Low Back Pain in Athletes
A Simple Approach to Evaluation and Treatment

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Definitions
• Low Back Pain (LBP): Pain between the 12th rib and inferior gluteal folds.
• Acute: < 6 weeks
• Subacute: 6 weeks to 3 months
• Chronic: > 3 months
• Specific low back pain (SLBP): Degenerative conditions, tumor, fractures, etc. (5-10%)
• Nonspecific low back pain (NSLBP): Back pain with no known underlying pathology (90-95%)

Possible Pain Sources
• Innervated structures:
  Vertebral periosteum
  Ligaments
  Fascia
  Muscle
  Intervertebral disc
  Zygapophyseal joint (ZAJ)

Other Possible Pain Sources
• 25% LBP could be referred from hip or SI joint pathology
  (Sembrano, 2008)
• Nerve root (Engseth, 2009)

Epidemiology - Athletes
• LBP in athletes: 1 to >30% depending on sport (position), training intensity and frequency.
• Most common prevalence: Wrestling, gymnastics, tennis, soccer, rowing.
• Most common condition: Ligamentous sprains or muscle strains.
• Persistent or recurrent symptoms: Degenerative disc disease or spondylolytic stress lesions.

Epidemiology - Athletes
• Highest frequency - Muscle strains:
  • College athletes (4,790) 1968-1978. (Keene, 1989)
  • College baseball 1988 – 2004. (Dick, 2007)
Epidemiology - Athletes

- Literature Review:
  - Athlete epidemiology from 1951 to 2013:
    - Degenerative disc disease
    - Spondylolysis
    - Muscle strain diagnosis:
      - Made by exclusion: Localized tenderness, pain with strength or stretch testing, (1) neurological findings and (1) imaging for defined pathologies.

- Literature:
  - Degenerative disc disease
  - Spondylolysis
  - Muscle strain diagnosis:

Epidemiology - Athletes

- Athletes at spine clinic:
  - Adolescent (100):
    - Spondylolysis or spondylolisthesis (47%)
    - Disc (11%)
    - Strain (6%)
  - Adult (100):
    - Spondylolysis or spondylolisthesis (5%)
    - Disc (48%)
    - Strain (27%)

([Micheli, 1995])

Conclusion

Primary Source of LBP in Athletes

- Intervertebral disc
- Spondylolysis / Spondylolisthesis

Disc Lesion Mechanism

- Majority are posterior-lateral & occur at L4, L5, S1 ([Wang, 2013])

- Rotation & flexion pushes nucleus posterior-lateral ([Fazey, 2006])

- Posterior-lateral anular tears may require anterolateral bending. ([Aultman, 2005])

Mechanism of LBP in Athletes

- Cyclists: Pain with greater flexion & rotation occurring in lower lumbar. ([Burnett, 2004])

- Baseball: Maximum axial rotation and acceleration: pitching; near front foot contact; batting; after ball contact. Repetition of axial rotation may cause anular tears. ([Fleisig, 2013])

- Tennis: Rotation and extension, cumulative load. ([Campbell, 2013])

- Golf: Lumbar axial rotation and contralateral side bending through impact phase of swing creates excessive intervertebral lateral shear resisted primarily by the disc. ([Lindsay, 2014])

Spondylolysis Mechanism

- Repeated lumbar flexion-extension or rotation with a congenitally weak pars interarticularis. ([Gaete, 2011])
Evaluation

Clinical Examination

• Discogenic Pain: **Centralization**: A clinical phenomenon first described by McKenzie during the mechanical assessment of patients with LBP. The progressive retreat of distal referred or radicular pain toward or to the lumbar midline. Commonly use end-range lumbar extension movements. Sensitivity 92% and specificity 64% and reliably differentiated discogenic from nondiscogenic pain using discography. (Donelson, 1997)

• Systematic Review: **Centralization** was the only clinical test found to increase the likelihood of the disc as the source of pain. (Hancock, 2007)

Clinical Examination

• Discogenic pain: **Slump Test**: Found to have sensitivity for disc herniation of sensitivity 83% and specificity 55% using CT or MR imaging. (Stankovic, 1999)

Clinical Examination

• Clinical Tests to Diagnose Lumbar Segmental Instability:
  • **Passive Lumbar Extension test**: Found to have the highest combined sensitivity 84% and specificity 90%, as well as the highest +LR (8.8), suggesting that this test might be of use in musculoskeletal and orthopedic clinical practice to diagnose structural lumbar segmental instability. The test is performed by having the patient in the prone position, grabbing both ankles, give slight traction to the legs and extend ~ 30cm. During this maneuver, a positive test is based on an increase in pain with extension that disappears on return to the starting position. Systematic Review: (Alqarni, 2011)

Clinical Examination

• Lumbar segment motion assessment:
  • Passive accessory intervertebral motion (Anteroposterior translation): Manual AP force applied to a single spinous process in the lumbar spine causes motion of the entire lumbar region assessed by dynamic MRI. (Klug, 2006)
AP - Passive accessory intervertebral motion

Clinical Examination

- Lumbar segment motion assessment:
- Passive physiological intervertebral motion: **Specific but not a sensitive test for lumbar segmental instability and detection of sagittal planar rotation or translation.** (Abbott, 2005)

Passive physiological intervertebral motion

Clinical Examination

- Spondolytic pain: Athletes with spondolytic LBP have **tighter hamstrings and increased sacral slope and pelvic incidence when compared to athletes with nonspondolytic LBP.** (Young, 2016)
- **Hamstring muscle-tendon unit does not influence lordotic curve.**

Lumbar Spondylolysis

- **Review** (Leone, 2011)
  - Hereditary factor: Family member incidence up to 69%.
  - Sport: Incidence up to 63%.
  - Level: L5 vertebrae 95% of cases
  - Clinical Findings: Pain with lumbar extension
    - Tight hamstrings
    - Often hyperlordotic
    - Step-off – Spondylolisthesis
Clinical Examination

Tests for Lumbar Motor Control:

- Transversus abdominis isolation test: Prone; distal edge of Pressure Biofeedback Unit (PBU) at ASIS; inflate to 70mmHg; draw-in reducing pressure 6-10mmHg. (Richardson, 1995)

- Lumbo-pelvic stability testing:
  - Supine, active straight leg raise test (PBU)
  - Supine, leg lowering test (PBU)
  - Standing, Trendelenburg test

(Cotney, 2014)

Clinical Examination

- Nerve root irritation: The straight leg raise test shows a sensitivity of 97% and specificity of 53% for nerve root tension or irritation using MR imaging. (Vroomen, 2002)

Clinical Examination - Biomechanics

- Male professional tennis players (Vad, 2003) and golfers (Vad, 2004) with LBP were more limited in lead hip medial rotation, then asymptomatic.

- Hip function is one potential factor that might affect risk for LBP in athletes who participate in rotation-related sports. (Harris-Hayes, 2009)

Clinical Examination

- Sacroiliac Joint Pain Provocation Test:
  - A cluster of tests: Distraction; Thigh Thrust; Gaenslen’s; Compression; Sacral Thrust. Sensitivity of 91% and specificity of 83% was found using SI joint injections.

(Lubett, 2013)

Clinical Examination

- Muscle Strain: Isometric – Trunk side bend
  - (Pain provocation with muscle strain)
Yellow Flags
• Psychiatric Disorders: Anxious, depressed
• Socioeconomic Issues: Death in family, job loss

(Ladeira, 2011)34

LBP – Red Flags
• Cauda Equina – Midline disc herniation on cauda equina nerve roots. Bowel or bladder dysfunction, perianal sensory loss.
• Upper motor neuron lesion - Neural pathway above the anterior horn cell (Spinal cord). (+) Babinski sign.
• Spinal tumor – Unexplained weight loss, thoracic pain, night pain.
• Multiple Sclerosis – Paresthesia in both lower extremities.
• Cord compression – Significant motor weakness, paresthesia in both lower extremities.
• Aortic aneurism – Deep aching low back pain.

Role of Lumbar Multifidus
• The data from this study support the hypothesis that the superficial multifidus contributes to the control of spine orientation (Lordosis), and that the deep multifidus has a role in controlling intersegmental motion.
(Moseley, 2002)36

Role of Psoas Muscle
• Psoas and lumbar spine stability:
  • T1-2 and L3-4 (Posterior force vector)
  • L4-5 and L5-S1 (In-line force vector)
  • L5 - S1 (Anterior force vector)
  (Penning, 2000)57
• Psoas does not influence lordotic curve

Atrophy of Multifidus and Psoas
• A decrease in the cross-sectional area of multifidus and psoas in patients with unilateral back pain was found using MR imaging.
(Barker, 2004)48
Treatment – Intervertebral Disc

Mckenzie Method

- Systematic review: McKenzie method is more effective than passive therapy (ice, massage, education) for acute LBP. (Machado, 2006)

Lumbar Disc Home Program

- Lumbar extension or lateral pelvic tilt in morning to dehydrate disc.
- Standing low back extension: 10x after sitting.
- Disassociation with hip and lumbar motion.
- Walk ½ hour per day.
- Lumbar stabilization: Drawing-in maneuver → Core bracing.
- Ergonomics: Sitting – Lumbar roll (maintain lumbar extension) & elevate seat (assist lumbar extension).

Treatment – Motion Segment Instability

Motor Control

- Cricket players with LBP demonstrated a reduced ability to perform the drawing-in maneuver and could not contract the transversus abdominis independently of the other abdominal muscles. (Hides, 2008)

Motor Control

- Cricket players with LBP experienced a decrease in the amount of contraction of the transversus abdominis and internal oblique found with ultrasound after motor control training. They also experienced an improvement in the ability to draw-in with training. This indicates the amount of contraction is not as important as the ability to contract these muscles independently of the other global muscles. (Hides, 2010)
Motor Control

• Segmental stabilization exercises as described by Richardson and Jull, 1992 were found to improve segmental stability using a joint play grading scale and pain using a pressure pain threshold technique with patients diagnosed with segmental instability. (Kumar, 2011)

Motor Control

• Drawing-in training: Re-education of deep trunk muscles, transversus abdominis and multifidus by drawing-in abdominal wall (umbilical and below: up-and-in to the spine) in prone and upright positions. (Richardson, 1995)

• Same as transversus abdominus isolation test

Motor Control

• Exercises:
  - The transversus abdominis had greatest activity with elbow-toe exercise (Okubo, 2010) and even greater when using an unstable surface (Imai, 2010) using fine wire electrodes.
  - The lumbar multifidus had greatest activity with the back bridge exercise. (Okubo, 2010)

Lumbar Stabilization Mechanisms

• Drawing-in maneuver:

• Intra-abdominal pressure – Stiffening effect on lumbar spine.

• Transversus abdominis-multifidus co-contraction - Causing tension on the thoracolumbar fascia and a “corset effect.”

• Hoop tension – Increase in intracompartmental pressure within the paraspinal space. (Schilling, 2008)

Motor Control

• Ex: The transversus abdominis had greatest activity with elbow-toe exercise (Okubo, 2010) and even greater when using an unstable surface (Imai, 2010) using fine wire electrodes.

• The lumbar multifidus had greatest activity with the back bridge exercise. (Okubo, 2010)

Elbow-Toe Exercise

Local & Global Exercises

• Local segmental musculature appears to stabilize the spine at the local level due to close proximity to the lumbar segments and tonic contractility. Global musculature appears to stabilize the spine globally through compressive loading of the spine through all available segments and contribute greatly to gross motion. Both appear to play distinct roles in spine stabilization. Our research shows that initially training segmental musculature via core stabilization exercises to provide active support directly to the lumbar spine will increase spinal stability and decrease pain. Global musculature can then be trained to provide further spinal stability. (Haydt, 2016)
Global Stabilization

- Global core training:
- Beginner-intermediate-advanced progression
- Curl-up
- Birddog (Instability - Careful with extension)
- Side-bridge

(Semirac, 2016)19

Treatment – Spondylolysis

- Unilateral defects heal 71.1% vs. bilateral 18.1%.
- No difference in outcomes with or without bracing.
- Successful clinical outcomes in pain and function improvement does not depend on healing of the lesion. (Klein, 2009)20

- Cessation of sport activity for 3 months:
- To minimize intervertebral motion needed for osseous healing and decrease risk of degenerative changes in ZAJ or disc. Patients who stopped sports for a minimum of 3 months were 16.39 times more likely to have excellent results than those who did not.
- Rigid Spine Brace:
  A spine brace can reduce gross body movement, but is not effective in controlling the lower lumbar segments to prevent instability. (EL Rassi, 2013)21

Treatment – Nerve Root

- Patients with acute lumbar sciatica secondary to a disc herniation reported reduced radicular pain and improved function after 10 sessions in 2-weeks of lumbar mechanical traction regardless if force was 50% or 10% of body weight. (Isner-Horobeti, 2016)22

Treatment of SI Joint Dysfunction

SI Joint Evidence

- Pain below PSIS (Majority literature)
- Athletic activities involving unilateral forceful movements: Punting, hurdling, etc.

- A review of the literature has suggested that rotational and translational movement at the SI joint, determined by 3-D digitizing from stereophotogrammetric analysis, is minute and most likely sub-clinically detectable. (Goode, 2008)23

- Although positional test results of the sacrum in relation to the ilium changed from asymmetrical to normal after manipulation, according to stereophotogrammetric analysis there was no alteration in position. (Tullberg, 1998)24

SI Joint Evidence

- Contraction of the transversus abdominis significantly decreases laxity or increases stiffness of the SI joint compared to lateral abdominal muscles with subjects in a prone position determined by Doppler imaging of vibrations. (Richardson, 2002)25

- Pelvic asymmetry appears very frequently and should be regarded as a physiologic adaptive alteration of the locomotor system to transmission of asymmetrical mechanical loads. (Grice, 2006)26
Si Joint Stabilizer Belt

Treatment of Chronic Low Back Pain

• Systematic review: Exercise programs consisting of coordination or stabilization and strength or resistance are effective in reducing CLBP. (Searle, 2015)

• Meta-Analysis: Core stability exercise is more effective in decreasing pain and improving function than general exercise in the short-term, but no significant difference in the long-term. (Hsing, 2012)

Treatment of Chronic Low Back Pain

• Using psychosocial therapy (for example: biofeedback or relaxation training) to change cognitive behaviors such as anxiety associated with pain experiences. A review of the literature suggests cognitive therapy is an effective component of the over-all therapy of CLBP. (Gatchel, 2008)

Summary:

Simple Low Back Pain Evaluation

• History: Sport/position, position of discomfort & relief (disc pain can refer beyond knee)
• Observation: Trunk shift, Hyperlordosis, Step off
• Trunk movement: (PN provocation)
• Resistance: Isometric trunk side bend (PN provocation)
• Neural motor screen: Heel & toe raises, great toe extension (L4 – S1)
• Special test: Pain above PSIS
  1. Discogenic: Centralization
  2. Instability / Spondolytic: PLE
Pain below PSIS
  1. SI joint dysfunction: Laslett’s cluster of 5
Radiating pain:
  1. Nerve root: SLR
• Instability – Refer for radiograph (oblique view) or bone scan

Summary:

Simple Low Back Pain Treatment
**SLBP**
- Spondyloytic
- Cessation of Sport
- Re-stabilization
- NSLBP
- Disc
- Segmental Instability
- Stable Segment
- Re-stabilization
- McKenzie
- Ergonomic
- Sport specific core training
- Sport specific functional training

**McKenzie / Ergonomic**
- **McKenzie:**
  - Lumbar hyperextension
  - Trunk shift
- **Ergonomic:**
  - Seated with roll in lumbar
  - Raise seat
  - Walking

**Re-Stabilization**
- **Local:**
  - Lumbo-pelvic stability tests (Outcome measures)
  - Drawing in training
  - Supine – limb movement
  - Elbow-toe exercise
  - Seated on unstable
  - Standing on unstable
- **Global:**
  - McGill’s big 3 (Bracing)
    - Side-bridge
    - Birddog
    - Curl-up

**Radicular Pain**
- Nerve root involvement (Radiating pain, + SLR):
  - Mechanical traction (Any force)

**Sacroiliac Joint Pain**
- Below PSIS; Laslett’s SI joint PN provocation tests
- Drawing-in training
- SI joint belt

**Chronic Low Back Pain**
- Motor control: Drawing-in progression
- General resistance exercise
- Psychosocial therapy referral
Core Training – Sport Specific

• Sports that involve trunk rotation:
• Seated isometric trunk rotation
• Standing isometric trunk rotation

This was meant to provide a simple, evidence-supported strategy for the evaluation and treatment of LBP in Athletes.

Questions?

Function Training – Sport Specific

• Hip:
• Internal rotation of lead leg
• Biomechanics:
• Golf – Reduce rotation and side bend
• Rotational sports – Lumbar-pelvic unit
• Lumbar-hip dissociation:
• Trunk flexion at hips with lumbar rigid

References


