Biomechanical analysis of a forehead top spin stroke in table tennis

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It is one of the important factors in winning the match of table tennis that the player can hit fast strokes when he anticipates the return of his opponent and has enough time to hit the ball. The purpose of this study was to investigate the kinematics of a forehand top spin stroke with three dimensional videography.

Two male table tennis players as subjects were videotaped with two high speed video cameras operating at 200 frames/s. The players who each had an 8-year career were qualified for the All Japan Table Tennis Championships of 1989 and 1990. The subjects were instructed to perform forehand top spin strokes with full effort in the right corner to flick returns. The body marks, the ball and the control points were digitized from the videotapes. Three dimensional coordinates obtained by using direct linear transformation technique were smoothed by a three-point digital filter cutting off at 10 Hz.

By analyzing the performance showing the maximum ball velocity for subject A, the following findings were obtained.

1) The velocity of the ball at 0.01 s after impact was 21.6 m/s.
2) The velocities at impact of the top of the racket, the right wrist, elbow and shoulder were 19.1 m/s, 12.2 m/s, 7.1 m/s, 3.0 m/s, respectively.
3) Instants of the maximum angular velocities for the segments on a horizontal plane appeared in the following order, the shoulder (0.06 s before impact), the right upper arm (0.015 s before), the right forearm (at impact) and the system of racket and hand (0.02 s after impact).
4) The joint angles and the joint angular velocities of the right elbow at impact were 103.9 deg and – 0.03 rad/s. These results suggest that subject A increased the angular velocities of the right forearm and the racket by medical rotation of the upper arm rather than elbow flexion.