work of van Jaarsveld et al[11] and of Childress and Knox[14]. The van Jaarsveld paper concluded that a shoe makes a soft foot stiffer and a stiff foot softer. The Knox paper suggested

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Brenda Besse grew up on her parents' farm just outside of Erie, Illinois, a rural area on the west side of the state not far from the Mississippi River. She belonged to 4-H, helped her family with 100 head of pure-bred Angus cattle and played sports. She was point guard on her high school basketball team and at Black Hawk College in Moline, where she began her college education. When she transferred to Northern Illinois University in DeKalb, she roomed with an avid golfer, Meg Cavenaugh and spent her spare time practicing golf with Meg, a sport she was taught by her parents.

Brenda was preparing to begin her career in teaching and coaching in the summer of 1981 when her life changed. As she recently told John Sloca, News Editor of the *Daily Chronicle*, DeKalb, IL, "I was trying to unclog the head on the combine and the machine crept forward. The head caught my pants and drew my leg into it. I knew the only way I'd get free was when my leg was cut off. I had to get loose or I was going to bleed to death." Alone in the field, Brenda decided she would have to rescue herself. "I decided I didn't want to lie there and bleed to death, so I grabbed ahold of the step rails on the combine and pulled myself into the cab. I drove off, leaving my boot and leg in the field."

Trading Cards are popluar on the golf circuit where Brenda spends much of her time — winning and showing others how to make the most of their lives.

Finding the new direction

Today, Brenda calmly notes that having a leg amputated "changes the direction of your life." It takes a while to find what that new direction is. For Brenda, that turning point was a simple gift that changed the course of her life. For several years after the amputation, she had avoided the activities she had enjoyed most — like golf. "It was hard just getting out of bed to face the things you have face," Brenda said. "But one day, my parents brought me a set of Tommy Armour graphite shafts (golf clubs) and said, 'OK, this has got to stop. You're going to play golf."

People who have experienced an amputation must re-evaluate their lifestyle. For some, new horizons are opened — as happened when Brenda Besse found

"Golf was an Immediate Fix.."

Brenda began on the path that many people with disabilities have taken back to a full life — participating in sports. Participation in sports often brings with it many side effects. Sports takes the person with an amputation out of the role of patient and into the role of competitor. Sports also change the image of the person with an amputation in the eyes of the spectator.

Playing golf may not be an activity many people automatically associate with people with amputations, but Brenda was not the first amputee to play golf. The National Amputee Golf Association (NAGA), headquartered in Milwaukee, WI, sponsors tournaments in many cities each year. It was at a NAGA tournament that Brenda met Wayne Vercellotti, an avid golfer who plays with a below-elbow prosthesis on his left arm. Wayne, who was a member of the NUPRL&RERP Consumer Advisory Committee for years, was one of the people who helped Brenda decide that her future lay in playing golf. "Wayne's like many people you meet in amputee golf," Brenda says. "Having gone through amputation seems to add something extra — like new determination to win."

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Golf was an Instant Fix

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Brenda has enjoyed the reaction that people, who may never have met an amputee, have to her competition. "I was playing in a Pro-Am event one day when I happened to hear two ladies, who appeared to be in their 70s talking about me. 'I think she's going to play', said one to the other. 'She's wearing golf shoes!'" Brenda laughs as she tells how the ladies sought out Brenda's parents in the gallery and became an instant cheering section. "They stayed with my folks all day — and went to dinner and dancing with us that evening. They were golfers and I'll bet no amputee golfer would have problems getting on the greens at any club where they played." Another time, a member of Brenda's foursome was a neurosurgeon. He admitted to Brenda that he was much taken aback at the idea of playing with an amputee at first. Later, he invited her to his hospital to lecture on attitude following onset of a disability.

To use a quote from Brenda about the attitude of golfers without amputations toward golfers with amputations, "Don't worry about what 'Joe Normy's' gonna think, because after a while, they get the drift that if you do it, anybody can do it." And shortly, Joe and Jill Normy got the idea that Brenda was a competitor to be respected. When she participates in a foursome in a Pro-Am Tourney, her handicap is expressed in strokes — the same as the other golfers.

The prosthesis as a tool for an improved game

For the athlete with a disability, perfecting their performance in sports often relegates the prosthesis — or wheelchair — to a tool that must be used to improve performance. Brenda found that to be true. In the interview for the DeKalb Daily Chronicle, she relates that the most challenging aspect of returning to golf with an above knee prosthesis was to determine her new center of gravity. "Your center of gravity, of course, moves over to the dominant side." For some time, she struggled with a prosthesis that did not give her the performance she knew she needed. Working with Kevin Carroll, prosthetist at NovaCare Research in Oklahoma City, she went through a number of fittings, changes and comfort issues until she and her prosthetist arrived at a sports leg that weighs 5.5 pounds. It not only gives her the function she wants on the golf course, according to Brenda, "having a prosthetic leg is no longer a burden."

Playing in PGA and LPGA Pro-Am events, Brenda has met golfers including Nancy Lopez, Si Ri Pak, Raymond Floyd, Ben Crenshaw, Kris Tschetter and Jan Stevenson.

• Brenda's sponsors include NovaCare, King of Prussia, PA; College Park Industries, Fraser, MI; ORTHOEUROPE, Ltd., United Kingdom; Liz Golf, division of Liz Claiborne, Inc., New York, NY; and Adidas Golf USA, Inc., San Diego, CA

You may reach the National Amputee Golf Association at PO Box 285, Milwaukee, WI 53223-0285 800/633-6242

Brenda's performance continued to improve. She has won 32 U. S. National Amputee Golf Association Tournaments in 41 outings. She has also played in seven Pro-Am events — four Professional Golf Association (PGA) and three Ladies Professional Golf Association (LPGA). In June of this year, she will play the Merit Club Course in Libertyville, IL as a competitor in the Rehabilitation Institute of Chicago's Fourth Annual Pro/Am Tournament. Each fivesome will have an amputee golfer and an LPGA professional.

Brenda Besse once was quoted, when asked what golf did for her outlook on life, that it was "an immediate fix!" How she plays golf has had an effect on the lives of many with whom she's come in contact. She is polishing her game working with Randy Weckerly, De Kalb, IL, as her coach. Weckerly was on the professional tour until arthritis forced him to give up competition. He recently asked Brenda if she could find time to come and work at the golf camps he's hoping to launch for kids and adults with disabilities.

She also has spent time with Casey Martin, who made headlines when he challenged the PGA for the right to use a cart between holes. Martin has a condition which drastically decreases circulation in his legs and makes walking distances difficult. The PGA first denied the "special consideration" of being able to use a cart, claiming that walking is a critical part of the game. They later relented. Brenda feels the incident caused people connected to golf to begin to see people with disabilities as competitors.

Brenda's new energy extends to her activities in United Way, Red Cross and Junior Achievement. She also works with Purdue University's Barn Builders Organization, a peer support group for people incurring disabilities in farm accidents, and the Amputee Coalition of America. Her activities in Limbs for Life Foundation (See page 4, *Capabilities*, April 1998 for more details on Limbs for Life) are resulting in her planning to go to La Paz, Bolivia later this year to work for the Foundation in the field.

She's also pursues her love of animals as a partner in a Brown Swiss cattle syndicate and a member of the National Brown Swiss Cattlemen's Association. Asking her about her cattle will result in her enthusing about Sybil, the syndicate's champion and a short course in cattle breeding. If you visit a state fair in the Midwest, you may see Brenda Besse — taking a break from the golf course — readying a purebred Brown Swiss cow to compete for its own championship. ❖

PALMS

News from Physicians Against Land Mines

The Need for Prosthetic Services in Low-Income Countries

By William K Smith, MD
Director, Center for International Rehabilitation

National Institute on Disability and Rehabilitation Research (NIDRR) materials have indicated that in the United States, amputees are perhaps the most well-mainstreamed of any disability group. Improvements in prosthetics and other assistive devices have played a large part in this success. Much of the research and development in prosthetics over the last two decades has focused on developing artificial limbs for amputees in affluent, industrialized countries. New lightweight materials, including plastics, together with electronic and other technological advances, have transformed the lives of amputees in these countries. Major advances are exhibited at meetings of the American Orthotic and Prosthetic Association (AOPA), the American Academy of Orthotists and Prosthetists (AAOP) and the International Society for Prosthetics and Orthotics (ISPO).

Standard technology can't be transferred worldwide

Unfortunately, the standard prosthetic technology used in industrialized countries today cannot be financed by either developing countries or international relief organizations in sufficient quantity, functionality and quality to meet needs. Similarly, many other resources that were developed specifically to improve service provision in high-income countries cannot be directly transferred to low-income countries without being adapted to accommodate for differences in language, culture, climate and local infrastructure.

This is a literal tragedy, because statistics show that a greater percentage of the population in low-income societies which have endured the type of conflict which gives rise to land mine injuries are in need of prosthetic services. For example, the rate of amputation in the United States is one in 22,000; in Cambodia, a heavily mined country, the rate is one in 236 persons - for a total between 25,000 and 35,000 amputees (Hansen, 1995). Vietnam may have over 200,000 amputees (Staats, 1995); Afghanistan has an unofficial UN estimate of over 60,000 (Berhane, 1995); and Angola, 30,000 to 60,000 (Winslow, 1997). The need for prosthetic limbs in other post-conflict societies (i.e., El Salvador, Guatemala, the former Yugoslavia, Rwanda and others), as well as countries that are still struggling with industrialization is not accurately known. Even without precise estimates, it is safe to say that the number of people who need prosthetics and rehabilitation worldwide is in the millions.

Land mine survivors tend to be younger people

It is also important to understand that the general rehabilitation needs of land mine survivors and other amputees in the developing world are somewhat different from those of amputees in the industrialized world. The most common cause of amputation in the United States, for example, is vascular disease; while in Cambodia, it is trauma - too often trauma related to anti-personnel mines. Amputees in Cambodia, therefore, tend to be younger and consequently, their mobility and reintegration problems are different from those of older amputees in industrialized nations.

One reason for the lack of services is that, on a per person basis, prostheses are relatively expensive in low-income countries. Prosthetic devices generally last for three to five years and must be regularly maintained. Children generally require new prostheses every six months. Even when costs are estimated to be as little as $125 per artificial limb (well below the $5,000-$15,000 cost for prostheses in the United States), the lifetime costs for replacement and maintenance will amount to thousands of dollars. In these countries, such costs are simply prohibitive.

Another reason for the lack of services is the lack of trained personnel. An artificial leg has the potential to significantly increase the independence of a person with an amputation, but properly constructing, fitting and aligning

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Need for Prosthetics in Low Income Countries

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a prosthesis requires skill and experience. Despite the enormous demand for trained prosthetists and technicians, very few education and training institutions exist in low-income countries. Studies by the World Health Organization (WHO), the International Society of Prosthetics and Orthotics (ISPO) and INTERBOR indicate that while the current supply of technicians falls short by about 40,000, it will take approximately 50 years to train just 18,000 more. Murdoch (1990) estimates that care for the three to four million current amputees requires equipping and training 50,000 to 100,000 additional prosthetists. Furthermore, the current level of prosthetic service provision is constantly in jeopardy because most nongovernmental organizations (NGOs) engaged in humanitarian assistance will not provide services indefinitely.

Service Delivery in Low-Income Countries

Harte (1998) has described five stages to prosthetics/orthotics (P&O) and rehabilitation programs in the war-affected countries where land mine survivors live.

1) Conflict: Generally dangerous conditions prevail in which the need for surgical and emergency services is acute. There is heavy reliance on expatriate expertise and labor, and rehabilitation services are considered a low priority.

2) Post-Conflict: There are large numbers of war disabled. Land mines and unexploded ordinance (UXO) are prevalent. Rehabilitation personnel have emigrated, or are demoralized and are emerging from war-induced professional isolation. Skilled local labor is in poor supply. Infrastructure to serve the disabled population is badly damaged - multiple NGOs operate, often with little coordination.

3) Recovery: Government is re-established and begins to enter into dialogue with service providers who are also, hopefully, increasingly engaged in interagency coordination activities. Increased awareness of disability issues is coupled with pressure from veterans and other war-disabled for rehabilitation services. Service provision, established in the conflict and post-conflict stages, generally continues to be managed by the International Committee of the Red Cross (ICRC) and NGOs. Providers predominantly employ expatriate professionals who engage in some training activities. Injection molding techniques and variations on the Jaipur limb system allow for local component manufacturing.

4) Development: Structured P&O training programs are established to international standards. Investment and external funding now focuses on developing local or government-managed hospitals and P&O facilities. International prosthetic component manufacturing companies begin to market heavily to ministries of health. Interagency cooperation and the coordination of services increase. Issues related to management and corruption become more acute.

5) Sustained Program Activity: International investment in infrastructure and service provision is scaled back. Programs are cut as they learn to survive on local or regional funding. P&O and rehabilitation services are nationalized, increasing integration with other sectors of the health care system, and training moves from production facilities to regional training programs. NGO input is reduced and disability issues are de-emphasized within the country.

A number of international organizations are now involved in the provision of assistance in the "conflict" through the "recovery" stages. The greatest challenge is to help local professionals and service providers as they deal with the difficult problems facing them when they transition from the development to the sustained program stage. It is also important to ensure that the often substantial investments made by international funders seeking to provide service to people with disabilities in the conflict through recovery stages continue to yield long-term, sustainable benefits.

The RERC on Improved Technology Access for Land Mine Survivors, administered by Physicians Against Land Mines (PALM) and located in Chicago's Center for International Rehabilitation (CIR), assists in the process of developing sustainable rehabilitation services for people with amputations in low income countries by:

Figure I.3 PALM Board Member, Michael Quigley, C.P.O, fits a Cambodian amputee.

1. Acting as a clearinghouse - providing researchers, educators, health care professionals, consumers, service

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NUPOC

News from
Northwestern University
Prosthetic-Orthotic Center

NUPOC Instructors Teach in Columbia, South America During Summer Break

By Desmond Masterton, CO
Instructor, NUPOC

"Oh! Colombia South America not South Carolina!" It took a bit of time for me to realize the difference when Bryan Malas and I were asked by Walter Ramos if we wanted to teach a course to orthotists in Colombia during the summer of 1998. A whole flood of questions then needed to be answered. Teach what about orthotics? To whom? How long? How do we get there? Isn't it dangerous? The mind has a tendency to race at times like this, cover everything and solve nothing. To give you a little background information about our adventure, Bryan and I are instructors of orthotic education at Northwestern University Prosthetic Orthotic Center (NUPOC). Walter Ramos is a physical therapist from Bogota, Colombia now living in the Chicago area studying prosthetics and orthotics.

Education in prosthetics and orthotics is not abundant in Colombia, but the desire for education is very strong. Orthotists and prosthetists in Colombia formed the Colombian Association of Orthotists and Prosthetists in 1992, which is usually referred to by the acronym, ASOCOPRO. Throughout the year the association puts on informational courses to further education of their members. Their thinking is global, with guest lecturers are from international locations in addition to those from Colombia.

NUPOC Instructors to give two courses

The plan was for the three of us was to stay with friends of Walter in Bogota, an excellent way to get to know the people and their life-style quickly. We would teach lower extremity orthotics to two groups of about 15-20 orthotists. The first course to the first group was held June 22 to 25. We then took a day off and repeated the course to the second group from June 26 to 28. The last two days we stayed at the hacienda of Hector Ramos, Walter's uncle.

In the weeks and months previous to our trip to prepare for our courses, we put together a manual for our students. We also put together slide presentations collected videos of patients for orthotic evaluation and recommendation. We packed a selection of orthoses for demonstration purposes.

Father's Day found us at O'Hare airport feeling like we were going on some covert mission to Colombia. Our imaginations caused us to wonder how we were going to explain the orthoses to customs because we thought some of them looked like they could be a weapon. After usual delays involved in catching connecting flights, midnight found us in Bogota Colombia. We were almost disappointed that no one in Customs had asked about the orthoses.

Coming out of the terminal there were a number of people waiting for us. Of course, most of them were Walter's family and friends. A 1950s vintage American car we came across in the parking lot gave us the first hint of conditions which exist in Columbia. The car obviously had not run in recent history and the moss under it was inches thick.

Bryan Malas, left, and Desmond Masterton, right with the President of ASOCOPRD, Luis Alfonso Lozano.

Our immediate concern, though was that, in seven hours we were to start the first course and it was a great time to get to bed. This plan fell apart when we went to get

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that a stiff-soled shoe has potential to improve the roll-over properties of a foot with a soft toe (e.g. SACH); whereas, the mechanical properties of stiff feet (e.g. Flex-Foot®) are relatively unaffected by shoe style. Other possible outcomes of Knox's studies may be rational methods for the design of artificial feet.

Prediction of foot alignment may change fabrication

The work of Hansen[17] suggests that the mechanical properties of feet may provide a new way of understanding prosthetic foot alignment. Zahedi et al[18] have studied foot alignment. If alignment can be accurately predicted, it may be possible to fabricate whole prostheses by automatic means, without alignment hardware and without a separate foot.

Shock absorption is important in lower limb prosthetics. If it is not adequately provided, the wearer of a prosthesis will slow down to reduce body forces. Miller and Childress[19] found the mechanical stiffness of the ReFlexVSP™ similar to the stiffness of the human foot in an equivalent support configuration. Gard[20] has investigated the mechanics of various shock absorbing pylons.

Research for the Next Milinneum

NURERP, funded by a grant from the National Institute on Disability and Rehabilitation Research (NIDRR), and the Prosthetics Research Laboratory, funded by the Department of Veterans Affairs, will continue to emphasize three basic areas: (1) human walking, (2) upper limb prostheses and (3) application of computer aided engineering to prosthetics and orthotics. In addition, research projects will include the development of a data base for collecting outcomes of prosthetic and orthotic prescriptions and fittings. A prototype data base to help select prosthetic components is being designed. In a closely related project, NUPRL&RERP staff will further develop the Prosthetic Arm Design and Simulation System (PADSS), which enables prosthetists to help clients visualize characteristics of proposed systems of components prior to fabrication. Further development of the Direct Ultrasound Ranging System (DURS) for quantification of certain aspects of ambulation is also part of the work.

Stress Analysis is an area where progress is being made in the development of models to help us understand the prosthesis-human interface. Klasson[21] has addressed prosthetic socket fitting on the basis of engineering principles and models. Stress and shear due to loads on interfaces (e.g. prosthetic sockets) can now be approximated computationally using finite-element methods.

Designs of wide variety can be examined with these tools. Silver-Thorn et al[22] and Zachariah and Sanders[23] have surveyed the work accomplished in this area. Sanders and Daly[24] have modeled shear stresses as well as normal stresses at socket interfaces in ambulation.

Conclusion

The physicist Richard Feynman remarked that in science it is easy to fool one's self. When using models, especially models that represent human systems, one must be careful not be fooled. Models must always be questioned and validated by alternate means. When used correctly, models can do much to improve human-prosthesis performance and comfort. ❖

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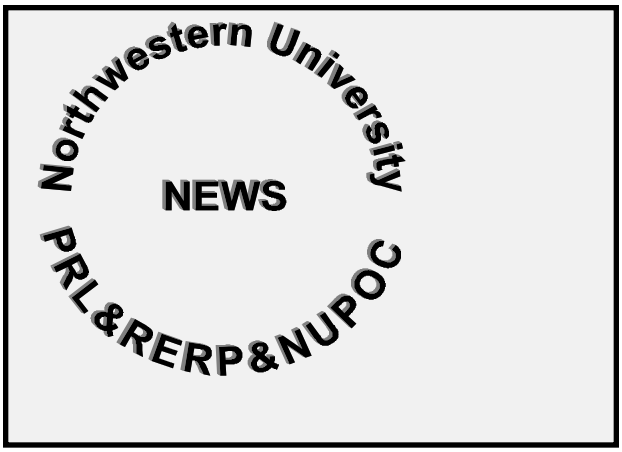

Dr. Childress featured in *North Shore* Magazine

Dudley S. Childress, PhD, Director of NUPRL&RERP research programs and NUPOC educational programs was the focus of an article in *North Shore* Magazine's *Supplement on Health*, which was included in the April 1999 issue.

The Supplement provides readers with a Hospital Guide to about 49 local hospitals. It contains stories about people working in health related fields. In addition to Childress, the Supplement also profiles Ginger Lane, a counselor at the Health Resource Center for Women with Disabilities at the Rehabilitation Institute of Chicago.

Traveling Orthopaedic Fellows visit NU from Germany, Switzerland and Austria

Staff members of Northwestern Univesity PRL&RERP and the Rehabilitation Institute fo Chicago (RIC) were hosts to three physicians and a prosthetist/orthotist spending the month of March in the United States and Canada to exchange research findings in prosthetics and orthotics. The guests presented lectures on topics including gait studies, orthotic interventions for a number of conditions, application of specific prostheses and other methods of prosthetic management of amputations.

The visiting Fellows included Dr. med. Reinald Brunner, Chief Physician, Director, Department of Neuro-Orthopaedics, Basler Children's Hospital, Basel, Switzerland; Alfons Fuchs, C.P.O., Director, Orthopaedic Workshop Orthopaedic Clinic, Univ. of Heidelberg, Heidelberg, Germany; Dr. med. Thomas Mueller, Chief Physician, Orthopaedic Clinic of Friedrich-Schiller-University (Jena) at the Waldkrankenhaus, Rudolf Elle GmbH, Eisenberg, Germany; and Dr. med. Walter-Michael Strobl, Chief Physician Orthopaedic Hospital, Vienna, Austria. In addition to spending time with the staff of the Northwestern research programs, the visiting Fellows visited Children's Memorial Hospital, the Prosthetic-Orthotic Clinical Services and other clinical areas and several research programs of RIC.

Steven Gard Addresses Texas A & M

Steven A. Gard, PhD, lectured to Biomedical Engineering students at Texas A & M University, College Station, TX on March 9. Gard's views of biomedical engineering as a career was particularly pertinent to students at Texas A & M since Dr. Gard's undergraduate work was conducted at that institution. Gard also joined Dr. Childress to present the works of the Center at the NIDRR Directors' Meeting held February 22-23, 1999 in Washington, DC.

Barbara Silver-Thorn Addresses BME Noon Seminar

Barbara Silver-Thorn, PhD, presented "Bulk Tissue Loading of the Lower Extremity Residual Limb" at the Biomedical Engineering Noon Seminar held Friday, February 5. Dr. Silver-Thorn earned her doctoral degree in Biomedical Engineering from Northwestern and was on the staff of the NUPRL&RERP prior to accepting an Assistant Professorship at Marquette University, Milwaukee, WI.

Kurzman Keeps NU Staff Updated

Steven Kurzman, who conducted part of his research for his PhD in cultural anthropology at NUPRL&RERP, uses e-mail to let the staff picture the lives of people with amputations in Preah Vihear, Cambodia. Recently, he described how a blacksmith in a small town used parts salvaged from landmines to repair the metal crutches used by a man who had a leg amputated after stepping on a land mine.

Andrew Hanson addresses Gait Meeting in Dallas

Andrew H. Hansen, who is studying for his doctoral degree after earning his M. S. in Biomedical Engineering from Northwestern University presented "Roll-over Shapes of Prosthetic Feet" at the Gait and Clinical Movement Analysis Conference, Saturday, March 13th in Dallas, TX. The presentation illustrates what a roll-over shape is: an effective geometry to which a prosthetic foot deforms during stance phase of walking. Hansen also discussed two methods used at NU to measure roll-over shapes of prosthetic feet and a comparison of the results from the two methods.❖

The VA Presents

News from the Department of Veterans Affairs

Department of Veterans Affairs Visual Impairment Service Teams

By: Robert M. Baum, Chief, PTC, VA Chicago Health Care System

Editor: Ray Leber

Most VA facilities have a Visual Impairment Services Team (VIST). The VIST program serves as the VA's front line identification of veterans who are legally blind. Its main goal is to help patients cope with their vision losses so they can retain their independence and achieve their maximum potential.

Upon enrollment in the VIST program, the veterans are interviewed and assessed by a local VIST coordinator to determine their emotional adjustment, social and family interactions, financial situation, and need for prosthetic or sensory aids ranging from white canes to computers. A VIST coordinator may also coordinate their annual physical, ocular and hearing examinations and other clinic visits so appointments are often clustered on the same day. "These examinations can literally be lifesavers," says Sheila Sims, VIST Coordinator for the VA Chicago Health Care System (VACHCS), "because the primary care physicians have been able to diagnose VIST patients with cancers, diabetes, and other medical conditions early enough to treat them.

Afterwards, Sims makes her patients aware of financial and community resources, including Talking Books, Chicagoland Radio Information Services (CRIS) radio and telephone exemptions for the disabled. She also assists patients with claims for social security or VA monthly compensations or pensions.

The VIST team also realizes they often cannot help legally blind veterans who are unable to admit they cannot see. "Our patients frequently deny they have a vision problem," says Thomas Stelmack, O.D., Chairman of the VIST at the VACHCS. "People who are losing their eyesight go through the same grieving process as they do when they lose a loved one. Part of VIST is to coach our patients through the denial process."

On the first Wednesday of each month, VIST patients meet at the West Side Division for a one-hour support group meeting that is both therapeutic and educational. "Just getting the veterans out of their homes to come to the meeting is therapeutic," says Sims. "Once they get here, they can socialize with other visually impaired veterans. They all share this common bond and they really look out for one another."

VIST patients are also invited to attend annual summer cookouts and holiday parties. Other social events include participation in the national veterans golf and winter sports tournaments.

VA Chicago's VIST program received a proclamation this year from Mayor Richard M. Daley in appreciation for its efforts to educate the community about White Cane Safety Appreciation Day on October 15.

What is legal Blindness?

Legal blindness is defined as when the best corrected visual acuity with ordinary eyeglasses or contact lenses is 20/200 or less in the better eye OR when there is a visual dimension of 20 degrees or less in the better eye.

Causes of blindness include such conditions as Glaucoma, Macular Degeneration, Retinal Detachments, Retinitis Pigmentosa, and Diabetic Retinopathy. Blindness can also be caused by a variety of other eye conditions.

Total blindness is not common. About 85 percent of legally blind veterans have some degree of usable vision.

VIST and VICTORS

VIST represents the second tier of a continuum of services at the VACHCS designed to serve patients with varying degrees of vision loss. Veterans who are partially sighted are served by the Vision Improvement Center to Optimize Remaining Sight (VICTORS) program – one of only three in the country. "The two programs are designed to compliment each other," Dr. Stelmack says. "We are fortunate to be able to provide patients with a full range of services that meet their specific needs." ❖

Need for Prosthetics in Low Income Countries

Continued from page 5

providers, administrators and funders, access to resources that have been developed to facilitate service delivery to amputees in the United States and other countries.

2. Developing and disseminating specific "appropriate" programs, products and technologies that address the needs of amputees and service providers in low-income countries.

Conclusion

In mine-infested countries like Angola, Afghanistan, Bosnia, Cambodia, and Mozambique, where the number of land mines per square mile is in the hundreds, the human suffering endured by survivors and their families is staggering. In societies that rely predominantly on muscle power, employment, farming and the economics of family life are all extremely difficult in the aftermath of a land mine injury. There are few available services to promote reintegration. Barriers to service include the difficulties involved in technology transfer, coordination of activities and the lack of infrastructure and resources. Effective attempts to improve technology access for land mine survivors must focus on improving service delivery for all amputees and promoting the availability of service for all people with disabilities. The RERC on improved technology access for land mine survivors is doing this through information sharing and the development of appropriate rehabilitation technology. These activities are especially crucial since land mine survivors, like all people with amputations, need access to a lifetime of activities. ❖

NUPOC Instructors in Columbia, SA

Continued from page 7

something to eat and talk with some of our hosts. Do not turn down hospitality the first hour you are there, we said. So at 2 a.m. we finally got to bed — and at 7:30 we were picked up and driven to the laboratory where the course was being held. The light of day allows us to view Bogota. It is a city of contrasts, new, old, rich, poor, compared to U.S. cities.

As travelers, we chose not judge, but rather observe, participate, and enjoy the experience. Nervous energy carried us through the first day, which for me ended at 6 p.m. — when I went for a nap and didn't wake up until I was told breakfast was ready. Day Two and Three went smoothly enough — we felt we had found a groove. What I had learned in four years of studying Spanish suddenly came back to me during breaks when attendees came up to me and start asking me questions in Spanish. They speak Castellano, which, fortunately is the dialect taught in the U.S. Speaking Castellano really enriched my experience, since I did not have to speak and listen through an interpreter all the time. Bryan's Castellano was limited. So, at times I would be talking with someone and across the room I would hear Bryan's plea "Desmond? Walter? Could you come over here? Help!"

During breaks I would tour the orthotic labs. The layout was different than in the States, but the function was very similar. There are numerous fitting rooms, offices for

The two class sessions taught by Malas and Masterton were attended by Columbian prosthetic and orthotic practioners eager to exchange ideas and methods.

staff and, upstairs, a fabrication area complete with materials, templates, sewing machines etc. Downstairs there was a tool room for fabricating components from scratch! Talk about central fabrication. At times I wondered who should be teaching who.

Topics included in the course were anatomy, physiology, pathologic and normal gait, pathologies, orthotic components, foot evaluation, and case studies, which the attendees presented. Videos our class members had made of patients being evaluated and orthotic recommendations being made were also used in the course. Walter's task was double duty. He had to listen and translate everything. The course sometimes grew so intense that he spoke English to the Colombians and Castellano to me. The fact that I sometimes would respond introduced some comic relief.

The last few days were Relaxation & Recreation when Hector Ramos drove the three of us to his vacation home — which is really in the country. Bogota is approximately 9000 feet above sea level. The altitude at Hector's vacation home is about 3000 ft. As we drove, and the altitude dropped, the temperature rose from 65 degrees — a high temp for Bogota — to the 80's. Our mini-vacation in the country was a perfect way to end our trip. ❖

Capabilities
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- ❒ Send me one copy of *P&O Resource Directory*.
- ❒ ADA List of Publications
- ❒ Amputee Support Groups
- ❒ Association. of Children's Prosthetic-Orthotic Clinics List
- ❒ Video List

Bibliographies of NUPRL&RERP Publications Available on the Following Topics:

- ❒ Above Knee Prosthetics
- ❒ Ambulation, Gait & Posture
- ❒ Biomaterials
- ❒ Below Knee Prosthetics
- ❒ Computer Aided Engineering/Design/Manufacturing
- ❒ Pediatric Prosthetics
- ❒ Prosthetic Feet
- ❒ Prosthetics & Orthotics: General
- ❒ Upper Limb Prosthetics & Orthotics

Other Sources for Prosthetic & Orthotic Information:

Consumer Information:
National Limb Loss Information Center
900 East Hill Avenue - Suite 285
Knoxville, TN 37915
Toll Free: (888)AMP-KNOW

Prosthetic-Orthotic Education:
National Association of Prosthetic & Orthotic Education
1650 King Street - Suite 500
Alexandria, VA 22314
e-mail: opncope@aol.com

General Information about Prosthetics & Orthotics:
American Orthotic & Prosthetic Association
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