

NIH News in Health

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Bionic Movements Connecting Mind and Machine

When you lose the use of a limb, even the simplest of daily tasks can turn into a challenge. High-tech devices can help restore independence. New technologies are even making it possible to connect the mind to an artificial limb. These artificial limbs are called bionic **prosthetic devices**.

“To get back some of that lost function, you need some sort of assistive tool or technology to either enhance recovery or restore the capability of the anatomy that’s missing now,” says Dr. Nick Langhals, who oversees NIH-supported prosthetic engineering research.

This fast-moving research aims to improve people’s lives by restoring both movement and feeling.



Prosthetic Control • Traditional prosthetic devices use a body-powered harness to control a hand device. These are easy to use. With a shrug of your shoulder, the prosthetic hand or hook opens. With the release of your shoulder, the prosthesis closes. Through the feel of the cable tension across your shoulders, you know whether the prosthesis is open or closed without looking at it.

Newer, motorized hands are not as easy to learn how to use. To close the device, you contract the remaining muscles in your arm. An electrical sensor placed over those muscles detects the

contraction and tells the hand to close. Since the original muscles that controlled the hand are gone, the remaining muscles must be retrained. Learning how to open and close a prosthetic hand in this way takes some time. And you still need to watch the device to know what it’s doing.

To make motorized hands more intuitive to use, researchers are developing ways to detect the electrical signals in your brain and **nerves** to help control advanced bionic prosthetics. This can be done many ways, such as by implanting tiny sensors in the parts of

the brain that control movement or by attaching small **electrodes** to the amputated nerves. Either way, the patients simply think about moving their hand and computers translate it into the movements of a bionic prosthetic hand.

Two-Way Communication • To regain a sense of wholeness, a person with a bionic limb needs to do more

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Definitions

Prosthetic Devices

Devices that replace a body part.

Nerves

Special tissues that carry signals between your brain and other parts of your body.

Electrodes

Tools that are used to carry electricity to or from different parts of the body.

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than control the device. They also need to “feel” what it’s doing. New bionic devices can send sensation from the device back to the brain. This allows a person with a bionic device to feel like they are using their own limb.

“The most important thing about the research that we’re doing is this sense of wholeness,” says Dr. Paul Marasco, a biomedical engineering researcher at Cleveland Clinic.

One way to help a person feel their prosthetic hand is to move the remaining sensory nerves from the amputated hand to the skin of the upper arm. You can then use small robots to press on the skin of the upper arm when the hand is touching something.

Marasco’s team devised a similar system to restore the feeling of movement, too. The bionic hand sends signals to a computerized control system outside of the body. The computer then tells a small robot worn on the arm to send vibrations to the arm muscle. These vibrations deep in the muscle create an illusion of movement that tells

the brain when the hand is closing or opening.

Marasco’s team tested this feedback system with several people who had a hand prosthesis. The study participants were able to operate the bionic hand and know what position it was in just as well as with their natural hand. With this feedback system, they didn’t have to look at the bionic hand to know when it was open or closed, or when it was reaching for an object.

“We fool their brains into believing that the prosthesis is actually part of their body,” Marasco says. This advancement directly taps into the way that the brain senses movement, which helps improve the two-way communication between prosthetic device and mind.

Wearable Robots • Research teams are also trying to help people who have lost the use of their legs. By wearing a robotic device called an exoskeleton, some people with leg paralysis have been able to regain the ability to walk.

A group led by Dr. Thomas Bulea, a biomedical engineer at the NIH Clinical Center, created a wearable exoskeleton for children with cerebral palsy. Cerebral palsy is a brain disorder that makes it hard to stand up straight, balance, and walk. The motorized, robotic exoskeleton changes the way the children walk by helping them straighten their knees at key points during the walking cycle. While the exoskeleton can make walking easier, children must be able to navigate at least small distances on their own to use it.

“The ultimate goal really is to have a person wear this outside of our



Ask Your Doctor

If you’re interested in a clinical study for prosthetic devices, ask:

- Why is the study being done?
- How long will I be in the study?
- What kinds of tests and treatments are involved?
- What are the possible side effects or risks of the new treatment?
- What are the possible benefits?

lab, or even outside of the clinical setting,” Bulea explains. “To do that you have to have a really robust control system that makes sure that the robot is behaving properly in all different kinds of environments.”

The team is now writing software so that the robotic device can be worn while navigating bumps in the terrain and other real-world conditions.

Finding the Right Device • “What I try to emphasize to people is that there are a lot of potential tools and technologies at our disposal to try and make people better, and they should explore them and consider embracing them,” Langhals says.

Many types of prosthetic devices are now in development. If you’d like to find a clinical study to help test one, you can search for one in clinicaltrials.gov, a database of both NIH-supported and other studies around the world.

If you’re interested in taking part in a study, talk with your doctor about the possible risks and benefits. See the Ask Your Doctor box for questions to ask. ■

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Web Links

For more about bionic devices, see “Links” in the online article: newsinhealth.nih.gov/2018/08/bionic-movements

Care and Connection

Loneliness Affects All Ages

Human beings are social creatures. Feeling like we're part of a community helps us thrive. But we sometimes have a hard time making and keeping the relationships that sustain us. Many Americans report feeling lonely for long periods of time. Connections with others are important for your health.

Social isolation and loneliness can both cause problems. "Isolation is about whether other people are physically there or not. Being lonely is about not feeling connected to others. You can feel lonely in a room full of people," explains Dr. Steve Cole, an NIH-funded researcher at the University of California, Los Angeles, who studies loneliness.

Loneliness not only feels bad, it may also be harmful to your health. People who feel lonely are at higher risk of many diseases. These include heart disease, high blood pressure, and Alzheimer's disease. Loneliness may also increase the risk of death for older adults.

Some of the increased risk of disease may come from changes in behavior. People who feel isolated may not have friends or family encouraging them to eat right, exercise, or see a doctor. New research suggests that loneliness can also directly harm our health.

"Lonely people have differences in their biology that make them more vulnerable to disease," Cole explains. He and colleagues have studied how loneliness affects the immune system, your body's disease fighting system. They found that loneliness may alter the tendency of cells in the immune



system to promote **inflammation**. Inflammation is necessary to help our bodies heal from injury. But when it goes on too long, it may raise the risk of chronic diseases.

People who feel lonely may also have weakened immune cells that have trouble fighting off viruses. "So that leaves lonely people more vulnerable to a variety of infectious diseases," Cole adds.

People often associate loneliness with getting older. But you can feel lonely at any age. A recent survey found that young Americans are more likely to feel lonely than older adults. Some research suggests that social media tools and resources are preventing younger people from connecting in real life, Cole says. However, more studies are needed to know whether this is true.

It can be hard for people to talk about loneliness, Cole explains. They may feel like something is

wrong with them, even though feeling lonely happens to almost everyone at some point.

NIH-funded researchers are looking into ways to help people break the cycle of loneliness. Studies have shown that feelings of loneliness can be reduced by helping others, Cole says. Caregiving and volunteering to help others may therefore help people to feel less lonely.

Having a sense of purpose in life may be another way to fight the effects of loneliness. Research has found that having a strong sense of mission in life is linked to healthier immune cells. "And when you start to pursue a goal that's important to you, you almost always have to cooperate with others to do that," Cole says. "That helps bring people together." ■



Wise Choices

Get Involved With Others

Being active in your community and helping others can reduce feelings of loneliness. You can get more involved with others by:

- Serving meals or organizing clothing donations for people in need
- Helping an organization send care packages to soldiers stationed overseas
- Caring for dogs and cats at an animal shelter
- Volunteering to run errands for people with disabilities
- Helping with gardening at a community garden or park
- Volunteering at a school, library, museum, or hospital

Definitions

Inflammation

Heat, swelling, and redness caused by the body's protective response to injury or infection.



Web Links

For more about loneliness, see "Links" in the online article: newsinhealth.nih.gov/2018/08/care-connection



Health Capsules

For links to more information, please visit our website and see these stories online.

Caring for Concussions

A study found that many people treated for a concussion may not receive follow-up care that could improve their health.

A concussion is a mild brain injury. It results from a bump, blow, or jolt to the head. Most people recover quickly from a concussion, but some have symptoms for weeks or months.

A concussion may give you a headache and make you feel confused, tired, or dizzy. You may have nausea and may vomit. You may feel groggy and have a hard time thinking and remembering. Your vision may be blurry. You may also have trouble sleeping or mood changes. Getting

treatment is important for recovery from any brain injury.

A research team wanted to find out if people were getting follow-up care after a concussion. Their study included more than 800 people diagnosed with a concussion in an emergency department. They asked patients if they received educational materials about concussions when leaving the hospital, if the hospital called to check up on them, and if they'd seen a health care provider since going home.

About 42% said they'd received educational materials when leaving the hospital. Only 27% received a follow-up call from the hospital.

Within 3 months of their injury, only 44% had seen a health care provider. People with severe symptoms were more likely to seek care. But only about half of people with at least 3 significant and persistent concussion symptoms sought care within 3 months of the injury.

“Even in the best trauma centers in the country, patients with concussion are not getting the follow-up care they desperately need,” says researcher Dr. Geoffrey Manley of the University of California, San Francisco. “For too many patients, concussion is being treated as a minor injury.” ■

Preventing Shingles

Did you ever have chickenpox? If so, you're at risk for getting a disease called shingles. About 1 out of every 3 people will get shingles at some point in their lives.

After you've had chickenpox, the virus becomes inactive and hides in your body. Shingles is caused by the virus becoming active again, but its symptoms can be much more severe.

Burning, itchy rashes and blisters may appear on one side of your body or face. You might also feel fatigue, fever, headache, or an upset stomach.

The rashes and blisters can take 3 to 5 weeks to heal. However, the pain could last much longer. It's possible to get shingles more than once.

As you get older, your risk for getting shingles grows. Shingles most

commonly occurs in adults over 50, but it can appear at any age.

There are now two shingles vaccines approved by the U.S. Food and Drug Administration (FDA) for people over 50. They can help prevent shingles or lower the extent of the effects it may cause.

Learn more about shingles at www.nia.nih.gov/health/shingles. ■



Featured Website

Palliative Care: Conversations Matter

www.ninr.nih.gov/conversationsmatter

Children who are seriously ill need a lot of support. And so do their parents and siblings. Palliative care treats the discomfort, symptoms, and stress of serious illness.

Find videos and other resources on how palliative care can help you and your family on the new “Palliative Care: Conversations Matter” site.



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