Suleyman Viran [1]
Umut Canli [1,*]

THE EFFECT OF PROPRIOCEPTIVE TRAINING ON HIGH-INTENSITY ACTIONS AND TECHNIQUE IN FOOTBALL PLAYERS: A TRAINING PROGRAM

VPLIV PROPRIOCEPTIVNEGA TRENINGA NA VISOKO INTENZIVNE AKCIJE IN TEHNIKO PRI NOGOMETAŠIH: NAČRT VADBE

ABSTRACT

It is aimed to determine the level of influence of proprioceptive training applied to young football players on high-intensity actions and football-specific skills of football players. The research group consists of 30 male football players (age = 15.86 ± 0.69). The participants were divided into 2 groups as proprioceptive training group (PTG) and control group, each consisting of 15 football players. The body height and body weight of the participants were measured. Hand-eye coordination, vertical jump, sprint, agility, and core endurance tests, which are defined as high-intensity actions, were applied to the participants. Dynamic balance performances of the participants were also determined. Passing, ball control and dribbling were measured by international tests to determine the participants' football-specific skills. No significant differences were found between the groups in the comparison of PTG and CG in terms of high-intensity actions ($p>0.05$). There was also no significant difference in the comparison of the dynamic balance performance of both dominant and non-dominant feet ($p>0.05$). Significant differences were determined in favor of the PTG group in the variables of football-specific skills such as pass shot rate and the number of ball control ($p<0.05$). There was no statistically significant difference between CG and PTG in the values of passing time and dribbling time ($p>0.05$). As a result, it can be stated that in addition to football training, proprioceptive training contributes positively to the development of skills such as passing and ball control, which we can show among the basic football skills.

Keywords: skill, football player, proprioceptive training, high-intensity action

[1]Tekirdag Namik Kemal University, Sports Science Faculty, Suleymanpasa/Tekirdag, Turkey

IZVLEČEK

Namen raziskave je bil ugotoviti stopnjo vpliva proprioceptivnega treninga, ki se izvaja pri mladih nogometaših, na visoko intenzivni napor in nogometno specifične spretnosti. Raziskovalno skupino je sestavljalo 30 nogometašev (starost = 15.86 ± 0.69). Udeleženci so bili razdeljeni v dve skupini, in sicer v skupino proprioceptivnega treninga (PTG) in kontrolno skupino (CG), v vsaki je bilo po 15 nogometašev. Vsi udeleženci so opravili meritve telesne višine in mase, koordinacije (roka-oko), vertikalnega skoka, sprinta, agilnosti, vzdržljivosti mišic jedra in dinamičnega ravnotežja. S pomočjo mednarodnih testov podaj, kontrole žoge in preigravanja se je za vsakega udeleženca določila raven njegove nogometne spretnosti. Med obema skupinama PTG in CG ni prihajalo do statistično pomembnih razlik pri visoko intenzivnih naporih ($p>0.05$) in dinamičnem ravnotežju na dominantni in nedominatni nogi ($p>0.05$). Pri spremenljivkah nogometno specifičnih spretnosti, kot sta stopnja podaje in število kontrol žoge, so bile ugotovljene statistično pomembne razlike v korist skupine PTG ($p<0.05$). Med CG in PTG ni bilo statistično pomembnih razlik v vrednostih časa podaje in časa preigravanja ($p>0.05$). Posledično lahko trdimo, da proprioceptivni trening poleg nogometne vadbe pozitivno prispeva k razvoju spretnosti, kot sta podajanje in kontrola žoge, ki sta eni izmed osnov v nogometu.

Ključne besede: spretnost, nogometaši, proprioceptivni trening, visoko intenzivni napor

Corresponding author:* Umut Canli,
Tekirdag Namik Kemal University, Sports Science Faculty: Namik Kemal Kampus Street No:1, 59030 Suleymanpasa/Tekirdag
E-mail: ucanli@nku.edu.tr

INTRODUCTION

Football requires players to have good technical, tactical and cognitive performance (Praça, Morales & Greco, 2017) along with physical fitness elements such as speed, power and strength (Iaia, Ermanno & Bangsbo, 2009). Research on the improvement of football performance mainly focuses on high-intensity actions such as strength, speed and endurance along with technical characteristics (Helgerud, Engen, Wisloff & Hoff, 2001). A wide range of training methods have been developed in the development of performance and combined training models have been used (Turna & Kilinc, 2018). However, especially short training periods during the season restrict the effective implementation of training programs that develop the skills and physical performance elements necessary to ensure the development and continuity of performance (Akyuz et al., 2016). This situation leads to the need to develop training methods aimed at the joint development of the emerging technical capacity and physical activity.

There are various training methods for developing the elements of physical fitness associated with the performance of football players. In recent years, one of the training methods that be used to increase the performance elements of football players is proprioceptive training. This training method is usually applied to prevent injuries in football players, accelerate recovery if an injury has occurred, and bring football players to their pre-injury performance (Dilek, 2010). When examining the relationship between sportive performance and proprioceptive ability, it is determined that there are significant relationships between the achievement levels in elite athletes winning competitions in different specialties in their disciplines and their proprioception scores. Moreover, it has been determined that the athletes with the highest proprioception scores participated in the Olympics (Röijezon et al., 2015). It is reported that proprioceptive exercises, in which balance and coordinated movements are mainly used, and jumping and agility are also significantly included, contribute significantly to sports performance (Gunay, 2019). Some studies that examined the performance characteristics of footballers applied to examine the effects of proprioceptive training; it is reported that it is effective in agility and speed performance (Šalaj, Milanović & Jukić, 2007), agility, aerobic endurance, the development of static and dynamic balance performance (Beydagı, 2018). There are studies examining the effects of proprioceptive training on technical skills in different sports branches other than football. A study conducted by Ganesh (2012) investigated the effects of proprioceptive exercises on hockey players' technical skills which are hitting accuracy, dribbling speed, and ball control. In his research, Canli (2019) investigated the effect of

neuromuscular and proprioceptive exercises on the basketball-related skill of young basketball players. However, researches and pieces of evidence on the level to which proprioceptive training affects football-specific skills are quite insufficient.

During the intensive competition period, training methods are needed that can improve the technical and performance characteristics of the teams together and ensure their continuity. In this process, as a result of the data obtained from the research, the effectiveness of a training method that takes into account the time limit that football teams can use, especially during the season, will be questioned. According to the results of this research, it is planned to determine a method that football coaches or trainers can incorporate into their training systems. From this point of view, the research is especially important for young football players in terms of the fact that they will be able to identify a training method that allows them to effectively use a limited period during the season. Accordingly, the purpose of this research is to determine the level of influence of proprioceptive training on young football players' high-intensity actions and football-specific skills.

METHODS

Participants

The research group consists of 30 male football players (age = 15.86 ± 0.69) who play football in the young team of a sports club. For the approval of the ethics committee, an application was submitted to the Chairman of the Scientific Research and Publication Ethics Committee of Tekirdag Namik Kemal University, and the necessary approval of the ethics committee (Protocol No: 2021.109.04.04) was obtained for the research. A voluntary and parental consent form containing information about the purpose, aim, method, and permission of the study were sent to the families of athletes and athletes who received permission were included in the study. As a result of the evaluation of all parameters with the help of hypothesis tests, taking into account the values of the preliminary tests of the participants, groups with two different and homogeneous characteristics were formed. These groups were named as (PTG) and (CG). The tests, measurements and training protocol applied in the study were carried out during the pandemic. At the initial stage of the research, two groups of fifteen athletes were formed. However, during the research period, some of the PTG and CG athletes suffered some injuries and wounds during competitions or training. Two athletes from PTG were transferred to a different sports club during the research process. Three athletes from CG quit playing football

and left their clubs. On the day of the final tests, one athlete from PTG and two athletes from CG were unable to participate in the tests due to catching COVID 19 disease. As a result, eleven football players from PTG and ten football players from CG participated in the final tests, and all statistical analysis was performed according to this sample number.

Data Collection Methods

Anthropometric Tests

Football players' body height and body weight measurements were made while they were barefoot. A Mesilife 13539 brand portable height meter with accuracy of 0.1 cm was used for measurements. The body weight measurements of the football players were measured wearing only shorts and T-shirts. The obtained values are recorded in the data sheet in kg (Karakoc, 2009). An Omron weighing device with an accuracy of 0.01 kg was used for the measurements.

Tests for High-Intensity Actions

The countermovement jump test was measured with an accelerometer device (Myotest, Myotest S.A. Switzerland). The measurement was repeated twice, and the best measurement value was recorded as a result of the measurement. A 3-minute rest interval was given between measurements (Casartelli & Müller Maffiuletti, 2010). In 20-meter sprint test, the start point and endpoint at a distance of 20 meters were determined with lines, photocells were placed at the start and endpoint. Two measurements were taken and a rest period of 3 minutes was given between the measurements. The lowest value in seconds is recorded in the data sheet. Sinar brand telemetric stopwatch (photocell) was used in the measurements. In agility test (Pro-Agility Test), the course of the test is determined by placing markers 5 yards (4.57m) to the left and right of the start line. A photocell gate is placed at the start line. In this way, repeated transition times can be obtained. Before the start of the practice, the athlete took his place at the start line. When he is ready, he first touches the pointer on the right and then the pointer on the left and finally passes through the start line and ends the test (Bayraktar, 2013). Core stability plank test (Sport-Specific Core Muscle Strength and Stability Plank Test), which covers 180 seconds, was used to observe the development of core strength and core stability of athletes. (Reiman & Manske, 2009). Alternate wall toss test, the purpose of the test is to measure the level of hand and eye coordination. By pulling the tape 2 meters away from a flat wall, the area where the football player will perform the test has been determined. The number of repetitions performed at the end of 30 seconds is recorded in the measurement form. After a 3-minute rest interval, the test was performed again. Y Balance test was used to determine the dynamic

balance characteristics of football players. The Y balance test is a test that measures the longest distance that an athlete can lie while pushing the movable table of the device with the other foot in the anterior, posteromedial and posterolateral direction without loss of balance while the support leg is in the middle of a special device (Plisky et al., 2009).

Tests for Football Skills

In yeagley football test**,** the football player has started to bounce the ball without dropping it using the feet, head, knees, shoulders and chest with other parts of the body except for the hands and arms with the start command. The player has tried to bounce the ball as many times as possible within 30 seconds. (Strand & Wilson, 1993). In Mor-Christian General Soccer Ability Skill Test Battery, only the dribbling test was used. The station measured and marked 18 meters in diameter. 12 cones (45 cm. in height) are arranged in circles, 4.5 meters apart. The player dribbled the ball placed on the start line in the beginning as fast as possible between the cones and returned to the start line. Two attempts were performed clockwise and in the opposite direction. The best time out of two attempts was recorded as the final score of the test. The Loughborough test is a test that measures the ability to pass a short distance at a specified time (Cox, Oppici, Hopkins & Varley, 2017). The test was started when the athletes touched the ball within the center point of the specified pass area. After touching the ball, the participant who was driving the ball quickly in the direction of the color that the coach said, moved to the pass area outside the center and tried to make a pas that was accurate to the specified target color. With the return of the pass, he controlled the ball and returned to the center point of the area again, and continued to make the same applications towards another color specified by the coach. (Yilmaz & Hosgorler, 2020).

Procuders

The first day of the tests and measurements, the athletes were first asked to fill in the form containing their descriptive characteristics. Then anthropometric measurements, body height and weight measurements were performed, respectively. In the following, the sprint, agility and vertical jump performances defined in high-intensity actions were measured. On the second day of tests and measurements, tests for high-intensity actions were performed again. The balance test, hand-eye coordination test and plank test were applied to the football players, respectively. On the third day of the tests and measurements, the skill performances of the football players related to the football branch were determined. The tests were applied as ball control, dribbling and pass test, respectively. The tests and measurements were applied to the participants by the

same researchers in the same order. A standard warm-up consisting of 10 minutes of jogging followed by 5 minutes of dynamic stretching was performed before high-intensity actions and skill tests. All tests were carried out at the same time of the day (17:30-19:30) to avoid the influence of circadian rhythms on the results of the study. After the completion of the tests, the athletes were given the necessary time to perform cool-down exercises. All tests were applied to all football players as a preliminary test and as a final test in the process after the completion of the training program.

Training Protocol

The training program applied to the proprioceptive training group continued for 8 weeks. The movements and duration of the training were changed every 2 weeks. The second section of the proprioceptive training program is shown in detail in Table 1. A training program consisting of a total of 8 movements was implemented, which was continued for 3 days a week, continuing for two weeks. At the end of the second week of the study, a different proprioceptive training program was designed by rearranging the movements and work-rest intervals, taking into account the changes in the levels of the training group. The circuit training method was used in proprioceptive training applied to this group. The training time applied to the test group lasted about 25-30 minutes, and the group continued football training after completing proprioceptive training. The total duration of the training is 90 minutes. The training group did proprioceptive training and football training on Mondays, Wednesdays and Fridays. The control group, on the other hand, did only football training designed by their trainers, 3 days a week, on Mondays, Wednesdays and Fridays. The football training applied by both groups was conducted by their coaches using the same methodology. Drills containing tactical studies along with studies aimed at improving technical skills were used in the content of football training. The duration of a football training session applied to the control group was made as 90 minutes.

Table 1. Proprioceptive training program.

WEEK	THE SEQUENCE OF EXERCISES	DESCRIPTION OF THE EXERCISE	NUMBER OF REPETITIONS	NUMBER OF SETS
WEEK 1 WEEK 2	1	The participant touches the bowls arranged at intervals of 1 meter on 4 sides (front, back, and both sides) with the tip of their toes.	20 sec	2 sets
	2	He bounces on bosuball with two feet. The continuation of the movement continues using the 4 sides. For example, the participant standing in front of the bosuball bounces on the bosuball with double feet, then bounces on the right side of the bosuball on the floor and bounces back on the bosuball in the same position again. The movement continues in this way on 4 sides.	20 sec	2 sets
	3	The participant makes lateral jumps over a 30 cm obstacle. In the first set, a jump is made with the right foot. In the second set, a jump is made with the left foot.	20 sec	2 sets
	4	The participant performs the squat movement with his bodyweight on the bosuball.	20 sec	2 sets
	5	The participant puts 3 large bowls on the floor on one leg and then tries to collect the bowls by maintaining the position.	20 sec	2 sets
	6	The participant maintains his balance primarily on the wobble board. Then, an instructor runs the participant with the stick or any equipment he uses to make contact with the stick by directing him in different directions and at the same time keeping him balanced on the wobble board.	20 sec	2 sets
	7	The participant tries to stand on the balance disc with a double leg and maintain his position.	20 sec	2 sets
	8	Participants hold the stability ball steady on a helper such as a wall, and then try to stay balanced by using their knees on the stability ball.	20 sec	2 sets
WEEK	**THE SEQUENCE OF EXERCISES**	**DESCRIPTION OF THE EXERCISE**	**NUMBER OF REPETITIONS**	**NUMBER OF SETS**
WEEK 3 WEEK 4	1	The participant jumps on the trampoline and then stops by providing stabilization. The movement continues in this order.	25 sec	2 sets
	2	The participant takes his position in front of bosuball. Bounces on the bosuball with one foot and returns to the same position. The movement proceeds fluently with this sequence.	25 sec	2 sets
	3	The participant stands on one foot and turns or drives the ball around the stable foot with the other foot.	25 sec	2 sets
	4	The participant gets on the double disc with both feet and turns the medicine ball around the waist.	25 sec	2 sets
	5	The participant jumps onto the double bosuball with his hands on his waist and jumps back to the starting position. The movement continues like this.	25 sec	2 sets
	6	Mutually, two participants throw 2 kg medicine balls to each other from a distance of about 4 meters on one leg.	25 sec	2 sets
	7	The participant stands on one leg, arms crossed over the body, eyes closed.	25 sec	2 sets

	8	The participant performs lateral jumps on the bosuball with one foot.	25 sec	2 sets
WEEK	**THE SEQUENCE OF EXERCISES**	**DESCRIPTION OF THE EXERCISE**	**NUMBER OF REPETITIONS**	**NUMBER OF SETS**
WEEK 5 WEEK 6	1	The participant tries to stand on the trampoline on one leg while jumping on the trampoline and hitting the ball thrown from the opposite direction.	30 sec	2 sets
	2	While standing on the discs with one disc under each foot, he hits the ball thrown from the opposite side with his foot and tries to stay stable on the disc again.	30 sec	2 sets
	3	The participant tries to maintain his balance by hitting the ball thrown from the opposite side while the knees are fully extended with both feet on the wobble board.	30 sec	2 sets
	4	One foot (right/left) is on a disc. While the knee is stable in full extension, he tries to hit the ball thrown from the opposite side with his free foot.	30 sec	2 sets
	5	Each foot of the participants is on two bosuballs. By making coordinated jumps on bosuball, he tries to hit the ball thrown from the opposite side with his foot.	30 sec	2 sets
	6	The participant crouches on the upside-down bosuball and heads the ball thrown from the opposite direction while standing.	30 sec	2 sets
	7	Both feet of the participant are on the balance disc. When he crouches down on the puck, he strikes alternately with his right and left feet.	30 sec	2 sets
	8	The participant stands on one foot on the balance disc. Tries to move or drive the ball around the balance disc with the other foot.	30 sec	2 sets
WEEK	**THE SEQUENCE OF EXERCISES**	**DESCRIPTION OF THE EXERCISE**	**NUMBER OF REPETITIONS**	**NUMBER OF SETS**
WEEK 7 **WEEK 8**	1	The participant tries to stand on the trampoline on one leg while jumping on the trampoline and hitting the ball thrown from the opposite direction.	35 sec	2 sets
	2	While standing on the discs with one disc under each foot, he hits the ball thrown from the opposite side with his foot and tries to stay stable on the disc again.	35 sec	2 sets
	3	The participant tries to maintain his balance by hitting the ball thrown from the opposite side while the knees are fully extended with both feet on the wobble board.	35 sec	2 sets
	4	One foot (right/left) is on a disc. While the knee is stable in full extension, he tries to hit the ball thrown from the opposite side with his free foot.	35 sec	2 sets
	5	Each foot of the participants is on two bosuballs. By making coordinated jumps on bosuball, he tries to hit the ball thrown from the opposite side with his foot.	35 sec	2 sets
	6	The participant crouches on the upside-down bosuball and heads the ball thrown from the opposite direction while standing.	35 sec	2 sets
	7	Both feet of the participant are on the balance disc. When he crouches down on the puck, he strikes alternately with his right and left feet.	35 sec	2 sets
	8	The participant stands on one foot on the balance disc. Tries to move or drive the ball around the balance disc with the other foot.	35 sec	2 sets

Analysis of the Data

Statistical analysis of all parameters was performed using SPSS 18 package program. The descriptive statistics (minimum and maximum values, mean and standard deviation) of the participants about age, anthropometric structure and sports age were determined. The homogeneity of the data was checked with kurtosis and skewness values. In order to determine the interaction of the changes in the performance values of the participants (post-test & pre-test) at the group level (Group x Measurement effect), a two-factor ANOVA test was used in repeated measurements. All conditions were met in order to apply the two-factor ANOVA test in repeated measurements (Can, 2017). The significance value was accepted as 0.05.

RESULTS

The minimum and maximum values of the participants' age, sports age, football age, height, weight and BMI values as well as the average and standard deviation values are shown in detail in Table 2.

Table 2. Descriptive data of participants' age, sports age, football age and anthropometric characteristics.

Variables	Minimum	Maximum	Mean	Sd
Age (years)	14.60	17.50	15.86	0.69
Sports age (years)	5.00	10.00	7.63	1.44
Age of football (years)	4.00	10.00	7.10	1.70
Body height (cm)	158.70	196.00	173.06	8.10
Body weight (kg)	43.00	90.00	64.80	9.68
BMI (kg/m^2)	17.20	25.20	21.59	1.99

The mean and standard deviation values of CG and PTG football players regarding hand-eye coordination, vertical jump, core endurance, agility and sprint performances are shown in detail in Table 3.

Table 3. Descriptive data on high-intensity actions of football players.

Variables	Groups	n	Pre-test		Post-test	
			Mean	Sd	Mean	Sd
Hand-eye coordination (n)	CG	10	21.20	3.04	20.50	3.30
	PTG	11	21.63	2.73	21.72	2.61
Vertical jump (cm)	CG	10	38.41	5.06	40.81	3.33
	PTG	11	38.94	4.61	42.31	5.07
Core endurance (sec)	CG	10	98.30	39.04	107.58	53.44
	PTG	11	129.72	38.42	121.90	44.94
Agility (sec)	CG	10	5.11	0.14	5.41	0.12
	PTG	11	5.04	0.31	5.24	0.29
Sprint (sec)	CG	10	3.12	0.15	3.18	0.11
	PTG	11	3.04	0.08	3.10	0.13

Table 4. Results of two-way analysis of variance in repeated measurements of high-intensity actions of CG and PTG football players.

Variables	Group x Measurement					Partial Eta Squared
	Sum of Squares	Sd	The mean square	F	p	
Hand-eye coordination	1.638	1	1.638	0.76	0.39	0.03
Vertical jump	2.478	1	2.478	0.48	0.49	0.02
Core endurance	765.673	1	765.673	0.88	0.35	0.04
Agility	0.025	1	0.025	1.23	0.28	0.06
Sprint	8.866	1	8.866	0.02	0.87	0.00

As a result of the two-way analysis of variance in repeated measurements to determine whether being in the proprioceptive training group has a significant effect on the parameters representing high-intensity actions, the group-measurement effect showed that the proprioceptive training group score increase was not significantly higher than the control group ($p>0.05$).

Table 5. Descriptive data for dynamic balance parameters of football players.

Variables	Groups	n	Pre-test		Post-test	
			Mean	Sd	Mean	Sd
Balance (on dominant foot)	CG	10	76.62	10.49	82.04	5.63
	PTG	11	71.69	8.36	81.52	7.01
Balance (on non-dominant foot)	CG	10	75.37	10.46	80.53	5.53
	PTG	11	70.40	7.85	79.04	5.89

The mean and standard deviation values for the dynamic balance parameters of CG and PTG football players are shown in detail in Table 5.

Table 6. Results of two-way analysis of variance in repeated measurements of the dynamic balance parameters of CG and PTG football players.

Variables	Group x Measurement					Partial Eta Squared
	Sum of Squares	sd	The mean square	F	p	
Balance (dominant foot)	51.041	1	51.041	2.14	0.16	0.10
Balance (non-dominant foot)	31.615	1	31.615	0.96	0.33	0.04

As a result of the two-way analysis of variance in repeated measurements to determine whether being in the proprioceptive training group has a significant effect on the parameters representing dynamic balance parameters, the group-measurement effect showed that the proprioceptive training group score increase was not significantly higher than the control group ($p>0.05$).

Table 7. Descriptive data on football-related skills of football players.

Variables	Groups	n	Pre-test		Post-test	
			Mean	Sd	Mean	Sd
Pass (time) (sec)	CG	10	59.60	12.08	55.70	18.64
	PTG	11	57.03	15.43	48.00	16.28
Pass (shot) (n)	CG	10	11.00	2.26	9.00	2.53
	PTG	11	10.09	2.58	11.27	1.42
Ball control (n)	CG	10	69.30	14.53	66.90	15.53
	PTG	11	70.09	16.15	72.09	15.74
Dribbling (sec)	CG	10	15.98	1.11	15.99	1.10
	PTG	11	14.80	1.13	15.40	1.41

The mean and standard deviation values of CG and PTG related to football-specific skills of football players such as passing, ball control and dribbling are shown in detail in Table 7.

Table 8. Results of two-way analysis of variance in repeated measurements of football-related skill of CG and PTG football players.

Variables	Group x Measurement					Partial Eta Squared
	Sum of Squares	sd	The mean square	F	p	
Pass (time)	68.950	1	68.950	0.38	0.54	0.02
Pass (shot)	26.515	1	26.515	5.09	**0.03**	0.21
Ball control	50.705	1	50.705	3.67	**0.04**	0.16
Dribbling	0.007	1	0.007	0.02	0.88	0.00

As a result of the two-way analysis of variance in repeated measurements to determine whether being in the proprioceptive training group has a significant effect on the parameters representing football-specific skills, the group-measurement effect on passing (time) and dribbling skills showed that the proprioceptive training group score increase was not significantly higher than the control group ($p>0.05$). In this case, it can be concluded that taking part in PTG or CG does not have a significant effect on the development of passing (time) and dribbling skills. However, it was found that in the skills of passing (shot) and ball control, the group-measurement joint effect, the proprioceptive training group score increase was significantly higher than in the control group (respectively; $F_{(1-19)} = 5.09$, $p<0.05$; $F_{(1-19)} = 3.67$, $p<P\ 0,05$).

DISCUSSION

The study aimed to reveal the effect of proprioceptive training applied to young football players on high-intensity actions such as hand-eye coordination, vertical jump, core endurance, agility and speed, balance performance and football-related technical skills such as passing, ball control, and dribbling.

There was no significant difference in the values of hand-eye coordination of CG and PTG in the study. It has been determined that the research examining the effect of proprioceptive training on hand-eye coordination in the body of literature is quite limited. In the study conducted by Ceylan (2015), it is seen that two different hand-eye coordination tests were applied to both experimental and control groups. When we examined the in-group comparisons, a significant difference was found between the pre and post-tests of the rotation and placement

tests of the experimental and control groups. Another study concluded that proprioceptive training can contribute to the development of agility in young rhythmic gymnasts, while it has been stated that it cannot be definitively asserted that the improvement in coordination ability is a direct product of proprioceptive training (Dobrijević, Moskovljević, Marković & Dabović, 2018). In another study, researchers found improvement in some coordination tests under the influence of proprioceptive training (Lukić, 2010).

It was determined that there were improvements in the vertical jump values of CG and PTG in the study. It was found that the improvement in vertical jump values of the proprioceptive training group was higher than that of the control group. The results obtained from Göktepe's (2019) study on female football players are quite similar to the results obtained from our study. Šalaj et al. (2007) found that proprioceptive training improved jumping, which is an indicator of leg strength. Knobloch et al. (2005) found that proprioceptive training and coordination studies in women football players have significant improvements in bounce strength. Bruhn, Kullmann & Gollhofer (2004) after a four-week proprioceptive training program on unstable surfaces, there was no significant change in jump height, although a numerical difference was found. However, an idea has been expressed that a 10-week training program will produce more significant effects.

No statistically significant difference was determined in the core endurance performance values of CG and PTG in the study. Based on this, it was revealed that the exercise protocols applied to PTG did not have a positive effect on core endurance. It has been found that proprioceptive exercises applied to football players do not provide a significant improvement in muscular endurance performances such as 30-second sit-ups and modified push-ups (Beydagı, 2018). Similar results were found in another study that examined the effect of proprioceptive exercises on muscle strength and endurance of athletes (Šalaj et al., 2007). No other research related to core strength endurance has been found in the body of literature. It is reported that in the development of muscular endurance performance, special muscular endurance and muscle strength programs that will be integrated into the training program of athletes will be more effective in their performance of athletes (Beydagı, 2018).

It was found that there was no improvement in the agility values of CG and PTG in the study. There is no statistically significant difference between the two groups. According to the preliminary and final values of agility in elite and amateur football players of proprioceptive training, it was found that there were statistically significant improvements in favor of elite

football players. In the control group, no significant changes were observed. In addition, no statistically significant difference was determined between the two groups (Beydagı, 2018). In our study, no improvement was determined in terms of agility level in both groups. Among the reasons for this, differences in sports branches, age levels and test protocols used in evaluation can be cited. When the studies examining the effects of proprioceptive exercises on athletes in different sports branches are analyzed, it was determined that there were improvements in the agility values of the groups that were given proprioceptive training, which is usually called the experimental group (Ganesh, 2012; Goktepe, 2019; Moreira et al., 2017; Riva et al., 2016; Šalaj et al. 2007; Taskin & Bicer, 2015).

It was found that there was no improvement in the sprint values of CG and PTG in the study. In addition, no statistical difference was determined between the two groups at the end of the program. In Beydağı's (2018) research it is determined that proprioceptive exercises applied to amateur football players provide positive improvements in their sprint development, while they found that they do not contribute to an improvement in sprint performance of elite football players. It has been reported that proprioceptive training to be applied to amateur football players is thought to be more effective in improving sprint performance. In the body of literature, it was determined that different proprioceptive training protocols applied to athletes in different sports branches made positive contributions to the sprint performance of athletes (Ganesh, 2012; Kirici, 2014; Moreira et al., 2017; Tanyeri, 2017). As a result of proprioceptive training applied to female football players, it was determined that there was no change in the sprint performance of both the training group and the control group (Goktepe, 2019). When analyzing the studies, it is thought that differences in the point of protocols of proprioceptive training and the experiences of athletes may also be effective in changing parameters such as sprint performance.

Positive improvements were found in the dynamic balance values of the dominant and non-dominant legs of CG and PTG in the study. However, no statistically significant difference was found in the comparison of the dynamic balance values of the two groups. It has been stated that proprioceptive training has significantly improved the static and dynamic balance values of elite and amateur football players, and it has been commented that improvements can be made in other performance elements of football players by improving the balance ability of football players (Beydagı, 2018). Results have been obtained that proprioceptive training programs improve the balance performance of athletes in team and individual sports other than football (Akbas, 2018; Dobrijević, Moskovljević & Daboviċ, 2016; Holm et al., 2004; McLeod

et al., 2009; Romero-Franco et al., 2012). Gioftsidou et al. (2006) determined that the balance program, which includes proprioceptive training applied to football players, has a positive effect on balance performance. It has also been determined that there are positive developments in the studies examined above. The results of all these studies do not show any similarity with the results of our study. There can be many reasons for this condition. Some of these reasons can be considered as the number of movements, content and duration of the training, limited period of training and its content in the proprioceptive training.

In the comparison of football-related skills in terms of CG and PTG; It was determined that the shot rate of the pass test used in the research and the number of ball control made a difference between the groups, and this difference was in favor of the PTG group. There was no statistically significant difference between the groups in terms of pass test time and dribbling time. In a study examining the effects of ankle inversion eversion proprioceptive training on the ball shot speed, hitting and body balance in football players, in the study group training for proprioceptive perception, the shot hit rate showed positive improvements in the dominant and non-dominant feet compared to the baseline level. It has been determined that perception-oriented training increases the upper stroke hit rates in football players and it has been reported that this situation is important for the technical capacity of the football player (Canuzmez, 2010). It is aimed to determine the effect of coordination practices and different learning methods on balance, flexibility, agility and skill on stable and unstable floors in young male snowboarders. In the study, it was found that all training affected snowboarding skills, but the level of the effect differed. While different learning methods had the most effect on snowboarding skills, the effect of proprioceptive and coordinating strength training was in second place and the effect of classical training was in third place (Tanyeri, 2017). It is observed that researches examining the effect of proprioceptive exercise or training programs on skill performances related to sports branches are quite limited in the body of literature.

CONCLUSION

As a result of the research findings, it has been determined that PTG provides improvements in all football skill elements. However, among the reasons for this situation, it is necessary to determine at what level the elements of football players such as coordination, leg strength, or balance contribute to this process. Therefore, it seems possible to get answers to these questions together with the design of similar studies, as well as more participating groups and more detailed measurement protocols and statistical analysis. However, it is believed that

proprioceptive training can be used during warm-up periods, especially in terms of diversifying training in young team football training.

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The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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