
Photo by Robert Turtil

VA research on

PROSTHETICS

To help meet the lifestyle and medical needs of Veterans who have lost limbs, VA researchers develop and test a wide variety of prosthetic devices. VA's goal is to offer Veterans prostheses that will restore them to their highest possible level of functioning within their families, communities, and workplaces.

ABOUT PROSTHETICS

• VA's Prosthetics and Sensory Aids Service is the largest and most comprehensive provider of prosthetic devices and sensory aids in the world. Although the term "prosthetic device" may suggest images of artificial limbs, it actually refers to any device that supports or replaces a body part or function.

• VA's involvement in providing prostheses to Veterans began in 1921, when the Veterans Bureau, a predecessor agency to the Department of Veterans Affairs, was given the responsibility to provide artificial limbs and appliances to World War I Veterans.

• VA provides a full range of equipment and services to Veterans. These range from items worn by the Veteran, such as artificial limbs and hearing aids; to those that improve accessibility, such as ramps and vehicle modifications; to devices surgically placed in the Veteran, such as hips and pacemakers.

• The department has more than 70 locations at which orthotics and prostheses are custom-fabricated and fitted, using state-of-the-art componentry. VA also has more than 600 contracts with accredited orthotic and prostheses providers to ensure access to care is provided near Veterans' homes.

VA RESEARCH ON PROSTHETICS: OVERVIEW

• Some VA researchers are working on developing high-functioning artificial limbs that are very similar to their natural counterparts. Others are working on advanced wheelchair designs that promote mobility and independence for wheelchair users, and make it easier to use a wheelchair.

• Others are using functional electrical stimulation and other technologies to help those with weak or paralyzed muscles, and developing and testing state-of-the-art adaptive devices to help those with vision or hearing loss.

• Many of the latest innovations and discoveries in prosthetics research in the United States take place at VA centers. These centers generally work in close partnership with affiliated universities, , as well as with commercial partners and other federal agencies.

• VA laboratories specializing in prosthetics development include the Advanced Platform Technology Center, in Cleveland; the Center for Functional Electrical Stimulation, also in Cleveland; the Human Engineering Research Laboratories in Pittsburgh; the Center of Excellence for Limb Loss Prevention and Prosthetic Engineering in Seattle; and the VA Center of Excellence for Neurorestoration and Neurotechnology in Providence, Rhode Island.

SELECTED MILESTONES AND MAJOR EVENTS

1947 – Introduced the first mobility and orientation rehabilitation-training program for blinded Veterans

2007 – Unveiled the first powered ankle-foot prosthesis, as part of a team with researchers at MIT and Brown University

2009 – Launched three-year optimization study of the DEKA arm, as clinical partner with DEKA and DARPA

2013 – Reported on new technology to help restore the sense of touch for those who have lost an upper limb and use an artificial hand

2013 – Began the first human study in the United States to investigate osseointegrated prosthetics, in which implants are firmly anchored in place by integrating implanted material in living bone

2014 – Published results of a study on how users and clinicians feel about the DEKA arm, the first prosthetic arm capable of performing multiple simultaneous powered movements

2015 – Invented a wheelchair allowing users to crank up the push rims to a standing position, providing them with increased functionality and independence

2016 – Determined that knee replacement surgery could benefit some patients aged 85 and older

2017 – Won the "Best New Concept" award in an international design competition for the MEBot robotic wheelchair, developed by a VA investigator

RECENT STUDIES: SELECTED HIGHLIGHTS

Most patients do not increase their physical activity levels after total hip or knee replacement, according to a literature review that included a Durham

(Continued on back)

VA Medical Center researcher. Patients often have large reductions in pain and increased physical function and quality of life after total hip or knee replacement. However, the researchers found no corresponding increases in physical activity after six months, and only modest increases after 12 months. The lack of physical activity may be behavioral, since sedentary lifestyle is hard to change, say the researchers. (*Arthritis Care & Research*, June 2018)

Neuroprostheses to allow patients with spinal cord injuries to stand were still functioning and useful several years after being implanted, found a Louis Stokes Cleveland VA Medical Center research team. The researchers followed up with 22 patients with lower-limb neuroprostheses and average of six years after they had the devices implanted. Sixty percent of patients still used their neuroprostheses for exercise and other activities for more than 10 minutes per day. First-generation implants still functioned correctly in 90 percent of patients with those devices. Second-generation implants (with slightly improved technology) still functioned in 98 percent of cases. Overall, 94 percent of the patients were satisfied with the prostheses. (*Archives of Physical Medicine and Rehabilitation*, February 2018)

Functional electrical stimulation improved the walking ability of a patient with multiple sclerosis, in a case study by researchers at the Louis Stokes Cleveland VA Medical Center. The patient had lower-limb weakness and was frequently unable to take a step unaided. Doctors implanted electrodes into the muscles of his hip, knee, and ankle. The electrodes delivered stimulation that helped activate the muscles in his legs. Over a 90-day trial, he was able to consistently take steps with electrical stimulation. The case study shows that implanted electrical stimulation devices could help restore walking in patients with muscle weakness caused by MS. (*American Journal of Physical Medicine & Rehabilitation*, September 2017)

Black Veterans were less likely than white Veterans to undergo knee replacement surgery, according to data from the VA Musculoskeletal Disorders Cohort. Over a 10-year period, rates of knee replacements were much lower for black than white Veterans. Hispanic Veterans had the same rates of knee replacement as white Veterans. This study shows the importance of developing ways to reduce racial differences in Veteran health care usage, say the researchers. (*Arthritis Care & Research*, August 2017)

A self-contained muscle-driven exoskeleton is a feasible intervention to restore stepping in people with paraplegia due to spinal cord injury, found a Louis Stokes Cleveland VA Medical Center study. The device combines implanted neural stimulation to activate paralyzed muscles with a controllable lower-limb exoskeleton to stabilize and support the user. An onboard controller allows the exoskeleton to be used without a tether or outside computer. In the study, three paralyzed patients were able to take independent steps by using the device. (*Journal of Neuroengineering and Rehabilitation*, May 30, 2017)

A paralyzed patient was able to perform reaching and grasping movements with his own arm thanks to implanted neuroprostheses. Researchers with the Louis Stokes Cleveland and Providence VA medical centers surgically implanted brain-computer interfaces into the motor cortex of the patient, along with 36 electrodes in his paralyzed arm. The patient was able to complete acts such as reaching to drink from a mug of coffee and feeding himself using his thoughts. The study is one of the first to use functional electrical stimulation and a brain-computer interface together to restore function to a paralyzed limb. (*Lancet*, May 6, 2017)

A device that varies the stiffness of materials inside a prosthetic socket could be useful to help reduce stress that can lead to soft tissue breakdown and discomfort. Researchers at the VA Center for Loss Prevention and Prosthetic Engineering designed a variable stiffness torsion adapter (VSTA) to be included in lower-limb prosthetic sockets. The stiffness of the VSTA can be adjusted, allowing the prosthesis to adapt to complex movements. Results showed that the device reduced transverse plane moment when participants walked with a prosthesis. This could help protect the soft tissue of the residual limb when users turn or twist while walking. (*Gait Posture*, January 2017)

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