Understanding Finger Motor Control In Young And Elderly

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The general aim of this thesis is to improve our understanding of hand and wrist motor control, as well as the changes that occur with ageing. One phenomenon in hand motor control that is not fully understood, is the so-called finger enslaving. Enslaving is defined as the inability of fingers to move or exert force completely independent. This phenomenon has been explained by two types of factors: mechanical and neural factors. To obtain more insight in the importance of each of the factors, enslaving was investigated in both young adults and elderly during a dynamic finger force task, which involved both force exertion and movement. Along with experimental research, musculoskeletal modelling can put more insight into our understanding of the neuro-mechanics of finger movements. The available models of hand do not offer the potential for the mentioned analysis as they face some issues such as inconsistent anatomical data-sets and not including the wrist and its interaction with finger motion. In the current study, a comprehensive musculoskeletal model of the hand and wrist was built and compared to available information regarding moment arms and predicted muscle forces. Having incorporated the anatomical data in the introduced model, a good consistency was found between computed moment arms by the model and those obtained in previous experimental studies. Computed extrinsic flexor forces of the index finger during index pinch tasks were within one standard deviation of previously measured in-vivo tendon forces. The results of the experimental studies showed that during dynamic finger tasks mechanical inter-connections between tendons and muscle bellies play a role in enslaving in young subjects. Higher amounts of enslaving accompanied with different neuromuscular control (reflected in different EMG patterns with mostly higher activation in comparison with young subjects) of fingers in elderly were found. The results did not allow for attributing these changes to either neural or mechanical factors. The developed musculoskeletal model, introduced in two different platforms (OpenSim and SPACAR), may provide more insight into the causes of finger enslaving. Before that , interconnections between fingers have to be included.