

July 2013

Healthy Movements

Your Body's Mechanics



Think about all the movements you do every day: walking, climbing stairs, typing, turning doorknobs and lifting. Your bones, muscles and joints all work together to make your body an amazingly movable machine. Like any machine, your body can suffer some wear and tear. It needs regular care and maintenance to keep moving with ease.

Scientists are studying the mechanical movements of our bodies to help us be as strong, flexible and mobile as possible throughout our lives. This type of research is called biomechanics. These studies are finding that the way you move—including walking, standing and bending—can affect your future mobility and overall health.

“All systems, whether in traditional mechanics or in the human body, are governed by the same basic physical laws,” says Dr. Jeffrey Weiss, a biomechanics expert at the University of Utah. Body movements involve force, balance, gravity and motion. “Biomechanics is effectively applying the physics of mechanics to problems in biology and medicine,” Weiss says.

The main moving parts of your body include the solid bones, the joint tissues that link bones together, and the muscles that attach to your bones. Your body has about 200 bones and more than 600 muscles. These parts all work together to help you move throughout the day.

NIH-funded studies of biomechanics have already led to better ways to prevent muscle and joint injuries in kids during sports and play, and to help older people stay more mobile and independent. Some researchers are working to develop better artificial joints. Others have devised improved treatments for movement disorders such as cerebral palsy and Parkinson’s disease.

Joints are a common source of problems and pain. Some joints, such as your shoulder joint, can move in many directions. But others, like your knee joint, can only bend one way. Any movements outside a joint’s natural range might cause injury.

Dr. Timothy Hewett, head of sports medicine research at Ohio State University, has long studied a part of the knee joint known as the ACL (or anterior cruciate [ligament](#)). The ACL connects the thigh bone to the shin bone. When it stretches or tears, some people hear or feel a “pop.” Athletes who need to make sudden stops or quickly change direction—as in basketball, tennis and soccer—are at risk for damaging the ACL.

Hewett and other biomechanics researchers use “motion capture” tools to study how people move. Reflective markers—about the size of coins—are attached to the skin or clothing over people’s joints and muscles to make it easy to visualize their movements on a computer screen. A series of cameras around the lab can then track how people run, jump, walk and twist. Feeding these data into computers allows scientists to create 3-D animations of full-body motions. It’s the same type of technology used to make animated characters in Hollywood movies, such as *Shrek* or *Avatar*.

“Using the tools of biomechanics, we can tell what’s normal and what’s abnormal in movement, and we can measure the forces on the body,” Hewett says. “We use biomechanics as a screening tool to figure out which athletes are at greater risk for injury and why.”

Hewett and his colleagues have identified certain movements that make some people more likely to get ACL injuries. For instance, athletes who allow their knees to collapse inward when landing from a jump are at risk for ACL tears. Once at-risk people are identified, coaches and physical therapists can develop exercises to help them strengthen certain muscles and learn to land and pivot in healthier, safer ways. “We’ve shown that we can use this information to reduce the relative risk of an ACL injury by 60-65%,” says Hewett.

Motion-tracking tools are also being used to learn how older people might avoid injury from falls. Dr. Clive Pai, a physical therapist and researcher at the University of Illinois at Chicago, explains, “We’re studying how older adults can learn to modify their movements to adapt to an unexpected environment, such as a slippery floor.”

Falls are serious at any age, but especially for older adults, who are more likely to break a bone. Each year, more than 1.6 million older Americans go to emergency rooms for fall-related injuries. “Falling causes a lot of suffering and is a huge problem for society,” says Pai.

Exercises that improve your balance and strengthen your muscles can help to prevent falls. Pai and his colleagues have also found that people can be trained to avoid falls if they practice walking over unstable—but safe—surfaces in the laboratory. “People age 65 and older can adapt and remember remarkably well how to keep their body posture upright when disturbances occur in the environment if they’ve encountered similar situations 2 or 3 times before,” Pai says.

Biomechanics can also be used to guide treatments for movement problems. Weiss uses computer models to look at how hip joints are stressed when someone walks or travels up and down stairs. He’s analyzing both normal hips and those with a condition called hip dysplasia. “Hip dysplasia produces an instability that can lead to early onset of **arthritis** over time,” Weiss says. Eventually, these computer models might help doctors choose appropriate treatments and figure out which patients could benefit from surgery.

People with cerebral palsy, Parkinson’s disease and multiple sclerosis could also benefit from biomechanical analysis. “We use motion tracking to look at how well these patients are walking and what might be wrong, so we can try to do something about it,” says Dr. Diane Damiano, a physical therapist who heads biomechanics research at the NIH Clinical Center in Bethesda, Maryland. “We focus on helping patients to strengthen their muscles and work to improve their balance and coordination. We’re also looking at brain activation while they’re moving. That can give us clues to how these movements are controlled by the brain.”

Muscle strengthening and proper joint alignment are important for just about anyone who wants to stay flexible and mobile. “The bottom line is that everybody needs to be active,” Damiano says. “We want to make it so that all people can move better, regardless of their age or health condition.”

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Creating Healthy Habits

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You're Never Too Old

Wise Choices

Body Maintenance

- Maintain a healthy weight. Too much weight can make your knees and hips ache.
- Engage in muscle strengthening (resistance) activities that involve all your major muscle groups 2 or more times a week.
- Stay active all week long. Aim for 150 minutes of moderate intensity activity a week, such as brisk walking.
- Wear comfortable, properly fitting shoes.
- Eat a well-balanced diet. Get enough calcium and vitamin D daily to protect your bones.
- Try to avoid lifting heavy objects. If you need to lift something heavy, bend your knees and keep your back straight.

Links

- [Arthritis](#)
- [Feeling Out of Joint](#)

- Exercise and Physical Activity
- Sprains and Strains
- Knee Problems
- Cerebral Palsy: Hope Through Research
- Back Pain

NIH Office of Communications and Public Liaison

Building 31, Room 5B52

Bethesda, MD 20892-2094

nihnewsinhealth@od.nih.gov

Tel: 301-451-8224

Editor: Harrison Wein, Ph.D.

Managing Editor: Tianna Hicklin, Ph.D.

Illustrator: Alan Defibaugh

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