Surface electromyogram spectra of the lower limb with MemCalc Frequency Analysis during running exercise of human

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Introduction

During running exercise on the treadmill, the faster types of motor unites(MUs) have generally been recruited related to the increase of the intensity and the duration of exercise. It have been thought these dynamic MUs that are constructed of the motor nerve and the muscle fiber, however measurements of MUs during exercise have been difficult to be estimated with activities of its recruitment, non-invasively. Then, this study was designed to evaluate relatively with these MUs in surface electromyogram(SEMG) of the agonist during running using with the excellent frequency analysis of Maximum Entropy Method Calculation(MemCalc).

Method

SEMG of the Rectus Femoris(RF) and the Biceps Femoris(BF) were recorded by the bio-telemeter system about twelve athletes subjects during running on the treadmill. These running load experiment were set for nine minutes at three stepwise exercise of 40%, 60%, and 80% of their maximum speed record(MSR) at 1500m distance. Those exercise SEMG were processed to induce the power spectrum with the sampling time of 1msec among 2Hz and 500Hz frequency bands applied with the computer frequency analysis program of MemCalc. Furthermore, relative MUs during running were estimated with two parameters of Total Power Spectra(area, TPS) and sloping value of curve-linear 1/f equation in the SEMG spectrum waves. And these mean TPS and the average values according to RF and BF of subjects were calculated and were summarized at the average recruitment patterns and changes of MUs related to three speed of 40%, 60%, and 80%MSR, comparatively.

Results

Power spectra of SEMG were obtained about twelve subjects, three speed, and two muscles, individually. Average TPS in the SEMG spectrum of RF and (show values in the case of BF) muscles were observed as increased data progressively of RF;4762(BF;3583)mV 2, RF;8165(BF;5094)mV 2, RF;17701 (BF; 9242) mV 2. related to 40%, 60%, 80%MSR of the running speed, significantly(p<0.05). Furthermore, mean values of 1/f equation of RF and (BF) were showed augmentative changes of significant sloping coefficient of RF;–0.0090(BF; -0.0088)slope, RF;–0.0096(BF;-0.0092)slope, BF;–0.0100(BF; -0.0095)slope angles gradually according to three speed of the running, quantitatively(refer to Fig.1)

![Fig.1 Total Power Spectrum(TPS) and slope values in Power Spectrum Density of SEMG of the RF and the BF related to 40%, 60% and 80%MSR](image)

Discussion/Conclusion

These results appeared that the fastest speed(80%MSR) of the running exercise should evoke the higher frequency (rate) waves of relative MUs and the more much recruitment of larger amplitude of these myo-signals than that of the case of the slower speed(40% and 60%MSR). Especially, augmentation of TPS in 80%MSR of RF may indicate that the most critical type and the fastest rate of relative MUs waves have been appeared during the running exercise more than those of BF. And these MUs should be depend upon the extensive movement of the knee joint connected to RF on the treadmill running more than the flexible one of BF. Furthermore, repression of slopoe values of 1/f equation related to the running speed might show the effectiveness on not a wave-rate, but an amplitude of the compound SEMG of RF and BF. In conclusion of this study, relative MUs during the running exercise were evaluated related to three speeds by the measures of MemCalc frequency analysis, quantitatively.

Reference


Keywords : surface electromyogram, frequency analysis, reference motor unit, running exercise