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Prevention and Management of Overuse Injuries Associated with Cycling

Michael T. Lebec, PT, Ph.D.
Professor
Department of Physical Therapy
and Athletic Training
Northern Arizona University

1

Learning Outcomes

After this course the participant:

- Describe the etiology of cycling overuse syndromes.
- Identify at least two important tests and measures, which guide treatment of cycling overuse syndromes.
- Outline a plan of care using at least three interventions that effectively reduce impaired body structures associated with cycling overuse injuries.
- Identify at least three strategies for preventing overuse conditions in cyclists.

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CONTINUED

3

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SciMedCentral **Annals of Sports Medicine and Research**

Mini Review

Etiology and Intervention for Common Overuse Syndromes Associated with Mountain Biking

Marin L. Campbell and Michael T. Lebec*
Department of Physical Therapy and Athletic Training, Northern Arizona University, USA

*Corresponding author
Michael T. Lebec, Department of Physical Therapy and Athletic Training, P.O. Box 15105, Flagstaff, AZ 86005, USA, Tel: 928-523-9971; Fax: 928-523-9289; Email: Mike.Lebec@nau.edu

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Article

Overuse Injuries Associated with Mountain Biking: Is Single-Speed Riding a Predisposing Factor?

Michael T. Lebec *, Kortny Cook and Drew Baumgartel

Northern Arizona University, P.O. Box 15105, Flagstaff, AZ 86011, USA;
E-Mails: kortny.cook@gmail.com (K.C.); drew.baumgartel@gmail.com (D.B.)

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CONTINUED

Case 1

A 29 year old female has been doing competitive road cycling for 3 years. Because she lives in Ohio, her riding season is limited to the warmer months but in the winter she stays in shape by running on a treadmill. Due to an early spring, she has been back on her bike for about 3 weeks and is starting to do some longer rides. However, she is beginning to develop anterior knee pain after riding for about 20-30 minutes which is affecting her ability to further progress her training. She comes to you for physical therapy for this issue.

- What factors might be contributing to the onset of her pain?
- Which tests and measures would be most important to perform during the physical exam?
- What interventions would help reduce her knee pain?
- What strategies might she use to prevent this problem in the future?

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CONTINUED

Case 2

A 42 year old mountain biker presents to physical therapy with neck and upper back pain that is exacerbated during and after long rides. He has a history of intermittent neck pain but has never had problems before while riding. This summer he is riding more days per week because he just moved to an area with easier trail access and he has more a more flexible riding schedule because he is working from home.

- What factors might be contributing to the onset of his pain?
- Which tests and measures would be most important to perform during the physical exam?
- What interventions would help reduce his neck pain?
- What strategies might he use to prevent this problem in the future?

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Traumatic Injuries

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CCO found here: https://www.maxpixel.net/Event-Bike-Collapse-Cycling-Compensation-1013177

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Road Riding vs. Mountain Biking

- "Roadies" vs. Mountain Bikers

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Which anatomical regions would you suspect are most susceptible to overuse injury due to cycling?

(CHOOSE UP TO 3)

A. Cervical
B. Thoracic
C. Shoulder
D. Hand/Wrist/Elbow
E. Lumbar
F. Hip
G. Knee
H. Foot/Ankle
I. General LE muscles

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Incidence of Overuse Injuries in Cyclists

Road Cyclists

1. Anterior Knee Pain (37%)
2. General LE Pain (28%)
   - Hamstrings, Gluts, Quads, etc.
3. Lumbar Spine (17%)
4. Cervical Spine (11%)

Up to 85% of Road Cyclists experience overuse injuries

Mountain Bikers

1. Lumbar Spine (24%)
2. Knee Pain (23%)
3. Hand/Wrist (18%)
4. Neck/Upper Back (16%)

45-90% of Mountain Bikers experience overuse injuries

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Physical Therapist Management of Cycling Overuse Injuries

Considerations for History Taking
Relevant Anatomy
Etiology of Cycling Overuse
Physical Examination
Interventions

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General Considerations for History Taking

- Training Volume:
  - Frequency, Duration, and Mileage per week
- Bike Fit:
  - Self-Performed? Done by a friend? Based on what guidelines?
  - Done by bike store personnel? What did fitting involve?
  - Professionally done?
- What type of Cross-Training does the cyclist engage in?
  - Flexibility? When and How?
  - Core training?
  - UE & LE strengthening – which muscle groups?
  - Other forms of cardio?

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CONTINUED

Low Back Pain in Cyclists

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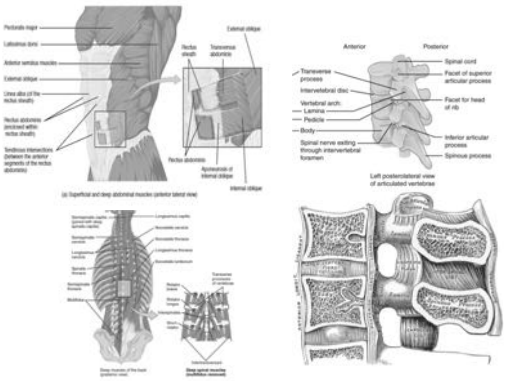
CONTINUED

Lumbar Pain Relevant Anatomy

- External Obliques
- Transversus Abdominis
- Lumbar Extensors
- Glut Max/Med
- Lumbar Discs
- Spinal Nerves
- Facet Joints
- Anterior and Posterior Ligamentous Structures



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What Causes Lumbar Pain in Cyclists?

Road Cyclists

- Sustained riding position
- Prolonged, flexed position proposed to cause pain by differing mechanisms:
  - Spinal extensor hyperactivity
  - Elongation stress on non-contractile structures
  - Decreased movement of lumbar disc fluid
    - Ischemic pain
    - Accumulation of waste products

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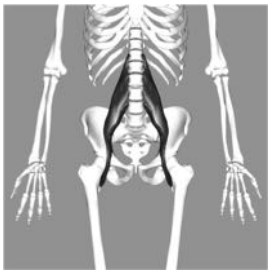
What Causes Lumbar Pain in Cyclists?

Road Cyclists

- Over-activity of spinal extensors and/or hip flexors
  - Constant isometric contraction of extensors = *ischemic pain*
  - Hip Flexor (iliopsoas) contraction exerts *shear forces on lumbar vertebrae*



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What Causes Lumbar Pain in Cyclists?

<u>Mountain Bikers</u>

- Sustained riding position
- Over-activity of spinal extensors & Hip Flexors
- And … **Ground Reaction Forces**
  - Anterior loading of lumbar discs
  - Traction forces on dorsal structures
    - Sustained stretch = deformation of soft tissue

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Lumbar Pain
Special Considerations for Physical Exam

- **Which positions induce pain? Which relieve?**
  - Directional preferences and classification systems
- **Range of motion**
  - Which segments move and which do not?
- **Joint mobility**
  - Lumbar and Thoracic
  - Hypo vs. Hyper-mobile areas
  - Painful segments
- **Muscle Length / Flexibility**
  - Hamstrings, Rectus, Hip Flexors, Gastroc/Soleus

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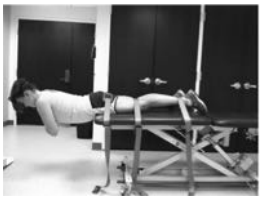
Assessment of "Core" Strength



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Management of Cycling-Induced Lumbar Pain

- Finding and maintaining asymptomatic pelvic position during riding
  - Anterior? Posterior? Neutral?
- Break up long rides with short rest periods !!!
  - Perform ROM and stretching during breaks and after rides
- Exercise
  - Stretching of HS, Hip Flexors, quads, piriformis, etc.
  - Core / Abdominal control & strength
    - Provide balance against spinal extensor activity
  - Spinal extensor postural endurance
    - How?

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"Activating" Spinal Extensors

21

What are commonly-used instructions to cue activation of Transversus Abdominis and other abdominal musculature?

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CONTINUED

Abdominal Muscle Recruitment During a Range of Voluntary Exercises
(Urquhart, Hodges, Allen, & Story, 2005)

Subtle, inward movement of lower abdominal wall most effective

"Gently and slowly draw in your lower abdomen below your navel without moving your upper stomach, back, pelvis"

- Mild effort (2 on Borg scale)
- Followed by superimposed UE/LE movements in progressively less stable positions

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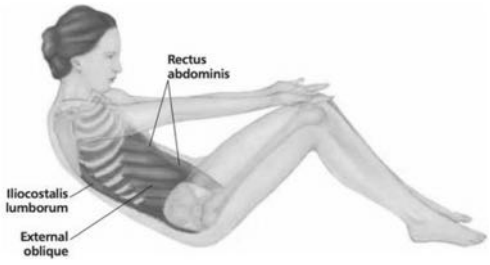
CONTINUED

Recruitment of Rectus Abdominis: Good or Bad?



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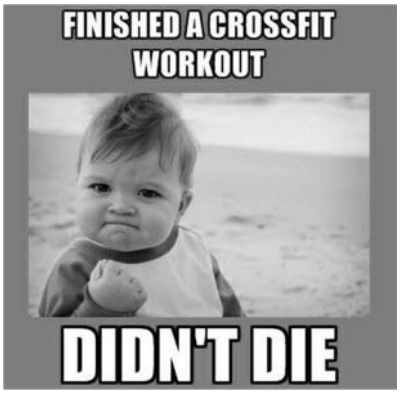
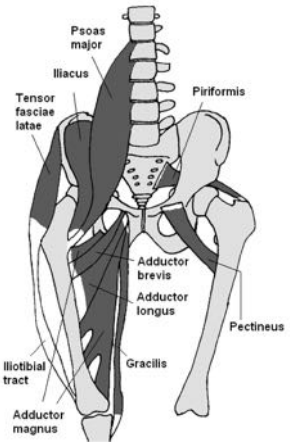
Sit ups: Good or Bad?





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Management of Cycling-Induced Lumbar Pain – Manual Therapy

- Manipulation
  - More effective if pain is acute
  - Use Clinical Prediction Rules
- Joint Mobilization
  - Identify hypo-mobile areas
    - Needs "WD40 not duct tape"
- Traction
  - Radiating pain

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CPR for Lumbar Manipulation (Child's et al., 2004)	C-spine Manipulation CPR (Tseng et al., 2005)	T-Spine Manipulation CPR (Cleland et al., 2007)
FABQ < 19	NDI<11.5	FABQPA<12
Pain does not radiate below the knee	Spondylosis w/o radiculopathy	No Sx's distal to shoulder
At least one hypo-mobile segment	Not feeling worse extending neck	Looking up does not↑ sx's
	Moving neck ↓'s sx's	↓ed thoracic kyphosis
Either hip IR >35 ˚	B involvement	Cerv ext<30
Onset ≤ 16 days prior	Not doing sedentary work > 5 hrs / day	Sx's < 30 days

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Neck and Upper Back Pain in Cyclists

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Neck and Upper Back Pain Relevant Anatomy

- Cervical discs
- Nerve Roots
- Facet Joints
- Cervical & Thoracic Extensors
- Deep Neck Flexors

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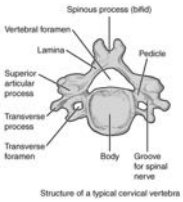
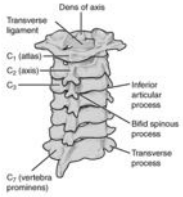


Structure of a typical cervical vertebra



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What Causes Neck and Upper Back Pain in Cyclists?

- Sustained cervical extension during cycling
  - "Trigger points in levator scapulae & trapezius muscles
- "Micro-Whiplash" mechanism
  - 2ndary to prolonged vibratory forces causes connective tissue injury
- Scapular protraction & Thoracic Flexion
  - Over-lengthening of posterior shoulder and thoracic muscles
  - Shortening of pectorals

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Neck and Upper Back Pain
Special Considerations for Physical Exam

- Which positions induce/relieve pain?
- Range of Motion
  - Which segments move and which do not?
    - Examine thoracic even if primary complaint is cervical pain
- Joint Mobility
  - Cervical and Thoracic; Possibly Lumbar
- Cervical Distraction
- Muscle Length / Flexibility
  - Pec Minor
  - Scalenes
  - Upper traps
  - Levator Scapulae
- Strength Assessment

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Assessment of Deep Cervical Flexors

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Assessment of Shoulder/Upper Back Musculature

- Rotator Cuff Musculature
- Serratus Anterior
- Lower Trapezius
- Middle Trapezius
- Rhomboids?

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Which Test is Which?

A. Middle Trapezius
B. Lower Trapezius
C. Serratus Anterior

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Management of Cycling-Induced Neck and Upper Back Pain

- Education
  - Change of position
  - ROM during stops/breaks
- Exercise
  - Decrease hyperactivity and spasm
    - Stretching of UT & Levator
    - Self-massage
  - Increase neuromuscular control
    - Recruitment of deep cervical flexors
    - Endurance exercise for mid-traps, lower traps, rhomboids, lats, spinal extensors
  - Decrease vibrational and impact forces ???
    - UE strengthening
    - Core strengthening

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Management of Cycling-Induced Neck and Upper Back Pain

Manual Therapy

Manipulation

Joint Mobilization

Traction

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Deep Cervical Flexor Activation

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ER with Towel

Side-lying ER

Horizontal ABD ER

(Thumb Up)

Horizontal ABD IR

(Thumb Down)

Full Can

Push Up w/ a "plus"

Rowing

Dynamic Hug

Serratus Punch 120°

Prone Full Can

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CONTINUED

Cervical/Thoracic Mobilization HEP

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What Causes Knee Pain in Cyclists?

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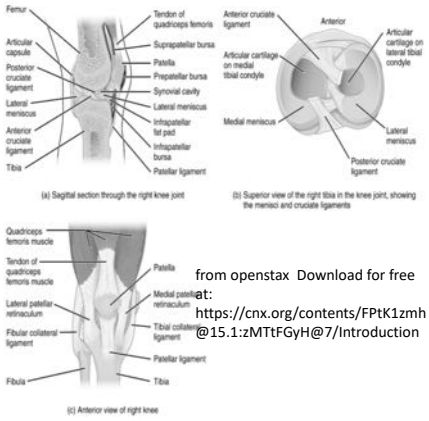
Knee Pain in Cyclists Relevant Anatomy



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- Sub and Peri-Patellar Structures
- Patellar Fat Pad(s)
- Bursae
- Patellar Tendon
- Illio-Tibial Band

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What Causes Knee Pain in Cyclists?

- ***Anterior and lateral knee*** most commonly affected
- ***PFPS*** – due to shearing F's under patella
- ***Illio-Tibial Band Syndrome*** – repetitive frictional stresses over distal IT Band insertion
- Predisposing Factors
  - Imbalances between proximal musculature (hips, core) and quadriceps
    - Research supports fatigue of these muscles alters biomechanical stresses
  - Pedaling through higher gears than appropriate for the situation
  - Seat Height and saddle position

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Knee Pain
Special Considerations for Physical Exam

- **Patellar Mobility**
  - Hyper vs. Hypo Mobility?
  - Pain?
- **Muscle Length / Flexibility**
  - Hamstrings, Rectus, Hip Flexors, Gastrocs, *IT Band*
- **Palpation – Identify Involved Structures**
  - Patellar Tendon
  - Fat Pads & Bursae
  - Sub-Patellar Stuctures
    - Glide medially and laterally and palpate exposed undersurface

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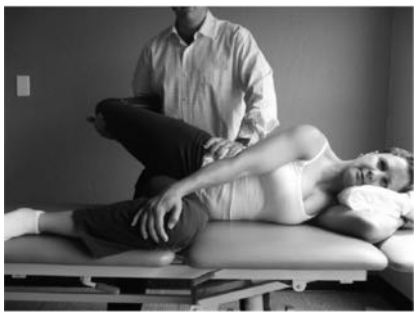
Ober's vs. Modified Ober's Test



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Strength Assessment

- Hip Abductors, Extensors, and External Rotators !!!
- Hamstrings
- Quadriceps?
- VMO Testing?

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Testing of the Vastus Medialis Oblique? (VMO)

Based on research evidence, which of the following is true about selectively training the VMO to normalize patellar mechanics and reduce symptoms in patients with patella-femoral pain syndrome?

A. It is a more effective approach than exercise programs that target other muscle groups
B. It is an equally effective approach as compared to exercise programs that target other muscle groups
C. It is questionable if exercises can selectively target the VMO without activating the other quad muscles
D. Exercise programs which selectively target the VMO are not as effective as those which target hip musculature

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Management of Knee Pain in Cyclists

- Bike fit of utmost importance
  - Plumb line from anterior knee thru ball of foot
  - Seat height; Saddle fore-aft
  - Shaped insole/orthotic?
- Exercise?
  - Hip strength
    - Glut max, medius, external rotators
  - Core strength
  - Graded training to prevent excess fatigue and poor biomechanics
    - Shorter / easier rides early in training season

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Exercises to Target Hip Musculature

Management of Patellofemoral Pain Targeting Hip, Pelvis, and Trunk Muscle Function: 2 Case Reports
by Catherine L. Mascal, PT, BSc, Robert Landel, DPT, OCS, and Christopher Powers PT, PhD

Journal of Orthopaedic & Sports Physical Therapy

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Etiology – Hand / Wrist

- Due to extended weight-bearing on handlebars
  - Stress on ligamentous, muscular, and nervous tissues
    - Especially which nerve?
      - A. Median
      - B. Ulnar
      - C. Radial
      - D. Musculocutaneous
- Education:
  - Adequately padded gloves
  - Position on bike for less Wbing thru hands
  - Alternative handle bar configurations
- Exercise
  - UE strengthening
  - Proximal strength

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Prevention Strategies

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Affix patient's bike to a trainer to assess fit and alignment

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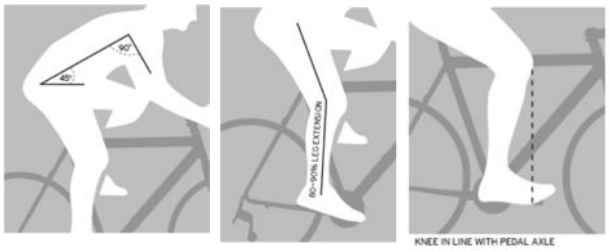
Bike Fit Basics

- Simple adjustments
  - Seat Height
  - Saddle Fore-Aft
  - Saddle angle
  - Stem angle and length



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CONTINUED

Stem Angle and Length

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Off-Season and Cross Training Considerations

Based on presentation thus far, what types of training/exercise would be important during offseason and/or to supplement cycling?

What body regions, tissues, muscles, etc. would be important to target with this training?

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Off-Season and Cross Training Considerations

- LE Strength
  - Quads & HS
  - Possibly more important for Hip Musculature !!!
- Core Stability
- UE strength
  - RC musculature
  - Shoulder girdle and arm musculature
- Neck and upper back muscle endurance
  - Means training using low load, high volume
  - Deep cervical flexors, cervical extensors, Mid/Lower Traps, Rhomboids, etc.
- Flexibility
  - Stay flexible in general but most important AFTER long rides
  - HS, Quads, Hip Flexors, IT Band, Gastrocs,

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Cross Training Options

- Weight Training
- Yoga
  - Flexibility and Stability
- Other Exercise Classes
  - Many forms
  - Do background research on safety
    - Be wary of timed and overly competitive settings that encourage loss of form !!!
- Maintain Cycling Fitness and Strength
  - Spin classes
  - Use of individual spin bike or trainer
  - Careful with basic stationary bike for extended training (limited options for fit)
  - Other cardio
    - Running
    - Swimming
    - Other cardio equipment

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Single-Speed Mountain Biking

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Article

Overuse Injuries Associated with Mountain Biking: Is Single-Speed Riding a Predisposing Factor?

Michael T. Lebec *, Kortny Cook and Drew Baumgartel

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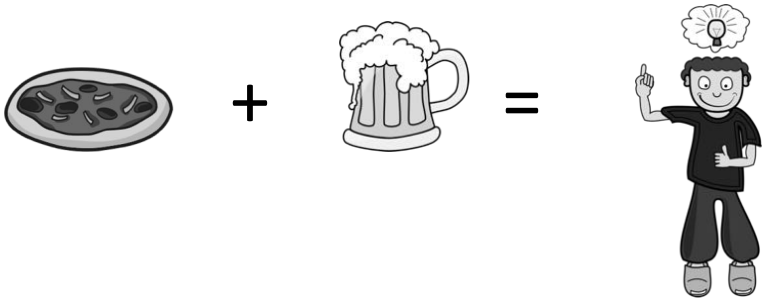
Single-Speed Riding and Overuse Injuries

- Zero previous studies
  - But according to grapevine, lots of anecdotal evidence



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Methods

- Distributed online survey
  - Personal demographics
  - Mountain bike set up
  - Riding volume & style
  - Overuse injuries sustained in last year:
    "The presence of pain, discomfort, swelling, bruising, or any other uncomfortable symptom which may have occurred as a result of cycling but did not result from a crash."
- 404 participants
  - 57 Single-Speed Riders (SS)
  - 280 Multiple-Geared Riders (MG)
  - 67 BOTH (SS/MG)
- Analyzed data via logistic regression model
  - Gender, Riding Volume, Gear Type

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Guess the Results

Which group do you think sustained a significantly higher number of overuse injuries?

A. Individuals who ride multiple-geared bikes
B. Individuals who ride single-speed bikes
C. Individuals who ride both multiple-geared and single speed bikes

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Incidence of overuse injury in MTN Bikers by anatomic region

	All	MG	SS	SS/MG
Any injury	**63%**	**59%**	**63%**	**78%****
Neck / Upper Back	16%	15%	14%	24%
Low Back	24%	21%	23%	34%
Shoulder	6%	6%	5%	6%
Elbow	7%	8%	5%	4%
Hand / Wrist	18%	18%	14%	19%
Saddle Region	15%	13%	26%	15%
Hip / Groin	7%	6%	12%	7%
Knee	23%	20%	25%	34%
Ankle / Foot	6%	6%	4%	7%

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Effect of gender, gear type, riding volume and suspension on overuse injuries.

	All Injuries	Back Injury	Neck Injury	Knee Injury
Variable	Percentage of observations P Value			
Gender	**Male 61%** **Female 68%** **P=0.0848**	Male 24% Female 22% P=0.8882	Male 16% Female 16% P=0.6521	Male 23% Female 26% P=0.6662
Gear Type	**SS 63%** **MG 59%** **SS/MG 78%** **P=0.0104**	**SS 23 %** **MG 21%** **SS/MG 34%** **P=0.0864**	SS 14% MG 14% SS/MG 24% P=0.2242	**SS 25%** **MG 20%** **SS/MG 34%** **P=0.0651**
Riding Volume (hrs/week)	≤8 56% 8-16 65% >16 73% P=0.1172	≤8 20% 8-16 26% >16 27% P=0.5410	≤8 12% 8-16 17% >16 27% P=0.1020	≤8 24% 8-16 23% >16 22% P=0.7974

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CONTINUED

Odds ratios associated with overuse injury

	ALL INJURIES	Back Injury	Neck Injury	Knee Injury
	Odds Ratio (95% confidence interval)			
Female vs. Male	1.58 (0.93,2.72)	1.04 (0.57,1.85)	1.19 (0.59,2.29)	1.13 (0.63,1.98)
SS/MG vs. MG	**2.69 (1.40,5.47)**	**2.03 (1.09,3.75)**	**1.88 (0.92,3.76)**	**2.10 (1.12,3.89)**
SS/MG vs. SS	**1.96 (0.85,4.58)**	**1.59 (0.70,3.71)**	**1.51 (0.57,4.25)**	**1.84 (0.83,4.23)**
MG vs. SS	0.72 (0.35,1.45)	0.78 (0.36,1.74)	0.81 (0.32,2.16)	0.88 (0.42,1.89)
8-16 hrs/wk vs. ≤8 hrs/wk	1.47 (0.93,2.32)	1.34 (0.80,2.28)	1.49 (0.80,2.84)	0.92 (0.55,1.54)
>16 hrs/wk vs. 8-16 hrs/wk	1.33 (0.65,2.84)	0.94 (0.44,1.91)	1.70 (0.77,3.59)	0.83 (0.37,1.75)
>16 hrs/wk vs. ≤8 hrs/wk	1.94 (0.94,4.25)	1.26 (0.56,2.72)	2.53 (1.07,5.88)	0.76 (0.33,1.67)
Full vs. Front	0.88 (0.54,1.43)	1.18 (0.69,2.02)	0.71 (0.38,1.30)	0.63 (0.37,1.06)
Full vs. None	**3.39 (1.56,7.61)**	**1.89 (0.77,5.21)**	**5.40 (1.43,35.69)**	1.12 (0.47,2.94)
Front vs. None	**3.84 (1.83,8.30)**	**1.61 (0.68,4.28)**	**3.83 (1.05,24.73)**	**1.79 (0.79, 4.50)**

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CONTINUED

Primary Conclusions

- Individuals in SS/MG group significantly more likely to report overuse injury
- Most commonly reported injured areas
  - Low back
  - Neck
  - Knees
  - Hand/wrist
  - Saddle

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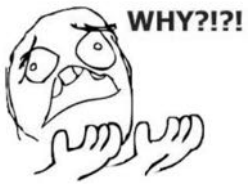
Differences Between Single Speed and Multiple-Geared Riding



- Greater effort due to single gear option
- Climbing while pedaling
  - Side to side motion
  - Pulling up on handle bars
- Potential for fatigue above and beyond normal levels
  - *And* altered cycling mechanics

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SS vs. SS-MG

- Single-speeders
  - Better trained for SS riding?
- SS-MG
  - Not as well trained for SS riding
  - Do they experience excess fatigue when riding SS bikes?
    - Altered mechanics?
      - And therefore predisposition to overuse injury

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Case 1

A 29 year old female has been doing competitive road cycling for 3 years. Because she lives in Ohio, her riding season is limited to the warmer months but in the winter she stays in shape by running on a treadmill. Due to an early spring, she has been back on her bike for about 3 weeks and is starting to do some longer rides. However, she is beginning to develop anterior knee pain after riding for about 20-30 minutes which is affecting her ability to further progress her training. She comes to you for physical therapy for this issue.

- What factors might be contributing to the onset of her pain?
- Which tests and measures would be most important to perform during the physical exam?
- What interventions would help reduce her knee pain?
- What strategies might she use to prevent this problem in the future?

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Case 1 – 29 y.o. F with knee pain

Which aspect of bike fit would have the LEAST influence on her knee pain?

A. Saddle height
B. Saddle fore-aft
C. Stem angle
D. Cleat position for clip-in shoes

- TRUE / FALSE: The most beneficial muscle to assess for strength and attempt to strengthen would be the quadriceps

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Case 1 – 29 y.o. F with knee pain

Which mode of offseason training would be most beneficial for this individual in reducing knee pain early in the training season

A. Yoga
B. Spin bike / spin classes
C. Higher intensity treadmill training
D. Free-weight training with dumbbells and barbells

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Case 2

A 42 year old mountain biker presents to physical therapy with neck and upper back pain that is exacerbated during and after long rides. He has a history of intermittent neck pain but has never had problems before while riding. This summer he is riding more days per week because he just moved to an area with easier trail access and he has more a more flexible riding schedule because he is working from home.

- What factors might be contributing to the onset of his pain?
- Which tests and measures would be most important to perform during the physical exam?
- What interventions would help reduce his neck pain?
- What strategies might he use to prevent this problem in the future?

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CONTINUED

Case 2 – 42 y.o. M with neck/upper back pain

Which combination of target muscles and training volume would be of most benefit for preventing future neck/upper back pain?

A. Triceps / Biceps – heavy load, low reps
B. Scapular stabilizers – low load, high reps
C. Pec muscles – moderate load, high reps
D. Core musculature – low load, very high reps

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CONTINUED

Summary

- Cycling-induced overuse syndrome **are common and occur in a predictable fashion**
- Understanding the **underlying physiology** behind these overuse syndromes is beneficial
- A structured PT evaluation can **identify limitations which cause overuse syndromes** in cyclists and be used to **create an effective treatment plan**
- Implementing **preventative measures** has great potential to limit the onset of cycling-induced overuse syndromes

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References

See pdf with course resources

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Questions?

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