Player-Surface Interaction

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Sports Surface Studies

- medical
- engineering
- biomechanical

- injury studies
- impact tests, characterisation
- human behaviour

Sport Surfaces Research Forum
www.sportsurf.org
Question

• What properties are required in a surface?
Question

- What properties are required in a surface?

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<th>Player requirements</th>
<th>Surface requirements</th>
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<tbody>
<tr>
<td>• Optimal performance</td>
<td>• Playability</td>
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<tr>
<td>• Minimal injury</td>
<td>• Durability</td>
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<tr>
<td></td>
<td>• Spatial uniformity</td>
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<td>• Temporal uniformity</td>
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<td>• Aesthetics</td>
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<td>• Sustainability</td>
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Player Requirements

• Quantify movement and loading patterns for different sports movements

- Running forehand footplant
- Sideways shuffle
Player Requirements

- Loading patterns for different movements

Running forehand footplant

Sideways shuffle

(Stiles and Dixon, 2005)
Player Requirements

- Manipulation of the playing surface may change the load and movement patterns

  ➢ Important to measure human-surface interaction for a range of surfaces
Surface Characteristics

- What are the specific differences between surfaces that influence the player?
  - Stiffness & Damping
  - Traction
  - Spatial and temporal uniformity
  - Environment

- How do these influence the player?
- How are these quantified?
Effect on surface

Acceptable, improved surface design

Change surface

Effect on surface

Effect on player

No improvement or surface failure

Unacceptable increase in injury risk
Biomechanical Studies: Example

- Tennis - running forehand foot plant
- Peak impact forces similar for different tennis surfaces
- No consistent changes in movement patterns
Biomechanical Studies: Example

- Tennis - running forehand foot plant
- In-shoe pressures for distinct surface conditions
Biomechanical Studies: Example

- Tennis - running forehand foot plant

- Different in-shoe peak pressure for differences in surface

  ➢ Higher peak heel pressures on stiffer surfaces
Mechanical Studies: Example
Mechanical Studies: Example
Mechanical Studies: Example

![Graphs showing draught force and dry bulk density over time and number of passes.]

- **Draught force, N**
  - Time, s
  - Run 1, Run 10, Run 20, Run 40, Run 70

- **Dry bulk density, kg m⁻³**
  - Number of passes
  - LSD 95%
  - 0-50 Light, 50-100 Light, 100-150 Light
Mechanical Studies: Example

Types of 'Going'

National Hunt Racing 2000-2002

Injuries per runner (%)
Mechanical Studies: Example

Flat Racing 2000-2002

Types of 'Going'

Data courtesy of: THE JOCKEY CLUB

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Mechanical Studies: Example

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Mechanical Studies: Example

Hardness

Ball rebound

Traction

Error bars represent the standard error
Integrated Approach

- Change surface
  - No improvement or surface failure
  - Unacceptable increase in injury risk
  - Acceptable, improved surface design

Effect on surface
Effect on player
Integrated Testing

In-shoe pressure

In-surface pressure
Integrated Testing

- Higher in-shoe pressures on surfaces with increased surface bulk density

- Higher surface pressures with increased surface bulk density
Natural Turf
Natural Turf

• Playing challenges
  – degradation with use
  – weather influences
  – inconsistent properties

• Maintenance challenges
Maintenance Challenges
Natural Turf

- Challenges for study
  - degradation over time (use, conditions, ...)
  - siting in a laboratory environment
Natural Turf

- **Challenges for study**
  - degradation over time (use, conditions, …)
  - siting in a laboratory environment
Conclusions

- Biomechanical and engineering studies provide useful information on player and surface behaviour.

- To understand player-surface interaction, an integrated approach is preferred.