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# COMPARISON OF THE EFFECTS OF KNEE ISOKINETIC MEASUREMENT WITH DIFFERENT POSITION ON KNEE ISOKINETIC STRENGTH

## ABSTRACT

The aim of this study was to examine the effect of isokinetic measurements performed in two different positions (prone and sitting) on knee isokinetic strength. For this purpose, 15 healthy sedentary males participated in the study. Isokinetic measurements of the study subjects were made 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 with $60^0s^{-1}$. Each movement 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 research, significant differences were found for $240°s^{-1}$, on peak torque (nm) and average power (w) flexion value in favor of the sitting position; $180°s^{-1}$, on peak torque (nm), total work (nm) and average power (w) both flexion and extension values in favor of the sitting position; $60°s^{-1}$, on peak torque (nm), total work (nm) and average power (w) both flexion and extension values in favor of the sitting position ($p < 0.05$). As a result, the effect of isokinetic measurements in two different positions on knee isokinetic strength has been significantly revealed. The effect of knee isokinetic measurements in the sitting position on the knee strength is significantly different from the measurements performed prone position.
**Keyword:** isokinetic measurement, isokinetic strength, position

## 1. INTRODUCTION

During isokinetic contraction, the contraction rate of the muscles is constant and maximal at every angle of movement along with the joint openness. No matter how much force the person perform top of the determined constant velocity, the maximum load is provided on the muscles. At the same time, strength is not applied by the device unless it is higher than the specified speed. It is especially safe for those with muscle and ligament injuries that the device does not apply strength (Şahin, 2010). İsokinetic knee strength measurements are important for determining performance in different branches or determining the level of disability and forming the necessary exercise protocols (Kannus, 1994; Kin-İşler, Arıburun, Özkan, Aytar & Tandoğan, 2008).

When looking at studies on isokinetic knee strength isokinetic measurements were carried out at different angular velocities (Magalhaes, Oliveira, Ascensao & Soares, 2004; Miller et al. 2006), it can be considered that they were different from exercise and general health studies (Özdal, Dağlıoğlu & Demir, 2013, Özdal, Bostancı, Dağlıoğlu, Ağaoğlu & Kabadayı, 2016; Dağlıoğlu, Mendes, Bostancı, Özdal & Demir, 2013; Özdal, Dağlıoğlu, Demir & Özkul, 2013). The measurements carried out at differ angular velocity has created the difference in the torque values. Higher torque values were obtained at knee strength measured at low angular velocity. Because the resistance applied by the isokinetic measuring device at low angular velocity is higher together with the torque value produced is also high (Nosse, 1982; Chan, Maffuli, Korkia & Ki, 1996; Şahin, 2010). In addition to measurements at a different angular velocity, comparison of the force produced by the same region in different positions has not been widely done in the literature. Based on this information, the aim of our study was to examine the effect of two different positions on isokinetic knee strength.

# 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)** | 21.87 | 2.10 |
| **Height (cm)** | 172.80 | 3.14 |
| **Weight (kg)** | 74.40 | 4.58 |

Table 1 shows the descriptive characteristics of the participant. According to the table, the mean age of the participants was determined as 21.87±2.10 years, height was 172.80±3.14 cm; weight was 74.40±4.58 kg.

## 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 $180^0s^{-1}$ angular velocities and 5 repetitions at $60^0s^{-1}$ 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 the significance level is examined as 0.05.

# 3. RESULT

**Table.2** Comparison of the 240° Isokinetic Knee Strength Analysis Between Positions

| Isokinetic Parameters | Trial | Mean | SD. | t | p |
|---|---|---|---|---|---|
| Peak torque extension (nm) | 1.Sitting | 86,86 | 15,15 | 1,734 | 0,107 |
| | 2.Prone | 69,29 | 18,75 | | |
| Total work extension (nm) | 1.Sitting | 70,50 | 29,39 | -1,424 | 0,178 |
| | 2.Prone | 93,00 | 13,49 | | |
| Average power extension (W) | 1.Sitting | 157,57 | 14,58 | 0,121 | 0,905 |
| | 2.Prone | 154,14 | 15,39 | | |
| Peak torque flexion (nm) | 1.Sitting | 68,21 | 11,36 | **5,552** | **0,001** |
| | 2.Prone | 46,57 | 15,76 | | |
| Total work flexion (nm) | 1.Sitting | 61,93 | 20,43 | 1,413 | 0,181 |
| | 2.Prone | 53,07 | 17,47 | | |
| Average power flexion (W) | 1.Sitting | 137,00 | 10,19 | **3,634** | **0,003** |
| | 2. Prone | 92,86 | 17,83 | | |

In Table 2, the isokinetic knee strength measurement at $240°s^{-1}$ is compared according to the positions. According to the table, the significant difference was determined in favor of measuring in the sitting position at peak torque flexion and average power < ($p < 0.05$).

**Table.3** Comparison of the 180s° Isokinetic Knee Strength Analysis Between Positions

| Isokinetic Parameters | Trial | Mean | SD. | t | p |
|---|---|---|---|---|---|
| Peak torque extension (nm) | 1.Sitting | 122,71 | 15,86 | **2,370** | **0,043** |
| | 2.Prone | 108,57 | 11,29 | | |
| Total work extension (nm) | 1.Sitting | 161,64 | 13,59 | **4,371** | **0,001** |
| | 2.Prone | 106,64 | 19,01 | | |
| Average power extension (W) | 1.Sitting | 191,30 | 15,98 | **2,227** | **0,049** |
| | 2.Prone | 155,36 | 12,71 | | |
| Peak torque flexion (nm) | 1.Sitting | 91,79 | 12,23 | **4,498** | **0,001** |
| | 2.Prone | 70,43 | 13,61 | | |
| Total work flexion (nm) | 1.Sitting | 93,57 | 15,37 | **2,304** | **0,046** |
| | 2.Prone | 84,21 | 17,20 | | |
| Average power flexion (W) | 1.Sitting | 165,64 | 17,14 | **7,644** | **0,001** |
| | 2. Prone | 94,07 | 19,64 | | |

In Table 3, the isokinetic knee strength measurement at 180°$s^{-1}$ is compared according to the positions. According to the table, a significant difference was found in the peak torque, total work and average torque flexion and extension values in favor of the measurement in the sitting position ($p < 0.05$).

**Table.4** Comparison of the 60° Isokinetic Knee Strength Analysis Between Positions

| Isokinetic Parameters | Trial | Mean | SD. | t | p |
|---|---|---|---|---|---|
| Peak torque extension (nm) | 1.Sitting | 208,57 | 18,58 | **6,983** | **0,001** |
| | 2.Prone | 163,36 | 19,58 | | |
| Total work extension (nm) | 1.Sitting | 192,64 | 16,26 | **2,348** | **0,042** |
| | 2.Prone | 174,50 | 17,65 | | |
| Average power extension (W) | 1.Sitting | 129,21 | 15,75 | **3,480** | **0,004** |
| | 2.Prone | 113,64 | 15,09 | | |
| Peak torque flexion (nm) | 1.Sitting | 132,50 | 16,27 | **8,388** | **0,001** |
| | 2.Prone | 85,79 | 15,35 | | |
| Total work flexion (nm) | 1.Sitting | 139,07 | 12,49 | **6,504** | **0,001** |
| | 2.Prone | 96,50 | 12,18 | | |
| Average power flexion (W) | 1.Sitting | 102,57 | 11,82 | **11,485** | **0,001** |
| | 2. Prone | 132,50 | 16,27 | | |

In Table 4, the isokinetic knee strength measurement at 60°$s^{-1}$ is compared according to the positions. According to the table, a significant difference was found in peak torque, total work and average torque flexion and extension values in favor of measurement in a sitting position ($p < 0.05$).

## 4. DISCUSSION

The aim of this study is to examine the effect of isokinetic measurements performed in two different positions (prone and sitting) on knee strength. For this purpose, 15 healthy sedentary males participated in the study. Significant differences between positions were detected in isokinetic knee strength measurements at 3 different angular speeds ($240^0s^{-1}$ / $180^0s^{-1}$ / $60^0s^{-1}$) during the working period.

In isokinetic measurements, the high angular speed value ensures that the movement occurs more serially. Torque values obtained at high angular speeds are lower. In our study, low torque values were obtained in peak torque and total peak torque parameters in knee isokinetic measurements in 240°$s^{-1}$. Comparison of knee strength according to positions, isokinetic force values were found to be higher in almost all parameters in the sitting position in all flexion and extension measurements. The parameters in which the resulting strength difference is significant appeared only in peak torque and average power flexion values in 240°$s^{-1}$. In knee isokinetic measurements at 180°$s^{-1}$, torque values are likely to be significantly higher than previous angular speed values. As the angular velocities values shrink in the isokinetic dynamometer, the resistance of the dynamometer during measurement increases. Movements cannot be made more quickly. At this angular velocity, the torque values obtained were higher than the previous angular speed. Again considering the effect of the two positions on the knee strength produced, higher values were obtained in the knee isokinetic force measured in sitting position compared to the knee isokinetic force performed by lying down. The resulting difference was significantly revealed in favor of peak torque, total work and average torque flexion and extension in favor of measurement in a sitting position. In our study, another angular speed is 60°$s^{-1}$, where the effect of positions on knee isokinetic force is examined. At this angular velocity, the dynamometer's resistance is quite high, and at this angular velocity, movements occur much slower than at other angular velocities. In cases where skeletal muscles are exposed to high resistances, decreases in mobility capacities occur. With the muscle going under a lot of loads, the contraction and relaxation system is operating a little slower (Wilk, Romaniello, Soscia, Arrigo & Andrew, 1994; Kannus, 1994). The torque values obtained at this angular rate are higher than the angular rates in other measurements. When we look at the effect of the two positions on the produced knee strength, higher values were obtained compared to the knee isokinetic force made by lying in the knee isokinetic force measured in the sitting position. The resulting difference was significant in favor of peak torque, total work and average torque flexion and extension in favor of measurement in a sitting position. Peak torque of isokinetic dynamometers is the most important variables carried out to study work and power values in contractions made at different angular speeds and to be measured in studies on muscle strength. The exponential inverse relationship between muscle strength and contraction rate expressed in hill equivalence is a physical fact that the rate at which the muscle is shorter should also be taken into account in measurements related to muscle strength (Brown, 2000; Mameletzi & Siatras, 2003; Ichinose, Kawakami, Ito, Kanehisa & Fukunaga, 2000; Thorstensson, Grimby & Karsson, 1976; Wickiewicz, Roy, Powell, Perrine & Edgerton, 1984). Previous studies have shown that isokinetic knee strength produces more torque at low angular velocity (Kannus & Kaplan, 1991; Hislop & Perrine, 1967). Studies investigating the difference in knee isokinetic strength between positions are not found in the literature. Therefore, there is no such study to which we can compare the results of the current study. The results we found in our study show that the knee isokinetic measurements made in the sitting position, in general, were better than the measurements made by reaching out. Higher values were obtained in peak torque, total work and average torque parameters. While there was a decrease in angular speeds in these parameters, there was also an increase in torque values. In a sitting position, the hip joint is anatomically in the flexion position and lumbar fixation is achieved. While in this position, it is inevitable that the knee will perform the flexion and extension movements more robustly. In this movement, the number of muscles involved in contraction is better controlled (Elliott, 1978). The person's 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 (Gray, Peterson & Bryant, 1992; Kannus & Jarvinen, 1991). In our study, the significant difference in the comparison of knee isokinetic force measurement between positions (sitting and lying down) in favor of sitting positions can be considered physiologically and anatomically as gravity, fixation and extremity control.

As a result, it can be said that knee isokinetic force measurements in two different positions are significantly different depending on the position and this change occurs in favor of the results of knee isokinetic force measurements in a sitting position.

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