

ELECTROMIOGRAPHIC ANALYSIS OF FEMORAL QUADRICEPS IN FUTSAL AND VOLLEYBALL AMATEUR ATHLETESFlavia Angela Servat Martins¹Aline Bevervanzo dos Santos¹Luiz Augusto da Silva¹Julio Cesar Lacerda Martins¹**ABSTRACT**

This research has as its subject the electromyographic analysis of the femoral quadriceps in futsal and volleyball amateur athletes. It is noteworthy that the sample in this direct and quantitative field study was characterized primarily by age, body mass, stature and electromyographic evaluations of the muscles that form (or make up) the quadriceps. The objective of this study was to evaluate the relation between quadriceps femoral contraction between amateur futsal and volleyball players. The subjects of the survey were 12 amateur futsal athletes and 12 amateur volleyball athletes. A comparative analysis of quadriceps femoral contraction between futsal and volleyball athletes was developed. The inferential statistical analysis to compare the studied variables with the use of the "t-test" for independent samples allows to compare independent groups whose scales were measured on a numerical scale. The results showed differences in the left rectus femoris muscles and left and right sides, among the hypotheses raised for this difference are the muscles required in each sport, the period of the training macrocycle in which the athletes are found, the frequency in strength training, or most likely all these allied associated.

Key words: Electromyographic. Futsal. Volleyball.

RESUMO

Análise eletromiográfica dos quadríceps femorais em atletas amadores de futsal e voleibol

Essa pesquisa tem como temática análise eletromiográfica do quadríceps femoral em atletas amadoras de futsal e voleibol. O objetivo do estudo foi avaliar a relação da contração muscular do quadríceps femoral entre atletas amadoras de futsal e voleibol. A amostra se caracteriza por pesquisa de campo, direta e quantitativa, contudo, caracterizada prioritariamente pela idade, massa corporal, estatura e avaliações eletromiográficas dos músculos que formam (ou compõem) o quadríceps. Os sujeitos da pesquisa foram 12 atletas amadoras de futsal e 12 atletas amadoras de voleibol. Foi desenvolvida uma análise comparativa da contração muscular do quadríceps femoral entre as atletas de futsal e voleibol. A análise estatística inferencial para comparar as variáveis estudadas com utilização do teste t para amostras independentes por permitir comparar grupos independentes cujas escalas foram mensuradas em escala numérica. Os resultados apresentaram diferenças nos músculos reto femoral esquerdo e vastos laterais esquerdo e direito, entre as hipóteses levantadas para essas diferenças, pode-se identificar a especificidade desses músculos necessários em cada esporte, o período do macrociclo de treinamento em que se encontram as atletas, a frequência em treinamento de força, ou de forma mais provável todos esses fatores associados.

Palavras-chave: Eletromiografia. Futsal. Voleibol.

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INTRODUCTION

The femoral quadriceps are composed of the rectus femoris (RF), vastus medialis obliquus (VMO), vastus lateralis oblique (VLO) and vastus medialis (VI), whose musculature is much sought after in sports, such as futsal and volleyball that need the strength and explosion that this musculature offers (McArdle, 2001).

Futsal is an invasion modality that originates from fast motor actions, which require a perfect kinesiological and muscular condition, both of which are strongly linked and worked for the purpose of the modality (Samulski, 2000).

The quadriceps femoris muscle is required all the time and one of the strongest moments that its action potential comes into play is in the kick action (Magalhães e colaboradores, 2001).

In volleyball, one of the inherent characteristics of his practice of great motor action is the vertical jump, which also involves an adequate kinesiological action and a great muscular recruitment of the lower limbs, but the muscle of greater responsibility and that suffers more actions of this recruitment is the femoral quadriceps (Okano, 2004).

It is agreed that any programmed physical exercise induces changes in the body from the cardiovascular, respiratory, reproductive, and muscular systems (McArdle, 2001).

Douglas (2002), in the context of the research, shows that the femoral quadriceps musculature is composed of different muscle fibers, type I (slow) and type IIa and IIb (fast). Training intensity can convert fast-twitch fibers to slow-twitch fibers (Lieber, 2002).

For Magalhães e colaboradores (2003), some of the characteristics of futsal inherent to its practice are common in volleyball, since the required strength of lower limbs is predominant, and it becomes indispensable and relevant to the monitoring of the responsible musculature, through electromyography.

Futsal is one of the modalities that has physiological variables, such as speed, power, muscle explosion, aerobic and anaerobic capacity, and one of the largest muscles responsible for these motor capacities is the quadriceps.

Volleyball has some physical characteristics inherent to futsal, because it requires the speed to perform rapid movements, the muscular explosion to obtain

the impulse and also, the power to carry out, for example, a strong serve. These are extreme physical abilities required in all positions of volleyball (Bompa, 2002; Silva e colaboradores, 2003).

Thus, these registers bring extremely relevant information to monitor and classify the action potential of muscle fibers, i.e. how is muscle strength, how are the physiological electrical signals under differentiated conditions of muscle contraction (Madelaine e colaboradores, 2000).

Also, in this sense, as a parameter to evaluate strength and performance, electromyography can also be used to prevent injury through its registers, and it is possible to know the actual conditions of muscle fibers, due to the high training loads applied (Powers e Holey, 2000).

However, Gonçalves and Cerqueira (2000), bring electromyography as a convincing methodology of study with respect to the various types of muscle contraction. For the authors, the importance of the action of muscular contraction, in this case of the quadriceps, goes far beyond these objectives, it participates in a direct and relevant way in the stabilization of joints, such as the knee.

Therefore, the present study has as a problem, to investigate if there is a relation between the muscular contraction of the quadriceps femoris between amateur athletes in futsal and volleyball? We then understand that the two modalities have physical capacities in common making the study interesting.

To find out in which of the modalities the action potential of the quadriceps muscle is greater or equal. It is known that the trainings differ among themselves, due to the purpose and objective of each modality, but the need to obtain the best performance in physical capacity is the same.

MATERIALS AND METHODS

Initially the project was sent to the Ethics Committee, with approval nº 2278562/2017, a letter of presentation was sent to the head of the Integrated Clinics of the Guairacá College, requesting the use of the dependence and the electromyograph. Immediately afterwards the Free Informed Consent Form (TCLE) the athletes to be signed.

Specifying the objectives of the research and explaining that the names of

participants will not be divulged as well as any other information.

For the study sample, a team composed of twelve athletes of the amateur team of the futsal modality and twelve of the amateur mode of volleyball were chosen, both of them female, aged between 18 and 25 years.

As inclusion criterion, active athletes of volleyball and futsal were indicated, that is, that they participate regularly in the training and games to six months. After the research was presented, they read and freely and voluntarily signed the Term of Free and Clarified Compromise.

As an exclusion criterion, athletes with some joint and muscular deformity, incapacitating traumas to perform the test, and those who verbally declare that they do not participate in the research and do not accept the Term of Free and Clarified Commitment.

An 8-channel electromyograph (EMG System Brasil Ltda.) Was used to evaluate the neuromuscular contraction of the quadriceps femoris in futsal and volleyball athletes and active, bipolar and differential type surface electrodes connected to the Windaq Signal Acquisition Software. A stretcher was also used for the correct positioning of the individual at 90° of knee flexion.

Initially performed tricotomy, with individual and disposable material, at the electrode coupling sites, as recommended by Surface ElectroMyoGraphy for the Non-Invasive Assessment of Muscles (SENIAM) for the removal of dead cells. In order to couple the electrodes, the anatomical technique described by Delagi and Perotto (1980) was established, fixed in the part of the muscle to be analyzed.

One of the electrodes, the reference electrode, will be attached to a bone end so that no interference occurs in the signal picked

up in the muscle being evaluated. A contraction will be performed on each leg, lasting 30 seconds each, after the evaluation the electrodes will be removed.

The analysis of results was done in a quantitative way, making it possible to collect data from a specific group in order to prove hypotheses, the analysis techniques are by means of tables and graphs with absolute values, as these bring standardized results and with a greater exposure.

The inferential statist analysis to compare the studied variables with the use of the t-test for independent samples allows to compare independent groups whose scales were measured on a numerical scale. Thus, it was possible to compare the results of futsal athletes with volleyball.

RESULTS

To perform the tests the days were defined according to the availability of the evaluated athletes. The aim of the study was to evaluate the electrical activity of the femoral quadriceps, Femoral Reto, Vasto Medial (VM), Vasto Lateral (VL), of futsal and volleyball amateur athletes, being force traction in the left loss (TFPE); Right loss force traction (TFPD); Left leg femoral challenge (RFPE); Right leg femoral challenge (RFPD); Vastus medialis of the left leg (VMPE); Vastus medialis on the right leg (VMPD); Vasto lateralis of the left leg (VLPE); Vasto Lateral right leg (VLPD) and compare the results between the two modalities.

The results of the descriptive static of maximum, minimum, mean and standard deviation referring to the characterization of the sample regarding age, height, body mass and the electromyographic evaluations of futsal athletes are shown in table 1.

Table 1 - Descriptive statistics of futsal athletes regarding height, height, body mass and electromyographic evaluations.

Futsal	Sample	Media	Minimum	Maximum	DP
Age (years)	12	21,00	19,00	24,00	1,66
Height (m)	12	1,63	1,56	1,75	0,06
Whight (kg)	12	57,58	53,00	65,00	3,45
TFPE (kgf)	12	38,85	20,57	57,59	10,42
TFPD (kgf)	12	32,77	8,48	49,84	10,76
RFPE	12	141,13	12,01	291,24	100,01
RFPD	12	87,36	12,42	212,44	66,02
VMPE	12	82,23	8,3,	236,95	76,35
VMPD	12	68,34	9,76	159,99	50,75
VLPE	12	47,52	20,22	221,05	58,38
VLPD	12	47,88	17,89	210,40	58,59

Table 2 - Descriptive statistics of volleyball athletes regarding height, weight, body mass and electromyographic evaluations.

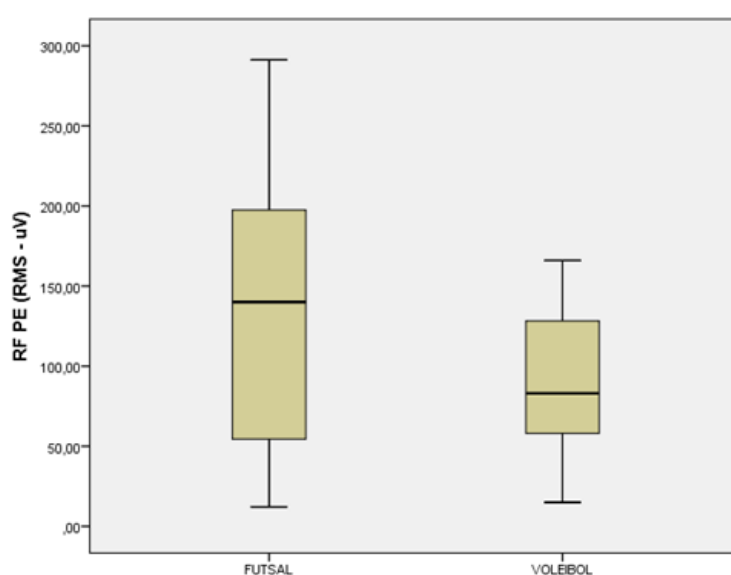
Volleyball	Sample	Media	Minimum	Maximum	DP
Age (years)	12	20,08	1,008	25,00	2,39
Height (m)	12	1,68	1,62	1,85	0,06
Weight (kg)	12	63,67	52,00	76,00	6,39
TFPE (kgf)	12	37,65	28,94	49,65	8,10
TFPD (kgf)	12	39,54	28,69	59,86	9,51
RFPE	12	75,38	14,97	166,01	41,16
RFPD	12	65,71	14,31	149,88	40,74
VMPE	12	44,87	11,37	93,81	26,47
VMPD	12	36,16	15,82	67,12	15,44
VLPE	12	32,36	13,12	58,27	13,49
VLPD	12	29,40	11,08	52,15	12,77

The results of the descriptive static of maximum, minimum, mean and standard deviation regarding the characterization of the sample regarding age, height, body mass and electromyographic evaluations of volleyball athletes are shown in table 2.

All samples were statistically tested for normality of distributions by the Kolmogorov-Smirnov test, which showed that all measured variables had a normal distribution (futsal age $Z = 0.215$ for $p = 0.130$, volleyball age $Z = 0.258$ for $p = .027$, futsal height $Z = 0.139$ for $p = 0.200$, height $Z = 0.218$ for $p = 0.120$, futsal body weight $Z = 0.202$ for $p = 0.190$ Body weight volleyball $Z = 0.167$ $p = 0.200$ TFPE futsal $Z = 0.096$ for $p =$ TFPD volleyball $Z = 0.201$ for $p = 0.197$, RFPE futsal $Z = 0.160$ for $p = 0.200$ RFPE volleyball $Z = 0.149$ for $p = 0.200$, TFPD futsal $Z = 0.212$ for $p = 0.141$,

TFPD volleyball $Z = 0.201$ for $p = 0.197$, VMPD futsal $Z = 0.227$ for $p = 0.088$, VMPE volleyball $Z = 0.201$ for $p = 0.194$, VMPD futsal $Z = 0.202$ for $p = 0.188$, $p = 0.120$ for $p = 0.118$; VMPD volleyball $Z = 0.152$; for $p = 0.200$; VLPE futsal $Z = 0.449$ for $p = 0.090$; VLPE volleyball $Z = 0.192$ for $p = 0.200$; VLPD futsal $Z = 0.458$ for $p = 0.085$; VLPD volleyball $Z = 0.222$ for $p = 0.106$).

The "t-test" was used for independent samples in order to verify if there was a significant difference between the futsal and volleyball athletes, where a significant difference was found in the variables studied: RF PE ($t = 10.766$ for $p = 0.003$); VM PE ($t = 10.744$ for $p = .003$); VM PD ($t = 22.580$ for $p = 0.000$). The graphical representations of the RF variables PE, VM PE and VM PD are shown in Figures 1,2 and 3 below.

**Figure 1** - comparison of the PE RF test between futsal and volleyball athletes.

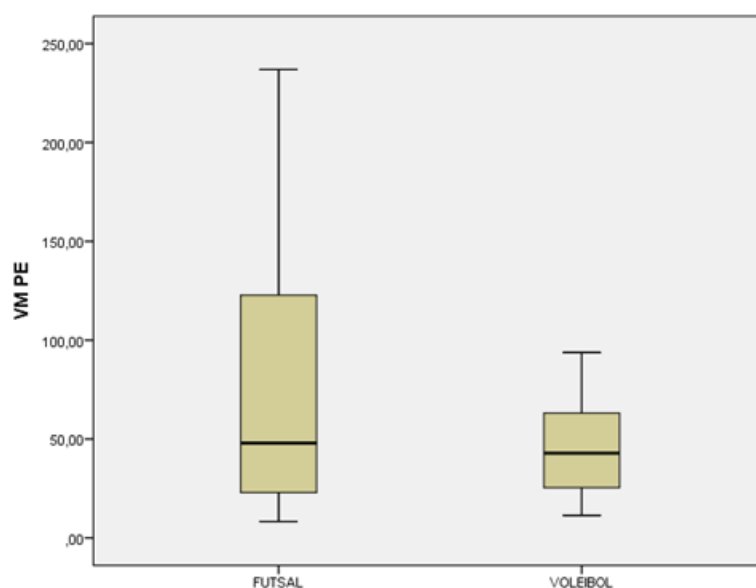


Figure 2 - Comparison of the MV PE test among futsal and volleyball athletes.

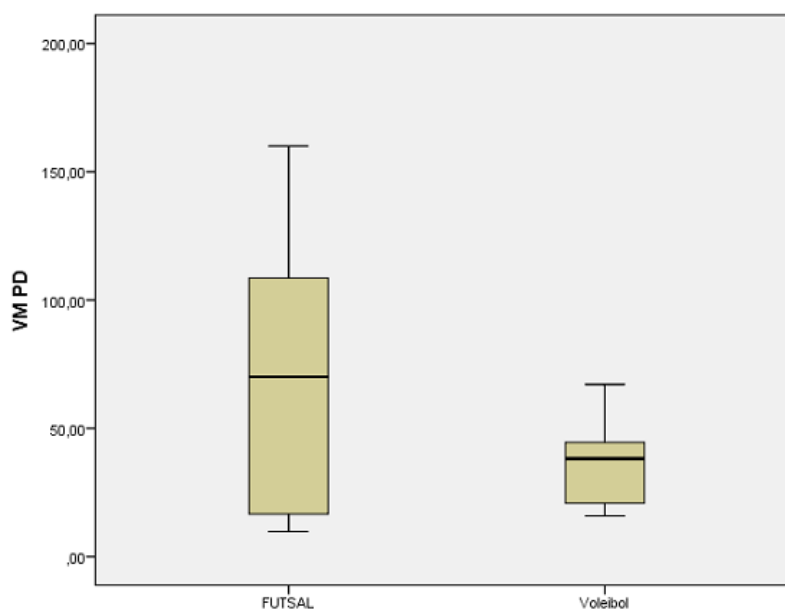


Figure 3 - Comparison of the MV PD test between futsal and volleyball athletes

DISCUSSION

The muscles, rectus femoris, vastus lateralis and vastus medialis the so-called quadriceps femoris, which is situated in the anterior part of the thigh, is considered the largest and most powerful muscle in the human body (Weineck, 1990).

The rectus femoris can be considered as the main acting muscle in the kick¹⁴. This may explain the superiority of femoral rectus numbers in futsal athletes compared to volleyball athletes.

In the study by Moraes e colaboradores (2003), the participation of the rectus femoris muscle in kicking and non-kicking exercises was evident and identified

the predominance of explosive strength of the kicking movement in both phases (initial and final).

Ferreira et al¹⁶, says that the quadriceps are the most required muscle in futsal and soccer practice because of the sprints, passes, kicks, leaps and jumps that occur during a match, so most of the actions that consist of futsal practice require the femoral quadriceps muscles, which explains the great strength acquired by the athletes of the sport. In contrast, by means of kinesiological analysis, jumping vertically (common action in volleyball) involves the action of several muscles, especially the quadriceps, which present certain singularities regarding muscular architecture, fiber type and biomechanics (Okano, 2004).

According to Oliveira (1997) the movements of attack and blocking are the greatest efforts in volleyball, two jumping actions that, therefore, use the quadriceps muscles in a dominant way in their action, as in futsal, volleyball also has a predominant action of quadriceps muscles.

Another factor that may influence the results of the study is the period in which the studied athletes are found, the futsal athletes are in the mesocycle phase of competition, now having their physical peak in the season, while the volleyball athletes meet in the microcycle of transition from his mesocycle and have already had their physical peak in the season.

Marques e colaboradores (2008), points out that in the competitive period muscle strength suffers an increase in maximum strength, that is, athletes who are in competition period tend to have an increase in their maximum strength, which explains the higher maximum strength among athletes of futsal, who are in competition period in comparison to the volleyball athletes that are not in competition.

This can be explained by technical planning because athletes have to reach their physical peak at a certain time of the year. Bompá (2000) says that the training should make the athlete achieve his highest level of performance at a given moment, so that he arrives the main competition of the year with a good athletic form.

One more factor that can make a difference in the test is that futsal athletes all have a frequency in gym activities three times weekly while volleyball athletes mostly did not perform strength activities.

In the study Mata e colaboradores (2011) it was evident that the gain of muscular strength in women in strength training is significant, corroborating the fact that the futsal athletes for attending gym, doing regular strength exercises have a force gain greater if athletes who did not perform such training.

However, depending on the angle of articulation, some factors may affect electromyography, such as the passive and active resistance of the antagonist muscles (moment of muscle stretching after muscle contraction), Golgi tendon organ, and the activity of muscle spindles (Onishi e colaboradores, 2003).

The results of the test indicate that the movement of the futsal kick works more muscular force than the vertical jump of the volleyball, either by the force exerted in the kick, by the microcycle in which they are found, by the frequency in the gym, or the most probable of the hypotheses, all of these allied factors, influence futsal's stronger result in comparison to volleyball.

With the study we could observe a great difference in the electromuscular activity between the volleyball and futsal athletes, having as main muscles with this difference the left femoral rectum and the vast medialis of both sides, with futsal as the modality with the highest results.

It was evidenced in the present study that futsal is a modality that requires more of the femoral quadriceps muscles in relation to the evaluated athletes of volleyball and such a difference can be explained due to strength training, period of the macrocycle in which the athletes are and difference in the skills required in the given sport, but most likely all these factors combined will contribute to the difference between sports.

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CONFLICT OF INTEREST

The authors report no declarations of interest.

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