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ORIGINAL ARTICLE

The Effect of Big Toe Strength Development on Some Athletic Performance Parameter in Young Male Footballers

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ABSTRACT

Aim: To examine the development of strength exercises for the big toe in young football players and to examine the effect of this development on the athletic performance parameters (vertical jump, contact, dynamic balance) we determined.

Materials and Methods: The study group consisted of 24 individuals, 12 experimental and 12 control groups, who played active football between the ages of 12-14. To the control and experimental group; big toe strength (BTS), vertical jump, tapping, dynamic balance tests were applied as pretest and posttest. BTS exercise was performed on the platform developed to improve the strength of the big toe, 3 days a week for 8 weeks, along with football training, in the experimental group. The control group continued football training for 8 weeks. Since the experimental and control groups of the study showed a normal distribution, it was checked whether the pretest scores of the groups were statistically different, and whether the pretest and post-test values of the experimental and control groups differed in percentage terms with the independent sample t-test. In the analysis of all hypothesis tests, the level of significance was evaluated by taking $p<0.05$

Results: In the 8-week strength exercise we have done to the participants in the experimental group of our study, we see that the BTS scores have increased at the level of significance compared to the control group. This development shows a positive improvement in all anaerobic athletic performance scores.

Conclusion: In conclusion, our study shows that BTS development is positively related to athletic performance parameters.

Keywords: Football, Big Toe, Athletic Performance, Training Science, Exercise

INTRODUCTION

In today's world, a lot of information has been obtained thanks to the data obtained from scientific studies carried out continuously in every field. One of these areas is the sports field, which is constantly developing and has become a large sector. Scientific studies in the field of sports attract the attention of athletes, trainers and sports clubs in this field in terms of contributing to the development of athletes. These studies are carefully followed because of their contribution to the development of athletes [1,2,3,4,5,6].

Playing football requires an actual interaction between technical, tactical, psychological and physiological elements. For this reason, it is stated that football performance depends on numerous factors [7,8]. Football includes many different motoric performances such as running at different tempos, dribbling, shooting, jumping and tackling. Team performance in football depends on the skill of the players, their communication with each other and team unity and harmony [9]. The development of the athletic performance of football players at the maximum levels, increasing their capacity from a technical and tactical point of view, is possible with the development of the physical quality of the athlete. [10, 11]. The sports parameters of football players, such as endurance, mobility, quickness and balance, should be supported and improved by studies appropriate for the football branch. The possibility of mental and tactical development of the athlete is made possible by the studies on the sports performance characteristics that we present [12].

The systematic and purposeful execution of the studies to improve the athlete's performance depends on the athlete's ability to do the exercise better and improve athlete's level [13]. In previous studies on improving athletic performance in football players, it is seen that basic motor skills such as the parameters of endurance, speed, flexibility, strength, balance and agility, contribute to the performance of the athlete. The fact that this development can happen depends on the fact that the football player has a planned and scientific basis for his work and can be applied correctly [14]. These parameters, which affect athletic performance, are very important in terms of improving the performance level of the athlete and reducing the risk of injury. The main factor that is important here is to determine the purpose of the training correctly and apply a training program that is appropriate for the purpose.

Athletic performance studies in football, as in every sport branch, contribute to the athlete's ability to demonstrate their technique better and reveal their talents. Studies show that athletic performance training that begins in childhood, and the performance development obtained by training the right parameters at the right age ranges affects the performance status of the individual in adulthood [15].

The fact that the lower extremity plays the main role in the football game and that it is a game played with the feet has inspired scientific studies. Our feet are in a structure that provides the connection between the outside world and our body. The feet are responsible for the perception of body positioning and providing support in the balance position, as well as for our movement by acting as leverage [16]. The human foot is a complex structure that performs a wide range of functions. The foot, in the position we are standing, provides support to our sole. The foot remains stable during walking and provides support to the pushing movement at the foot strike. The foot plays an important role in static posture and dynamic activities [17].

The thumb plays an important role in the functionality of the foot. During standing, the big toe is more loaded than the head of the five metatarsals and the heel [18]. The coordinated transfer of weight from one leg to the other during walking creates the walking pattern. Oscillating extremity hip flexion moves with knee extension, dorsiflexion of the ankle, and extension of the toe. Extremity hip extension in the stance phase moves with plantar flexion of the ankle and flexion of the toe, especially the thumb [19].

Running requires more power generation than walking. The biggest difference between running and walking is the so-called flying phase. In running, there is a cycle time in which both feet are off the ground. While large concentric forces are needed during the removal of these feet off the ground, eccentric forces are needed during the contact of the feet with the ground. The same muscles, the hip extensors, and ankle plantar flexors, control movement [19]. Mobility and stability of the big toe are critical for the foot to absorb and regulate shock as it touches the ground, stabilize the stride, and support the propulsion [20].

It is seen that the big toe plays an important role in movements such as walking, running, and standing, which are important for our daily life. Despite the fact that the big toe plays such an important role, when the literature is reviewed, there are not enough resources examining the relationship between the strength of the big toe and the athletic performance characteristics of the athletes. This situation showed us that there are deficiencies in this area and the importance of our study. The idea that our study will support the field of sports sciences in this sense has been a source of inspiration for us. In this study, it was aimed to examine the relationship of big toe strength with parameters that affect anaerobic athletic performance in football such as vertical jump (two feet, right-left single foot), foot contact time with the ground and dynamic balance (twp feet, right-left single foot) in young male individuals between the ages of 12-14 who get football education.

MATERIAL AND METHOD

Participants of the Study: Our study group consists of male football players between the ages of 12-14. The participants consisted of a total of 24 people, 12 of which were in the experimental group and 12 in the control group.

Time of the Study: Our study was determined as 3 days a week for 8 weeks. During this period, exercise with resistance bands to improve the toe strength was applied to the experimental group together with football training. The control group continued their football training during this time

Content of the Study: Extension (up) and flexion (down) exercises for the big toe were applied to the experimental group on the platform that we designed and seen below. The exercise was done as 3 sets and 15 repetitions. The athletes got on the platform and performed the exercise according to the instruction of the researcher. The researcher determined the tempo of the repetition numbers. All participants were commanded at the same tempo, and the number of repetitions and rest between sets were adjusted equally (Figure 1-2).

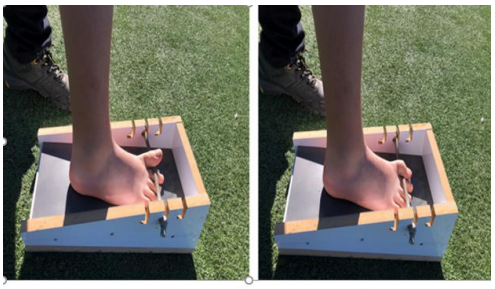

Figure 1: Big Toe Strength Training (Flexion)

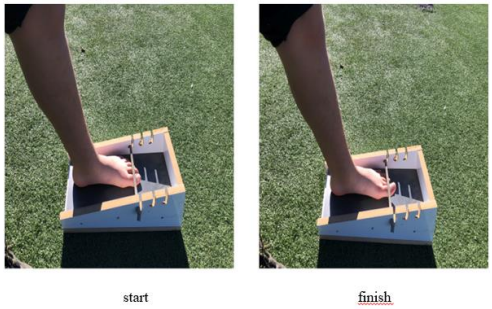

Figure 2: Big Toe Strength Training (Extension)

Measurement of Height: The height measurements of the participants were made with the Seca height measuring device in cm. In height measurements, the highest point of the participants was measured in cm after the spine zone and head were straightened.

Measurement of Body Weight: Participants were allowed to stand on the scale without shoes and clothes (shorts and t-shirts may be allowed) while keeping his/her balance. Weight measurements were measured with Arzum AR550 Sottile brand scale with 0.1 precision. Weight measurements were calculated in kilograms (kg).

Measurement of Big Toe Strength: The strength rate of the big toe was taken by using the Baseline brand digital display hydraulic pinch meter manufactured in the USA. Athletes placed their feet on the ground prepared in accordance with the big toe and adjusted their big toes according to the location of the pinch meter. During the measurement, athletes were asked to apply maximum force with their big toe. Strength measurements were made on the athletes in the sitting position without any support.


Figure 3: Measurement of Big Toe Strength

Tapping Testing: Athletes were asked to perform tapping by using the Desmotec e-board platform. The contact time of the athletes to the ground was measured and the average of 10 repetitions was taken.

Dynamic Balance Test: Dynamic balance measurements of the participants were taken with the Togu MFT Challenge Disc balance platform. Athletes were asked to stand in balance on the platform barefoot and in three different positions (two feet, right feet and left feet) for 30 seconds. The dynamic balance results of the participants were recorded on a computer compatible with the Togu MFT Challenge Disc balance platform.

Statistical Analysis: Statistical analysis was performed using SPSS 25.0 package program. Since the experimental and control groups of the study showed a normal distribution, terms were examined with the independent sample t-test, whether the pretest scores were statistically different between the groups, and whether the pretest and posttest values of the experimental and control groups differed in percentage. In the analyzes of all hypothesis tests, the level of significance was evaluated as $p<0.05$.

RESULTS

Table 1: Comparison of Pretest-Posttest BTS (Big Toe Strength) Development (%) of Experimental and Control Groups

Variant	Group	n	x	sd	t	P
BTS (Big Toe Strength) (Right)	Pretest-Posttest Difference (D.G.)	12	0,29	0,15	2,84	0,009*
	Pretest-Posttest Difference (K.G.)	12	0,10	0,18		
BTS (Big Toe Strength) (Left)	Pretest-Posttest Difference (D.G.)	12	0,40	0,3	3,87	0,001*
	Pretest-Posttest Difference (K.G.)	12	0,05	0,06		

Table 2: Comparison of Pretest-Posttest Jumping Development (%) of Experimental and Control Groups

Variant	Group	n	x	sd	t	P
Jumping (Diagonal)	Pretest-Posttest Difference (D.G.)	12	0,082	0,62	3,4	0,003*
	Pretest-Posttest Difference (K.G.)	12	0,010	0,04		
Jumping (Right)	Pretest-Posttest Difference (D.G.)	12	0,090	0,09	1,96	0,065
	Pretest-Posttest Difference (K.G.)	12	0,032	0,06		
Jumping (Left)	Pretest-Posttest Difference (D.G.)	12	0,123	0,13	1,62	0,119
	Pretest-Posttest Difference (K.G.)	12	0,058	0,06		
Tapping	Pretest-Posttest Difference (D.G.)	12	-0,072	0,06	-1,92	0,069
	Pretest-Posttest Difference (K.G.)	12	-0,030	0,05		

Table 3: Comparison of Pretest-Posttest Dynamic Balance Development (%) of Experimental and Control Groups

Variant	Group	n	x	sd	t	P
Dynamic balance test (two feetl)	Pretest-Posttest Difference (D.G.)	12	-0,131	0,073	-2,59	0,017*
	Pretest-Posttest Difference (K.G.)	12	-0,030	0,112		
Dynamic balance test (right foot)	Pretest-Posttest Difference (D.G.)	12	-0,157	0,097	-3,573	0.002*
	Pretest-Posttest Difference (K.G)	12	-0,044	0,048		
Dynamic balance test (left foot)	Pretest-Posttest Difference (D.G.)	12	-0,094	0,059	-3,431	0,002*
	Pretest-Posttest Difference (K.G.)	12	-0,015	0,054		

DISCUSSION

While the feet are in contact on the ground during walking, at the beginning of this contact, in a small part of the heel area of the foot, a large pressure of approximately 70%-100% of the body weight occurs for a very short time (.05 seconds) [21]. It has been determined that the pressure increases with the increase in speed while walking, and increasing pressure shifts to the medial region of our foot. The big toe has been determined to make the most contribution to the regions supporting this development [22].

When we examine the literature, we see that Goldman et al. (2013) analyzed the relationship between the metacarpophalangeal joint (MPJ) and its toe flexor muscles (TFM). As a result of increasing mechanical stimuli, the effects of walking, running and jumping scores were examined. 5 male individuals performed heavy resistance foot flexor strength training for the right and left foot for 7 weeks with 90% isometric rate. TFM responded highly to the increasing training within a few weeks and it was determined that this development contributed to improving the performance of the athlete [23]. Tanaka et al. (1996) measured swing responses in a single-leg stance on a moving platform and the pressure rates under the toes. The top pressure of the big toe was significantly higher for both sides (ap-ml) than the sum of the top of the other four fingers [24].

When we examine the Table 1, the pre-test and post-test BTS (right) percentile development of the experimental and control groups of our study was found to be 29.1% and 10%, respectively. The pre-test and post-test BTS (left) percentile development of the individuals in the experimental and control groups of the study were found to be 40% and 5%, respectively. In our study, the improvement in the right and left foot scores of the pretest-posttest BTS (Big Toe Strength) in favor of the experimental group shows us that the exercise we have done is effective for the development of BTS (Big Toe Strength). By looking at the effect of BTS (Big Toe Strength) development on other anaerobic athletic

performance parameters, it was determined whether their development was parallel or not.

One of the motor skills that is important for athletes is vertical jumping. Vertical jumping is directly related to the range of motion of the joints that make up the jump force. It has been stated in past studies that jumping performance determines the magnitude of explosive force in sports. Jumping ability is a crucial element in many sporting events. Jumping ability is critical to peak athletic performance [25].

When we examine the literature; in the strength study for the intrinsic flexor muscles conducted by Unger et al (2000), it was observed that there was an improvement in the vertical jump performance of the participants at the end of six weeks [25]. Zhao et al (2018) evaluated the extrinsic muscle strength of the foot with a dynamometer and physical performance with the vertical jump and forward jump tests in their study, however, they found the relationship between extrinsic muscle strength and physical performance weakly significant [26]. In a 6-week strength study conducted by Goldmann et al (2013) for the development of toe flexor muscles, the training group showed approximately 4 times more strength increase in the foot flexor muscles compared to the non-training group. The most remarkable improvement of this strength increase was seen in the performance scores of the horizontal jump and vertical jump with one leg [23]. When we look at the jump scores of the football players participating in our study in Table 2, the vertical jump and tapping developments of the two feet, right feet and left feet show a percentage improvement in favor of the experimental group. However, only the improvement of the two-leg vertical jump performance ($p<0.05$) is at the level of significance.

Our research shows us that there is a positive relationship between the development of big toe strength (ABK) and vertical jump and tapping performances. However, this relationship was found to be significant only in the two-leg vertical jump performance.

Foot flexor muscles are very important in providing static and dynamic balance throughout the movement. The sole of the foot is the area that carries the body in standing position and during movement. In addition, the foot flexor muscles are very important in the posture phase [23.25]. When we examine the literature; Mulligan ve ark (2013) investigated the effects of foot shortening exercise on the soles and toes of the feet for 4 weeks on arch morphology and balance function. As a result of the study, the star balance test was applied to the participants to determine the balance performance. As a result of the study, positive improvement was observed in the reach distances in other directions (anteromedial, medial, posteromedial, posterior) except the anterior direction [27]. Yamauchi and Koyamak (2019) stated that activating the plantar intrinsic muscle is important in stabilizing the foot, and that the weakness of the big toe flexors in sedentary people affects the postural control of the body [28]. Spink et al (2011) conducted a toe grip study for 8 weeks. As a result of the study, an increase of 16% and 26% was observed in the swing (balance) performances with eyes open and eyes closed, respectively. No improvement was observed in the control group participating in the study [29]. It was seen in a study by Lynn et al. (2012), in which the foot shortening and towel gathering exercise performed on the soles and toes for 4 weeks were compared, that while there was no improvement in the static balance rates of the participants after the exercise, an improvement was observed in the dynamic balance scores for both groups [30,31].

When we look at the dynamic balance performances of the football players participating in our study in Table 3, the dynamic balance developments of two feet, right feet and left feet show a percentage improvement in favor of the experimental group. The dynamic balance performances of the athletes were at the level of significance in all three different test scores (two feet, right foot, left foot) ($p<0.05$).

Our research shows us that there is a positive relationship between the development of BTS (big toe strength) and dynamic balance performances. It was observed that this relationship was achieved at the level of significance in all balance test performances.

CONCLUSION

In conclusion, our study shows us that the development of BTS (Big Toe Strength) is positively related to anaerobic athletic performance parameters. It is thought that this information will contribute to sports science and football teams. In previous studies, there is no study that examines only the relationship between BTS (Big Toe Strength) development and athletic performance, like our study. This shows the importance of our work and the necessity of studies in this field. In this sense, we think that it will contribute to the literature and shed light on it.

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