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NEUROMUSCULAR ASYMMETRIES IN ANTERIOR CRUCIATE LIGAMENT PATIENTS AND IN HEALTHY SUBJECTS USING THE TWITCH INTERPOLATION TECHNIQUE

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BACKGROUND AND AIM

Evaluating muscle strength and its physiological determinants is relevant for patient populations, because it can help identifying the impairment(s) and thus orient the rehabilitation process. This is particularly true for the knee extensor muscles, whose force-generating capacity strongly affects physical function and health-related quality of life in orthopedic patients (Mizner et al. 2005; Mizner and Snyder-Mackler 2005; Maffiuletti et al. 2010). The objective of this methodological study was to examine the validity of the twitch interpolation technique for evaluating neuromuscular quadriceps asymmetries.

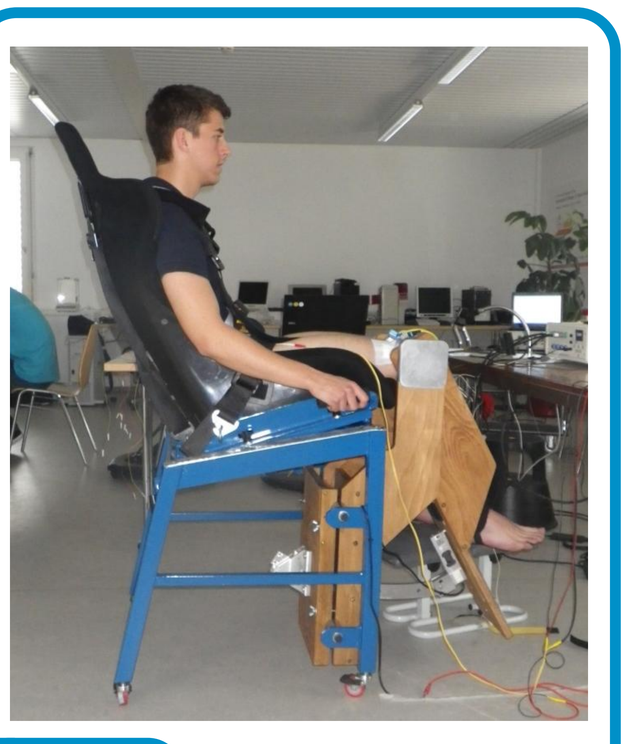

Figure 1 *Isometric Ergometer*

MATERIALS AND METHODS

Fifty-seven subjects participated in the study (19 healthy, 24 with unilaterally- and 14 with bilaterally-reconstructed anterior cruciate ligament). Supramaximal electrical paired stimuli were delivered to the quadriceps muscle during and after maximal voluntary contractions (MVC) (Place et al. 2007) The main outcomes were left and right MVC torque, activation level (AL) and resting doublet (DB) torque. Percent asymmetries between the left and the right side were computed for each parameter and MVC asymmetry (representing strength asymmetry) was plotted against AL ("neural") asymmetry and DB ("contractile") asymmetry. For MVC torque and doublet torque, left-right asymmetries were calculated according to the following formula: [(stronger side – weaker side) / stronger side] x 100%], where a negative sign was arbitrarily assigned when the left side was the stronger one and vice versa for the right side (Impellizzeri et al. 2007).

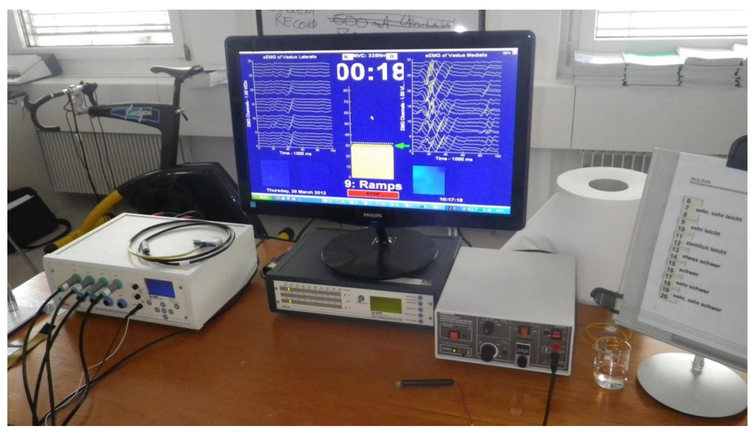

Figure 2 *Experimental Set-Up*

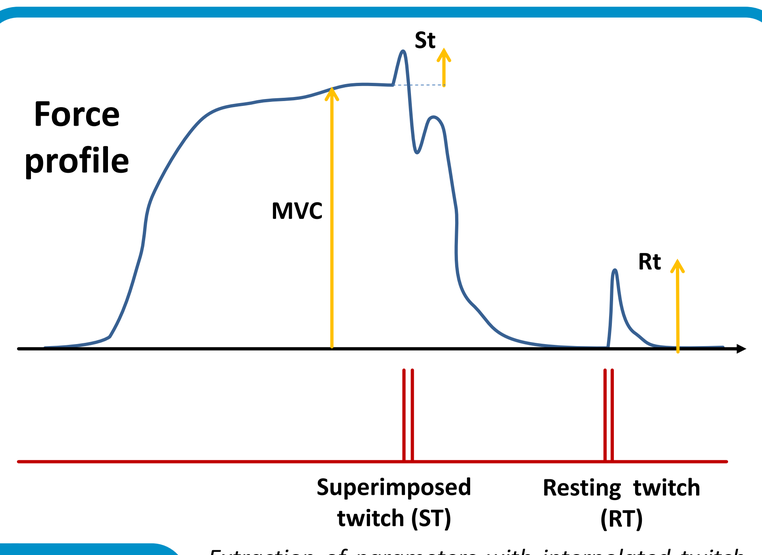

Figure 3 *Extraction of parameters with interpolated twitch technique*

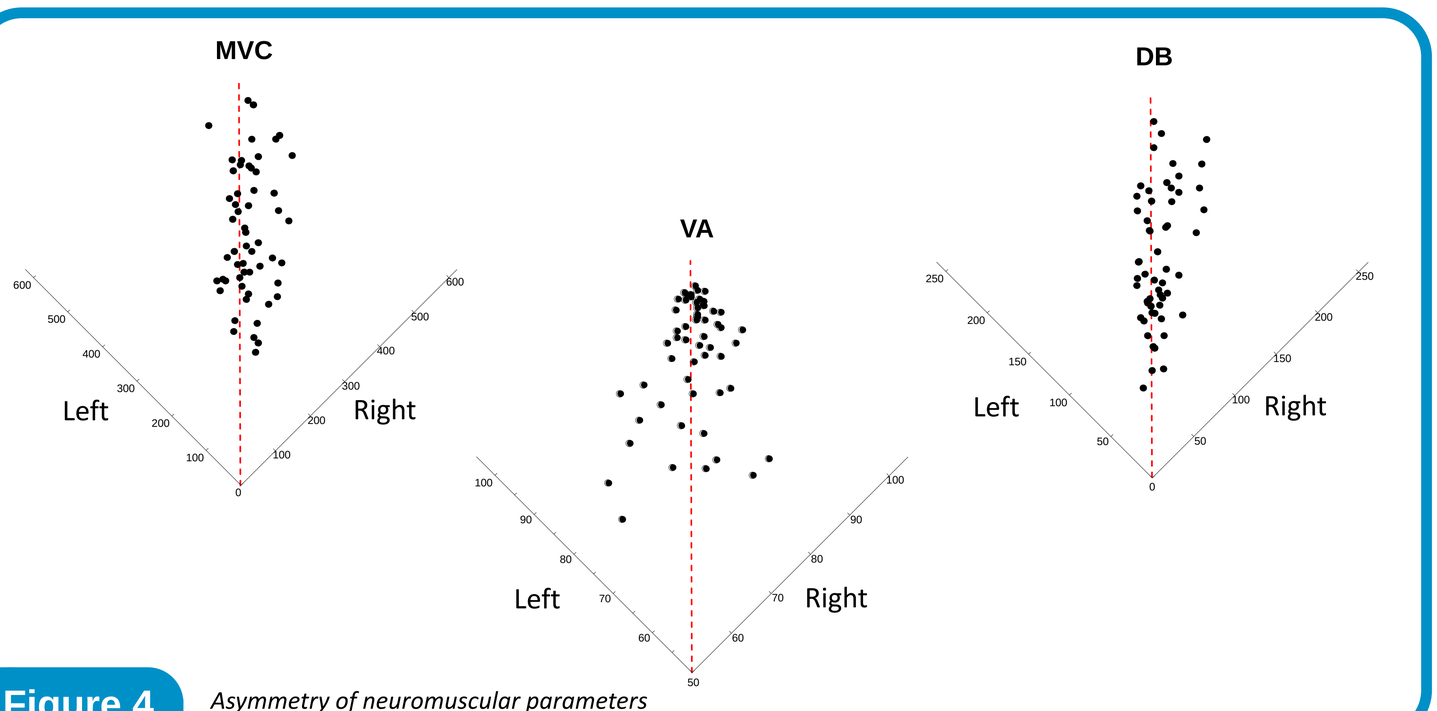

Figure 4 *Asymmetry of neuromuscular parameters*

RESULTS

The mean MVC torque was 353 ± 96 Nm for the left side (95% CI: 327-379 Nm) and 377 ± 99 Nm for the right side (95% CI: 350-403 Nm).

Mean activation was 90 ± 8% for both sides (95% CI: 88-92% for the left side and 87-92 for the right side). The mean doublet torque was 130 ± 38 Nm for the left side (95% CI: 120-140 Nm) and 139 ± 45 Nm for the right side (95% CI: 127-151 Nm).

Significant positive correlations were observed between AL asymmetry and MVC asymmetry ($r=0.404$; $p=0.004$) and between DB asymmetry and MVC asymmetry ($r=0.506$; $p<0.001$). An index of global neuromuscular asymmetry was then computed by summing up AL and DB asymmetries. This neuromuscular asymmetry index was strongly correlated with MVC asymmetry ($r=0.649$; $p<0.001$).

CONCLUSIONS

These results establish the validity of the twitch interpolation technique, which is based on the simple analysis of voluntary and evoked torque traces, for the evaluation of neuromuscular quadriceps asymmetries.

Our present findings also provide new insights into the contribution of neural (activation level) and muscular (contractility) mechanisms to voluntary force-generation capacity of the quadriceps femoris muscle.

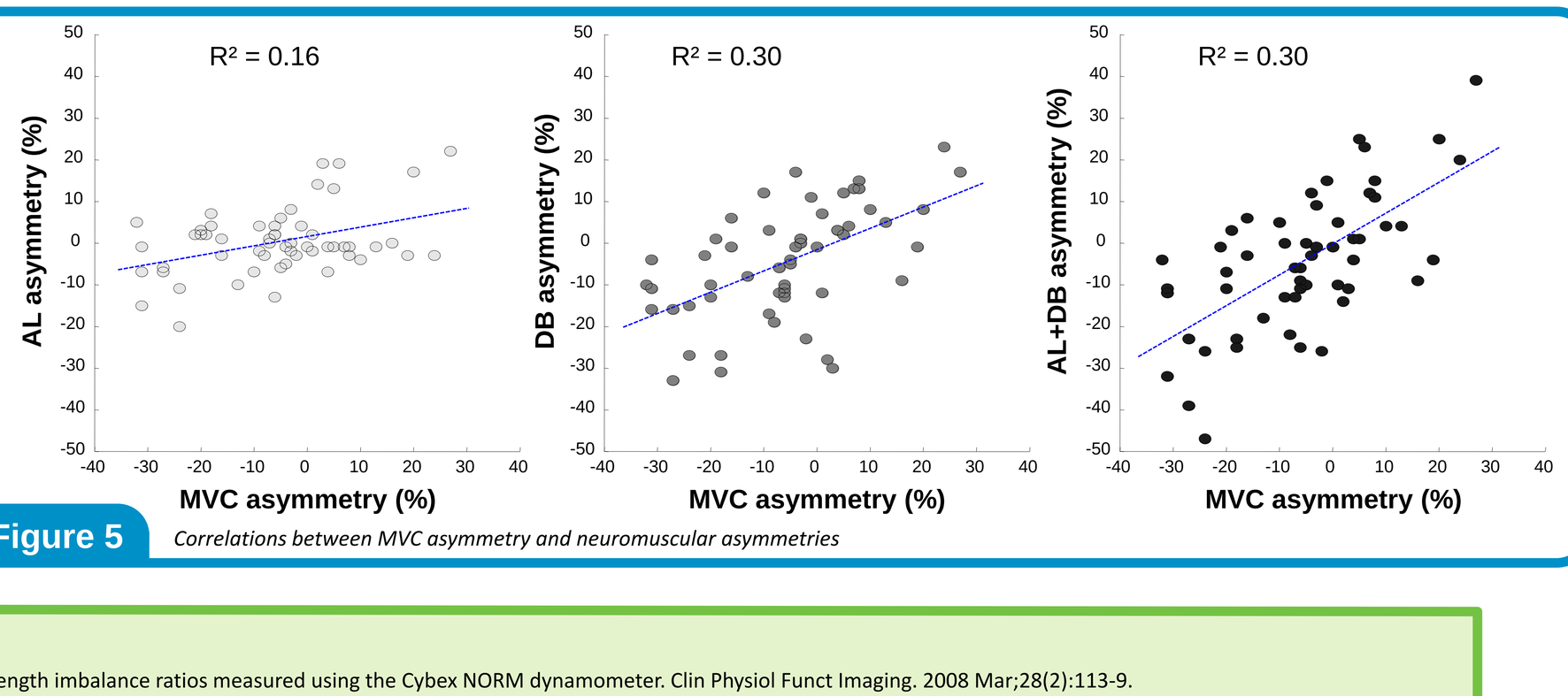

Figure 5 *Correlations between MVC asymmetry and neuromuscular asymmetries*

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