Effect of holding a racket on propulsion technique of wheelchair tennis players

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Introduction

Wheelchair tennis vs. other wheelchair sports:
-> different propulsion

Optimize propulsion in wheelchair tennis ->
important to study the effect of holding a racket on
propulsion technique
Introduction

Goosey-Tolfrey & Moss (2005):
Maximum velocity was reduced during the racket condition
Reduction in achieved velocity during the first three pushes

-> ineffective propulsion technique while holding a tennis racket?

Purpose
To investigate possible differences in propulsion technique between propelling the wheelchair with and without a racket in the hand.
**Participants:** 8 experienced wheelchair tennis players

<table>
<thead>
<tr>
<th>Personal characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Men/Women (N)</td>
<td>4/4</td>
</tr>
<tr>
<td>Age (years)</td>
<td>23.0 (6.4)</td>
</tr>
<tr>
<td>Body mass (kg)</td>
<td>63.4 (15.2)</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.72 (0.09)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disability</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Paraplegia</td>
<td>3</td>
</tr>
<tr>
<td>Spina Bifida</td>
<td>2</td>
</tr>
<tr>
<td>Short femur, hip deviation</td>
<td>1</td>
</tr>
<tr>
<td>Hip dysplasia</td>
<td>1</td>
</tr>
<tr>
<td>Spastic legs</td>
<td>1</td>
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</table>

<table>
<thead>
<tr>
<th>Wheelchair tennis level</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>International youth / adults</td>
<td>5/3</td>
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</table>
Methods

Design
3 Submaximal exercise tests and 6 sprints on a wheelchair ergometer

Submaximal
1) 1.5 m/s on 0.15 W/kg without racket
2) 1.5 m/s on 0.15 W/kg with racket
3) 1.5 m/s on 0.25 W/kg with racket

Sprint
1-3) With racket at 0.25 W/kg
4-6) Without racket at 0.25 W/kg
Data analysis
Propulsion technique out of torque and velocity signals

Methods

Push frequency
Push time
Power loss before push
POpeak during push
POmean during push
Overall mean speed

Vegter et al., 2013
Statistics

Racket hand vs. non-racket hand during blocks with racket:
- Repeated measures ANOVA
- 2 within factors:
  - racket vs. non-racket hand;
  - exercise blocks 0.15 and 0.25 W/kg

Same hand, with and without racket during the 0.15 W/kg blocks:
- paired sample t-test
Results

<table>
<thead>
<tr>
<th>Propulsion technique</th>
<th>Racket side vs. non-racket side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Push frequency</td>
<td>=</td>
</tr>
<tr>
<td>Push time</td>
<td>↓</td>
</tr>
<tr>
<td>Power loss before push</td>
<td>↑</td>
</tr>
<tr>
<td>Power loss after push</td>
<td>↑</td>
</tr>
<tr>
<td>POpeak during push</td>
<td>↑</td>
</tr>
<tr>
<td>POmean during push</td>
<td>↑</td>
</tr>
<tr>
<td>Overall mean speed</td>
<td>↓</td>
</tr>
</tbody>
</table>

- Same hand compared when propelling with and without racket: similar significant differences, except for mean overall speed.
- 5s Sprint tests with and without racket showed also similar results
Results

Both hands free, 0.15 W/kg 1.5 m/s

With racket in right hand, 0.15 W/kg 1.5 m/s
Discussion

How to avoid high power loss when coupling the hand/racket to the rim?

Change in grip of the racket?
- Shape
- Material

Change in hand rim?
Discussion

Injuries:
Ineffectiveness in propulsion technique (higher peak forces at same workload) caused by the racket might be related to injuries of the upper extremity.

Future studies:
• Monitoring upper-extremity injuries in wheelchair athletes
• Evaluate load on the shoulder with musculoskeletal modelling
Limitations:

• Stationary wheelchair ergometer

• Steady-state wheelchair propulsion, e.g. no braking, maneuvering
• Propelling the wheelchair while holding a racket has negative effects on the propulsion technique.

• On the long term the ineffectiveness in propulsion technique caused by the racket might be related to injuries of the upper extremity, since the racket arm has to endure higher peak forces at the same workload compared to the free hand.
Thank you for your attention!