

Analysis of reaching movements made at faster speed by spastic stroke patients.

Mandon, Laurence^{1,2}, Boudarham, Julien², Robertson, Johanna^{1,2}, Bensmail, Djamel^{1,2}, Roche, Nicolas^{1,2}, Roby-Brami Agnès^{2,3,4,5}.

1: Raymond Poincaré Hospital, France 2: EA4497, UVSQ, France. 3: ISIR CNRS, UMR 7222 France 4: Sorbonne Universités, UPMC France, 5: INSERM, U1150, France

Introduction

The recent technological assisted neurorehabilitation methods have been developed according motor learning principles in order to increase the intensity of task specific training. In this context, it has been recently proposed that hemiparetic stroke patients should be encouraged to perform faster movements in order to increase task intensity, claiming that faster task performance improves movement quality.

Methods

Kinematics of reaching movements were recorded in a group of 14 stroke patients with a severe spastic hemiparesis. A 3D motion analysis system was used to track the trajectories of 5 reflective markers fixed on the finger, wrist, elbow, acromion and sternum. The reaching movements were performed toward two targets at respectively 60% and 90% arm length, at their preferred and maximum possible velocity. The experiment was repeated with the trunk fixed.

Results

The analysis of the mean results in the group confirmed that hemiparetic stroke patients could increase voluntarily the velocity of the hand movement. This increase was independent of the modulation of velocity with movement distance. The present results demonstrated that faster movements were due to increased trunk compensation with a decrease of elbow extension. In addition, the quality of the movements (extent, coordination, smoothness) was decreased in trunk blocked condition. Examination of individual results showed that half of the patients were not able to increase elbow extension with target distance were neither able to increase voluntarily the velocity of elbow extension. However, clinical data (level of spasticity or impairment measured by clinical scales) did not show clear difference between these groups.

Conclusion

The present results demonstrate that faster speed encourages patients to use a motor schema involving compensation rather than coping with the impairment. Compensation may help patients to perform tasks in the short term, but are associated with long term problems and can lead to a pattern of learned nonuse, limiting subsequent recovery. Training at faster speeds should be carefully recommended only after a quantitative analysis of reaching coordination. It may be contraindicated in patients with severe impairment and reserved to patients who are able to modulate the range and velocity of elbow extension. Trunk restraint, which is already recommended to train elbow extension should be mandatory if a fast speed training protocol is envisaged.