



The relationship between distance of overhand ball throw and maximal ball speed of serve in elite junior tennis players

Károly Dobos and Csaba Nagykáldi

ABSTRACT

The aim of this research was to test the hypothesis that there is a positive correlation between the distance of the overhand ball throw and maximal ball speed of serve of elite junior tennis players for a wide-scale representative sample comprising both sexes (80 boys and 80 girls). A significant, positive correlation was found in both sexes (girls $r=0.72$; boys $r=0.78$), which is why the application of overhand ball throw training and its use as a performance diagnostic method is suggested in the general preparation of elite junior tennis players.

Key words: ball speed, correlation, plyometric movements

Received: 14 May 2017

Accepted: 27 August 2017

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INTRODUCTION

In the modern tennis game, the key role of the serve is unquestionable. The serve is the only technical element that is executed by the player independent of the opponent's ball. This independent execution ensures the highest possible level of movement control (Bhamonde & Knudson, 2003). In addition, the ability of the players to generate high-speed balls has become one of the basic fundamentals of successful competition performance (Cross & Pollard, 2009). The serve hit with a higher speed allows a shorter preparation time for the receiver. At a 117 km/hour average second serve speed, the preparation time is 1,200 milliseconds, which decreases to 900 milliseconds in the case of a 160 km/hour first serve. The time spent on preparation further decreases on hard court to about 200 milliseconds (Kleinöder, 2005). At the professional level, it is not rare that served balls travel at a speed of 200 km/hour for men and at 190 km/hour for women. This results in a further decrease in preparation time, which is why it is thought that the use of training equipment developing motor skills (e.g. overhand ball throw) in preparation phase (especially in the case of junior tennis players) is of key importance, helping the player in forming the proper service movements and in speeding up the racket.

Reid, Giblin & Whiteside (2015) and Wagner et al. (2014) investigated the relationship between the kinematic specialties of the overhand throw and of the serve. The results showed that the overhand throw and the speed of serve showed a slight

positive correlation. Besides the mechanical similarities of the two movements, there are several mechanical differences as well which show the difference between the two types of movements. But the researchers agreed that the movement pattern of the overhand throw ensures a proper basis for the development of the serve.

The mentioned tests were carried out on only a small sample ($n=28$; $n=10$). In addition, the relationship which exists between the distance of the overhand ball throw and the maximal speed of the serve could also be interesting as suggestions from the professions and other scientific researchers have already proven the relationship between the speed of stroke and the distance of different throws (Genevois, Pollet & Rogowski, 2014; Ikeda et al., 2007). Therefore, the aim of this research on a wide representative sample comprising both sexes (80 boys and 80 girls) was to test the hypothesis that the distance of the overhand ball throw of elite junior tennis players and the speed of serve shows a close positive correlation in both sexes.

METHODS AND PROCEDURES

The sample consisted of elite junior tennis players (under 12, 14, 16 and 18). The subjects were selected with the stratified random sampling method, so in each age-category 20 boys and 20 girls, altogether 160 people, were tested. From the point of view of the research, one boy and one girl age group was formed (Table 1). The selected sample represents the best girl and boy populations of Hungarian junior tennis players.

To examine the relationship between maximal ball speed of serve and distance of overhand ball throw, two field tests (Figure 1.) were used (Nádori et al., 2005; Ulbricht, Fernandez-Fernandez & Ferrauti, 2013). The players had to execute the field tests in a given order (overhand ball throw and serve velocity) after a 15-minute standard warm up. The players had three trials in the overhand ball throw and eight for the serve velocity tests. The best results were used for later analysis. The weight of the small ball was 100 grams (diameter 6.5cm). To measure the speed of serve, the "Stalker ATS II" serve speed measurer (within 1 km/h accuracy) was used.

Sex	Age	Distance of the overhand ball throw (m)			Maximal ball speed of the serve (km/h)	
		Mean (SD)	Mean (SD)	Range	Mean (SD)	Range
Girls	14.37(2.24)	28.84 (5.07)	16.57-	44.30	140.61 (19.12)	87.00 - 176.00
Boys	14.30±2.22	41.83 (9.41)	25.75-	66.18	157.56 (22.97)	110.00 - 211.00

Table 1. Basic statistics in elite junior tennis players.

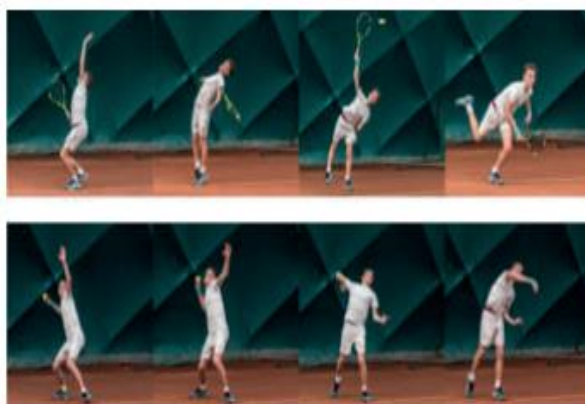


Figure 1. Serve and overhand ball throw tests.

Pearson correlation coefficient was calculated to determine the relationship between the maximal ball speed of the serve and distance achieved in the overhand ball throw. The level of significance was determined at $p < 0.05$. The statistical analysis of the data was carried out with SPSS 13.0 software.

RESULTS

In both sexes, a significant strong positive correlation was found between the distance of the overhand ball throw and the maximal ball speed of serve (Figure 2. 3.).

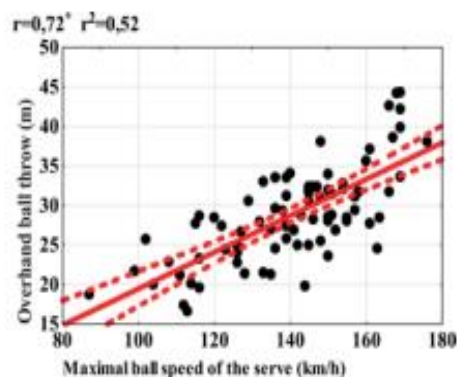


Figure 2. Correlation coefficients between the distance of the overhand ball throw and the maximal ball speed of the serve in elite girl junior tennis players $p < 0.05$.

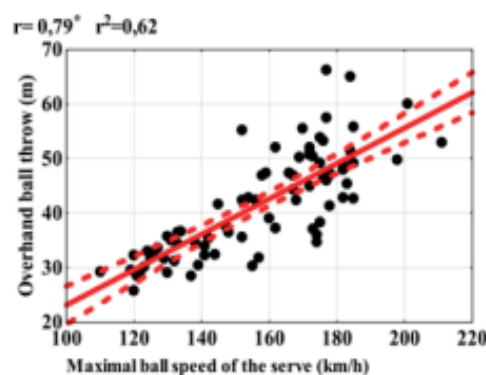


Figure 3. Correlation coefficients between the distance of the overhand ball throw and the maximal ball speed of the serve in elite boy junior tennis players $p < 0.05$.

DISCUSSION

The explosive strength of the dominant upper arm of elite junior tennis players showed a strong positive correlation to the maximal ball speed of serve. The results well-demonstrate the statement that the so-called "plyometric" movement form (the stretch-shorten cycle) is the most frequent muscle contraction type in tennis, as the coordination pattern of most of the strokes comprises this contraction type. Thus, those tennis players who can make use of their strength most effectively are able to hit the ball hardest, and will have the strongest serves (Chu, 2003). Furthermore, the mechanical similarities of these two movements (Reid, Giblin & Whiteside, 2015; Wagner et al., 2014) aid the player in building up a successful serve. Therefore, in our opinion the explosive strength manifested in the overhand ball throw can be well transferred to the movement pattern of the serve.

Accordingly, this is why the use of the overhand ball throw as a plyometric throwing practice is indispensable in creating a

proper serve speed. In addition, the determinant coefficients also show (girls, $r^2=0.52$; boys, $r^2=0.62$) that the two movement forms are similar to each other, but are not the same. The results reinforce the suggestions of the previous research results (Reid, Giblin & Whiteside, 2015; Wagner et al., 2014).

CONCLUSIONS

The research was carried out on a representative sample comprising all official age-groups, in which the distance of the overhand ball throw and the maximal ball speed of serve showed a strong and significant correlation in both sexes. Therefore, it is suggested that the overhand ball throw be a part of junior tennis players' general preparation and be used as a means of performance diagnostics.

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