

## **Electromyographic Analysis of Shoulder Function during Executing the Tennis Service in Volleyball**

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### **Abstract**

The Purpose of the study was to “**Electromyographic Analysis of Shoulder Function during Executing the Tennis Service in Volleyball**”. **Selection of Subjects:** For the purpose of the study, 12 male national and inter university level volleyball players whose age between 16 to 28 years were selected purposively as subject for the present study. The purpose of the study was explained to the subjects and requested to put in their best effort during each attempt. **Selection of Variables:** Observations were made on the following Variables/contents. **Anterior Group:** Pectoralis Major (PMJ), Pectoralis Minor (PMN) & Biceps brachii (BB). **Superior Group:** Anterior Deltoid (AD), Middle Deltoid (MD) & Posterior Deltoid (PD). **Posterior Group:** Triceps brachii (TB), Latissimus Dorsi (LD) & Trapezius (TP). **Criterion Measures:** Muscles activities during jump tennis service in volleyball were measured by Neuro Trac Myo Plus 4. The data was recorded in micro volt ( $\mu\text{v}$ ). **Statistical Techniques :** The concerned data was analyzed by using descriptive statistical in order to electromyographic analysis of shoulder function during executing the tennis service in Volleyball. In order to determine the relationship of selected muscles with the performance of service in Volleyball, Pearson Correlation technique was used. The data was analyzed by using SPSS (Statistical Package for the Social Sciences) version 17. The level of significance for the entire analysis was set at the 0.05 level. **Conclusions** According to finding the study, Trapezius muscle showed the highest activation level of EMG during execution of tennis service in Volleyball. Anterior Deltoid & Posterior Deltoid muscles showed the 2<sup>nd</sup> & 3<sup>rd</sup> highest activation level of EMG during execution of tennis service in Volleyball. Triceps muscles showed the 4<sup>th</sup> highest activation level of EMG during execution of tennis service in Volleyball. Pectoralis muscles showed the 5<sup>th</sup> highest activation level of EMG during execution of tennis service in Volleyball. Biceps muscles function showed lowest activation level of EMG during execution of tennis service in Volleyball. Only one muscles group that is Pectoralis is found correlated with the performance of tennis service in Volleyball. The insignificant relationship was found between all the selected muscles and with the performance of tennis service in Volleyball excepting the Pectoralis. This insignificant correlation was found between the Trapezius, Biceps, Triceps, Anterior Deltoid & Posterior Deltoid with the performance of Russel Lange Service Test. Significance relationship was also found between biceps and triceps muscles groups among independent Variables.

**Key Words: Electromyographic Analysis, Shoulder Function & Tennis Service.**

### **INTRODUCTION**

#### **EMG- Electromyography**

The electrical signal associated with the contraction of a muscle is called electromyogram or shorthand name EMG. The study of EMG is called electromyography. Electromyography (EMG) is the science of quantifying muscle activity. Several studies have reported shoulder muscle activity during a variety of upper extremity sports. Understanding when and how much specific shoulder muscles are active during upper extremity sports is helpful to physicians, therapists, trainers and coaches in providing appropriate treatment, training and rehabilitation protocols to these athletes, as well as helping health professionals better understand the shoulder injury mechanism. When interpreting EMG data it should be

emphasized that while the EMG amplitude does correlate reasonably well with muscle force for isometric contractions, it does not correlate well with muscle force as muscle contraction velocities increase, or during muscular fatigue (both of which occur in sport). Nevertheless, EMG analyses are helpful in determining the timing and quantity of muscle activation throughout a given movement. shoulder muscle activity in upper extremity sports, specifically: baseball pitching, American football throwing, windmill softball pitching, the volleyball serve and spike, the tennis serve and volley, baseball hitting, and the golf swing. Most of the movements that occur in the aforementioned sports involve overhead throwing type movements. Shoulder EMG data in the literature are far more extensive for overhead throwing activities, such as baseball pitching, compared with other upper extremity sports that do not involve the overhead throwing motion, such as baseball hitting. Therefore, much of this review focuses on shoulder EMG during activities that involve the overhead throwing motion. To help better interpret the applicability and meaningfulness of shoulder EMG data, EMG data will be integrated with shoulder joint kinematics (linear and angular shoulder displacements, velocities and accelerations) and kinetics (shoulder forces and torques) when these data are available. (Rafael F. Escamilla & James R. Andrews, 2009).

As the most mobile joint in the body, the shoulder is structurally insecure. The ball-shaped humeral head rotates and glides on a shallow scapular cup. A limited amount of passive stability is provided by the glenoid labrum, which slightly deepens the scapular cup, and by ligaments reinforcing the capsule on its superior and anterior surfaces. At peak maturity ligamentous restraint equals 50 to 80 kg. These structural limitations indicate that the primary source of joint stability must be balanced muscle control. Joint compression is the major factor. This is supplemented by active tangential restraint, which selectively opposes anterior, posterior, or superior displacement. The large external muscles used for purposeful motion and speed often create subluxating shear forces in addition to the desired actions. Impingement and attrition syndromes are common consequences. To counter this, as well as to provide selective rotation, there are the four muscles that constitute the rotator cuff. Joint compression is the major force generated by the supraspinatus and infraspinatus. The latter (accompanied by the teres minor) also provides a downward pull to oppose the upward displacement of early deltoid action. Anterior protection against excessive external rotation or extension is offered by the subscapularis. Athletic who use the arm for a propelling force strain the extremes of joint range in their drive for maximum performance. The threat of injury can be minimized by two actions, namely, modifying motion patterns, which may avoid impingement or make it a less frequent experience, and active protection, which is gained through specific strengthening of the rotator cuff muscles. (Perry J., 1983)

#### **Objectives of the Study:**

1. Electromyographic analyses of shoulder function during executing the tennis service in Volleyball.
2. To investigate the relationship of selected muscles with the performance of service in Volleyball.

#### **Research Questions or Hypotheses**

- (A) To test the significance of relationship between service performance and selected muscles of Shoulder Joint.
- (B) To test the significance of relationship among independent Variables.
- (C) Whether few Muscles are highly related with service performance.

**RESEARCH METHODOLOGY**

**Selection of Subjects**

For the purpose of the study, 12 male national and inter university level volleyball players whose age between 16 to 28 years were selected purposively as subject for the present study. The purpose of the study was explained to the subjects and requested to put in their best effort during each attempt.

**Selection of Variables:** Observations were made on the following Variables/contents.

**Muscles Groups of Shoulder joint**

**Anterior Group:** Pectoralis Major (PMJ), Pectoralis Minor (PMN) & Biceps brachii (BB)

**Superior Group:** Anterior Deltoid (AD), Middle Deltoid (MD) & Posterior Deltoid (PD)

**Posterior Group:** Triceps brachii (TB), Latissimus Dorsi (LD) & Trapezius (TP)

**Criterion Measures**

Muscles activities during jump tennis service in volleyball were measured by Neuro Trac Myo Plus 4. The data was recorded in micro volt ( $\mu v$ ).

**Collection of Data**

The primary/first hand data was collected from 12 male professional Volleyball players in India. The above mentioned tools and techniques for collection of various categories of proposed data were used.

The data for the selected muscles was obtained with the help of the instrument Neuro Trac Myo Plus 4 operated by the investigator at the performance of jump tennis service test. Before the actual testing, the subjects were given a complete demonstration of each test and the purpose of the tests was explained in detail to them. After the demonstration and explanation, electrode points were marked in the presence of specialized persons and physiotherapist, and then subjects were allowed to take practice trials in order to get familiar with the test. The data was collected only for jump tennis service performance in the court.

After making all entries of the subject pertaining to his profile on the software, the subject performed the skill and their readings were recorded in microvolt ( $\mu v$ ).

**Statistical Techniques**

The concerned data was analyzed by using descriptive statistical in order to electromyographic analysis of shoulder function during executing the tennis service in Volleyball.

In order to determine the relationship of selected muscles with the performance of service in Volleyball, Pearson Correlation technique was used.

The data was analyzed by using SPSS (Statistical Package for the Social Sciences) version 17.

The level of significance for the entire analysis was set at the 0.05 level.

**RESULT AND DISCUSSION**

**Table: 1: Descriptive Statistics of the Muscular Contraction of Selected Muscles**

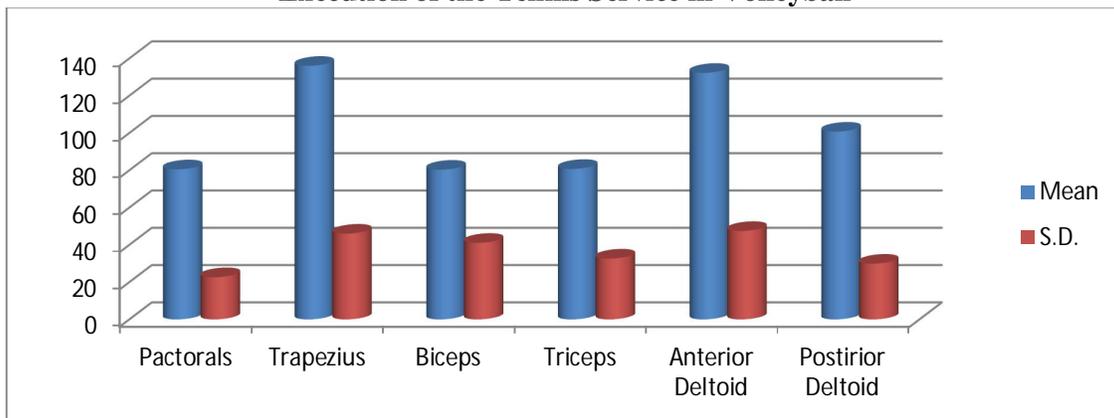
		Pectoralis	Trapezius	Biceps	Triceps	Anterior Deltoid	Posterior Deltoid
N	Valid	12	12	12	12	12	12
	Missing	0	0	0	0	0	0
Mean		80.4833	135.9917	80.2750	80.6833	132.2250	100.6917
Std. Error of Mean		6.53543	13.27810	11.85247	9.41844	13.69174	8.62316

Median	82.9000	121.8000	68.2500	73.2500	121.5000	96.7000
Mode	47.20 <sup>a</sup>	87.30 <sup>a</sup>	37.90 <sup>a</sup>	37.00 <sup>a</sup>	81.30 <sup>a</sup>	68.70 <sup>a</sup>
Std. Deviation	22.63938	45.99669	41.05817	32.62642	47.42957	29.87150
Variance	512.542	2115.695	1685.773	1064.483	2249.564	892.306
Skewness	.422	.942	1.453	1.434	.873	1.274
Std. Error of Skewness	.637	.637	.637	.637	.637	.637
Kurtosis	-.305	-.166	1.687	3.137	-.213	1.631
Std. Error of Kurtosis	1.232	1.232	1.232	1.232	1.232	1.232
Range	76.10	134.50	138.50	126.00	144.20	101.90
Minimum	47.20	87.30	37.90	37.00	81.30	68.70
Maximum	123.30	221.80	176.40	163.00	225.50	170.60

a. Multiple modes exist. The smallest value is shown

The table 1 reveals that the muscular contraction of selected muscles during tennis service in Volleyball, the mean and standard deviation of all six muscles were following: Trapezius muscle have the highest activation with Mean & SD (135.9917) and (45.99669) followed by Anterior Deltoid muscle have Mean & SD (132.2250) and (47.42957) Posterior Deltoid muscle have (100.6917) and (29.87150) Triceps muscles have (80.6833) and (32.62642) Pectoralis muscles have (80.4833) and (22.63938) Biceps muscles have the lowest activation with Mean & SD (80.2750) and (41.05817) respectively.

**Figure 1: Graphical Representation of Electromyographical Activity of Muscles during Execution of the Tennis Service in Volleyball**



**Table 2: Relationship of Muscular Contraction of Selected Muscles with the Performance of the Tennis Service in Volleyball Pearson Correlation (Multiple)**

		Performance	Pectoralis	Trapezius	Biceps	Triceps	Anterior Deltoid	Posterior Deltoid
Pearson Correlation (Multiple)	Performance	1.000	<b>.573*</b>	-.031	.222	-.011	.377	.144
	Pectoralis	<b>.573*</b>	1.000	-.030	.370	.182	.175	-.145
	Trapezius	-.031	-.030	1.000	-.025	.386	-.056	.462

	Biceps	.222	.370	-.025	1.000	.551	.299	-.087
	Triceps	-.011	.182	.386	.551	1.000	.373	.179
	Anterior Deltoid	.377	.175	-.056	.299	.373	1.000	-.216
	Posterior Deltoid	.144	-.145	.462	-.087	.179	-.216	1.000

\*Correlation is significant at the 0.05 level (1-tailed)

Significant value of the correlation coefficient at 0.05 level with 10 degree of freedom (1-tailed) is 0.497

As shown in table 2, only one muscles group that is Pectoralis is found correlated with the performance of tennis service in Volleyball where calculated 'r'(0.573) is found greater than the required tabulated value of 0.497 at 0.05 level of significance. However, the obtain value of Coefficient of correlation in other variables were less than the required tabulated value at selected level of significance, therefore these selected muscles have shown insignificant relationship with the performance of subjects in respect to tennis service in Volleyball.

Significance relationship was also found between biceps and triceps muscles groups among independent Variables as calculated 'r'(0.551) is found greater than the required tabulated value of 0.497 at 0.05 level of significance.

### Discussion of Findings

The finding of the study clearly indicate that activity of various muscles during execution of tennis service in Volleyball like **Trapezius muscle** showed the highest activation level of EMG during execution of tennis service in Volleyball. This higher muscular activity is occurred due to the forcefully right arm movement, when executing the tennis service in Volleyball. **Anterior Deltoid & Posterior Deltoid** muscles showed the 2<sup>nd</sup> & 3<sup>rd</sup> highest activation level of EMG during execution of tennis service in Volleyball. The deltoid muscle is the prime mover of arm abduction along the frontal plane. The arm must be medially rotated for the deltoid to have maximum effect. This makes the deltoid an antagonist muscle of pectoralis major and latissimus dorsi during arm adduction. **Triceps muscles** showed the 4<sup>th</sup> highest activation level of EMG during execution of tennis service in Volleyball. Triceps brachii is an extensor muscle of the elbow joint and an antagonist of the biceps and brachialis muscles. The triceps muscle can be worked through either isolation or compound elbow extension movements and can contract statically to keep the arm straightened against resistance. Triceps brachii is not responsible for the flexion of humerus, adducts the humerus and rotates the humerus medially when shoulder movement is occurred during the execution of tennis service. **Pectoralis muscles** showed the 5<sup>th</sup> highest activation level of EMG during execution of tennis service in Volleyball. Pectoral muscles (colloquially referred to as "pecs") are the muscles that connect the front of the human chest with the bones of the upper arm and shoulder. **Biceps muscles** function showed lowest activation level of EMG during execution of tennis service in Volleyball. Biceps brachii activity in this phase controls elbow extension at ball impact. The pattern of biceps activity noted in the throwing athlete occurs slightly later in an effort to control the rapidly extending and pronating elbow, and this pattern is also seen in the tennis serve. Biceps brachii is strongly responsible for the flexion and supination of the forearm at elbow.

The finding of the present study also indicated that only one muscles group that is Pectoralis is found correlated with the performance of tennis service in Volleyball. This may be attributed to the fact that Pectoralis muscles is the major muscle group at shoulder

joint/upper girdle which connect the front of the human chest with the bones of the upper arm and shoulder.

The insignificant relationship was found between all the selected muscles and with the performance of tennis service in Volleyball excepting the Pectoralis. This insignificant correlation was found between the Trapezius, Biceps, Triceps, Anterior Deltoid & Posterior Deltoid with the performance of Russel Lange Service Test.

Significance relationship was also found between biceps and triceps muscles groups among independent Variables as calculated 'r'(0.551) is found greater than the required tabulated value of 0.497 at 0.05 level of significance. The reason for this may be that both these muscles groups belong to upper arm and work in agnostic and antagonistic way.

#### **Discussion of Hypotheses**

One muscles group that is Pectoralis is found correlated with the performance of tennis service in Volleyball while insignificant correlation was found between the Trapezius, Biceps, Triceps, Anterior Deltoid & Posterior Deltoid with the performance of Russel Lange Service Test.

Significance relationship was also found between biceps and triceps muscles groups among independent Variables.

Pectoralis muscles group are highly related with tennis service performance in Volleyball.

#### **Conclusions:**

On the basis of results obtained, following conclusions were drawn:

1. According to finding the study, Trapezius muscle showed the highest activation level of EMG during execution of tennis service in Volleyball.
2. Anterior Deltoid & Posterior Deltoid muscles showed the 2<sup>nd</sup> & 3<sup>rd</sup> highest activation level of EMG during execution of tennis service in Volleyball.
3. Triceps muscles showed the 4<sup>th</sup> highest activation level of EMG during execution of tennis service in Volleyball.
4. Pectoralis muscles showed the 5<sup>th</sup> highest activation level of EMG during execution of tennis service in Volleyball.
5. Biceps muscles function showed lowest activation level of EMG during execution of tennis service in Volleyball.
6. Only one muscles group that is Pectoralis is found correlated with the performance of tennis service in Volleyball.
7. The insignificant relationship was found between all the selected muscles and with the performance of tennis service in Volleyball excepting the Pectoralis. This insignificant correlation was found between the Trapezius, Biceps, Triceps, Anterior Deltoid & Posterior Deltoid with the performance of Russel Lange Service Test.
8. Significance relationship was also found between biceps and triceps muscles groups among independent Variables.

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