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Comparison of Right- and Left-Leg Balance Points in Female Volleyball Players and Sedentary Controls

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ABSTRACT This research was conducted to compare the static and dynamic balance points of sedentary women and volleyball players. 10 athletes and 11 sedentary women participated in this research. Balance measurements were done by FBT (Flamingo Balance Test) for static balance and SEBT (Star Excursion Balance Test) for dynamic balance. Sedentary group's total dynamic balance value was measured as 619.1± 48.99, and athlete group's was 704.88±67.80. Static balance value of sedentary group was 17.46± 3.05, and athlete group's was 10.75±4.71. As a result, in the both dynamic and static balance values, athlete group had significantly better balance points than the others. It can be stated that this is a result of long term regular training of the athlete group. Also, the left-foot dynamic balance points were higher compared to the right-foot dynamic balance points in especially athletes. The results suggest that leg balances may be related to cerebral lateralization.

INTRODUCTION

Volleyball is one of the sports which are popular around the world. It is a complex sport requiring strength, endurance, coordination and agility. As in the other sports, the balance is one of the most important measurable values for coordination in volleyball. Researchers always keep the research projects about physical attributes, body composition and balance at the forefront when they are trying to define physical, physiological and psychological values which are needed for the top level athletes to be successful (Sucan et al. 2005).

Balance is studied under coordination, and it is basically defined as the ability to maintain the line of gravity of a body within the base of support. Balance is a general notion that explains the dynamics which prevent the body mass to fall down. It is the ability of the body to provide the intended position while moving. In well-developed motor skills, it is essential for the body to stay upright to be able to execute the required move. Balance is also defined as quick and postural adaptation against the changes in the centre of gravity at the time of activity (Erkmen 2006). Maintaining posture and balance are related with each other but they are not the same thing. Balance covers preservation of posture, and substantially it is the coordination of muscular activity (Noyan 1990). It is basis for a good performance and the ability to maintain balance can be defined as the determinant in other motor skills' development (Aksu 1994).

Balance can be explained under two topics; static balance and dynamic balance. Static balance is defined as the ability to control postural sway during standing stance. To sustain static balance, body mass should pass through second sacral vertebrae and stay on the base of support. Dynamic balance is defined as the ability to predict postural changes during movement, and to give appropriate responses to changes on balance (Duncan 1990).

Very complex neuromuscular mechanisms are required to maintain erect posture and to sustain balance during activities (Balaban et al. 2009; Michael and Rogers 2003). There are three groups of receptors relating to balance and orientation. These are vestibular receptors, visual receptors and proprioceptive receptors. In various environments, for body's upright stance and maintaining balance related to gravity, the vestibular system which is located in the inner ear plays an important role. Vestibular system works with the information coming from various systems such as auditory, visual and muscular systems. If vestibular system shuts down due to any cause; physiological and psychological problems such as disorientation, losing balance when walking, tinnitus, changes on heart rate and blood pressure, fear, anxiety and panic may occur (Siegel et al. 1991).

Balance includes hip, knee and ankle joint movements which are controlled by coordinated movements along the kinetic chain. These movements are important for fluidity in movement related to sports. Although balance is thought as a static process, it is actually a whole dynamic process which includes a lot of neural pathways (Prentice 1999). Sport-specific balance ability contributes to overcome emerging motor skills disorders in the situations where the base of support is narrow and the balance could be lost easily. Every branch of sports has its own kind of balance in various levels. Sustaining balance and body position are integral parts of most of the movement activities. Balance loss or failing to keep body position not only hinders the expected performance of the athlete, but also they may cause injuries (Erkmen 2006). In volleyball which is a dynamic branch of sport, while performing technical moves, the athletes must sustain their posture. Ensuring appropriate body balance, all body movements such as serving, defending, attacking can be performed. Performing these moves efficiently depends on the athlete's ability to control their postural sway.

During self-motion, the spatial and temporal properties of the optic flow input directly influence the body sway. Men and women have anatomical and biomechanical differences that influence the postural control during visual stimulation. Recent findings suggest a peculiar role of each leg in the postural control of the two genders. In a recent study, it has been reported that optic flow stimulation causes asymmetry in postural balance and different lateralization of postural controls (Persiani et al. 2015).

Dane et al. (2001) have reported that the left femur bone mineral density, in right-handed subjects, was significantly higher than that of the right femur, and vice versa in left-handed men. The present study's results are consistent with these results. In general, the data of the present study revealed a greater bone mineral density on the non-dominant side compared to dominant side. These studies suggest that the leg balance points may be also related to cerebral lateralization, that is, handedness. Therefore, the relation of hand preference to the bilateral leg-balance points was studied in the present work.

The aims of the present research are (1) to compare the static and dynamic balance values of a team in Turkish Women Volleyball League with sedentary women, and (2) to test the possible association between cerebral lateralization and the leg balance asymmetry.

MATERIAL AND METHODS

Ten trained athletes from Eregli (Turkey) Municipality female volleyball team and 11 sedentary persons (controls), residents of Eregli who had never done sports, in total 21 volunteers participated in this research. There are no statistically significant differences between athletes and sedentary control group for these anthropometric measurements (Table 1).

The height was measured with folding rule, their body mass are measured with Tanita-brand weighbridge with their shirts and shorts on, bare feet. Static and dynamic balance tests were measured individually for dominant leg, non-dominant leg and for various stances.

Body Mass Index (BMI): It is a value obtained by dividing the weight by the square of the height.

BMI = Weight (Kg) / Height x Height (m^2)

Body fat percentage of the participants is determined by putting two skinfold measures taken from triceps and suprailiac in the Sloan-Weir formula.

Body Density (gm/ml) = 1.0764 – 0.00081 (suprailiac) – 0.00088 (triceps)

Body Fat Percentage = (4.57 / Density – 4.142) x100

Dynamic Balance: Measured with SEBT (Star Excursion Balance Test). Participants lie down on the ground which is prepared before; the floor is marked with a star pattern in eight directions, 45° apart from each other. The participants reach as far as possible with the reaching limb along each reaching line. Then, their reaching distant is recorded. The participants are given 180 seconds before the application and 120 seconds between gaps to get to know the test. Balance point is calculated with the formula, distance / leg length x 100. (Bressel et al. 2007).

Static Balance: Measured with FBT (Flamingo Balance Test). The participants get up and maintain balance on a plank balance tool which has 50 cm length, 4 cm height and 3 cm width. Folding one leg from their knee and pulling to their hip then holding the leg with the same side hand. While the participants are in balance like this, timer starts and they try to sustain balance for 1 minute. When the balance is lost, timer stops. When the participants get back up the balance tool and maintain their balance, the timer continues from where it was stopped. This test lasts for 1 minute. When the time is out, every try of the participants' to maintain balance (after losing balance) is counted and then it is recorded as the points of the participants (Hazar et al. 2008). In Flamingo Balance Test, small values indicate better balance score (except 0) (Gürkan et al. 2012).

For statistical analysis, IBM SPSS Statistics v21 was used. Descriptive statistics are done for demographic data analysis. Kolmogorov-Smirnov test was used to determine the normalization of data distribution. The distribution of data calculated parametrically and Student's t-test was used to calculate the difference between averages. For statistical significance p-value < 0.05 was used.

RESULTS

Both static and dynamic balance points of the female volleyball players were statistically significantly different compared to sedentary women (Table 2). That is to say, athletes had the well balance control for both dynamic and static balance.

Also, dynamic balance points of left leg were statistically higher than in the right in athletes (players) (see Table 2). There was also this different for sedentary control group, but, different was not statistically significant.

DISCUSSION

In the present study, the both right- and left-foot dynamic balance points of the elite female volleyball players were higher compared to sedentary peoples. The cause of this statistically significant difference may be due to long term training programs. It is well known that the training programs have also the balance training applications. The female volleyball players had the higher dynamic balance points compared to those of the female football players (Lanning et al. 2006). It can be stated that long term volleyball trainings is important for good balance points in both right and left feet.

Also, the left-foot dynamic balance points were higher compared to the right-foot dynamic balance points in both athletes and sedentary persons. This result was consistent with the study performed by Dane et al. (2001) in which a greater mean bone mineral density in the left hip than the right hip in male right-handers and vice versa in left-handers was found. That is to say, the higher leg dynamic balance points in especially athletes may be associated with the higher bone mineral density their left legs. The results of the present study was also consistent with those of a recent study in which optic flow stimulation causes asymmetry in postural balance and different lateralization of postural controls (Persiani et al. 2015).

In the present study, dynamic balance points of left leg were statistically higher than in the right in athletes. Therefore, it can be stated that there is an asymmetry for leg dynamic balance points. Also, it can be suggested that the leg balance has a relationship cerebral lateralization, handedness, footedness. Some studies have re-

Table 1: The mean and SD of the different anthropometric measurements in the female volleyball players and the female sedentary controls.

	Controls (11)	*Players (10)*
Age (year)	21.09± 3.33 (18-28)	22.30± 4.88 (17-32)
Height (mm)	172.82± 2.63 (169-177)	179.80± 6.63 (170-192)
Weight (kg)	60.73± 5.4 (50-70)	64.80± 7.14 (52-78)
BMI (weight/height^2) (kg/m^2)	0.32± 1.63 (17.51-23.39)	20.03± 1.74 (17.37-22.34)
BFP (%)	19.53± 2.69 (15.25-24.00)	16.99± 1.36 (15.12-19.68)

Table 2: The mean and SDs of dynamic and static balance points in sedentary control group and volleyball players

	Controls (n=11)	*Players (n=10)*	*P*
Dynamic balance (Right Leg)	616.17± 54.51	691.37± 66.25*	0.01
Dynamic balance (Left Leg)	623.65± 53.24	718.39± 71.14*	0.003
Static balance (Right Leg)	17.00± 2.41	10.60± 5.42	0.002
Static balance (Left Leg)	17.91± 4.35	10.90± 4.33	0.002

*p<0.05

ported the relations among sportive success, sport injuries and handedness and cerebral lateralization (Dagistan et al. 2009; Dane et al. 1999; Dane and sekertekin 2005; Dane et al. 2004; Dane and Erzurumluoglu 2003; Ziyagil et al. 2010).

Tan (1985) has reported a negative correlation between hand skill and the excitability of motoneurons of the soleus muscle in right- and left-handers, whereas both-handers had not any significant right-left difference in motoneuronal excitability. That is to say, the motoneuronal excitability of the left-soleus muscle was greater than that of the right soleus muscle in right handers. Thus, in right-handers, the left soleus muscle is important for balance of the body in the upright position while the subject is performing relatively fine movements with the right foot during daily activities. Therefore, it is expected that the left femur is exposed to the weight-bearing effects of the body more than the right femur. The mean bone mineral density values of different sites of the left hip were, in general, higher than corresponding values of the right hip in these studies (Faulkner et al. 1995; Goerres et al. 1998; Yang et al. 1996). On the other hand, Franck et al. (1997) have reported that the total bone mineral density and bone mineral content of the left hip were significantly higher than corresponding values of the right hip in male and female subjects.

In another bone mineral asymmetry study, the mean total bone mineral density of the total right-handers and the mean trochanteric bone mineral density of the right-handed males were greater in the left femur than the right femur (Gümüstekin et al. 2004). The results suggest that femur- bone mineral density and also leg balances may be related to cerebral lateralization.

CONCLUSION

In the present study, dynamic balance points of left leg were statistically higher than in the right in athletes. Therefore, it can be stated that there is an asymmetry for leg dynamic balance points. Also, it can be suggested that the leg balance has a relationship cerebral lateralization, handedness, footedness.

RECOMMENDATIONS

Because of the possible relationship leg balance and cerebral lateralization and handedness, in the studies associated with balance of leg in future, handedness, eyedness, footedness must be taken into account.

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