THE BIOELECTRICAL STATUS OF THE GLUTEUS MAXIMUS

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ABSTRACT
The gluteus maximus muscle plays a very significant role in person’s life activity. Particularly when we take under consideration its function in protecting our back against pain. The aim of study was to state the bioelectrical status of both gluteus maximus muscles in persons without low back pain in anamnesis. 48 participants have had done EMG of these muscles. DISA-Electronic apparatus connected with PC equipped with EMG-LAB programme has been used. There have been a significant difference in values of mean amplitude and upper amplitude between right and left side.

INTRODUCTION
Low back pain is one of the most important problems of our civilization in a few past decades [1, 3, 4, 10, 15]. Mainly this problem refers to very developed nations [5, 8, 9, 18]. According to Hadjipavious and Gracovetsky [6] near 90% accidents of low back pain should be related to a mechanical factor. We have two situations here. The first when our spine has been damaged during many years by slow acting overloads for example prolonged sitting, driving or vibrations. The second situation we can meet, when in short period of the time, our spine must counteract external overloads for example lifting heavy loads [13, 14]. By the way this situation in many cases leads to low back pain. So, it is very interesting how our muscles are prepared to this form of activity. Generally three groups of muscles take part in lifting weights. There are the erector trunci, the gluteus maximus and the rectus femoris [7, 19].

Among many methods of examining these muscles very important role plays EMG [2, 12, 16, 21]. This is really a cheap, simple, non-invasive method. I would like to present the automatic analysis of interference pattern (IP) which represents muscle activity during maximum voluntary effort [11]. This analysis should give us new informations about a functional status of the gluteus maximus muscle.

AIM OF THE STUDY
It was a statement if among people without low back pain exist any differences in the functional status of the gluteus maximus between the right and left side. These results could be a basis for examining these muscles in low back pain cases.

MATERIAL
Forty eight persons without low back pain have been examined (24 men and 24 women, age 41±8 years). All participants have lived in the town and represented non-physical style of the work. Each subject has been informed of the purpose and potential risk of the study before his or her written voluntary consent has been obtained. The study has been approved by the local Medical Ethics Committee.

METHODS
All participants have had done EMG of the gluteus maximus muscle on both sides. Following appropriate skin preparation to reduce skin impedance, 10 mm surface
electrodes (AgCl) have been attached to the skin overlying the gluteus maximus in the centre of this muscle. A reference electrode has been attached to the skin overlying the right arm. I have used DISA-Electronic apparatus connected with PC equipped with EMG-LAB programme with possibility to make registration, transformation, amplification analysis and projection of results on-line. The summary of complete examination has been presented in form of statistical values of such parameters as mean amplitude (M.A.), mean density (M.D.), background amplitude (B.Amp.), background density (B.Dens.), upper amplitude (U.Amp.), and upper density (U.Dens.).

Subject has been placed in a prone position on an examination couch with hands lying parallel to the body. Subject has been required to extend the leg maximally and to maintain this position during 2 seconds. Each exam has been done twice for each of legs. The first one has been a probe for the patient and the second has been the right one.

Data are presented as mean, median, minimum, maximum and standard deviation. Statistical analysis of the data described has been carried out using the Wilcoxon test. Statistical significance has been accepted at the 5 percent level.

RESULTS

All values of parameters which I’ve received from the left gluteus maximus muscle are presented in the table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean</th>
<th>Median</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Std.Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.A.</td>
<td>437</td>
<td>345</td>
<td>120</td>
<td>1250</td>
<td>256</td>
</tr>
<tr>
<td>M.D.</td>
<td>38</td>
<td>36</td>
<td>22</td>
<td>94</td>
<td>12</td>
</tr>
<tr>
<td>B.Amp.</td>
<td>196</td>
<td>150</td>
<td>100</td>
<td>420</td>
<td>76</td>
</tr>
<tr>
<td>B.Dens.</td>
<td>40</td>
<td>20</td>
<td>20</td>
<td>285</td>
<td>49</td>
</tr>
<tr>
<td>U.Amp.</td>
<td>1155</td>
<td>756</td>
<td>120</td>
<td>6480</td>
<td>1164</td>
</tr>
<tr>
<td>U.Dens.</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>23</td>
<td>4</td>
</tr>
</tbody>
</table>

The same parameters refers to the right gluteus maximus muscle are shown in the table 2.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean</th>
<th>Median</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Std.Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.A.</td>
<td>489</td>
<td>404</td>
<td>116</td>
<td>1324</td>
<td>294</td>
</tr>
<tr>
<td>M.D.</td>
<td>38</td>
<td>36</td>
<td>20</td>
<td>69</td>
<td>10</td>
</tr>
<tr>
<td>B.Amp.</td>
<td>205</td>
<td>150</td>
<td>100</td>
<td>550</td>
<td>97</td>
</tr>
<tr>
<td>B.Dens.</td>
<td>37</td>
<td>20</td>
<td>20</td>
<td>133</td>
<td>30</td>
</tr>
<tr>
<td>U.Amp.</td>
<td>1260</td>
<td>860</td>
<td>103</td>
<td>4720</td>
<td>1115</td>
</tr>
<tr>
<td>U.Dens.</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>8</td>
<td>2</td>
</tr>
</tbody>
</table>

Interestingly, differences exist in values of mean amplitude and upper amplitude between the left and right side (table 3).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.A.</td>
<td>p=0.02</td>
</tr>
</tbody>
</table>
DISCUSSION
Trained weight lifters lift heavy loads without a concomitant degree of acute low back injuries [19]. They use the gluteus maximus during the early stage of the lift, perhaps contributing to earlier development of force. This process would stabilize the pelvis and permit the erector spinae to extend the trunk more efficiently. Other studies have looked at the activity of trunk and abdominal muscle groups [10, 12, 17], but only a few studies have analyzed action of the leg muscle groups [19].
In my study, the EMG signal has been received from a maximal voluntary isometric contraction of the gluteus maximus. Such a maximal effort implies that all motor units are firing at their maximal level [11]. Of course, the ability to perform a maximal isometric contraction of a muscle is somewhat dependent on physical conditioning, posture, body awareness and previous muscle training.
The interference pattern (IP) analysis is made on the new developed method. It allows to determine the parameters of different MU size, their quantity and intensity of recruitment. The automatic analysis requires proper duration of time measurement (1, 2 or 3 sec.). The global assessment of interference pattern is based on two parameters represented by mean amplitude and mean density. The most predominant activity of IP [11, 20] named „Background“ is generated in most cases by complex or polyphasic low threshold MUs which MUAPs are characteristic for a given muscle and its electrophysiological state. The other clinically important information concerns the large MUs activity obtained from upper centail measurement (Upp). „Upper“ activity is generally generated by high threshold MUs [11, 20].
Mean amplitude corresponds under some conditions with a number of muscle fibers in motor units, diameter of muscle fiber and synchronicity of their contraction. Mean density can reflect the number of motor units and their frequency recruitment [20]. So called „background“ amplitude is correlated with a number of muscle fibers in small motor units, diameter of these fibers and synchronicity of their contraction. Background density corresponds with a number of small motor units and their frequency recruitment. A small motor unit is consisted of slow twitch fibers type I. Upper amplitude and upper density corresponds with these same parameters but in large motor units which are consisted of fast twitch fibers type II [20].
Results which I’ve received can suggest that among people without back problems exists significant difference in bioelectrical status between the left and right gluteus maximus muscle (see chapter Results). Values of mean amplitude are dependent on values of upper amplitude. So, the most important difference refers to values of upper amplitude. If we’ll take under consideration the hypothesis that Upper Amplitude represents a number of muscle fibers in large motor units, diameter of muscle fiber and synchronicity of their contraction, such result could be associated with morphological differences between the left and right side. But it should been confirmed by biopsy. However results of EMG show that asymmetry in functioning of both muscles exists. Maybe such disproportion leads to back pain during lifting heavy loads.

CONCLUSIONS
1. There is a difference in bioelectrical status of gluteus maximus between right and left side.
2. Surface EMG is an objective, non-invasive method of examining.
3. It's necessary to exam patients with low back pain that to state a prognostic value of this procedure in ethiopathogenesis of low back pain.

REFERENCES