BY LIA DANGELICO

Striding Past "Status Quo"

Veteran and active-duty military amputees inspire innovation in patient care and prosthetic design

In the 11 years spanning wars in both Afghanistan and Iraq, more than 1,500 American combat soldiers have suffered major limb amputations, and almost 500 have experienced multiple amputations. Eighty-three percent of those individuals have lost one or both legs, according to a recent casualty report from the U.S. Army Surgeon General's Office.

With a steady influx of both active-duty military and veteran amputee patients, the prosthetic industry—from manufacturers and product researchers to prosthetists—has faced unprecedented challenges, as well as unique opportunities for innovation in patient care and prosthetic design.

Specialist Euard Lychik runs in the Austin Army Ten-Miler in 2012

A Common Interest

When they return home, these amputee soldiers receive treatment and rehabilitation at some of the best care centers in the world, including Walter Reed National Military Medical Center (WRNMMC) in Bethesda, Maryland. WRNMMC has a state-of-the-art gait lab, a prosthetic physical therapy program, rehab physicians, and a couple hundred participants who are "not happy with just the status quo," says Mike Corcoran, CP, who has worked with Össur on its Power Knee prosthesis and treats some of WRNMMC's most complex cases, including hemipelvectomy and hip-disarticulation amputees. Some of these patients will evolve beyond just receiving care to partner with clinicians, manufacturers, and product developers to wear and test the latest prosthetic products and technology.

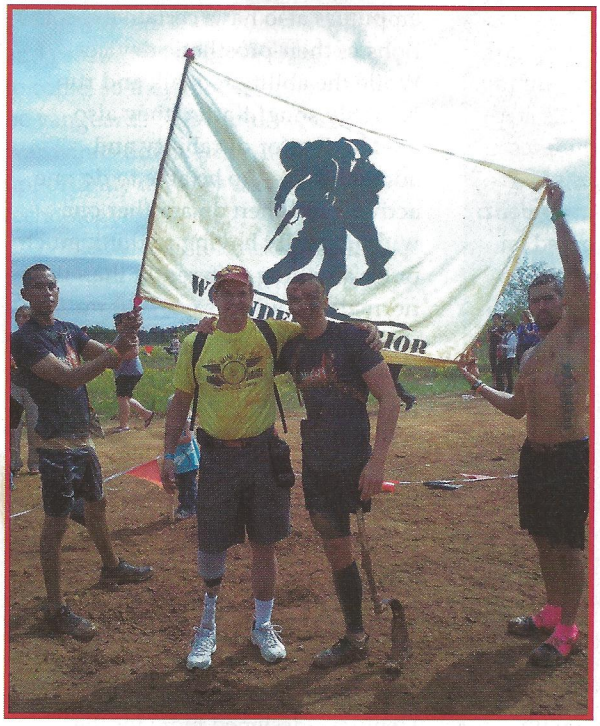
"There is this acute need here at Walter Reed and the other military treatment facilities to try and bring some type of normalcy back to these patients' lives," says Corcoran, "and technology enables us to get there more quickly." For example, powered

devices normalize a transfemoral amputee's gait far quicker than assisted devices and reduce wear and tear on the remaining joints. So, initially fitting that patient with Össur's Power Knee will get him or her up and walking with a reciprocal gait almost immediately. "We've put these guys through the gait lab, and their gait analysis is closer to a normal, intact individual than any other prosthetic device. So we see the benefits immediately," says Corcoran.

Peter Nohre, director of marketing, technical orthopedics and mobility solutions, for Ottobock, works with active-duty military amputees to develop and improve the products that will join the company's offerings. Nohre, who has been working on the development of Ottobock's X3 and Genium offerings since their inception, says sometimes collaboration is initiated just as much by the military as it is by companies looking to create new products. In the case of these products, "this was a need that the military had, and obviously it fit really well with our intentions to create that next generation of microprocessor knees. So it was combining our two projects into one."

Another appealing benefit for companies like Össur, iWalk, Ottobock, and others that conduct product research with military amputees is "access to a large number of patients, being able to try products on a number of them in a short period of time, and receive feedback almost immediately," says Nohre. Unlike the civilian patients who frequently move, military patients often reside at the medical center or on base and remain in one place for a long time.

"Companies have their ears open; they want to partner with us," says Corcoran. Plus, he says, the opportunity gives patients hope, which also helps to mitigate the psychological and emotional effects of losing a limb or multiple limbs. "We can tell them 'Look, you have an effect, an input on what the engineers develop, making these products—and lives—better.'"



Lychik with his prosthetist, Robert Kuenzi, MS, CP

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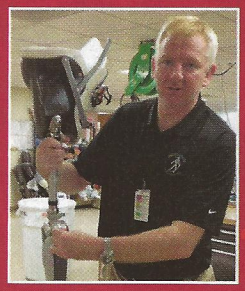

Power Knee

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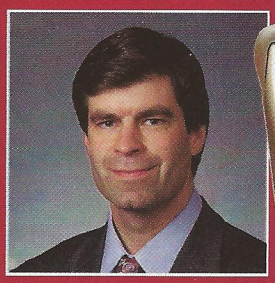


—Peter Nohre

Vanguards of the Future

Even after their service and sacrifices, these amputee patients are willing to bring their insight and feedback to the table when it comes to prosthetic advancements. "A large percentage of them have lost more than one limb. Some of them are double, triple, quadruple amputees," says Corcoran, "so providing more efficient prosthetic knees, feet, hip joints, powered knees, and ankles—there's a great need for that technology in this patient population."

As most were wounded in combat, these patients tend to be young, aged 19 to 40, but the average is mid-20s or younger. Most are in good physical shape, and they are not afraid to try new technology. "They're soldiers, they've been shot at," says Corcoran. Consequently, they don't see falling on the ground while practicing with a device as dangerous, whereas an older diabetic amputee or a vehicular trauma patient might have some reservations. "So that attitude makes these guys the best candidates, not only to take chances, but to observe and give feedback."

This patient population also is extremely motivated, which is a major benefit, says Nohre. "It's a progressive mindset of patients and clinicians to try anything for the sake of trying to get something that's the best."

That level of patient motivation often drives prosthetists to think outside the box when it comes to patient care. And that was the case when Robert Kuenzi, MS, CP, of the Center for the Intrepid in San Antonio, met U.S. Army Specialist Eduard Lychik, a hip disarticulation patient who was injured on duty in Afghanistan in the fall of 2011. From their first meeting, Lychik was emphatic that he wanted to run, despite the fact that there was little to no precedent for making a running prosthesis for a hip disarticulation patient. He began walking in December of 2011, and walked 300,000 steps in just six months. So Kuenzi began piecing together several different components—"I got more of a hinge hip joint and decided not to include an articulating knee," he says. But after Lychik started running, he wanted to be able to run instead of skip as most amputee runners do, so Kuenzi took the hip joint out, too. Within the first two weeks of running, Lychik was able to run one mile step-over-step in just over nine minutes.

Creating Lychik's prosthesis has "really been an evolution," says Kuenzi, who engineered the device based on Lychik's feedback and Kuenzi's own knowledge of prosthetic principles. He used plaster casting to create an intimate-fitting socket that enables Lychik to take a more natural step. "It's not one of these low-profile or suction designs," he says.

Lychik has completed a Tough Mudder, an Army Ten-Miler in 1:38 without stopping, and most recently, the Rock and Roll San Antonio Half Marathon in 2:09. Next up, he has set his sights on another half-marathon in Hawaii—all less than a year from when he first began walking with a prosthesis.

"He pretty much forced me to do [the work] and I'm glad about that," says Kuenzi.

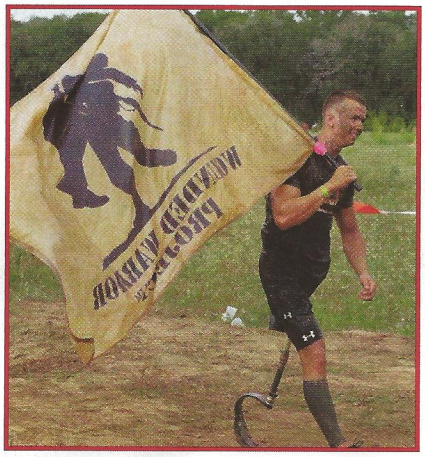
The "Trickle Down" Effect

Working with military amputees also comes with challenges, especially when the intent is application for the general population. These patients are prone to "pervasive damage to the body, and residual effects that affect fitting and quick, positive outcomes," says Corcoran. "Sometimes the body doesn't respond … and there is a plethora of other issues going on—family, relationship, confidence. There is a lot of coming to terms with limb loss and body image involved."

The young, fit, and active nature of the military population is not quite an accurate reflection of the overall amputee population at large, says Nohre. "Most civilian amputees are mobility grade 3, 2, or 1, while these military individuals are gait level 3 or 4. If a product is going to be used for the larger population as well, there's still some consideration [as] to how to adjust to the lower activity levels of the majority."

As with any patient, military amputees also have certain expectations of their prosthetic devices. While the ability to walk and run is highly sought-after, they also are looking for durability and adaptability—"to be able to do one activity and then do another one without really having to think much or do anything differently than they normally would," says Nohre.

That feedback guided the development of Ottobock's X3 and Genium products. Both products are the result of a seven-year development program from the Military Amputee Research Program, sponsored by the U.S. Army Medical Research and Materiel Command, to make a suitable prosthetic device for transfemoral military amputees who wish to remain on active duty. The "final deliverable" is now identified as the Genium—designed more for the civilian population—and the X3, which



Lychik carries the Wounded Warrior Project flag in a Tough Mudder competition

features a running mode for serious, long-distance running, and is fully waterproof and sealed. "It's a big jump forward in order to take an electronic microprocessor-controlled device under water, a big hurdle to cross," he says. It's that level of adaptability—to easily transition from a run on the beach, to a swim in the ocean—that amputee patients requested from this project and ultimately received.

But creating the right device and fitting these patients isn't the end of care, says Corcoran: "They are going to be members of the community and prosthetics users for many years to come, so they can essentially be vanguards of the future. As the war winds down, this window of opportunity to really drive prosthetic technology is closing."

While the goal for these prosthetists, researchers, and manufacturers is to improve the quality of life for their military patients, their work also is intended to benefit the greater good. "These patients have sacrificed life and limb," says Corcoran, "and that accentuates the need to bring prosthetic advancements, but it also trickles down to civilian amputees."

Although the majority of civilian amputees are not pursuing long-distance running or swimming, says Nohre, "it's safe to assume that if it is bringing clinical benefit to the user—who is highly active—some of that is going to translate to virtually every amputee, no matter what their mobility level."

Success becomes more about the degree to which the user will be able to use the device's features. This also is why therapy becomes such an important aspect of the fitting process, so patients, both military and civilian, can be taught and practice how to use all of the different features. Taking a cue from military medical centers that have developed significant physical therapy protocol, several manufacturers have developed therapy protocols to accompany their more advanced products.

The progression of care is another benefit to civilians. "We are able to fit civilian trauma patients more quickly with better prostheses initially, like the Power Knee," says Corcoran, "and that would never happen if we didn't have the experience of fitting a brand-new amputee with a powered device."

It may happen with military patients first, but "the technology that's developed from the military, and all the testing and projects from all sorts of companies, does go on to the civilian market as well," says Nohre. "It spurs innovation and helps a broader group—it helps everyone." O&P

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