ITF Coaches Education Programme

Biomechanics and stroke production: implications for the tennis coach

Biomechanics

• Key area in coach education and player development
• All tennis strokes have a fundamental mechanical structure
• Successful achievement of each stroke is greatly affected by the technique the player employs
Developing stroke production

• An individualised model for performance should be structured

• Consideration to:
  – the key mechanical features of each skill
  – the flair and physical characteristics of a player
The role of the coach

• Understanding the key mechanical features of a stroke
• Analyse movement
• Communicate
• Provide the best opportunity for optimal player development
• Provide a player with the best opportunity to play the game with minimal risk of injury
Developing power strokes in tennis

- The use of co-ordinated movements
- Distance and the Development of Racket-Speed
- The Use Of Elastic Energy/Muscle Pre-tension
- The Role of Muscle Performance: Endurance, Flexibility, Power and Strength
- The Role of Equipment Design
The use of coordinated movements

- Two major strategies of coordination used in tennis:
  - In strokes where **power** is required (such as the service and groundstrokes) a number of body segments must be coordinated in such a way that a high racket-speed is generated at impact.
  - Where precision is **needed**, you reduce the number of segments and move segments more as a unit (such as the volley at the net).
The use of coordinated movements

• This concept is introduced as the “kinematic chain”:
• A flow of movements from the ground, via the trunk to the racket-arm required for effective stroke production
• Factors that hinder flow:
  – Removing an action from this chain (eg, the rotation of the shoulders in the serve)
  – Reducing the number of segments used to generate racket-speed (see use of segments below)
Distance and the development of racket-speed

• The backswing increases the distance over which speed can be developed during the forward swing
• In groundstrokes it was commonly taught that “the racket should be pointed at the back fence”
• Today advanced players frequently rotate the racket 45° beyond this point for the forehand and 90° beyond this point (“parallel with back fence”) for a backhand groundstroke
Distance and the development of racket-speed

• This tendency of keeping the racket behind, yet away from the back in the service action is further evidence of players increasing the distance of the forward swing to impact

• This increased backswing also links to the storage of elastic energy and pre-tensing of muscles as discussed below
Elastic energy / muscle pre-tension

- Stretch-shorten-cycle movement
- Elastic energy stored during the eccentric phase of the action (the stretch in the backswing) is partially recovered
- The forward-swing phase (muscles shortening) is enhanced and begins with the appropriate muscles on-stretch
- Research: Benefit to performance from these is critical to success in tennis
Service

- The stretch of the shoulder muscles is maximised by a vigorous “leg-drive”
- This is combined with the effects of gravity and the inertia of the racket
- The off-centre “leg-drive” also helps to rotate the trunk forward (flexion, shoulder-over-shoulder and rotation) in preparation for impact
Groundstrokes

• Appropriate muscles on stretch during the backswing by the:
  – Rotation of the shoulders greater than the hips and
  – Positioning of the upper limb relative to the trunk

• Backhand groundstroke:
  – Racket rotated parallel to the baseline (approx. 270° from the ready position) in preparation for the forward swing
Volley / Service return

• The split-step:
  – Integral part of the volley actions and service return
  – Places the quadriceps muscle (extensor of the knee joint) on stretch
  – Permits quick movement to either side of the body in preparation for the subsequent stroke
Recovery of the elastic energy

- The key is the timing between the stretch (backswing) and then shorten (forward-swing) phases of the stroke.
- The benefit of the stored energy is reduced if a delay occurs between these phases.
- Speed racket-speed can be increased by approximately 20% if a pre-stretch occurs and 50% of this benefit will be lost if there is a pause of 1s between backswing and forward-swing phases of the stroke.
Pause between backswing and forward swing

• It is essential that a short or no pause occurs
• “Prepare early”, while good advice to beginners, may not be appropriate for advanced
• Backswing in the forehand:
  – Sufficient time to reach an extended backswing position thus putting muscles on stretch
  – Flowing immediately into the forward swing
  – Some players prefer to prepare early and then quickly take the arm back further prior to the forward-swing to impact
Role of muscle performance

• Muscle strength, flexibility, endurance and power must all be addressed if performance is to be enhanced and the incidence of injury reduced
• A specific training program can enhance racket-speed
• An increase in muscle strength means that a lower percentage of total strength is needed for each stroke
Role of muscle performance

• **Until puberty**: emphasis on stroke production and enjoyment of the game

• **Post-puberty**: integrate off-court strength/endurance/power training:
  – Pulleys, plyometrics, medicine ball drills
  – Flexibility training methods
Role of equipment design

- Modern designs have enabled the ball to be hit with a higher speed than was possible with previous designs
- These changes in racket design have affected players’ technique and the risk of injury
Conclusion

- Analyse stroke production
- Incorporate biomechanics into tennis stroke production
- Reduce the potential for injury