



Spinal Motion during Walking In Persons with Transfemoral Amputation With and Without Low Back Pain: Preliminary Results

Azucena Rodriguez¹, PhD, Rebecca Stine^{1,2}, MS, Stefania Fatone^{1,2}, PhD, BPO(Hons)

This work is supported by the Department of Education, National Institute on Disability and Rehabilitation Research (NIDRR) grant number H133E080009. The contents of this paper do not necessarily represent the policy of the Department of Education and do not constitute endorsement by the Federal Government. Data were collected at the Jesse Brown VA Medical Center Motion Analysis Research Laboratory, Chicago, IL. These are the current results of an ongoing NIDRR study.

Introduction

Low back pain (LBP) is a prevalent condition among the general population (Roach, et al., 1997); however it was found to be as much as 71% higher in persons with transfemoral amputation (TFA) (Smith, et al., 1997). Persons with TFA are significantly more likely to suffer from LBP than persons with transtibial amputation (Kulkarni, et al., 2005; Smith, et al., 1999). LBP is so problematic in persons with lower extremity amputations that it has been described as a secondary disability (Ehde, et al., 2001).

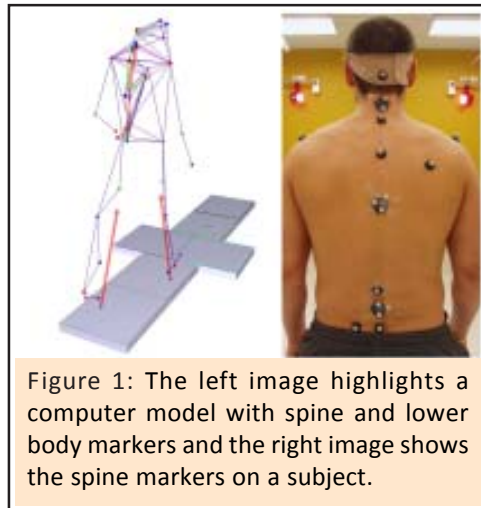


Figure 1: The left image highlights a computer model with spine and lower body markers and the right image shows the spine markers on a subject.

Although researchers have suggested that gait abnormalities may contribute to LBP (Nadler, et al., 1998), few investigations have attempted to correlate LBP to kinematic variables, especially spinal motion (Cappozzo, 1981; Tazawa, 1997). Typically, gait models disregard the spine entirely or regard it as a single rigid structure. Generally, few studies examine able-bodied subjects with respect to regional spinal movements in conjunction with lower limb data associated with walking and fewer

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NUPOC Faculty Office Donated in Memory of David Rubin, MD

NUPOC Executive Director **Steven A. Gard**, PhD, welcomed **Judith Rubin** to NUPOC and expressed appreciation for her generous gift of sponsoring a faculty research office in memory of her late father, **David Rubin**, MD.

Dr. Rubin earned his medical degree at Northwestern University (1947) and completed his residency in physical medicine and rehabilitation (PMR) at Los Angeles County General Hospital. A trail blazer in the field of PMR, Dr. Rubin practiced at the California Rehabilitation Center (1948-1951, 1955-1956). As a captain in the United States Army, Dr. Rubin served at the Percy Jones Army Hospital and Brooke Army Hospital, where he was in



David Rubin, MD

charge of amputee training. Subsequently, Dr. Rubin was Chief, Department of Physical Medicine, at Cedars Sinai Medical Center in Los Angeles (1961- 1966) and senior attending staff from 1966 until his retirement. From 1956 until his retirement, Dr. Rubin had a full-time private practice in PMR and also served as a consultant with the Department of Veterans Affairs (1959-1986).

This generous gift memorializes the important work of Dr. Rubin, who devoted his professional life to serving those who live with physical disabilities; and also enables NUPOC to continue improving the lives of people who live with physical disabilities.

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studies examine these variables in persons with TFA. Although knowledge of spinal motion in persons with TFA is limited, better understanding of spinal motion during walking in this population may advance understanding of the factors that contribute to LBP and ultimately lead to interventions that can alleviate LBP. The purpose of this ongoing study is to investigate whether differences exist in spine kinematics during walking in persons with unilateral TFA with and without LBP.

Study Protocol

Persons with unilateral TFA were recruited to participate in this study, which was approved by the Northwestern University Institutional Review Board. It is our aim to collect data from 22 subjects: 11 subjects with low back pain and 11 without low back pain. The group without low back pain must report being pain free for at least 30 days prior to the study.

Subjects are tested once in the motion analysis laboratory. Reflective markers are taped to anatomical landmarks on the lower limbs, pelvis, and spine using a modified Helen Hayes model (Kadaba, et al., 1990) and a regional spine model developed in our lab during a previous NIDRR funding cycle (Konz, et al., 2006) (Figure

1). A minimum of five walking trials at a comfortable, self-selected speed are recorded.

Participants are experienced prosthesis users who can walk without walking aids, other than their prosthesis. Subjects are excluded if they have any comorbidities that affect gait or function of their contralateral limb.

To complete the data analysis, OrthoTrak software (Motion Analysis Corp., Santa Rosa, CA) is used to analyze the lower extremity kinematic data, while spine kinematics are analyzed using Visual3D (C-Motion Inc., Germantown, MD). Student's two tailed t-tests were used to compare preliminary results between groups with statistical significance set at $p=0.05$.

Preliminary Results

To date, data have been collected from 10 persons with TFA (7 males, 3 females), with an average age of 48 ± 14 years, average height of 172 ± 8 cm, and average mass of 82 ± 20 kg. Four of the 10 subjects reported experiencing LBP in the 30 days prior to the study. For persons reporting back pain (BP), the average walking speed was 0.86 ± 0.28 m/s; while for persons reporting no back pain (NBP) it was 0.99 ± 0.31 m/s ($p=0.33$ indicating no statistically significant difference). Also, no statistically significant difference was found between groups in prosthetic limb knee flexion ($p=0.43$),

Plane	Segment	Range of Motion (degrees)		p-value
		BP Ave(SD) (n=4)	NBP Ave(SD) (n=6)	
Trans	Thoracic	11.81(4.78)	6.80(1.66)	0.10
	Lumbar	7.73(2.36)	6.39(2.94)	0.32
	Pelvic	13.49(5.37)	13.61(9.03)	0.80
Coronal	Thoracic	7.03(0.92)	5.26(0.62)	0.98
	Lumbar	9.82(2.86)	4.63(3.42)	0.23
	Pelvic	12.10(3.10)	9.19(4.62)	0.37
Sagittal	Thoracic	9.96(5.25)	7.04(2.25)	0.39
	Lumbar	10.46(3.15)	7.41(2.02)	0.04*
	Pelvic	9.44(0.81)	6.94(2.36)	0.05*

Table 1: ROM for the two groups (BP=Back Pain, NBP=No Back Pain, Ave=Average, SD=Standard Deviation, Asterisk=Significant Difference, Trans=Transverse Plane).

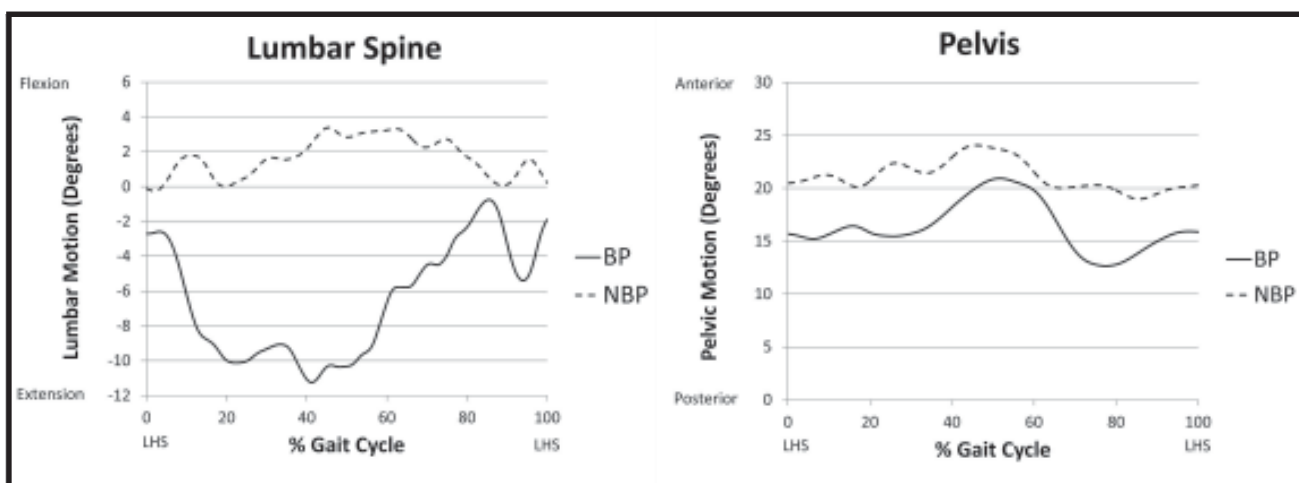


Figure 2: Average representative data of lumbar sagittal plane motion and pelvic sagittal plane motion for one subject (left amputation) from each group for one complete gait cycle (from left heel strike (LHS) at 0% to subsequent LHS at 100%): Back Pain (BP) and No Back Pain (NBP).

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hip adduction and abduction ($p=0.15$), and hip flexion ($p=0.17$) range of motion (ROM) during stance. Sagittal plane ROM for the lumbar spine ($p=0.04$) and sagittal plane ROM for the pelvis ($p=0.05$) were significantly larger in the group with LBP than in the group without LBP (Table 1 and Figure 2).

Initial Impressions

Preliminary results suggest that there exist some spine kinematic differences during walking in TFAs with and without LBP. Our results to date suggest that lumbar sagittal plane motion and pelvic sagittal plane motion are greater in TFAs with LBP than those without back pain. However, a recently published study of three-dimensional trunk kinematics during walking in persons with TFA with and without back pain reported an increase only in transverse plane trunk ROM (Morgenroth, et al., 2010). Differences in the results between our study and that of Morgenroth, et al. (2010) are most likely due to variation in how spine/trunk motion is modeled. Our study divided the spine into anatomical regions (cervical, thoracic, lumbar and pelvic) while Morgenroth, et al.'s study modeled only two regions (trunk and pelvis). In addition, the methods used to establish the pain and no pain groups and the average age of the subjects were different between studies.

We anticipate that the complete results from this study will help to identify whether differences exist in spinal motion for persons with TFA who walk with and without LBP. Potentially, these results may improve our understanding of factors that contribute to LBP and suggest interventions that can decrease LBP in persons with TFA.

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Azucena Rodriguez, PhD, postdoctoral fellow in the Department of Electrical Engineering, is conducting her spine research at NUPOC. She is funded at NURERC by the National Institutes of Health (NIH) through the Northwestern

University-Select Teaching and Research Training (NU-START) Program. Her 3-year appointment includes mentored research and teacher training.

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NUPOC Public Education and Dissemination

R. J. Garrick, PhD

NUPOC Welcomes the National Student Leadership Conference

Northwestern University Prosthetics-Orthotics Center (NUPOC) hosted educational tours for the **National Student Leadership Conference (NSLC)** on July 14, July 28, and August 11. Attending students plan to build careers



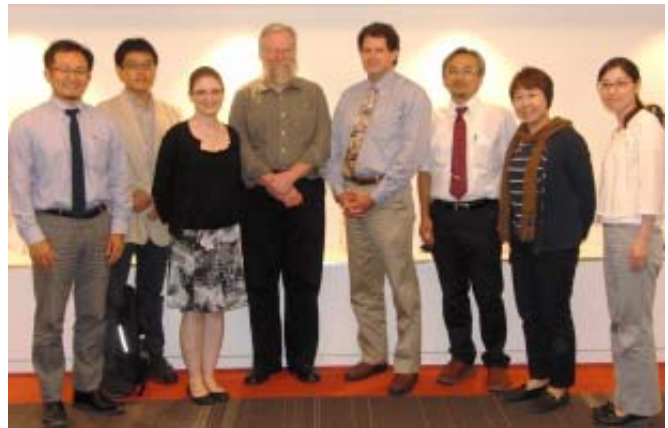
NUPOC doctoral candidate, BJ Johnson, MS, explains how a Reciprocating Gait Orthosis (RGO) works.

in engineering, medicine, and technology. NUPOC research and education personnel presented information about education and research in Prosthetics and Orthotics. NUPOC Executive Director **Steven A. Gard, PhD**, conducted an overview and tour of NUPOC Education Facilities (Fitting and Assessment Rooms, Fabrication Labs, and Smart Class Room).

NSLC students attended presentations by **Jared Howell, CPO**, “Careers in Prosthetics and Orthotics”; **Stefania Fatone, BPO(Hons), PhD**, “Careers and Research in Prosthetics and Orthotics”; **Craig Heckathorne, MSc**, “Upper Extremity Prostheses”; **Sara Koehler, MS**, “Prosthetic Alignment for Transfemoral Amputees”; **Kiki Zissimopoulos, MS**, “Dynamic Balance during Post-Stroke Ambulation”; **Erin Boutwell, MS**, “Prosthetic Compliance and Shock Absorption in Transtibial Amputees”; Stefania Fatone, PhD, “Clinical Outcome Measures”; and **BJ Johnson, MS**, “Modeling Reciprocating Gait Orthoses (RGO)”, assisted by **Oluseeni Komolafe, PhD**. Biomedical engineering doctoral candidates Sara Koehler, MS, Kiki Zissimopoulos, MS, Erin Boutwell, MS, and BJ Johnson, MS, presented a panel discussion, “Choosing Your Future” that allowed NSLC students to ask about careers in biomedical engineering and prosthetics and orthotics.

NUPOC Welcomes Researchers from Japan

Northwestern University Prosthetics-Orthotics Center (NUPOC) hosted a site visit and research presentations for visiting Japanese biomedical engineers, **Kengo Ohnishi, PhD, Tokyo Denki University** and **Isamu Kajitani, PhD, National Institute of Advanced Industrial Science and Technology (AIST)**; and occupational therapists **Yaeko Shibata, OT, Hyogo Rehabilitation Center**; **Junpei Oba, OT, Kobe Gakuin University**; and **Kumiko Sasao, OT, Saitama Prefectural University** on August 22. Ms. Shibata and Mr. Oba presented “*The Current State of Occupational Therapy for Upper Limb Amputees in Japan*”.



From left, Junpei Oba, OT, Isamu Kajitani, PhD, Stefania Fatone, PhD, Craig Heckathorne, MSc, Steven A. Gard, PhD, Kengo Ohnishi, PhD, Yaeko Shibata, OT, and Kumiko Sasao, OT.

NUPOC Executive Director **Steven A. Gard, PhD**, provided an orientation to the education and research programs; and **Stefania Fatone, PhD**, presented “*An Overview of NUPOC Research Projects*”. **Craig Heckathorne, MSc**, discussed the NIDRR-funded project, “*Meeting the Prosthetic Needs of Farmers and Ranchers*”. Also, Mr. Heckathorne presented didactic and practicum sessions on myoelectric (ME) signal acquisition and fitting upper extremity ME prostheses.

NUPOC Welcomes Rush Occupational Therapy Students

Northwestern University Prosthetics-Orthotics Center (NUPOC) hosted a site visit for **Linda Olson, PhD, OTR/L**, Assistant Professor, and members of the **Rush Occupational Therapy Program** on July 27. The students toured the NUPOC education and research facilities, and learned about upper limb prostheses presented by **Craig**

Heckathorne, MSc; lower limb prostheses and the use of computer aided design in prosthetic sockets presented by **Kerice Tucker**; and systems for the analysis of human gait and motion presented by **Rebecca Stine, MS**, and **Oluseeni Komolafe, PhD**.

NIDRR Scholar: Shingo Takemoto

R. J. Garrick, PhD



Mr. Shingo Takemoto

Shingo Takemoto comes to NUPOC as a **National Institute for Disability Rehabilitation Research Scholar** (NIDRR). From Gallaudet University (2007), he graduated with a BS in Mechanical Engineering (2010) from University of Maryland, Baltimore County Baltimore, MD. Experienced in Matlab, AutoCad and LabView software, he focuses on rehabilitation engineering with respect to prosthetics and orthotics. At NUPOC, Mr. Takemoto will work on design modifications to the NUPOC prosthetic ankle that

adapts to surface slope.

He helped design rehabilitation devices at Kansai Hospital for Rehabilitation (Japan), was a wheelchair mechanic at Chesapeake Rehabilitation Equipment (2009-2011), and applied his knowledge internationally at a hospital in Lima (Peru) where he built and adapted wheelchairs.

No stranger to disability, Mr. Takemoto is deaf. He has developed multi-cultural and multi-lingual proficiency that enable him to communicate well in written and spoken Japanese and English, as well as in Japanese, Korean, and American Sign Language (ASL). Educated in mainstream and deaf schools, he is an excellent lip-reader. He attributes some of his success to his mother's resolve that he achieve equally well in both hearing and deaf societies. Smiling ruefully, Mr. Takemoto reflected, *"Most of my childhood memories are not about playing and having fun. Instead, I spent double-duty learning in conventional schools and also in a school for deaf education. I spent most of my time studying!"*

Resourceful and sociable, deafness does not prevent his direct interaction with people. He is an avid traveler and has visited Korea, Mexico, and Viet Nam. As a volunteer, he helped develop Deaf Education programs in the Philippines. At Gallaudet University, he was Vice President of the English Language Institute Student Organization (ELISO). He loves to play basketball and also works out running, biking and swimming. He notes, *"I want to train hard because one of my future goals is to try out for the Japan Team of the Deaf Olympics."*

Mr. Takemoto says, *"Now I am evaluating master's programs to find the best match. I am interested in P&O, so I may apply to the NUPOC Master's in Prosthetics and Orthotics (MPO)."* He aims to use his engineering skills to improve the lives of those who live with physical disabilities. He notes, *"Energy is always expensive, so I want to design assistive devices that do not require electronic elements."* NUPOC is delighted to welcome NIDRR Scholar Shingo Takemoto!

NUPOC Extern: Tina Amirtha

R. J. Garrick, PhD

Tina Amirtha is conducting a 2-month externship at NUPOC. Ms. Amirtha graduated from Northwestern University (BS, 2006) and is an MSc candidate in Biomechanics, Mechanical Engineering, Delft University (Netherlands). Her learning objectives while at NUPOC are twofold: 1) to become familiar with methods used for gait stability analysis; and 2) to work with orthotics-assisted gait studies.



Ankle-Foot Orthosis

She will participate in the NUPOC research project that investigates stroke patients' stability during gait, specifically to determine the contribution of Ankle-Foot Orthoses (AFO) to gait stability.

Ms. Amirtha plans to conduct her master's research under the mentorship of **Jaap Harlaar**, PhD, Human Movement Laboratory, Department of Rehabilitation Medicine, Research Institute MOVE, VU Amsterdam Medical Center. While there, she will focus on gait stability in children with cerebral palsy.

As a Northwestern undergraduate, Ms. Amirtha was awarded a Gates Millennium Scholarship for leadership and merit, enabling her to spend her junior year at École Polytechnique (Palaiseau, France) where she focused on Applied Mathematics. After graduation, Ms. Amirtha spent four years working in industrial engineering where she managed projects that include development of automated testing of medical valves; quality improvement in the pneumatics performance of an apheresis device; and revisions to a financial planning tool.

Ms. Amirtha grew up in the Chicago area where her mother fostered her interest in mathematics; and her father, also an engineer, encouraged her to learn how things work and to address and answer difficult questions. She enjoys re-discovering her cultural roots through cooking fusion cuisine of Andhra Pradesh. A violinist since childhood, she is learning to play the guitar. Living in the Netherlands has engendered her advocacy of biking to lessen environmental pollution. International in her experience and perspectives, Ms. Amirtha enjoys a network of caring, cosmopolitan friends.

We are delighted that Ms. Amirtha has selected NUPOC for her externship. Welcome Tina Amirtha!

NUPOC NEWS

Publications

Robert D. Lipschutz, BSME, CP, Blair Lock, MS, Jonathon Sensinger, PhD, Aimee Schultz, MS, Todd A. Kuiken, MD, PhD, (2011) "Use of Two-axis Joystick for Control of Externally Powered Shoulder Disarticulation Prostheses." *Journal of Rehabilitation Research and Development*, Volume 48, Number 6, pp. 661-668.

Presentations

Matthew Major, PhD. "Stability and Fall Risk in Lower Limb Amputees." Presented at the AAOP Midwest Chapter Meeting, held in Lake Geneva, WI, on June 3-4 .

Stefania Fatone, PhD, BPO(Hons). "Effects of Different Orthotic Ankle Joint Conditions, on Lower Limb Gait Parameters in a Subject with Crouch Gait." Presented at the AAOP Midwest Chapter Meeting, held in Lake Geneva, WI, on June 3-4 .

Ingrid Masterton PT. "Bridging the Gap between Clinicians and Academics." Presented at the AAOP Midwest Chapter Meeting, held in Lake Geneva, WI, on June 3-4 .

William Brett (BJ) Johnson, MS. "Investigating the Effects of Hip Joint Stiffness on RGO Assisted Gait with a Lower Limb Paralysis Simulator." Presented at the AAOP Midwest Chapter Meeting, held in Lake Geneva, WI, on June 3-4 .

Craig Heckathorne, MSc, and **Rebecca Stine**, MS. "Using Motion Analysis to Augment Upper-limb Prosthetics Outcome Measures." Presented at the MEC 2011 Myoelectric Controls Symposium, Fredericton, New Brunswick, on August 17-19.

Craig Heckathorne, MSc, and **Kathy Waldera**, MS. "The Prosthetics Needs of Farmers and Ranchers with Upper-limb Amputations." Presented at the MEC 2011 Myoelectric Controls Symposium, Fredericton, New Brunswick, on August 17-19.

Craig Heckathorne, MSc, was an invited panelist for the symposium session "Raising the Standards," held at the MEC 2011 Myoelectric Controls Symposium, Fredericton, New Brunswick, on August 17-19.

Meetings

Steven A. Gard, PhD, attended the Journal of Rehabilitation Research & Development Editorial Board Meeting, held in Baltimore, MD, on July 21. Dr. Gard is a member of this editorial board.

Stefania Fatone, PhD, BPO(Hons), was invited to participate in the NIDRR Research Capacity Building Summit, held in Washington, DC, on July 21-22.

Steven A. Gard, PhD, and **Stefania Fatone**, PhD, BPO(Hons), attended the annual National Institute on Disability and

Rehabilitation Research (NIDRR) RERC Project Directors' meeting in Alexandria, VA, on August 17-18. They facilitated and presented a panel discussion on "State of the Science Meetings: Challenges and Solutions".

Honors

Stefania Fatone, PhD, BPO(Hons), accepted an invitation to join the Editorial Board of Archives of Physical Medicine and Rehabilitation. She is the Section Editor for Prosthetics and Orthotics.

Provisional Patents

Inventors **Andrew Nelson, Bennett Kuhar, Regan Radcliffe, Kevin Yngve, Sean Wood, Ryan Caldwell, Wei Chen, and Andrew Hansen** (Principal Investigator, **Stefania Fatone**, PhD), filed for a U.S. Provisional Patent Application with the U.S. Patent and Trademark Office on June 23, 2011. The patent is titled "Hybrid Prosthetic Vacuum Pump."

Grant Submissions

Gard, SA and Major, MJ. "Clinically Relevant Predictive Factors of Fall Risk in Transtibial Amputees." Submitted to the Department of Veterans Affairs for the June 2011 due date.

Gard, SA and Boutwell, EV. "Effect of Prosthetic Compliance on Shock Absorption and Proprioception." Submitted to the Department of Veterans Affairs for the June 2011 due date.

Gard, SA. "Effect of Prosthetic Foot and Ankle Stiffness on Standing and Walking." Submitted to the Department of Veterans Affairs for the June 2011 due date.

Gard, SA and Casanova, HR. "Evaluation of a Vacuum-Based Impression and Alignment Device (V-BIAD)." Submitted to the Department of Veterans Affairs for the June 2011 due date.

Gard, SA and Heckathorne, CW. "Force Feedback to Improve Performance of Transradial Prosthesis Users." Submitted to the Department of Veterans Affairs for the June 2011 due date.

Gard, SA and Zissimopoulos, AN. "Frontal Plane Dynamic Stability in a Chronic Post-Stroke Population." Submitted to the Department of Veterans Affairs for the June 2011 due date.

Gard, SA and Major, MJ. "Incidence and Covariates of Falls in Individuals with Upper Limb Amputations." Submitted to the Department of Veterans Affairs for the June 2011 due date.

Fatone, S. and Pavone, L. "Improving Lower Extremity Orthotic Management of Children with Cerebral Palsy." Submitted to the Davee Foundation Translational Research Awards at the Rehabilitation Institute of Chicago for the July 30, 2011 due date.

NUPOC Presentations at AAOP, Texas

Stefania Fatone, PhD, BPO(Hons), **John Michael**, CPO, FAAOP, FISPO, and **Bryan Malas**, CO, former Director of Orthotic Education at NUPOC, were invited to attend the annual meeting of the **Texas Chapter of the American Academy of Orthotists and Prosthetists** held in Austin, TX, on August 5-6. The first day of the meeting featured workshops and the second day featured presentations by invited speakers. Approximately 100 people attended the conference and presentations.

Mr. Michael presented a talk about the use of FES and a selection of clever solutions for difficult O&P cases. Dr. Fatone presented an overview of the NIDRR RERC projects, as well as information about her research about functional evaluation of ankle foot orthoses for persons post-stroke.

The NIDRR RERC includes twelve projects and, due to time constraints, Dr. Fatone allowed the audience to select four NU-RERC research (R) or development (D) projects for report. The audience selected: **R2-Evaluation of Spinal Motion in Persons with Transfemoral Amputations: Relationship to Low-Back Pain; R4-Investigation of Ankle Axis Misalignment in Ankle Foot Orthoses Using a Three-Dimensional Model; R7-Enhancing Quality of Prosthetic and Orthotic Services with Process and Outcome Information; and D5-Modeling the Effects of Hip Joint Stiffness on RGO Assisted Gait with a Novel Lower Limb Paralysis Simulator (LLPS)**. Attendees responded with interest to these presentations.

Johnson Presents Talk about RGO



BJ Johnson, MS, spoke about his research modeling RGO gait at a meeting of the IEEE. (Photo courtesy M.Major)

William Brett (BJ) Johnson, MS, and **Matthew Major**, PhD, attended the 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society from August 30 to September 3 in Boston, MA. Mr. Johnson presented a podium talk *“Modeling the Walking Patterns of Reciprocating Gait Orthosis Users with a Novel Lower-Limb Paralysis Simulator”* (co-authors S. Fatone and S. Gard) in the Mechanics of Locomotion and Balance session.

NUPOC in the NEWS

NUPOC: “...a college program that will pay the bills after graduation.”

Mother Jones, 2011

The publication, *Mother Jones*, identified NUPOC as a college program that will “pay the bills after graduation”. The article names Prosthetics and Orthotics at NUPOC one of the “top-notch degree programs in fields that are cool and practical: According to the Bureau of Labor Statistics, these...industries are on a hiring spree and show no signs of stopping.” (Read *“Campus Confidential-Get a Job”* by Gavin Aronsen and Jaeah Lee, Mother Jones, September/October 2011:18.)

Thesis Defenses



Desmond Masterton, CO, CPed, Director of Orthotics Education, completed his Masters of Science in Education and Social Policy from Northwestern University on June 17, 2011. The title of his thesis is *“Predictors of Student Success in a Blended Learning Program”*.

Sean Wood successfully defended his BS/MS thesis titled *“Vacuum Pump Characterization and Development”* at NUPOC in the Childress Commons on August 1, 2011. His project was funded by the Department of Defense project, **Development of Subischial Prosthetic Sockets with Vacuum-Assisted Suspension for Highly Active Persons with Transfemoral Amputations** (Principal Investigator **Stefania Fatone**, PhD). NUPOC Executive Director **Steven A. Gard**, PhD, was a member of Mr. Wood’s defense committee.

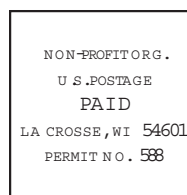


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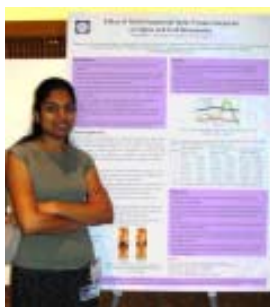
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NUPOC Posters at MRS Training Day



Dr. Gottipati was one of three NUPOC researchers who participated in the MRS Training Day.

NUPOC presented posters at the 1st Annual Movement and Rehabilitation Sciences (MRS) Training Day on August 23. This event featured research in movement and rehabilitation sciences at Northwestern University and affiliated institutions. The MRS Training Day is sponsored by three NIH funded training grants that include students, postdoctoral fellows, and investigators from various centers and departments.

NUPOC posters were: *“Effect of Multi-segmental Spine Fusion Surgeries on Spine and Gait Kinematics”* by **P. Gottipati, S. Fatone, R. Stine, and A. Ganju**; *“Relationships between Amputee Independent Prosthesis Properties and Gait Performance: A Preliminary Study”* by **M. Major, M. Twiste, L. Kenney, and D. Howard**; and *“Spinal Motion during Walking in Persons with Transfemoral Amputation with and Without Low Back Pain”* by **A. Rodriguez, R. Stine, and S. Fatone** (first author indicates presenter).

NUPOC’s Ziegler Receives Travel Award



Ms. **Jacqueline Ziegler** (NUPOC 2009, 2011) has received the **2011 Larry Lange Travel Fellowship Award**. This annual \$2000 award was developed in 2007 to honor Larry Lange, CPO, FAAOP, who diligently served patients and national O&P organizations for 27 years. These funds provide professional and educational opportunities to new practitioners in prosthetics or orthotics (P&O).

Ms. Ziegler is completing her orthotics residency at Children’s Memorial Hospital (Chicago). In April 2012, Ms. Ziegler will use the award to travel to Haiti, where she will conduct humanitarian P&O care under the direction of **Al Ingersoll**, CP, Director P&O Program, **Healing Hands for Haiti**.

Apply for the 2012 Larry Lange Travel Fellowship Award: www.ncope.org/larry_lange_fellowship/. Learn more about Healing Hands for Haiti: www.healinghandsforhaiti.org/.