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LETTER TO THE EDITOR

Is tensiomyography a useful assessment tool in sports medicine?

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To the Editor,

In recent years, a relatively new assessment tool known as tensiomyography (TMG) has been gaining popularity in the field of sports medicine with the main purpose of monitoring muscular impairments, imbalances and fatigue. However, it seems that despite the incremental number of publications each year, there is skepticism by editors, reviewers and researchers with major concerns related with the validity, reliability and usefulness of this technique in sports medicine. The purpose of this letter was to provide a general overview about TMG to the reader and discuss about its current usefulness as an assessment tool in sports medicine.

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TMG is a non-invasive, selective and easy-to-use assessment tool, which measures muscle belly enlargement in transversal plane during an isometric twitch contraction to detect impaired neuromuscular properties, muscle imbalances and side-to-side asymmetries. The main outputs/parameters are essentially five contractile parameters: maximal displacement (Dm), delay time (Td), contraction time (Tc), half relaxation time (Tr) and sustain time (Ts), with the first two considered as key elements. TMG shows good-to-excellent between-day, intra-session, long-term stability, and inter-observer reliability and low measurement error in all these parameters [5, 10, 11], except for Tr and Ts which, according to our experience and previous studies [11], are now no longer recommended.

An important finding in recent years has been that this tool significantly correlated with the fatigue-induced decreases in muscular force [4, 6]. In fact, Dm and the velocities of contraction until 10% (V_{10}) and 90% (V_{90}) of Dm have been considered as indirect markers of muscle fatigue [4, 7]. This technique has been also useful as an evaluation tool for muscular impairment in a number of conditions. First, TMG has been used to identify potential risk factors for anterior cruciate ligament (ACL) injuries [1]. Alentorn-Geli et al. [1] have suggested that a reduced Dm in the biceps femoris may be considered as a risk factor for ACL injury in male soccer players. Second, TMG has been shown to be a useful tool to evaluate and quantify painful trigger points (i.e., pain in the gluteus maximus area) in hip disorders (i.e., femoroacetabular impingement) [8]. Third, TMG has been used to monitor muscular changes/adaptations of the lower extremity (quadriceps, hamstrings and gastrocnemius) in response to ACL reconstruction and its subsequent rehabilitation process [2], and muscular changes/adaptations of the gluteus maximus in response to hip arthroscopy and subsequent rehabilitation for

femoroacetabular impingement [9]. Recently, Maeda et al. have demonstrated that the presence of strength and symmetry deficits (i.e., analyzed by TMG) in the vastus medialis and biceps femoris suggests the need for long-term postoperative training following ACL reconstruction, indicating that TMG could be of relevance in the follow-up of an ACL reconstruction [9]. These studies suggest a potential clinical usefulness of TMG to evaluate and monitor muscular impairment in several musculoskeletal injuries. Considering our experience and the available literature, there are several *advantages* and *disadvantages* that can be suggested:

Advantages

- Involuntary
- Does not affect performance for subsequent training sessions
- Individual muscles assessment
- Large groups (whole team squad) measured in a short period of time

Disadvantages

- Muscles are measured under a static state; no dynamic screening is yet possible
- No direct assessment of muscular chains is possible
- Not possible to evaluate deep muscles with current devices
- Previous training sessions or competition could affect data

In our experience, TMG may sometimes have questionable intra-observer, inter-observer, and between-day variability in particular muscles or conditions in non-experienced hands. In addition, according to the definition of validity, responsiveness, and reliability provided by some authors [3], TMG would still require much more research dedicated to this topic before it can be considered a valid and reliable assessment tool. Another area to be developed in future research is its usefulness as screening tool to identify athletes at risk of injury, particularly for muscle injuries.

In conclusion, despite TMG is widely used in sport clubs, training and rehabilitation centers, given the lack of high-quality, well-conducted studies there is not enough evidence to date to support its unquestionable and systematic use in sports medicine. However, recent insights suggest that TMG may be a promising tool for screening, diagnosis, and monitoring the response to surgical treatment. We hope this Letter encourages researchers to further investigate on measurement properties (validity, responsiveness, and reliability) and applicability of TMG in sports medicine, as this is an assessment tool that, in our experience, may have great potential to improve prevention and management of musculoskeletal injuries in athletes.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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