MULTICHANNEL ELECTROMYOGRAPHY DURING DYNAMIC KNEE EXTENSIONS

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INTRODUCTION

Surface electromyography (EMG) has been used to investigate neuromuscular function during force contractions. Much research has examined the relationship between force and EMG during isometric contractions, however uncertainty remains regarding the relationship under dynamic conditions. This could be due to the difficulty of comparing net force around a joint with individual muscle EMG recordings. Multichannel measurements may help with more accurate interpretation of the relationship between force and EMG [1, 2]. Multichannel surface EMG allows for the measurement of topographical information concerning the distribution of the EMG activity over a muscle and may provide better insight into the mechanisms of the neuromuscular system through the use of energy maps. The purpose of this study was to examine torque and multichannel surface EMG data from healthy thigh muscle during isokinetic knee extensions to examine the relationship between muscle activity and force development. Participants were asked to visit the laboratory twice to measure reliability of the data.

METHODS

Ten healthy male subjects were recruited to participate in this study (mean age = 21.2 ± 1.14 years, height 179.97 cm ± 8.3, body mass 82.6 ± 7.9 kg). Each participant visited the lab twice (6 – 8 days apart) and completed the same protocol each time. Prior to any data collection, participants were provided with a familiarization session and asked to review and complete an informed consent form. A High Density (HD) EMG system (REFA 128 model, TMS International, The Netherlands) and an isokinetic dynamometer (Cybex) were used for data collection. Up to 93 electrodes were placed over the three muscles of the thigh (rectus femoris, vastus medialis, and vastus lateralis). The electrodes were placed onto the subjects’ thigh consistently starting on the medial side of the thigh and placed in a grid formation. The participants were seated securely in the dynamometer and were first asked to perform two 5-second isometric maximal voluntary contractions (MVCs) of the knee extensors at 90 degrees with a one-minute rest between each MVC. The participants were then asked to produce five consecutive isokinetic maximal knee extensions at 60 deg/sec with rest in between each set.

RESULTS

Figure 1 illustrates the data from one subject showing the total EMG activity compared to the total isokinetic torque. It can be seen that the overall EMG from all channels (in this case 36 channels of EMG) appears to track the isokinetic torque produced. Similar results were seen in the other subjects.

DISCUSSION & CONCLUSIONS

The preliminary HD EMG energy maps indicate for each subject the area of greatest activation during the contraction. This data suggests that when the EMG of the whole muscle is considered, the relationship to torque development is more evident. Table 1 provides the data regarding the reliability between days 1 and 2. The torque data showed that there was no significant difference between days for either isokinetic or isometric torque. The EMG data showed that while there was no significant difference between days for the time to peak EMG there was a significant difference between days for the peak EMG values (p=0.01). The inconsistency in the EMG data could be due to the inherent variations in the EMG signal or the small sample size.

Table 1: Mean torque and EMG data.

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<tr>
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<th>Day 1</th>
<th>Day 2</th>
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<tbody>
<tr>
<td>Isokinetic Torque (Nm)</td>
<td>315.6 ± 35.7</td>
<td>313.6 ± 28.8</td>
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<tr>
<td>Isometric Torque (Nm)</td>
<td>369.2 ± 49.6</td>
<td>354.2 ± 53.6</td>
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<tr>
<td>Time to peak (ms)</td>
<td>508.5± 308</td>
<td>360.8 ± 292.1</td>
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<td>Peak EMG (RMS)</td>
<td>844.6 ± 195.9</td>
<td>995 ± 325</td>
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REFERENCES