MUSCLE ACTIVATION ASYMMETRY IN PATIENTS AFTER HIP REPLACEMENT EVALUATED USING SURFACE ELECTROMYOGRAPHY

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In the last years, surface electromyography (EMG) has been often used as a tool to assess and evaluate different diseases and disorders. Even though its effectiveness in analyzing muscle fatigue was largely shown [1-4], there is still lack of information regarding the evolution of muscle fatigue signals in patients with hip replacement during sub-acute period. The aim of this study was to evaluate muscle fatigue and asymmetry between healthy and operated limb, and to investigate these parameters during a two-week rehabilitation program.

Materials and methods
Surface EMG signals were recorded from vastus medialis (VM) and vastus lateralis (VL) muscles of 43 patients (28 females) with hip replacement using adhesive concentric ring electrodes (OT-Bioeletronica, Torino, Italy) during isometric squat.
A force platform was used to provide a visual feedback in order to have an equal distribution of the body weight on the two legs (Figure 1). Patients were asked to maintain a squat position for 60 seconds. The measurements were repeated in three sessions:
• T0 two-three days after the operation,
• T1 after one week of rehabilitation
• T2 after two weeks of rehabilitation.
Muscle force was measured separately during leg extension using a hand-held dynamometer. Borg scale, numeric rating scale (NRS) for pain, Timed Up and Go (TUG) Test, were collected during each session. In addition, a WOMAC Index was used to assess pain, stiffness and physical function before the rehabilitation program and two months after the discharge from clinic, as well as an EQ-5D questionnaire to measure the health-related quality of life.
EMG signals were analyzed in order to extract amplitude (ARV), mean power frequency (MNF) and fractal dimension (FD).
Linear regression analysis was applied in order to extract initial values and slopes of the three variables (Figure 2). Statistical analysis was performed using non parametric paired tests between the two limbs (Wilcoxon signed-rank test).

Results
MNF showed a statistically significant decrease in both legs indicating muscle fatigue during the task. A statistically significant asymmetry of ARV was observed between the two legs at T0, with the operated leg showing lower EMG amplitude as expected. The asymmetry was progressively reducing at T1 and disappeared at T2. A significant correlation was observed between amplitude asymmetry and WOMAC total score. MNF slope did not change significantly during the three sessions, indicating no variations of muscle fatigue in the vasti muscles.

Conclusions
An asymmetry of muscle activation was observed after the hip replacement, with lower EMG amplitude in the operated limb. Asymmetry progressively reduced during the rehabilitation period, and disappeared after two weeks. EMG signal amplitude asymmetry showed to be a promising tool to assess muscle activity during a rehabilitation period.

References:

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