Effect of Seat Height on Cycling Efficiency

By
Darren Dutto, PhD
Brian Sather, PhD

DIVISION OF PHYSICAL ACTIVITY & HEALTH

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Introduction

The Competitive Cyclist

*Base miles, extras, k's, putting in the miles*

= 6 hour rides, 100 milers, 2 hundie (k's)
Bike-Body Interface

- Feet to pedals
- Hip (ischial tuberosities) to saddle
- Hands to handlebars
Bike Setup

- Reach
- Drop
- Saddle Height
- Setback
Bike Setup

• Very particular
  – e.g. Merckx, Armstrong

• Ambivalent
  – e.g. Landis
Importance of Saddle Height

- Influence on the knee angle
- Pelvis fixed on seat
- Foot constrained by pedal
- Bi-lateral symmetry
- Knee is center of primary muscle contractions for force to the pedal
Review of Literature

- **Hamley and Thomas (1967).**
  - 109% of symphysis pubis height (measured from the top of the pedal to the top of the saddle)

- **Nordeen-Snyder (1977)**
  - 100% of trochanter height

- Both formulas yield similar results (Jorge and Hull, 1986)
Review of Literature

- Peveler (2008): VO2 was significantly lower at 25 degrees knee angle compared to both the 35 degrees knee angle and the Hamley method of 109% of inseam.

- Mandroukas, Angelopoulou, Christoulas, and Vrabas (2000): bent knee (140 degree) required lower oxygen uptake, straight knee (180 degree) lead to longer time to fatigue and higher VO2max.

- Price and Donne (1997): 104% of trochanteric height (knee angle 157.5 deg.), VO2 and heart rate significantly higher and power efficiency significantly lower than both 96 (146.4 deg.) and 100% (knee angle 136.9 deg.)
Review of Literature

- Titlow, Ishee, and Anders (1986): no significant difference in estimated VO2max and heart rate at different knee angles (175-180, 155-160, and 135-140 degrees)
- Other research has demonstrated metabolic differences in seated compared to standing posture on the bicycle.
- Some studies have shown decrease power at lower saddle heights, although the knee angle was not examined as part of the research (Hamley and Thomas 1967; Shenum, Devries 1976; Nordeen-Snyder, 1977).
How to Measure Saddle Height

• Percentage of Inseam: Problematic
  – anthropometric differences (e.g. variable relative femur, tibia, foot differences)
  – Pedalling style, load, incline differences
  – Mechanical differences (e.g. pedal, seat, crank arm q-factor)
  – Equipment differences: Pedal models, saddle types.

• Static goniometry

• Dynamic: Software like Dartfish
Recommendations

• Lemond method:
  – $0.883 \times$ inseam, center bottom bracket to top of saddle

• Carmichael (2003)
  – 145-155 degrees with crank arm in line with the seat post (5 o’clock or 150 degrees)

• The Howard method (Burke, 2002)
  – 150 degree angle with the ball of the foot on the pedal at 6 o’clock (180 degrees)

• The Pruitt method (Burke)
  – 145-150 degrees
Websites Resources

Pierce Library Colloquium Resources
http://pierce.eou.edu/home/faculty/colloquia/20100527

CyclingAnalysis.com

Annotated Bibliography of Cycling Research
http://www.cyclinganalysis.com/annotated-bibliography-cycl