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Comparison of electrical activity of Maximum Isometric Voluntary Contraction of Rectus and Biceps Femoris Muscles for Soccer Players

Mansour N. Al Sowayan [1]

King Saud University, Department of Biomechanics & Motor Behavior, Sport Sciences & Physical Activity College, Riyadh, Saudi Arabia

Abstract

The aim of this study was to compare the electromyographic (EMG) activity and maximum isometric voluntary muscle contraction between rectus and biceps femoris muscles for kick and support leg in soccer players. The performance of (11) of Saudi soccer players was examined, the authors collected data by measuring EMG using DELESYS which is one of the leading companies in manufacturing electrical activity measuring equipment by using two isometric tests for maximum voluntary muscle contraction from sitting and lying position, the main experiment has been conducted on the 4th and 5th of February 2019 in the biomechanics lab located inside the Biomechanics and Motor Behavior department in the faculty of Sport Science and Physical Activity at King Saud University.

The results reveal that the measures of Maximum Isometric Voluntary Contraction (MVC) indicate the need for balancing the intensity of training for all muscles group. A balance in strength between the both kicking and supporting rectus and biceps femoris muscles has been

[1] Address all correspondences to Mohammed M. Abdelaziz Ahmed, E-mail: mahmed2@ksu.edu.sa

shown to be of utmost importance, this is in turn reflected in the accuracy and effectiveness of skill performance which lowers the risk for injuries as a result of the existing balance between body parts.

Keywords: Electromyography (EMG), Maximum Isometric Voluntary Contraction, Soccer.

Introduction:

The improving of achievement in different sports became a big challenge and the competitive between countries around the world, and soccer is one of these sports which classified as the first popular and competitive sports in the world, the success of the game has been shown to be highly dependent on various physical, technical, tactical, and psychological factors (Dragijsky, 2017) , Since the physical aspect plays a critical role in soccer competitions, soccer players need a high fitness level to cope with the physical demands of the game (F. Marcello Iaia, 2009).

Muscle strength improving is very important for soccer players. That's why many studies have shown that strength training contributes to a decreased fatigue index and improve skills performance (Baldi, 2016) , also , many studies have supported that the development of strength reduces the risks for injuries among soccer players (Askling, 2003) , moreover, strength contributes to developed speed, acceleration and deceleration for soccer players.

In sport, muscle strength is measured in many different ways; one of these is Electromyography (EMG). Electromyography is the recording of the electrical activity of muscles, and therefore constitutes an extension of the physical exploration and testing of the integrity of the motor system (J., 1983).

EMG is an advanced technique to record and evaluate muscle activity (Nishi, 2016), EMG's typical benefits include: Directly looking into the muscle, measuring of muscular performance, helping in decision making both before and after surgery, documenting treatment and training regimes, helping patients find and train their muscles, allowing analysis to improve sports activities, and detecting muscle response in ergonomic studies (Peter, 2005).

EMG device enables to identify the electrical activity of the muscles during sport performance, EMG mechanism works through studying the characteristics of the neuromuscular system as it mainly depends on recording the electrical activity of muscles when it contracts. Muscles

are attached to a camera, then the data are sent to a computer through Bluetooth pairing and the previously used electrodes are no longer needed.

Previous studies have dealt with other aspects related to this study's emphasis. For instance, programs designed to promote muscular strength and explosive speed of soccer players are of utmost importance as demonstrated in "EMG evaluation of hip adduction exercises for soccer players" (Serner, 2014) , another study on "Quadriceps EMG muscle activation during accurate soccer instep kicking" (Scurr, 2011) has shown how critical EMG is in determining the differences in muscles activity during free kicks. Some other studies have dealt with recording EMG during ball kicks such as "EMG activity of the iliopsoas muscle and leg kinetics during the soccer place kick" (Dörge, 1999).

Other studies in this same area include "Electromyography of selected lower-limb muscles fatigued by exercise at the intensity of soccer match-play" (Rahnama, 2005).

In this paper, it is hypothesized that there are differences EMG activity between rectus and biceps femoris both kicking and supporting muscles which we as authors seek to identify these differences and consequently the required training modes for players.

The importance of this paper lies in determining muscles activity through EMG device which detects and stores electrical signals emerging from the muscles, this is how the electrical activity is detected during exercise. In addition, EMG helps in providing accurate and reliable indicators of the activity in each muscle.

The resulting data provides coaches with a clear view of muscle function and how to develop the working muscles according to the proper scientific methods. This has given rise to the study's emphasis to compare between the electrical activity of rectus and biceps femoris both kicking and supporting muscles for dynamic and constant force in expert soccer players. The aim here is to assess training and physical fitness of the players in order to develop training programs and avoid injuries.

The study aims to Identify the differences in EMG activity between the rectus and biceps femoris both kicking and supporting muscles for kick leg and support leg.

The question of the study is, what are the differences in EMG activity between the kicking and supporting rectus femoris and between the kicking and supporting biceps femoris, for the kick leg and support leg?

Methods:

The researchers used the experimental style in a manner of one group design for measuring Maximum Isometric Voluntary Contraction (MIVC) for kick leg and support leg in soccer players.

The sample of the study consisted of (11) elite soccer players in the youth league, with the details shown in table (1).

Table (1) The mean and coefficient of skewness for research sample

Statistical processing / Variables	less value	highest value	Range	Mean	coefficient of skewness
Age (years)	**19**	**20.2**	**1.2**	**19.7**	**0.398-**
Hight (cm)	**163**	**188**	**15**	**174.4**	**0.216-**
Mass (Kg)	**60**	**94**	**34**	**70.7**	**0.243-**

The range of coefficient of skewness was from - 0.398 ، -0.216 which appeared the homogeneity in the variables of age, height and mass for sample research.

- DELSYS Trigno wireless EMG measurement.

- Tape to install EMG electrodes on the skin.

- Razor blade.

- Weight Scale.

- Measure tape.

The researchers did a pilot study for the purpose of checking all the equipment and to clarify the aims of the study to the research sample and the working team.

The main test has been done from 4-5 Feb 2019 in the Biomechanics and Motor behavior lab at the Faculty of Physical Education and Sports science University Of - King Saud.

The variables of the research have been assigned as below: -

1- (MIVC) Maximum Voluntary Isometric Contraction.

2- Player height and weight.

3- Measuring the muscles contraction for kick leg and support leg (Rectus femoris, Biceps femoris).

4- The study used two tests from Sitting and lying position.

(a) (b)

Fig (1) The test of (MIVC) a- Sitting b- Lying

Statistical analysis: - Data for the two legs were analyzed using SPSS version 21 by (Mean, Standard deviation, Wilcoxon Test, Friedman test and ANOVA test).

Results: -

Table (2) Significance of statistical differences in measurement in the results of (MIVC) for Rectus femoris - Biceps femoris Muscles (kick leg and support leg)

Muscles groups	average of ranks	Value ($\chi 2$)	Degree of freedom	Significance level
(Rectus femoris)(MIVC)	1.70	11.640	3	0,009
(Rectus femoris) (MIVC)	2.20			
(Biceps femoris) (MIVC)	3.60			
(Biceps femoris) (MIVC)	2.50			

Table (3) Significance of statistical differences in measurement in the results of (MIVC) for Rectus femoris Muscle (kick leg and support leg)

Rectus femoris Muscle	$\overline{X}$	SD	Ranks	average of ranks	Sum of Ranks	(Z) value	Significance level	significance
Kick leg	164,40	46,02	negative	7,00	28,00	0,051	0,959	Non significance at ≤0.05
Support leg	162,00	88,00	Positive	4,50	27,00			

Table (4) Significance of statistical differences in measurement in the results of (MIVC) for Bices femoris Muscle (kick leg and support leg)

Rectus femoris Muscle	$\overline{X}$	SD	Ranks	average of ranks	Sum of Ranks	(Z) value	Significance level	significance
Kick leg	313,60	81,53	negative	5,88	47,00	1,988	0,047	Significance at ≤0.05
Support leg	236,40	85,10	Positive	4,00	8,00			

Table (5) Significance of statistical differences in measurement in the results of (MIVC) for Rectus-femoris & Biceps- femoris Muscle (kick leg)

Kick leg	$\overline{X}$	SD	Ranks	average of ranks	Sum of Ranks	(Z) value	Significance level	significance
Rectus femoris Muscle	164,40	49,02	negative	0,00	0,00	2,803	0,005	Significance at ≤0.01
Biceps femoris muscle	313,60	81,53	Positive	5,50	55,00			

Table (6) Significance of statistical differences in measurement in the results of (MIVC) for Rectus-femoris & Biceps- femoris Muscle (support leg)

support leg	$\overline{X}$	SD	Ranks	average of ranks	Sum of Ranks	(Z) value	Significance level	significance
Rectus femoris Muscle	162,00	88,00	negative	3,50	14,00	1,367	0,169	Significance at ≤0.05
Biceps femoris muscle	236,40	85,10	Positive	6,83	41,00			

Discussion: - The results showed a Statistically significant differences in the (MIVC) test between kick leg and support leg for the biceps- femoris in the favor of the support leg which effect the performance of soccer players during different scoring skills because of the weakness of the Biceps-Femoris of the kick leg , Several studies have been conducted to explain the muscle activation patterns during kick using electromyography, In these reports the soccer kick was considered to be the result of simultaneous activity of many muscles connecting segments and causing joint movement (Ali Onur Cerraha, 2011).

It important to distribution of training loads to improve strength for both kick and support leg this will improve the efficiency of performance of scoring skills and the others skills which need the strength of the kicking leg with high efficiency, kicking can be described as a summation of forces (Lois Rodrı´guez-Lorenzo, 2016).

The results indicate that the study sample has maximum electromyography for isometric strength in the biceps -femoris more than rectus - femoris that's an indicator for probability that exposed to a sample of the study to injury in the rectus - femoris because of the un balance of strength distribution during training, The rectus femoris is a fusiform and biarticular long muscle located in the anterior aspect of the quadriceps muscle, these types of muscles are designed to execute movements that require significant length change or high shortening velocity. (Jurdan Mendiguchia, 2012), the superiority of the isometric strength of the rectus - femoris in comparison with biceps-femoris pointing to an error in training which reflected the weakness and accuracy of players performance in addition to the probability of injury.

Conclusion: -A balance in strength between the both kicking and supporting rectus and biceps femoris muscles has been shown to be of utmost importance, this is in turn reflected in the accuracy and effectiveness of skill performance which lowers the risk for injuries as a result of the existing balance between body parts. Finally, this paper stresses the importance of variability in developing fitness factors according to scientific standards along with focusing on flexibility and lengthening trainings for the working muscles.

Perspective: - balancing in training for muscles group is very important to improve efficiency of performance in passing and scoring as well as to reduce and prevent injuries among soccer players.

References

[1] Ali Onur Cerraha, ∗ . E. (2011). Muscular activation patterns during the soccer in-step kick. *Isokinetics and Exercise Science*, 181-190.

[2] Askling, C. K. (2003). Hamstring injury occurrence in elite soccer players after preseason strength training with eccentric overload. *Scandinavian Journal of Medicine and Science in Sports*, 13, 244-250.

[3] Baldi, M. D. (2016). Repeated sprint ability in soccer players: associations with physiological and neuromuscular factors. *The Journal of Sports Medicine and Physical Fitness*, 57, 26-32.

[4] Dörge, H. A.-P. (1999). EMG activity of the iliopsoas muscle and leg kinetics during the soccer place kick. *Scandinavian Journal of Medicine & Science in Sports*, 9, 195-200.

[5] Dragijsky, M. M. (2017). Seasonal variation of agility, speed and endurance performance in young elite soccer players. *Sport*, 5-12.

[6] F. Marcello Iaia, E. R. (2009). High-Intensity Training in Football. *International Journal of Sports Physiology and Performance*, 291-306.

[7] J., K. (1983). *Electrodiagnosis in diseases of nerve and muscle.* Philadelphia: F.A. Davis Company.

[8] Jurdan Mendiguchia, 1. E.-G. (2012). Rectus femoris muscle injuries in football:a clinically relevant review of mechanisms of injury,risk factors and preventive strategies. *British Journal of Sports Medicine*.

[9] Lois Rodrı´guez-Lorenzo, B. M.-d.-O.-A. (2016). Strength and Kicking Performance in Soccer: A Review. *Strength and conditioning journal*, 106.

[10] Nishi, S. B. (2016). Uses of electromyography in dentistry: An overview with meta-analysis. *European Journal of Dentistry*, 10, 419-425.

[11] Peter, K. (. (2005). *The ABC of EMG: A practical introduction to kinesiological electromyography.* USA: Noraxon INC.

[12] Rahnama, N. L. (2005). Electromyography of selected lower-limb muscles fatigued by exercise at the intensity of soccer match-play. *Journal of Electromyography and Kinesiology*, 16, 257-263.

[13] Scurr, J. A. (2011). Quadriceps EMG muscle activation during accurate soccer instep kicking. *Journal of Sports Sciences*, 29, 247-251.

[14] Serner, A. J. (2014). EMG evaluation of hip adduction exercises for soccer players: Implications for exercise selection in prevention and treatment of groin injuries. *British Journal of Sports Medicine*, 48, 1108-1114.