ITF Coaches Education Programme

Biomechanical principles for the serve in tennis

At the end of this session you will be able to

- Understand the mechanical factors which help producing a good serve
- Understand the theory behind advanced serving mechanics
- Analyse the service actions from a biomechanical perspective

Speed of serve
1999 Wimbledon

- Sampras 218.8
- Rudseski 215.6
- Ivanisevic 215.6
- Henman 214.0
- Williams 201.1
- Novotna 180.2
- Serna 173.8
- Graf 17220

Service action
main phases

- Backswing
- Forward swing
- Follow through

Phases of the backswing

– Leg drive / foot orientation
– Trunk and shoulder rotation
– Upper arm external rotation
– Storage of elastic energy

Backswing
foot up & back techniques

- The foot up and foot back techniques are characterised by different considerations
  - Back foot just behind to allow hip rotation
  - Foot up: Better vertical drive
  - Foot back: Better preparation to the net

Backswing
leg drive

- The racket should be down behind the back side
- It is better if the racket is away from the body than too close to it
- The body moves forward
- Forward rotation of the trunk
- Efficiency: If the body is taken off the ground

Backswing
leg drive - hitting in the air

- An effective leg drive will not only affect the displacement of the racket but also will make hitting in the air
- Don’t teach hitting in the air
- It is a natural consequence of the leg drive

Backswing
right foot referred to left foot

- If, at impact, the back foot comes forward to be positioned in front of the front foot it will not allow the rotation of the trunk

- It is better to keep the back foot behind the front foot at impact

Backswing
shoulder and trunk rotation

- Rotation of the body
- Forward movement of the body
- Shoulder over shoulder

Backswing
rotation of the body

- It is the less important of the 3 movements of the body
- 2 directions:
  - To the ball
  - Counter rotation

Backswing
forward movement of the body

- To impact
- Rotation forward of the trunk
- The racket shoulder is moving forward into impact
- 10-20% of the power of the serve comes from this action

Backswing

shoulder over shoulder movement

- Right shoulder over the left shoulder
- Related to how high the ball toss is and to the location of the ball toss
- Free arm goes up
- This movement differentiates good serves from excellent ones

Backswing

link of leg drive and trunk/shoulder rotation

- Large forward rotation
- What differences slow vs. fast serves is the “cartwheel” rotation (shoulder over shoulder)

Backswing
trunk and shoulder rotation

- Horizontal (rotation)
- Vertical (shoulder over shoulder)

- There are movements you need to put the muscles of the arm in stretch

Backswing
external rotated position of the shoulder

- Stored energy around the shoulder
- It is different from the forearm
- You don´t want the hand to be hyperextended because it would create too much stretch on the forearm

Backswing
storage of elastic energy

- Need to put muscles and tissues of the upper limb and shoulder on stretch
- Look at if the movements of the trunk allow for this stretch of the shoulder muscles and tissues
- The body movements should create this stretch

Backswing
how to store elastic energy

- Take the shoulder back
- Use muscular effort
- Plyometric training:
  - do it better on soft surfaces
  - Box 1/2 metre
  - Amount of force: 4-5 times body weight on 2 legs

Backswing
use of elastic energy: timing

- If the movement has a delay of 1 sec., 50% of the energy is lost
- The longer the delay, the more energy is lost
- This does not mean that there should not be or there is not a pause
- The pause has to be shorter than 1 sec.

Backswing
benefits of use of elastic energy

- Pre-loading of the muscle
- 20% benefit of external followed by internal rotation
- I.e. Taking the arm back and then forward
- 20% increase of power in the serve
- Reduce 20% the muscular effort in the serve

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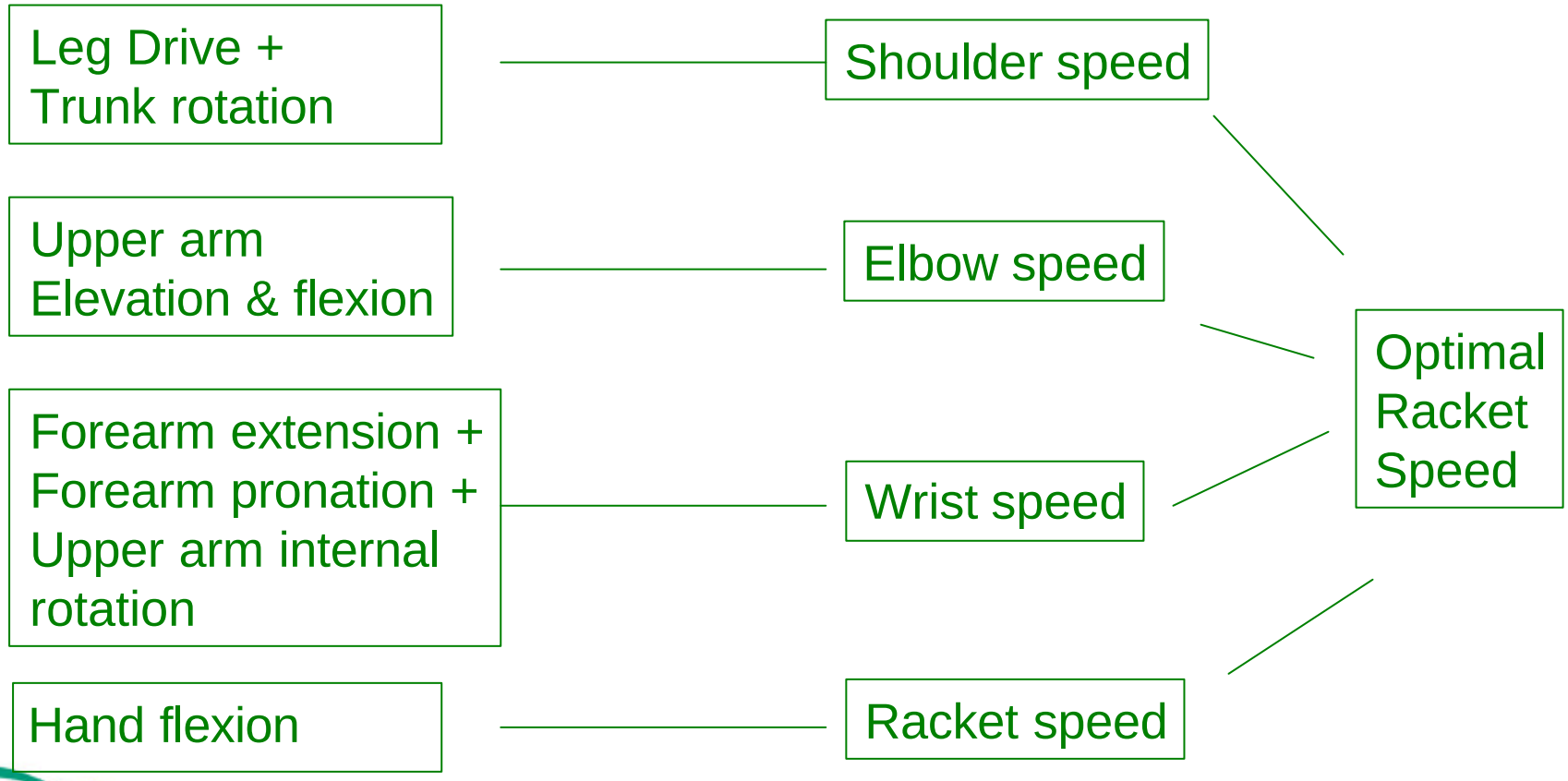
Phases of the forward swing

1. Co-ordinated action (kinematic chain))
2. Upper arm internal rotation and arm flexion
3. Ball toss
4. Impact alignment of hitting limb - trunk
5. Racquet trajectory
6. Foot landing sequence

Forward swing
co-ordinated swing



Forward swing
co-ordination

- Flow together
- Good rhythm
- All should take place
- Is the player using all the segments he can use?
- Females do not use shoulder over shoulder as much as males do

Forward swing
Forearm extension

- Gives height
- Pronation of forearm does not gives power but realigns the racket face
- It changes the angle

Forward swing
upper arm internal rotation

- It occurs very lightly
- It participates completely in the follow through
- Do not teach to finish the movement across the body
- It is detrimental to the speed

Forward swing

contributions to racket speed at impact

- Leg drive 10%
- Trunk flexion 20%
- Internal rotation 30-40%
- Hand flexion 30%

- This does not mean that there are parts which are less important in the serve

Forward swing

- Wrist action following internal rotation is wrist flexion
- Shoulders are almost parallel to the net prior to impact
- Area of highest speed is just above the area of percussion

Forward swing
Ball toss

- Should be considered as part of where is the trunk
- Not isolated, if not, it may be wrong
- Types:
  - Forward foot plane (B.Becker)
  - Facing plane (J. Newcombe)
- Don’t know which is better, easier for beginners to toss in front

Forward swing
Ball toss location

- On the left foot
- The upper limb is straight and the racket is tilted
- This permits a better shoulder rotation (internal rotation of the upper arm)
- Latissimus dorsi is the one which does much of the work

Forward swing
Movement of the free arm

- Push the ball into the air
- No Science involved on it
- Keep it close to the body when the hand goes down
- Better movement of inertia

Forward swing
Ball impact location

- Ball travels forward and left related to left toe
- It is not hit on the right but on the left side of the body

Forward swing

Impact alignment of the upper limb - trunk

- If the shoulders are horizontal to the ground the alignment is incorrect
- If the shoulders are almost parallel to the ground the alignment is correct

Forward swing
Up and out hitting action

- Feel like the right shoulder is hitting out
- This is affected by the leg drive
- This movement can be helped by using a "cue word" such as: "up and out", "drive"

Forward swing
Use of the whole body

- Just swinging with the upper body will not help your serve
- By using lower body the racket will move up and out to the ball

Forward swing
Spins

- Slice comes by putting the shoulders parallel to the net
- With the shoulder over shoulder movement the player can produce more topspin
- Flat serves do not exist

Forward swing
Other aspects

- Yandell (1998) found that there is not such thing as a flat serve in professional tennis
- The hitting action is up and out
- In the serve you don’t hit through the ball
- Landing foot:
  - 95% Left - left
  - 5% Left - right

Forward swing
Other aspects (II)

- Don´t let the arm swing too far away from the body
- Apply the same principle as when the kids take the racket from the throat. They can rotate the racket better when the point of contact is closer

Phases of the follow through

- Upper arm internal rotation
- Shoulder orientation

Follow through

- Internal rotation plays a very large role
- It takes the racket out of the body
- Check shoulder orientation:
  - Not horizontal
  - Better more vertical

Follow through

- Check internal rotation and pronation
- Check the movement of the racket when it is finished

Serve
teaching tips

- Beginners:
  - Rhythm is the most important thing

- Intermediate:
  - Include leg drive, trunk rotation, etc..

Angular momentum in the serve

- The body has to develop forward momentum about the X axis (trunk)
- As the trunk slows down, the arm gains momentum

Appropriate service techniques for a more powerful serve are result of

- Increased racket displacement
- Increased segment rotations
- Increased use of elastic energy
- Rhythmical action about a stable base

Summary
service mechanics

- Get leg drive, trunk rotation, shoulder over shoulder to increase racket displacement
- Increase segment rotation but not with beginners
- With advanced players work on trunk extension
- Increase stretch to pre-load muscles
- Rhythmical action