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On-site Practicum Ensures NUPOC's Continued Excellence

Northwestern University Prosthetics Orthotics Center (NUPOC) will continue to teach the P&O practicum and cadaver anatomy on campus, even after the February 2007 shift to blended learning (See *Capabilities*, Volume 14, Number 4, 2006). To preserve the importance of one-to-one instruction and attention to detail, students will attend the practicum and cadaver anatomy on-site, after they learn didactic material via internet. Prosthetists, orthotists and prospective students can be confident that NUPOC's balanced blend of on-site and distance education means continued excellence in P&O education.

Prospective students, as well as already established prosthetists and orthotists, can feel confident that NUPOC's balanced blend of on-site and distance education means continued excellence in P&O education.

"Raise your hand if you know how to make an ischial containment socket. Now, raise your hand if you can make one that fits! OK, let's learn how to make sockets that fit!" This might be a speedy preamble to the Practicum for Transfemoral Prostheses. Recently, *Capabilities* shadowed NUPOC instructors and observed various stages of the lower limb practicum. The practicum emphasizes application of theory, interaction with patients and working with one's hands. Ultimately, it prepares students to pass the American Board for Certification (ABC) exams.

During six intensive weeks, students create ischial containment sockets for three different patient models with transfemoral amputation. The prosthetics students already have completed anatomy, kinesiology, pathology, normal and pathological gait, biomechanics, and materials science. Energy and enthusiasm filled the laboratory as prosthetics students applied their knowledge and skills to fabricate ischial containment sockets for transfemoral prostheses.

So, how does one build an ischial containment socket? The short answer is: with science, art, hard work and painstaking care. In fact, the process is intricately complex, requiring interaction among students, instructors and volunteers referred to as "patient models." These volunteers are vitally important to the process because students can improve their abilities to communicate, evaluate and fit patients. NUPOC is deeply appreciative of these volunteers' time and patience. Students interview their volunteer and assess tissue quality, muscle strength and range of motion of the residual limb. Finally, based on anatomical landmarks, they take a series of measurements of their volunteer's residual limb.

Students begin the impression process by applying a casting sock to the residual limb and wrapping plaster-impregnated bandages around it. The plaster cast forms a negative impression of the residual limb. Next, they fill the negative impression with plaster to create a positive cast of the residual limb. During model rectification, students cut, scrape and shave the cast to correspond to the detailed measurements of their volunteer's residual limb. Throughout the process, NUPOC instructors

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supervise each student.

In the NU Prosthetics Laboratory, students worked in engrossed concentration at each fabrication station. Intently, they measured, pared and sanded the plaster casts of residual limbs. Instructors **Mark Edwards**, MHPE, CP, Thomas **Karolewski**, CP, FAAOP, and **Robert Lipschutz**, CP, moved briskly through the lab evaluating each student's work. Mr. Karolewski explained to **Kate Kopriva** (Hollidaysburg, PA) how to change specific planes and angles on her cast so they would match the patient's measurements. Tempering his exacting instructions with a smile and good-humored encouragement, Mr. Karolewski briskly penned hatch marks onto the model. Skillfully and precisely, he demonstrated how to re-form a difficult area using nippers, a round sureform and a Scarpa's knife.

Thomas Karolewski, CP, FAAOP (left) instructs NUPOC student **Kate Kopriva** (right) during her prosthetics practicum at NUPOC.

At another table, **Russ Shackson** (Brighton, MI) carefully shaved a thin layer from his model, smoothly sculpting the three-dimensional shape into anatomical verisimilitude. Russ has a degree in sports medicine with training in mathematics and business. Also, he forges ornamental ironwork and sells his original art. Russ listened and watched attentively as Mr. Lipschutz examined his work. With a sure touch, Mr. Lipschutz ran his hands over the cast, compared it with the patient's measurements and advised Russ to rebuild an area. Resuming his work, Russ noted, *"Our volunteers are helpful and we learn from them as well as from our instructors. They have a lot of experience with prostheses. Also, they are good role models."*

NUPOC instructor, **Thomas Karolewski**, CP, FAAOP, shows a student how to reshape a difficult area using a round sureform.

After instructors approve each positive cast, students create the check socket by vacuum forming. Wearing heat-proof gloves, each student works with an instructor to drape a hot (385 degrees Fahrenheit), flexible sheet of clear polypropylene (Vivac) over the distal end of the cast. Gravity pulls the polypropylene down to the base of the positive mold. Students gently press the pliable plastic around the plaster cast while a compressor removes air between the plaster and the plastic. When the plastic cools, it hardens and becomes a transparent "check socket." After removing the check socket from the plaster cast, students use acetylene torches to flare and grinders to smooth the edges.

Russ Shackson rebuilds an area on his cast.

Finally, students fit the plastic check socket to their volunteer's residual limb. Instructors and students examine the residual limb through the clear plastic socket to determine whether forces are distributed appropriately within the socket. Blanching of the skin indicates too

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tight a fit, while air gaps between the skin and the plastic socket show laxity of fit. Appropriate distribution of patient's weight (forces) determines a well-fitting prosthetic socket. When necessary, students make modifications to the socket, or create a new vacuum form.

Bench alignment and dynamic alignment are the next stages in the process. Bench alignment is conducted in the laboratory where students attach components to the check socket: knees, pylons, and feet with shoes. Adjusting the external rotation of the knee and the flexion of the socket, they squint at reference points behind their plumb bob. At last, they complete their bench alignment according to their manual: *"With the foot level and pylon vertical, the alignment reference line should fall 0-5mm anterior of the pivot axis."* Dynamic alignment requires the volunteers to don their prosthesis and walk. Instructors inspect every angle and point of contact while the patient models walk and students refine the alignment of the prosthesis.

NUPOC's prosthetics practicum culminates in a clinical critique that is conducted before a panel of instructors and all students. Students conduct their presentations in an expectant, attentive atmosphere. One by one, volunteers enter and don their student-constructed prostheses. While volunteers walk between parallel bars, instructors and students carefully observe each individual's gait. Instructors, student and subject evaluate the fit and alignment of each socket and prosthesis, concluding with suggestions for improvement.

Shadowing Mr. Edwards, Mr. Karolewski and Mr. Lipschutz as they instructed students brought home the importance of NUPOC's hands-on prosthetics practicum that will continue to place its graduates at the forefront of technological advances and well-tested clinical practices.

From February 2007, NUPOC didactic material will be delivered via internet, but the hands-on portion of the P&O program will continue to be taught on-site. This blend of distance and on-site education guarantees that prosthetists, orthotists and prospective students can rely on NUPOC's continued educational excellence.

~ R. J. Garrick, Ph.D.~

"Our instructors are golden. I've learned so much!"

Nydia Marzan-Harding talks about her experiences as a student at the NUPOC prosthetics program.

Polishing the plaster cast with wet felt sandwiched between two fine screens, **Nydia Marzan-Harding** (Puerto Rico) reflected on her experience in the NUPOC prosthetics practicum.

"I really like this work. Our instructors are golden. I've learned so much! I've been accepted in the Orthotics Course and I'm looking forward to taking it next term. I have a degree in mechanical engineering, but this was my first experience with cadaver dissection. I really want to take that part of the practicum again. You never get such a special look inside the human body. It is so important! Now, whenever I move my hand, I observe it differently than before. I think, 'Wow! I know what is under my skin and what moves each finger!'"

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