Bike Fit
or
Are You Sitting Comfortably?

Rachel McKay, ABCC Assistant Coach

Talk and demonstration given to the Verulam Cycle Club, 12 January 2004

This talk was put together and first given to members of my cycling club, Verulam CC, St Albans, Hertfordshire at the club night Monday 12th January 2004.

References:

[1] Kirby Palm**;** Making a Bicycle Fit; http://www.nettally.com/palmk/BikeFit.html

[2] Keith Bontrager; The Myth of "KOPS" An Alternative Method of Bike Fit; http://www.sheldonbrown.com/kops.html

[3] Peter Jon White; How to Fit a Bicycle; http://www.peterwhitecycles.com/fitting.htm (2001)

[4] Auriel Forrester, Pirko Korkkia; Differences between men and women (Coaching News, 4/97)

[5] Claude Genzling; Aerodynamics and the Role of Position on the Bike (CoachingNews, 2/88)

[6] John Bettinson; Are You Sitting Comfortably (Veteran Leaguer, Winter 2003)

[7] Doughty Geldard Firth; Some Thoughts on Estimating Bike Frame Size (CoachingNews, 2/90)

[8] Christopher Carrington; Your Position on your Cycles (Coaching News, 1985)

[9] Gerald O'Donovan; Thoughts on Frame Design (Coaching News, January 1988)

[10] Edmund Burke, High-Tec Cycling (Human Kinetics, 1996)

[11] Chris Boardman, The Complete Book Of Cycling (Partridge, 2000)

Why Is Bike Fit So Important?

- Efficiency
  - Aerodynamics
    - 80% effort required to overcome air resistance at 25mph
  - Power
    - Cannot let the legs do the pedalling if you're not relaxed
- Comfort
  - Neck ache (bars too low)
  - Over-reaching to handlebars (neck/shoulder/elbow pain)
  - Pain
    - Knee (saddle too low or too high)
    - Perineum (saddle too high, too forward/back, tilted up/down)
    - Lower back (saddle too high)
- Avoid Risk of Injury
  - Knee injury (damage to ligaments)
  - Tendinitis (neck/shoulder/elbow)
  - Male impotence (perineal nerve damage) / female chafing

12 January 2004 Rachel McKay, ABCC Assistant Coach 2

Aerodynamics [Ref 5]:

326 Watts needed to overcome air resistance + 63 Watts needed to overcome rolling resistance at 39.6 kmh

Power [Ref 6]:

Talking about the role of core stability in minimising the effort required to sit on the bike and, hence maximise the effort available to push the pedals.

What do I need?

- Turbo trainer
  - Ensure front wheel is raised so that the bike is level as on the road
- Plumb line
- Spirit level
- Straight edge (e.g. engineering rule)
- Tape measure
- Friend
  - To help do some of the measurements

Minimum set of equipment needed to perform basic static bike fit. Some shops and frame builders use bike fit jigs and/or programmatic systems based on body measurements (e.g. BioRacer). This is out of scope for this approach.

Bike Fit Theory

- Measurement based
  - Subtractive
    - "Inside leg measurement minus 10 inches" etc.
  - Proportional
    - Hinault/Genzling, Lemond, Geldard, etc.
    - "109% inside leg measurement" etc.
- Anatomical analysis based
  - Knee bend angle, foot position, etc.

Measurement based [Ref 7]:

"…these formulae are usually averaged from data collected from a wide range of riders and bikes. In other words, the frame sizes they suggest will suit some riders, others not so well."

Simple Bike Fit - Saddle

- Saddle height
  - Rocking hips a sure sign of saddle too high
  - Just pedal with heal
    - Doesn't take foot length into account
  - Heal slightly down at bottom of pedal stroke
    - Equivalent to 25-30 degree knee bend
- Saddle fore/aft position
  - Knee over pedal spindle
    - Plumb line from knee cap to middle of spindle at "quarter to three" position
  - Keith Bontrager's Centre of Gravity method

12 January 2004 Rachel McKay, ABCC Assistant Coach 5

•Saddle height

•Rocking hips [Ref 6]:

•"On the warm-weather training camps, for instance, I notice saddles too low, knees bursting; saddles too high, riding tiptoe, backside rolling. Stick a pump in their back pocket and it would oscillate like a metronome."

•Just pedal with heel [Ref 6]:

•"The old maxim, set the height so that you can just pedal with your heels, is still a good starting point."

•Keith Bontrager [Ref 2]:

•"For maximum power, the cyclist's legs should be nearly extended at the bottom of the pedal stroke."

•Saddle fore/aft position

•Various formulae exist, including middle of pedal spindle should align vertically with:

•Front of knee cap

•Half inch behind front of knee cap

•Tibial tuberosity

•The one consistent rule of thumb is that the knee should not be forward of the pedal spindle.

Simple Bike Fit - Handlebars

- Handlebar reach
  - Obscure front hub when on hoods
  - Thumb against knee, middle finger touches bars

•Keith Bontrager [Ref 2]:

•"The KOPS [Knee Over Pedal Spindle] rule of thumb has no biomechanical basis at all. It is, at best, a coincidental relationship that puts the rider somewhere near his or her correct position."

•"The CG [Centre of Gravity] of a seated rider in a fairly aerodynamic position will often be about 1 to 1.5 inches (2.5 to 3 cm) in front of the bottom bracket…Invariably, a climbing rider will place his CG at a spot two to three cm behind the pedal spindle at the nine o'clock pedal position. This is the case for all riders."

•Handlebar reach

•"The handlebars should be level with the raised knee cap, and the reach found by butting the thumb up against the knee and the middle finger reaching out to just touch the bars in the centre." [Ref 6]

•With the elbow on the tip of the saddle, the tips of the fingers reach the stem. With the other hand at 90 degrees, the palm width is the stem length. [Rule of thumb from the floor.]

Making it work for you

- Saddle tilt
  - Flat or just raised at front
- Brake lever position
  - Bars tilted up slightly
  - Tip of brake lever touches straight edge held against bottom of bars
- Time trial versus road race position
  - Body rotated forward about hips
    - Steeper seat tube angle, longer top tube
  - "closed cup" hand position
    - Hands together, elbows inside shoulders
  - Flat, straight back
    - Allowing for back, neck and hip flexibility
      - Lance Armstrong versus Chris Boardman

12 January 2004 Rachel McKay, ABCC Assistant Coach 7

•Saddle tilt

•"It must be flat or raised ever so slightly at the front." [Ref 6]

•Brake lever position

•The bars should be tilted up ever so slightly and, with the modern ergo lever, the tip of the lever just touching a straightedge held against the bottom of the bars." [Ref 6]

•Time trial versus road race position

•"The key to a flat back is pelvic rotation…With the pelvis rotated forward, the hump in the back can be eliminated." [Ref 10]

•"By narrowing the arms, the cyclist reduces the body's frontal area and allows for the wind to be directed around the body." [Ref 10]

•Chris Boardman: "No-one has got a position as extreme as mine for a time trial bike…I have a curved back…long arms and short legs." [Ref 11]

•Chris Carmichael: "He [Lance Armstrong] can't lean forward because of his lumbar fracture [L5], and he compensates by hinging higher in his torso, resulting in a rounded upper back." [Ref 12]

Fine Tuning On The Road

- Handlebar position
  - Rolling along road, backside squarely in saddle
  - Swap between tops, hoods, drops and no hands
    - Bars should be where hands fall
    - Little or no change in tension/stress in body
- Saddle position
  - Rolling along road
  - Swap between riding in and out of saddle
    - Each time, bottom should return to centre of saddle
- Putting it all together
  - Ride up slight, steady incline
  - Swap between in saddle, hands on tops to out of saddle, hands on hoods
    - Should be one, flowing movement
    - No change in tension/stress in body
    - No need for adjustments in hand or bottom positions

12 January 2004 Rachel McKay, ABCC Assistant Coach 8

[Ref 6] “You’ll know when you attain that perfect position. The bike will feel so stable yet so manoeuverable. Whether you’re riding on the tops, on the hoods or on the drops either position will feel efficient under pressure; but much more than that, you’ll be able to accommodate a wide range of cadence with equal effect. You won’t squirm or nod because you won’t need to.”

Women Are Different To Men!

- *Main anatomical and physiological differences:*
  - Hinge at lower back rather than hips
  - More flexible
  - Longer legs, shorter feet, torso and arms
  - Wider pelvis
  - Lower upper body strength
  - Lower centre of gravity
- *All adds up to:*
  - Steeper seat tube angle
  - Shorter top tube
  - Raised, narrower, shallower handlebars
    - Taking into account greater relative flexibility
  - Shorter cranks
  - Lighter frame tubing and wheels
    - Consider 650c wheels for under 20 inch frame
  - Women specific saddles, handlebars, brake levers

12 January 2004 Rachel McKay, ABCC Assistant Coach 9

Makers and suppliers of women specific bicycles, equipment and clothing (this does not constitute a recommendation):

Georgina Terry (http://www.terrybicycles.com)

Chas Roberts (http://www.robertscycles.com/)

Trek WSB (Women Specific Bikes) (http://www.trekbike.co.uk)

Corinne Dennis (http://www.corinnedennis.co.uk/)

N.B. There was a dramatic change in the thinking on women's bicycle design and fit in the early 1990s, resulting in a reversal of long held opinions, e.g.:

[Ref 4] "Long thigh bones mean the saddle will have to be further back and the seat angle shallow."

Bicycle Data Chart

Dimension	Road Race	Time Trial	Training	Touring
Bottom bracket to saddle				
Centre saddle to bars				
Saddle to bar height				
Seat tube angle				
Head tube angle				

Use this as a useful reference guide to recording the frame geometries and set up for your bicycles. [Ref 8]