

ITF Coaches Education Programme



Biomechanics of the forehand stroke



Original article: Bahamonde, R. (2001). *ITF CSSR*, 24, 6-8

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Introduction

- The tennis forehand stroke has changed drastically over the last 10 years
- Today's players seldom use the traditional forehand but the modern topspin forehand stroke



Introduction

- Changes in the forehand technique have been attributed to:
 - New racket designs,
 - Better physical fitness of the players, and
 - Increasing speed of the game

Changes in racket designs

- Rackets are bigger, lighter, and stiffer than the traditional wooden rackets
- Allow players to hit the ball with:
 - More power and
 - More control

Changes in racket designs

- These changes in the forehand technique have influenced:
 - The type of grip,
 - Footwork, and
 - Racket backswing and forward swing

Preparation

The Grip



- Functions of the grip:
 - Provide the proper racket orientation at impact,
 - Place the wrist in a favorable strength position,
and,
 - Allow for hand mobility

Preparation

The Grip



- Use a firm grip near impact to control the racket during off-centre hits
- Most tennis professionals advocate the use of a western or semi-western grip instead of the traditional eastern forehand grip

Preparation

The Grip



- Western:
 - Easier to generate topspin and maintain racket orientation at impact
 - Produce higher forward (toward the court) and sideways (along baseline) velocities than the Eastern
 - Difficult for players to hit low bouncing balls.

Preparation

The Grip



- Eastern forehand:
 - Greater wrist stability
 - Proper racket orientation at impact regardless of ball height
- Semi-Western forehand

Preparation

The stance



- Open stance:
 - Players must react faster and are forced to hit on the run due to the power developed in the groundstrokes and the serves
 - Little or no transfer of linear momentum since the step is taken side ways,
 - Only the segment rotations are used to generate power for the forward swing

Preparation

The stance



- Traditional square stance:
 - Takes longer to execute
 - It generates linear momentum; as the player steps forward toward the ball, and
 - Angular momentum; from the rotation of the legs, hips, and trunk

The backswing

Which type provides more racket velocity and control?



- Traditional straight:
 - Thought that provided more control
 - Loop (large and small) backswings provided greater racket velocity

The backswing

Which type provides more racket velocity and control?



- Large-loop:
 - Increases racket velocity, but affects racket control and timing
- Small-loop:
 - Increases racket velocity without affecting the timing and control of the stroke

The backswing

Which type provides more racket velocity and control?



- Regardless of the type of backswing used
- For more power and efficiency
- Transition between the backswing and forward swing:
 - Fluid motion: smooth and continuous
 - Enhances the player's ability to utilize the pre-stretching of the muscles

The forward swing *Type*



- Modified by the changes in the game
- Multi-segment forehand technique:
 - Used by top professional players
 - Individual segments of the upper extremity are used to generate racket velocity
 - More compact arm during the backswing
 - Generate higher racket and ball velocities

The forward swing *Type*



- Conventional / single unit forward swing:
 - Segments of the upper extremity move as a single unit from the shoulder
 - No differences in the grip or initial footwork

The forward swing

Type



- Select the forward swing:
 - Multi-segment or
 - single unit forehand

that best suits the player's physical and motor skill abilities

The forward swing

Racket trajectory and orientation



- The trajectory of the racket (stroke arc):
 - Horizontal motion: flattened arc near impact
 - Vertical plane: Optimum angle of the racket 28°

The forward swing

Racket trajectory and orientation



- Angles:
 - Smaller tend to produce less spin
 - Larger sacrifice ball speed and the depth
 - Changes in footwork and forward swing influence the arc

The forward swing

Racket trajectory and orientation



- Multi-segment forehand swing:
 - Smaller arc= smaller swing radius= less accurate
 - Steep vertical trajectory at impact (47°)

The forward swing

Racket trajectory and orientation



- Open stance:
 - Not more efficient
 - Result of lack of preparation time for the forehand stroke
 - Less time to successfully hit the ball on the racket face in the horizontal plane.

The forward swing

Racket trajectory and orientation



- Closed stance:
 - More accurate racket path in the horizontal plane.

The forward swing

Linear and Angular Momentum



- How to develop more power and control?
- Both can be achieved through the proper development of linear and angular momentum

The forward swing

Linear and Angular Momentum



- Linear momentum:
 - Quantity of linear motion that a body possesses
 - Developed through the forces generated from the ground as you step forward and transfer your body weight from the back leg to the forward leg (for a closed stance footwork)

The forward swing

Linear and Angular Momentum



- Angular momentum:
 - Quantity of angular motion that a body possesses
 - Developed from the ground reaction forces (GRF)
 - Tends to produce a sequence of body rotations (legs, hips, trunk, upper limb, and racket)
 - Optimal trunk rotation is one of the outcomes of angular momentum

The forward swing

Linear and Angular Momentum



- Trunk rotation:
 - Correlated with racket velocity (about 10%)
 - Used in the pre-stretching of the shoulder muscles to allow them to produce a larger tension

Conclusion

What to do to produce explosive forehands?

- Understand the basic biomechanical principles
- Understand how to apply them to the different components of the strokes

Conclusion

What to do to produce explosive forehands?

- The racket is one of the most important sources of power for a tennis player
- Stress the importance of using trunk rotation and the legs throughout the forehand stroke
- Explain to the players the importance of a proper follow-through.