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The Investigation Of The Effect Of Static And Dynamic Core Training On Performance On Football Players

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Abstract

This study was carried out to investigate the effect of static and dynamic core training on the performance of football players. In this study, static and dynamically applied core exercises were evaluated in terms of speed and agility in football players, and then their effects on anaerobic power tests, core stabilization tests and body composition were compared. While 10 of the 30 football players participating in the study were practicing dynamic core exercises and 10 of them were practicing static core exercises 2 days a week for about 9 weeks and 30 minutes a day, 10 athletes continued their football training with the other group athletes as control groups. The effects of the exercises, performed at the end of 9 weeks on performance, body composition, and core stabilization tests were compared in the pre and post-test in order ($p<0.05$). There is no significant difference in the height, body weight, body mass index parameters of 30 subjects (10 control, 10 static core, 10 dynamic core) belonging to the 3 groups participating in the study. Significant differences were found at waist level and hip circumference at the level of $p<0.05$ in comparisons between the first and last measurements of all anthropometric measurements. While there was a significant increase in the duration of leg lift, push-up, plank, shuttle, and isometric tests, a decrease was observed in the plank, shuttle and isometric test times in the control group. In the pre and post-test comparisons, 30 m speed, long jump, vertical jump, agility 550 and arrowhead agility tests showed a significant difference at $p<0.05$ level. It can be said that core studies should be included in training aimed at increasing performance in the football branch.

Keywords: Football, Core, Performance, Static Training, Dynamic Training.

INTRODUCTION

In recent studies, it has been observed that the interest in core exercises has increased considerably and the relationship between core training-body composition, trunk stabilization, athletic performance and disability has begun to be studied (23). In recent studies, it has been observed that the interest in core exercises has increased considerably and the relationship between core training-body composition, trunk stabilization, athletic performance, and disability has begun to be studied (23). However, the relationship between core stabilization and performance is a highly controversial issue (34). While many studies reveal that the relationship between core training and athletic performance is low (34), it can be said that the core training has many limiting factors affecting the results of many studies due to its structure (not working isolated, activating in many basic training structures and adapting). (26). Core exercises consist of movements that increase the flexibility and strength of the body. It also increases muscle endurance and cardiovascular fitness levels. They develop psychomotor skills and coordination, such as balance (3).

The word Core is a word derived from English, which is used to mean seed. It is the midpoint of the body, where the center of gravity of the human body, which is meant to be expressed in the core, in sports sciences (16). According to Behm et al. (4), when defined anatomically, the core is the muscle that provides the body's stability in connection with the skeletal system of the trunk area (rib cage, spine, pelvis, shoulder belt), soft tissues (cartilage and connective tissues). Core stability is a feature that positively affects sports performance. Tong et al. (30) examined the relationship between respiratory muscles and core muscles in high-intensity runs and stated that fatigue in core muscles as a result of insufficient respiratory muscles negatively affects the running performance. Core stability helps the person to stay in balance and maintain this condition.

A correct posture and a strong core structure are very important for balance ability (25). Majewski-Schrage et al. (15) state that core stability has overcome the physical health approach over time, becoming a part of health and physical performance issues with different approaches, and according to them, this situation is now related to physical fitness, rehabilitation programs, back-spine problems, and performance. In weight lifting training, the athlete changes his stability status, that is, if he intends to create a more unstable situation, the core muscles will perform more actively to maintain the technique of the movement (12). In many sports, force components that will disturb the balance of the body appear during a movement with arms and legs. Torque and momentum resulting from the movement of arms and legs when a tennis ball or a soccer ball is hit will force the body to move in the opposite direction with the arms and legs. In order to produce the desired level of force from the arms and legs and to continue the movement in the same direction, the core muscles must balance the spine (33).

This study is about which types of movement structure (static-dynamic) that increased trunk stabilization with core training will be more beneficial and how this effect will reflect on performance. Within the core training plan to be applied by coaches, the study is important in terms of which types of contractions should be used and reveal the effect of core exercises.

MATERIAL AND METHOD

Participants

The aim of the study is to investigate the effect of 9-week static and dynamic core training of football on some performance parameters. 30 students between the ages of 12 and 14 at the Yunus Emre Secondary School within the borders of İpekyolu district of Van province participated in the study on a voluntary basis. The dynamic (n: 10) and static (n: 10) groups were selected from the students who played in the school team in the previous year. The control group consists of only 10 students playing football. In addition to football training 2 days a week, only a dynamic core training program was applied to a group of 10 people for 2 days, and a static core training program was applied to another group of 10 people, and the dynamic and static core training program was applied to two different groups within the same days. The ethical committee report of our study was taken with the decision of the ethical committee number 27 Selçuk University, Faculty of Sport Sciences, non-interventional clinical research.

Working Groups and Training Program

Dynamic study group: The dynamic exercise group consisting of 10 subjects repeated 6 exercises (Balance Ball with Pocket Knife, Reverse Crunch, Russian Return, Shuttle, Leg Lift, and Back extension) for 9 weeks, and the level of difficulty increased gradually. The scope of exercise was determined by the number of repetitions and sets. The increase in the number of repetitions was provided to differentiate the muscle groups involved in the movement and to include the auxiliary weights in the movement. The number of sets is determined as 2 in all movements. The rest time between sets was determined as 1 minute. The number of repetitions of the exercises started between 10-15 repetitions and advanced to the level of 20-25 repetitions at the end of the 9th week.

Static study group: The static study group consisting of 10 subjects repeated 6 exercises (Side Plank, Shoulder Bridge, Plank, Static Crunch, Leg Lift, Back extension) 2 times a week, whose difficulty level gradually increased for 9 weeks. The scope of exercise was determined as the duration of the movement. The increase in loading was achieved by increasing the duration of the movement and differentiating the muscle groups included in the movement. The set numbers of all movements are determined as 2. The rest time between sets is 1 minute. In the first week, depending on the exercises, the movement time started from 20-35 seconds and was advanced to 30-60 seconds at the end of the 9th week

Control group: The control group which consists of 10 subjects, continued football training in which other group athletes also participated. They did not participate in any other training.

Measurements and Tests Applied in the Study

Height, weight, body mass index measurements: The lengths of the subjects were measured using a Holtain brand stadiometer with an accuracy of ± 1mm. This measurement was measured when the person was in an anatomical posture, his heels were combined, his head was in the frontal plane, and the overhead table was positioned at the vertex point, and then the values were recorded as cm '(26). Weight measurements of the subjects were made with a weighing scale of ± 100 g. Body mass indexes (BMIs) were obtained by dividing the weight in kilograms by the square of the neck in meters.

Waist-hip circumference and waist/hip ratio measurements: Waist Circumference: After the normal expiration of the subject between 2 - 2.5 cm above the navel hole and the thinnest point around the waist, it was measured with an anthropometric tape and recorded in centimeters (11). Hip Circumference: It was measured from the maximum posterior hip-width point with an anthropometric tape over the gluteal fold and it was recorded in centimeters (11). Waist-Hip Ratio: It is the figure obtained by dividing the waist circumference to the hip circumference (all measurements are in centimeters), which gives information about the distribution of body weight (visceral fat). It plays an important role in the determination of obesity and health risk factors. (35).

Leg lift test: Subjects were asked to raise their legs 5-10 cm up and keep them straight, with their back areas lying in contact with the mat. Hands were kept under the body between the back and hip during movement, and the load on the muscles of the abdominal region was increased. The test was terminated if the subjects touched their legs on the ground. The measurement was applied by means of a stopwatch and the scores obtained were recorded in seconds (22).

Push-up test: In a push-up position, a push-up is completed with the hands at shoulder level, the chest touching the mat and the elbows returning to the flat position (10). The number of repetitions achieved by the subjects by providing the correct posture without resting was recorded as the maximum push-up score.

Plank test: Plank test protocol consists of 8 steps and is applied against time. The total duration of the protocol is 3 minutes. After the first step is started, if the athlete fails to stay in the appropriate plank position (touching of the hand or foot on the ground, etc.) then the test score is recorded as the test score of the subject. If the subject successfully completes all 8 steps, the exact duration of the test is recorded as an athlete score (31).

Sit-up test: The abdominal resistance of the subjects was evaluated by performing a 1-minute sit-up test. Subjects were placed on the mat with their knees bent at about 90 degrees, with their hands tied to the back of the head, and each contact was counted as one point, and the correctly applied repetitions within 1 minute were recorded as the maximum number of sit-up (10).

Back isometric endurance test: For this test, the athlete was laid in a prone position, hanging from the bed. The athlete was fixed from the legs at the level of the gastrocnemius muscle and was asked to hold the body part parallel to the ground against the gravity with the hands clenched in the chest. When the posture is impaired or when the athlete cannot complete the experiment due to pain, the duration of the test is stopped and the score is recorded in seconds (18).

30m speed: The speed capabilities of the subjects were evaluated with 30 meters short running tests. Athletes repeated the test twice and their best grades were included in the evaluation. The 30-meter sprint test was determined in seconds when the athletes were standing at a distance of 1 meter from the photocell and completed the distance at a maximum speed, at a distance of 30m. Measurements were made on grass ground with soccer shoes (27).

Long jump by standing: When his feet are bilaterally behind the starting line, his hands are moved as desired, the athlete is asked to jump horizontally and fix it at the point where it falls, without losing its balance and falling. The athlete has been given three attempts. The best jump distance was accepted as the test score in centimeters (24).

Vertical jump: It was applied to determine the explosive forces of athletes. The highest distance from which the subject can reach upwards at the shoulder width is determined as the starting 0 point. The difference between the longest distance extends at the point where it is located without taking a step and the 0 point is recorded in cm as the jump distance value. (24).

Arrowhead agility: The Arrowhead test starts one meter behind the starting point and continues with a return to point D or C, located 5 meters to the right and left after passing 10 m from the photocell. This process involves returning from point B, which is 5 meters further from the starting point of point A, and stopping the photocell by crossing the starting point for the second time. Each athlete repeated the test three times, and the measurements were planned on the grass ground, allowing the athletes to recover (9).

505 agility test: As soon as the athlete exits one meter behind the starting point and passes through the starting point, the photocell time begins, after returning the distance of 10 meters from the direction he desires (on the right foot or on the left foot), he passes the second photocell at a distance of 5 meters and stops the time. The subject was given three attempts and the lowest time was recorded as the most successful score. The experiment was carried out on the grass ground with soccer shoes (24).

Data Analysis

Statistical analysis of the footballers' findings was made in the IBM SPSS 25 package program. Descriptive information for all footballers and groups is tabulated. The first and posttest distributions of the groups were examined, and normality of distributions and homogeneity of variances were determined by Mauchly ‘Sphericity Test and Levene test. Analyzes between the groups, within the group and the effect of training, were made with multiple measures analysis of variance (MANOVA) in repeated measurements. Bonferroni Test was continued in Post Hoc comparisons in meaningful relationships, and the degree of significance was accepted as 0.05.

FINDINGS

Table 1. Descriptive information about groups and comparison of height, weight, and body mass index between groups

Group		Mean ± SD	Maximum	Minimum	Comparison between groups	
Control n=10	Height (m)	1.57±0.98	1.74	1.38		
	Weight (kg)	47.20±11.13	69.00	33.00		
	BMI (kg/m2)	18.79±3.55	27.38	15.26		
Static core n=10	Height (m)	1.58±0.04	1.68	1.51		
	Weight (kg)	47.60±10.30	68.00	35.00		
	BMI (kg/m2)	19.02±3.76	26.25	14.40		
Dynamic core n=10	Height (m)	1.59±0.09	1.71	1.45		
	Weight (kg)	42.70±7.77	52.00	33.00		
	BMI (kg/m2)	16.75±1.23	18.18	14.76	x-square	P
Total n=30	Height (m)	1.58±0.08	1.74	1.38	0.109	0.389
	Weight (kg)	45.83±9.76	69.00	33.00	1.062	0.561
	BMI (kg/m2)	18.19±3.14	27.38	14.40	2.110	0.438

BMI: Body Mass Index. SD: Standart Devition

Descriptive values of the subjects are indicated in the table. The average height, body weight and body mass index of 30 subjects (10 control, 10 static core, 10 dynamic core) belonging to 3 groups participating in the study were respectively1.58 ± 0.08; 45.85 ± 9.76; 18.19 ± is 3,14't. For all descriptive variables, there is no significant difference between the groups before the training period.

Table 2. Comparison of the first and last anthropometric test changes of the groups

	Group	N	Pre-test	Post-test	In-Group Change (%)	Test* Group F	P
			Antropometric Measurements				
Weight (kg)	Control	10	47.20±11.13	49.80±9.3	-2.6 (-5.50)*	0.754	0.480
	Static Core	10	47.60±10.30	50.30±10.57	-2.7 (-5.67)*		
	Dynamic Core	10	42.70±7.77	44.40±7.51	-1.7 (-3.98)*		
BMI (kg/m2)	Control	10	18.79±3.55	19.53±2.47	-0.74 (-3.93)*	0.686	0.512
	Static Core	10	19.02±3.76	19.47±3.79	-0.45 (-2.36)*		
	Dynamic Core	10	16.75±1.23	16.94±1.08	-0.19 (-1.13)*		
Waist (cm)	Control	10	72.40±8.8	74.50±7.15	-2.1 (-2.90)*	12.440*	0.000
	Static Core	10	70.90±10.92	70.40±12.48	0.50 (0.70)*		
	Dynamic Core	10	66.60±4.27	64.60±3.74	2.00 (3.00)*		
Hip (cm)	Control	10	83.70±7.86	85.40±6.53	-1.70 (-2.03)*	3.677*	0.039
	Static Core	10	83.20±7.75	83.00±8.96	0.20 (0.24)*		
	Dynamic Core	10	79.60±6.02	78.10±4.55	1.50 (1.88)*		
Waist/Hip Ratio	Control	10	0.863±0.03	0.872±0.03	-0.009 (-1.04)*	1.272	0.297
	Static Core	10	0.849±0.06	0.844±0.06	0.005 (0.58)*		
	Dynamic Core	10	0.839±0.05	0.827±0.02	0.012 (1.43)*		

BMI: Body Mass Index

In the table, first and last test measurements of anthropometric measurements such as body weight, body mass index, waist circumference, hip circumference, and waist-hip ratio are compared in terms of inter-group, intra-group, and group * test interaction. Significant differences were found at waist level and hip circumference at the level of $p < 0.05$ in comparisons between the first and last measurements of all anthropometric measurements. In intra group comparisons, a significant difference was found at $p < 0.05$ level in all measurements. While test * group interaction is observed in waist and hip circumference tests, this interaction results from the intra-group development of static core and dynamic core groups. In other anthropometric variables, test * group interaction is not observed.

Table 3. Comparison of the first and last core test changes of the groups

	Group	N	Pre-test	Post-test	In-Group Change (%)	Test* Group F	P
			Core Measurements				
Leg lifting (sec)	Control	10	67.60±32.85	67.40b±30.54	0.20 (0.29)*	10.797*	0.000
	Static Core	10	72.40±16.26	74.00b±18.44	-1.60 (-2.20)*		
	Dynamic Core	10	91.10±28.12	96.70a±27.68	-5.60 (-6.14)*		
Push-up	Control	10	6.20±3.32	6.40b±2.71	-.020 (-3.22)*	11.304*	0.000
	Static Core	10	13.50±4.27	15.20b±5.09	-1.70 (-12.59)*		
	Dynamic Core	10	16.90±5.50	23.00a±4.66	-6.10 (-36.09)*		
Plank (sec)	Control	10	58.00±19.48	57.90b±19.89	0.10 (0.17)*	6.937*	0.004
	Static Core	10	59.50±16.91	63.30b±19.32	-3.80 (-6.38)*		
	Dynamic Core	10	65.50±22.05	71.90a±21.32	-6.40 (-9.77)*		
Shuttle	Control	10	26.40±4.32	25.50b±5.81	0.90 (3.40)*	27.000*	0.000
	Static Core	10	17.50±2.54	20.00b±4.96	-2.50 (-14.28)*		
	Dynamic Core	10	31.00±4.18	36.70a±4.27	-5.70 (-18.38)*		
Back isometric (sec)	Control	10	91.00±16.11	89.60b±16.58	1.40 (1.53)*	10.178*	0.001
	Static Core	10	118.80±38.40	121.40b±39.32	-2.60 (-2.18)*		
	Dynamic Core	10	113.20±36.21	129.30a±37.59	-16.10 (-14.22)*		

Intergroup comparisons: a>b *p<0.05

In the table, the measurement results showing the core performances of the groups are compared in terms of intergroup, intragroup and group * test relationships. Leg lift time shows a significant increase in dynamic and static groups, while a decrease is observed in the control group. While dynamic and static test groups significantly extended test times in push-ups, plank, sit-up, and isometric tests, a decrease in plank, shuttle and isometric test times were observed in the control group. Improvement was observed in the push-up test period of the control group. A significant difference was found at the p <0.05 level in all in-group comparisons. In all core tests, the dynamic group is statistically higher than the static and control groups. While test * group interaction is observed in all core tests, this interaction results from the intra-group development of dynamic and static test groups.

Table 4. Comparison of the changes in the first and last performance measurements of the groups

	Group	N	Pre-test	Post-test	In-Group Change (%)	Test* Group F	P
Dynamic Field Measurements							
30 m. (sec)	Control	10	5.86±0.49	5.93c±0.47	-0.07 (-1.19)*	10.397*	0.000
	Static Core	10	5.75±0.47	5.72b±0.52	0.03 (0.52)*		
	Dynamic Core	10	5.96±0.49	5.84a±0.48	0.12 (2.01)*		
Long Jump (cm)	Control	10	167.30±18.36	168.00c±16.22	0.70 (0.41)*	6.099*	0.007
	Static Core	10	169.40±20.16	173.00b±21.05	3.60 (2.12)*		
	Dynamic Core	10	177.40±16.43	184.10a±17.68	6.70 (3.77)*		
Vertical Jump Height (cm)	Control	10	32.10±5.25	33.30b±4.87	1.20 (3.73)*	0.089	0.915
	Static Core	10	26.90±3.57	27.80b±3.76	0.90 (3.34)*		
	Dynamic Core	10	34.30±7.13	35.70a±5.75	1.40 (4.08)*		
550 Agility (sec)	Control	10	4.91±0.17	4.99c±0.17	-0.08 (-1.62)*	9.029*	0.001
	Static Core	10	4.72±0.23	4.67b±0.34	0.05 (1.05)*		
	Dynamic Core	10	4.57±0.12	4.44a±0.12	0.13 (2.84)*		
Arrowhead Agility (sec)	Control	10	11.01±0.17	11.12c±0.11	-0.11 (-0.99)*	16.980*	0.000
	Static Core	10	10.74±0.50	10.69b±0.56	0.05 (0.46)*		
	Dynamic Core	10	10.46±0.37	10.29a±0.37	0.17 (1.62)*		

Intergroup comparisons: a>b *p<0.05

In the table, the measurement results showing the dynamic area measurements of the groups are compared in terms of inter-group, intra-group, and group * test relationships. In the in-group first and last test comparisons, 30 m speed, long jump, vertical jump, agility 550, and arrowhead agility tests showed a significant difference at p <0.05 level. In all 30 m speed, long jump, vertical jump, and agility tests, while dynamic and static test groups significantly extended the test times, a significant decrease was observed in the 30 m speed and agility test times in the control group. However, in all dynamic field tests, the dynamic group increased the test time more than the static and control group. An increase is observed in the long jump and vertical jump test times of the control group. While test * group interaction is observed in all dynamic field tests, this interaction results from the intra-group development of dynamic and static test groups.

DISCUSSION AND CONCLUSION

Today, the application areas of core exercise have increased. Fitness exercises such as pilates, yoga, tai-chi mostly work based on core force principles. The examinations conducted examine the effect of core force on different purposes for increasing performance, preventing disability and treatment (1).

The average height, body weight and body mass index of 30 subjects (10 control, 10 static core, 10 dynamic core) belonging to 3 groups participating in the study were respectively; 1.58 ± 0.08, 45.85 ± 9.76; 18.19 ± is 3,14't. For all descriptive variables, there is no significant difference between the groups before the training period.

Significant differences were found at waist level and hip circumference at the level of p <0.05 in comparisons between the first and last measurements of all anthropometric measurements. In intragroup comparisons, a significant difference was found at the p <0.05 level in all measurements. While test * group interaction is observed in waist and hip circumference tests, this interaction results from the intra-group development of static core and dynamic core groups.

Leg lift time shows a significant increase in dynamic and static groups, while a decrease is observed in the control group. While dynamic and static test groups significantly extended test times in push-ups, plank, sit-up, and isometric tests, a decrease in plank, sit-up and isometric test times were observed in the control group. Improvement was observed in the push-up test period of the control group. A significant difference was found at p <0.05 level in all in-group comparisons. In all core tests, the dynamic group is statistically higher than the static and control groups. While test * group interaction is observed in all core tests, this interaction is due to the intra-group development of dynamic and static test groups.

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10 different moderate-intensity dynamic core stabilization exercises applied before physical education lessons provided significant improvement in all of the back extension, plank, right-left plank, dynamic sit-up, static it-up test scores (2). In the study consisting of 10 experimental and 10 control groups, 50 m swimming time showed 2% improvement in elite swimmers with 12-week core training. In addition, in the prone bridge and asymmetric arm pull-down tests, moderate and high level improvement was demonstrated compared to the control group. At the same time, peak EMG activity increased with maximal voluntary contractions (32). In another study similar to this study, both dynamic and static study groups who were training on unstable surface increased their scores in core tests (plank, double foot lift, back extension) (22). Oliver and Di Brezzo (21) expressed the development of the 1-minute sit-up test as a result of balance exercises with and without the stepper board.

The effects of two different types of 8-week core training method (static-dynamic) on core stabilization and Stork balance test were examined. In all core stabilization tests performed before and after the exercise (except the Static group in the plank test), the exercise groups increased the test times statistically, while the control group did not change (28). For example, according to Noyes et al. (20) after 6 weeks / 3 days of 90-120 minutes of flexibility, quickness, speed, strength, and endurance exercises applied to 34 adolescent female volleyball players, it was seen that there was a significant increase in the lower extremity ranking, abdominal strength, maximal aerobic power and vertical jumps of the athletes (20). Mills et al. (17) investigated the effect of progressive trunk stabilization on performance in a 10-week lumbopelvic stabilization training involving 30 female basketball and volleyball athletes aged 18-23. Although the agility, vertical jump, and balance test scores of the experimental group developed, there was no relationship between the improvement in lumbopelvic stabilization and performance improvement (17).

In Lephart et al. (14) study, golfers who have received eight weeks of golf training have seen that they increase the abdominal-hip strength, trunk rotational strength and hip abduction strength with balance training, and this is in line with the literature. A positive improvement was observed in parameters such as sport-specific shooting distance, stroke rate, and ball speed. In the study of Myer et al. (19) in young volleyball players, 10-week neuromuscular trunk and hip exercise increased with standing hip abduction force (19). Cressey et al. (7) determined improvements in both groups in the repeated jump, deep jump, 40-10 yard sprint and t-agility tests in their studies where they mixed the performance effect of the weight study performed on a stable and unstable surface. In sprint tests, they concluded that the exercises performed in an unstable environment cause higher development (7).

As a result of the body stabilization program applied to ballet and modern dance students, statistically significant differences were found in vertical jump performance, dynamic balance and proprioception values for the dominant and non-dominant sides (13). In the study, in the vertical jump test applied for the dominant and non-dominant side lower extremities, a significant increase was observed in the dancers after the training. It has been explained by the fact that the increase in the performance of the leap is strengthening the trunk muscles in the trunk stabilization training, as well as the proximal stabilization and the better the explosive force in the distal (13). In the study of 12 football players playing in the Norwegian 1st League, the 8-week core stabilization exercises (sling exercises) applied twice a week improved the athlete's stroke rate (3,5%) and static balance scores more than the control group (29). In a study conducted with an experimental group of 43 people, 10 * 3 weeks old swissball core exercises increased isokinetic trunk extension and flexion strength (2). In a study in which 20 female athletes aged between 18-23 participated, it was found that after 10 weeks of lumbopelvic stabilization training, the lower extremity muscle strength of the training group was higher than the control group and group undergoing general muscle strength training (17). As a result of pilates exercises performed by young women without training, Cowley et al (6) did not see a difference of 1 RM increase between the group practicing resistance using the pilates ball and the group working on a stable flat bench. There was a significant improvement in the abdominal strength test in both groups (6). As a result of the 8-week core training in handball player, no change was observed in body compositions, while statistically positive results were found in vertical jump, flexibility, right and left paw strength and balance parameters (8).

As a result; Static and dynamic core training applied to football players is thought to contribute to the improvement of performance. In terms of performance, it is observed that in many sports branches, coaches include core exercises in their training programs. In this regard, it may be beneficial for core exercises to be included in football training due to the positive effects on protective and functional capacity, or for strength training to increase the stimulation and use of core muscle.

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