Abstract

The object of this thesis was to improve our understanding of bimanual coordination and neuromuscular activation in children with and without spastic hemiparetic cerebral palsy (SHCP) and to gain insight into the contribution of visual information towards interlimb coupling. The availability of visual information was manipulated by placing a glass screen, opaque screen or a mirror (‘mirror box’) between the arms. Using this arrangement, visual information was available from both arms (glass condition), from one arm only (opaque screen condition), or from one arm and its mirror reflection (‘mirror (box)’ condition) that was superimposed on the arm behind the mirror. When both arms were moved simultaneously in the latter condition, children with a strong asymmetry between body-sides as a result of SHCP saw a visual perception of a zero lag, symmetric movement between the two less impaired arms. Without visual manipulation it was found that children with SHCP exhibited a similar mean coordination pattern compared to typically developing (TD) children, but had greater movement variability between the arms. Additionally, children with SHCP had higher intensities of mean neuromuscular activity and the movement was characterised by longer phases of eccentric and concentric activity, indicating more co-activation, especially in the more impaired arm. The electromyography (EMG) signals yielded a higher mean power frequency in all muscles of the more impaired arm and the wrist and elbow flexors of the less impaired arm, which reflected a relatively higher contribution of type II muscle fibres compared to TD children. While manipulation of visual information did not affect the bimanual coordination or neuromuscular activation in TD children, movement variability in children with SHCP was significantly greater in the screen condition compared to the glass and mirror conditions. Furthermore, the EMG intensities in the shoulder muscles of children with SHCP were lower when veridical visual feedback was absent (i.e., screen and mirror conditions). Similar attenuating effects of the mirror were found for the relative durations of eccentric and concentric activity in the elbow muscles. These findings indicated that the movement difficulties in children with SHCP may be caused by a discrepancy between actual visual feedback and the internal efference copy of a movement. Removing actual visual information of the more impaired arm and replacing it with a mirror reflection of the less impaired arm seemed to improve their motor behaviour during interlimb coupling compared to the other conditions.