Neural consequences of immobilization and a possible role for motor imagery

Stenekes MW, De Jong BM*, Leenders KL*, Paans AMS**, Mulder Th***, Geertzen JHB**** Nicolai JPA
Department of Plastic Surgery, *Deparment of Neurology, **PET Center, ***Institute of Human Movement Sciences, ****Department of Rehabilitation Medicine, University of Groningen, Groningen

Traumatic flexor tendon injury of the hand is best treated surgically. To obtain optimal tendon recovery, patients are instructed not to make any active finger flexion movements after surgery. Passive flexion movements remain possible through a special dynamic splint (Kleinert's splint). After the immobilization period, patients report temporary clumsiness of the hand. In this positron emission tomography (PET) study we report the effects of functional immobilization of the hand on the cerebral organization.
Four patients with left-sided flexor tendon lesions were studied. The first study was performed six weeks postoperative when splint treatment ended and the second 6-8 weeks later. Movement related activation was explored by comparing six scans made during active finger flexion with three scans during a resting state. Regional increase of cerebral perfusion was used as indicator for local neuronal activation. This was measured with infusion of oxygen-15 labeled water and PET. Data analysis was performed using statistical parametric mapping (SPM99 software Wellcome Department of Cognitive Neurology, London).
Activation in the contralateral sensorimotor cortex and ipsilateral cerebellum was present in all flexion condition in both studies. Additionally, activation in both the contralateral parietal cortex [30,-56,66] and the cingulate cortex was present ($p<0.05$, corrected) in the initial study. This may indicate increased demand on a body scheme representation needed for instructing the appropriate parts of the hand to move. In contrast, in the second study, additional activation of the contralateral putamen [26,0,0] was found ($p<0.05$, corrected). This suggests simple movements have been relearned compared with the first study.
Functional flexor immobilization induces a temporary loss of efficient cerebral control of finger movement characterized by an increased cortical demand and reduced striatal involvement. Presumably, prevention of neural reorganization during the splint period leads to a less bad hand function after this period. Unfortunately, early active training results in tendon ruptures. Exploring abilities of motor imagery to improve actual motor function seems challenging.

Martin W Stenekes, MD, Institute of Human Mvement Siences, Department of Rehabilitation Medicine and Department of Plastic Surgery, Groningen University, Postbus 196, 9700 AD Groningen, t 050 3619965, e-mail m.w.stenekes@chir.azg.nl

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