Comparative Electromyographical Analysis of Triceps Medialis and Biceps Brachii during Forehand Stroke in Squash

Y. S. Rajpoot, Amritashish Bagchi and G. D. Ghai

ABSTRACT

The aim of this study was to compare the electromyographical responses between triceps medialis and biceps brachii muscles while performing forehand stroke in squash. Seven male (age = 20.71 ± 2.12 years) all India university level players were selected from squash match practice group of Lakshmibai National Institute of Physical Education by using consecutive sampling. The maximum voluntary contraction (MVC) was recorded with the help of biograph infinity software (EMG). Surface Electromyography (SEMG) was used for measuring muscle (Triceps Brachii and Biceps Brachii) electrical activity that occurs during forehand stroke in squash. Each subject performs ten trails, out of the several trails the mean value of first three correct trails were selected for the analysis. The results of the study reveals that, triceps medialis shows slightly higher muscles activation but no statistical differences was observed concluding that the muscles activation in both the muscles while performing the forehand stroke in squash is almost similar.

Key Words: Electromyography, Muscle activation, Forehand stroke, Triceps Brachii and Biceps Brachii.

Squash is a moderate to high-intensity intermittent exercise. In squash, it will be of great interest to study the mechanics involved in all the movement of squash activities, particularly in identifying the key contributors to a powerful stroke. The forehand and backhand strokes are fundamental movements of squash. It is necessary for the player to develop an accurate and powerful stroke to achieve any degree of success in playing the game (Ariff, Osman and Usman, 2012). In sport studies, electromyography (EMG) is often used in order to analyse muscle activation, intermuscular coordination and/or fatigue status. However, if absolute EMG level can be compared in one participant between different situations performed during a unique session, EMG normalisation is required to compare data between different muscles, individuals and across time (Soderberg & Knudson, 2000). Surface ElectroMyoGraphy (SEMG) is a non-invasive technique for measuring muscle electrical activity that occurs during muscle contraction and relaxation cycles. As the subject then moves the joint and contracts the muscles, the EMG unit detects the action potentials of the muscles and provides an electronic readout of the contraction intensity and duration. EMG is the most accurate way of detecting the presence and extent of muscle activity (Floyd, 2012). The fact that SEMG can analyse dynamic situations makes it of special interest in the field of sports. The improvement in the efficiency of a movement involves the correct use of the muscles, in terms of both economy of effort and effectiveness, as well as in the prevention of injury. In a training process, improvements in these parameters can be sought, follow-up carried out and corrective measures or steps for improvement determined. In particular, the performance of a task can be improved in terms of muscular activation and/or in terms of muscular fatigue, based on the analysis of the frequency of the electromyographic traces observed (Masso et al., 2010).

The aim of this study was to compare the electromyographycal responses between triceps medialis and biceps brachii muscles while performing forehand stroke in squash.

Methodology:

Seven male all India university and national level players were selected from squash (n = 7) by using purposive sampling. The age of the subjects was ranged from 19 to 23 years and all were regular squash players with good level of skill. More specifically, each
participant met our stringent requirement of at least 5 years training in their respective sports. The purpose of the research was explained to the subjects and they were motivated to put their best during each attempt. The average height and mass of the subjects were 1.72 ± 0.27 m and 67.85 ± 2.34 kg, respectively. All subjects were free from injuries that would have limited their ability to perform the forehand technique. Before participation consent was obtained from each subject.

For the purpose of the study the subjects were asked to perform 10 trails of the selected technique with surface electrodes positioned over the 2 muscle bellies (Triceps Medialis and Biceps Brachii). The subjects were also instructed to hit the ball hard and straight, but as per the technique they are supposed to hit the ball lawfully inside the court. The mean value of first three correct trails, out of the several trails were selected for the analysis. Surface ElectroMyoGraphy (SEMG) is a non-invasive technique for measuring muscle electrical activity that occurs during muscle contraction and relaxation cycles. The SEMG signal generated by the muscle fibers is captured by the electrodes, then amplified and filtered by the sensor before being converted to a digital signal by the encoder. It is then sent to the computer to be processed, displayed and recorded by the Infiniti software. The MyoScan-Pro sensor’s active range is from 20 to 500 Hz. It can record SEMG signals of up to 1600 microvolts (μV), RMS. A/D Converter (Encoder; ProComp Infiniti) has 2 channels (C and D) sampling at 256 samples per second. The participants performed 10 trails of the forehand technique one by one. Sufficient recovery time was provided to the participants after each stroke. On the testing day, maximum muscle activation was recorded with the help of Biograph infinity version 5.0 (Electromyography Software). After shaving and applying the abrasive cream to the electrodes, the EMG electrodes were placed parallel to the muscle fiber on two locations (i.e. channel C for Triceps Brachii and channel D for Biceps Brachii). Raw EMG signals were recorded using a 15 foot optic fiber wire that is directly connected to A/C encoder. A 20 mega pixels extended video camera was synchronized with the EMG software (Biograph infinity version 5.0), to find out the maximum voluntary contractions (MVCs) of the selected muscles at the time of performing the exercises. Myoscan-pro sensor with triode electrode was used.

The descriptive statistics (mean, standard deviation, skewness, kurtosis etc.) normal probability plots and Shapiro–Wilk’s test was used for testing the assumption of normality and to know the nature of data. All data are presented as mean with standard deviations. Paired t-test was used to detect the mean differences between two different muscles while performing forehand stroke in squash. For this purpose Statistical Package for Social Science (SPSS) version 20.0 was used. The level of significance was set at 0.05.

**Results:**

As a guideline, a skewness value more than twice its standard error indicates a departure from symmetry. Since none of the variables skewness is greater than twice its standard error, hence all the variables are symmetrically distributed. Similarly, the value of kurtosis for the data to be normal of any of the variable is not more than twice its standard error of kurtosis hence none of the kurtosis values are significant. In other words the distribution of all the variables is mesokurtic. Further for testing the normality Shapiro – Wilks test was used. It compares the scores in the sample to a normally distributed set of scores with the same mean and standard deviation. If the test is non – significant (p>.05) it tells that the distribution of the sample is not significantly different from a normal distribution (i.e. it is probably normal) and vice – versa. Here from table – 1 we can see that none of the variables p – value is less than .05, hence the data is normally distributed.

**Table 1: Descriptive Statistics and Test of Normality**

<table>
<thead>
<tr>
<th>Squash</th>
<th>Triceps Medialis</th>
<th>Biceps Brachii</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>453.2857</td>
<td>429.1429</td>
</tr>
<tr>
<td>Std. Error of Mean</td>
<td>45.43164</td>
<td>50.00877</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>120.2008</td>
<td>132.3108</td>
</tr>
<tr>
<td>Skewness</td>
<td>1.062</td>
<td>.469</td>
</tr>
<tr>
<td>Std. Error of Skewness</td>
<td>.794</td>
<td>.794</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>1.622</td>
<td>-.387</td>
</tr>
<tr>
<td>Std. Error of Kurtosis</td>
<td>1.587</td>
<td>1.587</td>
</tr>
<tr>
<td>Shapiro – Wilks (p-value)</td>
<td>.562</td>
<td>.955</td>
</tr>
</tbody>
</table>

**Fig 1:** Mean value of muscles activation (Triceps Medialis and Biceps Brachii) while performing forehand stroke

Figure 1 show that the mean value of the muscles activation in Triceps medialis is slightly higher than the muscles activation in Biceps Brachii muscles while performing the forehand stroke in squash. But to see the
actual differences between these two muscles paired t – test was used.

Table 2: A summary of the paired t - test among the Triceps Medialis and Biceps Brachii

<table>
<thead>
<tr>
<th>Pair</th>
<th>Paired Differences</th>
<th>t</th>
<th>Sig. 2 tail</th>
</tr>
</thead>
<tbody>
<tr>
<td>TM</td>
<td>24.14286</td>
<td>172.7169</td>
<td>65.281</td>
</tr>
<tr>
<td>– BB</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It can be seen from table 2 that the t – value is insignificant as the p – value is less than .05. Thus, the null hypothesis of equality of average muscle activation among Triceps Medialis and Biceps Brachii while performing the forehand stroke is fail to be rejected, and therefore, it may be concluded that the average muscle activation of Triceps Medialis and Biceps Brachii during forehand stroke in squash is similar.

Elliott, Marshall and Noffal in their study reported that in squash forehand drive Pronation of the forearm at the radio-ulnar joint and extension at the elbow joint both played a significant role in generating racket velocity in the period prior to impact. The elbow joint rapidly extended as the upper arm reached its maximum rotation at an angle 0.63 rad, the elbow was remained extended until right after ball contact (Ariff, Osman and Usman, 2012). This extension in elbow joint prior to the impact in squash results in less muscles activation in biceps brachii as compared to tennis forehand drive. As it can be seen from figure 1 that the muscles activation in triceps medialis is slightly higher than of the biceps brachii but as no statistical differences were found, it can be said that the muscle activation for both the muscles were almost similar.

Conclusions:
The study compared the EMG responses of triceps medialis and biceps brachii while performing the forehand stroke in squash. The muscles activation in triceps medialis is found to be slightly higher than of biceps brachii, as extension in elbow joint prior to the impact in squash results in higher muscles responses in triceps medialis. But when the mean values of these two muscles were compared no significant differences were found, concluding that both the muscles were equally activated while performing the forehand stroke in squash.

References:
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