Prosthetics and Related Technology for Restoring Veterans' Abilities

DISCOVERY — INNOVATION — ADVANCEMENT

PROSTHETICS AND RELATED TECHNOLOGY

VA Research and Development program is answering the call from Veterans who rely on prosthetic devices and related technology to perform day-to-day activities.

Veterans Health Administration
Research & Development
Improving Veterans' Lives — www.research.va.gov

A Message to Our Veterans

VA Research and Development Program:
Prosthetics and Related Technology for Restoring Veterans' Abilities

A top priority for VA is providing state-of-the-art prosthetic care for Veterans. Some have lost limbs from explosive blasts or other combat traumas, and others have needed amputations because of complications from diseases such as diabetes. To meet the lifestyle and medical needs of these Veterans who have lost the use of a limb, specialists in the VA Research and Development program are continually modernizing the materials and design of artificial limbs—moving toward more lifelike performance and minimized chance of mechanical failure.

Replacing lost limbs with more realistic and higher-functioning prostheses is just one way the VA Research program is helping to restore Veterans' capabilities. VA Research and Development specialists are working on numerous technologies to meet the diverse needs of Veterans with disabilities—for example, progressive wheelchairs to restore independence, hands-free computers with voice recognition, artificial retinas, and modern aids to restore hearing and other senses.

Nearly 1.5 million Veterans sought prosthetics-related care from VA over a recent one-year period. This brochure highlights the many forms of rehabilitation that these Veterans require, and introduces the VA Research program's broad spectrum of advances in prosthetics and related assistive devices to address these health care needs.

Joel Kupersmith, M.D.
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Spotlight on VA Research

In its longstanding role as a world leader in prosthetics research, VA's research program supports a broad portfolio related to amputations and prosthetics. In addition to continually developing improved materials and designs for prostheses, VA investigators are working to identify the best match for Veterans' prosthetic needs by collecting information such as how various prosthetic devices are used and how satisfied users are with each type.

Among those receiving prosthetics-related care in the VA system are many of the estimated 6 percent of wounded service members returning from Iraq who have lost a limb, and many other Veterans whose amputations were necessitated by diabetes, peripheral vascular disease, and other disorders. The total number of Veterans accessing VA health care for prosthetics, sensory aids, and related services has increased by more than 70 percent since 2000.

Developing More Lifelike Artificial Limbs

VA researchers constantly strive to improve the construction of prostheses, using leading-edge technologies such as robotics, tissue engineering, and nanotechnology to create lighter limbs that closely mimic their natural counterparts. The integration of body, mind, and machine is a major guiding principle as VA specialists design and build artificial limbs that look, feel, and respond like natural arms and legs.

Important areas of VA research on amputation and artificial limbs include:

- **Introducing the first powered ankle-foot prosthesis, which thrusts users forward with tendon-like springs and an electric motor.** The prototype, developed collaboratively by VA researchers with researchers at MIT and Brown University, has shown important benefits in early studies—among them, patients expended less energy during walking, had better balance, and walked 15 percent faster.

Garth Stewart, a 24-year-old Army veteran who lost his left leg below the knee while serving in Operation Iraqi Freedom, is pictured with Hugh Herr. Dr. Herr says of walking with the new powered ankle-foot prosthesis, "It's wild—like you're on one of those moving walkways in the airport."

Garth Stewart (left) pictured with ankle-foot prosthesis developer and double amputee **Hugh Herr**, Ph.D., MIT Media Lab Professor and VA-affiliated investigator.

Bruce J. Sangeorzan, M.D., Director of the VA Center of Excellence for Limb Loss Prevention and Prosthetic Engineering, received the 2007 Magnuson Award—an award presented annually to a VA Rehabilitation Research and Development investigator who exemplifies entrepreneurship, humanitarianism, and dedication to Veterans. Dr. Sangeorzan's research is focused on preserving the lower limb and better understanding the deformities that lead to foot ulcers to improve the quality of life of Veterans who might otherwise undergo amputation.

- **Studying how to best match prosthetic components with the needs of amputees,** including those whose active lifestyles call for versatile, high-performance artificial limbs.
- **Investigating different care strategies for residual limbs after surgery,** which may improve understanding of wound care in general and could ultimately reduce the need for amputations. Already, wound healing that used to take weeks or even months can now occur far faster.
- **Developing a family intervention program** to teach service members' spouses alternative and complementary medicine techniques shown to lessen anxiety and pain associated with traumatic limb loss.
- **Evaluating CT scans of diabetic feet** to identify which foot types are at highest risk for the ulcers that often lead to amputation.
- **Studying complex methods of tissue engineering** for addressing tendon loss from military trauma or degenerative arthritis and for regenerating cartilage lost to trauma, disease, or aging.

Using Electrical Signals to Restore Function

More than 40,000 Veterans, and a total of more than 250,000 Americans, have serious spinal cord injuries and disorders that may interfere with brain signals that control muscle movement. Many others have become blind from the loss of "photoreceptors" in the eye. For Veterans with these and some other types of functional loss due to disease or injury, VA investigators hope to restore function with electrical currents delivered through means of a "neural prosthesis."

Important areas of VA research in neural prostheses include:

- **Investigating the use of electrical stimulation,** delivered by devices implanted into the body like cardiac pacemakers, to enable Veterans with varying degrees of spinal cord injury to improve their ability to walk, control the movement of paralyzed limbs for grasping and releasing objects, and manage body functions such as bladder control and respiration.

In a study of 32 chronic stroke patients, VA researchers found that functional neuromuscular stimulation significantly enhanced walking ability. The therapy, which involved delivering small currents to electrodes implanted in weak or paralyzed leg muscles, outperformed other therapies used in the trial, such as body-weight-supported treadmill training or special walking exercises.

Stroke 2006 Jan;37(1):172-8.

VA researchers and colleagues are working toward restoring vision for Veterans with such conditions as macular degeneration—the leading cause of blindness in the industrialized world—by means of a microelectronic implant in the eye. The implanted device delivers small pulses of electricity to the retina with the goal of restoring some vision to patients with certain forms of retinal blindness.

Source: Boston Retinal Implant Project, funded in part by VA.

VA Prosthetics Research in the Real World

To ensure that no time is lost translating VA's groundbreaking research into life-improving advances in care, the VA Research and Development program relies on extensive collaboration among basic science researchers, clinician investigators, and rehabilitation specialists. VA has for the last several years conducted a series of "State of the Science—Research to Clinical Practice" workshops in cooperation with the Department of Defense and Walter Reed Army Medical Center on topics such as prosthetics, spinal cord injury, and wheelchair technology.
Upcoming workshops are announced at www.herlpitt.org.

Publishing Advances in Prosthetics

To stay up to date on the latest in prosthetics and rehabilitation care, read VA's international, peer-reviewed *Journal of Rehabilitation Research and Development (JRRD)*. For more than 40 years, this leading research journal has published current information in the field of rehabilitation medicine and technology, including original studies, topic reviews, and commentaries related to amputation, prosthetics, and many other topics. **For more information, go to www.rehab.research.va.gov.**

VA has an integrated delivery system to apply the latest technologies in prosthetics and related devices for their intended benefit: to maximally restore a Veteran's quality of life.

In a single recent year, for example, VA specialists provided about 150 Veterans with a "C-Leg," a sophisticated computerized leg that allows people with amputations above the knee to walk in a more natural way.
At Walter Reed Army Medical Center, VA's vocational rehabilitation and employment program has provided voice-recognition computers so OEF/OIF Veterans who have lost a hand can effectively use computers without having full typing capability.

The goal of VA prosthetic care providers goes far beyond teaching a patient with an amputation to walk or use an artificial arm.
Support for independent living can even extend to home improvements and adaptive equipment for the cars of Veterans with amputations or other service-connected disabilities. Long-term care and support from VA care teams have been shown to help some patients continue to improve their functioning months or even years after their injuries.

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