A COMPARATIVE ELECTROMYOGRAPHICAL ANALYSIS OF TRICEPS MEDIALIS AND BICEPS BRACHII DURING FOREHAND DRIVE IN TENNIS

Amritashish Bagchi, *PhD Scholar,*

Department of Centre for advanced studies, LNIPE, Gwalior (M.P.), India

Y.S.Rajpoot, *Assistant Professor,*

Department of Sports Biomechanics, LNIPE, Gwalior (M.P.), India

G.D.Ghai, *Professor,*

Department of Sports Biomechanics, LNIPE, Gwalior (M.P.), India

Abstract

The purpose of this study was to compare the electromyographycal responses between triceps medialis and biceps brachii muscles while performing forehand drive in tennis. Seven male (age = 21.12 ± 2.31 years) all India university level tennis players were selected by using purposive 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 Medialis and Biceps Brachii) electrical activity that occurs during forehand drivein tennis. 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 reveal that, Biceps Brachii shows higher muscles activation than the Triceps medialis muscles while performing the forehand drive in tennis.Significant differences was observed concluding that the biceps brachii muscles plays a more dominant role while performing forehand drive in tennis than triceps medialis.

Keywords: Electromyography, Muscle activation, Forehand drive, Triceps Medialisand Biceps Brachii

Introduction :

Electromyography can be a very valuable tool in measuring skeletal muscles electrical output during physical activities. It is important that the EMG is detected correctly and interpreted in light of basic biomedical signal processing, physiological, and biomechanical principles (Soderberg, 1992). Electromyographic recordings of muscle action during athleticactivities can provide valuable insights into performancerequirements, injury prevention, and rehabilitative strategies. In EMG, Muscle function can be determined using EMG recordingssynchronized with film of specific activities (Moynes Perry, Antonelli and Jobe, 1986). The usefulness of the EMG signal is greatly dependent on the ability to extract the information contained in it. Electromyography is attractive because it gives easy access to the physiological processes that cause the muscle to generate force and produce movement (De Luca, 1993).

In sports, Electromyographic studies help us to understand the location of the problem in the system of movement.It is important to snychronize the systems that supply cinematic data with electromyography to determine the period when different muscles join the muscle movement. Surface EMG has increasing importance in sports and occupational medicine and in ergonomic studies. It can also establish dynamic analysis and therefore is important in sports (Turker&Sze, 2013).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 (Masso et al., 2010).

The forehand drive is a key stroke in modern tennis, as it is themost frequent groundstroke played during matches (Johnson andMcHugh, 2006). Understanding its muscular coordination maytherefore contribute to enhance tennis player performance (Rota et al. 2012). Itis generally the first stroke taught to beginners and is a fundamental part of the game throughout a player's career (Funk, 2010).

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

Methodology :

    Subjects

A total of seven male all India university level tennis players were selected by using purposive sampling. All the subjects were regular tennis players with good level of skill and the age of the subjects was ranged from 19 to 23 years (21.12 ± 2.31). 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 ± 0.41 m and 66 ± 3.42 kg, respectively. All subjects were free from injuries that would have limited their ability to perform the forehand technique. Before participation, informed consent was obtained from each subject.

Instrumentation

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.

Data collection

Sufficient recovery time was provided to the participants after each trail. Bowling machine was used for feeding the ball more accurately to the tennis players. The subjects were instructed to hold the racquet at semi western grip.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.

Statistics

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 stoke 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 and discussion

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 meso-kurtic.

	TENNIS	
	TRICEPS MEDIALIS	**TRICEPS MEDIALIS**
Mean	396.0000	396.0000
Std. Error of Mean	45.52969	45.52969
Std. Deviation	120.46023	120.46023
Skewness	1.036	1.036
Std. Error of Skewness	.794	.794
Kurtosis	-.393	-.393
Std. Error of Kurtosis	1.587	1.587
Shapiro – Wilk (p-vaule)	.109	.109

Table 1: Descriptive Statistics and Test of Normality

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.
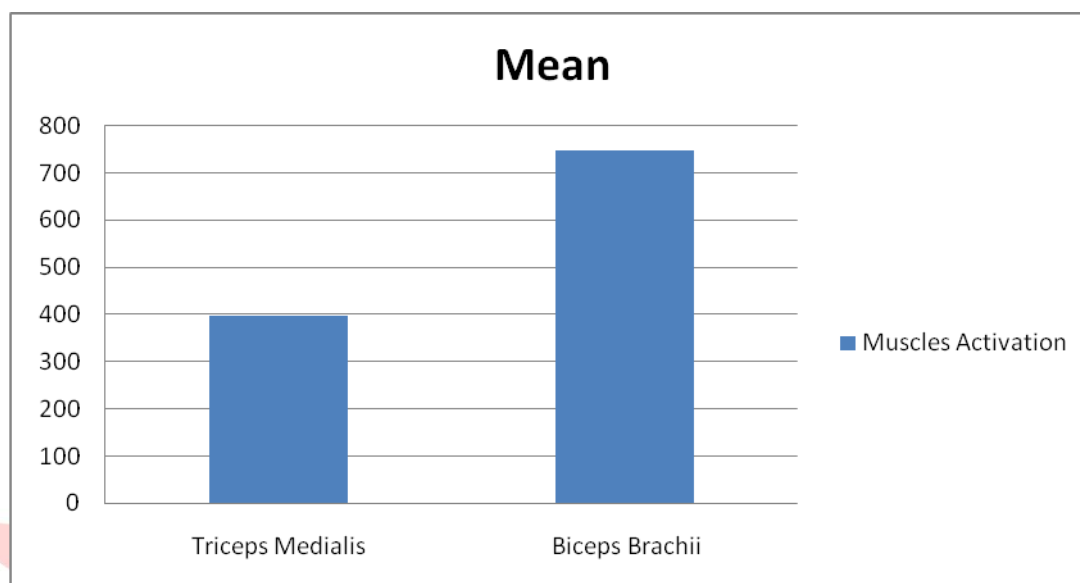
Figure 1: Mean value of muscles activation (Triceps Medialis and Biceps Brachii) while performing forehand drive

Figure 1 show that the mean value of the muscles activation in Biceps Brachiiis higher than the muscles activation in Triceps medialismuscles while performing the forehand drive in tennis. But to see the actual differences between these two muscles paired t – test was used by the researcher.

Pair	Paired Differences			t	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean		
TM – BB	-352.428	271.58661	102.65009	-3.433	.014

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

It can be seen from table 2 that the t – value is significant as the p – value is more than .05. Thus, the null hypothesis of equality of average muscle activation among Triceps Medialis and Biceps Brachii while performing the forehand stroke is rejected, and therefore, it may be concluded that the average muscle activation of Triceps Medialis and Biceps Brachii during forehand stroke in squash is not similar.

Elliott, et al. in his study reported that in the modern tennis forehand stroke, the upper arm, forearm, and wrist segments move as separate units to increase power. In other study Elliott mentioned that the elbow flexes during ball contact and follow through of the forehand and the wrist remains firm, but may slightly flex to increase racket velocity. This flexion of the elbow in contact and follow – through increases the muscle activation of biceps brachii.

Similarly, Ryu et al. reported in his study that Electromyography (EMG) analysis has shown that the pectoralis major, biceps brachii, subscapularis, and serratus anterior have high activity in the forward swing of a tennis forehand and should be targets of resistance training. Dynamic, explosive movements increase power and coordination in these involved muscles to increase the velocity of the forehand without sacrificing technique (Funk 2010).

Conclusion

The study compared the EMG responses of triceps medialis and biceps brachii while performing the forehand drive in tennis. The muscles activation in biceps brachii is found to be higher than of triceps medialis, as the elbow flexes during ball contact and follow through of the forehand results in higher muscles responses in biceps brachii. The results of the study reveal that the mean differences were significant, concluding that biceps brachii muscles plays a more dominant role while performing forehand drive in tennis than triceps medialis.

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