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Relationships Among sEMG Measures of Neuromuscular Excitation

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Mobility researchers interested in neuromuscular excitation rates calculate a variety of dependent measures from surface electromyograms (sEMG). This variation makes the interpretation of findings across studies difficult. **PURPOSE:** To determine the manner in which common sEMG dependent measures are related. **METHODS:** Isometric force and sEMG were recorded from 21 healthy young adults during isometric force-matching tasks with varied rates of force development (RFD). Participants were instructed to match, on a computer monitor, a real-time plot of their dorsiflexion force to a static plot of each RFD ramp-force condition. RFD conditions ranged from 20%MVC/s to the subject's fastest RFD. EMG was recorded at 2kHz, demeaned, rectified and zero-lag 4th order Butterworth filtered. Dependent measures were: peak rate of EMG rise (RER); integrated EMG of the initial 30ms of the EMG burst (Q30); root mean square amplitude of the initial 30ms and 50ms (RMS30, RMS50); peak EMG amplitude prior to peak force; integrated EMG 30ms prior to peak rate of force development (Q30b); RMS amplitude from EMG threshold to peak force generation (RMStp). Spearman's correlation was used to quantify relationships between variables. **RESULTS:** Strong correlations were observed between Q30 and both RMS30 and RMS50 ($\rho=0.951, 0.887$ respectively, $p<0.01$) followed by peak amplitude with peak RER and Q30b ($\rho=0.827, 0.802$ respectively, $p<0.01$). Additional considerable correlations observed were peak RER with RMS50, Q30, and RMS30 ($\rho=0.691, 0.631, 0.608$, respectively, $p<0.01$). RMStp displayed no substantial correlations with any other variables. **CONCLUSION:** Correlations support logical distinctions between measures. Q30, RMS30, and RMS50 are anchored at the onset of the contraction and are collectively suitable for hypotheses about movement initiation. RER, Q30b, and peak EMG amplitude prior to peak force quantify peak neural excitation with timing that is coupled to peak RFD. RMStp measures total excitation of task accomplishment. These relationships can guide the selection of measures for hypotheses related to either movement initiation or peak rates of force development.

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