When To Operate On The Athlete: Lumbar Spine

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Lumbar Intervertebral Disc

• Absorbs and dissipates loads of the spinal column
• Allows motion between segments
• Must be strong enough not to be injured during movements
• Deforms to accommodate rocking motion of the vertebral bodies
Annulus Fibrosis

- Sheets of interlacing lamellae of collagen
- Provide tensile strength and limit expansion of viscoelastic aggrecan molecules of nucleus that enable reversible deformation of tissue

Forces acting on disc

- Compressive forces through central layer of hyaline cartilage interposed between nucleus and bone
- Tensile forces in annulus transmitted to bone through Sharpey’s fibers

Lordotic lumbar spine

- Vectorial forces made up of two vertical axial loading compressive forces, one perpendicular to the disc and one horizontal – produce shear strain
- Result – tensile stress in annulus fibrosis and shear force in neural arch
- Abnormal stresses:
  - Annular tears
  - Stress fractures of neural arch
Neural Innervation

Sinovertebral nerve
- Arises from primary ventral ramus and gray rami communicans
- Supplies posterior annular fibers of posterior IVD, dura, PLL
- Gray rami communicans – ALL and anterior disc
- Primary dorsal rami – facet joint, interspinous ligament, paraspinal muscle

Common mechanisms of injury

• Compression or weight loading
• Torque or rotations (may result in shear forces in a more horizontal plane)
• Tensile stress produced through excessive motion

Injuries to the Disc: Rotation and Shear - Annular Tears

• A- Circumferential cleft or delamination
• B- Radial fissure – may correlate well with painful discography
• C- Peripheral rim
• Concentric, radial, transverse
Sports most commonly associated with lumbar injuries:

- Gymnastics
- Ballet
- Water sports
- Weight lifting
- Running
- Golfing
- Baseball
- Wrestling
- Football

General Indications for surgery in the athlete

- Sufficient morbidity to warrant surgery
  - Amount of pain
  - Loss of function
  - Occupation
- Failure of conservative care
- Identified pathologic lesion that can be corrected with a safe, effective operation
- A proper, fully developed post-operative rehabilitative program

Prior to decision to proceed to surgery:

- Aggressive conservative treatment
- Judge response to treatment
- Listen to patients expectations:
  - Concerning the sport
  - Of life outside of sport
- Understand timing concerns
- Understand fears concerning sport and life
- As always, decide what is in the patients best interest

Other considerations

- Is the surgery to enhance performance or relieve disabling pain?
- Age of patient and career longevity
- What will player be like after retiring from the sport?
- Chances surgery will be successful?
- Decisions for surgery team approach:
  - should be made within multidisciplinary team including rehabilitation specialists with surgeon having a understanding of and role in the rehabilitative process


Return-to-Play Guidelines

- Not as well addressed in the literature as those associated with cervical spine injury
- Mostly Based on expert opinion
- Some observational studies give guidelines
- Decisions should be based on:
  - Recovery status from acute or chronic injury
  - Recovery from and success of surgery
  - Restoration of sports specific skills
  - Psychosocial readiness

Return-to-Play Guidelines

- Watkins-Randle 1-5 rating scale of trunk stabilization exercises:
  1. Complete the appropriate level of stabilization program.
  2. Be in excellent aerobic conditioning compatible with the sport through aerobic conditioning while doing the stabilization program.
  3. Work with the coaching staff and training staff in a series of sport-specific exercises for the individual sport.
  4. Return slowly to the sport with playing time or position changes as needed and specific to the sport.
  5. Maintain the same level of stabilization training after return to the sport for a period of 6 months to a year.
Clinical syndromes of athletic injuries to the lumbar spine

- Mechanical axial back and/or leg pain
- Sciatica / radicular pain
- Neurogenic claudication

Specific diagnosis

- Lumbar disc herniation
- Degenerative disc disease
- Lumbar spondylolysis
- Lumbar spondylolisthesis
- Spinal stenosis

Lumbar Disc Herniation

Surgical Indications:
- Persistent symptoms despite conservative management
- Morbidity of sufficient severity and duration to warrant operative intervention
- Radicular pain > back pain in distribution of a radicular nerve
- Neurologic deficit and findings (motor, sensory, reflex loss) that correspond to specific nerve
- Studies that show a pathologic lesion that corresponds to patients symptoms and physical exam
Surgical indication in lumbar disc disease

• Absolute indications
  – Cauda equina syndrome
  – Progressive major neurologic deficit
• Relative indications
  – Static significant neurologic deficit
  – Unrelenting pain
  – Major loss of functional capability
  – Inability to play sport because of spinal pain


Cauda Equina Syndrome

Goals of surgery

• Lumbar discectomy:
  – Remove disc fragment and thus relieve neural compression
  – Minimize injury to all structures by utilizing adequate visualization, lighting and exposure
Lumbar Disc Herniation

- Operative techniques
  - Traditional open microdiscectomy
    • gold standard
    • Headlight / loupe or microscope magnification
  - Tubular discectomy
  - Percutaneous approaches

Comparison of Tubular Diskectomy and Conventional Microdiscectomy Techniques

Return-to-Play Guidelines

- After lumbar discectomy:
  - Eck and Riley Clin Sports Med 2004
    • 6-8 weeks non contact sports
    • 4-6 months contact sports
  - Kahanovitz Clin Sports Med 1993
    • 4-6 weeks non contact sports
    • 8-9 weeks contact sports
Lumbar Disc Herniation:
Surgical Outcomes in Athletes

- Watkins et al. Spine 2003
  - 60 Olympic and professional athletes
  - 53 returned to previous level of competition
  - Avg time of return 5.2 months (range 1-15 months)
  - Guidelines for return to play
    - Completion core strengthening program
    - Sufficient cardiovascular fitness
    - Ability to perform sport specific exercise and skills

- Wang et al. Spine 1999
  - 14 elite college athletes
  - One and two level procedures
  - All satisfied with results and pain free in ADL
  - 90% of single level discectomy patients returned to high level competition
  - Results less favorable with two level procedure

- Hsu et al. The Spine J 2011
  - Retrospective study including 226 athletes who underwent surgery from 4 major sports
  - Of those who had surgery, 81% returned to sport
  - Avg length of career after surgery 3.3 years
  - Age at diagnosis negative predictor for career length after injury
  - Greatest positive treatment effect from surgery seen in NFL players
    - 74% return to play
    - Surgical tx led to longer careers
Lumbar Disc Herniation: Surgical Outcomes in Athletes

- Hsu W K. Spine 2010
  - Performance based outcomes following LDH in 96 NFL players
  - 78% played at least one game
  - Surgically treated players played in more games
  - Conclusion: players who can complete rigorous rehab can expect excellent performance based outcomes after surgery

- Anakwenze et al. Spine 2010
  - Performance outcomes following discectomy in 24 NBA players compared to those treated non-operatively
  - 75% surgical patients returned to play (88% control)
  - Athletic performance slightly improved or no worse in post-op players

Commentary

Great rehabilitation and great physical bodies allow professional athletes undergoing lumbar discectomy to return to sport at a high rate.
Degenerative Disc Disease

- Increased prevalence among elite athletes
  - Sward et al. Spine 1991

- Kirkaldy-Willis et al described process of degeneration of lumbar motion segment
  - On the initial phase of segmental dysfunction pain from facets or disc

Degenerative Disc Disease

- Treatment considerations:
  - Tx primarily non-surgical
  - Fusion surgery for back pain a poor option for athletes and should only be considered when all other treatment has failed
  - Results difficult to predict
  - Lengthy post-operative course to required heal from fusion poorly tolerated by athletes
  - Aggressive demands placed on spine in early-healed phase
  - High demands placed on adjacent levels
  - No reliable data on return to sports following spinal fusion
Degenerative Disc Disease

- Surgical options for discogenic pain:
  - Spinal Fusion
    - Anterior interbody
    - Posterior
    - Transforaminal
    - Anterior / posterior
  - Artificial Disc Replacement

Degenerative Disc Disease

- Surgery
  - Anterior interbody fusion –
    - Addresses pain generator by removing disc
    - More stable fusion

Degenerative Disc Disease

- ALIF
  - With anterior fixation
  - With plate fixation and supplementary posterior pedicle screws
Return-to-Play Guidelines

- After lumbar fusion
  - Controversial
  - No reports available examining return to sports after interbody spinal fusion in athletes
  - Return to collision sports controversial and mostly not recommended
  - General guidelines for return to non contact sports:
    - Evidence of solid fusion
    - Resolution of pain
    - Restoration of range of motion and strength
    - Min. 6 months – 1 year

Artificial Disc Replacement

- Preserve motion
- Relieve back pain
- Avoid fusion and failed fusion
- Avoid altered biomechanics which may lead to adjacent segment degeneration
- Increase disc height – improve alignment

Lumbar Disc Replacement

- Alternative to fusion in athletes with discogenic low back pain that has failed conservative management
- Siepe et al. Eur Spine J 2007
  - 39 athletes, avg age 39.8
  - Encouraged return to non contact at 3 months following rehab
  - Allowed resumption of highly demanding or contact sports (marathon running, parachute jumping, soccer) at 4-6 months
  - Return to sports 94.9%; complete satisfaction 84.6%
  - Authors stated solid osteointegration of implants allow for further load increases
  - Concerns remain over implant migration, subsidence and load bearing capacity over time given the athletic increased load on spine during sport activities
Lumbar Stenosis

- Congenital or acquired narrowing of spinal canal
- Insidious onset of varying combination of neurogenic claudication, back pain and radiculopathy

Indications for surgery:
- CES – acute or chronic
- Persistent debilitating symptoms not responsive to conservative treatment lasting minimum 3 months (longer in non-athletes)
- Progressive neuro deficit
- Neuro deficit with functional disability
- Bowel / bladder dysfunction

Surgery
- Decompression only in absence of instability or deformity
- Laminectomy, hemilaminectomy, hemilaminotomy
Lumbar Stenosis
Types of decompressions

Spinal Stenosis

- Limited decompression via bilateral laminotomy
- Spares interspinous ligament
- May preserve spinal stability
  - Kleeman et al. Spine 2000

Return to Play Guidelines

- Post surgery for Spinal Stenosis
  - May return to full non collision competition if pain free, has full ROM, no neurologic deficit, no instability, undergone rehab
  - Return to collision sports controversial
  - No collision sports with persistent neuro deficit, instability or s/p fusion
Return to Play Guidelines

• Spinal stenosis in older athlete
  – Factors: age, type of surgery, operative success, sport in question and level of competition, patients desires, overall medical condition
  – Decompression only
    • 6 wks no heavy lifting, 3 wks gentle conditioning, 1 month PT
  – Fusion
    • Start PT at three months
  – Golf
    • Decompression w/ or w/out discectomy – 3-6 months
    • Fusion – min. 6 months

Lumbar Spondylolysis

• Stress fracture typically in pars but can be in pedicle or articular process
• Must always be ruled out in athlete with low back pain
• Associated with repetitive twisting and extension motion
• Diving, gymnastics, wrestling, weightlifting
• 2.4% incidence of acquired spondylolysis during 4 yr college football career

Lumbar Spondylolysis: Treatment

<table>
<thead>
<tr>
<th>Table 1 Treatment Algorithm: Bone Scan with Lumbar SPECT in Athletes with &gt;3 Weeks Back Pain</th>
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<tbody>
<tr>
<td>1. If the bone scan is positive, order CT scan</td>
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<tr>
<td>2. If the bone scan is positive and the CT shows spondylolysis = active healing lesion</td>
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<tr>
<td>3. If the bone scan is negative and the MRI shows spondylolysis = non-healing lesion</td>
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<tr>
<td>4. If the bone scan is negative, order MRI</td>
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<td>5. If the bone scan is negative and the MRI is negative</td>
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<td>6. Further work up necessary using bone mineral density scan</td>
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<tr>
<td>7. If the bone scan is negative and the CT shows spondylolysis = unknown, undetected spondylolysis</td>
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<tr>
<td>8. Not likely to heal, but not likely to require surgery</td>
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<tr>
<td>9. If paraspinal tendinitis confirmed with pain block, may be candidate for direct pain repair</td>
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<tr>
<td>10. If the bone scan is negative and the MRI is positive</td>
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<tr>
<td>11. Disk herniation and instability, with MRI scan</td>
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<td>12. Performing laminotomy or vertebrectomy</td>
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<td>13. Pre-op pain control, with nerve block, prophylactic pain</td>
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<td>14. Ankylosing spondylitis, with fusion</td>
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<td>15. Myelotomy precautions, with fusion</td>
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Lumbar Spondylolysis

Surgical Indications
- Surgery rarely required as stabilization training usually successful
- May consider surgery if persistent pain and decreased function for 6 months despite aggressive conservative management
- Surgical options:
  - Direct repair of defect
  - One level fusion

Lumbar Spondylolysis: Surgical Techniques
- Direct repair
  - Disc must be normal – MRI or discography
    - If sig. disc degen. may need 1 level fusion
  - Hook screws, pedicle screws with hooks or V shaped rod, translaminar screws, lag screws
Lumbar Spondylisis: Surgical Techniques

- Direct lag screw with image guidance

Return-to-Play Guidelines

- After spondylolis repair
  - Activity limited to ambulation 10 weeks
  - If solid fixation and minimal pain, then trunk stabilization program – neutral pain-free isometrics exercise
  - Check CT at 6 months
  - If healed and pt met RTP criteria, may RTP

Spondylisis: Surgical Outomes

  - 20 athletes with unilateral defect underwent segmental wire fixation
  - All returned to non collision sports (baseball, tennis golf)

- Reitman et al Spine J 2002
  - Direct screw fixation in 4 non collision sport athletes
  - At 1 yr all competed at pre-injury competitive level

- Debnath et al JBJS Br 2003
  - 22 athletes (13-soccer, 4-crickets, 3-hockey, 1- tennis and golf)
  - 19 modified Bucks screw, 3 Scotts fusion
  - 18/19 screw fixation returned to sport mean 7 months; none of Scott fusion returned
  - Sample too small to draw conclusion regarding specific technique
Spondylolisthesis

• Indications for surgery:
  – CES – acute or chronic if associated with stenosis
  – Persistent debilitating symptoms not responsive to conservative treatment lasting minimum 3 months (longer in non-athletes)
  – Progressive neuro deficit
  – Grade 3 or 4 slips
  – Slip progression
  – Neuro deficit with functional disability
  – Bowel / bladder dysfunction
  – “reluctant to allow a return to previous level of athletic participation to be the major goal of surgical treatment”
  • Wimbbery and Lauerman Clinic in Sports Medicine 2002

Spondylolisthesis

• Surgical options:
  – Fusion with or without decompression
  – Fusion
    • Anterior
    • Posterolateral
    • Combined
    • TLIF / PLIF
Spondylolisthesis

- Transforaminal Lumbar Interbody Fusion (TLIF)
  - Allows for unilateral decompression and circumferential fusion from posterior only approach
  - Can be done minimally invasive

Spondylolisthesis

- TLIF

Spondylolisthesis

- ALIF with minimally invasive posterior pedicle screw stabilization
Return to Play Guidelines

- Recommendations following fusion surgery lacking
- Return to full contact sports remains highly controversial
  - NASS questionnaire – 208 respondents: 19-35% discourage collision sports; 40% allowed return to HS sports; 62% college sports; 17% did not allow return to pre-fusion level of competition
- Rubery et al. Spine 2002
  - SRS survey – children and adolescents w/h high grade slips
  - 82% surgeons allowed pts to return to non-collision sports 6 mos to one yr post op
- Molinari et al. J Spinal Disord 2005
  - 30 US servicemen underwent post fusion for spondylolisthesis
  - 63% returned to full unrestricted duty avg 6 months post-op; 27% permanent physical restrictions; 10% disability discharge because of persisting pain

Proper management of lumbar spine injuries in athletes:

- Comprehensive, fast diagnosis – establish the pain generator
- Realize they may be minimizing their symptoms
- Aggressive, effective non-operative management
- Understand degeneration occurs earlier in athletes
- Education of the athlete as to their options and outcomes
- Operations that minimize damage to normal tissue but correct pathology
  - Patients undergoing smaller, minimally invasive and non-fusion procedures have a greater chance of returning to previous level of competition
- Thorough conditioning program in post-operative recovery and for chronic injuries
Thank you