

THE KINEMATIC ANALYSIS ON THOMAS ENQVIST'S FOREHAND TOPSPIN TECHNIQUE

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This paper presents knowledge on kinematic feature of an outstanding athlete who uses forehand topspin technique during a tennis match. Thomas Enqvist had used forehand topspin technique to receive for three times in the ATP Championship Round-robin Tournament Semifinal, which was held in Chengdu, China. The technique of forehand topspin has been further analyzed by three-dimensional video. Through study, the kinematic technical feature has been obtained, resulting in not only providing referential statistics for the technical training of the athletes, but also enriching the technical theory of tennis.

KEY WORDS: forehand topspin, technique, kinematic

INTRODUCTION: It is universally acknowledged that forehand stroke is one of the most popular ways of all the basic techniques in tennis. In modern times, it is a decisive factor whether forehand topspin technique has been used perfectly or not in a men's tennis match; and in professional tennis world, the master players all regard forehand as an ideal basic weapon. ^[1] Referring to the literature materials, the statistics collected about kinematic research of forehand skills is mostly focused on training professional and amateur athletes rather than on excellent tennis players. Besides, comparatively speaking, it is rare to collect data by the application of 3D video analysis no matter under which circumstance. Owing to the widespread application of forehand topspin in tennis matches, therefore, this paper will explore Thomas Enqvist's forehand topspin technique by 3D video in the ATP Championship Round-robin Tournament Semifinal, which was held in Chengdu, China. Additionally, the characteristics of topspin cover the flying range high, dropping fast, relatively small reflected angle of ground stroke, and comparatively big forward momentum. ^[2] It is worth mentioning that the key technique of Enqvist's winning ATP Championship Round-robin Tournament is by forehand topspin.

METHODS: Two JVC9800 cameras and a 24-pointed framework which are fixed at a certain point are then used to record Enqvist's forehand topspin serves in Chengdu International Tennis Exchange Center. The camera has a length of 1.25m, and their main axis angle is 65°. One of them is located about 15m behind the player to the right. Another is placed in front of him 20m or so to the right. 3D Single TEC analytical system has been adopted for the analysis of the video recorded. Meanwhile, the process will be studied one motion after another with the purpose of obtaining reliable statistics. Furthermore, in order to satisfy the need of this research, three measuring points are added which cover the top of racket, the tennis and the projected angle of shoulder and hip.

RESULTS AND DISCUSSION: Open stance in which the hitter's body facing is at an angle between parallel to the baseline and facing the opponent (hip rotation about 180°) was employed by Enqvist. Before the end of backswing, Enqvist's left hip angle is +164°, while the right hip angle is +133°; left knee angle +138° and the right knee angle +131°. All these data contribute to explain that Enqvist's hip as well as knees is

in buckling state. The right humeral angle ($+44^\circ$) and right elbow angle ($+131^\circ$) reflect that when the player finishes backswing, the arm is in stretched status relative to the trunk. Moreover, under the same stretched condition, the right humeral angle is inversely proportional to the right elbow angle; in other words, if the angle of shoulder is big, the right elbow angle will be less and vice versa. As for the speed of the right shoulder joint is 0.75m/s, of the right elbow joint 1.74m/s, of wrist joint 4.01m/s and of the center of gravity 1.99 m/s. In combination with the video, during Enqvist's process of dynamically squatting, the main direction of center gravity of linear velocity is downward. Naturally, it is the central gravity and the right shoulder joints as well as the right elbow joints because of backswing that constitute the linear velocity of Enqvist's right wrist. There are three different angles between Enqvist's shoulder and hip— by the end of backswing the angle is $+37^\circ$; while hitting the tennis, the angle is $+7^\circ$ and the rotational amplitude is $+45^\circ$. At the very moment of touching the ball, it will be greatly beneficial to serve hard shots afterwards if keeping the trunk muscles stretched to a certain extend. It takes 0.08s to finish the phrase from backswing (0.62s) to strike the ball (0.7s), during which the racket and the ground form an angle of $+11^\circ$. It turns out that the less included angle between the racket and the ground, the stronger force of the topspin. What's more, while hitting the ball, the speed of right shoulder joint is 2.21m/s, the right elbow joint 4.58m/s, the right wrist joint 6.27m/s and the right hand 7.50m/s. Judging from the figures listed, it goes without saying that the hand joint and wrist joint are of great speed, with the elbow joint taking the second place. That is to say, while hitting the forehand topspin, the wrist depends on the rotation of the elbow joint to move instead of being stationary. To complete movement requires the included angle between the moment of hitting and the trunk to be $+82^\circ$, and keep the head and trunk towards vertical nicely with the ground.

CONCLUSION: To sum up, open stance was adopted by Enqvist to stand parallel when he's about to strike a forehand topspin with his upper body turning the shoulder sideways. The technical features can be concluded as follows: (1) By the end of backswing, Enqvist's left hip angle is $+164^\circ$, while the right hip angle is $+133^\circ$; the right shoulder (with racket) angle is $+44^\circ$, right elbow angle is $+131^\circ$, and the right wrist joint speed is 4.01m/s. When Enqvist makes backswing, he keeps the racket away from body. The force in the arm which holds the racket is passed successively. (2) In the fore swing stage, the rotational amplitude between shoulder and hip is $+45^\circ$. Nevertheless, after backswing and it's about to hit the ball, the speed of right shoulder joint is 2.21m/s, together with the right elbow joint 4.58m/s, and the right hand 7.50m/s. The wrist depends on the rotation of the elbow joint to move instead of being stationary. Consequently, by means of the rotation of the elbow joint which enables the forearm swiftly to put the wrist to up-spinning motion, Enqvist strikes the forceful forehand topspin.

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