

Electromyographic and mechanomyographic changes induced by muscle fatigue

Daniela Motoc¹, Sorin Riga², Dan Riga², Nicoleta C. Turtoi¹, Cecilia R. Avram¹

¹*Physiology Department, Faculty of Medicine, Vasile Goldiș West University Arad*

²*Al. Obregia Clinical Psychiatric Hospital, Bucharest, Department of Prevention and Stress Research*

Abstract

Background. In the “hand-grip” voluntary isometric contraction, maximal or submaximal prolonged until exhaustion, appears a reduction of muscular capacity over a period to generate the required force, due to muscular fatigue, a phenomenon reflected in the electromyography (EMG) and mechanomyography (MMG) changes.

Aims. The study of surface electromyographic (S-EMG) and MMG signal changes during the muscular fatigue and identification of defining parameters. Also, the relationship between the functional capacity of the muscles involved in contraction, influenced by the type of athletes’ training and the S-EMG and MMG changes recorded during the isometric contraction.

Methods. Two groups of athletes - a group mainly engaged in isometric exercises and another one trained through predominantly dynamic effort. We used experimental and observational methods, graphic recordings of electrical and mechanical signals, analysis of EMG signal spectrum, and statistical-mathematical analysis.

Results. The investigated parameters were the EMG signal amplitude, EMG signal area (iEMG), median frequency (MDF) and the muscular contraction force. It was proved that in both groups of athletes there were statistically significant changes in the maximal voluntary contraction performed after a sustained isometric exercise. A more pronounced decrease of maximum amplitude and MDF in the predominantly resistance trained group allowed us to appreciate the value of isometric training, in order to increase the muscle resistance to fatigue. The results may validate the utilization of these parameters in the evaluation of neuromuscular fatigue.

Conclusions. The increase of EMG maximum amplitude and iEMG signal and the decrease of MDF and contraction force represent the EMG and MMG expression of muscular fatigue. The described parameters can be used in the development of muscular fatigue assessment protocols, useful in physiological quantification of effort and for the evaluation of athletes’ training level. These data justify the development of multiple applications using the two techniques in the investigation of muscular fatigue.

Keywords: maximal isometric voluntary contraction, muscular fatigue, surface electromyography (S-EMG), mechanomyography (MMG).