

Isokinetic Evaluation of Adolescent Athletes with Os Good Schlatter Disease

Os Good Schlatter Olan Sporcuların İzokinetik Sonuçları

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ABSTRACT

Aim: Os Good Schlatter Disease (OGS) is a common condition for sportspeople during the growth period. The etiology is still unclear. Its definition is traction apophysis. The OGS knees are thought to have stronger muscle power. The aim of this study is to evaluate muscle strength in OGS knees.

Materials and methods: We examined 96 athletes who applied to our clinic. We evaluated the muscular strength by separating the knees in two groups as the knees with OGS and without OGS. Knee muscle strength was measured in 60 and 180 degrees/second with isokinetic dynamometer CYBEX NORM (CSMI Humac Norm, ABD). Peak torque (PT), peak torque/body weight (PT/BW) and agonist/antagonist (flexor/extensor, AG/AN) values were collected. Independent samples t-test was used for statistical evaluation.

Results: At 60 degrees, we found a significant difference between PTE, PTF, PT / BW E and PT / BW F ($p=0.02$, $p=0.002$). PTE, PDF, PT / BWF were statistically significant also at 180 degrees ($p=0,00$).

Conclusion: Muscle strengths of the non-OGS group were statistically stronger than those of OGS group. In order to demonstrate better performance of the athletes with OGS, training plans should be conducted to increase their muscle strength.

Keywords: Knee Extensors, Muscle Strength, Sports

ÖZ

Amaç: Os good schlatter (OGS), büyüme döneminde sporcular için sık görülen bir durumdur. Etiyoloji halen belirsizdir. Traksiyon apofiziti şeklinde tanımlanmaktadır. OGS dizlerde daha güçlü kas gücü olduğu düşünülmektedir. Çalışmamızın amacı; OGS olanlarda kas gücünü değerlendirmektir.

Yöntem: Kliniğimize başvuran 96 sporcuyla inceledik. Dizleri OGS olan ve OGS olmayan dizler şeklinde iki gruba ayırarak kas kuvvetini değerlendirdik. Diz kasları 60 ve 180 derece / saniye izokinetik dinamometre CYBEX NORM (CSMI Humac Norm, ABD) ile ölçüldü. Tepe torku (PT), zirve torku / vücut ağırlığı (PT / BW) , PT / BW E zirve torku / vücut ağırlığı ekstansiyon, PT / BW F zirve torku / vücut ağırlığı fleksiyon ve agonist / antagonist (fleksör / ekstansör, AG / AN) değerleri belirlendi. İstatistiksel değerlendirme için bağımsız örneklem t-testi kullanıldı.

Bulgular: 60 derecede, PTE, PTF, PT / BW E ve PT / BW F arasında anlamlı bir fark bulduk ($p=0.02$, $p=0.002$). PTE, PDF, PT / BWF, 180 derece de istatistiksel olarak anlamlıydı ($p=0,00$).

Sonuç: OGS olmayan gruptaki sporcuların kas kuvvetleri ,OGS grubuna göre istatistiksel olarak daha güçlü idi. OGS olan sporcuların daha iyi performans sergilemeleri için, kas kuvvetlerini arttırmak yönelik antrenmanlar düzenlenmelidir.

Anahtar kelimeler: Diz Ekstansörleri, Kas Gücü, Spor

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Osgood Schlatter (OGS) is a well-described clinical condition, especially observed in the ages of 8 to 13 among females and ages of 10 to 15 among males, with a bilateral involvement incidence of 20 to 30% [1-3]. In their original reports, both Osgood and Schlatter claimed that OGS is produced by avulsion of a portion of tibia tuberosity secondary to contraction of the quadriceps muscle. Relatively rapid lengthening of the femur in relation to the quadriceps muscle during growth spurt may also lead to OGS [4].

Many factors such as mechanical, growth related or traumatic factors are suggested to be the causes of this lesion and even though its origin remains unclear. However, no specific injury or event can be directly related to the etiology in general. OGS is mainly diagnosed clinically. Plain radiograph of the knee is recommended to rule out other conditions such as acute tibia apophysis fractures, infection or tumor in unilateral cases [3].

Athletes who perform sports including jumping, such as soccer, basketball and volleyball, suffer from OGS more frequently. The incidence of the syndrome among adolescents involved in sports is around 13% compared to 6 % in general population. Muscular strength is one of the most important performance and injury occurrences [5-9].

OGS is still commonly defined as the traction apophysitis caused by the recurring strains in the tibia tubercle [3]. Traction apophysitis develops in various sections due to the shortness of muscles of athletes [5]. There are OGS related studies conducted by assessing the shortness of Rectus and Quadriceps muscles. Yet, the results of these studies are personal and subjective. We have found a study in the literature, which assesses the muscular force. The device used in this study is a hand dynamometer, and authors refer to the absence of an objective assessment method [10]. The purpose of this study is the evaluate if OGS is a case developed by traction. In order to understand if there is a traction because of a strong quadriceps muscle. We have measured the strength of quadriceps muscle of the athletes with isokinetic dynamometer.

METHODS

We have obtained the IRB (Institutional Review Board) approval, which is provided by a type of committee designated to supervise and review researches involving humans, and carried out an observational study

with 96 athletes (76 OGS, 20 without OGS) who were from different sports, aged between 11 and 18 and were admitted to our setting between March and November 2016 of our hospital, Sports medicine center.

The athletes who performed isokinetic test, had adequate knee radiographs and could comply with the procedure participated in the study. Exclusion criteria were set as follows; known osteoarthritis, knee flexion less than 90°, prior rupture of the quadriceps tendon or known insufficiency, patients with neurological disorders, prior patellar fracture, prior patellar tendon rupture, and prior patellar dislocation.

Study Design

All clinical and radiographic evaluations were conducted by the same physician in the department of sports medicine. OGS was diagnosed on the basis of the history and physical examination with radiographic findings. OGS was observed in 76 participants (131 knees of OGS, 21 knees of without OGS). Remaining 20 participants (40 knees) without OGS were used as a control group. Patellar height was measured to compare the prevalence of patella alta between knees with OGS and without OGS. Patellar height was evaluated via the lateral X-ray of the knees with flexion of 20-30° and measured according to Caton-Deschamps (CD) method by using the Infinity PACS system (Infinity Healthcare Co., Seoul, South Korea). Knees with CD score above 1.2 were referred to as patella alta. Plain radiograph evaluation on CD measurements revealed that 82 knees (62.5%) in the study group and 15 knees (71.4%) in the control group had patella alta.

OGS group was formed by 76 athletes (131 knees) and control group consisted of 20 athletes (40 knees). Fifty-five athletes had bilateral (110 knees) and twenty-one athletes had unilateral (21 knees; 13 right and 8 left) OGS (57% and 21%). Fourteen out of 21 knees were the dominant knee of the athletes (66%).

Knee muscle strength was measured with isokinetic dynamometer called "Cybex Norm" (CSMI Humac Norm, USA). Prior to the start of test, athletes warmed up in a mild pace for 7 minutes on the treadmill, and then carried out stretching and tensioning activities for 3-4 minutes for the knee joint. Athletes were placed on the isokinetic dynamometer so that lumbar support and knee and hip angles are 90°. Athletes were fastened to the device with straps in diagonal position at chest level and asked to hold the handles on the

sides of the seat. Femur, pelvis and body were also fastened via tapes. Adjustable level arm was attached tightly to the foot via a tape at proximal of the lateral malleolus. Axis of rotation for the level arm was adjusted to match exactly the lateral of lateral femoral condyle. It was set to provide 0° = knee extension and 90° = flexion. Corrective actions at 90° were calculated via computer to remove the impacts of gravitation on the force. Measurements of isokinetic concentric force for both knees of all the athletes participating in the study were assessed with an isokinetic dynamometer at an angular speed of $60^\circ/\text{second}$ and $180^\circ/\text{second}$.

5 submaximal warm ups were performed at $60^\circ/-180^\circ/\text{second}$ of angular speed, and 5 maximal were repeated when the person is ready, and then 30 seconds of cool down period were provided. Athletes were promoted verbally during the test for ensuring maximal participation. Cool down and tensioning exercises were conducted for 10 minutes and the test was finalized. (As shown in Figure1).

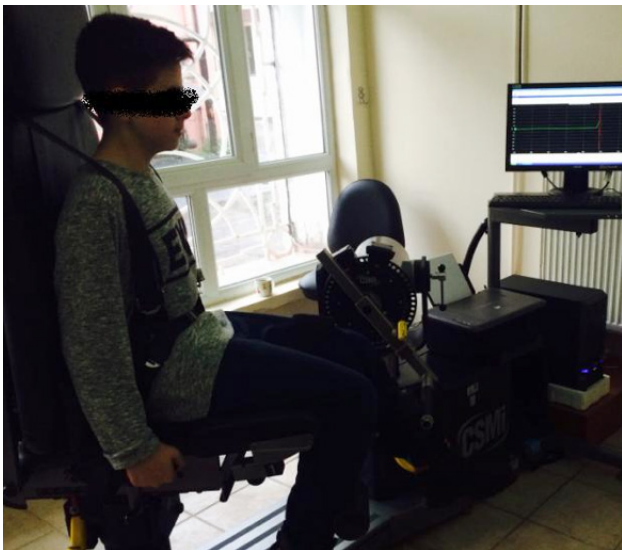


Figure 1: Isokinetic evaluation of the knee in flexion-extension

All tests were performed on both extremities and for concentric muscle strength. Tests were performed to assess maximum knee extensor and flexor muscle strength [Peak torque (PT)] at 60° , muscle of endurance [total work (TW)] at 180° Newton-meters (Nm). We then divided each subject's maximum torque (Nm) by their own body mass in kilograms (kg) to obtain a normalized measure of strength (peak torque/body weight (PT/BW) peak torque/body weight extension (PT/BWE) peak torque/body weight fleksion (PT/BWF)). Agonist/antagonist (AG/AN, flexor/extensor, Hamst-

ring/Quadriceps) ratio (%) was recorded [12, 13].

Statistical Analyses

Normality of the variable distribution was tested with the Kolmogorov-Smirnov test. Statistic evaluations were made using independent samples in t test on Statistical Package for the Social Sciences (SPSS) program version 22.0. P value below 0.05 was considered as statistically significant.

RESULTS

Control group was formed by 19 male athletes and 1 female athlete, and the study group was constituted by 67 males and 9 females. Mean age and BMI (Body Mass Index) values of the groups were not statistically different ($p=0.38$) (Table 1). In the control group, 3 athletes did taekwondo and 17 athletes played basketball. There were 11 different sports (Athletics, Basket, Fencing, Football, Wrestling, Handball, Gymnastics, Taekwondo, Tennis, Volleyball and Swimming). Per the branches, we have basketball players (41%) and soccer players (31.2%) in majority. Athletes have been doing sports regularly for 1 - 10 years. They had training programs for at least 3 days a week and 2 hours a day.

Table 1: Demographic attributes of the athletes BMI Body mass index

	study group	control group	p value
N	76	20	
Gender	9 F 67M	1F 19 M	
Age	13,6±2,1	13,1±1,9	0,38
BMI (kg/m ²)	19,6 ±3,1	20,5± 3,8	0,38

In the isokinetic evaluations of the OGS and non-OGS athletes, we evaluated their strength at an angular velocity of 60 degrees and their strength at 180 degrees. At 60 degrees; PTE ($p < 0.001$) and PTF ($p < 0.001$) were statistically significantly lower in the study group than the control group. Besides, PT / BWE ($p = 0.02$) and PT / BWF ($p = 0.002$), TWE ($p < 0.001$), TWF ($p < 0.001$) and PT / BWF ($p < 0.001$) were statistically significantly lower in the study group than the control group at 180 degrees. At 180 degrees, there was not a significant difference in PT / BWE ($p = 0.26$). (Table 2)

DISCUSSION

OGS etiology is defined as trauma-related apophysitis injury although it is not completely proven. But, there is no study to reveal the pulling force. Our work is the

first study to investigate muscle strength as isokinetic terms. One of the theories for the etiology of the OGS is the traction apophysitis due to strong quadriceps muscle. Patella alta was also believed to be an important risk factor in this pathology [14]. However, in the literature, there is no prospective biomechanical study that explains this theory.

Table 2: Isokinetic values

	study group	control group	P
	Mean±SS	Mean±SS	
knee	131	40	
PTE 60°/s (Nm)	88,9±33,4	114,4± 51,2	0,00*
PT/BW E 60°/s (Nm)	155,9±52,3	177,1 ± 54,7	0,02*
PTF 60°/s (Nm)	49,7 ± 20,1	66,9 ± 31,7	0,00*
PT/BWF 60°/s (Nm)	86± 28,9	103,6 ± 35,6	0,002*
F/E ratio 60°/s (Nm)	58,2 ± 18,7	59,0 ± 13,7	0,78
TWE 180°/s (Nm)	678 ± 268	826 ± 320	0,00*
PT/BW E 180°/s (Nm)	1197 ± 450	1287± 411	0,26
TWF 180°/s (Nm)	383± 216	530± 260	0,00*
PT/BWF180°/s (Nm)	667 ± 347	863± 341	0,00*
F/E ratio 180°/s (Nm)	60 ± 31	67± 24	0,15

PTE = peak torque extension , PT/BW E = peak torque / Body weight extension, PTF= peak torque flexion , PT/BWF == peak torque / Body weight flexion ,F/E ratio = flexion / extension ,TWE=Total work extension , TW/BW E= Total work / Body weight extension, TWF= Total work flexion ,TW/BWF= Total work / Body weight flexion * Independent samples't test *P<0,05

We supposed that OGS athletes might have a stronger muscle group than the non-OGS athletes. However, contrary to our belief, the muscle power of the knees in the control group were statistically more than the study group ($p < 0.001$, $p = 0.02$). PT / BW values, which we considered as a special test result for body weight, were statistically stronger in the control group than the study group, in terms of both flexion and extension. At 180 degrees, we evaluated the tolerance, and the PT and PT / BW were statistically significant only in the flexion group ($P < 0.001$). The PT value was statistically higher in the control group than in the study group only in extension. On the other hand, the PT / BW values were not statistically significant between two groups.

There are studies suggesting that OGS is observed mostly in men (72%). In another study, male to female ratio was given as 3/1 [4, 15, 16]. In recent studies, it

has been suggested that this gap narrowed down because girls tend to get involved in active sports life at an earlier age. In our study, males were the majority (88.1%).

There are studies investigating whether OGS is observed in a single knee or bilaterally. Jacob et al. studied OGS patients (185 knees) and found bilateral OGS in 60 knees (32%). In our study, we identified the bilateral OGS as 57%. Antich et al. examined 75 OGS patients (107 knees). Unilateral OGS was present in 57% (68% in the literature). In our study, we identified unilateral OGS in 21%. In the same study, 67% left sided OGS was observed. Left knee involvement was reported as 58% in the literature. In our study, OGS was observed in the left knee in the 38% of the cases. Twenty-four percent of the athletes were basketball players. In our group, 41% of the athletes were basketball players [17-20].

It is assumed that the athletes with OGS are more likely to engage in sports with jumping activities. Symptoms are exacerbated with sporting activities that involve jumping (basketball, volleyball, running) and/or direct contact (e.g. kneeling). However, both our study and other studies in the literature did not show a considerable level of difference [2, 3].

In the study of Jacob et al., where the Blackburne and Peel method was used to assess the position of the patella, patella alta was observed in 74% [20]. In our study, the patella alta ratio was 11%, but there may be a difference due to different measurement methods. The position of the patella may be described as normal, high (alta) or low (infera). A number of radio graphical techniques have been developed for the evaluation of patellar height. Thévenin-Lemoine C et al. showed that CD index was a reliable ratio to evaluate the patellar height in children and adolescents [11]. They also mentioned that Insall-Salvati index measurement is poor in reproducibility due to difficulties in determining the distal point of the patellar tendon and the Koshino index is complex to use. We used CD since our study group was formed by adolescent athletes.

We found a paper in the literature that resembles our study. Nakase et al. followed 150 footballers (300 knees) one year in the study. They found that OGS developed with a ratio of 14.3% in the control. They measured extensor and flexor muscle strengths with and without OGS on a hand held dynamometer (ITAS-F1; ANIMA Co., Tokyo, Japan). Hand held dynamome-

ter was used, and knee extension power was significantly ($p=0.03$) higher in OSD group than in patients without OSD [21]. They asserted that knee extensor strength is very important for OGS. But in our study, we found that the strength of the extension was statistically significantly weaker in the OGS group.

Isokinetic evaluation can be expected to show difference between the dominant and non-dominant extremities. However, studies did not show any difference between the dominant and non-dominant extremities in the healthy athletes. In a study, bilateral dynamic strength differences of the knee flexors and extensors in both the dominant and non-dominant plant legs in NCAA Division III players were examined. The strength of the knee flexors and extensors of both dominant and non-dominant plant legs of the sixteen soccer players was measured using a Cybex norm isokinetic dynamometer. There was no significant strength difference between dominant and non-dominant plant legs. Therefore, it was concluded that these Division III soccer players did not exhibit significant bilateral strength differences as found in other studies [22].

Rahnama et al. tested the knee flexors and extensors of dominant and non-dominant kicking leg [23]. In these studies, it is stated that there is not any muscular power difference between dominant and non-dominant legs. It is contemplated that training time and form is more effective on the muscular power. Based on these results, we ignored the dominant legs in our study.

As a limitation, shortness of the muscle and ROM could not be examined. In different sports branches, quadriceps muscle may have different strengths and different injury mechanisms. Muscle strength assessments of the athletes were evaluated by an open chain, in the concentric mode in the isokinetic device. Muscle groups could also be evaluated as closed-chain eccentric. The application of the eccentric test is difficult due to the perceived difficulty of the person and the risk of muscle injury. All of the athletes included in the study actively pursued their sporting life. Concentric mode was preferred for this reason. It was not clear how many players had OGS. Traction apophysitis develops in various sections due to the shortness of muscles of athletes.

Conclusions: Although OGS is a disease which has been defined many years ago, its etiology and treatment are yet unclear. Muscular force and muscular

strain are prioritized in this disease. Nevertheless, Quadriceps muscular force was higher for the non-OGS than the OGS participants in our study, as opposed to the popular belief. Also, these results reveal the correlation between OGS and the muscular force more clearly. Quadriceps force trainings must definitely be taken into consideration for these athletes.

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