SHOT OUTCOME AS A FUNCTION OF IMPACT LOCATION AND RACKET KINEMATICS IN THE BADMINTON JUMP SMASH

Mark King, Idrees Afzal, & Stuart McErlain-Naylor
FASTEST BADMINTON SMASH – 426 km/h
QUANTIFY SHOT OUTCOME

- shuttle speed
- shuttle direction
  - downwards angle
  - direction relative to court and opposition
CONTRIBUTING RACKET FACTORS

- racket head speed
- racket angle
- racket-shuttle impact location
- racket properties & strings
PURPOSE

• assess shot outcome as a function of:
  – racket head speed
  – racket angle
  – racket-shuttle impact location

• quantify elite player variability

• ignoring effect of racket & strings
DATA CAPTURE

- Vicon Motion Analysis System (400 Hz)
- reflective markers on racket and shuttle
PARTICIPANTS

• 14 international players
  – 2016 All England Championships
  – 2017 World Championships
MOTION CAPTURE
RESULTS
DATA SUMMARY

• shuttle speed
  – mean: 290 km/h
  – range: 192 to 368 km/h

• racket speed
  – mean: 203 km/h
  – range: 145 to 253 km/h
SHUTTLE DIRECTION

fastest per player
SHUTTLE DIRECTION

fastest per player

individual player fastest three
IMPACT LOCATION
SHUTTLE SPEED

• shuttle speed variation explained by:
  – racket head speed (70%)
  – longitudinal impact location (86%)
  – medio-lateral impact location (89%)
IMPACT LOCATION

Graph 1: % max speed vs. horizontal distance from centre (mm)

Graph 2: % max speed vs. vertical distance from centre (mm)
SHUTTLE SPEED

• shuttle speed variation explained by:
  – racket head speed (70%)
  – longitudinal impact location (86%)
  – medio-lateral impact location (89%)

• ‘sweet region’:
  – 1.1 cm mediolaterally
  – 3.0 cm longitudinally
  – less than 5% reduction in shuttle speed
SHUTTLE DIRECTION
SHUTTLE DIRECTION

- vertical shot direction explained by:
  - racket angle at impact (64%)
  - longitudinal impact location (72%)
• 53% lateral deviation explained by:
  – medio-lateral impact location
CONCLUSIONS

- shot outcome is determined by:
CONCLUSIONS

• shot outcome is determined by:
  – racket head speed and angle at impact
CONCLUSIONS

bullet shot outcome is determined by:
- racket head speed and angle at impact
- impact location of shuttle on racket face
CONCLUSIONS

• shot outcome is determined by:
  – racket head speed and angle at impact
  – impact location of shuttle on racket face

• greater understanding of margin for error
FUTURE WORK

• methods for increasing margin for error:
  – technique
  – racket properties
THANK YOU
# PBL - FASTEST SMASHES 2017

<table>
<thead>
<tr>
<th>male</th>
<th>speed km/h</th>
<th>female</th>
<th>speed km/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mads Pieler Kolding</td>
<td>426</td>
<td>P V Sindhu</td>
<td>375</td>
</tr>
<tr>
<td>Bodin Isara</td>
<td>419</td>
<td>Gabrielle Adcock</td>
<td>359</td>
</tr>
<tr>
<td>Ajay Jayaram</td>
<td>419</td>
<td>Carolina Marin</td>
<td>357</td>
</tr>
<tr>
<td>Goh V Shem</td>
<td>419</td>
<td>Ashwini Ponnappa</td>
<td>356</td>
</tr>
<tr>
<td>Vladimir Ivanov</td>
<td>419</td>
<td>Jwala Gutta</td>
<td>348</td>
</tr>
<tr>
<td>Markis Kido</td>
<td>415</td>
<td>Saina Nehwal</td>
<td>333</td>
</tr>
<tr>
<td>Sameer Verma</td>
<td>402</td>
<td>Nitchaon Jindapon</td>
<td>329</td>
</tr>
<tr>
<td>Jan O Jorgensen</td>
<td>401</td>
<td>Cheung Ngan Yi</td>
<td>324</td>
</tr>
</tbody>
</table>
QUESTIONS

• why can some smash much faster than others?
  – strength
  – technique
  – grip

• what is the limit for an individual?
• what does optimum look like?
• how to coach young players to smash faster?