



Reproducibility of goniometric measurement of joint angles to standardize Motor Evoked Potentials



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Introduction and Objective

Muscular pre-activation is commonly used to facilitate Motor Evoked Potentials (MEPs) in order to reduce latency and variability. However, no guidelines exist to standardize this procedure in terms of efficacy and reproducibility. We tested the reproducibility of joint goniometry during muscular facilitation maneuvers for Abductor Digit Minimi (ADM) and Tibialis Anterior (TA) muscles.

Methods

We enrolled 10 healthy subjects and recorded surface EMG of ADM and TA in different conditions at t0 (basal) and t1 (60-days after t0) evaluations. We used a standard two-arms goniometer for medical use to measure joint angles at various levels of the range of motion (ROM). To test the ADM muscle, we asked the subjects to perform fifth finger abductions at 50, 70, 90 and 100% of their maximum angle (MA). This angle was expressed as a percentage because of a greater variability in the fifth metacarpophalangeal joint. To test TA, we asked them to perform ankle dorsiflexion at rest, 0°, 10° and 15°. For TA fixed angles were chosen because of a minor variability in ROM between subjects. EMG signal was expressed as percentage of the maximum voluntary isometric contraction (MVIC). Mean values from t0 and t1 at the different conditions of angles were analyzed and two-way mixed intraclass correlation coefficient (ICC) was calculated.

Results

For ADM, mean EMG values at t0 were respectively 3.22, 6.47, 8.553 and 32.391 for 50, 70, 90 and 100% of MA. Values at t1 were 2.31, 6.725, 10.567, 37.951 respectively, with strong correlation for 50% and 70% of the MA (ICC = 0.892 and 0.868 respectively), while 90% and 100% of the MA conditions were less correlated in the two observations (ICC = 0.595, 0.035). For TA, mean EMG levels at t0 were 2.84, 15.85, 23.69 and 47.72 at rest, 0°, 10° and 15° respectively. At t1, these values were 3.839, 16.57, 25.812, 53.325; a strong correlation was found for all the conditions (ICC = 0.864, 0.724, 0.829, 0.858).

For ADM we found a greater variability within subjects over time for 90% and 100% of MA, maybe due to a complex anatomic-functional structure of the joint, on which many muscles activate with progressive increase of the ROM. However, this variability may be reduced using specific angles (50%-70% of MA). In opposite, TA showed a more linear progressive response with better reproducibility over time at all pre-activation levels, maybe due to a minor complexity of this joint.

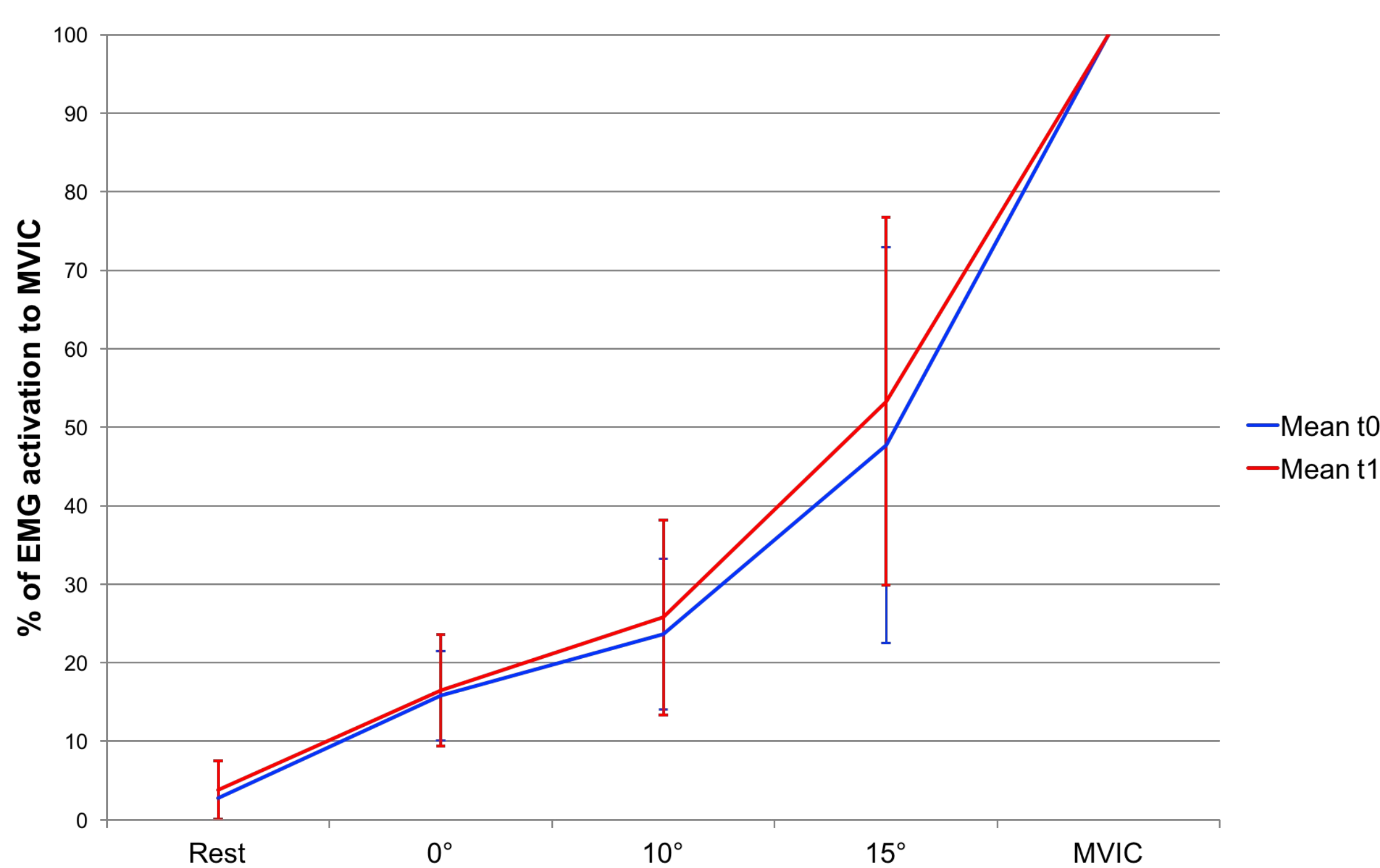


Figure 1 – Mean EMG levels expressed as a percentage of the maximum voluntary isometric contraction for tibialis anterior muscle (TA) at t0 and t1 (60-days after t0) evaluations

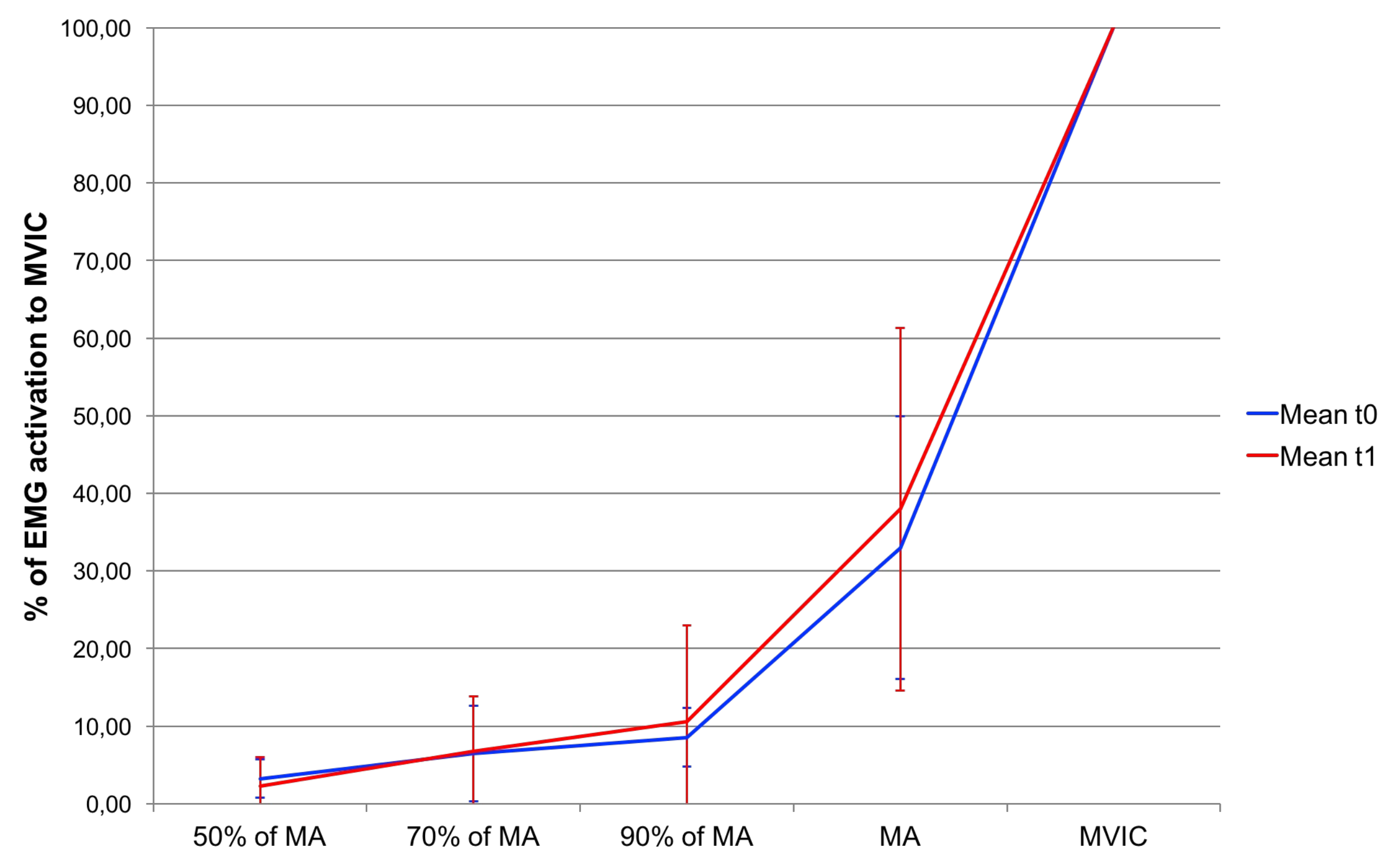


Figure 2 – Mean EMG levels expressed as a percentage of the maximum voluntary isometric contraction for Abductor Digiti Minimi (ADM) at t0 and t1 (60-days after t0) evaluations

Conclusions

Goniometric measurement of joint angles for muscular pre-activation in MEPs seems to be a reliable method both for ADM and TA muscles if specific levels of muscular contraction are chosen. If validated, this method may represent a low-cost, reproducible and simple way to standardize MEPs.

Bibliography

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