How to Use Bilateral Motions in Facilitation Techniques

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NAKAMURA, R. and CHIDA, T. How to Use Bilateral Motions in Facilitation Techniques. Tohoku J. exp. Med., 1983, 141(2), 241-242 — Influence of contralateral finger motions on ipsilateral finger extension was analyzed in order to explore optimal condition of bilateral motions as a facilitation technique, measuring motor times (MTs) of finger extensor muscles in four conditions; homonymous or non-homonymous as for muscle coupling and simultaneous or successive as for timing of motion-initiation. Compared to unilateral motion, MTs shortened only in bilateral motion with preceding sustained contractions of the contralateral homonymous muscle. —— facilitation techniques; motor time

Bilateral motions are often used in active-assistive exercises to restore the motor function of paralyzed muscles in hemiplegia (Harris 1978; Nakamura 1977). There still remain practical questions, i.e., what kinds of muscle coupling, homonymous or non-homonymous, and timing of movement initiation, simultaneous or successive, are more effective. This study, using reaction time (RT) experiments, analyzed the influence of contralateral finger motions on ipsilateral finger extension in order to explore optimal condition of bilateral motions as a facilitation technique.

RTs, premotor times (PMTs; latency from stimulus to EMG onset) and motor times (MTs; latency from EMG onset to actual motion) of finger extension were examined in 12 healthy right-handed adults. The method of RT measurements was already reported in details (Nakamura and Taniguchi 1971). In short, EMGs of the finger extensor muscles and movements of the middle finger were recorded on a memoscope where PMT and MT were measured with a msec scale. The tasks were performed in two tasks. In task 1 bilateral simultaneous motions with the homonymous or non-homonymous muscle coupling were administered, and in task 2 a sustained contraction of the contralateral homonymous or non-homonymous muscle was started with a warning signal. The order of the tasks was counterbalanced across the subjects. They were asked to extend rapidly their left or right fingers responding to a tone stimulus presented 2 sec after the warning in three conditions; without motions of the contralateral fingers (control, S), with the contralateral finger flexion (non-homonymous coupling, F), and with the contralateral finger extension (homonymous coupling, E). The first trial after change of the conditions was discarded and the remaining 20 trials in each condition were used for statistical analysis.

Table 1 shows the means of RTs, PMTs and MTs in tasks 1 and 2. PMTs of both tasks were longer in F and E than in S (p<0.01). PMTs prolonged in the bilateral motions regardless of the direction and the timing of motions. This phenomenon would be attributed to the increased attentional demands of movement organization and execution.
(Marteniuk and MacKenzie 1980). Compared to S, MTs of task 1 were long in F (p<0.01) but not different in E, and MTs of task 2 were not different in F but short in E (p<0.01). The shortening of MTs was obtained only in the task with preceding sustained contractions of the contralateral homonymous muscles. Coactivation of homonymous muscles of the contralateral side accompanied with unilateral motions is a common finding in healthy subjects, and its latency varies widely between 50 msec (Kristeva et al. 1979) and more than 500 msec (Hopf et al. 1974). According to Soto et al. (1974), the level of coactivation reached its maximum at 1.64 sec after the subject made a voluntary sustained contraction. These reports and the present results indicate that sustained contraction of the contralateral homonymous muscles should be executed about 2 sec before the initiation of active assistive exercises to facilitate the activity of paretic muscles.

References


\begin{table}
\centering
\caption{Means and standard deviations of PMTs, MTs and RTs (msec)}
\begin{tabular}{lccc}
\hline
 & Task 1 & Task 2 \\
\hline PMT & 96.1 & 108.3 & 101.5 & 100.8 & 108.0 & 109.1 \\
 & 9.3 & 13.8 & 11.3 & 9.1 & 13.5 & 11.8 \\
MT & 42.5 & 45.7 & 42.5 & 43.0 & 44.1 & 39.7 \\
 & 6.7 & 8.4 & 6.3 & 7.6 & 9.4 & 7.7 \\
RT & 138.6 & 153.9 & 144.0 & 143.8 & 152.0 & 148.8 \\
 & 12.9 & 16.9 & 15.9 & 11.6 & 15.6 & 12.3 \\
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S, F, E: See text.