Relation between maximal power output during isokinetic workout on a cycling ergometer and maximal strength

Dennis Sandig¹, Sebastian Mühlenhoff², Michael Fröhlich¹, Klaus Wirth³ & Dietmar Schmidtbleicher³

¹ Sportwissenschaftliches Institut der Universität des Saarlandes
² Hessischer Radsportverband
³ Institut für Sportwissenschaften der Johann Wolfgang Goethe-Universität Frankfurt am Main
Introduction

Strength & Endurance
− traditional strength training definitions based on sport
− definitions of “strength endurance” vary from sport to sport as well as from discipline to discipline
− traditional forms of strength endurance training hardly verified
− modern definitions on strength endurance not commonly known
− traditional forms of specific strength training preferred
Introduction

strength endurance characterization
– wide range of intensity and duration
– wide range of physiological training goals
– apart from dimensional analysis based structure hardly empirical knowledge exists

<table>
<thead>
<tr>
<th></th>
<th>Scientific knowledge based strength endurance definitions: (Schmidtbleicher 2003)</th>
<th>Therapeutic /Fitness related strength endurance training (Seidenspinner 2005)</th>
<th>Strength endurance in Cycling / Triathlon (Lindner, 2005; Neumann et al., 2005)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy / max. Duration</td>
<td>anaerobic / within 2 min</td>
<td>aerobic / 30 reps</td>
<td>aerobic / 50 minutes</td>
</tr>
<tr>
<td>Intensity</td>
<td>moderate intensity</td>
<td>moderate/ low intensity</td>
<td>low intensity</td>
</tr>
</tbody>
</table>
Introduction

strength training within cycling

- Seldom weight based strength training in off-season
- Specific strength training on a bike
- „Aerobic strength training“
- Long term sets in between 10 – 50 minutes on a bike with low cadence 50 – 60 rpm
Method

purpose of this study:
- explorative study
  - to examine the relationship between power output and maximal strength
  - to get further information about strength and power relationship

primary objective:
- Preparing further research concerning
  - effects of weight based strength training in endurance sports
  - adaptations through strength training in endurance sports
  - effects of specific strength endurance training method
Method

cross section study to determine power output and maximal strength

cross section study to determine power output and maximal strength

sample: Hessen Cycling Federation junior cyclists
(n=8; 16.4 years old; weight: 63.2kg)

–isokinetic measurement:
  • SRM Ergometer
  • 60 – 80 – 100 – 120 – 140 RPM
  • Maximum power /10s.
  • Mean PO

–isometric maximal strength (BAG)
  • 110°
Results
Results
## Results

<table>
<thead>
<tr>
<th></th>
<th>60 rpm</th>
<th>80 rpm</th>
<th>100 rpm</th>
<th>120 rpm</th>
<th>140 rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>mean max. p o</strong> (Watts)</td>
<td>690,0</td>
<td>743,5</td>
<td>826,9</td>
<td>860,9</td>
<td>845,3</td>
</tr>
<tr>
<td><strong>relative p o</strong> (Watt/kg)</td>
<td>10,7</td>
<td>11,6</td>
<td>12,8</td>
<td>13,3</td>
<td>12,9</td>
</tr>
<tr>
<td><strong>correlation</strong></td>
<td>0,35</td>
<td><strong>0,65</strong>*</td>
<td><strong>0,83</strong>**</td>
<td><strong>0,78</strong>*</td>
<td>0,35</td>
</tr>
</tbody>
</table>

* P < 0.05; ** p < 0.01
Discussion

• no correlation between max power output at 60 and 140 rpm
• strong correlation between max power output at 80, 100 and 120 rpm

- contraction speed seems to be important
- “specific strength trainings” movement speed to slow to improve cycling performance?
- race specific movement needs effort in specific contraction force?
- specific strength training on a bike has to be questioned
- improvements in maximum strength could enhance performance in short term efforts (sprint/ attack on mountain)
Conclusion

- adaptations are highly specific in strength training as well as in endurance training
- fast movement requires fast ankle speed in strength training as well as in endurance training

further proposals:
- evaluation of specific strength training and the recommendations from practice
- studies are necessary to proof adaptation, effects and impacts of specific strength training
- indications of superior effects of maximum strength training in endurance sports have to be proofed
- evaluation and studies concerning strength endurance are required
Thank you very much for your attention!

Vielen Dank für Ihre Aufmerksamkeit!

Dennis Sandig M.A.
d.sandig@mx.uni-saarland.de
Literatur beim Verfasser