Shoe-Surface Interaction in Tennis

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Study Impetus

- Tennis match-play
  - Year round season
  - Range of surfaces

- Participation in tennis
  - Overall increase

- Injuries in tennis
  - Site specific
  - Proportionally twice as many lower limb injuries in younger players
  - Injury mechanism

![Injury Incidence Graph]

- Age classification:
  - Junior
  - Senior
  - Veteran

- Injury Incidences (Absolute values)
  - Trunk
  - Upper Limb
  - Lower Limb
The Study

- Relationship between the mechanical properties of the independent systems and their combined effect on the tennis player
  - Surfaces
    - Deflection
    - Stiffness
  - Shoes
    - Mass
    - Impact Force
    - Impact Velocity
• Interaction Study
  – Surface comparison
  – Shoe comparison
    • Maximum Force
    • Peak Pressure
    • Impulse
    • Pressure-time integral
**Mechanical Properties: Surfaces**

**Deflection***

<table>
<thead>
<tr>
<th>Court Type</th>
<th>Co-efficient of Variation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylic Court</td>
<td>23.37</td>
</tr>
<tr>
<td>Clay Court</td>
<td>22.37</td>
</tr>
<tr>
<td>Grass Court</td>
<td>35.83</td>
</tr>
</tbody>
</table>

**Stiffness***

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<tbody>
<tr>
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<td>24.58</td>
</tr>
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<td>Clay Court</td>
<td>21.66</td>
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<tr>
<td>Grass Court</td>
<td>47.24</td>
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</tbody>
</table>
Mechanical Properties: Shoes

Relationship between tennis footwear weight and impact force (19 shoes tested).

No significant differences found in impact force between any of the tested shoes.
Interaction Study

Force Velocity Relationship on the 3 Court Surfaces

Variation in Maximum Force Across the 3 Court Surfaces during Open Stance Forehand Under the Multi-shoe Condition

Variation in maximum Force Across the 3 Court Surfaces during a Running Forehand Under the Multi-shoe Condition.
The Study Findings

- Highly significant differences in surfaces
- No significance differences in tennis footwear
- Trends on surfaces in relation to the velocity of the movements and the subsequent force production
- Significant differences are found for the maximum force experienced by players on the 3 surface types, this is only present in the higher velocity movements
Comments

- Movement velocity is the determining factor for increases in maximum impact force experienced.
- Rather than the surface stiffness and/or footwear condition.
- The players are adapting to the surface change independently of the footwear.

However

- Is the footwear ‘permitting’ the adaptation to take place?
- Is there a change in distribution of force across the area of the foot in response to surface?
Thank you for listening, any questions?