

A Comparison of Ball Characteristics and Swing Behaviors Between Top-Level Male and Female Japanese University Tennis Players

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Summary

This study assessed the swing behaviors and technical skills of top-level Japanese university tennis players using racket sensors, focusing on gender differences. Male players demonstrated significantly higher swing speeds (145.8 ± 11.7 km/h) and ball speeds than female players (118.2 ± 7.9 km/h). Spin rates were influenced by racket face angles. The results revealed gender-specific stroke characteristics and trends, indicating that optimized coaching strategies considering these differences can effectively enhance player performance.

Introduction

Recent advancements in the lightweight and high-resilience design of tennis rackets have led to diverse evolutions in tennis techniques. Achieving high performance requires high-quality shots as a fundamental prerequisite, and understanding the relationship between ball speed and spin rate is crucial for analyzing shot characteristics [1]. In particular, ball spin plays a significant role in determining ball trajectory and post-bounce behavior [2], effectively inducing errors and mistakes from opponents.

Methods

The participants were 26 players (14 males, 12 females) from a top-level university tennis team in Japan. The analyzed shots included forehand and backhand cross-court strokes. Swing motion was measured using a prototype tennis motion sensor equipped with an inertial measurement unit (IMU), which is detailed in a separate submitted paper, to assess racket head speed, racket face angle, swing trajectory angle, and racket inclination angle. Ball trajectory characteristics, including ball speed, spin rate, and launch angle, were recorded using a ball-tracking system (TrackMan, Denmark). All data were collected under actual on-court conditions, enabling a realistic evaluation of swing motion and ball trajectory during play.

Results and Discussion

The results of this study showed significant differences between male and female players in various parameters of the forehand stroke (Table 1). Racket head speed was significantly higher in male players (145.8 ± 11.7 km/h) compared to female players (118.2 ± 7.9 km/h), with $p < .001$. Similarly, the angle of attack showed a significant difference, with males recording 57.0 ± 5.1 degrees and females 67.8 ± 6.7 degrees ($p < .001$). Ball speed was also higher in male players (137.7 ± 9.9 km/h) than in female players (122.3 ± 6.3 km/h), indicating a statistically significant difference (p

$< .001$). Spin rate revealed a similar trend, with males generating 2509 ± 506 rpm compared to 1601 ± 334 rpm for females ($p < .001$). These results further indicated that, for both male and female players, ball speed was correlated with racket head speed, and spin rate was correlated with the angle of attack (Figure 1).

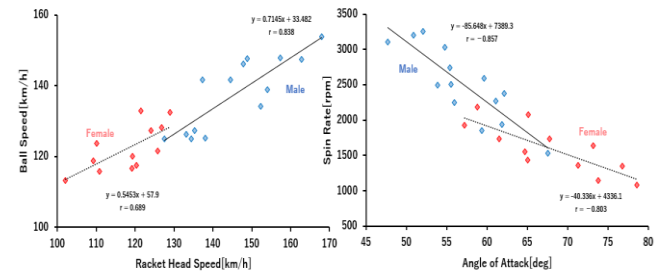


Figure 1: Relationship Between Ball Speed and Racket Speed in Forehand Strokes, Racket Inclination Angle and Ball Spin Rate

		Male		Female		p value (sex)
		mean	(SD)	mean	(SD)	
Head Speed [km/h]	Forehand	145.8	11.7	118.2	7.9	$p < .001$
	Backhand	123.7	7.4	112.4	6.0	$p < .001$
	p-value	$p < .001$		$p = .004$		
Ball Speed [km/h]	Forehand	137.7	9.9	122.3	6.3	$p < .001$
	Backhand	128.1	6.7	119.4	6.5	$p = .004$
	p-value	$p < .001$		$p = .021$		
Angle of attack [deg]	Forehand	57.0	5.1	67.8	6.7	$p < .001$
	Backhand	69.5	6.3	73.7	4.3	n.s.
	p-value	$p < .001$		$p = .006$		
Spin rate [rpm]	Forehand	2509	506	1601	334	$p < .001$
	Backhand	1503	357	1140	203	n.s.
	p-value	$p < .001$		$p < .001$		
Swing path angle [deg]	Forehand	25.0	4.4	21.0	4.2	$p = .031$
	Backhand	16.8	4.9	15.9	3.4	$p = .589$
	p-value	$p < .001$		$p < .001$		
Racket-face impact angle [deg]	Forehand	82.0	2.5	88.8	3.0	$p < .001$
	Backhand	86.4	2.2	89.6	2.6	$p = .003$
	p-value	$p < .001$		$p = .456$		

Table 1: Comparison of Swing and Ball Performance Parameters Between Male and Female Top-Level University Tennis Players

Conclusions

The results of this study revealed the characteristics and trends in stroke skills based on gender, suggesting that performance improvement can be effectively achieved through optimized coaching that considers these gender differences.

References

- [1] Muramatsu, T. et al. (2015). Relation between speed and spin of the ball in the forehand ground stroke of the world number one tennis player. *Research Journal of Sports Performance*, 7, 292-299.
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