

Combining several Most Voluntary Isometric Contraction to improve the reproducibility of the sEMG normalization of the gastrocnemius muscle

1	Cédric	Schwartz	cedric.schwartz@uliege.be	Laboratory of Human Motion Analysis, ULiège, Liège, Belgium
2	Bénédicte	Forthomme	bforthomme@chuliege.be	Laboratory of Human Motion Analysis, ULiège, Liège, Belgium
3	Olivier	Brüls	o.bruls@uliege.be	Laboratory of Human Motion Analysis, ULiège, Liège, Belgium
4	Vincent	Denoël	v.denoel@uliege.be	Laboratory of Human Motion Analysis, ULiège, Liège, Belgium
5	Jean-Louis	Croisier	jlcroisier@uliege.be	Laboratory of Human Motion Analysis, ULiège, Liège, Belgium

• Introduction

The lower limb muscles play an important role in the quality of gait. sEMG is commonly used to evaluate muscle contractions intensity ¹ during quantified gait evaluations. There is, however, no unequivocal relationship between the amplitude of the electrical signal and the force exerted by the muscle because of intrinsic and extrinsic factors ². Consequently, electromyographic recordings need to be normalized if comparisons between subjects or of one subject at different times are sought. Maximal voluntary isometric contractions (MVIC) are commonly used ³.

Most studies based the normalization of the EMG on a single position for the MVICs even though some results ⁴ suggest that several positions are needed. A key factor to use EMG evaluations for rehabilitation or clinical trials is the ability to obtain reliable measurements over time. To the best of our knowledge, little has been done to evaluate the effect of combining several MVICs positions on the inter-session reproducibility of the maximal voluntary activation (MVA) determination for the lower limb.

• Research Question

The effect of combining several positions for MVIC for the medial and lateral gastrocnemius on the inter-session reproducibility of MVA was evaluated.

• Methods

Eleven volunteers (23.6 ± 1.0 years old) were asked to perform three MVIC in six positions (unipodal leg straight, bipodal leg straight, bipodal leg flexed at 90°, prone 10° dorsiflexion, prone neutral, prone 30° plantarflexion). The same test was performed twice at one-week interval. For each muscle, the best combination of positions providing 90% of MVA for 90% of the volunteers with an inter-session MVA difference inferior to 10% of MVA was computed.

• Results

When considering only the 90% of MVA for 90% of the volunteers, the unipodal standing position was enough for the medial gastrocnemius but no single position was found for the lateral gastrocnemius (figure 1). When the criterion of reproducibility was taken into account, several positions were needed for both muscles. For the medial gastrocnemius, the bipodal standing position and prone neutral were recommended. For the lateral gastrocnemius, the same positions as the medial gastrocnemius were needed plus the unipodal standing position.

• Discussion

The present research has demonstrated that all subjects do not perform their maximal activation in the same position and in a reproducible way. This result which has already been demonstrated for the shoulder muscles

⁵ is here shown on for muscular group having lower level of muscular redundancy. The ability to obtain a maximal activation of the volunteers/patients have a direct impact on the normalized EMG signal and therefore on the clinical interpretation of it (diagnosis, effect of treatment/revalidation protocol ...). Based on our results, we would therefore recommend that the normalization of the EMG signal should be based on MVIC performed in several positions.

- **References**

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