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The kinematics of the upper limb: what indicates an improved reach-to-grasp movement?

Introduction

Arm rehabilitation following stroke usually involves the reach-to-grasp movement using various target objects, but the literature is not clear about which performance parameters to focus on. Reduced movement speed is intuitively an obvious culprit, but perception, motor recruitment, and top-down modulation may contribute.

This presentation will describe the use of movement analysis to examine upper limb function, and will contrast data from two participants where their reaching changed significantly following home practice. Although both participants were thought to have improved, the changes observed indicated that a specific kinematic definition of improved reaching (constructed from the literature) did not apply.

Methods

The project used a four-camera MacReflex system to capture the kinematics of the reach-to-grasp movement following stroke, using a repeated measures design. Two male participants [D & E, 10 & 5 months post-stroke, Rivermead Motor Assessment (arm section) score of 11 & 6] did reach-to-grasp home practice for a fortnight (15 mins, twice daily). Before and after the fortnight, kinematic analyses were performed twice (one week apart): data were pooled to allow for performance variability and natural recovery. Parameters derived were reaction and movement times; values and normalized timing of peak acceleration, peak velocity, deceleration and aperture; smoothness; and Index of Deviation.

Results

Both participants demonstrated significantly changed kinematics (ANOVA, two-factor with repetition, $p < 0.01$) in most parameters (D for 9 parameters; E for 8). According to the kinematic definition of better reaching, most of participant E's were better, but all of D's were worse. However, D's pattern of reaching (the path taken) had normalized and some scores on assessment scales had improved.

Conclusions

It is argued that the pattern transition was advantageous, possibly enabling further recovery. One clinical implication is that encouraging faster reaching may be counterproductive for some patients. However, it is acknowledged that the practice itself may not have caused the changes.