EFFECT OF TRAINING
ON CORTICOSPINAL CONTROL
OF HUMAN MOTOR UNITS

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ABSTRACT

The influence of different muscle usage patterns on corticospinal control of human motor units (MUs) was studied during voluntary isometric abduction of the index finger to activate the first dorsal interosseous (FDI) muscles. The primary aim was to quantify any control differences in MUs from hands which had been trained over many years, and to determine if any observed differences in these hands influenced the precision of force production.

Measures of correlated MU discharge patterns were different in FDI muscles of individuals with different hand preferences, and in individuals trained over many years for skill- or strength-related tasks. The mean strength of MU synchronization was weak, and of equivalent strength in both hands of skill-trained subjects and the dominant (skilled) hand of untrained right-handed (RH) subjects. A second measure of correlated MU discharge (common drive), which was found to arise from a separate mechanism to that of MU synchronization, was also weaker in skill-trained subjects compared to untrained and strength-trained subjects. A reduction in both measures of correlated MU discharge in skill-trained subjects indicate that certain features of the neural control of the FDI motoneuron pool are different in these individuals.

As corticospinal inputs are likely to be important for MU synchronization, transcranial magnetic stimulation (TMS) was used as a more direct measure of hemispheric differences in corticospinal excitability. TMS over each hemisphere in untrained RH subjects revealed that the corticospinal inputs controlling FDI were more active, and therefore contributed relatively more to the net excitatory command, when the non-dominant hand was used to perform index finger abduction. These hemispheric differences in corticospinal excitability were sufficient to explain the differences in MU synchrony in dominant and non-dominant hands during comparable low-force contractions. It is likely that reduced synchrony in 'skilled' hands is due to a reduced excitability of corticospinal inputs to the FDI motoneuron pool when these hands are used to perform the simple index finger abduction task.

The amplitude of the tremor force fluctuations of the index finger were much lower in skill-trained subjects. However, the weaker MU synchrony observed in these subjects was not responsible for the reduced force tremor, as correlations between the overall extent of MU synchrony and tremor were weak, and all non-significant.

Results from this thesis support the view that neural control of FDI muscle is different in individuals with different patterns of long-term muscle use. This enhances the possibility that a specific, short-term training regimen can modify the neural control of muscles, and is an area which warrants further investigation.