ITF Coaches
Education Programme
Level 2 Coaching Course

Energy systems in tennis
How human energy is produced?

ADENOSINE TRI-PHOSPHATE (ATP)

BREAKDOWN

ENERGY REQUIRED FOR MUSCULAR CONTRACTION DURING 2-3 secs.

3 ENERGY SYSTEMS TO REPLACE ATP
Energy systems

**ENERGY**

**Anaerobic**

- **Alactic Phospho-creatine**
  - Actions lasting (0-15 sec.)

- **Lactic Anaerobic Glycolysis**
  - Actions lasting (15-120 sec.)

**Aerobic**

- Actions lasting longer than 2 min.
Comparison between energy systems

**SPEED OF RELEASE**

- Fast
  - PC
  - Anae. Glycolysis
- Slow
  - Aerobic

**AMOUNT OF ENERGY AVAILABLE**

- Small
  - PC
  - Anae. Glycolysis
- Large
  - Aerobic
Phospho-creatine (PC)

- Provides an immediate form of energy
- Only supplies ATP for up to approximately 15 sec.
- It is anaerobic
- Examples:
  - Sprinting to a short ball
  - Serving and volleying
  - Playing a point for up to 15 sec.
Anaerobic glycolysis

• Not dynamic as the PC system
• Can provide energy for up to 2 minutes
• It produces as a bi-product a substance called LACTIC ACID:
  – This substance has been shown to be associated with fatigue
Lactic acid

• It is always being produced, when we don’t see it in the blood it is because production is less than removal

• If lactate production is:
  – equal to removal rate no change is seen
  – more than removal rate then there is an increase in blood lactate
  – less than removal rate then no change (increase) is seen
Lactic acid values

- ‘Flat out’ cycling for 30 secs: 19 mmol l.
- Football player: 6-9 mmol l.
- Tennis training match: 1-9 mmol l.
- Tennis tournament match: 2-8 mmol l.
Aerobic system

• Requires oxygen to function
• Cannot supply ATP to the working muscles as fast as the other two
• But it can sustain a steady demand for energy over a long period of time
ATP Replenishment

- 50-80% replenishment after 30 sec.
- 100% replenishment after 3 min.
Energy systems in tennis

- Anaerobic (Alactic)
- Anaerobic (Lactic)
- Aerobic
Energy systems in tennis

- Anaerobic (Alactic): 70%
- Anaerobic (Lactic): 20%
- Aerobic: 10%
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Physical demands of tennis
Strokes per point

<table>
<thead>
<tr>
<th>Court Surface</th>
<th>Green Set</th>
<th>Clay</th>
<th>Fast</th>
<th>Grass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seconds</td>
<td>5.1</td>
<td>7.6</td>
<td>3.9</td>
<td>1.9</td>
</tr>
</tbody>
</table>
Time points are played

- < 15 secs: 95%
- > 15 secs: 5%
Percentage of action/rest per match

Rest 85%

Action 15%

Rest 75%

Action 25%
Average time of points men’s pro tennis today

<table>
<thead>
<tr>
<th>Court Surface</th>
<th>Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass</td>
<td>2.7</td>
</tr>
<tr>
<td>Hard</td>
<td>6.5</td>
</tr>
<tr>
<td>Clay</td>
<td>8.3</td>
</tr>
</tbody>
</table>
Average time of points women’s pro tennis today

<table>
<thead>
<tr>
<th>Court Surface</th>
<th>Grass</th>
<th>Hard</th>
<th>Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seconds</td>
<td>5.4</td>
<td>6.6</td>
<td>10.7</td>
</tr>
</tbody>
</table>
Time between points professional tennis players

Men: 25.6 seconds
Women: 19.4 seconds
Physical demands of tennis

- **Flexibility**
  - 10
  - 8
  - 6
  - 4

- **Strength & Power**
  - 10
  - 8
  - 6
  - 4

- **Speed & Agility**
  - 10
  - 8
  - 6
  - 4

- **Endurance**
  - 4
  - 6
  - 8
  - 10

- **Coordination**
  - 4
  - 6
  - 8
  - 10
## Physical demands of tennis (I)

<table>
<thead>
<tr>
<th>Data</th>
<th>Condition</th>
<th>Training system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work:rest ratio 1:2 or 1:3</td>
<td>Mixed endurance activity anaerobic alactic (70%), anaerobic lactic (20%) and aerobic (10%)</td>
<td>Interval training</td>
</tr>
<tr>
<td>Intensity: submaximal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lactate levels: Less than 4 mmol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 change of direction every 1.1 sec. on average within 5.2 secs of play</td>
<td>Agility, balance</td>
<td>Agility drills on court Specific tennis footwork Dynamic balance</td>
</tr>
<tr>
<td>An average of 38 to 80 changes of direction occur in each set</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ball flight time of 1.4 secs. between two points of contact Baseline shot speeds of approx, 57-86 km/hour</td>
<td>Co-ordination</td>
<td>Hand-eye co-ordination drills Speed of co-ordination</td>
</tr>
<tr>
<td>The human eye can’t see the ball when it is 1.5 metres to impact Ball contact lasts 0.04 secs.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Physical demands of tennis (II)

<table>
<thead>
<tr>
<th>Data</th>
<th>Condition</th>
<th>Training system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each impact of the ball and the racket produces a load to the wrist and arm of 25 to 31 kgs. Abdominal and lower back muscles contract on average at 70-80% of their maximum intensity when hitting the ball.</td>
<td>Strength and power</td>
<td>Reaction power Upper and lower body strength</td>
</tr>
<tr>
<td>Court sprints may cover a maximum of 14 metres with a majority of sprints being between 2.5-6 metres. Total distance run during one point is 14 metres.</td>
<td>Speed</td>
<td>Power speed Reaction speed Short distance drills</td>
</tr>
<tr>
<td>Continuous bending, stretching and twisting of the body to reach and hit the ball.</td>
<td>Flexibility</td>
<td>Flexibility routine before and after each workout and match</td>
</tr>
</tbody>
</table>
# Physical demands of tennis

<table>
<thead>
<tr>
<th>Fitness components</th>
<th>% of importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLEXIBILITY</td>
<td>50</td>
</tr>
<tr>
<td>CO-ORDINATION</td>
<td>90</td>
</tr>
<tr>
<td>REACTION SP.</td>
<td>70</td>
</tr>
<tr>
<td>CO-ORDINAT. SP.</td>
<td>80</td>
</tr>
<tr>
<td>SPEED</td>
<td>55</td>
</tr>
<tr>
<td>SPEED E.</td>
<td>55</td>
</tr>
<tr>
<td>ELASTICITY</td>
<td>60</td>
</tr>
<tr>
<td>ACCELERATION</td>
<td>80</td>
</tr>
<tr>
<td>STRENGTH E.</td>
<td>50</td>
</tr>
<tr>
<td>ANAEROBIC E.</td>
<td>50</td>
</tr>
<tr>
<td>AEROBIC E.</td>
<td>55</td>
</tr>
</tbody>
</table>

Schonborn, 1987