

THE EFFECT OF VOLLEYBALL TRAINING IN TRUNK SYMMETRY

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Abstract: *The present study aims to determine postural deficiencies in volleyball players depending on the period of practice, in the initiation stage. The evaluation of the posture and the angle between the ankle and the trunk was carried out with the mobile app Apecs-AI Posture Evaluation and Correction System®, the symmetry of the trunk with the "Trunk Symmetry" application included in the device's program. The REEDCO Posture Assessment (RPS) rating scale was used to interpret the results. The results reveal that in maintaining the postural activity in optimal conditions in volleyball players, it is recommended to ensure symmetrical strength gains through conditioning training and core stabilization training.*

Key words: *Posture, Trunk Symmetry, Volleyball, Adolescent, Postural Dysfunction, Mobile app.*

1. Introduction

The aspects of maintaining a correct body position in volleyball players, is one of the directions that must be targeted in physical training, because technical-tactical training involves motor skills and specific positions, which can produce certain postural dysfunctions, with connotations in the efficiency of the game.

The relationship between sporting activity and body composition has often been examined by considering the effects of physical activity on body composition and density [4], [15]. The effects of intense physical activity on bilateral

symmetrical structures in athletes have mostly been addressed by examining the upper extremities [12], [23].

The human body, as a result of the harmonious operation of the musculoskeletal system in its structure and the elimination of existing mechanical problems, the posture posture is healthy, and the movements made by the left side without being balanced disrupt the symmetry of the body and may cause discomfort on the spine in the long term [20], [14]. One of the sports with the highest asymmetric loading is volleyball, which is widely preferred today. In volleyball, individuals aim to improve their

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technical skills such as serving, attacking, or blocking. One-way and repetitive exercises such as serving and attacking involve a series of asymmetrical techniques that can negatively affect posture, especially in adolescent volleyball players [3].

In volleyball, there are many other movements that we perform with our body members during the match other than hitting the ball. Players have to take the correct position in both the vertical and horizontal axis. The movements in the horizontal axis before the offense give the players the maximum opportunity to achieve the best result [29]. Although volleyball involves rotational movements, it is a sport in which flexion and extension posture is dominant in the spine. This posture of the spine has been associated with changes in sagittal plane curvatures [16]. In volleyball, movements such as spiking and serving are done with trunk rotation. With this trunk rotation, rotating the shoulders and hips in opposite directions provides diagonal stretching of the trunk. Core muscles have an important role in transferring this power produced in the trunk to the extremities [1].

Although it is stated in the literature that the anatomical and physiological stress parameters contained in sportive exercises cause deterioration in the postural structure [26], [28], different findings have been reported to positively affect the physical structures of children and young people in the developmental period [8], [5]. Good posture is defined as the vertical position of the center of gravity of each body segment on the segment below it. Postural deviations/anomalies occur when the gravitational centers of the segments are displaced [36].

In poor posture, the balance between body parts is disturbed, resulting in a negative relationship with each other. Tension increases in supporting structures; a less efficient body balance occurs; energy consumption increases and supporting structures become inadequate [6], [13], [33]. Posture analysis is one of the methods widely used by many researchers to evaluate the performance of professional athletes, examine their body profile, determine the risk of injury and improve their performance [21], [16].

It can be done in many different ways. The most effective and accurate method is the radiology method. However, since the availability and prevalence of this method is low, posture analyzes are performed with different methods. These methods have become more advanced over time thanks to technology. In the early periods, posture analyzes were performed with special rulers, plumb or posture boards, but recently posture analyzes have been performed with computers and smart phones or tablets [2]. Studies have shown that the period with the highest susceptibility to postural defects is the adolescent period [34], [25]. Unidirectional and repetitive exercises in sportive activities significantly affect the postural structure of young people in the development process. In this context, the postural structure of athletes has been the field of study of many researchers, and it has been determined that physical training affects body posture in a certain direction [16], [22].

The aim of this study was to compare the effects of training loads on the trunk symmetries of athletes with a training age of 1 year or less and athletes with a training age of 2 years or more.

2. Material and Method

Apecs-AI Posture Evaluation and Correction System® (Apecs Posture Analysis 8.2.6 Version) mobile app posture application was used for posture analysis of the participants.

Trunk symmetry measurements of the participants were made with the “Trunk Symmetry” application included in the “Apecs-AI Posture Evaluation and Correction System® (Apecs Posture Analysis 8.2.6 Version)” program.

The angle between the ankle and the trunk was considered in the posture analysis measurements of the participants. The posture data obtained from the participants were evaluated using a posture scoring scale called “Reedco Posture Assessment (RPS)”.

3. Data Collection Tools

3.1. Apecs-AI Posture Evaluation and Correction System®

APECS is software created for the assessment of posture with non-invasive photogrammetry techniques and for the correction and prevention of posture disorders through various exercises. The app has been in development since 2017 and was first available on Google Play in 2018.

3.2. Reedco Posture Assessment

The Reedco Posture Score is a standardized method for the assessment of whole-body posture in the sagittal and coronal planes in outpatient and inpatient settings since 1974 [30]. It is also widely used as an easy and cost-effective method. With this method, the individual is observationally evaluated laterally and posteriorly in terms of 10 postural

characteristics. The lateral assessment includes the neck, upper back, trunk, abdomen and lower back in the sagittal plane, while the posterior assessment includes the head, shoulders, spine, hips and ankles in the coronal plane. RPS scoring is based on postural alignment on a scale of 1 to 10, with “0” (poor posture or severe deviation), “5” (inadequate posture or minimal to moderate deviation) and “10” (good posture or normal alignment). A maximum score of 100 indicates good posture, while a score of 59% or less indicates postural dysfunction [27].

3.3. Posterior Trunk Symmetry Index (POTSI)

Posterior Trunk Symmetry Index (POTSI) is an objective method that evaluates body shape and symmetry from measurements made with a tape measure from certain anatomical points on the back in a standing position, without any part of the individual's body. It contains a total of six indices, including frontal asymmetry index and height difference index from each region for shoulder, axilla and trunk. POTSI total score is the sum of the scores obtained from these indexes. Higher values indicate increased asymmetry [32].

3.4. Participants

Our research included 55 adolescent youth players who were actively training in volleyball clubs operating in Manisa, with an average age ($X \pm SD$) of 12.75 ± 1.224 years, an average height of 1.61 ± 0.075 m, an average training age of 1.90 ± 1.323 years and an average body weight of 50.40 ± 9.115 kg and BMI 19.242 ± 2.584 . The training age of 23

athletes of the participants was determined as <2 , and the training age of 22 athletes was determined as >1 and they were categorized into two groups.

(ANOVA) was used for independent samples. Pearson Correlation Analysis was used to examine the relationship between variables.

4. Analysis

The data obtained from the research were analyzed using SPSS 22.0 package program. One-way Analysis of Variance

5. Results

After analyzing the results, the following were recorded:

Postural Assessment Results Centralizer

Table 1

Training Age	Indicators	Appreciation scale	N	X	SD	Std. Error Mean
	RPS_LEVEL	<50		27	2,111	1,219
>50			28	1,714	1,410	,266
POTSI_LEVEL	Under 9		25	2,360	1,629	,325
	Over 9		30	1,533	,860	,157

X-mean, SD- Std. Deviation

The interpretation of the results of the RPS indicator reveals the fact that no subject is at a zero value, the deviations being greater than 1 for 27 subjects and over 2 for a number of 28 child volleyball players, a fact which signifies a tendency to favor slight body deformities in the future. At the POTSI indicator, the closer

the value is to zero, the correct and normal postural attitude is recorded. In our subjects, 25 have a value above 1.5 and 30 below 1, which means a slight deviation of the symmetry of the trunk, but within normal limits, according to table 1.

Pearson correlation analysis between variables, on the whole sample

Table 2

Correlations (No. subjects=55)						
		Age	BMI	Training Age	RPS	POTSI
Age	Pearson Correlation	1	,184	,259	,018	-,111
	p		,178	,056	,896	,419
BMI	Pearson Correlation	,184	1	,348**	-,128	-,022
	p	,178		,009**	,351	,874
Training Age	Pearson Correlation	,259	,348**	1	-,177	-,231
	p	,056	,009**		,196	,089
RPS	Pearson Correlation	,018	-,128	-,177	1	,049
	p	,896	,351	,196		,721
POTSI	Pearson Correlation	-,111	-,022	-,231	,049	1
	p	,419	,874	,089	,721	

** . Correlation is significant at the $p \leq 0.01$ level (2-tailed).

According to the results in table 2, referring to Pearson's correlation coefficient, a very weak correlation is observed between age, BMI, RPS and POTSI. A weak correlation between training age and age, BMI and POTSI. As a

result of the analysis, a positive significant relationship was detected between the BMI averages of the participants and the Training Age variable ($p < 0.05$).

Table 3

One-Way Variance Analysis Results Between REEDCO Test Scores and Training Age Variable (One-Way ANOVA)

		Levene's Test for Equality of Variances		t	df	p	Mean Difference	95% Confidence Interval of the Difference	
		F	Sig.					Lower	Upper
Training Age	Equal variances assumed	14,129	,000	2,407	53	,020	,826	,137	1,515
	Equal variances not assumed			2,285	34,883	,029	,826	,091	1,561

p- Sig. (2-tailed); $p \leq 0.05$

According to table 3, between the volleyball specific training period and the REEDCO scores, they are strongly significant, $p \leq 0.01$, interconnecting.

6. Discussion

The posture habits acquired as a result of studies involving the movement content and postures of the sports branch from a young age affect the posture. Unilateral training loads may affect the symmetry of the physical structure [19]. Since fast and sudden movements are made in the vertical and extreme axis in volleyball, low muscular strength may cause an increase in sports injuries [35].

Specifically in the game of volleyball, after diving and blocking movements, due to joint and muscle demands and overloads, the incidence of sprains in the shoulders, elbows and knees increases. In addition, finger injuries and palm joint

tendon tears can occur during passing and blocking movements [17]. In particular, skills such as dunks and serving and receiving high-profile passes on defense place more stress on the front than the back of the body. This causes the chest and abdominal muscles in the front of the body to shorten. If concentric activity increases in the pectoralis major, pectoralis minor, serratus anterior muscles in the front of the body, the trapezius, rhomboid major and minor muscles in the dorsal part of the body are also maintained in eccentric activity. Normal anatomical curves are observed in the spine, which allows the body to have a correct posture. Game actions assume an anatomically normal dorsal kyphosis, but the affected muscle tone of the back muscles triggers an increase in the kyphosis angle, over time [9].

In a study conducted on adolescent volleyball players, considering a short training period, it was reported that the

kyphosis angle did not register significant differences compared to non-athletes. [16]. Previous studies have found higher kyphosis angles in elite volleyball players compared to novices [24], [37], these studies support the results of the present study. Sports science and athletes' training levels are constantly evolving. The foundations of this development are largely; It is based on understandings that have changed and expanded from past to present regarding how the body adapts to different physical and psychological loads [7], [31], [11]. At the same time, epidemiological studies have shown that posture disorders are generally common during adolescence [10]. When the results of literature studies were examined, it was determined that the most common posture disorder in volleyball athletes was kyphosis, which is characterized by rounded shoulders, and asymmetries in the pelvic girdle were associated with trunk rotation and negatively affected trunk symmetry [38], [18].

7. Conclusion

The postural adjustment and competition age of individuals are related, and the training loads acquired by the athletes are on the postural patterns. Due to the high susceptibility to postural defects, especially in the adolescence period, it is thought that the training methods applied in this period should be supported with corrective exercises. In order to keep postural activity in optimal condition in volleyball players, it is recommended to provide symmetrical strength gains through conditioning training and core stabilization training.

References

1. Akuthota, V., Nadler, S.: *Core Strengthening*. In: Archives of Physical Medicine and Rehabilitation, Vol. 85, 2004, S86-S929.
2. Altinel, L., Köse, Ç.K., Aksoy, Y.: *Degrees of hip rotation, inward walking problem and sitting habits in kindergarten children*. In: Acta Orthop Traumatol; Vol. 41(3), 2007, p. 190-194.
3. Aka, H., Akarçeşme, C., et al.: *The relationship of wrist and shoulder joint isokinetic strength and service and spike velocity in elite female volleyball players*. In: Turkish Journal of Sport and Exercise, Vol. 21 (1), 2019, p. 182-187. DOI: 10.15314/tsed.513422.
4. Badau, D.: *The role of symmetrization in the game of handball*. In: Ovidius University Annals, Series Physical Education & Sport/Science, Movement & Health, 2009, Vol. 9(2), 189-191
5. Badau, D., Badau, A., et al. *The effects of 6-weeks program of physical therapeutic exergames on cognitive flexibility focused by reaction times in relation to manual and podal motor abilities*. In: Balneo and PRM Research Journal, Vol. 14(3), 2023, p. 570
6. Badau, D., Badau, A., et al.: *The Motor Impact of the Static Balance in the Up Plank Position on Three Different Balls in Physical Activities of Physical Education Students*. In: Int. J. Environ. Res. Public Health Vol. 18, 2021, 2043. <https://doi.org/10.3390/ijerph18042043>
7. Bompa, T.O., Haff, G.G.: *Periodization: Training Theory and Method*. 1999. (Trans. Tanju Bağırgan), Sport Publishing House and Bookstore, Ankara, 2015.

8. Boreham, C., Riddoch, C.: *The physical activity, fitness and health of children*. In: *J Sports Sci*, Vol. 19, 2001, p. 915- 929.
9. Celik, A.Ş *The Most Common Injuries in Volleyball Players And Their Causes*. In: *International Journal of New Trends In Arts, Sports & Science Education* Vol. 12(3), 2023, p. 200-212.
10. Cho, C.Y.: *Survey of faulty postures and associated factors among Chinese adolescents*. In: *J Manip Physiol Ther*, Vol. 31(3), 2008, p. 224-9.
11. Ciulea, L.E., Szabo-Csifo, B.: *The role of the functional training in optimising the motric capacity of junior female teams i-volleyball*. In: *Stud. Univ. Babeş-Bolyai Educ. Artis Gymnast*, 2014, Vol. 59, p. 4
12. Claussen, BF.: *Chronic hypertrophy of the ulna in the professional rodeo cowboy*. In: *Clin Orthop Relat Res*, Vol. 164, 1982, p. 45-47.
13. Demir, I.C., Çilli, M.: *Examination of the effects of 12-week Pilates mat exercise on some biomotor properties and technical performance of 14-15 year old volleyball female students*. In: *Online Turkish Journal of Health Sciences*, Vol. 3(1), 2018, p. 1-13.
14. Dusa, F.S., Badau, A., et al.: *Investigating the Deformation Parameters of PVC Fitness Balls in Relation to the Height and Body Mass Index of the Users*. In: *Mater. Plast*. Vol. 54, 2017, p. 606–609.
15. Malata, M., Maly, T., et al.: *Unilateral and Bilateral Strength Asymmetry among Young Elite Athletes of Various Sports*. In: *Medicina (Kaunas)*. Vol. 10, 2020, 56(12), p. 683. doi: 10.3390/medicina56120683
16. Grabara, M.: *Comparison of posture among adolescent male volleyball players and non-athletes*, In: *Biol. Sport*, Vol. 32, 2015, p. 79-85. doi: 10.5604/20831862.1127286.
17. Ingle, B.H.: *The study of volleyball universal injuries: Its kinds and remedies*. *International Conference on Enhancing Skills in Physical Education and Sport Science bildiriler kitabı içinde*, 2020. London, Rubicon Publications, p. 524-526.
18. Jones, H.H., Priest, J.D., et al.: *Humeral hypertrophy in response to exercise*. In: *J Bone Joint Surg*, Vol. 59-A, 1977, p. 204-208.
19. Karakus, S., Kılıç, F.: *Postür ve Sportif Performans*. *Kastamonu Eğitim Dergisi*, Vol. 14(1), 2006, p. 309-322. Retrieved from <https://dergipark.org.tr/en/pub/kefdergi/issue/49106/626681>.
20. Kayacan, Y, Makaracı, Y.: *Analysis of postural structure of handball players with computer-based symmetry graph method*. In: *Journal of Sports and Performance Research*, Vol. 8(1), 2017, p. 27-33.
21. Kiliç, F., Yaman, et al.: *Investigation of the effects of intensive one-sided and double-sided training drills on the postures of basketball playing children*. In: *Journal of Physical Therapy Science*, Vol. 21(1), 2009, p. 23-28.
22. Kim, B.B., Lee, J.H., et al.: *Effects of suboccipital release with craniocervical flexion exercise on craniocervical alignment and extrinsic cervical muscle activity in subjects with forward head posture*, In: *Journal of Electromyography and Kinesiology*, Vol. 30, 2016, p. 31–37.
23. Kountulainen, S., Sievanen, H., et al.: *Effect of long-term impact-loading on mass, size and estimated strength of humerus and radius of female*

- raquet-sports players: a peripheral quantitative computed tomography study between young and old starters and controls.* In: J Bone Min Res. Vol. 18, 2003, p. 352-359.
24. Lichota, M., Plandowska, et al. *The shape of anterior-posterior curvatures of the spine in athletes practising selected sports.* In: Polish J. Sport Tour, Vol. 18(2), 2011, p. 112–116.
25. Morina, B., Miftari, F., Badau, D.: *Fitness Level Differences between Students in Kosovo and Montenegro.* In: Educ. Sci. Vol. 11, 2021, p. 140. <https://doi.org/10.3390/educsci11030140>
26. Nechita, F.: *Biomechanical and Kinetotherapeutical aspects of the Scapulo-Humeral Periarthritis Syndrome,* In: Bulletin of the Transilvania University of Braşov, Series IX: Sciences of Human Kinetics, Vol. 12(61), No. 2, 2019 <https://doi.org/10.31926/but.shk.2019.12.61.2.53>
27. O'Neil, M.B., Woodard, M., et al.: *Physical therapy assessment and treatment protocol for nursing home residents.* In: Phys Ther., Vol. 72(8), 1992, p. 596-604.
28. Park, K.H., Oh, J.S., et al.: *Difference in selective muscle activity of thoracic erector spinae during prone trunk extension exercise in subjects with slouched thoracic posture,* In: PM&R, Vol. 7(5), 2015, p. 479-484.
29. Pérez-Turpin, J.A., Cortell-Tormo, J.M., et al.: *Gross movement patterns in elite female beach volleyball.* In: Kinesiology, Vol. 41(2): 2009, p. 12-219.
30. REEDCO. *Reedco posture score.* Auburn, New York. 1974.
31. Scurt, M.-D., Scurt, C., et al.: *Relationship between Body Mass Index and Muscle Strength, Potential Health Risk Factor at Puberty.* In: Revista Românească pentru Educație Multidimensională, Vol. 14(4Sup1), 2022, p. 93-111. <https://doi.org/10.18662/rrem/14.4Sup1/661>.
32. Suzuki, N., Inami, K., et al. *Analysis of posterior trunk symmetry index (POTSI) in scoliosis. Part 1.* Stud Health Technol Inform. 1999;59:81-4.
32. Tittlbach, S.A., Sygusch, R., et al.: *Association between physical activity and health in German adolescents,* In: Eur J Sport Sci, Vol. 11(4), 2011, p. 283-291.
33. Tohänean, D.: *Morpho-Functional and Psychiatric aspects of Children at the age of 10-14 years,* In: Bulletin of the Transilvania University of Braşov, Vol. 2(51), 2009, Series VIII, p.157-162.
34. Verhagen, E.A., Van der Beek, A.J., et al.: *A one season prospective cohort study of volleyball injuries.* In: British Journal of Sports Medicine, Vol. 38(4), 2004, p. 477–481. (<https://doi.org/10.1136/bjism.2003.005785>).
35. Watson, A., Mac Donncha, C.: *A reliable technique for the assessment of posture: assessment criteria for aspects of posture.* In: J Sports Med Phys Fitness. Vol. 40(3), 2000, p. 260.
36. Ying, J., Ren, F., Fekete, G.: *Dynamictesting of volleyball players' body posture using a formetric 3D device.* In: Biosurface and Biotribology, Vol. 6(4), 2020, p. 114-117.
37. Yorukoğlu, U., Mitat, K.: (2007). *The Effect of Sports School Activities and Basketball Training on the Physical, Physiological and Anthropometric Characteristics of 10-13 Year Old Boys.* In: Spormetre Journal of Physical Education and Sports Sciences, Vol. 5(2), 2007, p. 79-83.