Quantitative EMG: Could it be used to differentiate between Type I and Type II muscle fibers?

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ABSTRACT

Background: Quantitative EMG analysis (QA) involves a discipline of quantitatively assessing the various features of the MUAPs. Objective: The mean amplitude depends on the number of discharging motor units, and the bias in the routine assessment of MUAPs is that they represent the degree of waveform variability. Methods: Quantitative EMG in the dominant vastus medialis muscle was studied in thirty three healthy male subjects, aged 18-25 years old. Surface EMGs of the dominant vastus medialis muscle were examined during mild and maximal voluntary contraction guided by a dynamometer (a standard measurement of strength). The electrophysiological parameters that characterize type I and type II muscle fibers including the internturn (duration between turns),T/A amplitude analysis,mean and maximum amplitude and the turns/second were analyzed in terms of mean, standard deviation, standard error of mean, mode, median, range and the minimum and maximum values. Results: A highly statistically significant difference P<0.000 was found between the electrophysical parameters characterizing type I and type II muscle fibers. Conclusion: QA appears to be a valuable supplement to the routine EMG examination. (Egypt J Neurol Psychiat Neurosurg, 2010; 47(1): 123-129)

Key Words: QA, muscle fiber types.

INTRODUCTION

There are two main types of fibers in our muscles. Slow Twitch are also known as Type I muscle fibers. They are responsible for long-duration, low intensity activity such as walking or any other aerobic activity. Fast Twitch are known as Type II fibers (divided further into A and B). They are responsible for short-duration, high intensity activity. Type IIB fibers are built for explosive, very short-duration activity such as Olympic lifts. Type IIA fibers are designed for regular high-intensity work.

To the electromyographer who is restricted to the potentials of contracting muscle fibers, many of the differences between types of motor units are not apparent. Moreover, there are a few EMG features which do reflect the underlying differences in motor units and the electromyographer should therefore be aware of the variety of motor units that exist.

Examination of individual motor unit potentials during weak voluntary effort only relates to low-threshold Type I muscle fibers. The bias in the routine assessment of MUAPs is that they represent the signals generated by low-threshold Type I (S) MUs and are superimposed between discharging MUAPs. These superimpositions may result in bizarre waveforms that may imply a pathological process in an otherwise normal study.

The final portion of the assessment of the MUAPs lies in their activation pattern. The patient gradually increases the force of contraction, resulting in greater recruitment of MUs until full activation is achieved.

In clinical tests, electromyographers always assess motor unit parameters by oscilloscope displays of waveforms and their audio characteristics and by using this simple means, an experienced examiner can detect abnormalities with reasonable certainty. Although such subjective assessment though satisfactory for the detection of unequivocal changes, may not suffice to delineate less obvious deviations or mixed patterns of abnormalities. These ambiguous circumstances call for quantitative measurement of motor unit potentials.

Physiologic properties that characterize the motor unit quantitatively include duration, spike, amplitude, phases, turns, number of satellites, and degree of waveform variability.

In 1964, Willison described a technique to analyze "turns" and "amplitudes" within the EMG trace. The EMG is converted into 2 trains of pulses that are counted to characterize the signal in terms of amplitudes and turns. Both the amplitudes/second and the turns/second increase with strength of muscle.

In 1983, Stalberg introduced a new version of the method, making it less dependent on force, by plotting the turns/second against the mean amplitude change/turn in an XY-diagram, the so-called turns/amplitude (T/A) analysis. The recordings are made during an epoch of steady contraction (typically 1 s, but 250-300 ms may be sufficient) at various levels of muscle contraction. Typically, 20 recordings are collected.
Stalberg et al. suggested a Turn-Detector to identify silent periods (acquisition was stopped if the number of turns was lower than 80).

The interference pattern of the electrical activity of muscle can be quantified by amplitude measurements, different spike counting methods, and power spectrum analyses. Interference pattern analysis (IPA) methods are used to describe the degree of activation of different muscles, muscle fatigue, occupational work, muscles in chronic pain syndromes, disused muscle, and dystonic muscle treated with botulinum toxin. In patients with neuromuscular disorders, the turns/amplitude analysis is useful for diagnosis. High diagnostic yields can be obtained without force measurements, for example, by using the amplitude as an indicator of force (the peak ratio method) or plotting the amplitude against the turns (cloud analysis).

Although, quantitation of the MUAP signal, termed quantitative analysis (QA), is currently not as cumbersome and time-consuming as in the past, it involves a discipline of quantitating the various features of the MUAPs and many electrodagnostic consultants have become accustomed to the expedient of subjective assessment of the EMG signal in routine analysis. A general trend also exists toward underutilization of new technology in instrumentation.

QA is not necessarily needed in every study, but careful analysis of the MUAP signal is essential. So why is an understanding of at least the principles of QA important? QA forms the foundation upon which routine subjective assessment of the MUAP waveforms is made.

Therefore, the aim of this study is to try to extract reliable and reproducible information from the waveforms, aiming to differentiate between type I and type II muscles fibers in a simple way by using QA.

**SUBJECTS AND METHODS**

**Subjects**
Thirty- three healthy male subjects participated in the present study. Their ages ranged from 18 to 25 years old, their heights ranged from 160 to 185 cm and their weights ranged from 60 to 100 kg. They were randomly selected from the students of the Faculty of Physical Therapy.

**Exclusion criteria:**
1- History of musculoskeletal disorders, particularly affecting the dominant lower limb.
2- Athletes subjects.
3- History of general medical disorders, particularly diabetes and uncontrolled hypertension.
4- History of surgical intervention, particularly on the tested limb.

All subjects were instructed to avoid lower limb exercises and activities during the period of the study except regular activities of daily living.

**Methods:**
QA was carried out on a four channel EMG Esaote Biomedica reporter device. Each subject was lying supine with the dominant knee flexed at 10 degrees and this was detected by a standard goniometer. The active electrode (Ag/AgCL disc electrode 1 cm in diameter) was placed over the motor point of the vastus medialis muscle and the reference was placed two cm apart.

1st phase: Each subject was asked to perform maximum contraction of the dominant vastus medialis muscle. A dynamometer was placed just above the ankle joint to detect the maximum muscle tension, and we asked the subject to maintain contracting his muscle at this level, during which automatic interference and turn/amplitude analysis were measured.

2nd phase: Each subject was instructed to make only a minimal contraction of the target muscle, often by using a phrase such as “...just think about contracting the muscle...” Just 1 motor unit firing regularly should be identified (i.e., MUAP A). Muscle tension is then measured by the dynamometer and we ask the subject to try to keep the muscle tension at this level. The screen is freezeed immediately and automatic interference analysis and turn/amplitude analysis were measured.

QA analysis was done using automatic interference pattern analysis (IPA) methods including zero-crossing, spike-counting, amplitude measurement, integration of the IP, decomposition, and turn/amplitude analysis (TAA) that allows evaluation of the interference pattern globally by eliminating the silent periods. Evaluated variables include:

- Intturn (is the time interval between two turns, that should be comprised between 0.3 and 5 ms): Mean interepoch, Mean interturn, Intturn > 3.5 ms and Intturn < 1 ms
- T/A : Mean amplitude, and Turns/second (T/S)
- Amplitude: Mean amplitude, Maximum amplitude and Mean maximum amplitude, and Amplitude/Turn (AT),
- Activity (is the number of interturns in a given epoch): Maximum activity, Time to max. activity, Activity < 30%, Activity > 30% and < 80%, and the Silent period (i.e., time intervals between a turn and the subsequent one higher than 5 ms are automatically discarded).
- Amplitude epochs: Total time, Total turns, Total turns/Total time, Mean ratio (Total mean amplitude/Turn/sec).

Automatic interference analysis was measured at the following parameters; Sweep 100 ms/div, Sensitivity 100 microvolt/div, Filters 20 Hz-10 KHz.
Minimum T/A 100 microvolt and epochs amplitude 200 msec.

**Statistical Methods:**
Data obtained during mild and maximum voluntary contraction were analyzed using the mean, standard deviation, standard error of mean, mode, median, range and the minimum and maximum values. To test the significance of differences between the two means, Paired samples t-test was applied.

**RESULTS**

**Demographic Data:**
Thirty three healthy male volunteers participated in the current study, their ages ranged from 18 to 25 years old with mean age 18.9±0.88 years, their weights ranged from 60 to 100 kg with a mean weight 77.8 ±10.13 Kgs and their heights ranged from 160 to 185 cm with mean height 175.1±3.39 cms

**Neurophysiological Data:**
The mean, standard deviation, minimum and maximum values of the electrophysiological parameters characterizing type I muscle fibers were significantly different from the same values that characterize type II muscle fibers.

Tables (1) to (5) are descriptive summary tables that illustrate the electrophysiological parameters that characterize type I and type II muscle fibers.

On Comparing the electrophysiological parameters characterizing type I (during mild contraction) and type II (during max. contraction) muscle fibers, a highly statistically significant difference was found between all variables P<0.000, except for the activity <80% P<0.12. (Table 6).

**Table 1:** Shows the mean interturn, interturn >3.5 msec and interturn <1 ms in type I and type II muscle fibers.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean interturn mild</th>
<th>Mean interturn max.</th>
<th>Interturn &lt;3.5 mild</th>
<th>Interturn &gt;3.5 max.</th>
<th>Interturn &lt;1 mild</th>
<th>Interturn &lt;1 max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3.35</td>
<td>2.69</td>
<td>49.29</td>
<td>27.80</td>
<td>0.64</td>
<td>5.18</td>
</tr>
<tr>
<td>Std. error of mean</td>
<td>6.17±0.02</td>
<td>4.95±0.02</td>
<td>2.27</td>
<td>1.40</td>
<td>0.36</td>
<td>0.69</td>
</tr>
<tr>
<td>Median</td>
<td>3.82</td>
<td>2.69</td>
<td>49.57</td>
<td>27.73</td>
<td>0.16</td>
<td>3.95</td>
</tr>
<tr>
<td>Mode</td>
<td>3.82</td>
<td>2.59</td>
<td>22.57</td>
<td>8.33</td>
<td>0.00</td>
<td>2.25</td>
</tr>
<tr>
<td>Std. deviation</td>
<td>0.35</td>
<td>0.28</td>
<td>13.05</td>
<td>8.09</td>
<td>2.11</td>
<td>3.97</td>
</tr>
<tr>
<td>Range</td>
<td>1.53</td>
<td>1.45</td>
<td>52.27</td>
<td>41.79</td>
<td>11.81</td>
<td>16.77</td>
</tr>
<tr>
<td>Min.</td>
<td>2.46</td>
<td>1.93</td>
<td>22.57</td>
<td>8.33</td>
<td>0.00</td>
<td>0.7</td>
</tr>
<tr>
<td>Max.</td>
<td>3.99</td>
<td>3.38</td>
<td>74.84</td>
<td>50.12</td>
<td>11.81</td>
<td>17.47</td>
</tr>
</tbody>
</table>

**Table 2.** Shows the T/A analysis, Turn/sec and the total turn in type I and type II muscle fibers.

<table>
<thead>
<tr>
<th>Variable</th>
<th>TA Mean AMP mild</th>
<th>TA Mean AMP max.</th>
<th>Turn/sec mild</th>
<th>Turn/sec max.</th>
<th>Total turn mild</th>
<th>Total turn max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.18</td>
<td>0.38</td>
<td>701.58</td>
<td>501.06</td>
<td>3538.3</td>
<td>2495.34</td>
</tr>
<tr>
<td>Std. error of mean</td>
<td>7.68±0.03</td>
<td>1.67±0.02</td>
<td>34.28</td>
<td>8.94</td>
<td>172.62</td>
<td>65.93</td>
</tr>
<tr>
<td>Median</td>
<td>0.17</td>
<td>0.37</td>
<td>628.8</td>
<td>491.73</td>
<td>3169</td>
<td>2478.5</td>
</tr>
<tr>
<td>Mode</td>
<td>0.15</td>
<td>0.37</td>
<td>453.94</td>
<td>402.43</td>
<td>2288</td>
<td>932</td>
</tr>
<tr>
<td>Std. deviation</td>
<td>4.41±0.02</td>
<td>9.59±0.02</td>
<td>196.95</td>
<td>51.38</td>
<td>991.66</td>
<td>372.98</td>
</tr>
<tr>
<td>Range</td>
<td>0.16</td>
<td>0.46</td>
<td>684.68</td>
<td>306.66</td>
<td>3448</td>
<td>2648</td>
</tr>
<tr>
<td>Min.</td>
<td>0.12</td>
<td>0.23</td>
<td>453.94</td>
<td>402.43</td>
<td>2288</td>
<td>932</td>
</tr>
<tr>
<td>Max.</td>
<td>0.28</td>
<td>0.69</td>
<td>1138.62</td>
<td>709.09</td>
<td>5736</td>
<td>3580</td>
</tr>
</tbody>
</table>

**Table 3:** Shows the maximum activity and the time to max. activity in type I and type II muscle fibers.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Max. activity mild</th>
<th>Max. activity max.</th>
<th>Time to max. activity mild</th>
<th>Time to max. activity max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>42.41</td>
<td>65.07</td>
<td>21.09</td>
<td>5.66</td>
</tr>
<tr>
<td>Std. error of mean</td>
<td>4.55</td>
<td>2.59</td>
<td>3.67</td>
<td>0.97</td>
</tr>
<tr>
<td>Median</td>
<td>32.62</td>
<td>62.69</td>
<td>15.3</td>
<td>4.6</td>
</tr>
<tr>
<td>Mode</td>
<td>100</td>
<td>30.91</td>
<td>2.6</td>
<td>0.2</td>
</tr>
<tr>
<td>Std. deviation</td>
<td>25.79</td>
<td>14.93</td>
<td>20.76</td>
<td>5.61</td>
</tr>
<tr>
<td>Range</td>
<td>86.03</td>
<td>69.09</td>
<td>84.8</td>
<td>24</td>
</tr>
<tr>
<td>Min.</td>
<td>13.97</td>
<td>30.91</td>
<td>1.6</td>
<td>0.00</td>
</tr>
<tr>
<td>Max.</td>
<td>100</td>
<td>100</td>
<td>86.4</td>
<td>24.00</td>
</tr>
</tbody>
</table>
**Table 4:** Shows the activity < 30%, activity <= 80%, the activity > 80%, and the silent period in type I and type II muscle fibers.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Activity &lt; 30%</th>
<th>Activity &lt;= 80%</th>
<th>Activity &gt; 80%</th>
<th>Silent period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>88.17</td>
<td>23.57</td>
<td>11.32</td>
<td>70.99</td>
</tr>
<tr>
<td>Std. error of mean</td>
<td>4.55</td>
<td>5.10</td>
<td>4.37</td>
<td>9.679</td>
</tr>
<tr>
<td>Median</td>
<td>99.35</td>
<td>15.38</td>
<td>0.40</td>
<td>0.00</td>
</tr>
<tr>
<td>Mode</td>
<td>100</td>
<td>0.00</td>
<td>100</td>
<td>0.00</td>
</tr>
<tr>
<td>Std. deviation</td>
<td>25.73</td>
<td>29.33</td>
<td>25.12</td>
<td>30.78</td>
</tr>
<tr>
<td>Range</td>
<td>100</td>
<td>99.30</td>
<td>100</td>
<td>99.30</td>
</tr>
<tr>
<td>Min.</td>
<td>0.00</td>
<td>0.00</td>
<td>0.70</td>
<td>0.00</td>
</tr>
<tr>
<td>Max.</td>
<td>100</td>
<td>99.30</td>
<td>100</td>
<td>99.30</td>
</tr>
</tbody>
</table>

**Table 5:** Shows the mean amplitude, maximum amplitude and mean maximum amplitude in type I and type II muscle fibers.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.17</td>
<td>0.37</td>
<td>1.32</td>
<td>1.45</td>
<td>0.42</td>
<td>1.16</td>
</tr>
<tr>
<td>Std. error of mean</td>
<td>7.27E-03</td>
<td>1.81E-02</td>
<td>4.37</td>
<td>1.49</td>
<td>0.39</td>
<td>1.26</td>
</tr>
<tr>
<td>Median</td>
<td>0.17</td>
<td>0.37</td>
<td>0.40</td>
<td>1.49</td>
<td>0.28</td>
<td>1.23</td>
</tr>
<tr>
<td>Mode</td>
<td>0.14</td>
<td>0.29</td>
<td>0.00</td>
<td>0.49</td>
<td>0.28</td>
<td>1.23</td>
</tr>
<tr>
<td>Std. deviation</td>
<td>4.18E-02</td>
<td>0.33E-02</td>
<td>25.12</td>
<td>7.179</td>
<td>0.19</td>
<td>1.28</td>
</tr>
<tr>
<td>Range</td>
<td>0.17</td>
<td>0.52</td>
<td>100</td>
<td>0.27</td>
<td>0.78</td>
<td>1.02</td>
</tr>
<tr>
<td>Min.</td>
<td>0.11</td>
<td>0.17</td>
<td>0.00</td>
<td>1.22</td>
<td>0.15</td>
<td>0.47</td>
</tr>
<tr>
<td>Max.</td>
<td>0.28</td>
<td>0.69</td>
<td>100</td>
<td>1.49</td>
<td>0.93</td>
<td>1.49</td>
</tr>
</tbody>
</table>

**Table 6:** Compares the electrophysiological parameters characterizing type I (during mild contraction) and type II (during max. contraction) muscle fibers.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. deviation</th>
<th>Std. error of mean</th>
<th>95% CI Upper</th>
<th>95% CI Lower</th>
<th>T</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean inturturn</td>
<td>0.66</td>
<td>0.32</td>
<td>5.6E-02</td>
<td>0.55</td>
<td>0.78</td>
<td>-11.7</td>
<td>0.000</td>
</tr>
<tr>
<td>Inturturn&lt;3.5</td>
<td>21.4</td>
<td>11.15</td>
<td>1.94</td>
<td>17.53</td>
<td>25.43</td>
<td>11.06</td>
<td>0.000</td>
</tr>
<tr>
<td>Inturturn&lt;1</td>
<td>*****</td>
<td>3.26</td>
<td>*****</td>
<td>*****</td>
<td>*****</td>
<td>0.7</td>
<td>0.000</td>
</tr>
<tr>
<td>TA Mean Amp.</td>
<td>-0.20</td>
<td>9.97E-02</td>
<td>1.73E-02</td>
<td>-0.23</td>
<td>-0.16</td>
<td>-11.7</td>
<td>0.000</td>
</tr>
<tr>
<td>Turn/sec</td>
<td>200.52</td>
<td>179.49</td>
<td>31.24</td>
<td>136.88</td>
<td>264.17</td>
<td>6.41</td>
<td>0.000</td>
</tr>
<tr>
<td>Max. activity</td>
<td>-23</td>
<td>31.9</td>
<td>5.65</td>
<td>-34.5</td>
<td>-11.5</td>
<td>-4.0</td>
<td>0.000</td>
</tr>
<tr>
<td>Time to max activity</td>
<td>15.3</td>
<td>18.9</td>
<td>3.34</td>
<td>8.52</td>
<td>22.18</td>
<td>4.5</td>
<td>0.000</td>
</tr>
<tr>
<td>Activity &lt;30%</td>
<td>66.57</td>
<td>33.96</td>
<td>6.0</td>
<td>54.3</td>
<td>78.8</td>
<td>11.08</td>
<td>0.000</td>
</tr>
<tr>
<td>Activity &lt;=80%</td>
<td>-61.1</td>
<td>45.69</td>
<td>8.0</td>
<td>-77.59</td>
<td>-44.64</td>
<td>-7.5</td>
<td>0.000</td>
</tr>
<tr>
<td>Activity &gt;80%</td>
<td>-5.18</td>
<td>18.73</td>
<td>3.31</td>
<td>-11.9</td>
<td>1.57</td>
<td>-1.56</td>
<td>0.12</td>
</tr>
<tr>
<td>Silent period</td>
<td>28.45</td>
<td>14.64</td>
<td>2.58</td>
<td>23.17</td>
<td>33.73</td>
<td>10.98</td>
<td>0.000</td>
</tr>
<tr>
<td>Mean amp.</td>
<td>-0.19</td>
<td>0.11</td>
<td>1.93E-02</td>
<td>-0.23</td>
<td>-0.15</td>
<td>-10.0</td>
<td>0.000</td>
</tr>
<tr>
<td>Max. amp.</td>
<td>-0.60</td>
<td>0.32</td>
<td>5.68E-02</td>
<td>-0.72</td>
<td>-0.49</td>
<td>-10.6</td>
<td>0.000</td>
</tr>
<tr>
<td>Total turn</td>
<td>1509.54</td>
<td>977.29</td>
<td>172.76</td>
<td>707.17</td>
<td>1411.88</td>
<td>6.13</td>
<td>0.000</td>
</tr>
</tbody>
</table>

P<0.000 highly significant, P<0.05 significant, P>0.05 non-significant
DISCUSSION

A motor unit (MU) is simply a bundle or grouping of muscle fibers. The number of muscle fibers and type (fast twitch or slow twitch) in your body is determined during the 2nd trimester of pregnancy.12

Since the only way to directly determine the fiber-type composition is to perform an invasive muscle biopsy test, some studies have tried to indirectly estimate the fiber-type composition by quantitative analysis of the MU.13,14

EMG signals are occasionally difficult to identify as they may overlap with each other.15 In our study, assessment is made at different levels of activation — minimal muscle contraction to determine the low threshold type I muscle fibers; and maximal voluntary contraction that allows quantitative assessment over a wider range and provide information about the interference pattern for assessment of the turns/amplitude analysis.15

We utilize an automated technique during a fixed time epoch.16

As the force exerted by the muscle is critical for the analysis and needs to be kept constant at a defined level, for accurate assessment ,we take our measurements during a fixed time epoch and nearly steady muscle tension level guided by the dynamometer readings because both the amplitudes/second and the turns/second increase with strength of muscle contraction.15

As a general rule, motor units are recruited in order of their size. When the muscle is activated initially, the first motor units to fire are small in size and weak in the degree of tension they can generate. Starting with the smallest motor units, progressively larger units are recruited with increasing strength of muscle contraction. The result is an orderly addition of sequentially larger and stronger motor units resulting in a smooth increase in muscle strength.17

On analyzing the electrophysiological parameters characterizing type I and type II muscle fibers, a highly statistically significant difference P<0.000 was found between all evaluated variables as the Inturn (duration between turns): Inturn >3.5 ms and Inturn < 1 ms; T/A, Mean and Maximum amplitude and Turns/second (T/S): Amplitude/Turn (AT): Maximum activity, Time to max. activity, Activity <30%, Activity <80% and >80%, and the silent period.

A turn was defined as a change in the direction of the signal of at least 100 microvolts (μV). An amplitude count is produced for a fixed voltage change, usually 100 μV, between successive turns.18 In our sample, during mild contraction, the mean turn count of the first recruited muscle fibers (type I) is 701

while that of the progressively recruited fast fibers (type II) during maximum contraction is 501. 

MUAP amplitudes are relatively lower at low levels of activation than at higher levels. At maximal levels of voluntary effort, MUAP amplitudes increase, reflecting activation of the larger type II MUs.19 In our samples, the mean and maximum amplitude at low activation level is 0.17 and 1.32 mV and at high levels is 0.37 and 1.45 mV.

The type II motor units are capable of greater levels of absolute force than type I and also fatigue a lot quicker. Type IIA fibers reach peak power in about 50 milliseconds whereas type IIB reach peak power in about 25 milliseconds. Because of their greater contraction speeds, the total peak power by IIB can be up to 5 times higher then the IIA’s.20 In our samples the mean maximum activity is 42.41 during mild contraction and the time it takes to reach peak power is 21 msec, while, during maximal contraction, the mean maximum activity is 65 and the time it takes to reach peak power is only 5.6 msec , in agreement with Milner-Brown20

In routine EMG or subjective analysis, the strategy is different. The electrodiagnostic consultant looks qualitatively for MUAPs only with features that would not be observed in normal muscle (e.g., increased amplitude, long duration, increased number of phases), and many of the differences between muscle fiber types are not apparent and this differentiation may be of value in diagnosis certain muscle disorders with preferential abnormalities of a single fiber type e.g.

a- Type IIB fibers atrophy in cachexia and disuse atrophy.

b- Type IIB fibers may be absent in myotonia congenita.

c- Type I fibers may be preferentially atrophied in myotonic dystrophy.21

Muscle fibers also play a major role in dictating the potential for improving muscular size, strength and endurance. By having a general idea of their muscle-fiber types, individuals will have a better understanding of how they can maximize their response to strength training.

Understanding the differences between human skeletal muscle fiber types allow clinicians to understand the morphological and physiological basis of the effectiveness of physical therapy interventions as resistance training and electrical stimulation that can affect muscle fiber types leading to improvements in muscle performance.22

Moreover, the decrease use of skeletal muscle can lead to a conversion of muscle fiber types in the slow to fast direction.

Some of the loss of muscle performance due to aging does not appear to be only due to the conversion
of muscle fibers from one type to another, but largely
due to selective atrophy of certain population of
muscle fiber types.23,24,25,26

In summary, QA requires a discipline in
acquisition and recording that may be time-
consuming. Because it is not needed in the majority of
studies, it may be considered superfluous by many
electrodiagnostic consultants. However, QA is the
foundation upon which current understanding of EMG
is based. Therefore, understanding at least the basics is
essential so that, in turn, disease processes are better
understood.

Analysis of recruitment pattern reveals an overall
muscle performance by demonstrating the number and
discharge pattern of all the motor units. These
methods hold great promise as supplements to routine
electromyography.27

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