Electromyography in Front Crawl Technique - Case Study

A. Conceição¹,², A. Silva²,⁴, *, S. Palma³, H. Silva³, H. Gamboa³ and H. Louro¹,²

¹Sports Sciences School of Rio Maior, Polytechnical Institute of Santarém, Portugal
²Research Center for Sport, Health and Human Development (CIDESD), UTAD, Vila Real, Portugal
³PLUX - Wireless Biosignals, Lisboa Portugal
⁴Department of C. of Sport, Exercise and Health of University of Trás-os-Montes and Alto Douro; Vila Real, Portugal

Abstract: The need to develop systems electromyographic (EMG) in the aquatic environment, has led several researchers to refine these instruments to ensure the credibility of the data provided by EMG. The aim of this study is to characterize the behavior of two muscle muscles involved in the crawl technique (biceps brachii and triceps brachii) over a test of 200m crawl.

METHODS

One male swimmer trained, with 20 years old, 72kg, 1.78 meters, 1.78 cm in size and with a %Fat mass: 6.6 was subjected to a test consisting of a maximum voluntary contraction (MVC) of the Biceps Brachii (BB) and Triceps Brachii (TB) for standardization. A protocol of 4 x 50m with an interval of 15 seconds at a swimming speed of pre-established, making each part to 95% of transit time for 200m crawl. EMG surface electrodes were used with a Wireless bioPLUX.research. The EMG signal of the BB and TB muscles of the right arm was removed throughout the test and then synchronized with the video image, and selected 5 cycles of swimming on all identical pathways.

There is a gradual decrease of its average muscle activity. The BB was about 43% and TB was 26%. The largest variation on it, in the case of BB, between the third and fourth route (21%), and in the case of TB, between the second and third route (14%).

The muscles studied demonstrated changes in the duration of swim cycles, indicating that, there is a decrease in muscle activity, this supposed to be due to limitations in production capacity under swimmer and the characteristics of the art of swimming which are changing as increasing fatigue.

Keywords: Electromyography, kinematics analysis, front crawl technique.
was done offline using the **numpy** toolbox (version 1.0) in the **python** language (version 2.4).

**RESULTS**

Having determined the moments of Entry and Exit of the hand in the water based on the sign of acceleration, we determined the length of the swim cycles during the test. In Table 1, we present the duration (measured from the stages of entry and exit of the hand in water) and we conclude that it increases gradually over the four paths of 50 m. Between the beginning and end of the test, the average length of cycles increased from 0.87 s to 1.07 s, consisting in a relative increase of 23% with the largest relative increase (12%) occurred between the first and second path.

The test results are presented in Table 2, in absolute and relative values of the EMG mean ± standard deviation over the test. Comparing the average values of EMG of BB and TB over the four pathways to swim (4x 50m), the results shows that there is a gradual decrease in the average muscle activity. Between the beginning and end of the test, the relative decrease of the BB was 43%, while on the TB muscle the decrease was 26%. The largest variation in the case of BB, between the third and fourth route was 21%) and in the case of TB, between the second and third route was 14%.

Representing the average EMG recorded for each cycle of swimming in terms of its duration (Fig. 1), we conclude that when the cycles are longer, the average muscle activity tends to be smaller. When doing a statistical analysis the variables correlate moderately. This trend is found both in BB ($r = -0.6$) and in TB ($r = -0.6$)

**DISCUSSION**

The results of this case study indicate that both muscles have changes in the duration of swim cycles, pointing that, with increasing duration of cycles of swimming, there is a decrease in muscle activity. This is supposed to be caused by limitations in production capacity of the swimmer and/or due to characteristics of the art of swimming which are changing.

### Table 1. Average Duration ± Standard Deviation of the Cycle of Swimming in Each Part of Swimming Throught the Test

<table>
<thead>
<tr>
<th></th>
<th>1st_50m</th>
<th>2nd_50m</th>
<th>3thr_50m</th>
<th>4th_50m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± DV (s)</td>
<td>0.87±0.10</td>
<td>0.98±0.14</td>
<td>1.07±0.12</td>
<td>1.07±0.14</td>
</tr>
<tr>
<td>% of mean duration of 1st route</td>
<td>100</td>
<td>112.6</td>
<td>123</td>
<td>123</td>
</tr>
<tr>
<td>% of mean duration of last route</td>
<td>--</td>
<td>112.6</td>
<td>109.2</td>
<td>100</td>
</tr>
</tbody>
</table>

### Table 2. Muscle Activity (%MVC) Average of the Monitored Muscles and Their Variations of Each Part of Swimming

<table>
<thead>
<tr>
<th></th>
<th>50m</th>
<th>50m</th>
<th>50m</th>
<th>50m</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biceps Brachii (BB)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean±DV (%CVm)</td>
<td>25,68±16,09</td>
<td>20,6±13,95</td>
<td>18,39±13,8</td>
<td>14,58±12,19</td>
</tr>
<tr>
<td>% EMG of 1st route</td>
<td>100</td>
<td>80.2</td>
<td>71.6</td>
<td>56.8</td>
</tr>
<tr>
<td>% EMG of last route</td>
<td>--</td>
<td>80.2</td>
<td>89.3</td>
<td>79.3</td>
</tr>
<tr>
<td><strong>Triceps Brachii (TB)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean±DV (%CVm)</td>
<td>52,84±36,97</td>
<td>46,2±30,57</td>
<td>39,52±28,14</td>
<td>39,32±28</td>
</tr>
<tr>
<td>% EMG of 1st route</td>
<td>100</td>
<td>87.4</td>
<td>74.8</td>
<td>74.4</td>
</tr>
<tr>
<td>% EMG of last route</td>
<td>--</td>
<td>87.4</td>
<td>85.5</td>
<td>99.5</td>
</tr>
</tbody>
</table>

**Fig. (1).** Relationship between the duration of cycle of swimming activity and mean biceps brachii muscle (A) and triceps brachii (B).
with fatigue increase. As found during the course increased the duration of the slide, making the swimmer less mechanic efficient, according to the values of muscle activation observed.

The coach must use a planning strategy towards the work of resistance and / or strength taking into account the process observed in the current experiment.

REFERENCES