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EFFECT OF KNEE ISOKINETIC MEASUREMENT WITH DIFFERENT ANGULAR VELOCITIES ON ISOKINETICS H/Q RATIOS

ABSTRACT

The athlete's injury, performance and follow-up can be interpreted with isokinetic H/Q ratios. The purpose of this study was to investigate the effect of different position (prone and sitting) H/Q ratios in knee isokinetic measurement. For this purpose, 15 healthy sedentary males participated in the study. Isokinetic measurements of the subjects were carried out with Isokinetic dynamometer (CSMI Cybex Humac Norm, USA). Isokinetic measurements were performed in 3 different range of motion (240^0s^{-1} / 180^0s^{-1} / 60^0s^{-1}). The test was carried out 10 repetitions with 240^0s^{-1} and 180^0s^{-1}, and 5 repetitions at 60^0s^{-1}degrees angular velocities. 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 $p < 0.05$. As a result of the analysis of the data, there was no significant difference between the two positions in the isokinetic H/Q peak torque, total work and average power parameters at an angular speed of $240°s^{-1}$ ($p > 0.05$). At angular velocities of $180°s^{-1}$ and $60°s^{-1}$, there was a significant difference between two positions in the isokinetic H/Q peak torque, total work and average power parameters ($p > 0.05$). As a result, the significant difference was determined in favor of the sitting position. In conclusion, it can be said that the isokinetic measurement in different positions has a significant effect on isokinetic knee H/Q ratios.

Keyword: isokinetic, H/Q ratio, position

1. INTRODUCTION

Sufficient degrees quadriceps and hamstring muscle strength are important in exercise performance. These two muscle groups have an antagonistic function. The contraction of the hamstring muscle group results in the flexion of the knee joint, while knee extension occurs with the contraction of the quadriceps muscle group. The muscle groups here work together to control the slowing and acceleration of the leg enough strength and thighs required for running, splashing, falling after splashing and other physical activities (Willigenburg, Mcnally & Hewett, 2014). Making the right decisions about muscle balance and dynamic stabilization of the knee joint depends on research to determine H/Q (hamstring/quadriceps) strength ratios. The H/Q ratio is calculated by the ratio of the peak torque of the hamstring and quadriceps to the measurements of the same angular velocity and concentric contraction. The H/Q ratio depends on the speed and position. This ratio is also known as a suitable tool to show trends in injury. Because of the importance of flexor - extensor muscle strength balance, H/Q ratio is used for rehabilitation in case of knee injury (Alangari & Al-Hazzaa, 2004), especially with unsystematic loading and without warm-up sessions (Tuzcuoğulları, 2016); considering the general health benefits of exercise (Özdal, Bostancı, Dağlıoğlu, Ağaoğlu & Kabadayı, 2016; Daglıoglu, Mendes, Bostancı, Ozdal & Demir, 2013; Ozdal, Daglıoglu & Demir, 2013), the value of studies involving isokinetic contraction is undeniable. Studies on isokinetic H/Q ratios are common in the literature. In these studies, it was observed that the angular velocity rate of isokinetic measurements increased and the H/Q rates increased in the same parallel. (Akın, Oner, Ozberk, Ertan & Korkusuz, 2004; Kayatekin, 1994). When other studies were examined, isokinetic H/Q ratios were examined in terms of different branches, age and gender and significant differences were found between the variables examined (Aagaard, Simonsen, Magnusson, Larsson & Dyhre-Poulsen, 1998). In addition, physiologically, it was detected that the effect of muscle length and muscle section was significant on the isokinetic H/Q ratios (Holcomb, Rubley, Lee & Guadagnoli, 2007; Nosse, 1982). In these studies, it has been found that muscle cross section and muscle length have a significant effect on isokinetic strength and H/Q ratios. When the literature is investigated, there are no studies investigating the effects of different positions on the measured knee isokinetic H/Q ratios. For this reason, examining the effect of knee isokinetic H / Q ratios in different positions in our study will be important in terms of providing a new approach and information to the literature. In this way, the purpose of this study investigates the effect of knee isokinetic measurement with different position (sitting/prone) on isokinetic H/Q ratios.

2. MATERIAL METHOD

2.1. Experimental 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 subjects 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)	21.80	2.14
Height (cm)	174.40	4.88
Weight (kg)	75.67	5.78

Table 1 shows the descriptive characteristics of the participant. According to the table, the mean age of the participants was determined as 21.80±2.14 years, height was 174.40±4.88 cm; weight was 75.67±5.78 kg.

2.2. İsokinetic Measurement

Isokinetic knee strength measurements were performed 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 and prone position, 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 20.0 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 the significance level is examined as 0.05.

3. RESULTS

Table.2 Comparison of the 240º isokinetic knee H/Q ratios analysis between trials

Isokinetic Parameters	Trial	Mean	SD.	t	p
H/Q peak torque ratio (%)	1.Sitting	82,36	15,29	-0,448	0,662
	2.Prone	88,36	11,15		
H/Q total work ratio (%)	1.Sitting	87,00	29,62	0,049	0,962
	2.Prone	86,14	17,81		
H/Q average power ratio (%)	1.Sitting	94,14	22,73	-0,309	0,762
	2.Prone	103,79	18,24		

Table 2 shows that the knee isokinetic H/Q ratios performed at $180°s^{-1}$ are compared by positions. According to knee isokinetic H/Q ratios made at $240°s^{-1}$ are compared according to positions. According to the table, no significant differences were detected between positions in H/Q peak torque, total work and average power ratio parameters (p > 0.05).

Table 3. Comparison of the 180⁰ Isokinetic knee H/Q ratios analysis between trials

Isokinetic Parameters	Trial	Mean	SD	t	p
H/Q peak torque ratio (%)	1.Sitting	80,07	7,70	**3,623**	**0,003**
	2.Prone	61,71	18,52		
H/Q total work ratio (%)	1.Sitting	88,14	9,09	**4,989**	**0,001**
	2.Prone	61,00	17,57		
H/Q average power ratio (%)	1.Sitting	86,93	8,66	**4,582**	**0,001**
	2.Prone	61,86	18,19		

Table 3 shows that the knee isokinetic H/Q ratios performed at 180°s^{-1} are compared by positions. According to the table, significant differences were detected between positions in H/Q peak torque, total work and average power ratio parameters (p > 0.05). The resulting significant difference resulted in favor of the measurement performed in the sitting position

Table.4 Comparison of the 60º Isokinetic knee H/Q ratios analysis between trials

Isokinetic Parameters	Trial	Mean	SD	t	p
H/Q peak torque ratio (%)	1.Sitting	63,93	7,25	**3,090**	**0,009**
	2.Prone	52,57	12,40		
H/Q total work ratio (%)	1.Sitting	79,86	9,26	**9,487**	**0,001**
	2.Prone	51,71	9,93		
H/Q average power ratio (%)	1.Sitting	79,50	8,94	**9,554**	**0,001**
	2.Prone	53,36	8,44		

Table 4 shows that the knee isokinetic H/Q ratios performed at 180°s^{-1} are compared by positions. According to, knee isokinetic H/Q ratios made at 60°s^{-1} are compared according to positions. According to the table, significant differences were detected between positions in H/Q peak torque, total work and average power ratio parameters (p > 0.05). The resulting significant difference resulted in favor of the measurement made in the sitting position.

4. DISCUSSION

The purpose of this study was to determine the effect of knee isokinetic measurement with different position (sitting/prone) on isokinetic H/Q ratios. For this purpose, 15 healthy sedentary males participated in the study. Isokinetic measurements of the study subjects were carried out with Isokinetic dynamometer (CSMI Cybex Humac Norm, USA). Isokinetic measurements were performed in 3 different ranges of motion (240ºs^{-1} / 180ºs^{-1} / 60ºs^{-1}). The test was carried out with 10 repetitions at 240ºs^{-1} and 180ºs^{-1} degree's angular velocities and 5 repetitions at 60ºs^{-1} degree's angular velocities. Each movement angle was performed 45 second rest intervals. When the data from the study are analyzed; there was no significant difference between positions in H/Q rates obtained at 240°s^{-1}. At 180°s^{-1} and 60°s^{-1} angles, significant differences were found between positions in peak torque, total work and average power ratio parameters.

H/Q strength ratio plays an important role in accurately assessing athletes' muscle strengths, creating appropriate training programs, improving performance, preventing injuries caused by athlete's lack of strength, and creating programs suitable for the treatment process after injury (Kannus, 1989; Osteras, Augestad & Tondel, 1998). Previous studies show that the H/Q strength ratio ensures that accurate decisions can be made about dynamic stabilization and muscle balance in the knee joint (Çolakoğlu, Selamoğlu, Gündüz, Acarbay & Çolakoğlu, 1993; Koutedakis, Frischknecht & Murthy, 1997). In isokinetic measurements, as the speed increases, the H/Q ratio decreases. (Perrin, 1993). While the results obtained in the current study showed that the high degrees of H/Q ratio were both reduced and there was no significant difference between positions, H/Q values increased at low angular speeds and the difference between positions was significantly revealed. It is emphasized in the literature that the hamstring muscle group at high speeds have higher strength than the quadriceps muscle group (Rankin &Thompson, 1983).

Isokinetic H/Q ratios were also affected by the physical necessity of different branches (Özçaldıran, Acar & Durmaz, 1998; Magalhaes, Oliveira, Ascensao & Soares, 2004). Other studies conducted in the literature it has been observed that the isokinetic H/Q ratios had reduced because of prolonged training time, differentiation of study techniques and other physical and physiological reasons (Rankin & Thompson, 1983). In our study, it could be said that the muscle groups participating in the movement as the reason for the differences we achieved in angular speeds were missing in the production of strength with full capacity when they made the movement faster and that imbalance occurred due to lack of coordination. As the angular velocity of the isokinetic dynamometer increases, the movement must be performed at a certain speed and constant tempo. Therefore, it is difficult for the hamstring and quadriceps muscles to produce strength in a balanced way while mutually participating in the movement (Pincivero, Lephart & Karunakara, 1997; Holcomb, Rubley, Lee & Guadagnoli, 2007). Another issue; In our study, we can say the following as the reasons for the difference between the knee isokinetic H/Q strength ratios measured in two different positions in favor of the measurement performed in the sitting position. In the sitting position, the hip joint is anatomically in the flexion position and the lumbar is fixed. In this position, it is inevitable for the knee to perform the flexion and extension movements more firmly. In this movement, the number of muscles involved in the contraction is better controlled (Miller et al, 2006). The person vertical position against gravity allows for more comfortable control of the lower extremity muscle functions. The position that extends above the face, the whole body in a parallel position against gravity, in the lower part, especially the lower extremity muscles, make it a little more difficult to control (Dvir, 1996).

As a result of the investigation of the positional differentiation in the measurement of knee isokinetic H/Q force ratios performed in two different positions; it could be said that the isokinetic H/Q ratios are different according to the positions and this differences revealed in favor of the knee isokinetic H/Q ratios performed in a sitting position.

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