

Original Article

Investigating the role of ipsilateral and contralateral eye-hand dominance in tennis serve accuracy of amateur tennis players

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Abstract:

Eye and hand dominance, as a laterality index, represents structural and functional asymmetries of brain hemispheres. Their contribution to phylogenic and ontogenetic development of human, have been well documented by neuroscientific data. Since the second half of the twentieth century, researchers and sport psychologists, were concerned with the contribution of hand and eye dominance to aiming skills. The aim of this study was to investigate the role of ipsilateral and contralateral eye-hand dominance in tennis serve accuracy. Forty-one right handed amateur tennis players, 22 males and 19 females, mean age 20,9 (SD= ±0.66 years) participated in this study. The mean training age in this period was one to three years. According to ipsilateral and contralateral eye-hand dominance, sample was divided into two groups: contralateral eye-hand dominance group, including 21 participants (11 males and 10 females) and ipsilateral eye-hand dominance group, including 20 participants (11 males and 9 females). Hand dominance was defined by two different tests, showing the same results. Participants were asked to serve 20 times (10 serves from the “deuce side” of court and 10 from the “advantage side”). Serve accuracy was examined by two experienced, independent examiners. One way Anova analysis has shown no significant differences in accuracy test between the two groups of contralateral and ipsilateral eye-hand dominance. However, contralateral group achieved higher scores in accuracy from the deuce court with mean score 5,71 against 5,45 of the ipsilateral group. Those findings are in contrast to previous studies with regard to aiming tasks. On another study which is currently in progress, the hypothesis about the impact of ipsilateral and contralateral hand - eye dominance on tennis serves accuracy is being examined in professional tennis players.

Key words: eye, hand, preference, tennis, serve, accuracy

Introduction

Tennis serve has been developed in recent times, thus serving speed has been significantly increased. In Roland Garros for example, from 2002 to 2009 the mean difference in average serving speed has been reported to increase from 165,1 to 188,9 km/h, the percentage of first serve accuracy from 60,2% to 64,2% and aces from 2.2 to 8,6 (Pollard, Pollard, Barnett & Zeleznikow, 2009; Born, 2011). Considering that in this period there was no change in athletes body characteristics, we may support the hypothesis that serve speed is independent of body strength or advantages due to body characteristic, although depends on improved tennis serve technique, as has been mentioned in recent studies (Pugh, Kovaleski, Heitman, & Gilley, 2003; Reid, Elliott & Alderson, 2007; Reid, Whiteside, & Elliott, 2011). Another research examined the contribution of muscle activation of selected muscle groups involved in tennis serve. They concluded that, elasticity of muscles of the dominant hand, such as wrist flexors, plays a significant role in accuracy and serve speed ($P < 0,05$) (Anderson, 1979; Cohen, Mont, Campbell, Vogelstein, & Loewy, 1994; Chow, Shim, & Lim, 2003; Kibler, Chandler, Shapiro, & Conuel, 2007).

Coordination seems to be the main factor affecting tennis serve performance (Schoenborn, 1998; Durovic, Lozovina & Mrduljas, 2008; Reid, Whiteside, & Elliott, 2011). Muscle synergy and coordination depends on the side of the serving court. A recent study (Wend, Ehstand & Prechtl, 2010), found that a training program aiming to improve serve speed, shown better results when athletes performed serve from the right side (5,49 km / h) than the left side (4,81 km / h). Lower limbs technique also, during the serve, i.e if the player holds behind the right foot (right-handed) (foot-back technique) or moves it next to the left (foot-up technique) seemed to affect the service speed. The foot up technique accomplishes higher speeds on the vertical axis (larger vertical forces) according to the study of Elliott and Wood (Elliott, & Wood, 1983).

Visual contact with the ball when tossing the ball during serve is a basic prerequisite of expertise technique (Knudson, Luedtke, & Faribault, 1994; Brown, 2004). A critical detail at this point, is player's eye dominance

when tossing the ball with the non-dominant hand and just before the contact between the ball and the head of the racquet.

Hand dominance, as a laterality index, represents structural and functional asymmetries of brain hemispheres. Their contribution to phylogenic and ontogenetic development of human, have been well documented by neuroscientific data. Since the second half of the twentieth century, researchers and sport psychologists, were concerned with the contribution of hand and eye preference to aiming skills. To the best of our knowledge, despite a few researches who mentioned eye movements when tossing the ball (Knudson et al., 1994) and the eye hand coordination while hitting the ball (Sahan, & Erman, 2009), there are no studies investigating eye hand dominance in tennis. The purpose of this study was to investigate the effect of ipsilateral and contralateral eye hand dominance in tennis serve accuracy. Additionally, the aim of this study was to test the hypothesis that players with ipsilateral and contralateral eye hand dominance do not differ significantly in tennis serve accuracy.

Materials and Methods

Participants: 41 right handed amateur level tennis players participated in this study, 22 male and 19 female (table1). The average age was 20.9 (S.D.= ± 0,66). The training years in tennis were between 1 and 3 years.

Table 1

The gender of participants

		Frequency	Percentage (%)
Gender	Male	22	53,7
	Female	19	46,3
	N	41	100,0

Procedure – tools – measures: Eye and hand dominance were evaluated using the self-reported questionnaire "Lateral Preference Inventory" of Coren (Coren, 1993) and by the use of two tests, which gave the same results. According to ipsilateral or contralateral eye-hand preference model, the sample was divided into two groups: the ipsilateral eye-hand dominance group and the contralateral eye-hand dominance group. Then, tennis players performed 20 serves (10 from the advantage court and 10 from the deuce court). During the field test, the participants' relevance and technical execution of the serve was evaluated by two independent experienced tennis coaches.

Statistical analysis: Data was processed using SPSS v.24. We performed descriptive statistical analysis (means, standard deviations and cross-tabulation of qualitative variables) and tested the hypothesis (One way ANOVA). The significance level was set at $p = 0,05$.

Results

The evaluation of eye-hand dominance and after crossbreeding (cross-tabulation) qualitative, categorical variables such as "gender*Hand dominance" and "gender* Eye dominance", indicated that out of the 41 participants, 95.1% (N = 39) showed right hand dominance while 4.9% (N = 2) showed left hand dominance. In the subgroup of 39 right-handed, 53.8% (N = 21) were male and 46.6% (N = 18) female athletes. In the subgroup, which displayed left hand dominance, 50% (N = 1) was male and 50% was (N = 1) female. Regarding the eye dominance, 48.8% (N = 20) of participants showed right eye dominance and the rest 51.2% (N = 21) left eye dominance. In the subset of 20 participants with right eye dominance 50% (N = 10) were male and 50% (N = 10) female, while in the subset of 21 who showed left eye dominance, 57.1% (N = 12) were male and the rest 42.8% (N = 9) female. More details about the cross-tabulation of the variables gender, eye dominance and hand dominance are presented in table 2.

Table 2.

Descriptive statistics regarding gender and hand dominance / gender and eye dominance.

			Hand dominance		Eye dominance		Total
			Right	Left	Right	Left	
Gender	Male	N	21	1	10	12	22
		% within gender	95,5%	4,5%	45,5%	54,5%	100,0%
		% within dominance	53,8%	50,0%	50,0%	57,1%	53,7%
		% Total	51,2%	2,4%	24,4%	29,3%	53,7%
	Female	N	18	1	10	9	19
		% within gender	94,7%	5,3%	52,6%	47,4%	100,0%
		% within dominance	46,2%	50,0%	50,0%	42,9%	46,3%
		% Total	43,9%	2,4%	24,4%	22,0%	46,3%
	Total	N	39	2	20	21	41
		% within gender	95,1%	4,9%	48,8%	51,2%	100,0%
		% within dominance	100,0%	100,0%	100,0%	100,0%	100,0%
		% Total	95,1%	4,9%	48,8%	51,2%	100,0%

Considering contralateral and ipsilateral eye and hand dominance, participants were separated into two subsets. The contralateral group included 51.2% (N=21) of participants. In this group 52.4% (N=11) were male and 46.7% (N=10) were female. The ipsilateral group included 48.8% of the participants (N=20) in which 55% (N=11) were male and 45% (n=9) were female. More details about the ipsilateral and contralateral subgroups are presented in Table 3.

Table 3.
Descriptive statistics regarding gender and eye-hand dominance.

			Gender		Total
			Male	Female	
Eye-hand dominance	Ipsilateral	N	11	9	20
		% within dominance	55,0%	45,0%	100,0%
		% within gender	50,0%	47,4%	48,8%
		% Total	26,8%	22,0%	48,8%
	Contralateral	N	11	10	21
		% within dominance	52,4%	47,6%	100,0%
		% within gender	50,0%	52,6%	51,2%
		% Total	26,8%	24,4%	51,2%
	Total	N	22	19	41
		% within dominance	53,7%	46,3%	100,0%
		% within gender	100,0%	100,0%	100,0%
		% Total	53,7%	46,3%	100,0%

With regard to tennis serve accuracy between the ipsilateral and contralateral groups, one way analysis of variance (One way ANOVA) showed no significant differences between the two groups. No significant differences were found either at the advantage ($F_{(1,155)}=0.365$, $p=0.549$) or at the deuce court ($F_{(1,0.716)}=0.219$, $p=0.642$). In particular, from the deuce court, ipsilateral group performed at means 5.45 (S.D.= ± 1.91) succeeded serves and the contralateral group succeeded at means 5.71 (S.D.= ± 1.71) serves. From the advantage side court ipsilateral group performed at means 4.95 (S.D.= ± 1.73) succeeded serves and the contralateral group succeeded at means 5.29 (S.D.= ± 1.82) serves. Results from tennis serve performance between contralateral and ipsilateral eye-hand dominance groups are presented in table 4.

Table 4.
Descriptive statistics regarding tennis serve accuracy between contralateral – ipsilateral eye-hand dominance groups, performing serves from the deuce and advantage court.

		N	Mean	Standard deviation
Deuce court	Ipsilateral dominance	20	5,45	1,91
	Contralateral dominance	21	5,71	1,71
	Total	41	5,59	1,79
Advantage court	Ipsilateral dominance	20	4,95	1,73
	Contralateral dominance	21	5,29	1,82
	Total	41	5,12	1,76

Discussion

This study was designed to investigate the role of the ipsilateral and contralateral eye-hand dominance in tennis serve accuracy. The findings confirm the hypothesis that there are no significant differences in tennis serve accuracy between players with ipsilateral or contralateral eye –hand dominance. However, it was observed that tennis players who have contralateral eye hand dominance tend to achieve higher scores than ipsilateral eye hand dominance players, while serving the advantage or the deuce court.

According to the up-to-date international literature, no similar study concerning tennis serve performance among individuals with ipsilateral or contralateral eye hand dominance was found. Consequently, there are no directly comparable results with the findings of the present study. However, as reported in the literature regarding other ball sports, athletes who are contralateral seem to benefit, especially right-handed players using the left eye for targeting (Siefer, Ehrenstein, Arnold-Schulz-Gahmen, Sökeland & Luttmann, 2003; Mann, the Runswick, & Allen, 2016). On the contrary, in sports without ball, which require aiming skills e.g. archery or darts (Dart skills) recent findings (Laborde, Dosseville, Leconte, & Margas, 2009; Razezghi, Shafie,

Shebab, & Maleki, 2012) demonstrate that athletes with ipsilateral eye hand dominance have the advantage. The present study does not confirm this view, because we found no significant differences between ipsilateral or contralateral eye-hand dominance groups leading us to conclude that the ipsilateral eye hand dominance gives no advantage in tennis serve performance. Possible causes leading to this discrepancy between this study and other related studies conducted in other sports, occur probably due to the specific nature of sport. The handling of tennis racket differentiates the targeting process from other ball sports like football or basketball. Similar differences are presented in other aiming sports, such as archery, where ipsilateral eye-hand dominance is required (Laborde, Dosseville, Leconte, & Margas, 2009). Regarding the fact that the results showed higher performance in tennis serve from the advantage court, it should be mentioned that greater attention is shown on the technical execution of tennis serve from the advantage court during training or during performance assessment of tennis serve, particularly in novice athletes, even more in women. This can probably be explained by the difficulty of right handed beginners to serve from the left side, as opposed to professionals, who are accustomed serving both sides.

Conclusion

In conclusion, the effect of the eye hand dominance in sports performance appears to depend on the particular requirements of each sport on visual perception. However, the present study showed that the ipsilateral or contralateral eye-hand dominance does not affect performance in tennis serve.

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