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EFFECT OF DIFFERENT WARM-UP PROTOCOLS ON KNEE ISOKINETIC STRENGTH

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ABSTRACT

The aim of this study was to investigate the effect of different warm-up protocols on knee isokinetic strength (PT_{EX} and PT_{FLX}). With this purpose, a total of 33 sedentary male (19.00±1.94) participated voluntarily in the study. The subjects divided randomly three groups as an active warm-up, passive warm-up and control. Isokinetic measurements of the participants were performed with an isokinetic dynamometer (CSMI Cybex Humac Norm, USA). Isokinetic tests were performed at 4 different motion angles (60 °s⁻¹ / 120°s⁻¹ / 180°s⁻¹ / 240 °s⁻¹). Each movement angle was performed 15 repetitions. Two different warm-up protocols performed (active-passive). SPSS 20.0 package program was used for the analysis of the data. Significant level was accepted as p < 0.05. According to the results of the research, significant differences were found isokinetic knee strength in 60 °s⁻¹ / 120°s⁻¹ / 180°s⁻¹ / 240 °s⁻¹ in favor of active warm-up groups on PT_{EX} and PT_{FLX}. Significant differences were not found in the control group. In conclusion, it can be said that active warm-up had a significant effect on isokinetic knee strength (PT_{EX} and PT_{FLX}).

Keywords: isokinetic, strength, warm-up

1. INTRODUCTION

Isokinetic dynamometry is considered the gold standard for objective muscle strength assessment, enabling a detailed evaluation of muscle function throughout the full range of motion by providing equivalent opposing torque at set testing velocities (Jones, 2000). Isokinetic dynamometry is widely utilized in research and clinical practice and is considered safe for use in pediatric populations. The knee flexors (KF) and knee extensors (KE) are commonly assessed given they are prime movers for many functional activities. They play a key role in stabilizing the knee joint and act as shock absorbers during gait by attenuating ground reaction forces (Mikesky, Meyer and Thompson, 2000).

Muscle strength is one of the most important components of sport for high performance, injury prevention, and the effectiveness of injury rehabilitation in athletes (Vural & Özdal, 2019). Muscle strength has two components: maximal and explosive which play a decisive role in many individual and team performances. Maximal strength sets the upper functional limit of the musculoskeletal system and is important for relatively slow movement tasks, while explosive strength is considered more important where the time available to develop strength is limited in sports activities such as sprinting and jumping (Tillin and Folland, 2014; Tillin, Pain & Folland, 2012). Thus, these movements are closely related to maximal strength and aerobic-anaerobic power of the neuromuscular system (Vural, Ozdal and

Öztutuncu, 2017; Pancar, Ozdal and Vural, 2018; Tahhan, Ozdal, Vural & Pancar, 2018, Tahhan, Ozdal, Vural & Mayda, 2018).

The effect of warm-up on the contractile properties of skeletal muscle has been studied extensively. It is clear from this research that increasing muscle temperature increases the speed of muscle contraction, thereby decreasing both times to peak tension and half relaxation time (Bennett, 1984; Davies and Young, 1983; Vural, 2019). Furthermore, these findings are consistent irrespective of whether muscle temperature is elevated as a consequence of exercise or passive warming (Davies, Mecrow and White, 1982). However, it was not studied that the effect of active and passive warm-up on knee isokinetic strength widely. Therefore, our study is important. Thus the aim of this study was to investigate the effect of different warm-up protocols on knee isokinetic strength.

2. MATERIAL METHOD

2.1. Experimental Design and Participants

This study was designed according to the cross-controlled experimental design. A total of 15 sedentary individuals 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 four times in total. During the first visit, the participants were given detailed information about the measurements. In the second visit, isokinetic knee strength was measured for control. In the third visit, isokinetic knee strength was measured after active warm-up. In the last visit, isokinetic knee strength was measured after passive warm-up. Our study was conducted according to the Declaration of Helsinki and the ethics committee permission was obtained from Gaziantep University Clinical Research and Ethics Committee.

Table 1. Descriptive Characteristics of the Participants (N=33)

Variable	Minimum	Maximum	Mean	Std. Deviation
Age (year)	19,00	27,00	21,71	1,94
Height (cm)	173,00	185,00	173,63	3,11
Weight (kg)	75,00	88,00	75,75	3,18

Table 1 shows the descriptive characteristics of the participant. According to the table the mean age of the participants was determined as 19.00 ± 1.94 years, height was 173.00 ± 3.11 cm; weight was 75.00 ± 3.18 kg.

2.2. Isokinetic Measurement

Isokinetic measurements of the participants were performed with an isokinetic dynamometer (CSMI Cybex Humac Norm, USA). Isokinetic tests were performed at 4 different motion angles (60°s^{-1} / 120°s^{-1} / 180°s^{-1} / 240°s^{-1}). Each movement angle was performed 15 repetitions. 10 repetitive warm-up exercises were performed on an isokinetic dynamometer at 300os-1 before testing at each angular velocity. The rest interval between each angular velocity was set to 45 seconds (Ermis, Yilmaz, Kabadayi, Bostanci & Mayda, 2019).

2.3. Active and Passive Warm-up

The passive warm-up was carried out with the massage method. The Masseur was helped to de subjects for passive warm-up on the lower extremity (hamstring and quadriceps). The Active warm-up was performed for the lower extremity.

2.4. Statistical Analysis

SPSS 20 program was used for statistical analysis. Independent Sample t Test was used to compare the groups. Values are presented as mean and standard deviation, and the significance level is examined as 0.05.

3. RESULT

Table 2. Analysis of 60° Isokinetic Strength Test Data Between Intervention

Variable	Intervention	Mean	SD.	Partial ETA	F	p
60° PT _{Ex} (nm)	Control	163.12	30.86	0.098	3.261	0.049
	Active warm-up	169.82 ^a	31.10			
	Passive warm-up	167.52 ^a	32.10			
60° PT _{Flx} (nm)	Control	106.67	24.23	0.096	3.214	0.050
	Active warm-up	110.12 ^a	23.08			
	Passive warm-up	107.85	19.87			

a: Significant difference with control group. SD: standard deviation. Ex: Extension. Flx: Flexion. PT: Peak Torque.

Table 2 shows that the analysis of 60° knee isokinetic strength test. According to the table, a significant difference was found between active and passive warm-up and control group in favor of active and passive warm-up intervention in 60° PT_{EX} (p<0.05). In the same way, significant differences were found between active and passive warm-up and control group in favor of active and passive warm-up intervention in 60° PT_{FLX} (p<0.05).

Table 3. Analysis of 120° Isokinetic Strength Test Data Between Intervention

Variable	Intervention	Mean	SD.	Partial ETA	F	P
120° PT _{Ex} (nm)	Control	13.94	28.84	0.109	4.272	0.019
	Active warm-up	144.27 ^{ac}	28.00			
	Passive warm-up	139.18 ^a	26.52			
120° PT _{Flx} (nm)	Control	89.03	24.79	0.124	4.636	0.014
	Active warm-up	96.09 ^{ac}	19.55			
	Passive warm-up	92.12	16.57			

a: Significant difference with control group. c: Significant difference with passive warm-up intervention. SD: standard deviation. Ex: Extension. Flx: Flexion. PT: Peak Torque.

Table 3 shows that the analysis of 120° knee isokinetic strength test. According to the table, a significant difference was found between active and passive warm-up and control group in favor of active and passive warm-up intervention in 120° PT_{EX} (p<0.05). In addition to this significant differences was also found between active warm-up and passive warm-up in favor of an active warm-up group (p<0.05). In the same way, significant differences were found between active and passive warm-up and control group in favor of active and passive warm-up intervention in 120° PT_{FLX} (p<0.05). Significant differences were also found between active warm-up and passive warm-up in favor of active warm-up group (p<0.05).

Table 4. Analysis of 180° Isokinetic Strength Test Data Between Intervention

Variable	Intervention	Mean	SD.	Partial ETA	F	P
180° PT _{Ex} (nm)	Control	118.12	26.00	0.098	3.225	0.047
	Active warm-up	124.55 ^a	24.64			
	Passive warm-up	122.55	25.32			
180° PT _{Flx} (nm)	Control	77.70	21.90	0.118	4.288	0.018
	Active warm-up	84.52 ^a	17.63			
	Passive warm-up	85.36 ^a	16.12			

a: Significant difference with control group. c: Significant difference with passive warm-up intervention. SD: standard deviation. Ex: Extension. Flx: Flexion. PT: Peak Torque.

Table 4 shows that the analysis of 180° knee isokinetic strength test. According to the table, a significant difference was found between active and passive warm-up and control group in favor of active warm-up intervention in 180° PT_{EX} (p<0.05). In the same way, significant differences were found between active and passive warm-up and control group in favor of active and passive warm-up intervention in 180° PT_{FLX} (p<0.05).

Table 5. Analysis of 240° isokinetic strength test data between intervention

Variable	Intervention	Mean	SD.	Partial ETA	F	P
240° PT _{EX} (nm)	Control	97.85	29.61	0.201	8.040	0.001
	Active warm-up	109.12 ^a	23.66			
	Passive warm-up	108.36 ^a	25.91			
240° PT _{FLX} (nm)	Control	62.73	22.55	0.273	12.009	0.001
	Active warm-up	73.61 ^a	17.68			
	Passive warm-up	75.61 ^a	16.36			

a: Significant difference with control group. c: Significant difference with passive warm-up intervention. SD: standard deviation. Ex: Extension. Flx: Flexion. PT: Peak Torque.

Table 5 shows that the analysis of 240° knee isokinetic strength test. According to the table, a significant difference was found between active and passive warm-up and control group in favor of active and passive warm-up intervention in 240° PT_{EX} ($p < 0.05$). In the same way, significant differences were found between active and passive warm-up and control group in favor of active and passive warm-up intervention in 240° PT_{FLX} ($p < 0.05$).

4. DISCUSSION

The aim of this study was to investigate the effect of different warm-up protocols on knee isokinetic strength (PT_{EX} and PT_{FLX}). With this purpose, a total of 33 sedentary male participated voluntarily in the study. The subjects divided randomly three groups as an active warm-up, passive warm-up and control. Isokinetic measurements of the participants were performed with an isokinetic dynamometer (CSMI Cybex Humac Norm, USA). Isokinetic tests were performed at 4 different motion angles ($60^\circ \text{s}^{-1} / 120^\circ \text{s}^{-1} / 180^\circ \text{s}^{-1} / 240^\circ \text{s}^{-1}$). Each movement angle was performed 15 repetitions. Two different warm-up protocols performed (active-passive). At all angular velocities measured isokinetic, the active and passive warm-up was significant with the control group. Comparing between groups, significant differences were detected all angular velocities in favor of the active and passive warm-up groups.

Today, isokinetic strength measurements and isokinetic strength training enable the use of different and up-to-date methods thanks to developing technological devices and equipment. Isokinetic measurements allow the objective and measurable data collection opportunity to monitor the athletes' strength to gain values. Muscle performance can be classified as normal or abnormal according to isokinetic test results. This is also important in terms of quantifying exercise management (Gürol and Yılmaz, 2013).

From a lot of researchers, it has been proved that the exercises of the static stretching applied in the warming up session have a negative impact with a statistical importance in the speed, agility and the explosive force of the football players (Brandey, Ajit, Richard & Jennifer, 2012; Gelen, 2010; Haddad et al, 2014; La Torre et al, 2010; Little & Williams, 2006; Nelson, Driscoll, Landin, Young & Schexnayder, 2004; Power, Behm, Cahill, Carroll and Young, 2004; Ermis, Yılmaz, Kabadayi, Bostanci & Mayda, 2019). Compared to the mentioned researches above, some researches have researched in the impact of the combined stretching (dynamic and static) and have not proved any determinant impacts in the motoric performances: speed and agility (Power et al., 2004).

It has previously been shown that an acute bout of passive muscle stretching can impede maximal force production in both isometric and concentric contractions (Avela, Kyrolainen and Komi 1999; Fowles, Sale and MacDougall, 2000; Kokkonen, Nelson and Cornwell, 1998; Yılmaz, Kabadayi, Bostanci, Ozdal & Mayda, 2019). In addition, prior stretching can also compromise the performance of a skill for which success is dependent on the rate of force production or power, rather than just the ability to maximize force output (Cornwell, Nelson, Heise and Sidaway, 2001, Young & Behm, 2003).

In conclusion, it could be said that active and passive warm-up had a positive and significant effect on knee isokinetic strength, PT_{EX} and PT_{FLX} in $60^\circ \text{s}^{-1} / 120^\circ \text{s}^{-1} / 180^\circ \text{s}^{-1} / 240^\circ \text{s}^{-1}$ angular velocities.

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