Myoelectric comparison of selected sEMG parameter of Basketball set shot using different situation: A study on a paired sample

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Abstract: This study aimed to examine the differences between successful set shot in Basketball with and without an opponent. The participants were filmed as they executed the set shot in basketball. To ensure the same condition for all the participants the same distance from the basket, and all the subjects of the study were right-handed, had almost similar shooting action. An electrode was placed on the right side of the player’s body due to her right-handedness. Absolute muscle involvement was estimated based on average rectified EMG signals (µV) measured in all muscles (anterior deltoid, posterior deltoid, triceps brachii longus, biceps brachii longus, flexor carpi radialis, extensor carpi radialis, and brachioradialis). A paired t-test was used to compare the two technique i.e. set shot with and without an opponent, on the bases of sEMG of muscles in the different phases. Differences were considered significant at the 0.05 level. The findings showed us that in the seven observed muscles only two muscles (flexor and extensor carpi radialis) differences in the intensity of EMG signals are significant in both situations. A mean difference existed in other muscles also. So, it could be concluded that the player uses more muscle activities in a set shot with an opponent and also we concluded that the contraction of flexor and extensor carpi radialis is more powerful when the player performs the shot with an opponent.

Keywords: Basketball, Set shot, Surface Electromyography(sEMG), Muscle activity.
INTRODUCTION

The advancement of Electromyographic (EMG) devices for the detection of electrical activity of the muscles in static and dynamic movements, EMG plays a very important role for evaluating and recording properties of muscle at rest and while contracting and the evolution of methodological approaches to data acquisition and computerized analysis of patterns, are responsible for the increased applications of EMG in rehabilitation, sport and clinical biomechanics, physiology and to a lesser extent in sports sciences.

Surface Electromyography (sEMG) is used in the evaluation of muscle activation patterns during body movements. Surface electromyography (sEMG) is an important tool to evaluate muscle function. The current Electromyography setup has a common problem: they are wired over the body to a central gateway. Even using pre-amplification and a coating, these wires can cause noise artifacts due to movements of the electrode cables. So, the portable Wireless sEMG copes with this problem.

The worldwide popularity of basketball is unquestionable, especially among the young. Basketball is a dynamic team sport that involves a pattern of intermittent dynamic and skilled movement activities. There are complex demands that require a combination of individual skills, team plays, tactics, and motivational aspects. During a basketball game, we can see a variety of movements such as running, dribbling, shuffling, and jumping. These movements are directional, multidirectional, intense and short-lasting (Jakovljevic et al., 2011).

Shooting is the principal method used to score points in Basketball and for this reason, it is the most frequently used technical action (Hay 1994). Basketball players usually score points during the game using the set shot. For this reason, the set shot is considered to be the most important element of technique in Basketball and requires a high level of performance.

The purpose of the set shot is to make the defender's job more difficult allowing the offensive player to elevate above the defender in an attempt to get a clear shot off. By elevating off the ground it allows the shooter to create space between his or her defender. The set shot is a shot that can be taken in transition as well as one on one off the dribble in any situation. Due to the fast pace movement of the game, the set shot proves to be very effective in scoring.
These influencing factors, no research group has attempted to establish the effects of opposition on the movement characteristics of the set shot. As the technical performance of the shot may be expected to change with the presence of opposition, then practicing the set shot skill without realistic opposition may be less beneficial to skill development and maintenance. Therefore, this study aimed to determine the influence of the presence of an opponent on the set shot technique. This aim was met by investigating the Electromyographical characteristics of set shot technique with and without an opponent.

SURFACE ELECTROMYOGRAPHY

Surface EMG (sEMG) is a non-invasive measurement, which means a procedure that does not involve tools that break the skin or physically enter the body. In other words, sEMG is a result derived in space and time of electrical activities in muscles under the skin. The applications of sEMG signals are included in rehabilitation and assistive technology. The potentials are recorded in the voltage field generated by active muscle cells or fibers of a contracting muscle [8]

sEMG is very easy to use but it needs practice and preparation so you can get good results, hence it is appropriate for a large group of muscles muscle's that are close to surface. But is not suitable for deep muscles that lie underneath different muscles.

Figure 1 - BTS FREEEMG 300 (Surface electromyography)
A. Instrumentation

In this research study for analyzing the muscles activities apparatus used BTS FREEEMG 300 for surface EMG recording, because it’s a noninvasive procedure for estimating muscle electrical activity that happens during muscle relaxation and contraction periods. This is the most widely recognized type of EMG recording in most gait and biomechanics situations – it includes the position of the electrodes or EMG probes (two or more) on the site of placement on the subject’s skin.

B. EMG operating

The start and end of data collection were controlled by the experimenter using a PDA (Personal Digital Assistant). When the subject ready to perform the researcher gives the command to start and stop.

C. Experimental procedures

The quality of an EMG measurement strongly depends on proper skin preparation and electrode positioning and it is necessary to perform some skin preparation before the electrode can be applied. The following procedures were considered to prepare the electrode application:

a) Skin preparation procedure

Each subject’s skin was prepared for SEMG for electrode placement by shaved (removing the hair), for cleaning of the skin special abrasive pastes was used for removing the dead skin cells (they produce high impedance) and clean the skin from dirt and sweat. Then the electrode placement site skin was cleaned and dried, alcohol was also used with a textile towel for rubbing to get a good result. At last, the skin typically received a light red color. This indicated good skin Impedance condition.
b) **Electrode Placement**

Placement of surface electrodes must be in the midline of the belly. Aiming to place the sensor correctly, some specific maneuvers allow maximum muscle contraction facilitating to identify each muscle location. The recommendation for the inter-electrode distance is 2 cm (center point to center point). Also, the electrodes must be applied parallel to the muscle fiber direction to have the best selectivity, using the dominant middle portion of the muscle belly. It is imperative to avoid the region of motor points. It’s very important to keep in mind when the EMG data collection procedure with its electrode ought to permit total freedom of the subject movements without the extra resistance.

c) **Skin surface electrodes**

Basically, in this research study researcher used the surface electrodes because of their non-invasive character and in most cases, this type of surface electrodes is used in kinesiological studies. Besides the benefit of easy handling, their main limitation is that only surface muscles can be detected. The selection of an electrode type strongly depends on the given investigation
and condition; one electrode type cannot cover all possible requirements. Also, the conductive area of the electrode should be sized to 1cm or smaller. This increases the selectivity of measurements avoiding cross-talk with other muscles.

**METHODS**

**Design**
To design an optimal physical preparation for the basketball player, it is essential first to establish exactly which muscles of the handwork harder or more in the set shot. We measured the magnitude of the difference in myoelectric signals between the set shot performed with the opponent and the set shot performed without an opponent. We analyzed the muscles that are primarily involved in the set shot in basketball: *anterior deltoid, posterior deltoid, triceps brachii longus, biceps brachii longus, flexor carpi radialis, extensor carpi radialis, and brachioradialis*.

**Participants**
The intensity, as well as the duration of the contraction of the above-mentioned muscles, was measured on a professional female basketball player, a member of the All India university team. The data were collected and analyzed both visually and quantitatively.

**Materials**
The EMG signal measurement technique is a standardized one and corresponds to the classical procedure of detection, amplification, and registration of bioelectrical activity changes in the skeletal musculature (Mereletti, 1999). It uses a differential mode of detection, with two electrodes, positioned at the midpoint of the measured muscle at a standardized distance of 2 cm (center to center) along the muscular fibers. The "BTS FREEEMG 300" biomechanical system was used for data collection and analysis.

**Procedure**
The measurements were conducted during the set shot performed with the opponent and without an opponent. The participant was filmed as she performed the set shot. To ensure the same conditions for all the performances (the same shooting action was used), Electrodes were placed on the right side of the player's body due to her right-handedness. The intensity and duration of contractions of the following muscles were measured:
Methods for measured signal processing

Averaged EMG signals were translated into a numerical ASCII format and stored into the computer. SPSS statistical package was used for the statistical signal process. Absolute muscle involvement was estimated based on averaged rectified EMG signals (µV) measured in all muscles (Medved, 2001). The mean value of averaged rectified EMG signals was calculated for each analyzed muscle, and both situations. Descriptive statistical parameters (min, max, mean, and SD) were calculated for these data. The paired t-test was used for calculating the differences between overall mean values of averaged EMG signals among all muscles.

ANALYSIS OF DATA AND THE RESULTS:

The statistical analysis of electromyographical data on ten female basketballers for the analysis of set shots with and without opponent was selected for the study. To compare the electromyographical activity of muscles between two situations, a paired 't' test was used. The level of significance was set at 0.05.

The statistical findings of comparisons of paired ‘t’ test were presented on the followings tables:
Table 1.1 - Basic parameter of sEMG signals in µV (descriptive statistics)

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANTERIOR DELTOID WITH OPPONENT</td>
<td>201.95</td>
<td>10</td>
<td>110.04</td>
<td>34.79</td>
</tr>
<tr>
<td>ANTERIOR DELTOID WITHOUT OPPONENT</td>
<td>174.04</td>
<td>10</td>
<td>70.92</td>
<td>22.42</td>
</tr>
<tr>
<td>Pair 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POSTERIOR DELTOID WITH OPPONENT</td>
<td>137.22</td>
<td>10</td>
<td>86.04</td>
<td>27.20</td>
</tr>
<tr>
<td>POSTERIOR DELTOID WITHOUT OPPONENT</td>
<td>125.05</td>
<td>10</td>
<td>51.77</td>
<td>16.37</td>
</tr>
<tr>
<td>Pair 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BICEPS WITH OPPONENT</td>
<td>97.91</td>
<td>10</td>
<td>36.12</td>
<td>11.41</td>
</tr>
<tr>
<td>BICEPS WITHOUT OPPONENT</td>
<td>97.31</td>
<td>10</td>
<td>42.54</td>
<td>13.45</td>
</tr>
<tr>
<td>Pair 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRICEPS WITH OPPONENT</td>
<td>90.36</td>
<td>10</td>
<td>29.74</td>
<td>9.41</td>
</tr>
<tr>
<td>TRICEPS WITHOUT OPPONENT</td>
<td>87.14</td>
<td>10</td>
<td>27.05</td>
<td>8.55</td>
</tr>
<tr>
<td>Pair 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLEXOR WITH OPPONENT</td>
<td>104.64</td>
<td>10</td>
<td>67.90</td>
<td>21.47</td>
</tr>
<tr>
<td>FLEXOR WITHOUT OPPONENT</td>
<td>107.46</td>
<td>10</td>
<td>49.82</td>
<td>15.75</td>
</tr>
<tr>
<td>Pair 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXTENSOR WITH OPPONENT</td>
<td>112.61</td>
<td>10</td>
<td>33.43</td>
<td>10.57</td>
</tr>
<tr>
<td>EXTENSOR WITHOUT OPPONENT</td>
<td>127.55</td>
<td>10</td>
<td>36.43</td>
<td>11.52</td>
</tr>
<tr>
<td>Pair 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRANCHIORADIALIS WITH OPPONENT</td>
<td>80.46</td>
<td>10</td>
<td>40.61</td>
<td>12.84</td>
</tr>
<tr>
<td>BRANCHIORADIALIS WITHOUT OPPONENT</td>
<td>85.77</td>
<td>10</td>
<td>28.70</td>
<td>9.07</td>
</tr>
</tbody>
</table>

The values of the mean, standard deviation, and standard error of the mean for the data of different muscles on basketball set shot with and without opponent are shown in table 1.1. These values can be used to conclude as to whether the muscle involvement was different or not in the two different situations and Graphical comparison was made for the mean values of ARV EMG to present the relevance as a ready reference.
Table 1.2- Results of the paired t-test.

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>MEAN</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>P- Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANTERIOR_DELTOID_WITH_OPPONENT</td>
<td>27.90</td>
<td>95.51</td>
<td>.92</td>
<td>9</td>
<td>.38</td>
</tr>
<tr>
<td>ANTERIOR_DELTOID_WITHOUT_OPPONENT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POSTERIOR_DELTOID_WITH_OPPONENT</td>
<td>12.17</td>
<td>58.06</td>
<td>.66</td>
<td>9</td>
<td>.52</td>
</tr>
<tr>
<td>POSTERIOR_DELTOID_WITHOUT_OPPONENT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BICEPS_WITH_OPPONENT - BICEPS_WITHOUT_OPPONENT</td>
<td>00.60</td>
<td>35.81</td>
<td>.05</td>
<td>9</td>
<td>.95</td>
</tr>
<tr>
<td>Pair 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRICEPS_WITH_OPPONENT - TRICEPS_WITHOUT_OPPONENT</td>
<td>3.22</td>
<td>34.51</td>
<td>.29</td>
<td>9</td>
<td>.77</td>
</tr>
<tr>
<td>Pair 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLEXOR_WITH_OPPONENT - FLEXOR_WITHOUT_OPPONENT</td>
<td>-2.81</td>
<td>73.93</td>
<td>-.12</td>
<td>9</td>
<td>.02</td>
</tr>
<tr>
<td>Pair 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXTENSOR_WITH_OPPONENT - EXTENSOR_WITHOUT_OPPONENT</td>
<td>-14.93</td>
<td>22.86</td>
<td>-2.06</td>
<td>9</td>
<td>.04</td>
</tr>
<tr>
<td>Pair 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRANCHIO_WITH_OPPONENT - BRANCHIO_WITHOUT_OPPONENT</td>
<td>-5.31</td>
<td>28.61</td>
<td>-.58</td>
<td>9</td>
<td>.57</td>
</tr>
</tbody>
</table>

CONCLUSION

Table 1.2 the following interpretations can be made based on the results shown in the above-paired t-test for the data on different muscles.
a) It can be seen from pair 1 that the value of t statistics is .924 this t value is insignificant as the p-value is .38 which is more than 0.05. thus, it may be concluded that the muscle average involvement in both the situation is the same.

b) It can be seen from the pair 2,3,4,7 that the t value of is insignificant as the p-value is not less than 0.05 which was set as the level of significance, thus it is concluded that the muscle involvement in both the situation is same.

c) It can be seen that the p-value of pair 5 and pair 6 i.e. flexor carpi radialis and extensor carpi radialis muscle is less than .05, which was set as the level of significance, hence it can be concluded that there was significant difference found between these 2 muscles when the player performs the set shot with and without opponent.

Figure 3 The Graphical representation of ARV EMG Values of muscles in the Set shot with and without an opponent
The above column graph shows that in case of Set shot with and without opponent anterior deltoid, flexor and extensor carpi radialis play the dominant role and other muscles play the least role in performance (series 1 shows the set shot data with the opponent and series 2 shows data without an opponent)

**DISCUSSION**

It is revealed from the statistical analysis that Two of the selected electromyographical variable showed a significant difference in flexor carpi radialis and extensor carpi radialis of a set shot in basketball perform in two situations at 0.05 level of significance. Reasons for significant difference result of mentioned 2 electromyographical variables during the successful set shot of with and without an opponent in basketball is due to the following reason: When players perform the set shot with an opponent they have higher muscle involvement and adaptation. In the set shot, players just use the flick of their wrist in attempts which mainly involve the use of following 2 muscle: Extensor Carpi Radialis Longus (major involvement), and Flexor carpi radialis longus.

There is no difference in the electrical activation of anterior deltoid, posterior deltoid, triceps brachii longus, biceps brachii longus, and brachioradialis muscle. Further, many other factors might affect the performance that is not included in the study. Causes of an insignificant result of mentioned electromyographical variables during a successful set shot with and without an opponent in basketball are: Maybe due to the less sample size and Anterior Deltoid and Biceps Brachii muscle have very less involvement in the execution of the set shot.

**RECOMMENDATIONS**

Based on the conclusion drawn in this study, the following recommendations have been made:

1. A study may be undertaken with a large number of subjects and variables contributing to the effect of a set shot.
2. The same study can also be conducted on male basketball players.
3. The same study may be replicated on the Jump shot or 3 Pt. Shooting to have more objective and accurate data for Electromyographically analysis.

4. The same study can also be taken to biomechanically analyze the shooting pattern of basketball players playing at different positions.

REFERENCES
Hudson, J. L. 1985, Prediction of basketball skill using biomechanical variables, Research Quarterly for Exercise and Sport, 56, 115 ± 121.
White, L. and elliott, B. C. 1989, A comparison of the female jump shot technique for the two point and three point goals in basketball, Sports Coach, 12(4), 33 ± 35.
Masso, N, Rey, F, Romero, D, Gual, G, Costa, L, & German, A. Surface electromyography applications in the sport. Apunts Medicine de Esport (2010)., 45(165), 121-130.