

INDOOR CYCLING INSTRUCTOR TRAINING SERIES



Biomechanics
Your Body and the Bike




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BIOMECHANICS | YOUR BODY AND THE BIKE

Agenda


- Functional Anatomy (oh my!)
- The Pedal Stroke
- Form and Technique
- Breathing
- Postural Alignment and Awareness
- Indoor Bike Setup
- Let's Ride (~90min)
- Q&A



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Functional Anatomy

- The body is made up of bones (levers) and joints (fulcrums)
- Muscles cross joints to create movement
- Where does the muscle start (origin) and where does it end (insertion)?
- The angle of the joint impacts the effective use of the muscle(s)



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The Legs & Respective Muscles

Pedal Stroke / Technique

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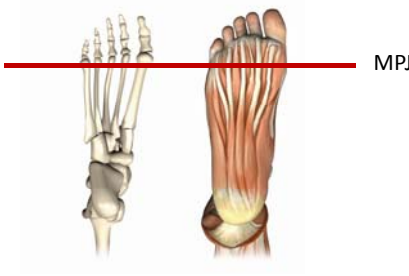
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The Pedal Stroke / Muscles


- The Feet are “fixed” to the pedals.
- The foot and the crankarm are levers
- Just like an arrow going farther and farther off course, if the feet are wrong, the rest of the body may pay the price.



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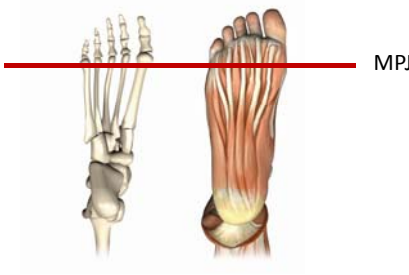
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Anatomy of the Foot

- Anatomy of the Foot
- The metatarsophalangeal joint (MPJ) is the point on the foot which can safely sustain considerable pedal force.



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Ankling

- The foot should be a “firm” but **not** a “stiff” lever
- A natural ankling movement



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Reciprocal Inhibition

- Reciprocal Inhibition occurs when both an agonist and antagonist muscle (group) contract simultaneously
- The body has a build-in neurologic safety mechanism which will hinder mechanics
 - Scenario 1: Attempting to stop ankling movement (stiff foot)
 - Scenario 2: Forcing the heels down
- Which muscles are being activated?

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Reciprocal Inhibition (Cont.)

- Both the calves and tibialis anterior contract, fighting each other
- The gastrocnemius crosses the back of the knee joint. When contracted (voluntarily), hinders the movement (speed) of the leg.



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The Upstroke

- The Upstroke engages the hip flexors (Iliacus, Psoas Major and Minor, Rectus Femoris)
- The Rectus Femoris is both a hip flexor and knee extensor because it crosses both the hip and knee joints.



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Top of the Stroke?


- The top of the stroke is more a transition from upstroke to down stroke
- Hip Flexors handing off to the Glutes
- Glutes handing off to the Quads




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The Downstroke

- The downstroke starts with the Glutes firing at the top (extending the hips)
- The Hamstrings (hip extensors) do not have a mechanical advantage at Top Dead Center (12 o'clock)
- The Quads (leg extension) do not have a mechanical advantage at 12 o'clock
- If the upstroke is not emphasized (and trained) Glute engagement is hindered
- Think of this as pulling the hammer back on a gun which loads (stretches) the Glute muscle fibers.

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The Downstroke

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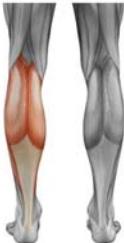

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The Bottom of the Stroke


- Pulling back at the bottom of the stroke engages the hamstrings, and to a lesser extent, the calves (stabilizers)
- Transition from the downstroke to the upstroke

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Misconception / Confusion

“EFFICIENCY”
 Theory: There is no difference in the metabolic cost of either only pushing down on the pedals (piston-style) or circular pedaling.
 From what we know: Yes, sort of...


Thought: Regardless of whether one uses 100% of 1 muscle groups or 50%-30%-20% of 3 muscle groups, the total is still 100%

Additionally: Metabolic cost has not currently considered the mechanical cost / muscle fatigue

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Misconception / Confusion

“CIRCULAR PEDAL STROKE”
 Theory: Pedaling circles means one is using all of the muscles equally


NO. The size and strength of the muscles varies greatly. The strength of the hip flexors (upstroke) generally does not equal the strength of the quadriceps (downstroke)

A smooth pedal stroke indicates that muscles are contributing to a smooth “transition” (maintaining velocity) between muscle groups.

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Misconception / Confusion


“Piston or Circular Pedaling?”
 Theory: Based on the previous slide, pulling up is futile since we just said the hamstrings can’t apply the same force as the quads. The best we can do is “un-weight” the back foot so as not to fight the quads.

INSERT “GRAVITY”
 Wait a minute, we said “un-weight”. How do you do that? We LIFT the leg.


Also, we don’t begin pulling up at 6 o’clock (which is how many people explain it), we pull up closer to 10 o’clock after the quads have exceeded their mechanical advantage.

These “lifting” and “pulling-up” muscles (hip flexors) need to be conditioned, hence the need for drills that focus on pedal stroke.

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The Upper Body

Proper Form and Technique

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Relax!

- When a muscle is not relaxed it is contracted.
- Muscles require oxygen to contract
- Muscles require fuel to contract
- Prolonged muscle contraction can lead to fatigue.

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Relax!


- If your upper body muscles are tense (neck, shoulders, arms, hands, back, chest), oxygen and fuel is being wasted and fatigue is inevitable

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Relax and Breathe!

- Between your thoracic cavity and abdomen is a muscle called the diaphragm.
- The diaphragm is up against the lungs when relaxed and moves away from the lungs when contracted (similar to the tightening of a drum head).

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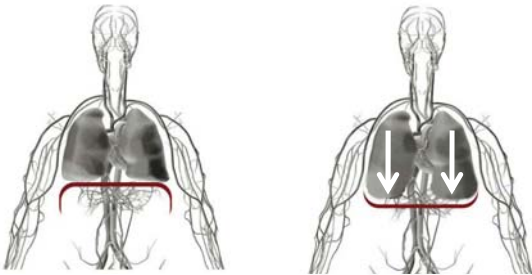


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Relax and Breathe!



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Relax and Breathe!

- You diaphragm needs to move (contract) to breathe deeply.
- Relax Your Stomach!
Tightening your stomach muscles will prevent the diaphragm from fully contracting and hinder your breathing
- Sucking in your stomach (engaging the Rectus Abdominis) will hinder your ability to exhale. The contraction of the Rectus Abdominis is used the expiration.
- Allow your stomach to “visibly” balloon out when breathing

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I thought I was supposed to have a strong core as a cyclist?


- Absolutely!
A strong core does not mean sucking in one’s stomach. It is the conditioning of the muscles surrounding the abdomen and back to protect and stabilize the spine.
- Your core also provides stability to the upper body for better power transfer to the pedals. A strong core will help a cyclist resist fatigue.



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Real Bikes MOVE!

- Real bikes move forward and backwards
- Real bikes move side to side
- Real bikes fall over


Since most indoor bikes do not move forward or backwards, up or down, it is important to maintain a relaxed upper body to allow natural movement



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Real Bikes MOVE!

- Riding Seated
Under load, the upper body should move naturally, side-to-side to compensate for a bike that is not moving
- Out of the Saddle (Standing)
The upper body should always display gentle side-to-side movement when riding out of the saddle.

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Proper Form


Excessive Angling

- Excessive movement of the foot during the pedal stroke can contribute to a loss of power.
- This includes lifting the heel all the way up during the upstroke and forcing the heel down on the downstroke.
- The absence of a firm level diminishes power transfer the pedals

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Proper Form


Hip Rock

- Excessive movement of the hips (side-to-side) on the saddle maybe an indication of the following:
 - Saddle height is too high causing a rider to reach for the pedals
 - Tight hamstrings and/or lower back muscles hindering a riders range of motion (hip flexion / leg extension)
 - Muscle Memory: Ride's muscles may be conditioned to dropping the heel or compensating for a saddle that was too low.

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Proper Form Cervical Spine

- Excess curvature (extension) of the cervical spine (neck)
- Common during indoor cycling classes because riders are looking “up” at the instructor (particularly if the instructor’s bike is on a raised platform)
- Rider’s should keep their necks in a neutral position and look out of their top field of vision.
- Can strain and fatigue the neck extensors

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Proper Form Curvature of the Spine

- Rider’s should display a relaxed flat back
- Curvature of the spine can be caused by the following:
 - Bending at the thoracic spine (hump) to reach for the handlebars instead of folding at the hips
 - Hips are rotated backwards (posterior pelvic tilt) causing a curvature of the lumbar spine
 - Maintaining a flat back is NOT created by hyper-extending the lower back but by proper position and relaxation
 - Curvature of the spine caused by posterior pelvic tilt can inhibit muscles that act at the hip (Hip Flexors, Glutes, etc.)

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Putting it all Together

Are You Fighting the Bike?

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Proper Bike Setup

- Improper bike setup can place you in a position that is mechanically inefficient.
- Bones and joints (levers and fulcrums) need to be in position so range of movement is not hindered
- A rider should be able to remain a relaxed position on the bike without feeling off balance or excess pressure in the hands, arms, shoulders, neck and butt

NOTE: Is it not uncommon for the saddle on indoor bikes to shift and move over time. Saddles that are tilted nose down can force a rider to slide forward placing stress on the hands. Saddles that are tilted nose up can place pressure on the pubic area and surrounding soft tissue

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Cleat Position

- CAUTION: Unless you are a certified bike fitter or biomechanist, NEVER install or reposition a rider's cleats. You can place yourself and the facility at risk if the rider experiences pain (knees, hips, etc.) as a result. Refer them to a local bike shop
- Improper cleat position can lead to much discomfort on the bike including burning (hot feet), numbness and pain.
- Remember our "Arrow" analogy. Improper cleat positioning can cause discomfort and pain in the ankles, knees, hips, back, etc.)

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Relaxation

- Tight, tense muscles will waste oxygen, fuel and eventually become fatigued.
- Tight upper body muscles can also restrict movement of the rib cage and hinder breathing.
- Remember that muscles cross joints. Tight (contracted) muscles can hinder (slow) joint movement

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Riding Out of the Saddle

- Stay relaxed on static indoor bikes and allow natural (side-to-side) body movement
- With the exception of explosive efforts, PUSH the handlebars away from you instead of pulling on the handlebars.


Pulling on the handlebars unnecessarily engages the forearms, biceps, shoulders, neck, back and abdomen

Pushing the bars away from you requires much less muscle involvement (triceps) and allows your upper body weight to assist you

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Q & A
Questions, Concerns &
Cries of Despair

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