INTRODUCTION

Spasticity and contracture are major sources of disability in stroke patients, disrupting the remaining functional use of muscles and impeding motion. Spasticity may cause severe pain and result in a reduction in joint range of motion (ROM), clinical contracture, and muscle weakness (Rymer and Katz, 1994). While controversial, many investigators believe that changed joint properties in spasticity not only result from hyperactive stretch reflexes, but also from non-reflex changes like structural changes of muscle fibers and connective tissue.

Physical therapy treatment for most spastic ankles may involve manual stretching of a joint with the intent of restoring movement and reducing spasticity and contracture. However, this therapy is labor intensive and strenuous, while the amount of force used may differ between therapists. We have developed a device to stretch the spastic ankle to its extreme positions with accurate control of the stretching torque and velocity (Zhang et al., 2002). The purpose of this study was to investigate biomechanical changes over multiple sessions of stretching treatment of the spastic ankle in stroke.

METHODS

The spastic ankle of a 69 years old male stroke patient with severe spasticity in his left ankle due to a cerebrovascular accident in October 1999 (Ashworth scale 3, tendon reflex scale 3) was stretched during 7 sessions of 45 minutes with 2 or 3-day intervals.
of motion was significantly larger at 10Nm than at 5Nm, suggesting that this passive range was not limited by bony structures but by resistance due to stretch of the spastic muscles. Overall, the maximal resistance torque allowed in this subject during the treatment was 10Nm in PF direction and 20Nm in DF direction.

![Figure 2](image)

**Figure 2:** Joint torque (positive corresponds to a resistance torque in PF direction) and angle and during two stretching trials allowing maximally 5 (blue line) and 10Nm (thick red line) resistance torque.

The angle-torque curves of similar stretching sessions as in Figure 2 are shown in Figure 3. It can be seen that the ankle moved further into DF before 5Nm resistance torque was measured. Figure 3 illustrates the general finding that after 2 weeks of stretching, the joint ROM was changed considerably under the same amount of torque, indicating that the joint became less stiff.

![Figure 3](image)

**Figure 3:** Angle-torque curve of stretching session at the beginning (blue line) and end (red dotted line) of a two-week period. Maximal resistance torque of 5 Nm was allowed in each direction in these trials.

**SUMMARY**

Preliminary data of a study stretching the spastic joints of stroke patients using an intelligent stretching device were shown, suggesting positive effects in terms of range of motion and joint stiffness. Evaluation of more subjects in this study is needed to further validate the device and the treatment.

**REFERENCES**


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