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The Influence of functional training on biomotor skills in girl tennis players aged 10–12

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Abstract

Background: The purpose of this study is to examine whether functional training has an impact on biomotor skills of 10–12-year-old girls. Material and methods: The study involved 20 girls (10 controls and 10 subjects) – who had been playing tennis for at least 2 years. A routine tennis training program was applied to the control group of tennis players participating in the study: 4 days a week, 90 minutes a day for 8 weeks. A 2+2 training program (2 days routine and 2 days functional training) was applied to the experimental group of tennis players for 8 weeks, 4 days a week, 90 minutes a day. At the end of the training program, biomotor tests were conducted. Results: There was not any significant differences when the pre-test and post-test values of the control group of tennis players who performed traditional tennis training were compared with their biomotor skills and Wingate anaerobic power ($p > .05$). When the pre-test and post-test values of the experimental group of tennis players with 8-week functional tennis training were compared with their biomotor skills and Wingate anaerobic power, a significant difference was found in all variables ($p < 0.01$). Conclusions: The obtained data shows that the "functional training" programs implemented together with "routine tennis training" can positively improve the biomotor characteristics of 10–12 year-old girl tennis players.

Keywords

functional training, tennis, biomotor skills, Wingate test

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B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

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abstract

Background: The purpose of this study is to examine whether functional training has an impact on biomotor skills of 10–12-year-old girls.

Material and methods: The study involved 20 girls (10 controls and 10 subjects) – who had been playing tennis for at least 2 years. A routine tennis training program was applied to the control group of tennis players participating in the study: 4 days a week, 90 minutes a day for 8 weeks. A 2+2 training program (2 days routine and 2 days functional training) was applied to the experimental group of tennis players for 8 weeks, 4 days a week, 90 minutes a day. At the end of the training program, biomotor tests were conducted.

Results: There was not any significant differences when the pre-test and post-test values of the control group of tennis players who performed traditional tennis training were compared with their biomotor skills and Wingate anaerobic power (p> .05). When the pre-test and post-test values of the experimental group of tennis players with 8-week functional tennis training were compared with their biomotor skills and Wingate anaerobic power, a significant difference was found in all variables (p <0.01).

Conclusions: The obtained data shows that the "functional training" programs implemented together with "routine tennis training" can positively improve the biomotor characteristics of 10–12 year-old girl tennis players.

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INTRODUCTION

Functional training contributes to different systems of the body with functional exercises in different parts of the body (covering the whole body, developing universal motor skills, applied in multiple motion planes) through intensive, short and constantly changing sessions [1, 2, 3]. In the literature, practices created as a form of functional training have different resting rates with similar training content (gymnastics, weightlifting, aerobic exercises, etc.) [4, 5]. Along with functional training capacity, muscle endurance is associated with strength and a positive increase in body composition with the potential to increase strength [2, 6, 7]. While endurance largely depends on the aerobic capacity of the athlete, it is less dependent on anaerobic capacity [8]. Functional training, while simultaneously increasing athletes' muscular endurance, hypertrophy, power and strength, also creates an excellent impact to improve aerobic power and anaerobic capacity [9, 10].

Success in tennis depends on numerous factors such as physical condition, technical skill and tactical strategy [11]. The physiological requirements of tennis are quite complicated because it covers all of the strength, short distance runs and endurance exercises in the game. With this aspect, controversy among many sports scientists, tennis coaches and players continues as regards the implementation of training programs. In this way, the question of which aerobic or anaerobic energy systems are dominant in tennis is addressed [12]. The question is examined in five sections according to the contextual structure of the basic motor qualities. The first three are basic and the other two are complementary. These qualities include strength, speed, flexibility, mobility, coordination. The basic motor qualities of an individual consist of the elements that determine the person's body strength and ability and the degree of complex motor power. These qualities are the basis and the primary condition for every motor sports movement performed during the functional training process. The development of basic motor features in all sports is an indispensable part of the applied training [13]. Kinematics and the associated factors of performance are essential for trainers to help the player to develop his/her skills and to improve performance.

While specific training is planned to develop a specific area or a specific feature, combined training aims to co-develop the basic biomotor qualities. Especially in combined trainings, it is a prerequisite to work in strength, speed, endurance, technical and tactical integrity. With functional training, both to improve strength characteristics and to train in a unity with flexibility, speed, endurance, mobility and coordination has been aimed. The idea was that the development of all these biomotor qualities in sports development could be done in single training [14, 15]. It is designed to increase the quality and sports performance of daily life activities. It targets the neuromuscular system; namely, it trains not only muscles, but also movements. It involves functional training, dynamic and static balance, and challenges to improve coordination and proprioception, using a staged and individualized program in a multi-joint and multi-plane exercise program [16]. In this study, it is presumed that functional training to be performed according to the branch-specific age period will increase the functional capacity of the athletes and further increase their sports performance in the future [17].

It is suggested that functional training positively influences sports performance, especially in singles tennis. As the training programs are renewed with the developed functional training programs and in the light of science, it is observed that their success in tennis sports also increases [18]. In order to train internationally successful athletes, it is critical to implement appropriate training programs. Functional training practices will improve the basic movement skills of tennis players, while at the same time, it will enable children to easily perform sports-specific movement skills at the age of expertise. With this study, it is important that athletes contribute to improving their biomotor skills, and positive changes are reflected in tennis performance. The aim of this study is to investigate whether functional training has an impact on biomotor skills of 10–12-year-old girls.

MATERIAL AND METHOD

PARTICIPANTS

Mersin University Non-Interventional Ethics Committee's approval was received for the study. Participants were informed about the issues, potential risks and benefits before participating in the study, and written informed consent was obtained for their participation in accordance with the Helsinki Declaration's policies and procedures. Written consent was also approved by the parents of all minors participating in the study. Volunteer participants were selected from tennis clubs active in Mersin. Girl athletes between 10–12 years old who had been playing tennis for at least 2 years were preferred. Measurements were initiated with 26 athletes (age: 11.20 ±0.834, height: 148.50 ±7.57, body weight: 41.29 ±7.23 and body fat percentage: 22.21 ±4.50), and 6 persons who were not suitable to the criteria and were not included in the study (Fig. 1).

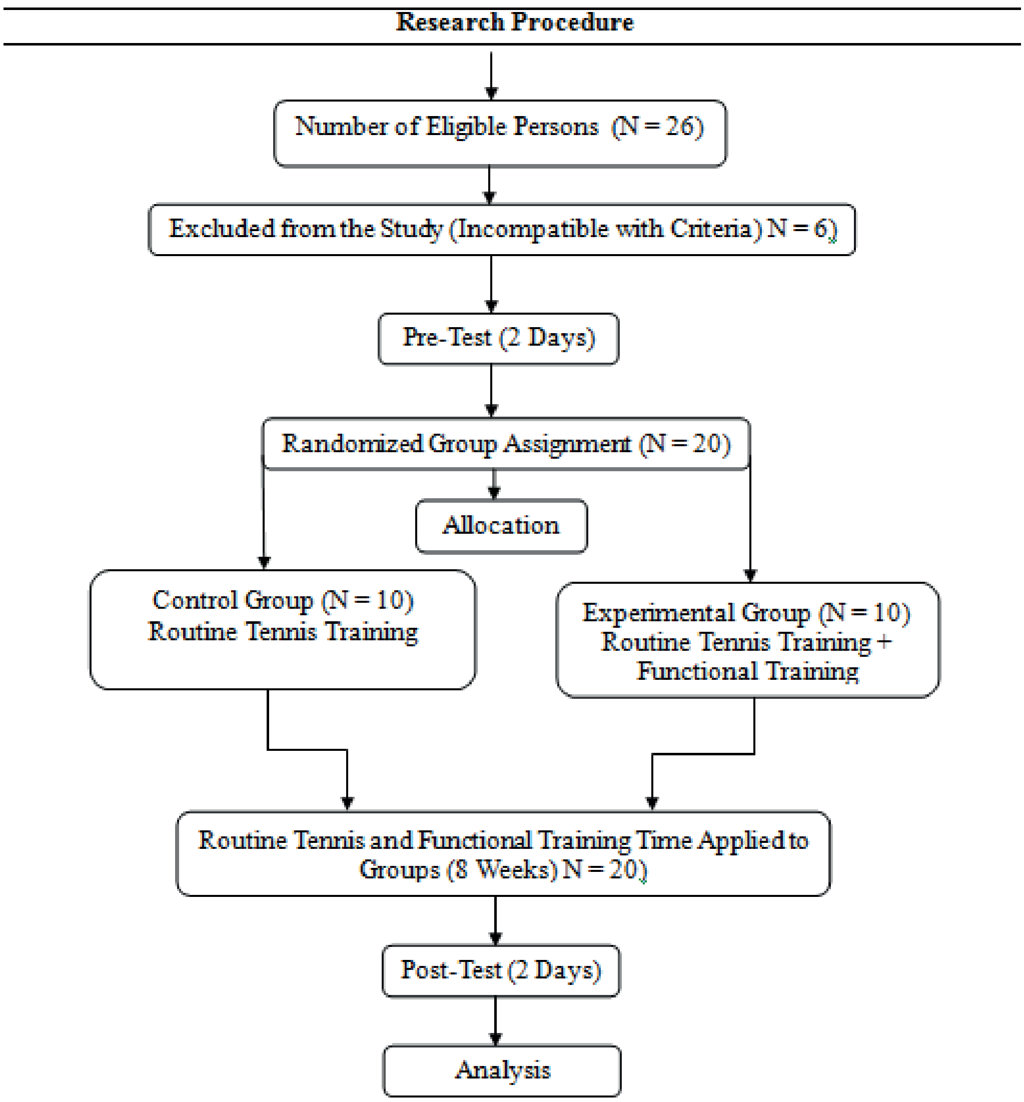


Fig. 1. Flow diagram representing study design

The study was continued with 10 persons in CG and 10 persons in EG. A presentation including the details of the training program was made by giving information about the aims of the study, research design, training program, measurement procedure, participant responsibility to the participants and their parents. Participants were allowed to participate in the first measurements and continue training regularly. The measurement procedure was introduced in detail to each subject, and a summarized information package describing their responsibilities to participate in the training program was delivered. Participants from both groups were provided with regular diet and exercise routines.

Research model

In the study, an experimental model with a control group including pre-test–post-test measurements was used. Participants were divided into the control group (CG) and the experimental group (EG) by randomized appointment. The routine tennis training program was applied to the control group of tennis players participating in the study, 90 minutes a day, 4 days a week for 8 weeks. The 2+2 (2-day routine tennis training and 2-day functional training) program was applied to the experimental group of tennis players for 4 days a week, 90 minutes a day, for 8 weeks.

Tests applied before the training program

Bioelectrical impedance analysis measurements

Height and weight measurements were made to determine the individuals' anthropometric characteristics, and body fat percentage were determined with the method of bioelectric impedance analysis (Tanita 418-MA Japan). Bioelectric impedance analysis was performed by the same person on the first measurement day. The body weight (BW) was calculated with the subjects wearing standard sportswear (shorts, tops) without shoes, with (±0.1) error margin on the weighbridge (T Tanita 418-MA JApan). Their heights were calculated with heads on the frankfort plane, following deep inspiration and with the measurement of the distance between the vertex of the head and the foot with a use of a stadiometer (Holtain Ltd. U.K.) with an error margin of (±1 mm). Anthropometric measurements of individuals were taken before both tests on different days.

Biomotor performance measurements

The variables of the study were composed of biomotor performance components, including the 10-m Speed Test, Vertical Leap Test, Sit Down Test, Grip Force Test, Agility Test (T Test) and Anaerobic Power. The tests of both groups were carried out as a pre-test at the beginning and post-test at the end of the study. Participants were taken to the test after warm-up of 5-minute light pace running and then 5 minutes of stretching exercises for each test.

10-m Speed Test

The participants' speed performance was measured using a stopwatch in the area marked with a distance of 10 meters. At the starting point, the athlete took a standing position with one line in the front and the other in a linear standing static position. No swinging was allowed in any way. Between each run, athletes were given complete rest and asked to do 3 maximum repetitions. The best time was recorded [19].

Vertical Leap Test

Vertical Leap is measured as the vertical jump value of the individual by measuring the difference between the most extreme point that a person can reach by stretching her arm against the wall and the highest point she can touch by jumping. The measurement was repeated three times and the highest value was recorded for analysis.

Sit-and-Reach Test

Athletes' flexibility was evaluated by the sit-and-reach test. Athletes were in a long sitting position with both knees in full extension, ankles at 90 degrees and their feet bare.

Athletes were asked to lean forward as long as they can with their hands in front of their bodies without bending their knees and wait 2 seconds at the last point they can reach. The difference between baseline and the reach was measured in centimetres (cm). The measuring person stood next to the participants and prevented their knees from bending. The measurement was repeated three times and the highest value was recorded for analysis.

Hand Grip Strength Test
The right and left hand-grip forces of the athletes included in the study were measured before and after the training with the help of a hand dynamometer (CAMRY brand, EH 101 model digital LCD Dynamometer, resistant to 90 kg / 198lb resistance). Handgrip force measurements were performed with the arms hanging down and at an angle of 180 degrees without bending the elbow. Measurements were performed in the same way for both arms. Force measurements were repeated three times, the arm without measurement did not receive support from anywhere. The measurement of each athlete was performed by calibrating the dynamometer and adjusting the dynamometer according to the hand and finger characteristics of the athlete.

Agility Test (T Test)
Agility performance was measured using a stopwatch (OnnPnnQ Brand, PC2810 model) on the track prepared for athletes. The “T” test is an agility test that requires running forward, sideways and backwards for athletes. Equipment needed for this test includes meters, sign cones, stopwatch and timing lines. When the athlete felt ready while waiting for both feet to be behind the starting line (point A), she exited and ran from the "A" cone to the "B" cone with a straight run and touched the cone with her right hand. Then she ran left to the "C" cone with a side run and touched the "C" cone with her left hand, then she ran to the right to the "D" cone with her right hand. Then she came to the "B" cone, came with a side run and touched it with her left hand, then returned to the "A" cone with a back run. As soon as she reached the "A" cone, the stopwatch was stopped and the duration was recorded. In this study, the participant performed 3 repetitions with full rest and the time obtained at the end of the test was recorded in seconds.

Wingate Anaerobic Power Test
Anaerobic powers of the experimental and control group athletes were evaluated with the Wingate test (WAnT), which can be applied on a bicycle ergometer (Ergoline Ergoselect 100/200 brand). The Wingate test is a supramaximal test lasting 30 seconds. When the subject reached the maximal pedal speed without load, the determined load per body weight (75 g / kg) was applied as resistance. The number of pedals is recorded for every 5 seconds.

Procedure

Applied training procedure
Both training programs in the research consisted of three phases:
1. a warm-up phase (running and dynamic stretching exercise) 15 min.
2. the main exercises (loading) phase 60 min.
3. active cooling phase (running and static stretching exercise) 15 min.

Routine tennis training program
The routine tennis training program, which both groups practiced, was initiated with a 15-minute warm-up phase and completed with a 15-minute cool-down phase after the 60-minute main phase, where tennis-specific stroke techniques were applied. In this training, the athletes were asked to play with an estimated power intensity of 75%. The participation of athletes in the training program for 8 weeks was ensured with their

coaches' support. Throughout the training, the durations and resting frequency in the program was adhered to in the way specified to the athletes (Table 1).

Table 1. 8-week routine tennis training program (a sample week)

Day 1: Manual low-ball feed, 100 forehand (Fh) strokes on the incoming ball. Manual low-ball feed, 100 backhand (Bh) strokes on the incoming ball. Flat feeding with racket, spinning incoming ball 100 Fh. strike. Flat feeding with racket, spinning incoming ball 100 Bh. strike. Baseline also 100 cm long hand feed from the front of the obstacle, high spin on the incoming ball, 100 Fh. strike. Baseline 100 cm long hand feed from the obstacle, high spin on the incoming ball, 100 Bh. strike. Midi field-to-field "drive vole" training 100 Fh. strike. Midi field-to-field "drive vole" training 100 Bh. strike. Feeding the "slice" from the opposite field with the racket, spinning the incoming ball 100 Fh. strike. Feeding the "slice" from the opposite field with the racket, spinning the incoming ball 100 Bh. strike.
Day 2: Cross forehand rally in the height-increased net, Cross backhand rally in height-increased net, Parallel forehand rally in the height-increased net, Parallel backhand rally in the height-increased net, Mixed rally in an increased height net.
Day 3: Low ball feed in front of the net, spinning the incoming ball, 100 forehand strokes. Low ball feeding in front of the net, spinning the incoming ball, 100 backhand strokes. 100 forehand strokes "drive volley" on the low ball in the mini field. 100 backhand strokes "drive volley" on the low ball in the mini field.
Day 4: The service boxes of the field were closed, and deep ball exercises were applied to the baseline with mixed techniques.

While this study was carried out for 8 weeks, different direction and intensity hitting techniques were used for different angles of the court, and enrichment of the study was considered. The direction and intensity of ball feeding techniques were changed from time to time. By hand or racket flings, bouncing and feeding with mixed techniques, the athletes were asked to respond to the incoming balls with mixed, circular strokes. With similar studies, while athletes were sometimes directed to a target, from time to time, short or long balls of different heights were thrown. On the last training day of the fourth and eighth weeks of the program, some analysis and evaluations were made by monitoring the athletes with in-point matches.

Functional training program

2-day functional training program was prepared in addition to the 2-day routine tennis training program (Table 2), and for this training program the maximum heart rate was 75% and above. It was delivered by the researcher for 8 weeks according to the athletes' performance. The prepared training program was chosen from movements that complement the kinetic chain and improve the athletes' biomotor skills. These movements are made up of exercises for muscles and muscle groups used in kicking techniques such as pushing, pulling, rotation, squatting, getting up and jumping, and forming the kinetic chain of this technique. These athletes also continued their routine tennis training programs.

Table 2. 8-Week functional training program (a sample week)

Movement	Equipment to be used	Set-Number of Repetitions-Duration	Rest Time between Sets	Movement Description
burpees	bosu ball	3 sets 10 repetitions	3 mins	Push-up position is taken with the hands on the bosu ball. While the two knees are pulled towards the abdomen, it jumps up in the vertical plane. While falling down, push-up position is taken again.
bungee run	bungee band	3 sets once to each direction	3 mins	At baseline, the athlete is stopped at the service point facing the net. A bungee band is attached to the waistband attached to the waist. The athlete sprints towards the net. She then runs back in the same direction. When she reaches the starting point, she runs to the right couples corridor, and then to the left couples corridor, with the side sliding steps towards the beginning.
forward jump squat	12-22 lbs power band	set 10 repetitions	3 mins	12 and 22 lbs resistance resistant power bands are added to each other, and 22lbs are attached to the athlete's waist. While holding on one end, the athlete on the other end leaps forward to squat and completes the motion by jumping over and over again.
plank	mat	3 sets maximum durability time	3 mins	Two arms, elbows and forearm are placed on the floor with the mat. Feet are placed on the ground as in the push-up position and they are expected to be fixed. With the command accompanied, the right arm is lifted from the ground after 15 seconds. Every 15 seconds, the left arm, right leg and left leg are lifted off the ground, respectively. Finally, the cross arms and legs are lifted from the ground at the same time and the movement is tried to be continued.
torso rotation	2 cone heads, 3 kg medicine ball	3 sets right 10 – left 10 repetitions	3 mins	Sliding steps are made between 2 conic heads placed at a distance of 3 meters. When it comes to the conic head, the right and left sides of the athlete are fed with a medicine ball. The athlete is asked to throw back the medicine ball by imitating the backhand and forehand technique.
side to side run	1 racket, 5 cone heads, 5 tennis balls	3 sets 5 repetitions	3 mins	The athlete stands between 5 conic heads lined up half a meter apart and a racket put on the ground at a distance of 2.5 meters. A tennis ball is placed on each conic head. The balls on the heads are put on the racket with the side-sliding steps, respectively, and placed on the heads again.
agility run	1 agility ladder, 4kg medicine ball	3 sets 7 repetitions	3 mins	Front-to-front, inside-side front, right and left front-back runs on agility ladder
side to side crash	1 medicine ball of 3 kg	3 sets 10 right 10 left repetitions	3 mins	While the athlete is standing, she raises the medicine ball left and right overhead, hitting hard. Applied up to the number of repetitions.
reverse walking	flat wall	3 sets 7 repetitions	3 mins	The athlete puts her hands on the floor while standing with her back facing the wall at a distance of 1-1.5 meters. She steps up with her feet using the wall and lowers it again. These moves are applied as much as the number of moves before the hands are off the ground.

Statistical analysis

Mean and standard deviation values were used as descriptive statistics. The research data were analysed separately for each sub-problem. Two-way analysis of variance was applied for mixed measurements to determine whether there is a difference between pre-test–post-test applications in the experimental and control groups. However, in order to perform this analysis, the basic assumptions of the analysis (normality, equality of covariance matrices, equality of error variances and equality of error covariance matrices) had to be tested [20]. In testing basic assumptions of variance analysis for mixed measurements, Shapiro Wilk normality test, Box's M covariance matrix test, Levene's error variance test and Mauchly's sphericity error covariance matrices were performed. Due to normal distribution of the groups, paired samples T-Test was used in group comparisons. Statistical results were evaluated at 95% confidence range and p <0.05 significance levels.

RESULTS

Table 3 presents demographic and anthropometric parameters of all participants in the control and experiment groups. Because there is no significant difference between anthropometric and demographic parameters, such as age, height, body weight and body fat percentage between groups, it can be stated that the difference in the parameters related to biomotor skills (10m speed run, vertical jump, flexibility, hand grip force, t test) and Wingate measurements between groups is not due to anthropometric and demographic features.

Table 3. Demographic and anthropometric parameters of all participants in the study

Variable	N	Min.	Max.	Average ±S.S.
Age (year)	20	10	12	11.20±0.834
Height (cm)	20	137.00	163.00	148.50±7.57
BW (kg)	20	29.20	57.60	41.29±7.23
BFP (%)	20	13.60	33.10	22.21±4.50

BW: body weight, BFP: body fat percentage

When comparing the pre-test and post-test values related to the biomotor skills of the control group of tennis players with traditional tennis training, it was determined that there was no significant difference (p> .05) (Table 4). When the pre-test and post-test values related to the biomotor skills of the experimental group of tennis players with 8-week functional tennis training were compared, it was found that there was a significant difference in all variables (p <0.01) (Table 5).

Table 4. Comparison of the pre-test and post-test values of the 8-week routine tennis training in the control group

Group	Variables	Test	N	$\bar{x}$	sS	P
Control	10-m. Speed Run (s)	Pre-test	10	2.46	0.24	.194
	10-m Speed Run (s)	Post-test	10	2.49	0.23	
	Vertical Leap (kg.m/sn)	Pre-test	10	18.50	7.99	.751
	Vertical Leap (kg.m/sn)	Post-test	10	18.70	8.01	
	Flexibility (cm)	Pre-test	10	6.50	5.38	.226
	Flexibility (cm)	Post-test	10	7.20	4.59	
	Hand Gripping Force (kg)-right	Pre-test	10	20.94	4.18	.401
	Hand Gripping Force (kg)-right	Post-test	10	21.01	4.62	
	Hand Gripping Force (kg)-left	Pre-test	10	18.59	4.54	.847
	Hand Gripping Force (kg)-left	Post-test	10	18.41	4.79	
	"T" Test	Pre-test	10	13.92	0.847	.561
	"T" Test	Post-test	10	13.86	0.898	

Table 5. Comparison of pre-test and post-test values of the 8-week functional tennis training in the experimental group

Group	Variables	Test	N	$\bar{x}$	sS	P
Experimental	10-m. Speed Run (s)	Pre-test	10	2.25	0.21	.007
	10-m Speed Run (s)	Post-test	10	2.10	0.20	
	Vertical Leap (kg.m/sn)	Pre-test	10	22.70	6.14	.004
	Vertical Leap (kg.m/sn)	Post-test	10	25.90	6.17	
	Flexibility (cm)	Pre-test	10	8.30	7.68	.005
	Flexibility (cm)	Post-test	10	12.70	8.22	
	Hand Gripping Force (kg)-right	Pre-test	10	23.85	3.76	.000
	Hand Gripping Force (kg)-right	Post-test	10	27.45	4.38	
	Hand Gripping Force (kg)-left	Pre-test	10	21.43	4.74	.000
	Hand Gripping Force (kg)-left	Post-test	10	24.86	4.76	
	"T" Test	Pre-test	10	13.44	0.433	.000
	"T" Test	Post-test	10	12.35	0.479	

It was determined that there was no significant difference between the control group of tennis players who applied 8-week routine tennis training, when the pre-test and post-test values related to the Wingate anaerobic power test were compared ($p > .05$). A significant difference was found when the pre-test and post-test values related to the Wingate anaerobic power test of the experimental group tennis players who underwent 8-week functional tennis training were compared ($p < 0.01$) (Table 6).

Table 6. Comparison of pre-test-post-test measurements of the group applying 8-week routine and functional tennis training program in terms of anaerobic capacity

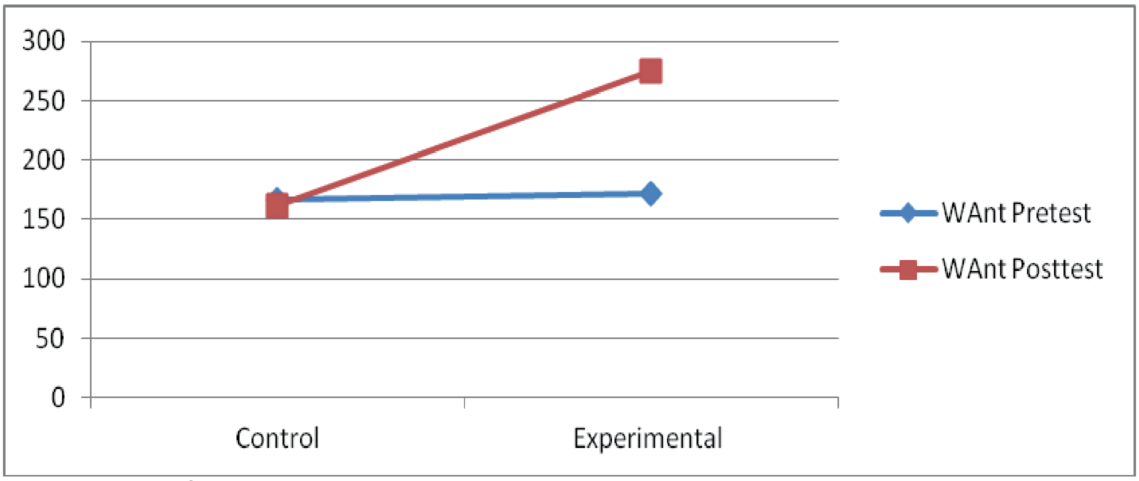
		Test	N	$\bar{x}$	sS	P
WAnt	Control	Pre-test	10	166.73	46.72	.231
			10	161.44	55.75	
WAnt	Experimental	Pre-test	10	172.11	51.22	.022
			10	275.16	73.92	

WAnt: Wingate Anaerobic Power Test

When the biomotor skills of the experimental and the control group of tennis players with 8-week functional and traditional routine tennis training and Wingate anaerobic power test measurements were compared, a significant difference was found in all variables in favour of the experimental group ($p < 0.01$) (Table 7). When comparing the pre-test–post-test values in terms of inter-group anaerobic capacity of the group, which applied the 8-week routine tennis and functional training program, a significant difference was found in favour of the experimental group ($p < 0.01$) (Fig. 2).

Table. 7. Comparison of intergroup pre-test and post-test values of the 8-week routine and functional tennis training in the experimental and control groups

Variables	Group	N	Pre-test	Post-test	sd	F	Sig.
10-m Speed Run (s)	Experimental	10	2.25±0.21	2.10±0.20	18	14.260	.001
	Control	10	2.46±0.24	2.49±0.23			
Vertical Leap (cm)	Experimental	10	22.70±6.14	25.90±6.17	18	10.929	.004
	Control	10	18.70±8.01	18.50±7.99			
Flexibility (cm)	Experimental	10	6.20±10.74	11.90±9.45	18	21.834	.000
	Control	10	6.50±5.38	6.80±5.22			
Hand Gripping Force (kg)-right	Experimental	10	23.85±3.76	27.45±4.38	18	57.686	.000
	Control	10	20.94±4.18	21.01±4.62			
Hand Gripping Force (kg)-left	Experimental	10	21.43±4.74	24.86±4.76	18	62.799	.000
	Control	10	18.59±4.54	18.41±4.79			
"T" Test (s)	Experimental	10	13.44±0.43	12.35±0.47	18	25.023	.000
	Control	10	13.92±0.84	13.86±0.89			



WAnT: Wingate Anaerobic Power Test

Fig. 2. Comparison of the pre-test-post-test measurements in terms of intergroup anaerobic capacity of the group for which the 8-week routine tennis and functional training program was applied

DISCUSSION

Scientific studies [4, 5, 21] shows that functional training practices affect various physiological and biomotor features. Our study shows that there are statistically significant differences between the control and experimental group of girl tennis players before and after the test. It has been suggested that functional training can be as effective as traditional resistance training to increase muscle strength and endurance. According to the findings of the research, because there was no significant difference between anthropometric and demographic parameters, such as age, height, body weight and body fat percentage, it can be asserted that the differences in parameters related to biomotor skills (10m speed run, Vertical Jump, Flexibility, Hand Grip Force, T Test) and Wingate measurements between groups are not due to anthropometric and demographic features. In addition, the findings reveal that functional movement exercises related to tennis improve the biomotor skills of 10–12 year-old tennis players, when applied in parallel with routine tennis training. The literature review reveals few academic studies on functional training in children and child tennis players, and the effect of functional training when it is added to the training programs in addition to tennis training has not been examined [22, 23]. At the same time, there are some studies on the development of biomotor characteristics in children and the relationship between them are revealed. However, it is possible to argue that there is a limited number of studies on "functional training" with regard to the development of athletic performance and biomotor skills in children.

This study found that there was no significant difference regarding biomotor skills between the pre-test and post-test values of the control group of tennis players, who had routine tennis training. The reason for this is the fact that one-way practices are insufficient to develop biomotor skills. In our study, it was found that, when the pre-test and post-test values related to the biomotor skills of the experimental group of tennis players who were applied 8-week functional tennis training were compared, there was a significant difference in all variables. In our study, when comparing the pre-test and post-test values of the control group of tennis players who underwent 8-week routine tennis training, there was no significant difference regarding the Wingate anaerobic power test. In terms of anaerobic power, it can be said that routine tennis training alone is not effective in improving this feature. However, when the pre-test and post-test values of the experimental group of tennis players with 8-week functional tennis training were compared, there was a significant difference regarding the Wingate anaerobic power test. In the study by Song et al. [24], elite high school baseball players implemented a 16-week functional training program, and an increase in strength and flexibility was reported. In another study, Weiss et al. [25] investigated the effects of training methods on muscle strength and endurance, flexibility, agility, balance and anthropometric measurements by applying a 7-week functional training and traditional training program to 38 mixed gender participants between the ages of 18 and 32. In this study, a significant increase in the flexibility characteristics of only the functional training group was detected; contrary to the current study, no significant difference was found in other features. The results of this study support the results demonstrating that functional training has positive effects on biomotor properties.

In the functional training method, it was demonstrated that not only strength and endurance, but also flexibility, balance, coordination and deep sense improved by performing exercises by activating multiple muscles and joints in multiple planes and axes [16, 26-30]. However, the traditional method of training includes exercises to increase the strength and endurance of a particular muscle. These exercises are done in one way. Therefore, recovery with heavy loading is only fast in the corresponding muscle. In addition, routine / traditional training is designed to exercise with free weights in a supported or fixed position, or with stationary training tools. Therefore, it can be considered that the traditional training method alone cannot be sufficient to achieve the desired level of performance [31, 32-33]. As a reason, it is thought that one-way studies are insufficient to improve biomotor skills.

According to the findings, when the biomotor skills and Wingate anaerobic power test measurements of the 8-week functional and traditional routine tennis training practitioners and control group of tennis players were compared, there was a significant difference in all variables in favour of the experimental group. It can be argued that the reason for this significant difference is the functional training practices. In a study by Yıldız et al. [31], it is seen that the functional tennis training model is more effective than traditional tennis training model in terms of athletic performance improvement. When functional training (FT) is considered as a new training method for athletes, it is asserted that athletes develop features such as strength, flexibility, balance and coordination in the target movement in a more balanced way compared to traditional training, because in the functional training approach, movement training, not muscle training, is important. Shaikh and Mondal [34] examined in their study the effect of physical fitness parameters on high school students in 3 days a week for 8 weeks. In the study, it is suggested that functional training provides more muscle dominance, balance, more strength increase, changes in power distribution to large and small muscle groups, and more efficiency in a shorter time. In the study by Ju-sik [35], the effect of the functional exercise program on eight elite Taekwondo players for 6 weeks (three times a week, 60 minutes/session) was investigated. The Wingate test, which tested anaerobic capacity before and after application of training, showed that there was a statistically significant difference in all measurement items. Regarding anaerobic exercise ability, there was a significant increase in both peak power, average power, total power and peak power drop.

So, basic mobility skills are the basic skills that need to be improved by the age of 10, and these skills are almost essential for any sport. Some biomotor skills of children should not be neglected while developing these basic movement skills. Therefore, when the age of specialization comes, children will be able to realize easily their special mobility skills.

CONCLUSION

Functional training practices were performed to demonstrate its contribution to developing biomotor skills when applied in conjunction with routine tennis training, which we consider to be one-way. The findings reveal that functional training performed by imitating tennis, parallel to routine tennis training, improves the biomotor skills of 10–12 year-old tennis player girls. According to the research results, with Wingate (Anaerobic Power) test, regarding the biomotor skills of the control and the experimental group of tennis players who performed the 8-week routine and functional tennis training (10-m speed run, vertical leap, flexibility, Hand Gripping Force (kg)-right and Hand Gripping Force (kg)-left, “T” Test), comparing pre-test and post-test values within and between the groups, there was a significant increase in the experimental group that applied functional tennis training. In this case, it can be suggested that, depending on the design of FT exercises for young tennis players for at least 8 weeks, it contributes significantly to the development of anaerobic capacity as well as biomotor skills. Although working muscles develop individual motor skills, the quality of movement may decrease if the exercises are not performed in accordance with the principles of functional movement (exercises are often performed in one joint and on one plane). Muscles that do not communicate and cooperate with each other as a result of single-joint and single-plane exercises will cause problems in movements. For this reason, it may be recommended that athletes and trainers execute trainings according to the FT principles.

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