

RANGE OF MOTION AND ELECTROMYOGRAPHIC RECORDINGS IN  
UPPER AND LOWER LIMBS DURING FAST ALTERNATING MOVEMENTS  
IN HEMIPLEGIA

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Abstract:

The range of motion and muscle activity during dynamic voluntary movements were studied in 20 hemiplegic patients and compared to normal values. Fast alternating voluntary movements without resistance were executed in the elbow, knee and ankle joint during 30 seconds. The output of the electro goniometer as well as the integrated EMG of two muscle groups were averaged (time-averaging) and cross-correlated. The output of the electro goniometer was also transformed into a power density spectrum for further analysis of the speed and regularity of the movement.

The frequency, the range of motion, the regularity were diminished or affected in all patients. Co-activation was most prominent in flexor muscles. It was found that each patient had his own reproducible and typical range of motion (frequency and angular displacement of the joint) and muscle activation pattern, if the patient was instructed to move as fast as possible.

Introduction

Impairment of voluntary movement in patients with hemiplegia depend to a paresis of primary movers and an increased and widespread co-activation (Yusevich 1968, McLellan 1977, Knutsson and Martensson 1980).

These changes are usually recorded by measurement of the angular displacement and simultaneous registration of electromyographic activities of the involved muscles or muscle groups.

However, the design of investigation determines the amount of activation in the primary movements as well as in antagonists and synergists. For instance co-activation in antagonists and synergists during isometric contractions seems to be less prominent compared with coactivation during isokinetic movements (McLellan 1977, Knutsson and Martensson 1980, Prevo et.al. 1982). An increase in force or speed gives rise to an exaggeration of spasticity (Okhnyanskaya et.al. 1974, Knutsson and Martensson 1980). Pre-selection of

patients is necessary if a tracking target test has to be performed (McLellan 1977).

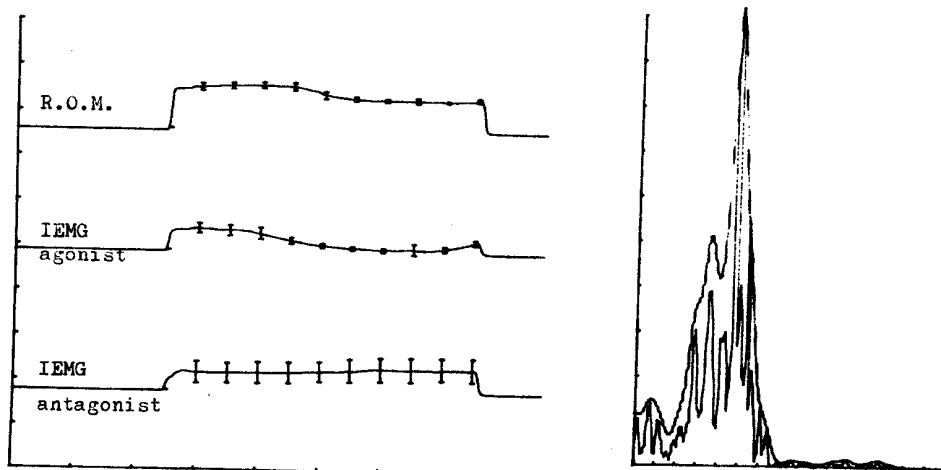
Evaluation of treatment in spastic syndroms in our department are focussed on the registrations of angular displacement and simultaneous recordings of electromyographic activities of different muscle groups during dynamic alternating voluntary flexion and extension movements as fast as possible and without practicing a target tracking test.

#### Method

Voluntary flexion and extension movements in the elbow, knee and ankle joint were executed. The patient was asked to perform these successive alternating movements as regular and as fast as possible during a period of 30 seconds. The range of motion was recorded by an electro goniometer. Bipolar surface electrodes were used. Pre-amplifiers were attached to the surface electrodes. The EMG activity of two muscle groups were recorded simultaneously together with the output of the electro goniometer. The electromyogram was also registered on a writer to detect artefacts. The integrated EMG of the two involved muscle groups and the output of the electro goniometer were analysed by computer (sample frequency of 60 Hz). The mean and S.D. of the range of motion and the integrated EMG's of all successive flexion and extension movements were plotted on a X-Y-writer and calculated. Ratio of agonist and antagonist was determined at several times or periods during the alternating movements. The output of the electro goniometer was transformed into a powerdensity spectrum. Frequency was set on percentage of energy. The frequency was accepted as a parameter for speed. The appearance of high and low frequency components, together with the bandwidth of the maximum peak was used as a parameter for the regularity of the movements.

A number of 20 patients with a spastic hemiparesis due to a cerebral vascular accident were studied. The possible influence of spontaneous neurological recovery could be left out of consideration because each patient has a cerebral vascular accident at least for one year ago.

Patients were sitting in a comfortable chair and were instructed to make fast alternating movements in the knee, elbow and ankle joint successively.



Time-avarage R.O.M.-IEMG

Power density spectrum Hz.

### Results

All patients showed a decrease in frequency and range of motion compared to normal values. Regularity of the movement was diminished in several patients. The variation of the range of motion was less restricted compared to the electromyographic output of the muscles. Increased and abnormal co-activation was most prominent in flexor muscles. Continuous activation in these muscles could be observed as a prolonged activity if the movement started in the opposite direction.

The ratio between the muscle activity of agonist and antagonist depends on the time or period in which the ratio was analysed. Power density spectrum seems to be a good parameter to measure regularity and speed of the movements.

Voluntary movements in each hemiplegic patient were performed in typical frequency and angular displacement.

Changes in range of motion, patterns of muscle activation and power density spectrum will be presented after nerve blocks and spasmolytic agents.

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