Task-dependent changes of motor cortical network excitability during precision grip compared to isolated finger contraction

The purpose of this study was to determine whether task-dependent differences in corticospinal pathway excitability occur in going from isolated contractions of the index finger to its coordinated activity with the thumb. Focal transcranial magnetic stimulation (TMS) was used to measure input-output (I/O) curves—a measure of corticospinal pathway excitability—of the contralateral first dorsal interosseus (FDI) muscle in 21 healthy subjects performing two isometric motor tasks: index abduction and precision grip. The level of FDI electromyographic (EMG) activity was kept constant across tasks. The amplitude of the FDI motor evoked potentials (MEPs) and the duration of FDI silent period (SP) were plotted against TMS stimulus intensity and fitted, respectively, to a Boltzmann sigmoidal function. The plateau level of the FDI MEP amplitude I/O curve increased by an average of 40% during the precision grip compared with index abduction. Likewise, the steepness of the curve, as measured by the value of the maximum slope, increased by nearly 70%. By contrast, all I/O curve parameters [plateau, stimulus intensity required to obtain 50% of maximum response (S50), and slope] of SP duration were similar between the two tasks. Short- and long-latency intracortical inhibitions (SICI and LICI, respectively) were also measured in each task. Both measures of inhibition decreased during precision grip compared with the isolated contraction. The results demonstrate that the motor cortical circuits controlling index and thumb muscles become functionally coupled when the muscles are used synergistically and this may be due, at least in part, to a decrease of intracortical inhibition and an increase of recurrent excitation.

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