Stimulation of motor units (MUs) with repeated pulses evokes tetanic contractions, which consist of overlapping responses. The summation of these responses into tetanus is a nonlinear process connected with dynamic changes of amplitudes and time parameters of successive twitches. In the first series of experiments the summation of successive twitches at regular stimulation frequency was studied. In order to study the changes of successive twitches summating into tetanus, fast and slow MU were stimulated with progressively increasing number of impulses, from one to sixteen at a constant frequency of stimulation. The successive responses were calculated by subtracting the (i)-th tetanus recording from the (i+1)-th one. The so obtained twitches were modeled using a 6-parameters analytical function. The main conclusions are: (1) the shape of the individual, simple twitch and the subtracted ones are different and additionally they differ between slow and fast MUs; (2) the parameters of these twitches underwent different changes for slow and fast MUs: the maximal force of the successive subtracted twitches of the slow MU and their time parameters increased considerably to the 4-th twitch and after that increased slightly or remained at a constant level; for the fast MU, the maximal force and twitch duration also increased, whereas the remaining time parameters initially increased and than decreased or maintained a constant level and the last observation might be a reason for the sag phenomenon visible in the fast MUs' unfused tetani. In the second series of experiments the MU force during a stimulation with irregularly delivered pulses (i.e., at variable interpulse intervals) was studied. Analysis of changes in the tetanic force revealed the linear relationship between the interpulse interval as well as the initial level of the force and the amplitude of force increase of the following contraction. The variability of instantaneous tetanic force during irregular stimulation depends on the level of the fusion of tetanus and was the highest for middle-fused tetani. Moreover, for low and moderately fused tetani the effectiveness of MU contractions was considerably higher in contractions evoked by irregular pattern. It was concluded that during voluntary contractions the influence of changes in motoneuronal firing rate on the motor unit force depends on the initial level of force and that irregular pattern produces higher output of motor units than regular stimulation during tetanic contractions used for motor tasks requiring low or moderate level of force.

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