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Effect Of The Calisthenics Exercises on Static and Dynamic Balance in Tennis Players

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ABSTRACT

The purpose of the study is to examine the effects of calisthenics exercises performed with tennis trainings on static and dynamic balance performances. 17 male tennis players with ages of 20.82 + 4.42 years, height 1.80 + 0.03 m, body weight 58.75 kg participated in the study voluntarily. The tennis players participating in the study were randomly divided into 2 groups. 9 tennis players in the experimental group (EG) performed calisthenics exercise and tennis training, and 8 tennis players in the control group (CG) performed only tennis training. The study lasted a total of 8 weeks, with 3 workouts per week. Study; height length, body weight, BMI, static balance and dynamic balance measurements were taken. Static balance measurements were measured with ALFA Stabilometric Platform device and dynamic balance Y test. Statistical analysis findings of the subjects were evaluated in the SPSS 22 program. As a result of the study, statistically improvement was observed in eyes with open-to-back standard deviation (34.47%), right-left standard deviation (20.82%) and static balance (28.29%) in calisthenics exercise. In DG, positive developments were observed in eyes with open-to-back swing speed (23.23%), left-to-left swing speed (31.68%) and total swing speed (27.16%), ($p < 0.05$), There was no significant difference in CG ($p > 0.05$). It has been determined that EG, which performs calisthenics exercise in the eyes closed static balance score, has a 25.17% improvement. Significant improvements were observed in EG with eyes closed forward-to-back oscillation speed by 20.40%, right-to-left oscillation rate by 26.23%, and total oscillation speed by 22.98% ($p < 0.05$). According to the results of Y balance test, it was determined that EG performing calisthenics exercise showed significant improvement in Anterior value of 3.47%, Posteromedial value of 3.31% and Posterolateral value of 3.65% ($p < 0.05$). It was determined that EG showed an improvement of 4.27% in Anterior value for nondominant foot, 3.24% for Posteromedial value and 3.41% for Posterolateral value ($p < 0.05$). When the results are analyzed, both static balance scores and oscillation speeds and dynamic balance results are seen in the findings of the study, where more improvement was detected in EG, which performs calisthenics exercise, compared to CG.

As a result; it can be said that the applied calisthenics exercise has positive contributions on the static and dynamic balance feature of tennis players.

1. Introduction

The notion of balance, which does not come to mind as the first connotation when one speaks of sports, takes its place among the most basic features of sports (Kejonen & Kauranen, 2002). Good balance performance in many sports branches is crucial to prevent success and injuries (Noe´ et al., 2009). Balance can be defined as the ability of the body to maintain its posture over the support area (Leavey, 2006). Control of balance is a complex motor capability that includes the integration and planning of flexible movement patterns as well as the integration of sensory inputs (Ferdjallah et al., 2002).

Balance is divided into two as static and dynamic balance. Static balance is one of the important factors for athletes to make progress in terms of performance. In the coordination of muscles, tendons and ligaments in coordination, the ability of the movement to perceive the environment at the time of formation and an improved static dynamic balance harmony for a high coordination is one of the prerequisites (Kriese, 1997). Dynamic balance is important in cases where motor control ability such as sudden acceleration or deceleration frequently coincided by athletes in many sports branches, moving by changing the direction of the body in different situations and conditions (Haynes, 2004).

In all sports branches, certain motoric features need to be developed in order for athletes to perform at a high level (Ölçücü, 2011). Considering the playing time and intensity of the tennis match, which is one of the most popular sports of recent times; strength, speed, agility, balance, endurance, skill and coordination are all needed (Söyleyici, 2011). Physiological demands should be known when training and research are organized for optimal performance in tennis, as in every sport branch.

Successful display of sportive activities depends on ensuring the appropriate posture and establishing the balance in the correct position. All sports contain a certain level of balance (Kriese, 1997). The gymnast must finish the movement by restoring the balance lost during the movement, after the basketball player struggling to grab the ball in the air despite the opposing opponent; the volleyball player must have a balanced landing on the ground by maintaining his body composition after the shot of a handball player. Otherwise, the athlete will not be able to perform the motor performance at the desired level and will face the risk of injury. It has an important place in all strokes in the game such as forehand, backhand, volley and spike, starting with the service shot that initiates the balance game in the tennis and return the ball. For example, the body should be balanced in the starting position during the shooting so as not to interfere with energy production. If this balance is achieved, the energy stored in the muscles can be released in accordance with the kinetic chain. As the energy starts from the central body, the shoulder axis rotates back and the shoulder and arm move to the maximum force and balance position. The movement is then terminated with maximum acceleration. Otherwise, an effective service hit cannot be achieved. In the finishing stage, following the ball to be performed by the racket, the acceleration is reduced and the balance has a key role in the proper completion of the movement, recovery and preparation for the next stroke (Segal, 2005).

Although balance is generally thought of as a static process, it is defined as an integrated dynamic process that contains many neurological pathways. (Erkmen et al., 2007). Again, when we examine the movements of tennis players in the game, there are two different equilibrium states. In the first part, the knee is bent and in the state of stagnation, the phase against which the movement occurs, the static balance may be mentioned and defined as the ability of the athlete to maintain the support base with minimal movement during physical activation (Winter et al., 1990).) In the side rotation, which is the second part, the athlete acts according to the perception of the place where the ball will fall. Firstly, the foot closer to the ball moves out and the hip and knee position changes. The dynamic balance, which is defined as the ability to perform a task while maintaining the current stable state (Winter et al., 1990), comes to the fore when the arm and racket act together with the body on an unstable ground (Kioumourtzoglou et al., 1997).

In the tennis branch, which is an Olympic sports branch, coaches need training models that have been proven by scientific means. Calisthenics Exercise is defined as exercises performed using our body's own weight without using any extra weight. Calisthenics exercises are aerobic and dynamic exercises.

It is a useful and beneficial form of exercise because of the cadent, low intensity and modification that large muscle groups are used in the upper and lower extremities. Exercises are performed by counting rhythmic and number. They are fun because they are made as a group and they can be adjusted according to the suitability levels of the people. It can be used as a home exercise program or it can be used as a part of physical education in schools (Kurt et al., 2010). Calisthenics exercises consist of movements that increase the body's flexibility and strength. It also increases both muscle endurance and cardiovascular fitness. They provide psychomotor skills such as balance and coordination development (Staud et al., 2001). In calisthenics exercises, proprioception and coordination development can be achieved by activation of different muscle groups. For this reason, calisthenics exercises are frequently used in both rehabilitation and sports training. Calisthenics exercises are discussed in the literature in different populations due to their various central and peripheral effects (Özer Kaya et al., 2012).

In this context, calisthenics exercises are vital and innovative approach in terms of the fact that it consists of all the movements performed by the person's own body weight and the use of muscle groups used in the tennis branch without the need for weight. When the literature research was performed out, very few studies investigating the effect of calisthenics exercises specific to tennis branch on balance were found. Our research is designed as a research that will benefit the science of sports and originality in the scope of the reasons mentioned above.

2. Method

a. Creation of Voluntary Groups

Totally 17 athletes who participated in competitions in the tennis branch and participated in a competition over 7 hours (4-5 units) weekly and in accordance with the training plan participated in the study. The tennis players participating in the study were divided into 2 groups by random method. 9 tennis players in the first group performed calisthenics exercise and (4-5 units) tennis training, and 8 tennis players (4-5 units) tennis training in the second group. The study lasted a total of 8 weeks, 3 days a week. The study was planned to start in the preparation seasons of the athletes, so that it is aimed to have the least impact on the absence of working in a period when the changes in the basic motor strengths such as strength, endurance, and speed are balanced. With the aim of eliminating the learning effect in terms of affecting the test results, all athletes including the control group were informed about the test procedure a week ago and the teaching phase of the movements was completed.

b. Measurements

i. Anthropometric Measurements

Anthropometric measurements are physical measurements of athletes' bodies and body parts (Preedy, 2012). In our study, height, body weight and body mass index measurements of tennis players were taken. The lengths of the subjects participating in the study were made with Holtain brand, a stadiometer with an accuracy of ± 1mm. Height of the subjects; In the anatomical posture, bare feet and toe heels are combined, while the subject is holding the breath, the head is measured in the frontal plane after the position of the overhead table is valued at the vertex point and the values are recorded in "cm" (Günay, 2006). Weight measurements of the subjects were made with a weighing scale of ± 100 g. Measurement was taken in "kg" and the subjects in bare feet and in an anatomical position, while only shorts were on them. Body mass indexes

(BMIs) are obtained by dividing the weight in kilograms by the height square in meters.

ii. Balance Measurements

Static balance

ALFA Stabilometric Platform device was applied for static balance measurements. The subjects were taken to the tests after doing warm-up and stretching exercises for 5 minutes in their sports clothes. Static balance test was performed at double foot postures. After the subjects had exercised on the balance platform for about 2-3 minutes, the tests were started and a 1 minute rest was given between the test series. During the tests, the subjects were asked to cross their arms at chest level. With this position, the effect of arms on balance is planned to reduce the chance of the person to mislead the test by touching the support rail. During the test, subjects were informed that upper trunk movements should be minimized and the test should be completed using only the legs. If it was observed that the subject could not keep his balance during the measurement or touched the instrument with his hands or feet, the measurement was canceled and the test was repeated. During the test, which lasted a total of 30 seconds, it was asked to maintain the position. The test was started by pressing the start button on the computer keyboard and was automatically submitted by the computer at the end of the test period. A printout showing the static test results is taken. Besides, the data and units formed after the static balance measurements are as follows.

Forward – Backward Standard Deviation,

Medium – Lateral Standard Deviation,

Average Forward – Backward Speed (mm/s),

Average Medium – Lateral Speed (mm/s),

From these data, the static balance score of each individual was obtained by adding standard deviation to the front and back and standard deviation to the right. It is assumed that the balance of the individual is poor as the balance score grows and the balance is good as the score decreases.

Dynamic balance measurements (Y Test)

Y Balance Test was used to determine the dynamic balance performances of the study group. In the Y balance test application, it requires the individual to maintain body stability with the support leg and to reach maximum position in different directions with the other leg and return to the first position. The participant was asked to extend to the lines (anterior, posteriormedial and posteriorlateral) in three different directions at the last point where he could reach. During the test, the participant was able to return to the starting position in the center without touching the reaching point of the other foot without disturbing the position of the other foot. The maximum reach distance was determined as the distance reached by the reach foot at the last point. If the participant lifts the support foot off the ground, moves it away from the center point, and the foot reaches the point where it reaches to support it, it is not accepted and re-applied. With the Y balance test, each participant was given the right to try 3 on 3 lines with both feet. Each subject started the test with the right foot in the center at the beginning of the test. At the end of 3 trials, 5 minutes of pause was given and 3 more trials were applied with the other foot (Gribble et al., 2012).

3. Training Plan

The athletes belonging to the experimental groups completed the exercises in the training unit determined in the training plan, which lasted for 20-30 minutes in total 3 days a week and 1 minute rest between each set (coverage about 1 hour / week, 24 training units in total). 1 week before the first training unit; the exercises they will do for 8 weeks have been applied one by one, the errors have been corrected and it has been provided to perform the movement as desired. The exercises included in the calisthenics training program are selected according to 4 basic features. Plank versions for stabilization of the spine, crunch versions for flexion of the spine, bridge versions for hip activation and pelvic part stabilization, and oblikcrunch versions for rotation of the spine and hip (Brookbush, 2011). According to the increasing loading principle as the time progresses, the versions of the movements become harder and their number is increased again (Bompa & Haff, 2009).

***Table 1**. 8-week calisthenics training program*

Movements	1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week	7th Week	8th Week
Uneven Plank	2X10	2X15	2X20	2X25	2X25	2X30	2X30	2X35
Crunch	2X10	2X15	2X20	2X25	2X25	2X30	2X30	2X35
Abdominal Oblique Side Plank	2X10	2X15	2X20	2X25	2X25	2X30	2X30	2X35
Super Plank with Leg Raise	2X10	2X15	2X20	2X25	2X25	2X30	2X30	2X35
Lying Side Crunch	2X10	2X15	2X20	2X25	2X25	2X30	2X30	2X35
Superman	2X10	2X15	2X20	2X25	2X25	2X30	2X30	2X35
V-Up					2X25	2X30	2X30	2X35
Skater Hops					2X25	2X30	2X30	2X35
One Arm / Leg Plank Balance					2X25	2X30	2X30	2X35
Plank Skiers							2X30	2X35
Single Leg Deadlift Hops							2X30	2X35
Air Bike Crunches							2X30	2X35

i. Statistics and Data Analysis

The data obtained from the pre and post-training measurements of tennis players were analyzed in the IBM SPSS 22 statistical program. Descriptive statistics are categorized according to all tennis players and groups. The pre- and post-test distributions of the variables were examined according to groups, the normality of the distributions and the homogeneity of the variance were determined by the Mauchly's Sphericity Test and the Levene Test. Analysis of intergroup, intra group and the effect of training was carried out with multiple analysisof variance (MANOVA) in repeated measurements. Bonferroni test was used for Post Hoc comparisons, the significance level was accepted as 0.05.

4. Findings

Table 2: *Descriptive Characteristics Distribution of Participants*

Variances	n	Group	Mean	S.D
Age (year)	9	EG	20,56	1,13
	8	CG	21,12	1,73
Height (cm)	9	EG	179,44	5,92
	8	CG	180,63	4,97
Body Weight (kg)	9	EG	58,62	4,98
	8	CG	58,90	3,05
BMI (kg/m2)	9	EG	18,18	1,13
	8	CG	18,06	1,03

When the arithmetic average and standard deviation values of the experimental group and control group participating in our research are examined; For the experimental group, the age was determined as 20.56 ± 1.13 years, height of 179.44 ± 5.92 cm, body weight as 58.62 ± 4.98 kg and BMI18.18 ± 1.13 kg / m2. . The control group's age was 21.12 ± 1.73 years, height was 180.63 ± 4.97cm, body weight was 58.90 ± 3.05 kg and BMI was 18.06 ± 1.03 kg / m2. (Table.2). In the table, it is seen that the groups are distributed homogeneously.

Table 3. *Tennis Players' Open-eye static balance intra-group and intergroup comparison*

Variances	Group	Test Pre- X±SS	Post-Test X±SS	Intra-group Change(%)	Test *Group F	p
OEFBSD	DG	6,44±1,12	4,22±1,09	**2,22 (%34,47)***	**16,307**	**0,001***
	KG	6,87±1,45	6,37±1,40	0,50 (%7,27)		
OEMLSD	DG	5,33±1,22	4,22±1,09	**1,11 (%20,82)***	**8,213**	**0,012***
	KG	6,12±1,12	5,62±0,91	0,50 (%8,16)		
SBS	DG	11,77±1,27	8,44±1,06	**3,33 (%28,29)***	**16,575**	**0,000***
	KG	12,99±1,21	11,99±1,21	1,00 (%7,69)		

p<0,05*

OEFBSD : OpenEyesForward – Backward Standard Deviation**, OEMLSD:** Open EyesMedium – Lateral Standard Deviation, **SBC:**StaticBalanceScore

In Table 3, in the comparisons within the group, 34.47% improvement was observed in the standard deviation value of the experimental group, while the control group showed a development of 7.27%. While 20.82% improvement was observed in the right and left standard deviation value of the experimental group, an improvement of 8.16% was found in the control group. While 28.29% improvement was determined in the static balance score of the experimental group, it was determined that the control group showed a development of 7.69%.

***Table 4.** Tennis Players' Open eyes static balance oscillation speed inter-group and intra-group comparison*

Variances	Group	Test	Pre-X±SS	Post-Test X±SS	Intra-group change(%)	Test* Group F	p
OEFBV (mm/s)	DG		7,66±2,00	5,88±1,76	**1,78 (%23,23)***	**36,441**	**0,000***
	KG		8,12±3,13	7,75±2,91	0,37 (%4,56)		
OEMLV (mm/s)	DG		6,66±1,58	4,55±0,88	**2,11 (%31,68)***	**28,310**	**0,000***
	KG		7,13±2,64	6,75±2,43	0,38 (%5,32)		
TOS (mm/s)	DG		14,32±1,82	10,43±1,51	**3,89 (%27,16)***	**62,431**	**0,000***
	KG		15,25±2,84	14,50±2,64	0,75 (%4,91)		

p<0,05*

OEFBV : OpenEyesForward – BackwardVelocity, **OEMLV:** Open EyesMedium – LateralVelocity, **TOS:** TotalOscillationSpeed

The differences in front-to-back, right-to-left oscillation speed and total oscillation speed result from statistically significant differences in the experimental group and control group post-test measurement results. In the in-group comparisons, a 23.23% improvement was observed in the value of the swing speed of the experimental group, while the control group showed a 4.56% improvement. 31.68% improvement was observed in the right-to-left oscillation rate of the experimental group, while 5.32% of the control group was observed. While 27.16% improvement was determined in the static balance total release rate score of the experimental group, it was determined that the control group showed a 4.91% improvement.

***Table 5.** Tennis Players' Close eyes static balance intra group and intergroup comparison*

Variances	Group	Test	Pre-X±SS	Post-Test X±SS	Intra-group Change(%)	Test* Group F	p
CEFBSD	DG		7,55±1,22	5,44±1,23	**2,11 (%27,94)***	**14,030**	**0,002***
	KG		7,87±3,12	7,12±0,83	0,75 (%9,52)		
CEMLSD	DG		6,55±1,22	5,11±1,16	**1,44 (%21,98)***	**11,917**	**0,004***
	KG		7,37±1,18	7,00±1,19	0,37 (%5,00)		
SBS	DG		14,10±1,27	10,55±1,06	**3,55 (%25,17)***	**19,098**	**0,000***
	KG		15,24±1,21	14,12±1,21	1,12 (%7,34)		

p<0,05*

CEFBSD: ClosedEyesForward – Backward Standard Deviation**, CEMLSD:** ClosedEyesMedium – Lateral Standard Deviation, **SBC:**StaticBalanceScore

In Table 5, within the group comparisons, it was determined that the experimental group showed a 27.94% improvement in the blind forward-backward standard deviation, while the control group showed a 9.52% improvement. While 21.98% improvement was observed in the right and left standard deviation value of the experimental group, 5.00% improvement was observed in the control group. While 25.17% improvement was determined in the static balance score of the experimental group, it was determined that the control group showed 7.34% improvement. The differences in the forward-backward standard deviation, right-left standard deviation, and static balance score between the groups result from statistically significant differences in the experimental group and control group posttest measurement results.

Table 6. *Tennis Players' Close eyes static balance oscillation speed intra-group and intergroup comparison*

Variances	Group	Test Pre-X±SS	Post-Test X±SS	Intra-group Change(%)	Test* Group F	p
CEFBV (mm/s)	DG	10,88±1,76	8,66±1,80	**2,22 (% 20,40)**	**47,440**	**0,000***
	KG	11,62±2,55	10,75±2,60	0,25 (% 2,15)		
CEMLV (mm/s)	DG	8,88±1,76	6,55±1,50	**2,33 (% 26,23)**	**41,471**	**0,000***
	KG	8,87±2,20	8,51±2,44	0,36 (% 4,05)		
TOS (mm/s)	DG	19,75±1,90	15,21±3,42	**4,54 (% 22,98)***	9,354	0,004
	KG	20,49±2,03	19,26±2,92	1,23 (% 6,00)		

p<0,05*

CEFBV: Open EyesForward – BackwardVelocity, **CEMLV:** Open EyesMedium – LateralVelocity**, TOS:** Total OscillationSpeed

According to Table 6; In the comparison between groups, significant difference was found in the values of blind forward forward-backward swing speed, right-left swing speed and total swing speed (p <0.05). These differences arise from the post-tests of the experimental and control groups. In intra-group comparisons, an increase of 20.40% in the forward-backward swing speed of the experimental group was observed, while the control group showed a 2.15% improvement. In the comparison between the groups, a significant difference was observed at the level of p <0.05. While there was a 26.23% improvement in the right-to-left oscillation rate of the experimental group, a 4.05% improvement was observed in the control group. In the comparison between the groups, a significant difference was found at the level of p <0.05. While 22.98% improvement was determined in the static balance total release rate score of the experimental group, it was determined that the control group showed a growth of 6.00%.

Table 7. *Tennis Players' Dominant and Dynamic balance intra-group and inter group comparisons*

Variances	Group	Pre-Test X±SS	Post-Test X±SS	Intra-group Change(%)	Test* Group F	p
DFA (cm)	DG	99,11±5,06	102,55±5,10	**3,44 (% 3,47)***	**41,234**	**0,000***
	KG	96,62±8,51	96,87±8,20	0,25 (% 0,25)		
DFPM (cm)	DG	117,44±4,06	119,55±3,84	**3,89 (% 3,21)***	**39,817**	**0,000***
	KG	114,87±5,33	115,00±5,47	0,13 (% 0,12)		
DFPL (cm)	DG	112,33±3,46	116,44±3,67	**4,11 (% 3,65)***	**66,580**	**0,000***
	KG	111,25±5,44	111,62±5,37	0,37 (% 0,33)		

p<0,05*

DFA: *DominantFootAnterior,* **DFPM:** *DominantFootPosteromedial,* **DFPL:** *DominantFootPosterolateral*

In intra-group comparisons of dominant foot dynamic balance scores, a significant difference was observed in the pretest and posttest values of the experimental group (p <0.05). Although there was a development in the control group, there was no difference (p> 0.05). Posteromedial value created a significant difference in the pretest and posttest values of the experimental group (p <0.05). Although there was improvement in the control group, there was no statistically difference (p> 0.05). While the posterolateral value created a significant difference between the pretest and posttest values of the experimental group (p <0.05), there was no statistically difference despite the improvement in the control group (p> 0.05). A significant difference was found in anterior value, posteromedial value, and posterolateral value in group comparisons. While anterior, posteromedial, posterolateral values of the experimental group were statistically significant increases in the pre-test and post-test values of 3.47%, 3.31%, 3.65% (p <0.05); In the control group, although there was a 0.25%, 0.12% and 0.33% improvement in the anterior, posteromedial, and posterolateral values, respectively, there was no statistically difference (p> 0.05).

Table 8. *Tennis Players' Nondominant Foot Dynamic balance intra group and intergroup comparisons*

Variances	Group	Pre-Test X±SS	Post-Test X±SS	Intra Group Change(%)	Test* Group F	p
NFA (cm)	DC	98,66±6,26	102,88±5,08	**4,22 (% 4,27)***	**36,441**	**0,000***
	KC	95,37±5,82	95,75±5,94	0,38 (% 0,39)		
NFPM (cm)	DC	116,55±4,55	120,33±4,41	**3,78 (% 3,24)***	**30,563**	**0,000***
	KC	112,62±4,82	113,00±5,20	0,38 (0,33)		
NFPL (cm)	DC	110,77±4,22	114,55±4,26	**3,78 (% 3,41)***	**73,726**	**0,000***
	KC	107,87±6,26	108,25±6,43	0,38 (% 0,35)		

p<0,05*

LFA: NondominatFootAnterior, **LFPM:** NondominatFootPosteromedial, **LFPL:** NondominatFootPosterolateral

In intra-group comparisons of nondominant foot dynamic balance scores, a significant difference was observed in the pretest and posttest values of the experimental group in the anterior, posteromedial, and posterolateral values (p <0.05). Despite the development in the control group, no significant difference was found in any value (p> 0.05). While anterior, posteromedial, posterolateral values of the experimental group were statistically significant increases in the pre-test and post-test values of 4.27%, 3.24% and 3.41% (p <0.05); In the control group, although there was a 0.39%, 0.33% and 0.35% improvement in the anterior, posteromedial, posterolateral values, respectively, there was no statistically difference (p> 0.05).

5. Discussion and Conclusion

Studies in the literature show that regular exercises have positive effects on athlete's speed, strength and balance performance (Toumi et al. 2004, (LeSuer 1997, Brown et al. 2007, Lephart et al., 1996).

The development of core force to increase sporting performance is an issue under discussion. The core consists of abdominal muscles at the front, back muscles at the back, diaphragm at the top and pelvic floor muscles at the bottom. For this reason, the core force protects the spine and ensures the sustainability of the pelvic neutral position (Standaert et al., 2008). This may be important in terms of preventing sports injuries and improving the control and balance of the body (Koz and Ersöz, 2010). However, researchers found different results regarding the relationships between balance and calisthenics exercise programs (Abt et al., 2007; Myer et al., 2006; Cosio-Lima et al., 2003).

In this study, the effects of 8-week regular calisthenics exercise applied to male tennis players on the static and dynamic balance properties of athletes were examined.

In our study, a statistically positive improvement was observed in the calisthenics exercise group with eyes open, forward-backward standard deviation (34.47%), right-left standard deviation (20.82%) and static balance (28.29%) (p <0 , 05). Despite the development observed in the control groups, there was no statistically difference (p> 0.05). While statistically positive developments were observed in the experimental group (p <0.05), with eyes open forward-backward swing speed (23.23%), right-left swing speed (31.68%) and total swing speed (27.16%), There was no significant difference in the control group (p> 0.05) (Table 4). In our study, statistical improvements were observed in the group comparisons of subjects who exercised static balance calisthenics exercise with eyes closed (p <0.05). Static balance score with eyes closed revealed more positive results in subjects who exercised calisthenics compared to the control group. It has been determined that subjects who exercise calisthenics in eyes closed static balance score showed 25,17% improvement (Table 5). Positive developments were observed in the experimental group at the rate of 20.40% in the forward-to-back swing speed with eyes closed, 26.23% in the right-to-left swing speed and 22.98% in the total swing speed. In the control group, with the eyes closed forward-to-back oscillation speed, 2.15%, right-to-left oscillation speed 4.05%, and the total oscillation speed 6.00% low development. Improvement rates of subjects who exercise calisthenics are higher than the control group. While in-group comparisons, a difference was observed in the subject group (p <0.05), there was no significant difference encountered in the control group (p> 0.05) (Table 6).

In our study, Y Balance test was performed to determine the dynamic balance. Anterior, Posteromedial and Posterolateral values for dominant and nondominant foot were found statistically significant differences between the pretest-posttest comparisons in both feet in the experimental group (p <0.05) and it was determined that they showed positive improvement. An improvement of 3.47% of subjects who performed calisthenics exercise for anterior value for dominant foot was observed. It was determined that the posteromedial value showed improvement in 3.31% of subjects who performed calisthenics exercise. It was determined that subjects who exercise calisthenics for their posterolateral value showed an improvement of 3.65% (Table 7). 4.27% of the subjects who performed calisthenics exercise in the Anterior value for the nondominant foot were observed. It was determined that subjects who performed calisthenics exercise for posteromedial value showed a 3.24% improvement. It was determined that subjects who exercise calisthenics for their posterolateral value showed a 3.41% improvement (Table 8).

In the study of Gür and Ersöz (2017) evaluating the effect of core training on 8-10 age group tennis athletes, core strength, static and dynamic balance properties, more improvement was detected in the average middle lateral speed and forward-back speed values of the experimental group compared to the control group. Bayrakdar reported that (2018), in the study of the effect of calisthenics exercises on balance on stable and unstable grounds in swimmer children, it is positive for the groups that perform calisthenics exercise on stable and unstable ground, both eyes open and eyes closed forward-back standard deviation, right-left standard deviation and static balance. According to Kılınç et al. (2018) examination of the effects of swimming exercises and thera-band workouts on dynamic and static balance in children changes between 7-12 years of age. A statistically significant increase in exercise group was observed in deviation and static balance. Aggarwal et al. (2010) stated that in their studies, they examined the effect of core stability and balance training on static and dynamic balance performance, that static balance increased statistically significantly, and that core stability training had a greater effect on static balance than balance training. Cosio-Lima et al. (2003) reported that 5-week core stability and balance training performed with a pilates ball compared to traditional training, and the group performing the balance stability and balance training in one foot balance values had positive progress. Emery et al. (2005) reported improvement in static balance and dynamic balance values after 6 weeks of training on healthy adolescents using Wobble board. In addition, a 6-month follow-up period was performed after this intervention and it was emphasized that the training in question reduced the risk of disability of the participants. Yaggie and Campbell (2006) observed a significant difference in the static balance ability of the experimental group after training with 36 participants using bosu ball for 4 weeks. Aslan and Livanelioğlu (2003) stated that hatha yoga and calisthenics exercises were effective in studying their effects on static balance with eyes closed static balance (Aslan and Livanelioğlu, 2003). A significant improvement in the dynamic balance feature of the experimental group was observed in the studies of Samson (2007), in which they examined the relationship between core training and dynamic balance on tennis athletes with an average age of 20.

When this research is compared with the above literature examples, it is shown that the core studies performed with the instrument of theraband, bosu ball, pilates ball, and the types of exercises examined under the heading of calisthenics exercises that the athlete can perform with his own body weight can be effective on the balance ability and supports our study. In the light of these data, it can be said that the application of regular calisthenics training three times a week, eight weeks or more according to the continuity principle will contribute positively to balance.

In conclusion, it can be said that calisthenics exercises performed for 8 weeks have an impact on the static and dynamic balance development of tennis players.

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