Bike Fit Clinic 3/11/2014
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1. Zinn, L. (2009). *Zinn and the Art of Road Bike Maintenance, 3rd Ed*. Boulder, CO: Velo Press.

Basic frame guidelines
- Should be able to have at least an inch of clearance between top tube and crotch
- Make sure your knee can't hit the handlebars
- Make sure your toe won't overlap the front wheel when turning

Establishing seat height
- A good guideline: Have the pedal clipped in, with the knee straight, at the bottom of the stroke. At this position the foot should be even or very slightly heel up.
- This will result in ~30 degree bend at the knee in the downstroke during cycling.

Establishing cleat position
- The cleat should be placed under the ball of the foot, or slightly behind the ball of the foot depending on preference

Establishing saddle setback (fore/aft positioning)
- In the horizontal position the knee cap should be directly over the end of the crank arm
- Recheck saddle height after adjusting saddle setback

Saddle
- Should be positioned level, or tilted very slightly down

Establishing handle bar height
- 4cm of drop between saddle and bars is a good starting point
- Higher bar height can be more comfortable if you have decreased flexibility, but will place more weight on your bottom and surrounding soft tissue. You will also experience more wind resistance

Establishing handle bar reach
- A plumb line down from the bend of the elbow, with the hands supported on the brake hoods, should be approximately 2 to 4 inches ahead of the knee with the pedal horizontal

Summary
- Set pedalling efficiency first: Seat height, fore/aft positioning, saddle tilt, and cleat position
- THEN check handlebar height and reach adjusting with stem or spacer changes

2. Brady, P. (2011). *The No-Drop Zone: Everything you need know about the peloton, your gear, and riding strong*. Birmingham, AL: Menasha Ridge Press.

Comfort - The ability to continue pedaling in a given position

Control - The ability to move forward as well as the ability to change direction
Efficiency - The degree of balance between power, comfort, and aerodynamic drag

Points of contact
- Where the rider meets the bike: Pedals, Saddle, Handlebar
- Points where vibration and shock can be transmitted to the rider

Feet
- Contact at the pedals
- Clipless pedals enable greater weight distribution when turning
example: try to turn with both feet off of the pedals
- Shoes should have a stiff soles to better transfer power and a secure upper to hold the foot in place

Bottom
- Contacts the saddle
- The two highest contoured parts of the saddle should match the distance between the sit bones. Dense foam is more supportive, and softer foam can be used in other areas for comfort and to help relieve pressure.
- Cut-outs can help to relieve soft tissue pressure and achieve a better position and balance on the bike

Hands
- Contact the Handlebar
Bar top for climbing or easy pedaling. Best visibility and breathing
Brake hoods for efficient riding with access to brakes and shifting
Drops for descending or sprinting
- Gloves are padded to cushion the palm decreasing vibration and also help protect
- Handlebar tape can also provide cushioning and improve grip.

Pedaling Mechanics
- Studies show that the most efficient cadence lies between 80 and 110rpm
- This preserves strength by placing more of the work on the aerobic system
- Pedal stroke should be smooth rather than “box like”
- “hopping” in the pedal stroke is a sign of inefficiency
- The rear should not rise off the saddle, with minimal rocking

Summary
- To be fast you need to be comfortable and efficient
3. Clarsen, B et al. (2010). Overuse Injuries in Professional Road Cyclists. *The American Journal of Sports Medicine*, 38 (12), 2494-2500.

- Lower back pain (36%) and anterior knee pain (58%) were found to be the most prevalent

overuse injuries in professional cyclists observed over the training year
- The prevalence of both injuries increased significantly from the off season LBP (13%) and knee pain (27%) to the early competition period
- Recreational riders are prone to both knee and LBP, but are much more likely to also have neck pain and hand pain and numbness

4. Silberman, M et al. (2005). Road Bicycle Fit. *Clin J Sport Med*, 15 (4), 271-275.

- It can be expected to complete about 30,000 revolutions over a 100 mile course
- 81,000 revolutions are possible over a week of consistent training
- Over time, overuse injuries will develop with improper bicycle fit, especially when combined with training error
- Fit is based upon the three areas where a rider makes contact with the bicycle: pelvis/saddle, shoe/cleat/pedal, hands/handlebar
- The cleat should be positioned so that the 1st metatarsal head lies over the pedal axis
- Up to ½ a true leg length difference can be corrected with shims or orthotics or the cleat on the long leg could be moved slightly back
- Saddle height can be estimated by having the knee flexed 25-30 degrees with the pedal at the bottom of the stroke
- Saddle fore/aft position is determined at the 3 o'clock position and the patella should hang directly over the pedal axle
- Moving the saddle forward effectively lowers the saddle height
- The saddle tilt should be close to level, and approximately 60% of the body weight can be balanced on the saddle
- For handlebar height a good estimate is to have the torso flexed to 45 degrees with hands on the brake hoods
- This angle should increase to 60 degrees in the drops
- Handlebar drop typically extends from even to 3 inches, with a higher position becoming more comfortable with less reach, but at an aerodynamic cost
- Since up to 80% of drag is determined by the riders frontal area, experimenting with the amount of drop can make sense
- The brake hoods should be slightly elevated which can minimize pressure on the hands
- For stem length, the front hip should be obscured by the handlebar when the hands are in the drops. Also the knees should not hit the elbows with the arms bent 60-70 degrees when in the drops.
- With pedaling technique it is probably more important on the downward drive from 1 to 4oclock positions. Studies have demonstrated that even in elite cyclists the net force vector is downward in the recovery phase
- Posture height: Involve injuries to the lower extremities and are adjusted with saddle position
- Posture length: Involve injuries to the neck, upper extremities and back and are adjusted by handlebars
- The lumbosacral and pelvic regions are in an intermediate area

Pain by region

- Posterior neck or scapular pain: possibly caused by too much reach, a more upright position might help
- Ulnar neuropathy: bars might be too low, saddle might be too far forward, saddle might be too tilted down.
- Low back pain may be from being too elongated. Shortening the reach or raising the handlebars may help.
- Anterior tibialis pain or achilles pain could be due to a seat that is too high (because of stretch)
- Achilles pain could also be due to a seat that is too low (because of increased power generation)
- Foot neuropathy could be due to cleat placed too far forward, or a worn shoe, or a shoe that is too tight
- Anterior knee pain: saddle might be too low, might be too forward, possibly too much climbing, pushing too big a gear, or having a crank arm that is too long.
- Posterior knee pain: saddle may be too far back or too high
- Medial knee pain: toes could be point too far out, could be from repeatedly exiting clipless pedals, or the feet could be positioned too wide, or there could be too much float (limit to 5 degrees)
- Lateral knee pain: toes could be pointing too far in, or the feet could be too close together, or too much float (limit to 5 degrees)
- Perineal neuropathy: seat is too hight, has too much tilt, or too narrow to support bones

5. Asplund, C et al. (2005). Neck and Back Pain in Bicycling. *Current Sports Medicine Reports*, (4), 271-274.

- Overuse injuries occur when soft tissue accumulates damage over time with repetitive loading
- Without enough recovery, micro-trauma leads to inflammation, and if not treated leads to degenerative breakdown of muscle, tendons and bone.
- They happen most often when the type, intensity, or duration of training is changed
- Extrinsic factors (training volume and intensity) and Intrinsic factors (physiology and bicycle fit) combine to cause overuse injuries
- The back and neck are at risk for overuse injuries because of the flexed position of the lumbar spine and extension of the neck
- Left levator often painful because of always looking over the shoulder for traffic
- For neck pain: can try raising handlebars, shortening reach, or moving the saddle forward as long as it doesn't interfere with knee and foot alignment
- Riding in a relaxed position with elbows bent may help limit shock and vibration from reaching the neck
- Stretching the neck during relaxed portions of the ride can prevent more serious pain
- If helmets are too loose or too low they can obscure vision and require more next hyperextension
- Handlebars should not be much wider than the shoulders or could strain scapular muscles
- Determining the right reach and handlebar height should help with low back pain
- Maintaining LE flexibility and core strength can help with pelvic alignment and decreased stress

on the low back
- Total reach is the most important factor in regards to neck and low back pain.
- Another way of estimating reach is that when sitting comfortably with the hands on the brake hoods and looking ahead, a plumb line from the nose should intersect the strem
- Overall much of the forward lean should come from the pelvis rotating forward and not bending/flexing the spine forward. In an ideal world the back will be flat with the pelvis tilted anteriorly
- Changing hand positions frequently from bar tops, to hoods can also be helpful
- For handlebar height having the bars even or up to 4cm lower than the saddle height is probably a good starting point. Neck hyperextension increases with drop

Adjustments for Pudendal Neuralgia
- Seat too high (Lower seat so that 30 degree knee bend)
- Seat tilted up too much (Seat should be even or slightly tilted down)
- Seat too narrow to support pelvis (Experiment)
- Seat does not have optimal cut-outs or support (Experiment)
- Seat is too worn (Replace)
- Padded bike shorts may help (Helps with correct positioning on saddle)

Adjustments for Ulnar Neuropathy
- Handlebar drop is too much (Even is a good starting point)
- Seat is too far forward (Knee cap over pedal spindle)
- Seat is tilted too far downward (Level or slightly down)
- Handlebars are tilted too far down (level or slightly up)
- Padded gloves may help
- Padded handlebar tape may help
- Change hand positions frequently between bar top, brake hoods, and sometimes drops
- Stay relaxed through the shoulders and elbows to help absorb vibration