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An Electromyographical analysis of biceps brachii and triceps brachii during three different types of throw in cricket

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Abstract
The aim of this study is to analysis the maximum muscles activation of biceps brachii and triceps brachii during three different types (i.e. underarm, sidearm and overarm) of throw in cricket. A total of ten male (20.90 ± 2.64 years) cricketers perform two trails of each throw. The maximum muscles activation (MMA) for each throw was recorded with the help of biograph infinity software (EMG). For measuring the muscle electrical activity that occurs during muscle contraction, Surface ElectroMyoGraphy (SEMG) was used. The results of this study indicated that, in case of muscle activation of both Biceps Brachii and Triceps Brachii muscles significant differences were found in relation to three different types of throw. No statistical differences were observed when comparing the biceps brachii muscle activation in underarm throw with overarm throw. Also similar EMG responses were found between sidearm and overarm throw in relation to triceps brachii muscle activation.

Keywords: Electromyography, Muscle activation, Throw, Biceps Brachii and Triceps Brachii.

1. Introduction
Getting the ball in from the deep, or attempting a run – out with a direct hit or a low, flat throw into the wicket – keepers gloves, requires strength and accuracy. The ideal throw is the one used in baseball, in which the ball is drawn back over the shoulder so that it faces backwards, before the arm unwinds and throws it straight over the shoulder at the target. But the nature of the game doesn't always allow for ideal technique. Batters steal singles, fielders find themselves on the wrong side of the ball needing to shy at the stumps, or fielders in the deep are wrong – footed by an unpredictable bounce. At any situation the fielder should try as far as possible to get into a strong position after picking up the ball (Woolmer, 2008). Then according to the situation they should choose the correct throw (underarm, sidearm and overarm) and get it deliver to the stumps or into the wicket keepers gloves. For doing this, with proper technique a great deal of strength and accuracy as mentioned above are required. Resistance exercise is a specialized method of conditioning, involving progressive use of resistance to increase one's ability to exert or resist force (Baechle and Earle, 2000) [1]. The specific exercise performed is based on the action of a target muscle group. Even athletes and coaches are continually looking for new methods that will be helpful in improving power and strength.

For the success in education of sports and exercise various performance and ability tests are carried out. Various exercise equipment's are used in test protocols that are developed for this goal. The reason to use various kinds of exercise equipment's for performance measurement is that every equipment and protocol cause different responses in human body. The cause for evolution of different physiological responses is about the different shapes and densities of different muscles. In this very respect, the electromyographic measurements gain great importance (Türker and Sözen, 2013) [7].

It has been seen that now – a – days Electromyography used in many sports techniques. Electromyography (EMG) utilizes either surface electrodes that are placed over the muscle or finewire/needle electrodes placed into the muscle. For measuring muscle electrical activity that occurs during muscle contraction and relaxation cycles a non-invasive technique Surface ElectroMyoGraphy (SEMG) is used. 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) [3].

The purpose of the study was to analysis the maximum muscles activation of biceps brachii and triceps brachii during three different types (i.e. underarm, sidearm and overarm) of throw in cricket.

2. Methods

2.1 Subjects

Ten male interuniversity level cricketers (20.90 ± 2.64 years) were participated in this study. As the subjects had been undergoing training for a considerable period (at least 4 years), therefore, it is assumed that they possess a good level of technique. All subjects were free from injuries that would have limited their ability to perform the three different types of throws in cricket. For the selection of the subjects, purposive sampling technique was used. Before participation, informed consent was obtained from each subject.

2.2 Experimental Approach to the Problem

The surface electrodes are positioned over the 2 muscle bellies i.e. Biceps Brachii and Triceps Brachii, to compare and analysis the muscles activation (EMG response) between three different types of throws in cricket. The subjects were instructed to throw as quickly as possible with maximum power to the given target for each throw. The 3 different types of throws were Underarm throw, Sidearm throw and Overarm throw. For measuring muscle electrical activity that occurs during muscle contraction and relaxation cycles a non-invasive technique Surface Electro Myo Graphy (SEMG) was used. 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 active range of Myo Scan-Pro sensor's that was used for the study is from 20 to 500 Hz. It can record SEMG signals of up to 1600 microvolts (μV), RMS. A/D Converter (Encoder; Pro Comp Infiniti) has 2 channels (C and D) sampling at 256 samples per second.

2.3 Data collection

All the participants performed two trails of each throw one by one. Sufficient recovery time was provided to the participants after completing one trail, so that they can focus on the given target for each throw. According to the nature of the throws, as each of the throw depends upon the distance, three different targets were given so that the technique for throwing remains same. And it helps the researcher to get the original data in a set-up that is more similar to real situation. With the help of Biograph infinity version 5.0 (Electromyography Software), the maximum muscle activation for each muscle was recorded. Before placing the EMG electrodes to the selected muscle fiber, cleaning of the skin and application of the abrasive cream to the electrodes were carried out. The electrodes were placed parallel to the muscle fiber on two locations (i.e. channel C for Biceps Brachii and channel D for Triceps Brachii). A 15 foot optic fiber wire that is directly connected to A/C encoder was used to record the Raw EMG signals. 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.

2.4 Statistics

To know the nature of data and for testing the assumption of normality, descriptive statistics (mean, standard deviation, skewness, kurtosis etc.) and Shapiro–Wilk's test was used. All data are presented as mean with standard deviations. A repeated measure analysis of variance (ANOVA) was used to detect the mean differences between each three different throws. For this purpose Statistical Package for Social Science (SPSS) version 20.0 was used. The level of significance was set at 0.05.

3. Results and Discussion

A departure from symmetry can be indicated if the skewness value is more than twice its standard error. The results of the descriptive statistics indicated that all the variables are symmetrically distributed, as none of the variables skewness is greater than twice its standard error. 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.

Shapiro – Wilks test was used for testing the normality of the data. 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

		Mean	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Shapiro – Wilk (p-vaule)
Underarm Throw	Biceps Brachii	729.60	186.37	.653	.687	-.670	1.334	.234
	Triceps Brachii	389.10	201.48	.810	.687	-1.157	1.334	.058
Sidearm Throw	Biceps Brachii	486.70	188.70	.938	.687	-.145	1.334	.179
	Triceps Brachii	975.60	224.38	-.423	.687	.479	1.334	.270
Overarm Throw	Biceps Brachii	773.00	386.86	.461	.687	-1.460	1.334	.135
	Triceps Brachii	1063.70	235.78	-.111	.687	-.803	1.334	.534

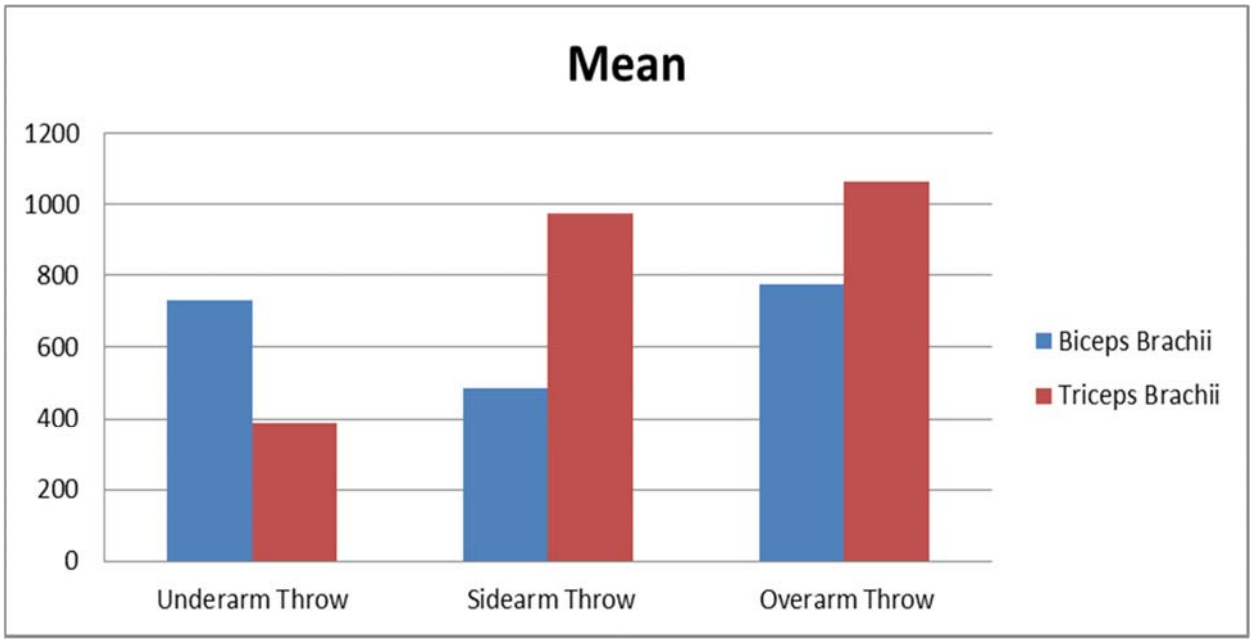

Fig 1: Mean value of muscles activation (Biceps Brachii and Triceps Brachii) in three different types of throw.

It can be seen from Figure 1 that in underarm throw the activation of Triceps Brachii muscles is less than the other throwing techniques, whereas, in overarm throw high muscles activation was found. Similarly when it comes to the muscles activation of biceps brachii overarm and underarm throw shows almost similar kind of responses, whereas, sidearm throw shows more muscles activation. To see whether this differences were significant the statistical technique repeated measure ANOVA was applied.

Table 2: Mauchly's Test of Sphericity and corrections

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Biceps Brachii	.745	2.355	2	.308	.797	.941	.500
Triceps Brachii	.750	2.306	2	.316	.800	.946	.500

Mauchly's Test of Sphericity was used to test the equality of variances of the differences between the treatment levels. Repeated measures ANOVAs (within-subject factors) are particularly susceptible to the violation of the assumption of sphericity, as violation causes the test to become too liberal (i.e., an increase in the Type I error rate). Therefore, to determine whether sphericity has been violated is very vital. Mauchly's Test of Sphericity tests the null hypothesis that the variances of the differences are equal. Thus, if Mauchly's Test of Sphericity is statistically significant ($p < .05$), we can reject the null hypothesis and accept the alternative hypothesis that the variances of the differences are not equal (i.e., sphericity has been violated) (Statistics.laerd.com, 2015) [6]. The results of Table 2 show that the assumption of sphericity has not been violated as mauchly's test was not significant.

Table 3: A summary of with – in repeated measure analysis of variance of three different types of throw with regard to muscles activation in Biceps Brachii and Triceps Brachii

Muscles	Groups	Type III Sum of Squares	df	Mean Square	F	Sig.
Biceps Brachii	Sphericity Assumed	476172.2	2	238086.1	3.966	0.037
	Error	1080470	18	60026.1		
Triceps Brachii	Sphericity Assumed	2689430	2	1344715	36.004	.000
	Error	672291.9	18	37349.55		

The muscle activation of both Biceps Brachii and Triceps Brachii showed significant differences related to three different types of throw. In the above table, for both the muscles, the p – value is less than .05. Hence the F-ratio for Biceps Brachii as well as Triceps Brachii is significant at 5% level. In both of the cases the null hypothesis is rejected; therefore at least one of the means will be different. Since ANOVA does not tell us where the difference lies; Bonferroni's post hoc test was used to get the clear picture. The result of Bonferroni's post hoc test shows that, in case of muscles activation of Biceps Brachii, the critical differences were found only between underarm throw and sidearm throw. It indicates that in Underarm throw the biceps muscles dominate more than in comparison of Sidearm throw. Almost similar EMG responses (Biceps Brachii) were found between underarm and overarm throw.

In case of Triceps Brachii muscles activation, critical differences were found between Underarm Throw with Sidearm and Overarm Throw, indicating that the Triceps plays a more dominating role in both of the throws (Sidearm and Overarm) than Underarm Throw.

Table 4: A summary of the paired t – test

Pair (Biceps – Triceps)	Paired Differences			t	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean		
Underarm Throw	340.5	295.9457	93.58623	3.638	0.005
Sidearm Throw	-488.9	259.8027	82.15682	-5.951	.000
Overarm Throw	-290.7	355.0014	112.2613	-2.589	0.029

It can be clearly seen from above table that in all three types of throws the p – value is less than .05 indicating that significant differences exist between the biceps and triceps muscles activation. In underarm throw biceps is more dominating than triceps, as in performing the underarm throw after the pick-up, for gaining angular momentum the throwing arm (in supine position) moves backward followed by in forward direction and release the ball towards the target with elbow remain straight along with the follow through (cricket coaching India, 2009) [4]. Here the hand position (supine) that moves in forward direction may activate the biceps muscles more than the triceps at the time of throw. Similarly in sidearm and overarm throw it is found that the triceps muscle is more dominating than the biceps muscles. As in both of the throws elbows were extended at the time of release; power, speed and accuracy are common physical parameter for both throws. In overarm throw with power, speed and accuracy, distance is another factor that must be kept in mind (Tyson, 1986) [8]. The overarm throw is considered as long distance throw and generally it is used when the fielders throw the ball from boundary line. As compare to the overarm throw, the sidearm throw is considered as a short distance throw and can also be taken from the mid-field region depending upon once strength to get it delivered correctly. Sometimes, the sidearm throw is also known as flat throw due to the trajectory of the ball or the parabola that it makes.

4. Conclusion

This study analyzed the maximum muscles activation of biceps brachii and triceps brachii during three different types (i.e. underarm, sidearm and overarm) of throws in cricket. Both the Biceps Brachii and Triceps Brachii muscles showed significant differences related to three different types of throw. Concluding that in Underarm throw the biceps muscles dominate more than in comparison of Sidearm throw. And in case of muscle activation of Triceps Brachii, triceps plays a more dominating role in both of the throws (Sidearm and Overarm) than Underarm Throw. It is also concluded that the muscle biceps brachii dominate more than the triceps brachii while performing the underarm throw. Similarly the muscles triceps brachii dominate more than the biceps brachii while performing the sidearm and overarm throw.

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