Mental practice and physical therapy effective treatment for stroke, research shows

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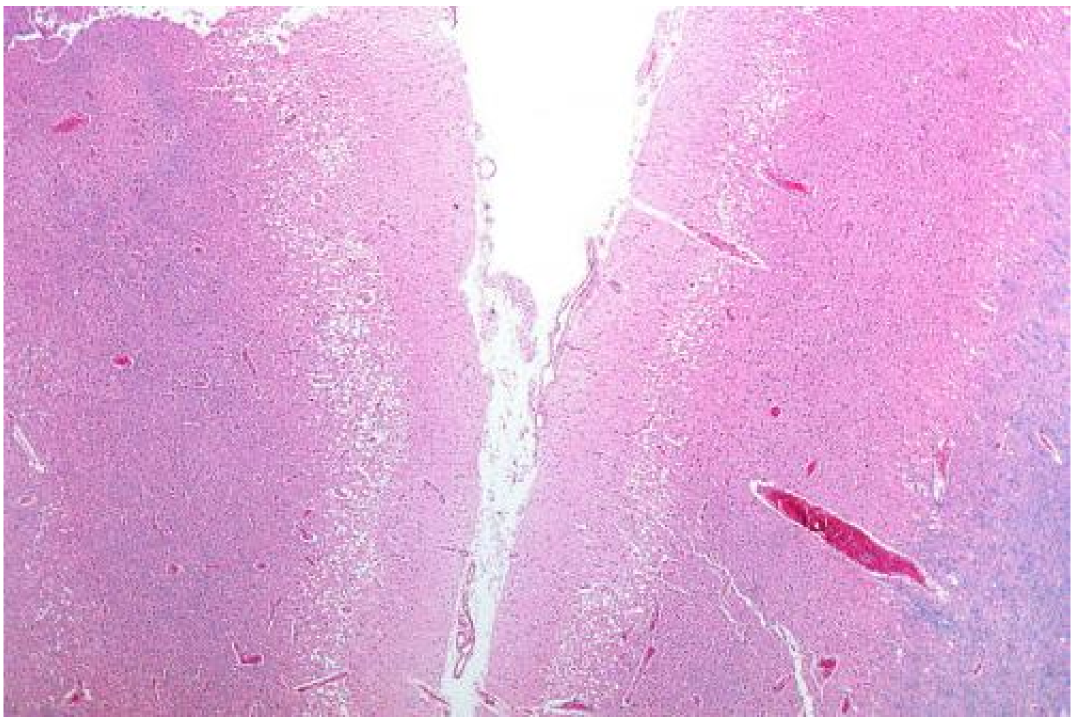

Micrograph showing cortical pseudolaminar necrosis, a finding seen in strokes on medical imaging and at autopsy. H&E-LFB stain. Credit: Nephron/Wikipedia

A combination of mental practice and physical therapy is an effective treatment for people recovering from a stroke, according to researchers at Georgia State University.

The findings, published on March 30 in the journal *Frontiers in Human*

Neuroscience, examine how the brains of stroke patients change after treatment.

Mental practice and physical therapy are interventions used to improve impaired motor movement, coordination and balance following stroke. Mental practice, also known as motor imagery, is the mental rehearsal of a motor action without an overt action. Physical therapy consists of repetitive, task-oriented training of the impaired extremity.

The study involved 17 young, healthy controls and 13 aged stroke survivors. Stroke participants were placed in two different groups for rehabilitation: mental practice only or both mental practice and physical therapy. Stroke survivors received the treatment within 14 to 51 days of their stroke and participated in 60 total hours of rehabilitation.

The researchers determined the effectiveness of these treatments by performing functional magnetic resonance imaging (fMRI) scans on the control group and on the stroke survivors before and after their treatment. The fMRI scans were performed while participants were inactive and determined the network activity of five core areas of the brain associated with motor execution: left primary motor area (LM1), right primary motor area (RM1), left pre-motor cortex (LPMC), right pre-motor cortex (RPMC) and supplementary motor area (SMA).

During normal brain function, multiple cortical areas of the brain communicate with each other, but these interactions are disrupted after a stroke. This study investigated how stroke affects these interactions and how function is regained from rehabilitation as people begin to recover motor behaviors, which has not been studied in detail.

"When people have a stroke, there's damage to brain cells and it takes a long time for neurons to grow back, if at all. You can use certain treatments to make the brain adapt or compensate in order to recruit new neurons and make you move again," said Dr. Andrew Butler, interim dean in the Byrdine F. Lewis School of Nursing and Health Professions and associate faculty in the Neuroscience Institute at Georgia State.

"One of these treatments is really intense physical therapy, but some people can't move at all. We found in our data that if they just think about moving, it keeps the neurons active right around the area that died in the brain. We used mental practice as a primer for physical training. As people improve and move along in their rehabilitation, they can progress from mental practice to physical practice and this can result in behavioral change, meaning they could move their arms better."

The research team found the causal flow of information between several brain regions - how one area causes an influence on the other - was reduced significantly for stroke survivors. The following brain connections were significantly reduced: LM1 and SMA, RPMC and SMA, RPMC and LM1, SMA and RM1, and SMA and LPMC. This flow of information did not increase significantly after mental practice alone, but it increased significantly when mental practice and physical therapy were combined.

In addition, sensation and motor function scores were significantly higher when stroke survivors underwent the combined mental practice and physical therapy.

The findings provide evidence that a combination of mental practice and physical therapy can be an effective means of treatment for stroke survivors to recover or regain the strength of motor behaviors. The study also found that causal information flow can be a reliable way to evaluate rehabilitation in stroke survivors.

The researchers used spectral Granger causality, a complex statistical technique that can accommodate time-series data, to interpret the fMRI results, study oscillatory network activity as stroke survivors underwent treatment and infer causal interactions.

Butler, a neuroscientist and physical therapist, and Dr. Mukesh Dhamala, a physicist and associate professor in the Department of Physics and Astronomy at Georgia State, partnered for the study. Butler had patient data and Dhamala had experience working with new, sophisticated statistical techniques, such as Granger causality, that analyze data and perhaps provide more information than other techniques.

Provided by Georgia State University

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