Centre for Sport & Exercise Sciences
FACULTY OF BIOLOGICAL SCIENCES

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The influence of court surface impact properties on the loading response in tennis players

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Introduction

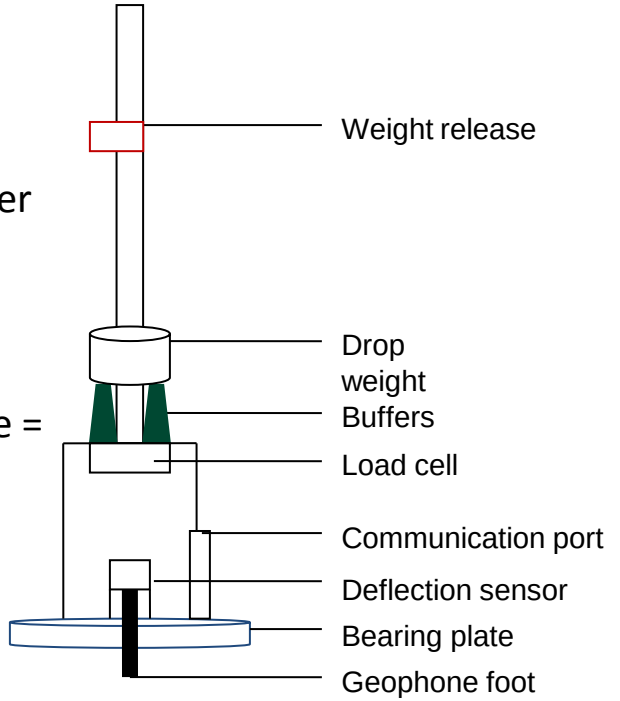
- "Impact experienced is thought to influence movement strategy and injury potential"
- Development of suitable test procedures
  - Out of the lab
- An example – tennis
  - Various surfaces (nature of the game)
    - Knowledge of ball-surface interface
  - Movement (multidirectional)
  - Material tests (attempt to consider vertical and shear loads)

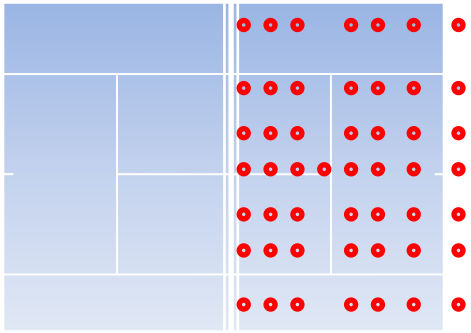
Material testing *in vivo*

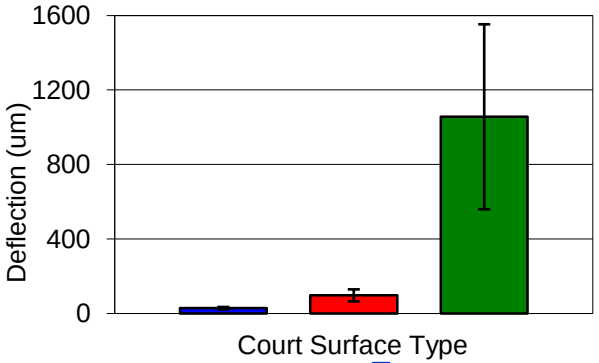
- Difficulties with measuring court surface friction
- Equipment available
  - Tortus II (dynamic friction)
  - Traction meter (traction)
  - TRL pendulum (limiting friction)
- Results
  - Unsuitable for all surface types

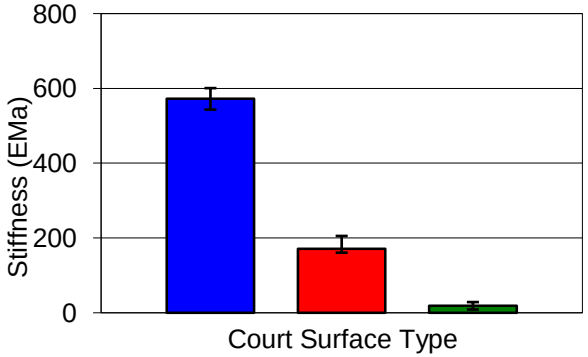
Material testing *in vivo*

- Keros Prima 100 device (Dynatest UK Limited)
- Distinguish between court types
  - ‘same’ protocol
    - **Drop height** (no effect of impact stiffness but height effects contact pressures; greater drop height = greater impact pressure)
    - **Buffers** (effects impact pulse time but not recorded stiffness)
    - **Loading plate** (plate size effects stiffness; smaller plate = greater stiffness) link to human action
  - **No damage**



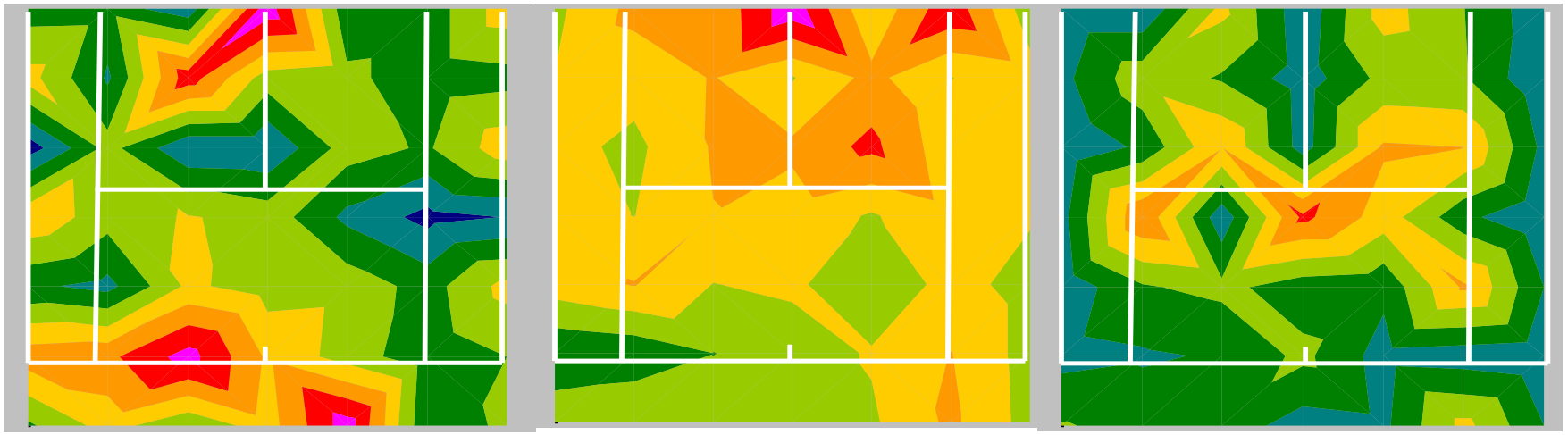






2 buffers, 300mm plate, average of 3 drops

Acrylic Court Clay Court Grass Court



Acrylic Court
Stiffness Range 300-940 EMa

Clay Court
Stiffness Range 50-250 EMa

Grass Court
Stiffness Range 5-50 EMa

- Significant difference between court types
- Surface maps suggest trends possibly in relation to human traffic

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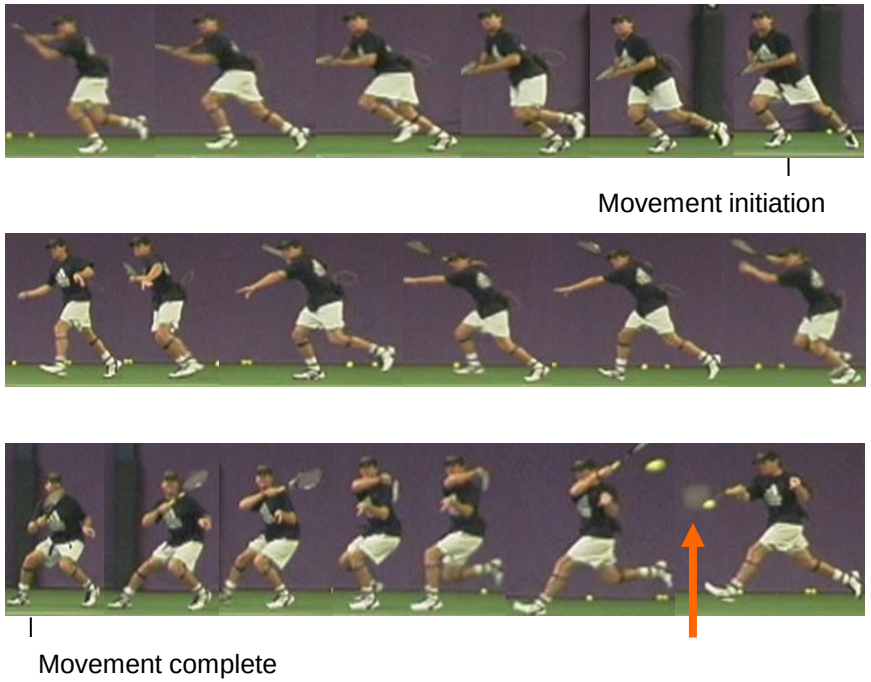
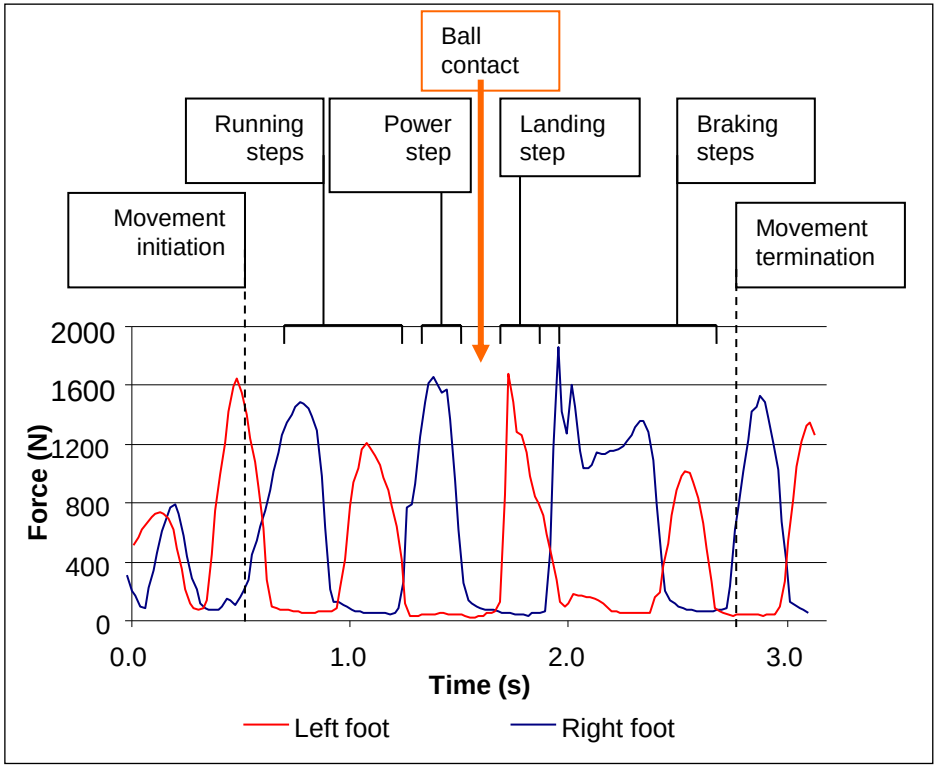
Human Performance testing *in vivo*

- No *in vivo* method to measure shear force components
- Pedar X (Novel$_{gmbh}$, Germany)
  - Matrix insoles
  - Normal force
- Protocol
  - 17 subjects with ranging ability
  - 2 movements, 10 trials each
  - 3 surfaces, 2 shoes
  - Variables
    - Velocity
    - Peak Imapct
    - Maximum loading rate
    - Pressure distribution

Human Performance: understanding movement





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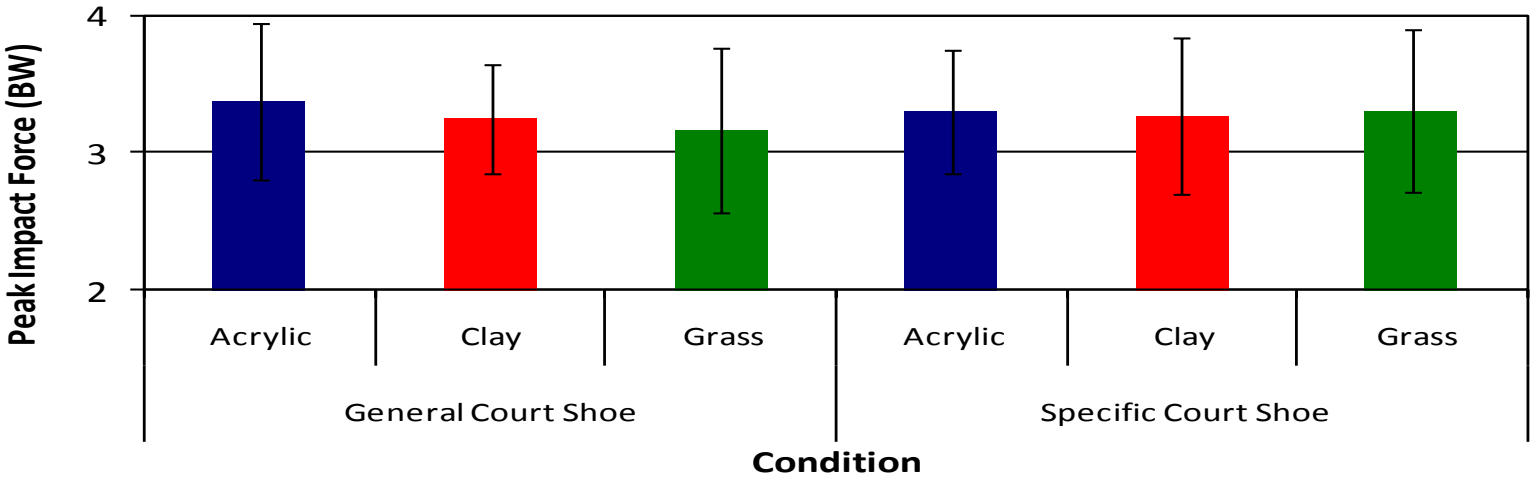
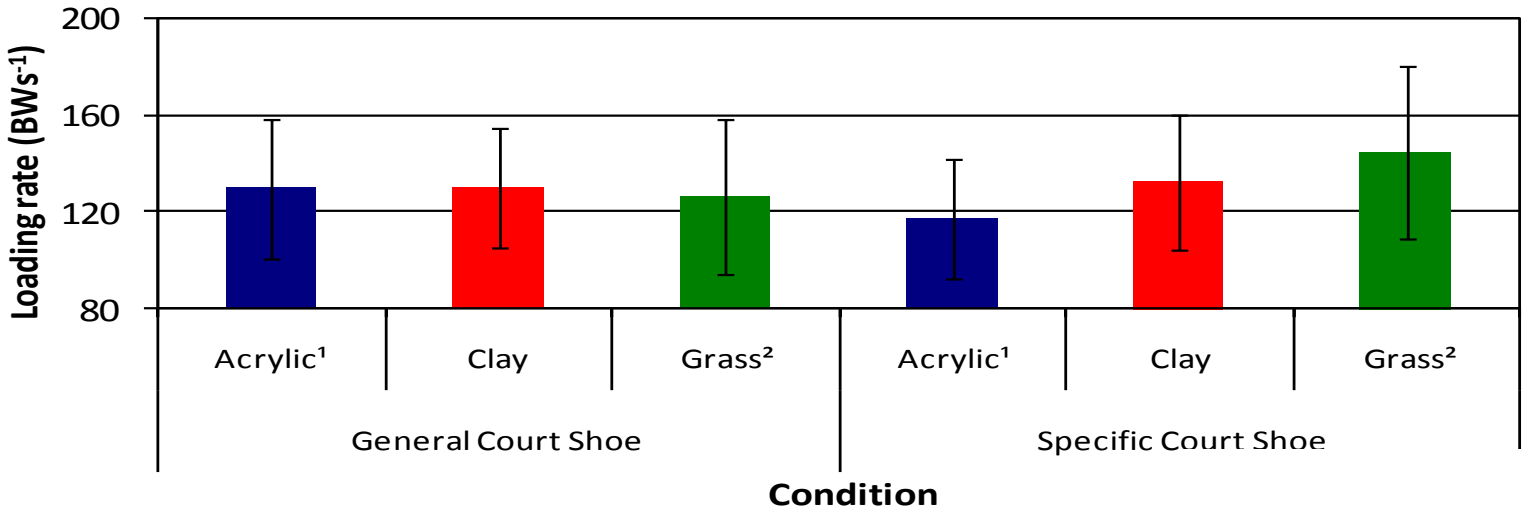
Loading Response





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Conclusions

- The Keros Prima 100 device provided a measure of the impact properties of the court surfaces.
  - a useful addition to surface testing equipment, particularly with reference to the information provided by 'surface maps'
- The acrylic court was found to be significantly stiffer than any other court surface.
  - 3 and 33 times stiffer than clay and grass courts respectively.
- Maximum forces experienced by players are generally higher on acrylic courts than any other surface.

But

- Not in parallel to the magnitude of difference between the stiffness displayed by the surfaces.
- Loading rates appears to be independent of surface type.
- The discourse between the scale of differences between court hardness and player-surface impact is currently unexplained.

Thank you & time for questions