The relationship between joint kinematics and racket velocity during tennis serve

Kiatbodin Wanglertpanich[1], Gareth Irwin[2,3], **Jamkrajang Parunchaya**[3]
[1]Department of Mechanical Engineering, Thammasat School of Engineering, Faculty of Engineering, Thammasat University, Pathumthani, Thailand
[2] Cardiff Metropolitan University, Cardiff, UK
[3]College of Sports Science and Technology, Mahidol University, Nakhon Pathom, Thailand
Email: parunchaya.jam@mahidol.edu

Summary

Tennis players can take advantage of fast serve speed. The findings from this study confirm that shoulder rotation is the primary contributor to racket speed. Our regression model can effectively predict racket velocity and inform coaching strategies. Also, this numerical relationship between joint kinematics and tennis serve can be extended to future analyses to improve or optimise service speed.

Introduction

One important action while playing tennis is the serve. The faster an athlete performs serve speed, the more advantage that player can take over an opponent. The serve speed was contributed by upper limb motions [1, 2]. However, this relationship between a serve and upper limb speed has not been fully investigated. A numerical relationship between these two aspects may help tennis players optimise their practice and improve their serve speed. We aimed to determine relationships between joint kinematics and racket velocity while driving a tennis serve. We hypothesised that a positive relationship would be shown between maximum racket velocity and both linear and angular velocity of upper limb joints.

Methods

Shoulder, elbow and wrist kinematics while serving ten right-handed experienced tennis players (five males and five females; age, 22.3 ± 4.20 yrs; height, 1.73 ± 0.06 m; body mass 63.1 ± 5.63 kg) were obtained from our previous work [3]. Linear and angular resultant velocities of the three upper limb joints were compared and determined relationship with the peak racket velocity was by using Peason's coefficient. These joint velocities in this study were obtained when the peak racket speed occurred. In addition, linear multiple regression was used to determine the relationship between the joints and racket velocities.

Results and Discussion

The results showed relationships between upper limbs and peak racket velocities were positive, except angular velocity of the elbow. These relationships agreed with regression slopes, in which only the elbow angular velocity caused the negative slope. The wrist and the shoulder had the strongest relationship when relating the linear and angular velocities to the peak racket velocity, respectively (Figure 1).

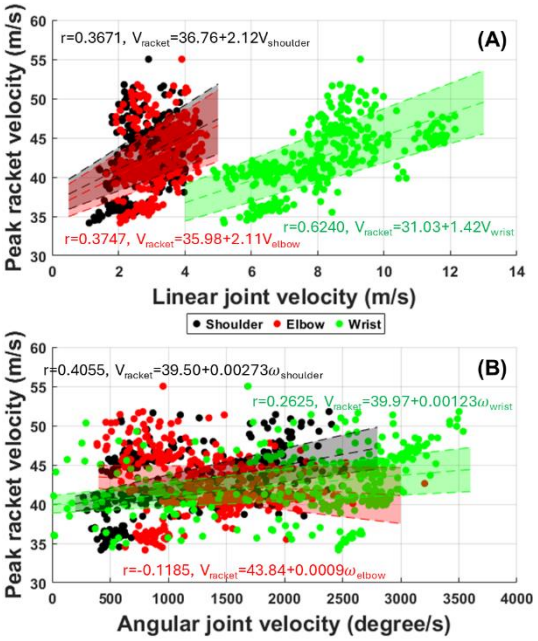

Figure 1: Scatter plots and linear regression results of (A) linear and (B) angular velocities against peak racket velocity

Our results agreed with previous literature that racket speed relates to motions of the upper limbs, and shoulder rotation is the major contributor to racket speed [1, 2]. The negative role due to elbow rotation also was found by [1]. We suggested that the elbow rotation during a serve may reduce a moment arm between the shoulder and racket, resulting in less serve speed. This agreement can confirm that our regression model can predict the racket speed with upper limb kinematics. Therefore, this regression model can be used to inform the serve speed of a tennis player and provide information to a coach to create a practice session in a future step.

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References

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