



SCIENCE FOR  
BODY EVOLUTION.

## LOCAL MUSCLE FATIGUE

### APPLICATION NOTE

The concept that helps the understanding  
of what occurs within the muscles  
during loading.

# Local muscle fatigue - introduction

Local muscle fatigue (LMF) is a phenomenon that can assist the understanding of what occurs within the muscles during muscle loading. It essentially sets the boundary between differing functional states of the muscles. Therefore, determining the degree of LMF may be a universally applied process in training optimisation and injury prevention.

## APPLICATIONS

### 1. LMF & Muscle Activation

Determine the loading limits at which LMF does not negatively influence the pattern of muscle activation.

#### Practical Examples:

- A.** It is necessary to know when changes in muscle activation patterns occur, especially in sports that require the combination of fine controlled movement, speed and force. The effectiveness of training is related to muscle activation or recruitment order. LMF influences muscle activation and recruitment order, more specifically LMF can have a negative influence whilst learning new movement skills. In addition, when returning from an injury an athlete typically presents inefficient movement patterns, these may be explained by distinct alterations in LMF. Therefore, LMF should be monitored to control muscle function for optimal movement patterns. Monitoring may be effectively achieved by incorporating the TMG 100 system. Athletes are measured at baseline and during specific tests aimed at identifying LMF (via significant TMG signal changes). The tests are devised in a way in which measurements for LMF are taken after each repetition, in order to ascertain the level at which the athlete begins to be influenced by LMF. Exercise is terminated once LMF is evident on the muscle level.
- B.** Sports in which speed of cyclical movements is essential: For optimal maximum rapid movement, it is essential that movements are carried with a high degree of automaticity. Varying levels of LMF through different muscles, causes decreased intra-muscle synchronisation, which further leads to a negative effect upon efficiency and also raises the probability of sustaining an injury. In order to measure



systemic LMF, at least 2 relevant muscle groups must be measured.

Two muscle groups are measured as muscles operate synchronously, and often synergistically or as antagonists. LMF may reduce efficiency, and also increase the risk of injury. The measurements should be conducted in various stages of muscle activation.

### 2. LMF & Potentiation

Neuromuscular potentiation is a phenomenon which is related to the ability of the neuromuscular system

# Example - tracking field athlete

to perform faster movements after initial loading. The warm-up phase would be an example of initial loading. Generally it was considered to occur before reaching the LMF potentiation.

## Practical Examples:

- **A.** The term 'neuromuscular potentiation' is characterised by both an increase in force (amplitude) and speed of contraction (signal shifts to the left). During the warm-up phase, measurements may be obtained in order to identify the moment in which this potentiation stabilises, and therefore the athlete may begin competition. This may be useful in order to optimise the preparation time for an athlete.
- **B.** Under normal circumstances, athletes present typical changes when potentiation occurs. However, significant deviations from typical signals may be caused by underlying chronic fatigue. Chronic fatigue may be illustrated by a decrease in both amplitude of potentiation and signal offset to the left. This procedure is applicable to sports which involve intermittently low, and high intensity movements, such as football and basketball. Measurements must be performed repeatedly, at pre and post introductory training, in order to compare changes in the signal.

## 3. LMF & Injury

Determine the range in which there is LMF, in order to reduce the risk of injury in sport or training with elements of endurance. The relationship between intensity and efficiency of movement is a key factor. LMF at relatively low exercise intensities would indicate dynamic muscle weakness and underlying clinical conditions. In contrast, LMF present at relatively high intensity exercise may indicate insufficient neuromuscular adaptation to particular tasks. Thus, it is imperative to identify potential imbalances in order to provide training to assist in avoiding the risk of musculoskeletal injuries. It is also necessary to determine how different muscles respond to a variety of training programmes as monitoring may provide a

platform in which to reduce the risk of injury. In such cases, further evaluation is required.

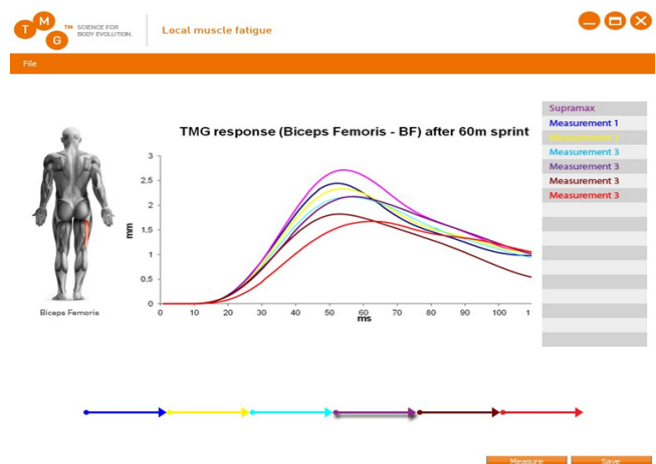
TMG allows measurements of important characteristics related to LMF. In addition, it can also be used to quantitatively determine the degree of change known as 'size of LMF'. Furthermore, LMF determination requires individual testing.

## EXAMPLE

We have been monitoring 60m sprint type run repeated on 6 occasions with 3-minute rest intervals.

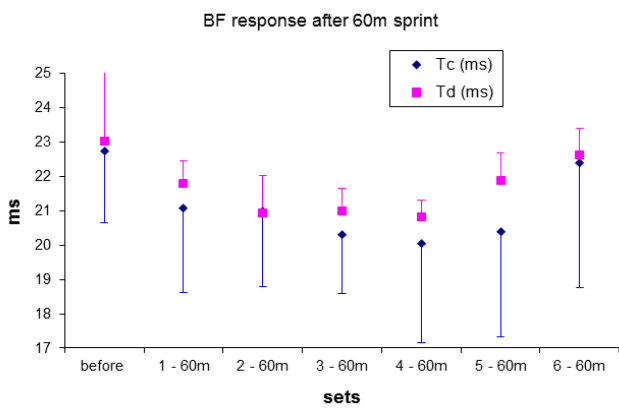
Muscle radial displacement is decreasing after every repetition, while time of contraction improves after the first sprint. Initially (in our case after 4th repetition) fast muscle

*Picture 1: Graphical presentations of muscle function after each repetition.*

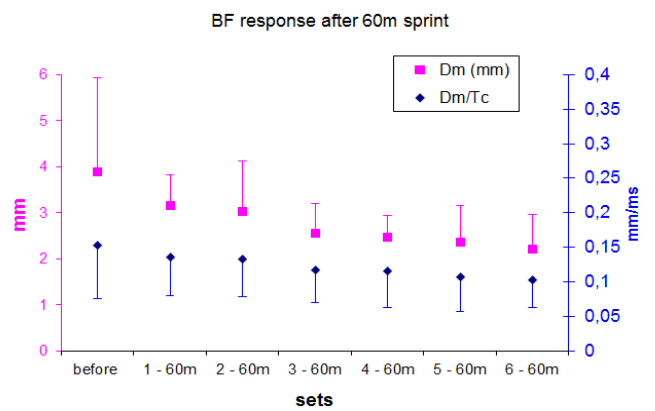


# Example - tracking field athlete

Picture 2: Example: contraction time ( $T_c$ ) of BF muscle starts to increase after 4th repetition



Picture 3: Example: Muscle radial displacement ( $D_m$ ) is lower after each repetition.



# About - TMG 100 System

TMG 100 System is a device, widely used by experts in the field of physical medicine (doctors and physiotherapists), qualified to diagnose status of skeletal muscles.

It is used to monitor contractile properties of skeletal muscles and electrically evoked muscle contraction dynamics, revealing muscle function status.

The system can be used in the rehabilitation process (by acute and chronic injuries), in optimisation of training process, in monitoring of muscle fatigue and diagnosing muscle diseases.

The measurement method is called TMG (tensiomyography), which is validated by many scientific articles and is also patented.

Visit [www.tmg.si](http://www.tmg.si) for more information. Or get to us on one of the following contacts:

TMG-BMC Ltd., Splitska 5, 1000 Ljubljana, Slovenia

Tel: +386 838 43 007

Email: [info@tmg.si](mailto:info@tmg.si)

