

# Research shows how a stroke affects hand function

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BETHESDA, Md. (June 15, 2009) A person whose hand function has been affected by a stroke can release an object more quickly when the affected arm is supported on a platform, but the support does not make it easier to grip the object, according to a new study. The study also found that active muscle-stretching exercises improved how quickly the stroke survivor could grip an object, but made release of the object more difficult. These findings show how a stroke affects hand function, and provide a roadmap for rehabilitation.

Stroke is a leading cause of long-term disability among American adults. People who have suffered strokes often experience hand impairment, including significant delays in how long it takes to grip and release objects. This study included 10 people who had hand impairments from a severe stroke that had injured one hemisphere of the brain but not the other.

The study, "Delays in grip initiation and termination in persons with stroke: Effects of arm support and active muscle stretch exercise" appears in the online edition of the *Journal of Neurophysiology*. The authors are Na Jin Seo, William Z. Rymer and Derek G. Kamper, of the Rehabilitation Institute of Chicago. Dr. Rymer is also affiliated with Northwestern University, and Dr. Kamper with the Illinois Institute of Chicago.

In this study, the authors wanted to quantify the time needed to:

- grip an object with the hand directly affected by the stroke (the paretic hand) and the non-paretic hand (the unaffected hand controlled by the uninjured hemisphere)
- release an object with both the paretic and non-paretic hands

They also wanted to determine the effect that:

- a device that supports the arm has on grip and release times
- stretching exercises for the hand and finger muscles has on grip and release times

## Experimental design

The study included 10 people with severe hand impairment because of a stroke. The study also included five healthy people as controls.

The study participants sat in front of a cylinder that they gripped as quickly and as strongly as they could when they heard an auditory signal. The researchers instructed them to release the cylinder as quickly as they could when the signal stopped. The researchers recorded grip initiation and release by using an electromyogram, which detects muscle activity.

The study found that the speed of grip and release was impaired in both hands for those who suffered a stroke, even though only one hemisphere of the brain had been injured. They found that:

- Stroke survivors could grip the cylinder much more quickly than they could release it. The paretic hand took 1.9 seconds to grip the cylinder but required 5 seconds to release it. In comparison, the healthy controls took 0.2 seconds to grip and 0.4 seconds to release.

- The study also found that the non-paretic hands of the stroke survivors had been affected, although not nearly as much as the paretic hand. The non-paretic hand took 0.5 seconds to grip and 1.6 seconds to release.

The researchers also looked at grip initiation and grip termination when the stroke survivors used a device that supported the arm on a platform, leaving the hand free. They found that the device helped stroke survivors release the cylinder more quickly. With the device, they were able to reduce the delay in grip termination by 37%. The device made no significant difference in the time needed to initiate the grip.

The assistive device compensates for gravitational forces, thereby supporting the weight of the arm and permitting relaxation of the muscles of the arm and shoulder. This allows the stroke survivor to more easily control the muscles of the fingers, wrist and hand, Dr. Seo said. She also noted that a special device may not be necessary. Supporting the paretic arm with the non-paretic arm, or using a table to support the arm, may do just as well.

The researchers also tested grip and release following 30 minutes of hand, wrist and finger muscle stretching exercises. They found the muscle stretch exercises helped stroke survivors grip the cylinder more quickly, but it further delayed time to release. The stretches reduced delay in grip initiation by the paretic hand by 32% but increased delay in grip termination by 24%.

The researchers hypothesize that the exercises activate muscles, making it easier to grip but more difficult to relax the muscles, which makes it harder to release. The stroke survivors performed the grip-and-release trials shortly after the muscle-stretching exercises. It is possible that the negative effect on release could be reduced if there was a greater time

interval between the stretching and the grip and release task, Dr. Seo said. She recommends further research on this question.

In addition, according to Dr. Seo, these therapies may help improve hand function:

- **Active-passive bilateral therapy.** In the healthy brain, the hemispheres work together to respond to stimuli and coordinate movement. When one hemisphere of the brain suffers injury from a stroke, it upsets the balance between the two hemispheres. Active-passive bilateral therapy is an attempt to restore that balance, so that the two sides can work together. The therapy involves having stroke survivors perform a task using the non-paretic and the paretic hand together to retrain balance between the hemispheres. When added to the conventional therapy that forces the use of the paretic limb repeatedly, this active-passive bilateral therapy may improve hand function.
- **Brain stimulation.** Repeated stimulation of the neurons in the brain's cortex via trans-cranial magnetic stimulation or trans-cranial direct current stimulation can eventually reduce the activities of the neurons that are overactive. Applying this stimulation to the healthy hemisphere will reduce its ability to dominate and inhibit the injured hemisphere, restoring some of the balance.
- **Biofeedback.** Following a [stroke](#), survivors have impaired ability to sense motor function in the paretic limb. Biofeedback may give them greater awareness of muscle contractions and help them relax their hand muscles or coordinate their hand movements.

Source: American Physiological Society ([news](#) : [web](#))

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