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AN INVESTIGATION OF KNEE ISOKINETIC TIME TO PEAK TORQUE AND JOINT ANGLE AT PEAK TORQUE: DIFFERENT BODY POSITION EFFECT

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Abstract:
The purpose of study was to investigate the effects of isokinetic knee measurement with different positions (prone and sitting) on knee isokinetic time to peak torque and joint angle at peak torque. For this purpose, 15 health sedentary male participated in the study. Isokinetic measurements were performed with isokinetic dynamometer (CSMI Cybex Humac Norm, USA). Isokinetic tests were performed at 3 different motion angles ($60^{o}s^{-1}$ / $180^{o}s^{-1}$ / $240^{o}s^{-1}$). The test was carried out with 10 repetitions at $240^{o}s^{-1}$and $180^{o}s^{-1}$ and 5 repetitions at $60^{o}s^{-1}$. Each movement angle was performed 45 second rest intervals. SPSS 20.0 package program was used for the analysis of the data. Significance level was accepted as $p < 0.05$. According to the result of the analysis significant differences were found for $240°s^{-1}$ on joint angle at peak torque extension parameter in favor of prone position; for $180^{o}s^{-1}$ on time to peak torque extension and flexion parameter in favor of the prone position; for $60°s^{-1}$, on joint angle at peak torque parameter in favor of the sitting position, on time to peak torque extension and time to peak torque flexion parameter in favor of the prone position ($p < 0.05$). As a result, it can be said that different positions have significant effects on the time to peak torque and joint angle at peak torque in isokinetic knee measurement.

Keywords: isokinetic, torque angle, strength

1. Introduction

In isokinetic contraction, the joint range of motion during the contraction occurs at a constant speed and the force is maximal at every angle of movement (Kalyon, 197). At the time to peak torque, the contraction speed is at the forefront and its unit is the second. This refers to the time to reach peak torque. It is used in evaluating athletes that require

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explosive power and available condition (Vural, 2019) and it affected by the physiological situation (Pancar et al., 2018; Taşdoğan et al., 2020a; Taşdoğan et al., 2020b). If the time to peak torque is long, it indicates Type II muscle working least (Kannus, 1994). The joint angle at peak torque represents the range of motion at which peak torque occurs. With increasing test speed, peak torque occurs towards the end of joint motion (Chan and Maffulli, 1996).

When the studies are examined, isokinetic knee strength has been reported in general terms as a whole (Appen and Duncan, 1986; Burdet and Swearingen, 1987; Clarkson et al., 1982; Dowson et al., 1998; Kayar et al., 2020). The peak torque values of knee isokinetic force measurement were taken into account by H/Q ratios, performance, and recovery after injury, training planning and such as these parameters were taken into consideration (Dvir, 1996; Holcomb et al., 2007; Vural and Özdal, 2019). However, the lack of examining the peak torque values produced by quadriceps and hamstring muscles in isokinetic measurements from joint angle and duration has created the idea that there is a deficiency in this respect in the literature. Because the joint angle at the stage of producing an athlete's peak torque strength is actually directly related to the muscle section and the contraction capacity of the muscle and strength programs (Markovic et al., 2007; Miller, Pierson and Richardson, 2006; Vural et al., 2017). On the other hand, the time for the muscle to reach peak torque at a certain movement angle is important for performance athletes, especially in activities that require explosive power especially anaerobic power (Kannus, 1994; Tahhan et al., 2018a; Tahhan et al., 2018b). In this way, the differentiation of peak torque generation times of the muscle has shown that it is open to evaluation in terms of the type and physiological characteristics of the muscle involved in the contraction. So, the aim of this study is to examine the effects of different positions on the peak torque angle and duration in isokinetic knee strength.

2. Material Method

2.1 Experiment Design and Participants

This study was designed according to the cross-controlled experimental design. 15 healthy sedentary individuals voluntarily participated in the study. G Power 3.1 program was used to determine the number of subjects participating in the study. The subject visited the laboratory three times in total. During the first visit, the participants were given detailed information about the measurements. On the second visit, the subjects were taken with an application card and it was determined in which position to measure. On the third visit, other position measurements were carried out. Necessary permissions were obtained from the Gaziantep University Clinical Research Ethics Committee for this study.

Table 1: Descriptive Characteristics of the Participants

	Mean	Std. Deviation
Age (years)	22.80	1.48
Height (cm)	177.60	7.75
Weight (kg)	70.00	5.96

Table 1 shows the descriptive characteristics of the participant. According to the table the mean age of the participants was determined as 22.80±1.48 years, height was 173.00 ± 3.11 cm; weight was 75.00±3.18kg.

2.2 İsokinetic Measurement

Isokinetic knee strength measurements were measured with an isokinetic dynamometer (CSMI Cybex Humac Norm, USA). Measurements in both positions were carried out at 3 angular speed (240^0s^{-1} / 180^0s^{-1} / 60^0s^{-1}). The test was carried out with 10 repetitions at 240^0s^{-1} and 180^0s^{-1} degrees angular velocities and 5 repetitions at 60^0s^{-1} degrees angular velocities. The rest interval between each angular velocity was set to 45 seconds.

In Isokinetic measurements performed in a sitting position and lying down, the Isokinetic dynamometer was used to the same degrees in both measurements. The movement angle is set to 40° and the dynamometer tilt is also set at a high of 40° degrees and 8 cm. In the isokinetic measurements made by lying down, the subject lay face down on the isokinetic platform. In this way, both knees were measured for strength.

2.3 Statistical Analysis

SPSS 20 program was used for statistical analysis. Kolmogorov-Smirnov test was used for normality testing. Independent Samples t Test was used to compare two different measurement results. Values are presented as mean and standard deviation, and significance level is examined as 0.05.

4. Results

Table 2: 240^o Isokinetic Knee Time to Peak Torque and Joint Angle at Peak Torque Measurements Analysis between Trials

Isokinetic parameters	Trial	Mean	SD.	t	p
Joint angle at peak torque extension (^{o})	1. Sitting	57,07	3,32	**-4,697**	**0,001**
	2. Prone	79,79	18,38		
Time to peak torque extension (sec)	1. Sitting	0,18	0,06	-1,517	0,153
	2. Prone	0,23	0,12		
Joint angle at peak torque flexion (^{o})	1. Sitting	31,43	11,84	-0,943	0,363
	2. Prone	38,21	13,24		
Time to peak torque flexion (sec)	1. Sitting	0,19	0,07	1,331	0,206
	2. Prone	0,16	0,09		

Table 2 shows $240°s^{-1}$ knee isokinetic peak torque time and angle values are compared according to positions. In according to the table, significant difference between positions

was found in the angle of the extension joint reaching the peak torque ($p < 0.05$). This difference resulted in favor of the measurement made in the sitting position.

Table 3: 180° Isokinetic Knee time to Peak Torque and Joint Angle at Peak Torque Measurements Analysis between Trials

Isokinetic parameters	Trial	Mean	SD.	t	p
Joint angle at peak torque extension (°)	1. Sitting	57,07	4,97	-1,372	0,193
	2. Prone	62,64	12,36		
Time to peak torque extension (sec)	1. Sitting	0,21	0,04	**-4,124**	**0,001**
	2. Prone	0,45	0,20		
Joint angle at peak torque flexion (°)	1. Sitting	37,00	9,22	-1,101	0,291
	2. Prone	42,71	15,54		
Time to peak torque flexion (sec)	1. Sitting	0,26	0,06	**-2,229**	**0,049**
	2. Prone	0,32	0,10		

Table 3 shows 180°s^{-1} knee isokinetic peak torque time and angle values are compared according to positions. In according to the table, significant difference between positions was found during the extension and flexion period of reaching the peak torque ($p < 0.05$). This difference resulted in favor of the measurement made in the sitting position.

Table 4: 60° Isokinetic Knee Time to Peak Torque and Joint Angle at Peak Torque Measurements Analysis between Trials

Isokinetic parameters	Trial	Mean	SD.	t	p
Joint angle at peak torque extension (°)	1. Sitting	67,29	13,56	**2,639**	**0,020**
	2. Prone	56,79	4,69		
Time to peak torque extension (sec)	1. Sitting	0,46	0,08	**-6,749**	**0,001**
	2. Prone	0,83	0,20		
Joint angle at peak torque flexion (°)	1. Sitting	40,57	9,73	-0,229	0,822
	2. Prone	41,93	15,96		
Time to peak torque flexion (sec)	1. Sitting	0,42	0,15	**-2,466**	**0,016**
	2. Prone	0,62	0,18		

Table 4 shows 60°s^{-1} knee isokinetic peak torque time and angle values are compared according to positions. In according to the table, significant difference was found between positions in the flexion parameters of peak torque extension joint angle and time, and time to reach peak torque ($p <0.05$). This difference resulted in favor of the measurement made in the sitting position.

5. Discussion

The purpose of study was to examine the effects of knee isokinetic measurement with different positions on time to peak torque and joint angle at peak torque. For this purpose, 15 health sedentary male (22.80±1.48 year) participated in the study. Isokinetic measurements of the participants were performed with isokinetic dynamometer (CSMI Cybex Humac Norm, USA).

When the data evaluated, participant's peak torque reach angles and durations vary both according to angular speeds and according to the measured position. Significant difference was detected only in the extension joint angle at peak torque at an angular speed of 240°s^{-1}. This difference resulted in favor of the sitting position. In the measurements made in 180°s^{-1}, significant difference between positions was found in the duration of extension and flexion of peak torque. This difference resulted in favor of the sitting position. At the last angular speed of 60°s^{-1}, significant differences between positions were detected in the angle and duration of the extension at peak torque, and the time to peak torque was found in the flexion parameters. This difference resulted in favor of the sitting position. To explain the time to peak torque was in favor of isokinetic knee strength measured in a sitting position, the average time in which peak torque is produced have been based. In the measurements made in the sitting position in the parameters where significant difference was detected, the time to peak torque was realized in a shorter time compared to the measurements made by prone position.

When examined the previously studies, the peak torque values produced by the subjects participating in the measurement, whether athlete or sedentary, are given only as peak torque, average torque and total torque values (Pincivero et al., 1997; Robinson et al., 2004). In another respect, studies have evaluated knee isokinetic strength with H/Q ratios (Rosene et al., 2001). In these studies, knee isokinetic strength was carried out for the purposes of determining the effect of the training methods applied (Newman et al., 2004), creating identifying diagnostic reports about athletes (Rosch et al., 2000), and comparing different angular speeds (Yamamato, 1993).

In our study, the joint angle at peak torque and the time to peak torque were evaluated. The angle and duration of on the peak torque are important for sporting performance. In particular, time to peak torque, so reaching the peak power required as soon as possible at the constant speed of movement of the muscle group involved in contraction, can be important in sporting branches requiring explosive power (Newman et al., 2004). The time to peak torque is closely related to the type of muscle involved in the contraction and its physiological content (Kannus, 1994). It can be thought that the significant difference in the sitting position compared to the other position is due to the fact that the person is in a more stable position during the measurement and the lower extremity is in a fixed state.

As a result, in our study, the effect of isokinetic knee measurement with two different positions on the joint angle and duration of the peak torque was examined. As a result of these examinations, it can be said that the positions have a significant effect on the angle and duration of the quadriceps and hamstring muscles' peak torque.

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Conflict of interest
There are no potential conflicts of interest between authors of this article.

Authors' Contribution

Mustafa Özdal designed the study, and carried out the statistical analysis. Mustafa Burak Cağdanlıoğlu collected the data, wrote and revised the manuscript.

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