Project Title: *ARM Guide: Robotic Therapy for Force Training of the Upper Extremity in Chronic Hemiparetic Stroke*

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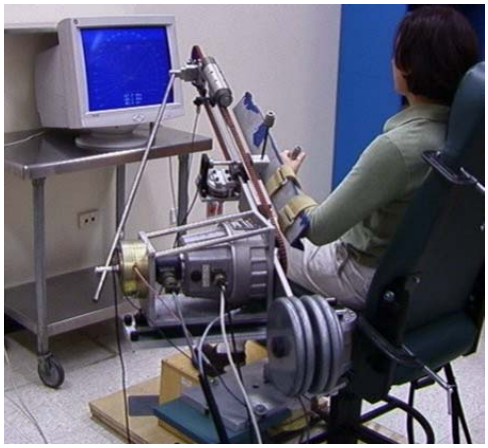
Project Description

The goal of this project is to use a novel robotic therapy device, the ARM Guide, to improve recovery of upper extremity function after stroke. We have already demonstrated in an initial pilot study that the device can improve movement recovery following chronic stroke. However, the results from our study, combined with evidence from other recent studies of robotic therapy, suggest that robotic therapy might be substantially enhanced by specifically targeting abnormal force generation after stroke. The current project implements this novel form of robotic therapy with biofeedback of limb forces, called "guided force training", and tests whether this therapy can improve recovery beyond previous forms of robotic and conventional therapy.



We are examining 48 stroke survivors who are at least six months post-injury. Subjects participate in one of three therapy programs across 24 one-hour sessions in eight weeks. The first program, free reaching therapy, involves subjects practicing unsupported reaching movements with the affected arm to an array of targets throughout the workspace. A second group participates in conventional therapy during one-on-one sessions with an occupational therapist, using a task-oriented approach. Finally, the robotic therapy group engages in reaching therapy with the device. As the subject attempts to make reaching movements while holding onto a hand piece along a linear track (see figure at right), a force sensor in the hand piece records the direction of forces generated by the user. If impaired coordination causes the user to push the hand piece in a direction other than towards the intended target, the motor will halt movement and the user will be given graphical feedback showing them how to correct their reach. This punishment-reward system (proper endpoint force rewarded by allowing smooth, unimpeded movement) trains users to consciously aim hand movements toward the desired target.

Progress to Date

We have enrolled thirty subjects and twenty-six have completed the training program. During the past year we added a fourth training group that participates in a mixture of the three experimental approaches. The decision to add this group was based on the fact that both the PT and the OT involved in the project agreed that if these therapies were available to them in the clinic, their practice would involve using all three with each patient. One subject has completed this mixed protocol and one is currently in enrolled with a target of 6 total participants. Current results across groups show positive changes in upper extremity function during both simple supported and unsupported reaching movements and more complex activities of daily living. While more subjects are still needed to be able to make distinctions between the outcomes of each group with statistical certainty, some potential differences between the therapies are beginning to emerge. Some differential benefits of robot-aided therapy may be seen in the performance of everyday tasks according to our clinical tests.

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