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Evaluation of knee muscles isokinetic evaluation between professional and amateur athletes first year students of the faculty of sport and physical education

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Abstract

The purpose of this study was to evaluate the isokinetic dynamometer with maximum torque, total work, reciprocity between agonist / antagonist of the knee joint between professional and amateur athletes of students of the Faculty of Sport and Physical Education. Test strength of dynamic stabilizing knee was performed on the Biodex device 3 on the angular velocities 60 and 180 degrees / sec. The sample represented 42 athletes (22 professional athletes and amateur athletes 20). The data may represent the parameters for the function of dynamic stabilizing knee muscles among athletes students of the Faculty of Sport and Physical Education in Sarajevo. Compared to other categories, professional athletes presented significantly higher values for total work and maximum torque of knee flexor angular velocity 60 ° / s. The results showed that a reciprocal relationship between muscle groups (agonists antagonisa) is lower than the reference value expected for both categories, thus presented a preponderance of the extensor muscles of the flexors dynamic knee stabilizers. Muscular imbalance between flexors and extensors, which may be present, may be caused by overloading and trauma to the muscle-ligament structures of the knee joint. It is necessary to establish normal relations of reciprocal muscle agonists and antagonists of dynamic knee stabilizers. This scientific study can be useful as a basis for comparison for future studies to assess muscle isokinetic knee stabilizer with students from the Faculty of Sport and Physical Education.

Key words: **maximum torque, total work, reciprocal relationship**

Introduction

As one of the most important motor skills in sport is referred to the vertical jump. Authors Thissen-Milder M, Mayhew JL (1990) discussed the possibility of a jump as an important factor for most athletes in sports, because jump is part of the attack and defense movements in all sports games. The vertical jump is characterized as a ballistic movement, which consists of rapid eccentric muscle activity following by maximal concentric actions. Performing this motor movements require a high capacity to develop muscle strength and dynamic stabilizers of the knee. The main function of extensors, muscle dynamic knee stabilizer based on the requirements of the sport are impulsive phase of the jump and landing phase (A Panni, Biedert RM, Maffulli N, Tararone M, Romanini E. 2002).

The demands of certain sports games on the knee joint may be related to the high incidence of injury in that joint (Richards DP, Ajemian SV, Wiley P, Zernicke RF. 1996).

Sport results in practice impose a growing burden on the knee joint which can cause imbalances in muscle strength antagonist dynamic knee stabilizers. These muscle imbalances can cause injury of athletes, such as products with high levels of stress in tissues (Oberg B, Moller M, Gillquist J, Ekstrand J. 1986). Since

Sažetak

Svrha ovog istraživanja bila je pomoću izokinetičkog dinamometra ocijeniti maksimalni moment sile, ukupni rad, recipročni odnos agonist/antagonist zgloba koljena između profesionalnih i sportaša amatera studenata Fakulteta sporta i tjelesnog odgoja. Test jačine dinamičkih stabilizatora koljena izveden je na aparatu Biodex 3 na ugaonim brzinama 60 i 180 °/sec. Uzorak ispitanika je predstavljao 42 sportaša (22 profesionalna sportaša i 20 sportaša amatera). Podaci mogu predstavljati parametre za funkciju mišića dinamičkih stabilizatora koljena među sportašima studentima Fakulteta sporta i tjelesnog odgoja u Sarajevu. U odnosu na druge kategorije, profesionalni sportaši prezentirali znatno veće vrijednosti za ukupni rad i maksimalni moment sile fleksora koljena na ugaonoj brzini 60 °/s. Rezultati su pokazali da recipročni odnos mišićnih grupa (agonista/antagonista) je niži od referentne vrijednosti očekivanih za obje kategorije, na taj način prezentirana je nadmoć mišića ekstenzora nad mišićima fleksorima dinamičkim stabilizatorima koljena. Mišićna nejednakost između ekstenzora i fleksora koja može biti prisutna, može biti prouzrokovana preopterećenjem i povredama na mišićno-ligamentnim strukturama zgloba koljena. Potrebno je uspostavljanje normalnog recipročnog odnosa mišića agonista i antagonista dinamičkih stabilizatora koljena. Ova naučna studija može biti korisni kao osnova za usporedbu budućih studija s ciljem procjene mišića isokinetičkih stabilizatora koljena kod studenata Fakulteta sporta i tjelesnog odgoja.

Ključne riječi: **maksimalni moment, ukupni rad, recipročni odnos**

it is also necessary to set the parameters for the function of muscles related to wrist in athletes. Isokinetic dynamometer provides fast and reliable quantification of variables related to muscle performance at different angular velocities, including the maximum torque, total work, reciprocity between agonist and antagonist muscles and fatigue index (Perrin DH, Robertson RJ, Ray RL. 1987). Isokinetic assessment allows the identification of muscle strength deficit between the bilateral muscle groups and between reciprocal muscle groups (agonist and antagonist) (Siqueira CM, Pellegrini FR, Fontana MF, Greve JM. 2002).

There are several studies that used isokinetic dynamometer at different populations of respondents (Kazazović et al 2008). However, there is little information about the measurements used for athletes in team sports, especially the research of the lower extremities (Kazazović et al 2009).

Therefore, the purpose of this study was to evaluate the differences of dynamic muscle strength of knee stabilizer in the first year students of the Faculty of Sport and Physical Education students between the categories of professional athletes and amateur athletes, as well as to determine the differences in the volume of training.

Methods

Sample

Forty-two students from the Faculty of Sport and Physical Education: twenty-two professional athletes, aged 20 years (± 1.38), body mass 84.1 (± 8.9), height 1.84 (± 0.07), and twenty athletes age 19.6 years (± 0.96), weight 96.4 (± 7.7), height 1.83 (± 0.09). All subjects gave written consent to participate in the isokinetic tests.

Instruments

Isokinetic dynamometer Biodex System 3 Pro [®] was used to assess the maximum muscle strength of the dynamic stabilizer knee, peak torque, total work, reciprocity between agonist / antagonist in the angular velocities 60 ° / sec and 180 degrees / sec. Isokinetic dynamometer provides a continuous resistance along the size of the movement.

Procedures

The maximum peak torque in the extensor muscles and knee flexors was measured for both legs over dynamometer isokinetic (Biodex System 3) the angular velocities, 60 and 180 ° / s. These angular velocities are used by many researchers to measure the effect of dynamic knee stabilizer (Kellis, Gerodimos, Kellis, Manou 2001; Dauty, Poriton-Josse, Rochcongar 2003; Ergun, Islegen, Taskiran 2004; Kazazović, Radja, Dervisevic, Smith 2007). The study was conducted at the Institute of Sport in School Sport and Physical Education in Sarajevo. Before the initial test subjects spent two hours getting acquainted with the instruments for testing and training protocols and have had a period of preparation that consisted of warming up exercise and stretching the muscles of the lower extremities, and 5 to 10 minute warm up on a bicycle ergometer. The power dynamic knee stabilizer was tested in a sitting position on the Biodex chair, where the participants fixed belt around her stomach and thighs to stabilize the thigh of the lower limb. Respondents were instructed to keep their hands comfortably on your chest so that the isolated muscle movements flash and knee extensors. Setting tibialnog pads, dynamometer seat height and angle were recorded in order to maintain the reliability

and reproducibility during the test. Before beginning the test, the subjects do the first three submaximal repetitions to familiarize them with the direct execution of the test. During the test had verbal encouragement. During the performance of the test, athletes have performed up to five repetitions of flexion and extension at speeds of 60 ° / sec. and five repetitions at 180 degrees / sec. Each athlete received a verbal stimulation during the test.

Methods of data processing

Data collected were analyzed by testing the statistical software package SPSS 12.0 and presented in the tables. To determine the significance of the differences between the dynamic stabilizer of experimental and control groups under the influence of training was used Paired - Samples T - test. Statistical significance at level $p < 0,05$ was set for all analysis.

Results

The result of this study showed statistically significant differences ($p < 0.01$) between professional athletes and student athletes amateur when it comes to variable volume of weekly workout. Total time spent in the training cycle shows no statistically significant differences ($p > 0,05$). Values are presented in Table 1.

Table 1. Characteristics of training (average \pm standard deviation)

	Amateur athletes	Professional athletes	p-Value
Total time (years)	5.11 \pm 1.78	5.78 \pm 1.51	>0.05
Training hours / week	14.4 \pm 6.23	26.4 \pm 7.36	<0.01

Results show that there are significant differences values found bilaterally and reciprocally for both legs of the values found at different angular velocities (60 ° / s and 180 ° / s). The values of maximum torque and total work were higher at low angular velocity and lower at higher angular velocity. Was not shown a strong association between the dominant and nondominant side, indicating that the maximal dynamic muscle strength of knee stabilizer for any of the tested muscle groups does not affect the dominance between the groups (Table 2).

Table 2 - Torque (Nm) and total muscle extensors and flexors of knee angular velocities 60, and 180 ° / s and the comparison between the right and left athletes and professional athletes amateur students of the Faculty of Sport and Physical Education in Sarajevo

Angular velocity	Professional athletes				Amateur athletes				
	Left leg		Right leg		Left leg		Right leg		
			t	p			t	p	
Ekstenzori 60°/s	Maksimalni moment sile	248,82 \pm 53	185,60 \pm 43	7,233	,000	241,03 \pm 48	187,57 \pm 47	5,402	,000
	Ukupni rad	1003,05 \pm 182	798,23 \pm 149	5,371	,000	974,45 \pm 171	758,85 \pm 163	4,295	,000
Ekstenzori 180°/s	Maksimalni moment sile	156,33 \pm 29	128,15 \pm 28	4,297	,000	154,72 \pm 26	124,73 \pm 230	4,919	,000
	Ukupni rad	706,97 \pm 121	699,94 \pm 111	4,713	,000	573,86 \pm 126	581,38 \pm 115	3,806	,000
Fleksori 60°/s	Maksimalni moment sile	131,77 \pm 31	107,68 \pm 25	3,707	,001	133,85 \pm 32	117,29 \pm 27	2,932	,006
	Ukupni rad	650,37 \pm 143	515,66 \pm 121	4,281	,000	676,39 \pm 157	555,20 \pm 140	3,775	,001
Fleksori 180°/s	Maksimalni moment sile	106,23 \pm 27	81,63 \pm 25	4,221	,000	103,83 \pm 24	85,38 \pm 20	6,681	,001
	Ukupni rad	494,57 \pm 139	397,68 \pm 111	3,271	,001	516,19 \pm 143	434,26 \pm 119	2,768	,008

Reciprocal relationship between muscle agonists and antagonists of dynamic stabilizing knee right and left legs of student athletes and professional athletes amateurs presented in (Table 3). Statistically significant differences were recorded for the intramuscular ratio between these two groups.

Table 3 Comparison between the ratio of reciprocal muscle groups of muscles on both legs for both the angular velocity in athletes, professional and amateur athletes.

Angular velocity	Professional athletes					Amateur athletes				
	Left leg	Right leg	r	t	p	Left leg	Right leg	r	t	p
60°/s	55,06 ± 3,0	55,98 ± 6,0	0,490	-1,211	,192	54,33 ± 4,8	55,74 ± 7,2	0,512	-,742	,782
180°/s	66,35 ± 12,9	67,02 ± 8,1	0,683	-,466	,602	63,44 ± 9,4	64,43 ± 9,1	0,643	-,893	,432

So that the data of this study set the parameters of dynamic stabilizing knee strength obtained with the isokinetic dynamometer with students from the Faculty of Sport and Physical Education in Sarajevo professional athletes and amateur athletes, and they can be used as a reference for future comparisons. In both groups, the maximum torque of dynamic knee stabilizer is of greater value than those from the normative data for the population of non-athletes received from manufacturers of instruments isokinetic (Biodex 3) used in this study. In the case of team sports (since the majority of students engaged in team sports), these results may explain the large amount of jumps that require these sports. This study analyzes differences in variables dynamic stabilizer knee strength between two different categories of athletes (professional athletes and amateur athletes). The results of this analysis pointed out significant differences of maximum torque and total work of knee extensors and flexors, between professional athletes and amateur athletes.

Another factor that may point to significant differences in knee flexors between professional athletes and amateur athletes can be no change in the methodology of training, because professional athletes are exposed to a specific work, ie. exercises that have a direct impact on the knee flexors. In addition, many athletes, as part of this study declared that they had already once had injuries to the knee joint (professional athletes = 31.4%, and amateur athletes = 17.2%). So there is a possibility as athletes to compensate for muscle development strategy of dynamic knee stabilizers giving priority flexors.

We also found a significant difference in the maximum flexor strength at 60 degrees / s between the dominant and non-dominant leg in professional athletes, the dominant leg has higher results than the non-dominant. Such a deficit was found in some studies as a risk factor for injuries of the knee joint (Oberg, et al., 1986; Siqueira, et al., 2002).

Standard, reciprocal relationship (agonist / antagonist) was calculated as the ratio between the results of the value of the maximum torque flexors and a maximum torque knee extensor muscles. Variables reciprocal relationship (agonist / antagonist) to assess the athletes in this study represent a lower value than anticipated in both categories. Relationship agonists and antagonists indicates the superiority of the extensor muscles or deficit in flexors, which can be a muscle imbalance of dynamic stabilizing knee.

This test was performed to estimate the parameters of dynamic stabilizing knee strength (maximum torque, total work, the reciprocal relationship between muscle groups) (Oberg, et al., 1986;

Discussion

There are few studies isokinetic performance that can be found in the sports literature (Kazazović, et al., 2009). However, despite the large prevalence of lower limb injuries in sport and the importance of jumps in the acquisition of high-level performance in sports, there are few studies that explore the dynamic stabilizers of the knee such populations (Tabakovic, et al., 2009).

Zakas, et al., 1995). Therefore, this measure achieved through isokinetic evaluation can be very effective in detecting muscular-skeletal changes, important for preventive measures, the implementation of specific training programs for each athlete and to enhance sports performance (Siqueira, et al., 2002).

Conclusion

Data obtained from this survey will allow obtaining the parameters with isokinetic dynamometer for dynamic knee stabilizers in students of professional athletes and amateur athletes. The results of this study show that significant differences appear between the extensor and flexor muscles of dynamic stabilizing knee, but no differences in muscle reciprocal relationship agonist and antagonist muscles in both legs, with the student athletes and professional athletes amateur. Active participation in training at the appropriate time through the training frequency (6 times a week with professional athletes) can provide an important role to assist in developing a level of maximum torque and total work. Reciprocal relationship between muscle agonists and antagonists in these muscle groups does not show the presence of differences between the two groups. However, because all have limits of experimental testing, the coaches are aware of the individual design of power for players who have asymmetry of bilateral and reciprocal muscle group dynamic knee stabilizers. In the case of asymmetry, the proper treatment of its removal should be mandatory part of the exercise of power.

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