Biomechanics of movement in tennis

Introduction

The movement patterns in tennis

- Understand the movement patterns of tennis
- Know how they relate to different surfaces
- Design training programs that match the individual needs of the players
- Movement potential determined by:
  - The individual’s conditioning
  - Coordination abilities
- These abilities should be integrated into tennis technique (Schönborn, 1998)
Court movement

Effects of surface

• Tennis played on a wide variety of surface types
• Three-quarters of a million tennis courts in more than 200 countries worldwide
• Tennis courts can now be classified according to their pace characteristics
Court movement

Effects of surface

• Rallies and gender:
  – Women’s singles matches (avg. 7.1 sec.) longer than men’s (5.2 sec.)

• Rallies and surface:
  – French Open (men and women) longer than any other Grand Slam
  – Wimbledon were significantly shorter

(O’Donoghue & Ingram, 2001)
Court movement

Effects of surface

• Proportion of baseline rallies on each surface:
  – French Open 51% of points
  – Australian Open 46% of points
  – US Open 35% of points
  – Wimbledon 19% of points

• This illustrates the different movements by players on the 4 different surfaces
Court movement

*Effects of surface in championships tennis*

- A quarter to a third of all strokes are hit under time pressure (i.e. one stroke per point)

- The influence of the various forms of speed on the result of matches is obvious

(Grosser, Kraft and Schönborn, 2000)
Court movement

Effects of tennis balls

• Research on the effects of the larger ball (larger) on court movement:
  – A greater number of forehands were struck in a position closer to the net
  – A greater amount of forward movement is required when playing with the larger ball in recreational players.
Court movement

Traditional technique

• In the past, coaches told players to:
  – Take the racquet back early during preparation for a groundstroke
  – Lead with the racquet as the body was rotated in a direction
  – Leave the body sideways to the net
Court movement

Effect of modern technique: Research

- Body rotation is initiated with shoulder rotation
- Movement of the dominant shoulder backwards away from the direction of incoming ball
- Shoulder rotation before racket movement occurs
Court movement

Effect of modern technique: Research

• Early movement to a groundstroke occurs in the lower body
• The racquet is not in an awkward position that would interfere with court movement
• Beginners attempt to move to a shot with the arm and racquet straight out behind them to prepare
Court Movement

Characteristics & Demands

• Move quickly and change directions often
• Stop and start (Sprinting, stopping, starting and bending)
• Maintain balance and control
• Repetitive demands on the bones, ligaments and muscles to absorb the shear forces
• Proper training exercises, including flexibility and strength training, are needed for injury prevention

(Chandler, 1995)
Dynamic Balance

Characteristics

• Correct position= solid platform to hit the ball:
  – Agility, speed and balance
  – Dynamic balance: ability to keep the center of gravity over the base of support while the body is moving
  – Move the COG to the edge of the base of support to move in that direction.
  – COG no far outside the base of support: unstable or over-committed

• The preparatory movement before changing direction is the “split step”
Split step

Mechanics

• Less time to prepare for strokes due to:
  – Continued changes in the game
  – Dominance of powerful exchanges

• Split step (early description):
  – Both feet coming down from the air
  – Landing on the court simultaneously
  – Enables the player to begin to move to either the forehand or backhand side to execute a shot
Split step

Recent research in elite players

• Specific landing and foot position (RH):
  – Landing with the foot farthest away from the ball (left) a split second ahead of the other
  – As the right foot prepares to touch the court, start rotating that foot towards the ball
  – Pointing the right foot outward in a RH player
Split step

Recent research in elite players

- Performed without apparent conscious
- Enhances lateral or sideways movement
- May initiate body rotation towards the side of intended movement
Split step
Sequence of the toe-out technique

- External rotation (toe-out) of the foot
- Rotates outward the tibia and fibula
- Rotates the upper leg (femur) outward
- This leads to a rotation of the pelvis toward the direction of movement
- These actions:
  - Happen in a split second
  - Can be difficult to detect with the naked eye
Foot and ankle

Mechanics during on-court movement

• A common myth:
  – The player is on his toes or the balls of the feet

• Reality:
  – Tennis players move on the court using the same heel to toe progression as runners and other athletes
Foot and ankle

Mechanics during on-court movement

• Upon striking the ground:
  – The foot is in a supinated position
  – Foot and heel are turned inward, with a relatively high arch position
Foot and ankle

Mechanics during on-court movement

• Upon landing:
  – Foot immediately pronates or flattens
  – Foot and ankle turn outward with arch flattening
  – Serves to absorb shock and protect the body from the impact
  – Allows the foot to adapt to the court surface
Foot and ankle

Mechanics during on-court movement

• After pronating:
  – The foot is flat on the court surface
  – The foot and ankle re-supinate prior to pushing off of the ground
  – Failure to re-supinate prior to pushing off the court surface can lead to injury and non-efficient propulsion
Foot and ankle

Injuries and prevention

• Very flat and pronated feet:
  – Overuse injuries: plantar fascitis, achilles tendonitis, and shin splints

• Minimizing the risk of injury:
  – Proper footwear
  – Applying orthotics (custom inserts)