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REVIEWING THE EFFECT OF PLYOMETRICS TRAINING PERFORMED BY ICEMEN PLAY IN SUPER LEAGUE ON QUICK POWER AND MAXIMAL POWER

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Abstract:
This study is planned to review the effect of the plyometrics training performed by icemen on the Dominant and Nondominant leg concentric and isokinetic power values at angular speed. Totally 14 male icemen, the age average of training group is (21,42±4,79), control group's age average is (21,12±3,44). After being measured the knee extension and flexion, concentric isokinetic power properties, the athletes were divided into two groups as control and training groups so as to be seven people in each of them by the random method. The data obtained are analyzed by Mann Whitney-U and Wilcoxon Signed tests by computing the descriptive statistics in SPSS 16 program. While the control group was performing ice hockey for three days a week for eight weeks, the training group was performing the plyometrics training in addition to the same technical training. There is found a significant difference ($p<0.05$) between 60 deg/sec, 180 deg/sec and 300 deg/sec dominant leg extensor concentric and isokinetic powers. Even though there is a numerical increase between 60 deg/sec, 180 deg/sec, and 300 deg/sec dominant leg flexor concentric and isokinetic powers, no statistically significant difference is determined ($p>0.05$). A numerical increment is found in 60 dec/sec, 180 dec/sec and 300 dec/sec nondominant leg extensor concentric and isokinetic power. However, there is not seen any statistical enhancement in nondominant leg extensor concentric and isokinetic powers in spite of the numerical increase as 60 dec/sec, 180 dec/sec and 300 dec/sec.

Keywords: plyometrics, ice hockey, concentric, isokinetic

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1. Introduction

Plyometrics is the way to increase the sportive performance through training performed by jumping and throwing methods to power or explosiveness. The studies refer that the anterior cruciate ligaments get injured more frequent (Dick, 1995). This ratio increases in women because of the neuromuscular system (Myer et al, 2016). Plyometrics exercises are composed of the jumping moves with lower extremities and moves with upper extremities and performed by the equipment such as the med ball, etc. The jumping moves are implemented as horizontal jumps, jumps by stopping, mixed hops, cross jumps, and desk drills. The goal of the consecutive flat jumps by low density is to shorten the amortization period. The jumps by stopping with the mixed jumps and leaps are performed by the distances as less than 30 meters to prepare to the desk drills. Cross jumps are the jumping drills develop the deflection and endurance of the athletes (Chu, 1983;, Chu, 1984;, Chu, 1992;, Chu et al, 1998). This technique aims to increase the explosive reaction of the sporter by powerful muscular contraction as the result of eccentric contraction. As a summary, the plyometrics is a serious of explosive move provides muscles to reach the maximum level in the shortest time (Bayraktar, 2006). One of the training methods used in many of the sportive games is the plyometric exercises (Bompa, 2003).

An example supports the intensifier power of plyometrics training is the US Volleyball team that has 1984 Olympiad gold medal. After the plyometrics training performed by US Volleyball team, an extraordinary increment as 10,16 cm was observed (Radcliffe & Farentinos, 1999).

Plyometrics training is defined as the exercises increase the power or reactive, explosive move and include workouts that are the mix of speed and power (Chu, 1998). Plyometrics training is used as connected with the power training. Bodyweight is 33% of the maximal leg power. This ratio accords with the building exercises (Topuz, 2008). The purpose of the plyometrics training is mostly connected with the elastic power and to apply force in a short time by concentric contraction after the eccentric contraction of the muscle.

The functions such as bodyweight and gravity are at the forefront in the exercises used in plyometrics training. Exercises programs that benefit from the plyometrics positively affect the performance for the power-related moves like speed and jump. The foremost reason of performing the plyometrics training is the necessity to activate the motor units for providing a better neural harmony (Bompa, 1996). As the physiology of plyometrics, it can be analyzed under three parts as the eccentric loading, amortization and concentric contraction phases of the activity (Little et al, 1996).

Plyometrics exercises are composed of the jumping moves with lower extremities (legs) and move with upper extremities (arms) and performed by the equipment such as the med ball, etc., (Ateş & Ateşoğlu, 2007). Plyometrics training is the method increases the exit and finisher boots. This type of training provides to turn the sudden deceleration, and eccentric muscle moves into the sudden acceleration and concentric

muscle moves. Since this training causes to sudden deceleration and acceleration of the muscle, it is known as an opening-stretching cycle. The eccentric muscle moves cannot gain power as much as the concentric muscle moves in the opening-stretching cycle start in a static position. That's why the elastic muscle power is used, and they cannot produce power as much as the concentric muscle moves (Reyment et al, 2006).

This paper aims to review the effect of plyometric training performed by the icemen play in Kağıtspor Club of Kocaeli Metropolitan Municipality on Dominant and Non dominant leg concentric and isokinetic power values at two different angular velocities.

2. Material and Method

Research group consists of 14 icemen who play within Kocaeli Metropolitan Municipality in super league, represent the national team, have been trained for five years so as to be 4-5 times in a week, and have never got injured. The human subjects were divided into two groups as unbiased and random. This survey contains 14 male icemen, the age average of training group is (21,42±4,79), control group's age average is (21,12±3,44). Plyometric training group is constituted for the research. While the control group was performing routine exercises, the training group was playing the plyometrics training for three days a week in addition to the ordinary practices. Knee extension and flexion, concentric isokinetic power tests were applied in attendees before and after the research. Permission was received from the club directors and trainers before the survey.

3. Research Technıque and Protocol

A. Height and weight measurement

A wall-mounted tape measured the heights of the athletes; weights were measured by a Homend branded Gramatic 3901 model bascule. The heights of the icemen were measured as the body depth from the heel to the upper point of the head. The weights were measured when the icemen with are just a short and t-shirt.

B. Test Applications

After the training was performed by all the athletes, the device called 'Biodex Medical Systems, Inc, Shirley, New York, USA' in the Isokinetic laboratory of School of Physical Education and Sports measured knee flexion-extension in the lower extremity. 60/60 dec/sec, five repetitions, 180/180 dec/sec, ten repetitions, 300/300 dec/sec 20 repetitions were actualized in Biodex System 3 Dynamometer as the Test protocol by Con-Con test protocol. Each of the athletes attended the warm-up program before the isokinetic test. These athletes run for 10 minutes to warm, then willingly did stretching exercises and completed the warm-up program. The iceman who finished the warm-up program were taken into the isokinetic dynamometer one by one for knee extension and flexion test. Isokinetic concentric power measurements for both the knees of the attendees were

evaluated via Biodex System 3 isokinetic dynamometer at 60°/sec, 180°/sec, and 300°/sec angular velocities. (Biodex Medical Systems, Inc, Shirley, New York, USA.) They sit on the isokinetic dynamometer by 90° of the lumbar support and knee angle.

After the flexion and extension angles (0° — 90°, 0° = knee in full extension) were arranged, the athletes prepared for the maximal isokinetic test by being calculated the correcting procedures via the computer at 45° to eliminate the effects of the gravity on the power. Isokinetic power measurements were actualized as five maximal contractions following one trial at 60°/sec angular velocity, ten maximal contractions following one trial at 180°/sec angular velocity, 20 maximal repetitions following one trial at 300°/sec angular velocity. All the athletes rested for 2 minutes after each of the test speed. At first, the dominant leg, then the other leg was measured. All the athletes rested for 5 minutes between two measurings. These attendees were encouraged verbally to provide the maximal participation to the tests. Peak torque parameter is utilized as the muscular force property.

C. Training procedures

Athletes were informed about the plyometric training and the movement techniques after the pretests completed. Plyometric exercises were performed by the icemen for three times in a week during totally eight weeks. The training was actualized in Olympic Ice Sports saloon of Kocaeli Metropolitan Municipality. The athletes gathered in training saloon with trainer and investigators in 3 times a week during totally eight weeks at 8 pm. After 10 minutes general warm-up run, 5 minutes ice hockey warm-up exercises and 45 minutes of single unit training were performed.

Table 1: Trainig Program

	1st, 2nd Weeks	**3rd, 4th Weeks**	**5th, 6th Weeks**	**7th, 8th Weeks**
High knee pulling	2 x10m	3 x10m	4 x10m	5 x10m
Heeling	2x10m	3x10m	4x10m	5x10m
Slalom step	4x10	5x10	6x10	6x10
Jumping to sides by bending single foot from the knee	4x10: 40 repetition	5x10: 50 repetition	6x10: 60 repetition	6x10: 60 repetition
Squad	10 repetition	12 repetition	2x10 repetition	3x10 repetition
Step	10 repetition	10 repetition	2x10 repetition	3x10 repetition
Squat jump	10 repetition	2x8:16 repetition	3x8:24 repetition	3x10 repetition
Split squat jump	10 repetition	2x8:16 repetition	3x8:24 repetition	3x10: 30 repetition
Box jump (right-left foot)	2x10 right-left foot	3x10 right-left foot	4x10 right-left foot	4x10 right-left foot
Cross over jump	10 repetition	2x8: 16 repetition	3x8: 16 repetition	3x10: 30 repetition

Jump to the box	10 repetition	2x8:16 repetition	3x8: 24 repetition	3x10: 30 repetition
Line jumps (forward-back)	1x10 right-left foot	2x8:16 repetitions right-left foot	3x8:24 repetitions right-left foot	3x10:30 repetitions right-left foot
Line jumps (to side-to side)	1x10 right-left foot	2x8:16 repetitions right-left foot	3x8:24 repetitions right-left foot	3x10: 30 repetitions right-left foot
Take steps to side	10 right 10 left	2x8:16 repetitions16 right 16 left	3x8:24 repetitions 24 right 24 left	3x10:30 repetitions 30 right 30 left

D. Collecting, Coding, Transferring to Computer Environment of the Data and Statistical Procedures

Microsoft Excel tabulation program is utilized to collect the data to the electronic nvironment. After the data tables are created in Microsoft Excel tabulation program for evaluating statistically, SPSS version 17 (Statistical Package Chicago, II for the Social Science) is used to the statistical analysis. Pretest and posttest results are compared before and after the Plyometric Trainings. Wilcoxon Test actualized this comparison. Mann Whitney – U test determined the differences between the groups. The standard deviations and averages of age, training age, height and weight values of the athletes are used as descriptive statistics in SPSS version 17 program.

4. Findings

Table 2: Statistical values of Age, Height, and Body Weight values of Control Group and Training Group

	Training Group	**Control Group**	**P**
Age	21,42±4,79	21,12±3,44	0,086
Height	176,00±0,06	178,88±0,07	0,077
Weight	77,00±14,39	77,62±11,17	1,000

There is not found a statistically significant difference between the age, height, and body weight values of both groups (p>0.05).

Table 3: Training Group's statistical values of pretest-posttest knee flexion and knee extension muscular force

			Before Training	**After Training**	**P**	**Z**
60 Deg./Sn.	Extensions	Dominant	206.5±46.03	232.71±33.26	**0,043***	**-2,028**
		Non dominant	214.09±50.08	224.91±32.21	0,398	-,845
	Flexions	Dominant	105.49±29.48	120.67±32.59	0,173	-1,363
		Non dominant	105.27±15.54	114.16±24.48	0,173	-1,363
	Extensions	Dominant	139.91±32.84	159.61±22.77	**0,028***	**-2,197**

180 Deg./Sn.		Non dominant	140.76±27.47	149.2±18.89	0,398	-,845
	Flexions	Dominant	82.54±22.68	91.19±20.1	0,176	-1,352
		Non dominant	83.39±11.73	87.43±12.69	0,398	-,845
300 Deg./Sn.	Extensions	Dominant	106.79±19.59	120.19±16.91	**0,018***	**-2,366**
		Non dominant	105.21±19.43	113.37±14.71	0,237	-1,183
	Flexions	Dominant	67.04±16.59	75.14±14.3	0,398	-,845
		Non dominant	67.39±13.66	73.64±12.17	0,091	-1,690

A significant difference (p<0,05) is found at 0,05 level between the pretest and posttest scores at the end of 60 dec/sec. Extension Dominant PeakT (Z=-2,03; p<0,05), 180 dec/sec. Extension Dominant PeakT (Z=-2,20; p<0,05), 300 dec/sec. Extension Dominant.

Table 4: Control Group's statistical values of pretest-posttest knee flexion and knee extension muscular force

			Before Training	**After Training**	**P**	**Z**
60 Deg./Sec.	Extensions	Dominant	272,21±48,19	234,29±47,82	**0,012***	**-2,521**
		Non dominant	228,93±37,77	228,06±39,05	0,889	-,140
	Flexions	Dominant	140,19±27,71	121,00±34,42	**0,012***	**-2,521**
		Non dominant	122,49±25,76	121,24±28,62	0,674	-,420
180 Deg./Sec.	Extensions	Dominant	168,08±27,8	160,48±37,08	0,401	-,840
		Non dominant	156,60±17,28	162,36±25,5	0,208	-1,260
	Flexions	Dominant	104,24±15,8	83,21±33,38	**0,036***	**-2,100**
		Non dominant	89,74±13,76	93,08±15,13	0,575	-,560
300 Deg./Sec.	Extensions	Dominant	130,2±17,59	129,99±19,01	0,779	-,280
		Non dominant	124,7±17,21	140,86±47,26	0,484	-,700
	Flexions	Dominant	82,94±14,48	88,59±46,95	0,263	-1,120
		Non dominant	70,88±10,86	78,69±21,48	1,000	,000

A significant difference (p<0,05) is found between pretest and posttest scores in the measurements of 60 dec/sec. Extension Dominant PeakT (Z=-2,52; p<0,05), 60 dec/sec. Flexion Dominant PeakT (Z=-2,52; p<0,05), 180 dec/sec. Flexion Dominant PeakT (Z=-2,10; p<0,05) in the control group.

Table 5: Training Group's and Control Group's pretest statistical values of knee flexion and knee extension muscular force

Measurement	Training Group	Control Group	P
60 deg/sec. Extension Dominant PeakT	206,50±46,02	272,21±48,19	**0,028***
60 deg/sec. Extension Non Dominant PeakT	214,08±50,08	228,92±37,77	0,298
60 deg/sec. Flexion Dominant PeakT	105,48±29,47	140,18±27,71	0,073
60 deg/sec. Flexion Non Dominant PeakT	105,27±15,53	122,48±25,75	0,183
180 deg/sec. Extension Dominant PeakT	139,91±32,84	168,07±27,80	0,064
180 deg/sec. Extension Non Dominant PeakT	140,75±27,47	156,60±17,27	0,247
180 deg/sec. Flexion Dominant PeakT	82,54±22,68	104,23±15,79	0,064
180 deg/sec. Flexion Non Dominant PeakT	83,38±11,72	89,73±13,76	0,203
300 deg/sec. Extension Dominant PeakT	106,78±19,59	130,20±17,59	**0,037***
300 deg/sec. Extension Non Dominant PeakT	105,21±19,43	124,70±17,20	**0,049***
300 deg/sec. Flexion Dominant PeakT	67,04±16,59	82,93±14,48	**0,037***
300 deg/sec. Flexion Non Dominant PeakT	67,38±13,66	70,87±10,86	0,487

After comparing the pretest muscular force of both groups are compared, a statistically significant difference ($p<0,05$) is found between 60 dec/sec and 300 dec/sec dominant knee extension values and 300 dec/sec dominant knee flexion measurements.

Table 6: Training Group's and Control Group's posttest statistical values of knee flexion and extension knee muscular force

Measurements	Trainig Group	Control Group	P
60 deg/sec. Extension Dominant PeakT	232,71±33,26	234,28±47,81	0,817
60 deg/sec. Extension Non Dominant PeakT	224,91±32,20	228,06±39,04	0,908
60 deg/sec. Flexion Dominant PeakT	120,67±32,59	126,68±26,87	0,728
60 deg/sec. Flexion Non Dominant PeakT	114,15±24,48	121,23±28,62	0,817
180 deg/sec. Extension Dominant PeakT	159,61±22,77	160,47±37,07	0,643
180 deg/sec. Extension Non Dominant PeakT	149,20±18,89	162,36±25,49	0,325
180 deg/sn. Flexion Dominant PeakT	91,18±20,09	90,63±25,74	0,817
180 deg/sec. Flexion Non Dominant PeakT	87,42±12,69	93,07±15,13	0,418
300 deg/sec. Extension Dominant PeakT	120,18±16,90	129,98±19,01	0,418
300 deg/sec. Extension Non Dominant PeakT	113,37±14,71	128,35±26,00	0,298
300 deg/sec. Flexion Dominant PeakT	75,14±14,29	76,06±20,18	0,817
300 deg/sec. Flexion Non Dominant PeakT	73,64±12,17	71,78±10,41	0,728

Any statistically significant difference is not found when the muscular force measurements of both groups are compared (p>0,05).

5. Discussion and Conclusion

Physiologically, power functions as a force source of the lever systems consist of muscles and bones (Günay & Yüce, 2001). Biologically, the power is a concept means moving mass, overcoming a resistance or affect that resistance via the muscle exercises (Muratlı, 1997). The muscle force and power are the indicators of satisfactory performance in individual or team sports. Over the past decade, the trainers and investigators have pointed out the plyometric training that is one of the optimal training methods develops the power, force and race performance (Adams et al, 1992;, Newton & Kraemer, 1994;, Little et al, 1996; Wilson et al, 1993). The results of the study we conducted within this context are given below.

After comparing the pretest muscle force measurements of both groups, a statistically significant difference (p<0,05) is specified between 60 dec/sec and 300 dec/sec dominant knee extension values and 300 dec/sec. Dominant knee flexion measurements. However, after comparing the posttest muscle force measurements, no statistically significant differences found (p>0,05).60 deg/sec. Extension Dominant PeakT of the control group is determined as 272,21±48,19 Newton in the first measurements, while it is found as 234,29±47,82 Newton in the final measures. The presence of a statistical difference in the direction of decrement is confirmed (p<0,05). 60 dec/sec. Extension Dominant PeakT values of the training group that played exercises three days a week during totally eight weeks are 206.5±46.03 Newton; these same values increased as 232.71±33.26 Newton after the training. It is seen when the dominant foot peakT. Values of the group performed plyometric training are compared that there is a meaningful increase (p<0.05) 60 dec/sec. Extension Dominant PeakT values of the group 180 deg/sec. Extension Dominant PeakT values of the control group are determined as 168,08±27,8 Newton in the first measurements, this same value is found as 160,48±37,08 Newton for the final measures. There is not found any statistically significant difference (p>0,05). While the 180 deg/sec. Extension Dominant PeakT measurements are 139.91±32.84 Newton before the exercises in the training group, this same value is specified as 159.61±22.77 Newton after the exercises. Since it is observed when the dominant foot peakT. Values of the group performed plyometric training are statistically compared that there is an increment in 180 deg/sec. Extension Dominant PeakT values, a statistically significant difference can be accepted as well (p>0.05). 300 deg/sec. Extension Dominant PeakT values of the control group are measured as 130,2±17,59 Newton for the first time, this same value is found as 129,99±19,01 Newton. Therefore, we cannot talk about the presence of a statistically significant difference (p>0,05). 300 deg/sec. Extension Dominant PeakT values of training group are measured as 106.79±19.59 Newton before the exercises; these same values are measured as 120.19±16.91 Newton after the training. A significant increment

(p<0.05) is observed in 300 deg/sec. Extension Dominant PeakT values of the group performed plyometric training when the dominant foot peakT. Values of the group are statically compared. There is found statistically significant differences (p<0,05) in 60 deg/sec. 180 deg/sec. And 300 dec/sec. dominant knee Extension PeakT values of the training group in the force measurements. 60 deg/sec. Flexion Dominant PeakT values of the control group in research are measured as 140,19±27,71 Newton for the first time; these same values are measured as 121,00±34,42 for the final. It can be said that this change is in the decrease direction and accepted as a statistically significant difference (p<0,05). 60 deg/sec. Flexion dominant PeakT values of the training group are measured as 105.49±29.48 Newton for the first time, these same values are found as 120.67±32.59 Newton after the exercises. Even though there is a meaningful increase in 60 deg/sec. Flexion Dominant PeakT values of the group performed plyometric training when the dominant foot peakT. Values of this team are statistically compared, no statistically significant difference occurred (p>0.05).180 deg/sec. Flexion Dominant PeakT values of the control group are found as 104,24±15,8 Newton in the first measurement, these same values are determined as 83,21±33,38 Newton for the final. It is confirmed that the change occurred in decrease direction and a statistically significant difference can be accepted (p<0,05). 180 deg/sec. Flexion Dominant PeakT measurements of the training group are 82.54±22.68 Newton before the exercises, these same measurements are found as 91.19±20.1 Newton after the exercises. Even though there is an increment in first and last measurements of 180 deg/sec. Flexion Dominant PeakT values of the group performed plyometric training when the dominant foot peakT. Values of the group are compared before, and after the exercises, no statistically significant difference occurs (p>0.05). 300 deg/sec. Flexion Dominant PeakT values of the control group are found as 82,94±14,48 Newton in the first measures; these same values are measured as 88,59±46,95 Newton for the final. There is not found any statistically significant difference (p>0,05). 300 deg/sec. Flexion dominant PeakT values of the training group are measured as 67.04±16.59 Newton before the exercises; these same values are measured as 75.14±14.3 Newton after the exercises. There is not seen any statistically significant difference in first and least measures of 300 deg/sec. Flexion Dominant PeakT values of the group performed Plyometric training when the dominant foot peakT. Values are compared before and after the training (p>0.05).

The first measures of 60 deg/sec. Extension Nondominant PeakT values of the control group are 228,93±37,77 Newton, these same values are specified as 228,06±39,05 Newton for the final measurements. This change is not statistically meaningful (p>0,05). 60 deg/sec. Extension Nondominant PeakT values of the training group are 214.09±50.08 Newton; these same values are measured as 224.91±32.21 Newton after the exercises. Even though this previous increase, there is not found a significant increment in 60 dec/sec. Extension Nondominant PeakT values of the group performed plyometric training when the Nondominant foot peakT. values are compared before and after the workout (p>0.05). 180 deg/sec. Extension Nondominant PeakT values of the control group are measured as 156,60±17,28 Newton for the first time, these same values are

specified as 162,36±25,5 Newton for the final measurements. There is not found a statistically significant difference (p>0,05). 180 deg/sec. Extension Nondominant PeakT measures of the training group are found as 140.76±27.47 Newton for the first time; these same values are measured as 149.2±18.89 Newton after the workout. Even though there is an increase in first and last measures of 180 deg/sec. Extension Nondominant PeakT values of the groups when the Nondominant foot peakT values of the group performed plyometric training are compared, no statistically significant difference occurred (p>0.05). The first measures for 300 dec/sec. Extension Nondominant PeakT values of the control group are 124,7±17,21 Newton; these same values are measured as 140,86±47,26 Newton after the exercises. Thus, a statistically significant cannot be told (p>0,05). 300 deg/sec. Extension Nondominant PeakT measurement values of the training group are 105.21±19.43 Newton, these same values are found as 113.37±14.71 Newton after the exercises. There is not found a statistically significant difference. No statistically significant difference occurred (p>0.05) in the first and last measures of 300 deg/sec. Extension Nondominant PeakT values of the groups when the Nondominant foot peakT. Values of the team performed plyometric training are compared. The first measures of 60 deg/sec. Flexion Nondominant PeakT values of the control group are found as 122,49±25,76 Newton, these same measures are seen as 121,24±28,62 Newton for the last time. There is not noticed a statistically significant difference (p>0,05). While the 60 deg/sec. Flexion Nondominant PeakT measures of the training group are 105.27±15.54 Newton before the exercises, this value is found as 114.16±24.48 Newton after the exercises. Even though there is an increase in 60 deg/sec. Flexion Nondominant PeakT values of the groups when the Nondominant foot peakT values of the team performed plyometric training are compared, no meaningful difference occurred (p>0.05). First measurement values of 180 deg/sec. Flexion Nondominant PeakT values of the control group are found as 89,74±13,76 Newton; these same values are measured as 93,08±15,13 Newton after the exercises. We cannot talk about a statistically significant difference (p>0,05). 180 deg/sec. Flexion Nondominant PeakT measurements of the training group are determined as 83.39±11.73 Newton before the exercises, these same values are found as 87.43±12.69 Newton after the workout. Even though there is an increase in 180 deg/sec. Flexion Nondominant PeakT values of the groups in the first and last measurements when the Nondominant foot peakT values of the group performed plyometric training are compared, no meaningful difference occurred (p>0.05). The first measures of 300 deg/sec. Flexion Nondominant PeakT values of the control group are found as 70,88±10,86 Newton, the last measures are found as 78,69±21,48 Newton. There is not found a statistically significant difference (p>0,05). 300 deg/sec. Flexion Nondominant PeakT values of the training group are found as 67.39±13.66 Newton before the exercises, these same values are specified as 73.64±12.17 Newton after the workouts. There is not found a statistically significant difference (p>0.05) in the first and last measures of 00 deg/sec. Flexion Nondominant PeakT values of the groups when the Nondominant foot PeakT values of the group performed plyometric training before and after the exercises. According to the Boraczynski &

Urniaz, (2008) research conducted to the effect of plyometric training of the power-speed competences of the basketball players, eight weeks basketball training with plyometric exercises created a significant impact on the development of mechanic parameters such as power-speed of the athletes. Vassil&Bazanovk, (2012) analyzed the effects of combining the plyometric training for the young volleyball players in the standard training period. According to the results of this research, the arm and leg speeds of the athletes significantly improved in the statistical analyses of the test results of the long jump, standing depth jump, throw the gymnastic ball in 10 seconds, maximum vertical jump height. Tortop, (2010) conducted a study to determine H/Q ratios between elite-level athletes in different sports branches and sedentary individuals and also reveal the disability tendencies under the data collected. Concerning the finding of this research, much as these human subjects are not in the tendency to get injured at the first-degree, they make light of the exercises for the hamstring muscle group. Gregory, et al. (2005) determined that the volleyball players are positively affected ($p<0,05$) from the plyometric training in the pool for six weeks for 60° and 180° knee extension and flexion. But these extra training didn't create a significant different regarding the improvement ($p<0,05$). Hossini et al. (2012) found a significant increase in the muscle force of the female students after the plyometric training performed three times a week during totally six weeks. There is not found a significant difference between three different plyometric training methods (drop jump, handle jump, high jump). Avery et al. (2007) analyzed the effect of short-termed plyometric and endurance training programs of the fitness performance of the males between 12 and 15 ages. According to the finding of this survey, the plyometric and endurance training are more beneficial for lower and upper body powers of the children ($p<0,05$). Chelly et al. (2010) studied to understand the effect of the short termed plyometric training program within the season on the leg power, jumping and sprint performances of the football players. They mentioned at the end of the study that the plyometric exercises remarkably contributed to the workup performances of the athletes in addition to the training within the season. Chimera et al. (2004) researched to evaluate the effect of plyometric training on the lower extremity performance and muscle activation strategies during the jump exercises. For this purpose, the human subjects performed plyometric exercises for two times a week during totally six weeks. It is found at the end of the research that if the plyometric exercises are counted in the training of female, the risk of injury decreases and the lower extremity can be balanced. Another research was actualized by Herrero et al. (2005) to compare the four weeks effect of 20 m sprint time of knee muscles, jumping skill, electromyostimulation (ems) in maximal isometric power, plyometric training (P) or EMS and P training. According to the finding of this survey, EMS that is combined with just the plyometric training caused to increase the maximum power and hypertrophy of the muscles. Vaczi et al. (2013) reviewed the effect of short-run plyometric exercises within the season on the power, agility and knee extensor force. The female football players in the 3rd league were performed for six weeks plyometric training. It is monitored by the program that the single and double-

sided plyometric programs at a high density significantly contributed to the football by proving progress in lower extremity power and the knee extensor power. Gregory et al. (2006) analyzed the impact of the plyometric on the lower extremity biomechanics in comparison with the Balance and Dynamic Stabilization training. They found that the plyometric training increased the initial contact knee flexion and maximum knee flexion during the vertical jump while the balance training increased the maximum knee flexion during the medial landing.

Literature has the studies show positive effects of the plyometric exercises on the leg force. The similar results are found in this study as well. It is mentioned that the plyometric training performed created a statistical increment in extensor muscles belong to the dominant leg. About the flexor muscles, much as being statistically insignificant, there are still better results in comparison with the initial values. This circumstance may stem from the training program. In opposition to the flexor muscles, it can be mentioned that there is a better improvement in extensor muscles due to being preferred the training procedures towards the extensor muscles. In conclusion, since the plyometric exercises to be performed for three times a week in addition to the workout performed in the race season will affect the leg concentric and isokinetic power, being counted the plyometric exercises into the training programs can be suggested to the Ice hockey athletes play in the super league.

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