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THE INFLUENCE OF LONG-TERM TABLE TENNIS TRAINING ON THE INCIDENCE OF THE IMPROPER POSTURAL ALIGNMENTS (PARAMORPHISMS)

Abstract

The main objectives of this investigation were to (a) classify the subjects (table tennis players - TTP, and age-related controls - C) according to their postural alignment status, as well as to (b) determine is there any relation between long-term active table tennis training and emergence of improper postural alignments (paramorphisms) in children and youth. The sample of subjects comprised 67 TTP, younger cadets and cadets; and 80 C (all 10-14 years of age). Measurement of the postural status indicators was performed using the photo-equipment of the high-resolution. Digitalized photo shots were taken in the frontal and sagital plane, and additionally processed using the "Posture Screening" software program in beta version.

According to data calculated by means of the taxonomic and discriminant analysis it can be concluded that there is (a) no significant difference between TTP and C regarding their clustering into groups of the different-postural-alignments, while (b) significant differences were found in several indicators of the postural status. Although considerable incidence of the improper postural alignments is found, it has to be stressed as the general problem in youth and not to be directly related to regular table tennis training. Table tennis training brings forward some specific circumstances in a problem of the improper postural alignment, e.g. lowered shoulder of the dominant hand and somewhat hunchbacked basic position in a sagital plane, all mainly linked to biomechanical and structural characteristics of the sport.

Results obtained herein, as well as the high incidence of the improper postural alignments, directly point at importance of the general preparation of a locomotor system in athletes; mainly because that there is no doubt that multi-approachable conditioning training, adjusted to the athletes age; can positively influence the proper and symmetrical development in young TTP. In such manner, it is possible to diminish some negative consequences that a frequent and intensive table tennis trainings could have on the postural status.

Key words: *postural alignments, paramorphisms, table tennis, software program (computer program)*

INTRODUCTION

Increasing incidence of the improper and incorrect body postures (paramorphisms) in children and youth is recognized as highly important problem in modern societies, which, in case of underestimation can lead to structural deformities (dismorphisms), which are hardly correctable, and inquire a long-term and serious medical treatments (in particular cases - even the orthopedic).

Although it is generally clear that the physical activity unquestionably positively influences several organs and organ systems, sport medicine physicians report an increasing incidence of the incorrect and improper body postures and deformities in children and youth regularly included in some sport activities (Kosinac 2002). Therefore, although proper application of the kinesiological operators (in a term of physical exercising and sports) in kinesitherapy is a one of the most reliable basis in the treatment of some ailing conditions and sicknesses, it is also obvious that in some cases and in several sports, exclusive positive influence and effects has to be inquired. It

especially considers modern top-level sport, which implicate regular and maximal - even extreme workloads and training intensities, which can initiate negative consequences on children and youth in sensitive developmental age. In young athletes, spine is on particular risk, but the other parts of the locomotor system are also significantly impacted.

Although attitudes of the experts are opposed, and there are no reliable scientific evidence regarding sport as a direct cause and the initiation of some paramorphisms like scoliosis and kyphosis, there are indications that together with some of inheritance and genetically determined inclinations, several sports, especially those asymmetrical, can negatively influence the postural status, and therefore – to cause some deformities. In athletes it can lead to several health issues and problems (e.g. back pain; chronic fatigue,…), and therefore negatively influence theirs' competitive efficacy, and in some cases – theirs' sport career as a whole.

Because of the biomechanical and structural characteristics of the table tennis, which is observable in (a) asymmetrical nature (repetitive performance of the strong, one-arm-strokes); (b) hunched basic position; and (c) strong rotations in hips and lumbar region; there is reasonable doubt that the table tennis players are additionally imposed to several factors which can initiate occurrence and development of the paramorphisms, when comparing to the normal population. Consequently, the main objective of the present study was to (a) classify the subjects - table tennis players in several clusters according to their postural alignment status, as well as to (b) determine is there any relation between the long-term active table tennis training and the emergence of improper postural alignments (paramorphisms) in children and youth.

METHODS

Cases

The sample of examinees in this study was consisted of 67 table tennis players (E; TTP) of the high competitive rank in its age group (younger cadets and cadets; 10-14 years of age). The only obligatory circumstance for the study entry of the TTP was the proper registration in Croatian table tennis federation, and active practicing of the table tennis for three years minimally. The control group (C) was consisted of 80 same-aged boys; non-engaged in table tennis training, for the purpose of presenting general population of boys, 10-14 years of age.

Variables

The sample of variables consisted of postural status indicators. The measurement was conducted knowing the referent points of the body regarding the gravity line in sagital and frontal plane (Auxter, Pyfer, Huettig 1997; Palmer and Epler, 1998) and comprised numerical values of the four referral points in the sagital plane (Figure 1), and five referral points in the frontal plane.

Postural status indicators in the frontal plane:

- FUHO – the indicator of the divergence between the (a) line which connects upper ear lobes (left – to- right) and (b) horizontal line. Indicator is measured by computer program in degrees
- FRAM - the indicator of the divergence between the (a) line which connects left and right sacromion and (b) horizontal line. Indicator is measured by computer program in degrees
- FZDJ - the indicator of the divergence between the (a) line which connects left and right spina iliaca anterior superior and (b) horizontal line. Indicator is measured by computer program in degrees
- FKOL - the indicator of the divergence between the (a) line which connects left and right s epicondylus medialis and (b) horizontal line. Indicator is measured by computer program in degrees
- FNZG - the indicator of the divergence between the (a) line which connects left and right s malleolus medialisa and (b) horizontal line. Indicator is measured by computer program in degrees

Postural status indicators in the sagital plane:

- SUHO – the indicator of the divergence between the (a) upper left ear lobe, and (b) gravity line. Indicator is measured by computer program in numerical unit
- SRAM – the indicator of the divergence between the (a) left acromion, and (b) gravity line. Indicator is measured by computer program in numerical unit
- SZDJ – the indicator of the divergence between the (a) left spina iliaca anterior superior, and (b) gravity line. Indicator is measured by computer program in numerical unit
- SKOL – the indicator of the divergence between the (a) epicondylus medialis, and (b) gravity line. Indicator is measured by computer program in numerical unit

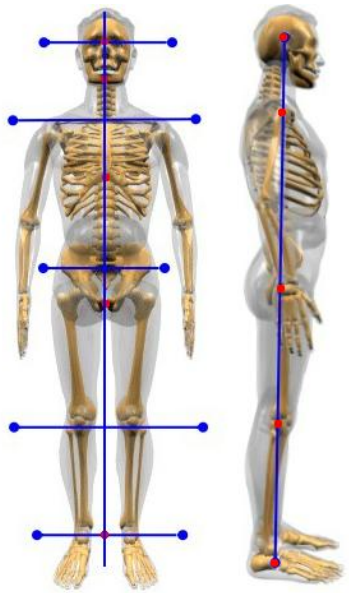

Figure 1. Referral points in frontal and sagital plane including gravity line

The measurement is performed using the digital photo equipment (camera; computer applied with adequate software). The data application is performed by importing digital photo of the subjects in sagital and frontal plane. Accordingly, it was possible to determine eventual improper postural alignments, known as kyphotic, lordotic, and scoliotic body postures; as well as different incorrectness, like improper alignment in the cervical spine, shoulder positioning, flat back, chest muscle asymmetry, so called "X" and "O" legs, etc.

Figure 2. Test managing (photographing of the examinee)

The whole measuring procedure, in each parameter, was repeated three times, to reveal measuring instrument of the composite type with three times. The measuring procedure was performed by the standardized measuring protocol, explained in the following measuring card.

Presentation 1. Test explanation

Exact naming of the test	Posture positioning in two planes
Technical characteristics	The space where the measuring is performed has to be of minimally 5 x 2 meters, and well lightened. The examinees positioning spot is marked by one line on the floor. Three meters apart of the examinee's positioning, photo equipment on stativ-holder is placed.
Explanation of the measurement	The examinee stands on the line drawn on the floor facing the photo. The examiner places yellow markers (small circle adhesives) on referral points of the examinee. Following, the photo was taken. Next, the examinee is placed in sagital plane, markers are positioned, and photo is taken.
Instructions given to the examinee	"You should stand on the drawn line facing the camera in straight relaxed position, hands relaxed, foots shoulder-wide apart. Next, you should turn for 90 degrees in the same position"
Results of the examinee	The results of each referral point will be calculated using the computer software, and referred in degrees and/or centimeters.

Data processing methods

Photographs obtained were processed by software program "Posture screening" in beta version, authored by Jelena Paušić. The results in each indicator of the postural alignment were computed by statistical software package Statistica 6 (StatSoft).

Results were calculated by discriminant analysis (by means of Burtlet's χ^2 test), and included following parameters; variance of the discriminant function (λ), canonical correlation coefficient (*Rc*) and Wilk's lambda coefficient ($W\lambda$) discriminant functions, correlations of the variables with discriminant functions (matrix of the structure), centroids of the groups on the discriminant functions, and descriptive parameters: means (AS), and standard deviation (SD). The types of the postural alignment in frontal and sagital plane were obtained by taxonomic analysis, by method of K-Means, with selection of three clusters.

RESULTS AND DISCUSSION

The calculated indicators of the body posture are divided in two groups regarding plane in which photo was taken. Therefore, they are independent, and can divide examinees in several groups based on the type of body alignment. The types of the body alignment were defined by taxonomic analysis, and three types of body alignment were identified, separately in each plane. The types obtained, and categorizations in each type (expressed in percent) are presented in tables 1 and 2.

Accordingly, it is evident that in both groups (C and E) single type of the body-posture-alignment exists, and that there is a large percent of the boys within some of the groups with improper body-posture-alignment.

Generally, when observing boys in a sample of table tennis players, only few more than one-third (34,3%) can be stipulated as correct in frontal posture. However, it is still far better than in general population, where only each fifth pupil (19,4%) can be considered as correct in the frontal posture. Regarding the sample of table tennis players, situation is far worse in the sagital plane, since only one-fourth can be considered as correct in (sagital) posture (26,9%), while even one-third has highly incorrect posture status (31.3%). The main reason for such a condition can probably be found in hunched basic position while playing, highly characteristic in table tennis, which - if accomplished for a long time, can greatly increase the probability for improper postural alignment in the sagital plane.

Table 1. The percent of the examinees belonging to the different types of frontal postural alignments (OP – general population of boys, ST- boys table tennis players)

Types of frontal postural alignments	**%$_{OP}$**	**%$_{ST}$**
correct frontal postural alignment	19,4	34,3
mildly scoliotic postural alignment	47,6	28,4
mildly two-sided scoliotic postural alignment	33,0	37,3
Total	100,0	100,0

Table 2. The percent of the examinees belonging to the different types of sagital postural alignments (OP – general population of boys, ST- boys table tennis players)

Types of frontal postural alignments	**$\%_{OP}$**	**$\%_{ST}$**
correct sagital postural alignment	29,3	26,9
mildly incorrect sagital postural alignment	41,8	41,8
highly incorrect sagital postural alignment	28,9	31,3
Total	100,0	100,0

To establish the differences between the two samples of boys we studied, we defined the structure of discriminant functions, calculated separately in frontal and sagital indicators of the body posture. Results presented in the following tables (3 and 4) shows that discriminant functions are statistically significant, and therefore significant differences between two studied samples can be identified in some of the indicators studied.

Table 3. Test of the significance for the discriminant functions *(F – frontal indicators of the postural alignment, S - sagital indicators of the postural alignment)I*

	λ	**R_C**	**Wλ**	**χ^2**	**df**	**p**
DF_F	0,18	0,39	0,85	23,5	5	0,00
DF_S	0,97	0,70	0,51	96,8	4	0,00

In the frontal indicators, the most important factor of the significant differences between samples is – positioning of the knees. This indicator in frontal plane is more correct in the table tennis players than in boys drawn from the general population. Another one important indicator is divergence in shoulders in frontal plane, where the table tennis players achieve higher divergence than the boys drawn from the general population (0,98 and 0,35 degree respectively). Positive values in degrees, of their average values, indicate that in both samples inclination of the left shoulder when comparing to right one is evident. Since it is more indicated in the table tennis players, the main reason have to be found in a simple fact that a most of the tested players are right-handers. Therefore, it seems reasonable to conclude that they have relatively more developed muscles of the right side of torso, especially m. lattisimus dorsi and m-trapezius, which "pull" the peak of the shoulder down and back. Somewhat lower shoulder of the dominant hand in the table tennis players is often clearly observable, and does not necessarily to be identified by software program.

Table 4. Descriptive indicators *(mean – AS and standard deviation – SD) with identification of the discriminant function structure (DF), and analysis of the variance (ANOVA) separately in frontal, and in sagital indicators of the body posture)*

Indicators	AS $_{OP}$	SD $_{OP}$	AS $_{ST}$	SD $_{ST}$	F	p	DF
FUHO	-0,20	2,15	-0,85	2,86	2,2	0,14	0,31
FRAM	0,35	1,60	0,98	2,37	3,7	0,05	-0,37
FZDJ	-1,47	1,46	-0,64	2,24	3,5	0,06	-0,53
FKOL	-1,04	1,51	0,10	2,39	10,4	0,00	-0,69
FNZG	-1,23	1,61	-1,63	2,99	1,8	0,19	0,20
						C $_{OP}$	0,39
						C $_{ST}$	-0,46

Indicators	AS $_{OP}$	SD $_{OP}$	AS $_{ST}$	SD $_{ST}$	F	p	DF
SUHO	-3,88	2,71	-6,05	3,14	0,09	0,77	0,38
SRAM	-3,23	2,87	-4,82	3,04	3,24	0,07	0,27
SZDJ	-5,11	2,45	-9,05	2,72	68,32	0,00	0,78
SKOL	-1,72	2,04	-0,39	1,41	27,63	0,00	-0,38
						C $_{OP}$	0,89
						C $_{ST}$	-1,07

The factor which mostly contributes to significant differences between samples in sagital parameters is the indicator of the pelvis divergence. This parameter is on average 4 cm larger in the table tennis players, than in control subjects. Additionally, divergence in knees is more proper in table tennis players than in controls. Generally, the mean values in sagital parameters indicate somewhat more inappropriate postural alignment in the table tennis players than in controls. The parameters of the head positioning, and the shoulders positioning lead us to conclusion about somewhat hunched position of the table tennis players, when comparing to control group – general population of the same aged boys.

CONCLUSION

Results of the present investigation show that there is (a) no significant difference between TTP and C regarding their clustering into groups of the different-postural-alignments, while (b) significant differences were found in several indicators of the postural status. Although considerable incidence of the improper postural alignments is found, it has to be stressed as the general problem in youth, and not to be directly related to regular table tennis training. Table tennis training brings forward some specific circumstances in a problem of the improper postural alignment, e.g. lowered shoulder of the dominant hand, and somewhat hunchbacked basic position in a sagital plane, all mainly linked to biomechanical and structural characteristics of the sport.

Anyway, results from this study directly point at particular importance of the general preparation of a locomotor system in table tennis athletes; mainly because that there is no doubt that multi-approachable conditioning training, adjusted to the athletes age; can positively influence the proper and symmetrical development in young TTP. In such manner, it is possible to diminish some negative consequences that a frequent and intensive table tennis trainings could have on the postural status.

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