

Conditioning muscles for fatigue resistance: the effect of on/off pattern

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The use of artificial electrical stimulation to restore function to paralysed muscles requires the muscles to be conditioned so that they are sufficiently resistant to fatigue. In this laboratory, chronic stimulation studies with rabbit tibialis anterior (TA) muscles have shown that fatigue resistance can be achieved without excessive power loss by using low-frequency patterns. We are investigating stimulation regimes that could produce the same muscle phenotype in a clinically more acceptable way. In a preliminary study we stimulated rabbit TA muscles at 10 Hz for equal on/off periods of 30 s, 30 min and 12 hours. All 3 patterns resulted in an equivalent transformed state in which fast-glycolytic fibres had been replaced by fast-oxidative fibres. The muscles had fatigue-resistant properties but retained a higher contractile speed and power production than muscles transformed completely to the slow-oxidative type. From these data we concluded that the threshold for this intermediate transformation could be attained with on and off periods of stimulation throughout the range from 30 s to 12 hours.

To take these studies of conditioning regimes for clinical use further, we are now investigating stimulation with a 30-min on-period and different off-periods. The object is to determine the minimum number of cycles that need to be delivered during any 24-hour period for a fatigue-resistant phenotype to be achieved and maintained. The results to date are surprising, for they suggest that as little as one 30-min period of stimulation in 24 hours results in a substantial elevation of oxidative capacity. The muscles show no significant reduction in power output and there is even evidence of hypertrophy in the case of the *less* intensive regimes.

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