Kadrić Zlatan[1], Erol Kovačević[1,2], Mensur Vrcić[1], Čaućević Denis[1], Babajić Fuad[3] and Užičanin Edin[3]

ASYMMETRY INDOMINANT AND NONDOMINANT UPPER LIMBS IN YOUNG BOSNIAN TENNIS PLAYERS

[1] Faculty of Sport and Physical Education, University of Sarajevo
[2] Institute of Sport, University of Sarajevo
[3] Faculty of physical education and sport, Tuzla University

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Abstract
The aim of this study is to determine existence and the amount of deviation of morphological features in relation to dominant/ non dominant upper limb. The sample subjects were 30 healthy male tennis players (age: 12.45 ± 1.12). They were measured by 7 morphological measures. The aim of this testing was to collect information about differences between dominant and non-dominant arm of a player. Obtained results indicate that results of dominant arm are statistically and significantly different ($p < 0.01$) from results of non-dominant arm (in all variables), Due to unilaterality of the sport, tennis players have predisposition to develop certain morphological asymmetry. However, it is necessary to delay development and to work on development of non-dominant side of the body (through quality training) and to prevent injuries in that way.

Key words: hand, racket, injury, training, unilaterality, anthropometry

Introduction

Symmetry presents term for balance and harmony while every deviation of mentioned is called asymmetry (Rynkiewicz et al. 2013). Human body seems symmetrical but more detailed analysis of position of internal organs and body structure show that human body is asymmetrical. Percentage of asymmetry is different for each individual. 96% of population predominates one limb over another (Annett, M. 1988), which is an indicator of asymmetry. Dominant arm is more precise and faster in solving certain tasks (Boulinguez et al. 2001; Bagesteiro, L. B., & Sainburg, R. L. 2002), which indicates that it is more dominant than non-dominant arm.

Previous studies of body asymmetry showed that there are negative effects of dominant arm on competition results and on overall development of an athlete (Rynkiewicz et al. 2007).

This is a big problem in tennis, which is considered one of the most popular sports in which asymmetric movements are expressed. Although most of movements, performed by tennis player on a court, are mostly symmetrical (Rynkiewicz et al. 2013), asymmetry occurs more dominantly on arm which holds the recket and hits the ball, This type of hitting the ball by using one hand, and one side of the body, more dominantly, than the other, can lead to to asymmetric distribution of muscles and unbalanced muscle tonus (Sanchis-Moysi et al. 2004). Disproportional distribution of muscles at the end leads to deviation of postural status (Ćirić et al. 2015) which leads to bigger predispositions for injuries due to additional pressure on wrist structures (Iwai et al. 2006).

These findings can be very dangerous for young athletes, especially those who are in sensitive period of development of osteoarticular system. Therefore, it is very important to recognize occurrence of body asymmetries, in time, and to find quick and effective way to remove them. The aim of this study is to determine existence and the volume of morphological deviations of morphological features in relation to dominant/non- upper limb.

Methods

Sample

The sample of this study consisted of 30 healthy male tennis players, who at the time of testing were of a good health and physically active with at least 5 years of experience. All players have stated that they did not have any upper extremities' injuries in the past two years. The basic characteristics of the players (mean±SD) are: age (12.45 ± 1.12), body mass (55.76 ± 11.53), height (166.13 ± 11.83).

Variable sample

Anthropometric means are determined according to standard procedure recommended by "International Biological Program" which were conducted by educated measurers (Medved, R., & Barbir, Ž. 1987). Variables of this research included hypothetical area of morphological features of tennis players (7 variables overall), which are measured on dominant and non-dominant upper limb. Variables that are used in this research are: Arm length, Hand width, Diameter of wrist, Size of upper limb in extension, Size of upper limb in flexion, size of forearm. All measurements were conducted by recommendation of Petrinović et al. 2015.In order to eliminate errors and to create optimal conditions for testing and measurement, testing was conducted in morning (8:30) in order to avoid variance of certain body parts and measured sizes, body mass and height, respectively. Measurement was conducted in bright area and the temperature was about 22^{0}C. Sample subjects were barefooted and in shorts. All measurements were conducted by experienced measurers.

Table 1. Descriptive parameters

Descriptive Statistic				
	Dominant	**Undominant**	**T -test**	
	AS ± SD	AS ± SD	T	Sig.
Arm length	736.00 ± 63.75	729.87 ± 63.99	5.953	.000
Hand width	76.73 ± 6.22	74.33 ± 6.17	7.679	.000
Wrist diameter	53.77 ± 4.23	52.67 ± 4.13	5.216	.000
Elbow diameter	64.97 ± 5.11	63.87 ± 4.92	4.748	.000
Size of upper arm in extension	249.83 ± 30.25	243.80 ± 28.48	6.964	.000
Size of upper arm in flexion	266.13 ± 31.50	258.67 ± 30.32	9.181	.000
Size of forearm	241.13 ± 22.30	233.50 ± 20.70	7.718	.000

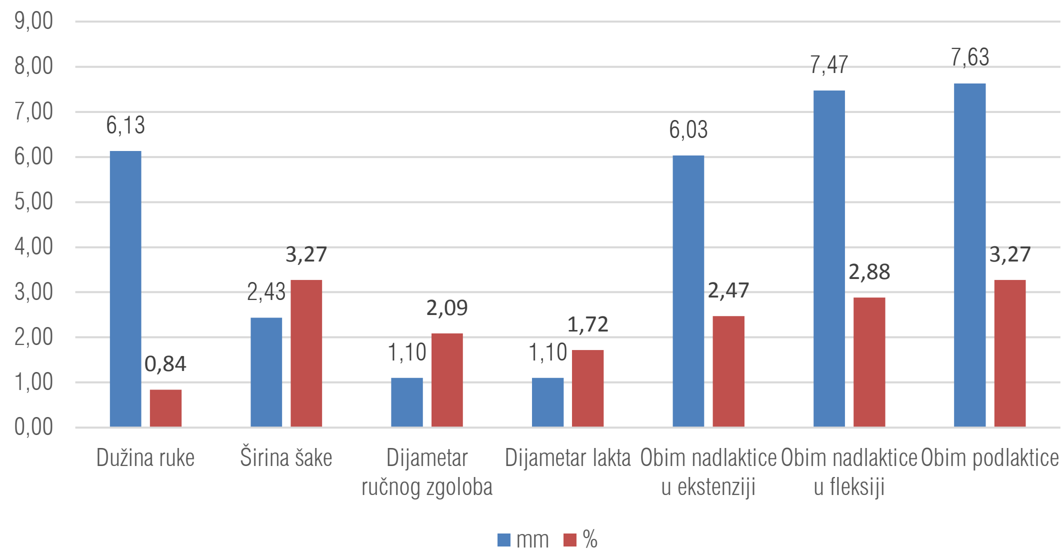
Statistical Analysis

The results were processed using SPSS. 23 for Windows (IBM Corp. Chicago). Arithmetic mean values and standard deviations were calculated, for all variables, followed by Kolmogorov-Smirnov test in order to determine normality of distribution of results and by T-test to determine differences between limbs.

Results

Results of Kolmogorov – Smirnov's test confirmed normality of distribution of results of all treated variables. Table *1.* presents the results of arithmetic means and standard deviations of treated variables. It is noticeable that the results of the pair sample T-test show statistically significant difference in all variables. Results indicate that results of dominant arm are significantly and statistically different ($p < 0.01$) than results of non-dominant arm. Dominant arm is longer by 6.113 mm (0.84%) and wider by 2.433 mm which is by 3.27% more than non-dominant arm. Diameters of wrist and elbow joint show that differences are identical in benefit of dominant arm and they are 1.1 mm which is by 2.09% and 1.72%, respectively, more than in non-dominant hand. Size of upper arm is 6,033 mm and 2,47% respectively, with extension and 7,467 mm and 2,88% respectively with flexion. Size of forearm and size of upper arm is bigger in dominant side of the body (7,633 mm and 3,27%, respectively) (Graph1).

Graph 1. Limb differences



Discussion

The main goal of this research is to determine existence and the number of morphological features in relation to dominant /non-dominant upper limb. Obtained results indicate statistically significant differences between dominant and non-dominant upper limb in all treated variables. Amount of differences moved in range from 0.84% to 3.27%. Differences are consistent in present studies (Kannus et al., 1995; Abrahão & Mello, 2008; Balius et al. 2012; Ducher et al. 2009; Rogowski et al. 2008). These studies show that dominant arm can be up to 20% stronger in relation to non-dominant arm and that can lead to significant morphological differences between tennis players.

As told earlier, around 90% of individuals show tendency of more frequent using dominant arm rather than non-dominant arm. Therefore, if body asymmetry of upper limb is a consequence of more frequent usage of dominant arm it can be expected that 90% of observed individuals has one-sided asymmetry. However, correlation between these two features is not in that ratio due to complex factors, such as active body musculature. Results of this research show that length of an arm can be the most precise predictor of dominant arm, which is opposite to results of research conducted by Auerbach & Ruff (2006) who determined that diameter of elbow is better predictor of dominant arm (arm which tennis player uses more) than arm length. Biomechanical force has an impact on arm length, during the process of growth, but its impact ends with the influence of external factors and by development of morphological features and full development of bone system, respectively (Steele & Mays, 1995).

Diameters of joints and transversal dimension of the body, respectively, are very sensitive on biomechanical impacts and modifications during the individual's whole life. As such, these measures present direct reflection to physical activity and the evidence of differences between dominant and non-dominant arm. Finally, although diameter of elbow joint (epicondylar width) and diameter of head of hummerus are not under the influence of environment as other measure, they still show lower body asymmetries than it is expected. It is possible that this is caused by different size of muscle activity which has an influence on distal parts of upper limb bones. Activities which primary affect head of lumbers, include movements which are primary caused by muscle engagement around shoulder joint. It needs to be mentioned that dimensions of joint areas of more active arm still stay relatively unchanged (Ruff et all. 1991; Lieberman et al. 2001). Obtained asymmetries in this case study can be attributed to the age of an individual and to insufficient knowledge of technique, which causes bigger muscle activity of dominant side, which creates conditions for development of asymmetry. Former is confirmed by the fact of statistically significant differences ($p < 0.01$) in all variables, which indicates the appearance of muscle volume in dominant arm of tennis player (Daly et al. 2004).

Differences obtained in this research indicate existence od asymmetry of upper limbs of young tennis players. This can lead to unequal division of muscle mass, which influences directly posture status of young athletes (Petrinović et al. 2015; Pluim et al. 2018), which slows potential development of player and makes predispositions for injuries. Therefore, it is necessary to implement exercises in training process, which can improve symetric development, and in that way reduce negative effects, caused by intense training.

Conclusion

The results obtained by this study have established significant differences between all variables asymmetry for dominant and nondominant upper limbs of young tennis players. In tennis asymmetry between sides of body can raise the risk of injuries and therefore have negative effects in top-level performances in match and training as well. Since tennis players, due to unilaterality of the sport, are predisposed to develop morphological asymmetry, it is necessary to implement additional physical exercises, for development of non-dominant arm, through adequate planning of training, and to tend to achieve symmetry of the body.

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Corresponding author:
Erol Kovačević, PhD
Faculty of Sport and Physical Education, University of Sarajevo, BiH
e-mail: ekovacevic@fasto.unsa.ba

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