Tensiomyography in Physical Rehabilitation of High Level Athletes

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Abstract: The proprieties of a skeletal muscle were examined using the method Tensiomyography (TMG) in team sports high-level athletes who contracted a skeletal muscle injury, lesion confirmed by a magnetic resonance image (MRI). The analysis by the TMG is performed during the rehabilitation process, a non-invasive method, allowing the recording of chances in muscle following parameters: Td (time of reaction); Tc (time of contraction); Dm (maximum displacement); Tr (time of relaxation) and Ts (time of during contraction). Therefore, the aim of the study is to analyze the muscular reaction to the process of rehabilitation training.

Keywords: Skeletal muscle, muscle injury, tensiomyography, muscle reaction.

INTRODUCTION

Tensiomyography (TMG) is a simple and non-invasive method for measuring muscle properties (contraction speed, and consequently, percentage of fast and slow muscle fibres) and their functional profile/response and adaptation (chronic and acute fatigue and the extent of muscle tissue damage after injury).

TMG measurements provide benefits in monitoring post-traumatic recovery. Due to its non-invasive nature, the TMG method can provide useful information about the extent of damage of the injured muscle. Obtained information can then be used to determine the type, intensity, and frequency of training in order to make the recovery quicker and more effective.

This approach can be used to investigate high level athletes who are in the process of training for muscle recovery, as a result of skeletal muscle injury. After detection and to allow a specific diagnose of the lesion, the individual is subjected to a protocol with the method of measurement (TMG), a non-invasive method.

TMG is a measuring method for skeletal muscles contractile proprieties detection. This measurement is carried out under isometric conditions. With a displacement sensor the radial enlargement of muscle belly is measured. Measuring results are presented as time/displacement curves (muscle belly displacement against time). Muscle belly displacement is proportional to muscle force. When the skeletal muscle contracts, its middle parte (muscle belly) is radially thickened. Muscle belly enlargement is obtained with involuntary or electrically evoked contraction.

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BACKGROUND

To apply TMG method, the individual must be laid in bed and relaxed; the skin should be cleaned with alcohol and dried. It is not necessary that the individual perform any effort or any kind of resistance. This means that the subject is totally relaxed. The placement of the electrodes is ten centimetres from the source. The sensor is placed in the middle of the electrodes (muscle belly). The method consists of a discharge to the muscle that causes involuntary contraction. The discharge is increased to achieve maximum muscle displacement. The sensor detects the radial displacement and the software translates the mechanical movement in a curve of time / displacement.

First, some initial steps should be taken to determine the initial state of the muscle. Then, a specific protocol is used for Intermittent Stimulation to completely exhaust of the muscle in question. This phase usually lasts 7 minutes. Finally, the state of muscle is measured every 10 seconds during 10 minutes. In this step, one can observe the period of recovery of the muscle. From the period of recovery of the muscle it can be determined the optimal interval of rest. This information is obtained under supervision of the recovery process of the muscle and it is determined by the time that the fast fibbers of the muscle become reactive again.

TMG protocol consists of three intensities of stimulation. In the beginning, "supramaximal" amplitude of stimulation is applied in all the contractile muscle fibbers that are active for stimulation. The extent of stimulation ensures the large displacement of the muscle belly. In the TMG "supramaximal" corresponds to an amplitude of 40-60mA and the pulse has reached the duration of 1ms. Second, the amplitude of stimulation is reduced in 50% of the "supramaximal" stimulation. In the end, the third part of the protocol, the magnitude of stimulation decreased in 10% of "supramaximal" load. The belly of the muscle responds to stimulation whereas a reflex recruitment superficial fibber occurs.

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DISCUSSION

The method Tensiomyography started to be used in 1983, when scholars of the Laboratory for Biomedical Visualization and Muscle Biomechanics Laboratory for Computational and Electromagnetic "University of Ljubljana (Slovenia), led by Professor Vojko Valencic, began to develop this method.

Tensiomyography is an innovative and easy technique that allows detecting and analyzing separately the properties of the superficial muscles of each individual. It is a method of diagnosis that runs through the observation of canonicals time and maximum displacement of muscles during contraction. The purpose of continuous maintenance of the state of muscle fibbers and monitoring of their evolution separately will provide selective information of the muscles measured.

TMG permit to detect the "critical points" of each individual and to avoid injury, or if they have already occurred, to identify them with certainty and to prescribe a personalized recovery until the lesion are completely recovered.

What is important is that this can be obtained through a non-invasive method, without any effort of the subject. It is repeatable which enables to assess the best monitoring of the recovery in each moment. Regarding the high-level sports, it can be even better by optimizing the process of training, allowing to dose the load and intensity of work, or to detect muscle fatigue when it appears.

TMG technology can be of great help to integrate rapidly an athlete in the team training process after a rehabilitation process. It is particularly useful to improve the decision about the moment in which the athlete should return to normal work, avoiding the precipitation returns to the routine of training. Moreover, one can control the muscle properties and to detect any change in the same muscle, due to a recent injury or an inadequate amount of work.

This information can be of great interest in the process of postoperative recovery.

According to a brief review of several studies on Tensiomyography published in scientific journals, the main studies aimed the following dimensions: (i) comparison with other methods of measurement (histioquimics, [1]; electromyography, [2]; (ii) validation of the method TMG [3]; (iii) time factor, age [4]; (iv) implementation of TMG in the sports [5]; (v) understanding of the phenomenon fatigue [6, 7] and; (vi) medical aspects of the implementation of TMG [8-10].

CONCLUSION

The TMG method can be used as a further contribution to optimize the process of rehabilitation and physical recovery of athletes with muscle injuries. A simple methodology is an important factor for the feasibility of the method. In addition, it is objective, non-invasive, rapid and selective, and can give repetitive information. The characteristics of the equipment allow assessing the data with great mobility, important factor in sports teams.

RECOMMENDATION

TMG measurements should be continuous with the sports teams. The changes in contractile properties of the muscles of each athlete should be examined to allow controlling the training process. This aim could help avoiding injuries and to recover completely from those. The optimization of the training method could be achieved with TMG.

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