Short Report

EMG Activities of the Biceps Brachii at Rapid Elbow Flexion during Passive Movements

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SATO, K., NAKAMURA, R. and NAGASAKI, H. EMG Activities of the Biceps Brachii at Rapid Elbow Flexion during Passive Movements. Tohoku J. exp. Med., 1983, 139 (2), 219-220 — Seven normal subjects were asked to flex the left elbow as quickly as possible, responding to a tone stimulus under three conditions: 1) during passive flexion of the elbow, 2) during passive extension and 3) without passive movements. The EMG activities in passive movements reduced significantly during first 60 to 70 msec, compared to the condition without passive movements. — passive movements; ballistic movement; EMG activities; motor program

Exercises with passive or active-assistive motion are empirically known to be effective for the functional restoration of the paretic muscles (Rusk 1977). Our previous study revealed that ongoing passive flexion of the elbow decreased electromyographic reaction time (EMG-RT) of the biceps brachii for the elbow flexion while passive extension increased it (Nakamura et al. 1981). This study examined how early EMG activities of the biceps brachii at rapid elbow flexion were affected by passive elbow movements, using RT paradigm.

Subjects were seven healthy males aged from 30 to 45 years. The subject sat in front of a forearm-rotator equipped with a moving bar on which his left forearm was fixed. The bar rotated at constant velocity 20°/sec. The experimental conditions were 1) during passive flexion (PFLX), 2) during passive extension (PEXT) and 3) without passive movements (STAT). The subject was asked to flex his left elbow as quickly as possible responding to a tone stimulus given 2 sec after a verbal warning. In PFLX and PEXT the bar which started to move with the warning signal rotated from 20° to 100° of the elbow angle or vice versa, and in STAT it was fixed at 60°. Every response was made at the same elbow angle of 60° flexion. Detailed descriptions of the method are given elsewhere (Nakamura et al. 1981). Surface EMG activities of the biceps brachii were amplified and filtered with time constant 0.03. They were full wave rectified and fed to a memoscope which was triggered at 100 µV of the rectified EMG activities with pre delay of 128 msec. For each experimental condition these activities were added 10 times during first 128 msec on the memoscope.

Fig. 1 illustrates the added EMG activities for a subject. All through the subjects, the temporal patterns of the EMG activities under three conditions were characterized as follows: (1) in STAT the activities attained maximum at 40 to 60 msec after the onset, (2) in PFLX and PEXT the EMG activities reduced during first 60 to 70 msec, compared to STAT, (3) between PFLX and PEXT the difference of the EMG activities was not so distinctive as between STAT and PFLX or PEXT, although the activities during PEXT tended to increase slightly more than during PFLX and (4) after 70 msec from the onset of

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the activities, no consistent differentiation of their temporal patterns was noticed among
the three conditions.

In short, it was the most characteristic that the ongoing passive movements, of whichever
directions, restrained the early EMG activities in the ballistic movement. This pheno-
menon is hardly explainable by the change of spinal excitability induced by stretching or
shortening of the prime-mover, just as for EMG-RT during passive movements (Nakamura
et al. 1981). Instead, the temporal and spatial recruitment of the motor unit for the
ballistic movement would be centrally adjusted by kinesthetic information of the ongoing
passive movements. Recent studies (Maton and Bouisset 1975; Schmidt 1980) report
that the rate of ballistic movement is determined by the amplitude of an initial agonist
EMG burst of relatively constant duration which is centrally preprogrammed. All these
findings suggest that passive or active-assistive motion is influential in modifying the
motor command or motor program.

References


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