

I. INTRODUCTION

Several investigators have highlighted the benefits of quadriceps stimulation during rehabilitation following traumatic injury or surgery of the knee and during physical preparation of athletes (1). However, the practical modalities of quadriceps stimulation (number, size and localization of electrodes) remain controversial (2). The present work aimed to determine the optimal electrodes setting for neuromuscular electrical stimulations (NMES) applied to the quadriceps.

III. RESULTS

The MPVM and MPVL were situated 10 ± 2 cm and 14 ± 3 from the patellar base, respectively. The stimulated contractions reached 9.2 ± 7.4 Nm for **ES1**, 8 ± 4.8 Nm for **ES2**, 15 ± 8.3 Nm for **ES3**, 16.3 ± 7.7 Nm for **ES4** and 40.4 ± 11.3 Nm for **ES5** ($p < 0.05$) (**Figure 2**).

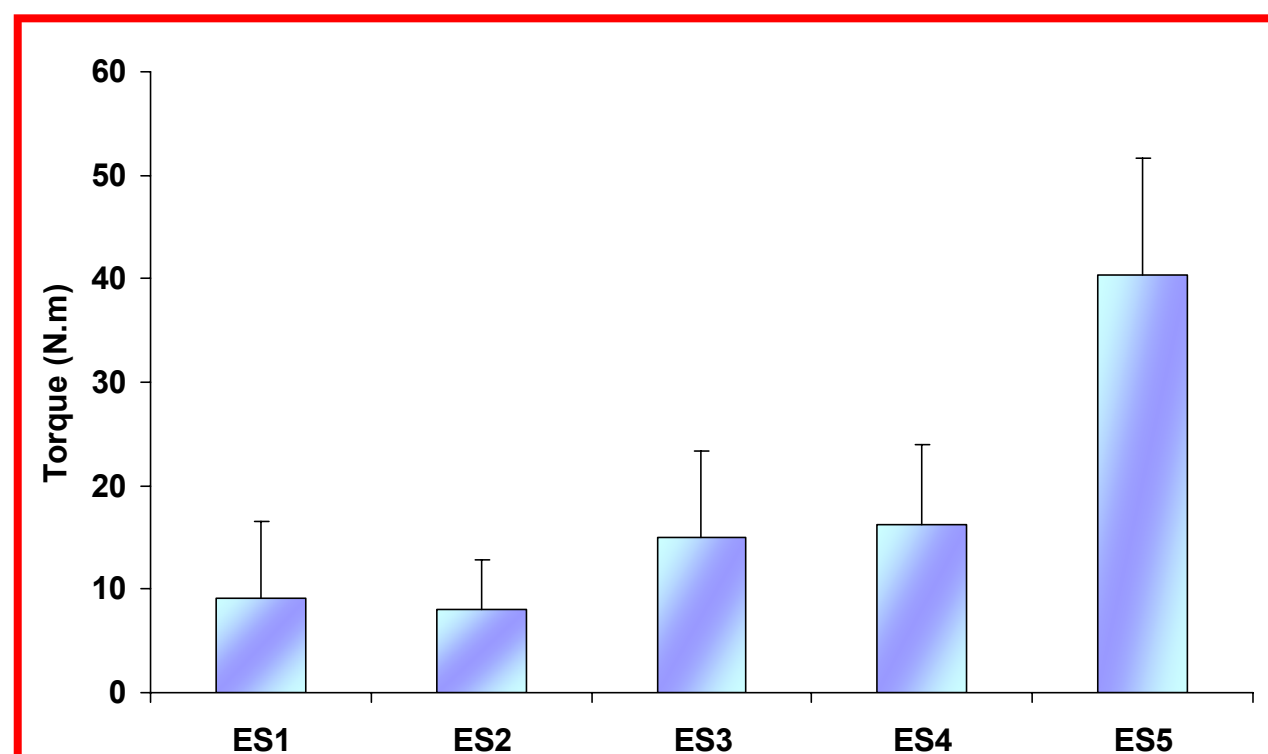


Figure 2: Mean peak torques (+ SD) measured during quadriceps stimulation with five electrodes settings (ES)

II. METHODS

The exact localization of the motor points of vastus medialis (MPVM) and vastus lateralis (MPVL) was determined in twenty physically active men (23 ± 2 years, 180 ± 8 cm, 75 ± 12 Kg). Then, we tested unilaterally, isometrically and consecutively five electrodes settings (ES) (**Figure 1**) including rectangular (10 x 5 cm) (RE) or square (5 x 5 cm) (SE) electrodes, with identical stimulation parameters (biphasic symmetric rectangular pulses, 80 Hz, pulse duration 0.35 ms, constant current intensity (42 ± 11 mA)): **ES1**= 1 channel, 2 RE transversally on the thigh (with the distal electrode placed on MPVM and MPVL); **ES2**= 1 channel, 2 RE longitudinally on MPVM and MPVL; **ES3**= 1 channel, 2 SE on MPVM and MPVL; **ES4**= 2 channels, 4 SE (with 2 SE placed on MPVM and MPVL); **ES5**= 2 channels, channel 1= 1 SE on MPVM and 1 RE transversally on the proximal part of the thigh, channel 2= 1 SE on MPVL and 1 RE transversally on the proximal part of the thigh. For each ES we measured the electrostimulated torque.

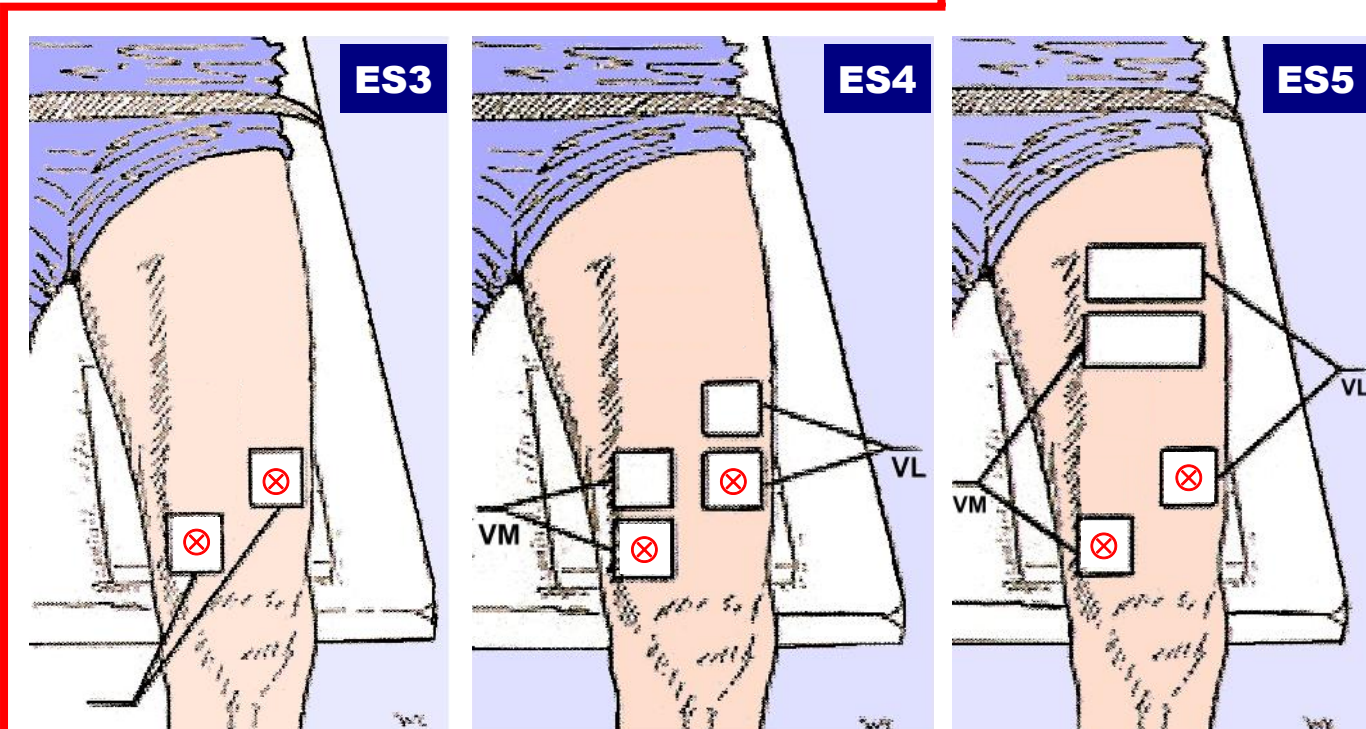
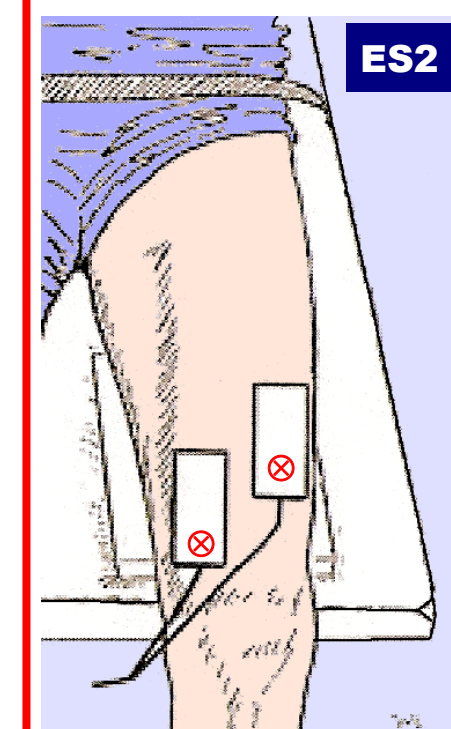
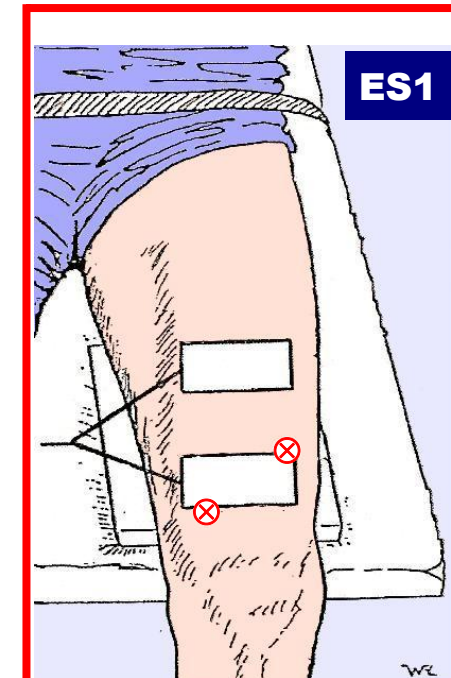


Figure 1: Schematic representation of the 5 electrodes settings (ES). ⊗ = localization of the motor points of vastus medialis (VM) and vastus lateralis (VL)

IV. DISCUSSION

During NMES programs it appears crucial to use a proper electrode setting ensuring efficient muscle recruitment and therefore optimized training effects. This study demonstrated the relevance of using two channels for quadriceps NMES and of setting, for each channel, one small “excitatory” electrode exactly on the motor point of vastus medialis or lateralis and one bigger “dispersive” electrode transversally on the proximal part of the thigh (in order to close the circuit).

V. REFERENCES

- (1) Kramer JF, Mendryk SW. (1982). Phys Ther, 4, 1657-1667.
- (2) Vanderthommen M, Duchateau J (2007). Exerc Sport Sci Rev, 35, 180-185.