SENIAM instructions for surface electrode positioning are widely accepted in the science community (Hermens et al. 1999). These instructions define the optimal positioning of the electrodes on the muscle on the basis of anatomical landmarks. However, it is still not clear what level of quality or accuracy can be obtained in the EMG signal by following the electrode placement instructions. This study examined the medio-lateral surface EMG electrode positioning using SENIAM instructions for sensor locations with the aim to determine whether differences in the placement of the electrode influence the cross-talk from adjacent muscles.

Electrodes were positioned on the vastus medialis (VM), rectus femoris (RF) and vastus lateralis (VL) muscles in 19 male volunteers (28 ± 6 yrs, 75.6 ± 7.7 kg). The electrode placement procedure was performed by the department students who were well familiarized with the SENIAM instructions including the starting posture and identifying two anatomical landmarks. A longitudinal line was drawn between the landmarks and the electrode was positioned on the line, to halfway from the distal motor endplate zone and distal tendon. EMG signal was recorded during squat jump, counter movement jump and maximal voluntary contraction. After these measurements the electrodes were removed and the electrode locations were marked with capsules visible to MRI. Using axial MR images the electrode location along the length of the arc of the external border of the muscle was defined as a %-value from the medial border (Osiris 4 software). The distance between the electrodes in adjacent muscles was also determined. Cross-correlation of the EMG signal between adjacent muscles (peak cross-correlation efficient and the phase shift at which it occurred) was measured using Mathematica 5.0 software. Bivariate correlation was calculated between the relative electrode location on the muscle and the peak cross-correlation coefficients, as well as between the fat thickness and aEMG amplitude in each muscle.

Results showed that the medio-lateral placement of the electrodes can vary according to the muscle when the SENIAM instructions are followed. In VM the electrode position was 47 ± 11 % (range 17–67 %) along the length of the arc of the external border of the muscle. In RF the electrode position was 68 ± 15 % (range 40–100 %) and in VL 19 ± 6 % (7–28 %). We found moderate correlation in jumping conditions in the distance between RF and VL electrodes and peak cross-correlation coefficient (r=0.48 and r=0.56, respectively, p<0.05).

In the SENIAM instructions the superior-inferior positioning of the electrode is well defined while the medio-lateral positioning is not. The present study clearly shows that the electrode placement in the axial plane varies most in the VL muscle and this might influence the EMG signal.

References:


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