

CHANGES IN CIRCLE AREA AFTER GRAVITY COMPENSATION TRAINING IN CHRONIC STROKE PATIENTS

T Krabben¹, GB Prange¹, J de Boer^{1,2}, HJ Hermens^{1,3}, H van der Kooij⁴, MJA Jannink^{1,4}

¹Roessingh Research and Development, Enschede (NL)

²Roessingh Rehabilitation Center, Enschede (NL)

³University of Twente, Department of Electrical Eng., Mathematics and Computer Science, Enschede (NL)

⁴University of Twente, Department of Biomechanical Engineering, Enschede (NL)

1. Introduction

After a stroke, many people experience difficulties to selectively activate muscles. As a result many patients move the affected arm in stereotypical patterns. Shoulder abduction is often accompanied by elbow flexion, reducing the ability to extend the elbow. This involuntary coupling reduces the patient's active range of motion. Gravity compensation reduces the activation level of shoulder abductors which limits the amount of coupled elbow flexion. As a result, stroke patients can instantaneously increase their active range of motion [1]. The objective of the present study is to examine whether training in a gravity compensated environment can also lead to an increased range of motion in an unsupported environment. Parts of this work have been presented at EMBC2009, Minneapolis, USA.

2. Methods

Eight chronic stroke patients received 18 half hour sessions of gravity compensation training in a period of six weeks. The training consisted of reaching exercises needed to play a computer game called FurballHunt, see Figure 1. Gravity compensation was applied through a passive device called Freebal, see Figure 1.



Figure 1 Training setup with FurballHunt and Freebal

To examine the effect of training in arm function, motor status and movement performance were evaluated before and after training. Motor status was evaluated with the Fugl-Meyer (FM) assessment, and movement performance with an unsupported circle drawing task. During this task shoulder and elbow angles were measured by a robotic exoskeleton called Dampace. From these data the area of the enclosed handpath during circle drawing was calculated.

3. Results

After training, FM scores increased in seven of eight patients. The average increase was 3.3 points. Circle area also increased in the same seven patients. The average increase was 113 cm² (34.4%). One patient showed a decreased FM score (-4.5) and a reduced circle area (-8.6 cm², -5.6%).

4. Discussion and conclusion

The majority of chronic stroke patients increased motor status and movement performance after training. Training in a gravity compensated environment can lead to an increased range of motion as represented by the increased circle area. Similar results were reported after instantaneous application of gravity compensation [1], suggesting an improved selectivity of movements of the shoulder and elbow. Gravity compensation training by means of a simple robotic device can induce improvements in arm function. Low-tech equipment such as the Freebal seems a suitable tool in post stroke rehabilitation.

References

- [1] Stienen AHA, Van der Helm FCT, Prange GB, Jannink MJA, Van der Kooij H. *Effects of gravity compensation on the range-of-motion of the upper extremities in robotic rehabilitation after stroke*. In: Proc Inter Shoulder Group: 2006 Oct 12-13; Chicago (IL), USA.