



NUPOC International Service: Building Limbs, Restoring Lives

R. J. Garrick, PhD

Restoration of mobility and enabling people to live independent, productive lives motivates many prosthetists and orthotists to enter the discipline. **Northwestern University Prosthetics-Orthotics Center International Service (NUPOC-IS)** gives students an annual opportunity to volunteer their P&O expertise at the **Range of Motion Project (ROMP) Loren J. Mallon Centro de Rehabilitacion** in Zacapa, Guatemala, where they build P&O devices for underserved Guatemalans. Founded in 2005 by NUPOC graduate **David Krupa, CP**, and **Eric Neufeld, CPO**, ROMP provides prostheses and orthoses to Guatemalans through contributions from private donors. The clinic is staffed by a local team and a rotating cohort of trained, supervised P&O volunteers. **Melinda Thorpe, CPO**, coordinates the annual NUPOC-IS program

In December 2011, nine NUPOC graduates, practitioners, and faculty participated in a five day, collaborative learning experience and medical outreach. **Dave Krupa, CP**, ROMP co-founder, and **Robert Lipschutz, CP** (Assistant Professor, NUPOC) headed a team consisting of **Shenan Hoppe-Ludwig, CO** (orthotics BLP3; prosthetics BLP13, and a full-time professional at NUPOC); **Charles Wang, MS** (NUPOC biomedical engineering graduate 2009; prosthetics BLP11); **Angela Bauer, CO** (traditional orthotics program; prosthetics BLP12); **Paul Leimkuehler** (orthotics BLP13); **William**

Leimhkuehler, CPO; **Andy Morschl** (orthotics BLP11); and **Stephanie Seaman** (prosthetics BLP13).

Working at the ROMP Clinic

NUPOC-IS participants work side-by-side with the ROMP P&O service team. In spite of limited Spanish, the NUPOC-IS team adapted immediately to the collaborative work environment. Ms. Seaman recalled, *“My Spanish is limited, so there was much laughter as I fumbled and used the wrong word. After assessment and discussing their goals and daily lives, I returned the patient to the waiting area so I could begin to work on their device. The local staff at the ROMP clinic helped me gather the parts I needed and talked me through their surprisingly low cost methods of creating devices.”*

Mr. Wang remarked on the facilities, including the outdoor fabrication area, *“At the ROMP facility, the patient-use area has high ceilings, is spacious and clean; the fabrication area has all the tools, materials, and equipment necessary to produce top quality thermoplastic, endoskeletal prostheses. But, nothing compares to the natural light and warm breezes that wafted through the outdoor work area!”* Ms. Shenan Hoppe-Ludwig agreed, *“Modifying outdoors under a tree with roosters crowing really changes the way you look at your work spaces at home.”*



NUPOC-IS 2011 at the ROMP clinic (front row, from left) Luis Aragon, Angela Bauer, Shenan Hoppe-Ludwig, Stephanie Seaman, Robert Lipschutz; (back row, from left) Karen Acevedo, Bill Leimkuehler, Cristian Aguirre, Paul Leimkuehler, Carlos Levi Larios, Luis Antonio Aragon, Andrew Morschl, Charles Wang, David Krupa, Vivian Aragon.

Seeing Results

Mr. Lipschutz summarized the clinical opportunities, *“We saw*

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approximately 25 individuals who needed prostheses and orthoses with conditions that ranged from spinal cord injuries to high level upper- and lower-limb amputations. The NUPOC-IS team and ROMP staff worked diligently and cohesively to provide prostheses and orthoses to nearly all these individuals.”

The NUPOC-IS team was surprised and gratified to see immediate results. Mr. Lipschutz observed the quick turn around between fitting and return to home with a P&O device, “A young man with a spinal cord injury was fit for the first time, stood up, walked with a set of bilateral Knee-Ankle-Foot Orthoses (KAFOs), and wore them home the same day. This is very different from our experiences here in the USA where patients require several fittings before they can take P&O devices home.” Expressing amazement at the speedy completion of P&O products, Ms. Seaman said, “A check socket was often fit the very same day! Often I found myself chasing after my clients as they joyfully walked around the room. They

were so delighted to have their mobility restored that they could not wait to start walking, whether I was ready or not! I saw the local ROMP staff converse with the clients about basic gait training and in about 15 minutes they enabled a transfemoral amputee who had been on crutches for nearly a year to walk up and down stairs. The look of elation on his face moved me to tears.”

Donations Enable Humanitarian Aims

ROMP’s use of trained P&O volunteers and donated devices successfully delivers essential services to Guatemalans. Mr. Lipschutz remarked, “David Krupa deserves recognition for his commitment and leadership. Through his work, David demonstrates his genuine passion for helping others.” Donations of P&O devices and components are essential to providing care to the clientele. Ms. Hoppe-Ludwig said, “We took note of O&P devices and materials that were needed, but unavailable and plan to seek donations.” Mr. Wang, whose career goals include developing P&O services in underserved countries, remarked, “The storeroom was filled with a variety of clean, functional, used components. This is a heartwarming testament to the generosity and commitment of American practitioners and prosthesis



Mobility restored: A ROMP client fitted with a hip disarticulation prosthesis eagerly resumes independent activities.

users who have donated them over the years. This is a template for how P&O services can be in developing regions. In the USA, I think that we often enjoy abundance without proper appreciation. We should have a way to use our overflow and serve the neediest of other nations. Without proper P&O care, too many people who rely on physical labor to support their families cannot work or even care for themselves. I hope that this sustainable, non-profit business model will be replicated in other locations.”

Resiliency of Spirit

Among ROMP’s clients are those who survived machete attacks, electrical burns, gunshot, traffic accidents, and other traumatic amputations and injuries. Mr. Wang noted, “The serene, rural landscape, a blend of mountainous backdrops, abundant rivers, and seasonal crops, provided a distinct contrast to the patients we worked with. Treating them was a stark, daily reminder that I was not in Guatemala on vacation.”

Mr. Lipschutz reflected on the characteristics of the clients he met at ROMP, “Resiliency of spirit and determination are hallmarks of Guatemalan clients who are treated in the ROMP clinic. An elderly woman demonstrated her resiliency of spirit when she wore her transfemoral prosthesis for the first time and nudged me out of the way so that she could walk more and farther.”

Exceeding Expectations

NUPOC-IS participants reported that their service in Guatemala enriched their professional goals and exceeded their personal expectations. They expressed a renewed perception of their P&O career potential. Ms. Seaman reflected on her NUPOC-IS experience, “My goals were to advance my prosthetics education and to experience a different culture, but what I learned was so much more valuable. I may have assisted my clients in their ability to perform daily tasks, but they helped me to understand what this profession truly means. I am grateful to all my clients, the personnel at ROMP, and my Northwestern University cohort for contributing to my learning and enriching my experience. All of them have touched my life forever.”

Mr. Wang reflected on his experience, “I traveled with NUPOC-IS to Guatemala with the hopes of improving my

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technical skills, learning about P&O work in a developing country, and meeting and working alongside like-minded prosthetists and orthotists. I accomplished these and more: I witnessed the inner-workings of an effective and successful non-profit organization, learned about some of the problems and potentials of operating in the developing world, and gained new insights into how my career can potentially develop! I consider myself blessed to have developed a passion for making prostheses, and discovered a career that simultaneously is intellectually challenging and also instantaneously gratifying. The opportunity to help an individual to stand, walk and return to work motivated me to work hard and do my best during this brieffield experience."



Shenan Hoppe-Ludwig makes final adjustments to a client's knee-ankle-foot orthosis.

Mr. Lipschutz concluded, "At ROMP, I saw many P&O successes. In the future, I hope to return to Guatemala with another NUPOC-IS group that will dedicate their time, energy and skills to serving a population that needs prostheses and orthoses."

NUPOC annually offers the International Service trip to trained prosthetists and



Gait training facilities at ROMP's Loren J. Mallon Centro de Rehabilitacion in Zacapa, Guatemala.

orthotists. Participation in NUPOC-IS offers opportunities to contribute P&O skills to an underserved Guatemalan population while gaining valuable clinical and cultural experience. To learn more about NUPOC-IS, visit: www.nupoc.northwestern.edu/education/NUPOCInternationalService/nupoc_is_overview. If you are interested in contributing to ROMP's humanitarian P&O outreach, please contact: <http://rompglobal.org/donate.php>.

Capabilities appreciates Robert Lipschutz, Shenan Hoppe-Ludwig, Charles Wang and Stephanie Seaman for generously sharing their thoughtful reflections and photographs about their 2011 NUPOC-IS experience; and Melinda Thorpe for managing NUPOC-IS communications and logistics.

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Megan Carroll: Managing NUPOC's Special Collection

R. J. Garrick, PhD

Megan Carroll attends Dominican University (DU) in River Forest, IL, where she is completing her Master's in Library and Information Science (MLIS). Currently, Ms. Carroll is conducting her MLIS Practicum organizing the **NUPOC Special Collection** supervised by her advisor **Christopher Stewart**, MBA, EdD (Assistant Professor, Dominican University Graduate School of Library Information Science) and **Anna Fleming**, MA, MLIS Head, Galter Health Sciences Library, Northwestern University.



Megan Carroll, BA

In addition to her LIS Practicum, Ms. Carroll is studying LIS Technology Requirements in American Library Association (ALA) accredited programs and plans to publish a paper about her research. Also, she is working to archive and transfer copies of the journal, *Third World Libraries*, onto their website. After graduation, she plans to work within a Health Sciences Library at an academic institution.

From age five, Ms. Carroll spent her childhood in Southwest Ranches, a town located in Southeast Florida, a 30-minute drive from Ft. Lauderdale. Her family lived on a 2.5-acre ranch with 8 horses. At an early age, she learned to ride and eventually rode as a flag girl in the local Five Star Rodeo. She was an enthusiastic athlete and participated in basketball, track, and volleyball. At age 13, she was diagnosed with Type 1 Diabetes, which intensified her participation in physical activities and

adherence to a healthy diet. She notes, "Staying active decreased my need for insulin. Eventually, I left the rodeo and played sports year round. Throughout middle and high school, my life was a circuit of sports practices and games, alternated with doctor appointments. My experience with diabetes also helped to direct my focus toward medical resources."

Ms. Carroll graduated from Saint Thomas Aquinas High School (2002), a private school in Ft. Lauderdale, FL. She earned her Bachelor of Arts in English Literature at Saint Mary's College (2006), Notre Dame, IN, where she enjoyed

playing intramural sports and working part time as a Residential Computer Consultant. Ms. Carroll moved briefly to Chicago, but opted to move back to Ft. Lauderdale where she worked until 2011 for Humana, Inc, as a Medicare Risk Adjustment Coordinator.

She is a member of the Library Information Science Student Association (LISSA) and the ALA. When she has time, Ms. Carroll reads avidly, recently focusing on fantasy literature. She loves to travel, has practiced yoga for 5 years, and writes a patient care blog called *BionicDiabetic*.

NUPOC is delighted that Ms. Carroll and DU-LIS have selected NUPOC for her Practicum. We appreciate Ms. Carroll for exercising her LIS skills to organize the NUPOC Special Collection. Welcome to NUPOC, Megan!

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NUPOC Hosts Orthotech Seminar

NUPOC personnel offered focused tours of three research stations. **Craig Heckathorne**, MSc, presented work on upper extremity prostheses and *Serving the Prosthetic Needs of Farmers and Ranchers*; **Rebecca Stine**, MS, and **Matty Major**, PhD, discussed research projects that use the **Jesse Brown VA Medical Center Motion Analysis Research Laboratory**. **Kerice Tucker**, BS, demonstrated and discussed NUPOC rapid prototyping using NUPOC's Stratasys and Squirt Shape machines. Mr. Tucker provided an overview of NUPOC testing equipment; and Mr. **Dilip Thaker**, Instrument Maker, discussed fine tolerance tools available in the Machine Shop.



Kerice Tucker (center) discusses Rapid Prototyping of prosthetic sockets with Christoph Thaler (left) and Martin Berli (right).

In German-speaking countries, Technical Orthopedics is a comprehensive musculoskeletal discipline that includes orthopedic surgery, physical medicine and rehabilitation, motion analysis, physical therapy and prosthetics and orthotics.

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NUPOC Extern: Freek Verbakel

R. J. Garrick, PhD

Freek Verbakel, BSc, is conducting a ten week externship at NUPOC where he works under the mentorship of **Stefania Fatone**, PhD, BPO(Hons), to analyze data about center of pressure progression in ankle-foot orthoses (AFO). He is examining roll-over shape in subjects who are tested in four different AFOs and is using MatLab and statistical progression in his data analysis.

Mr. Verbakel earned his Bachelor's degree in Mechanical Engineering, Delft University of Technology; and he expects to earn his Master's degree in Mechanical Engineering and Biomechanical Design (expected October 2012), with a specialization in Intelligent Mechanical Systems. At Delft, **Erwin De Vlugt**, PhD, supervises Mr. Verbakel's research and thesis work on mechanical AFOs' spring balance mechanisms that yield improved walking motion. Mr. Verbakel particularly enjoys concentrating on the technical design of mechanical devices.

While some people select engineering as a sequela to a childhood spent dismantling and building things, Mr. Verbakel selected engineering because it is a discipline that can be useful and applied in myriad and diverse ways. Mr. Verbakel said, *"I considered medical school, but in the end I selected engineering for its broad future possibilities. Knowledge in Mechanical Engineering can be useful in medicine, marine, micro and many other applications."*

Born in the southern Dutch city of Veghel, Mr. Verbakel



Freek Verbakel, BSc

moved with his family to Germany where he lived for four years. The family relocated to Rotterdam where he attended school in the pre-collegiate track that emphasizes natural sciences (math, physics and chemistry), with electives in biology and Latin. During high school, he ran for relaxation, played fiercely competitive water polo, and also broadened his experience through various part time jobs. Mr. Verbakel said that his work experience in everything from catering to newspaper routes gave him new perspectives about directions he might pursue in life. *"Even now, my interests are not only engineering. In the past, I could have imagined becoming a cook or a chef in a restaurant. On the other*

hand, in the future, if possible I would like to develop my own product-based technology business. Perhaps I will develop a product and market it. Nearly everything is a possibility in Mechanical Engineering."

The multilingual Mr. Verbakel speaks Dutch, English, German and French fluently. He has programming skills in Matlab and Pascal, conducts computer aided design (CAD) in Solid Works and Pro/Engineer, and is knowledgeable in Finite Element (FE) methods. While in Chicago, Mr. Verbakel has enjoyed architectural tours, visited Chicago parks and neighborhoods, and viewed exhibits at the Museum of Science and Industry. It is a pleasure to include Freek Verbakel in the NUPOC research team and we wish him success in his future endeavors.

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NUPOC Hosts Orthotech Seminar

Approximately every two years, a cohort of Technical Orthopedics specialists from German-speaking countries is awarded a two-year fellowship funded by **Initiative '93**. Initiative '93 was founded by **Georg Neff**, MD (Berlin), **René Baumgartner**, MD (Münster), and others during the 1992 International Society of Prosthetics and Orthotics (ISPO) World Congress (Chicago) that was chaired by NUPOC Professor Emeritus **Dudley S. Childress**, PhD. Currently, the fellowship program is headed by **Bernard Greitemann**, MD.

NUPOC has hosted eight successive cohorts of German-speaking Technical Orthopedics specialists and looks forward to hosting future groups. Each group spends about 4 weeks in North America where they attend professional meetings and visit research centers to develop new knowledge. The Fellows present information about their research and exchange scientific knowledge with their USA counterparts. Upon their return, the Fellows report to their professional communities, thus disseminating important intellectual and scientific knowledge on both sides of the Atlantic.

NUPOC Presents at 41st Annual Career Day for Girls

R. J. Garrick, PhD

On February 25, 2012, NUPOC Research Engineer **Craig Heckathorne**, MSc, and Biomedical Engineering doctoral candidate, **Erin Boutwell**, MS, presented three career and educational workshops to 40 young women at the 41st Annual Career Day for Girls.

Mr. Heckathorne discussed upper limb prostheses and Ms. Boutwell discussed lower limb prostheses and orthoses. During the presentations, Career Day participants were able to handle and explore many examples of upper- and lower-limb prosthetic components. They also learned about some areas of biomedical engineering research that are conducted at NUPOC.



NUPOC BME doctoral candidate, Erin Boutwell, MS (left), and Research Engineer Craig Heckathorne, MSc (right), and represented Biomedical Engineering at Career Day for Girls.

Career Day is an outreach event for middle and high school girls who are interested in science and engineering careers. The day-long program included a design competition, laboratory tours, hands-on activities, and panel discussions about engineering experiences and educational preparation. This annual event is sponsored by the **Society of Women Engineers Northwestern University Chapter** and the **Robert R. McCormick School of Engineering and Applied Science**.

Learn more about SWE at:
<http://swe.mccormick.northwestern.edu/>

In Memory: James C. Russ, CO (1934-2012)

R. J. Garrick, PhD

James C. Russ, CO, passed away February 25, 2012. Assistant Professor Emeritus at Northwestern University Feinberg School of Medicine, Mr. Russ began teaching at NUPOC in 1968 and directed the Orthotics program from 1973 to 1993. Mr. Russ trained to become a Certified Orthotist at Georgia Warm Springs Foundation (1957) during the height of the poliomyelitis epidemic.

During his 50 year professional career in Orthotics, Mr. Russ successfully established post-secondary programs, standardized curricula, and established orthotic residencies. As the NUPOC Director of Orthotic Education for 20 years, Mr. Russ trained many students for practitioner-level certification in orthotics and helped to elevate orthotics from a trade to an allied health profession.



James C. Russ, CO

Mr. Russ received numerous awards, including recognition by the Northwestern University Feinberg School of Medicine (1992) for his commitment, service, and dedicated performance in Orthotic education. He received the American Academy of Orthotists and Prosthetists (AAOP) Outstanding Educator Award (1997). This award recognized Mr. Russ as an educator who demonstrated didactic skills that permanently contributed to his students' knowledge and professional skills. Mr. Russ was a member of the AAOP, American Orthotic & Prosthetic Association (AOPA), and American Board for Certification in Orthotics, Prosthetics & Pedorthics (ABC). He is remembered by NUPOC and will be missed by his many colleagues and friends.

NUPOC NEWS

Publications

Gard, SA, Su, PF, Lipschutz, RD and Hansen, AH. (2011). The Effect of Prosthetic Ankle Units on Roll-Over Shape Characteristics during Walking in Persons with Bilateral Transtibial Amputations. *Journal of Rehabilitation Research & Development*, 48(9), 1037-1047.

Boutwell, E, Stine, R, Hansen, A, Tucker, K and Gard, SA. (2012). Effect of Prosthetic Gel Liner Thickness on Gait and Pressure Distribution within the Transtibial Socket. *Journal of Rehabilitation Research & Development* (In press).

Meier, MR, Hansen, AH, Gard, SA and McFadyen, AK. (2012). Unilateral Transfemoral Prosthesis Users' Performance and Movement Efficiency When Using the C-leg, 3R60 and the SNS Prosthetic Knee Joints on an Obstacle Course. *Journal of Rehabilitation Research & Development* (In press).

Meetings

Ingrid Masterton, MPT, attended the annual meeting of the Alliance for Disability in Health Professional Education held in Boston, MA, on December 2, 2011.

Grant Submissions

Gard, SA. "Effect of Prosthetic Foot and Ankle Stiffness on Standing and Walking." Revised grant submitted to the Department of Veterans Affairs for December 2011.

Gard, SA and Boutwell, E. "Effect of Prosthetic Compliance on Shock Absorption & Proprioception." Revised grant submitted to the Department of Veterans Affairs for December 2011.

Gard, SA and Casanova, H. "Evaluation of a Vacuum-Based Impression and Alignment Device (V-BIAD)." Grant submitted to the Department of Veterans Affairs for December 2011.

Gard, SA and Heckathorne, CW. "Force Feedback to Improve Performance of Transradial Prosthesis Users." Revised grant submitted to the Department of Veterans Affairs for December 2011.

Gard, SA and Zissimopoulos, A. "Frontal Plane Dynamic Stability in a Chronic Post-Stroke Population." Grant submitted to the Department of Veterans Affairs for December 2011.

Gard, SA and Major, MJ. "Incidence and Covariates of Falls in Individuals with Upper Limb Amputations." Revised grant submitted to the Department of Veterans Affairs for December 2011.

Fatone, S and Major, M. "Validation of the Berg Balance

Scale for Individuals with Lower Limb Amputation." Grant submitted to the Orthotic and Prosthetic Education & Research Foundation (OPERF) for January 2012.

Fatone, S. "Promoting Outcome Measurement in Prosthetics and Orthotics Practice: Development of a Toolkit and Curriculum." Subcontract with the Rehabilitation Institute of Chicago. Grant submitted to the Orthotic and Prosthetic Education & Research Foundation (OPERF) for January 2012.

Fatone, S and Pavone, L. "Improving Lower Extremity Orthotic Management of Children with Cerebral Palsy." Grant submitted to the Orthotic and Prosthetic Education & Research Foundation (OPERF) for January 2012.

Huang, Y and Fatone, S. "Interface Monitoring System to Promote Residual Limb Health." Smart Health and Wellbeing (SHB), Type II Integrative (INT), Collaborative Research grant submitted to the National Science Foundation for February 2012.

Heinemann, A (PI) and Fatone, S (Subaward PI). "Enhancing Quality of Orthotics Services with Process and Outcome Information." Resubmitted to the National Institute for Disability and Rehabilitation Research Field Initiated Project for March 2012.



Yeongchi Wu, MD (left) explains to Florian Dennerlein, Dipl Inform (right) the process of dilatancy casting and its potential for clinical application.

Laboratory Visits

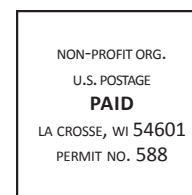
Northwestern University Prosthetics-Orthotics Center (NUPOC) hosted an interactive and instructive tour of research and education facilities for **Florian Dennerlein, Dipl Inform,** who visited from Fraunhofer Institute, Stuttgart, Germany on March 13, 2012.

Capabilities

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NUPOC Hosts Seminar in Technical Orthopedics

R. J. Garrick, PhD

During a day-long seminar on March 1, 2012, orthopedic surgeons **Martin Berli**, MD (Zurich, Switzerland), **Christoph Thaler**, MD (Salzburg, Austria), **Michael Pinzur**, MD, Professor of Orthopaedic Surgery and Rehabilitation, Loyola University Medical Center (Chicago, IL), and engineer-prosthetist-orthotist **Daniel Heitzmann**, Dipl Ing (Heidelberg, Germany), discussed current research. Dr. Berli discussed *Amputations: Which Is the Correct Level?*; Mr. Heitzmann discussed *Can Gait Deviations of Transfemoral and Transtibial Amputees Be Attributed to Strength Deficits of the Involved Limb?*; and Dr. Thaler discussed *Cerebral Palsy: Time Is Running Out*. By special invitation, Dr. Pinzur attended the seminar and discussed *Outcome Measures Used by US Orthopaedic Surgeons to Evaluate Lower Limb Amputations*. NUPOC Executive Director **Steven A. Gard**, PhD, facilitated the session.

In the afternoon session, **Stefania Fatone**, PhD, BPO(Hons), presented an introduction and overview



(From left) Daniel Heitzmann, Dipl Ing, CP, Steven A. Gard, PhD, Christoph Thaler, MD, R. J. Garrick, PhD, and Martin Berli, MD.

of current research at NUPOC that is funded by the **National Institute for Disability and Rehabilitation Research (NIDRR)**, **Veterans Affairs**, the **US Department of Defense**, and other sources. NUPOC doctoral candidates in biomedical engineering presented their work: **Erin Boutwell**, MS, presented *Effect of Prosthesis Stiffness in Transtibial Amputees*; **Sara Koehler**, MS, presented *Prosthetic Alignment for Transfemoral Amputees*; and **Kiki Zissimopoulos**, MS, presented *Effects of an Ankle-foot Orthosis on Foot Placement Post-Stroke: Balance Implications*. NUPOC postdoctoral fellows also presented their work: **Oluseeni Komolafe**, PhD, discussed *Development of a Flexible Transfemoral Prosthetic Socket Using Stress-Strain Analysis*; **Azucena Rodriguez**, PhD, discussed *Spinal Motion during Walking in Persons with Transfemoral Amputation with and without Low Back Pain*; and **Matty Major**, PhD, discussed *Stability and Fall Risk in Lower Limb Amputees*.

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