The effect of the fatty tissue on EMG signal among young women

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1. Introduction

Excessive muscle load and fatigue may lead to disorders of the musculoskeletal system [1, 2]. Load and fatigue of the musculoskeletal system can be assessed with usage of non-invasive surface electromyography (EMG) [3]. Studies indicate, that the EMG signal is affected not only by muscle force and fatigue, but also by subcutaneous layer [4, 5]. Fatty tissue layer between the electrode and the muscle, can cause inaccuracy in the results of the measurement obtained with application of surface electromyography [6, 7].

The aim of this study was to investigate the influence of fatty tissue layer on EMG parameters as a function of level of force and type of muscle among young women. Results of this study will provide information regarding muscles sensitive to inaccuracy when obese population is considered.

2. Methods

The research among 30 young women (mean age: 23 years old, standard deviation: 3 years) was performed. The participants were divided into two equal groups: obese group (O) with BMI ranging from 27 to 34 and level of fatty tissue (FT) above 31% as well as reference group (R) with BMI ranging from 18 to 22 and level of FT up to 25%.

During measurements five levels of load (5%, 15%, 30%, 50% and 70% MVC) were carried out. The participants activated palmaris longus (PL) and rectus abdominis (RA) muscles with constant force and under isometric conditions (constant length of muscles).

For measurements and registration of the raw EMG signal the Bagnoli-16 device (Delsys, USA) was used. The registered EMG signal was sampled at the frequency of 4 kHz. Amount of FT was measured with Futrex 6100 (Futrex, USA).

3. Results

The RMS (root mean square) amplitude, expressed in % MVC (maximal voluntary contraction) and the MPF (mean power frequency) determined on the basis of the power spectrum of the EMG signal were analysed. Table 1 presents the effect of the fatty tissue layer and the force on the values of the RMS and MPF parameters from PL and RA muscles. The marginal means and confidence intervals for analysed parameters from PL and RA muscles for O and R groups during muscle tension at the 5 levels of load were presented in figure 1.

Table 1 The effect of the fatty tissue layer (O-obese and R-reference group) and the force on the values of the RMS (root mean square) and MPF (mean power frequency) parameters from PL (palmaris longus) and RA (rectus abdominis) muscles, obtained by ANOVA application

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Parameter</th>
<th>Fat layer</th>
<th>Force</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>p</td>
</tr>
<tr>
<td>PL</td>
<td>RMS</td>
<td>0.65</td>
<td>0.4214</td>
</tr>
<tr>
<td></td>
<td>MPF</td>
<td>0.93</td>
<td>0.3364</td>
</tr>
<tr>
<td>RA</td>
<td>RMS</td>
<td>14.54</td>
<td>0.0002</td>
</tr>
<tr>
<td></td>
<td>MPF</td>
<td>21.85</td>
<td>0.0001</td>
</tr>
</tbody>
</table>
Fig. 1 The mean values and 95% confidence intervals for RMS (root mean square) and MPF (mean power frequency) parameters from PL (palmaris longus) and RA (rectus abdominis) muscles for O (obese) and R (reference) groups during muscle tension at the 5 levels of load (5, 15, 30, 50 and 70% MVC)

4. Discussion

The results of the analysis indicate, that contraction level influence the EMG signal parameters in both analysed muscles, whereas the fat layer affect values of RMS and MPF parameters only in RA muscle. In PL muscle there was no influence of fatty tissue layer on analysed parameters. It can suggest that EMG signal registered from rectus abdominis muscle is sensitive to fatty tissue layer and that the influence of fatty tissue layer on EMG signal registered from this muscle should be considered. Analysis of dependence of the EMG signal on fatty tissue layer based on more detailed parameters of the power spectrum is desirable.

Acknowledgements The study financed from the resources on science in the years 2008-2010 as research project.

References