

Thoracolumbar Degenerative Disease

Dr. Mesfin A. Lemma
Johns Hopkins Medical Institutions
Division of Spinal Surgery
Baltimore, Maryland




Thoracic Disc Herniations Etiology

- Most are degenerative in nature
- Trauma may play a role in a subset of pts
- Scheuermann's disease ?

Outline

- Thoracic disc disease
- Lumbar degenerative disc disease
- Lumbar spinal stenosis and disc herniations
- Lumbar spondylolisthesis


Thoracic Disc Herniations Pathoanatomy

- 75% occur between T8 and L1
- 70% are either central or centrolateral 
- Often calcified, may adhere to the dura



Thoracic Disc Herniations Epidemiology

- Uncommon and underreported
- Challenging to diagnose
- Asymptomatic TDH 7-15% (autopsy studies)
- Overall, symptomatic TDH is only 1% of all spinal disc herniations

Thoracic Disc Herniations Clinical

- History
 - Variable clinical presentations
 - Axial pain
 - Radicular "bandlike" pain
 - Lower extremity weakness/myelopathy
 - SC:Canal ratio in thoracic spine 40%
 - SC:Canal ratio in lumbar spine only 25% 
- Physical
 - Usually normal exam

Thoracic Disc Herniations Clinical






Thoracic Disc Herniations Surgical Treatment

- Laminectomy
 - Poor results
 - Associated with 20 - 40% worsening neurologic status CTQ
 - Likely due to tenuous blood supply

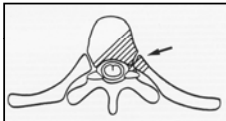
Love, J Neurosurg 1950

Thoracic Disc Herniations Clinical

Thoracic Disc Herniations Surgical Treatment

- Preferred surgical approach
- Transthoracic
- Costrotransversectomy (above T5)
- Lateral extracavitary




Transthoracic Approach:
Discectomy
Partial corpectomy

Thoracic Disc Herniations Treatment

- Indications for surgery
 - Leg weakness
 - Bowel/bladder
 - Myelopathy
 - Refractory radicular pain

Lumbar Degenerative Disc Disease (LDDD) Epidemiology

- Lifetime incidence 60-90%. CTQ
- 90% resolve spontaneously.
- Peak incidence approx. 40 years.



Lumbar Degenerative Disc Disease Epidemiology

- Radiographic evidence increases with age.
- LBP and radiographic evidence of LDDD do NOT correlate.
- LDDD begins in 2nd decade of life.

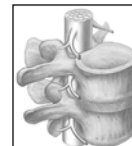


CTQ

CTQ

Lumbar Degenerative Disc Disease Disc Anatomy/Physiology

- Functional spine unit:
 - 2 adjacent vertebral bodies
 - Intervertebral disc.
- Anterior elements bear 90% of forces in sitting, 80% during standing.



Lumbar Degenerative Disc Disease Risk Factors

- Association between smoking and DDD.
- Likely secondary to vasoconstrictive and atherosclerotic effects of nicotine.
- Industrial vibrations.

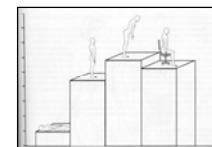


CTQ

CTQ

Lumbar Degenerative Disc Disease Disc Anatomy/Physiology

- Intradiscal pressure lowest in supine position with appropriate pillow support.
- Highest when standing and leaning forward.



CTQ

CTQ

Nachemson, Clin Orthop, 1966

Lumbar Degenerative Disc Disease Risk Factors

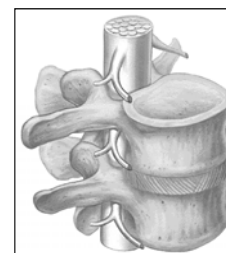
- Prolonged driving.
- Human spine has a resonance frequency of 5Hz, nearly identical to dominant frequency in many vehicles.



CTQ

Lumbar Degenerative Disc Disease Anatomic Changes

- Kirkaldy-Willis has described 3 anatomic phases.
- Comprises a continuum with gradual transition.

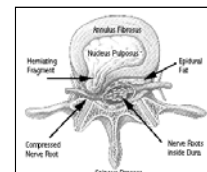


Lumbar Degenerative Disc Disease Anatomic Changes

- Phase 1 – Dysfunctional phase.
 - Biochemical changes in aggregating proteoglycans.
 - Circumferential tears or fissures in outer annulus.

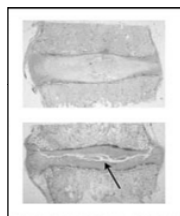
Lumbar Degenerative Disc Disease Anatomic Changes

- Phase 2 – Unstable Phase
 - Facet joint/capsular laxity, subluxation.
 - Segmental instability.
 - Disc herniation.
 - Pain.



Lumbar Degenerative Disc Disease Anatomic Changes

- Phase 1 – Dysfunctional phase.
 - Radial tears.
 - Pain.
 - Most common levels are L4-5 and L5-S1.



Lumbar Degenerative Disc Disease Anatomic Changes

- Phase 3 – Final/Stabilization Phase
 - Further disc resorption.
 - Endplate destruction, osteophyte formation.
 - Less pain.



Lumbar Degenerative Disc Disease Anatomic Changes

- Phase 2 – Unstable Phase
 - Progressive loss of mechanical integrity.
 - Multiple annular tears (radial, circumferential).
 - Loss of disc-space height.



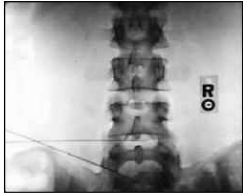
Lumbar Degenerative Disc Disease Clinical

- Waddell's Signs
 - Tenderness: Pain with light touch
 - Simulation: Pain with light axial loading, pelvic rotation
 - Distraction: Negative sitting, Positive supine SLR testing
 - Regional: Nonanatomic complaints
 - Overreaction
- Used to evaluate psychologic component
- >2 suggestive of malingering, secondary gain, or psych component



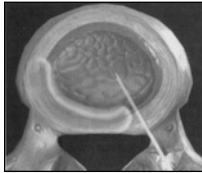
Management of Lumbar Degenerative Disc Disease Discography

- Controversial.
- Indications:
 - Failed conservative therapy.
 - Diagnostic tests inconclusive.
 - Verification of levels to be fused.



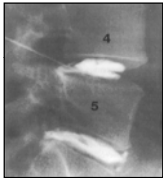
Management of Lumbar Degenerative Disc Disease Intradiscal Electrothermal Treatment (IDET)

- Most studies show improvement in 50-75% of patients.
- No long term outcomes.




Management of Lumbar Degenerative Disc Disease Discography

- Provocative testing of concordant pain.
- Key is patient's response, not disc appearance.



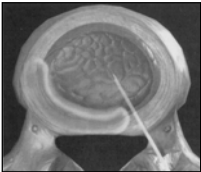
Management of Lumbar Degenerative Disc Disease Operative Intervention - Fusion

- Remains controversial.
- No prospective, randomized, blind study demonstrating superiority of any surgical approach or technique.




Management of Lumbar Degenerative Disc Disease Intradiscal Electrothermal Treatment (IDET)

- Postulated mechanisms:
 - Destruction of nociceptive nerve endings by heat energy.
 - Modulation of collagen.
- Overall, mixed results.



Spinal Stenosis Etiology

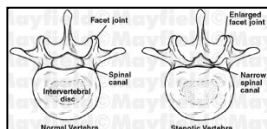
- **Primary stenosis**
 - Congenital
 - Spinal dysraphism
 - Osteopetrosis
 - Uncommon
- **Secondary (Acquired)**
 - Degenerative
 - Iatrogenic
 - Systemic (neoplasm, AS)
 - Trauma



Spinal Stenosis Causes

■ **Degenerative Process**

- Disc bulge or herniation
- Facet hypertrophy
- Osteophyte formation
- Instability



Spinal Stenosis Diagnosis

■ **History and Physical Exam.**

- **X-rays** – Always the first study.
- **MRI** – The best tool to diagnose spinal stenosis.
- **CT Scan/myelogram** – Good alternative if unable to have an MRI.

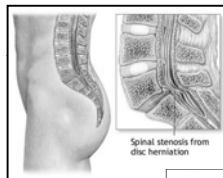


Spinal Stenosis Symptoms

■ **Narrowing + inflammation causes symptoms**

CTQ

- Pain
- Numbness
- Weakness



Spinal Stenosis Non-Surgical Treatment

- Physical therapy
- Medications
- Epidural steroid injections
 - Efficacy not yet established
 - 60-80% report relief
 - 25% long term relief



Schonstrom, Spine 1985

Spinal Stenosis Symptoms

■ **Neurogenic claudication**

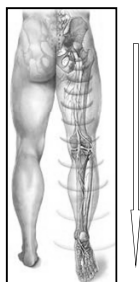
- Radiates from proximal to distal
- Alleviated by flexing forward

CTQ

■ **Vascular claudication**

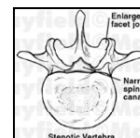
- Radiates retrograde
- Alleviated by stopping

CTQ



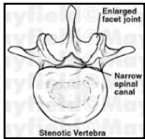
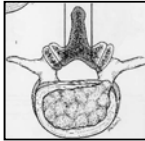
Spinal Stenosis Surgical Treatment

- **Diagnosis dependent.**



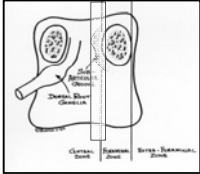
Spinal Stenosis Surgical Treatment

- Diagnosis dependent.
- Laminectomy is procedure of choice for uncomplicated central stenosis.

Lumbar Foraminal Stenosis Three Zones


- **Entrance Zone**
 - Subarticular area
 - "Lateral recess"
 - Medial to pedicle and SAP
 - **Symptoms with:**
 - SAP hypertrophy
 - HNP



Lee, Spine 1980.

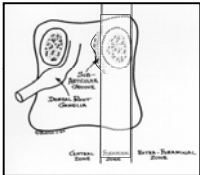
Spinal Stenosis Surgical Treatment

- Spinal stenosis + spondylolistheses
- Laminectomy
- PSF CTQ



Lumbar Foraminal Stenosis Three Zones


- **Mid Zone**
 - "Foraminal" stenosis
 - Underneath the pars and below pedicle
 - **Symptoms with:**
 - Fibrocartilaginous hypertrophy of a pars defect



Lee, Spine 1980.

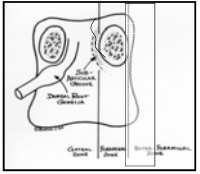
Lumbar Foraminal Stenosis

- **Foramen**
 - Openings through which spinal nerves exit.
 - In lumbar spine, nerve exists **BELOW** numbered pedicle. CTQ




Lumbar Foraminal Stenosis Three Zones

- **Exit-zone**
 - Intraforaminal
 - Nerve lies closest to the SAP when exiting the foramen CTQ
 - **Symptoms from:**
 - Foraminal HNP, instability, scoliosis




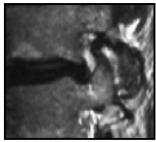
Lee, Spine 1980.

**Lumbar Spinal Stenosis
Foraminal Stenosis**


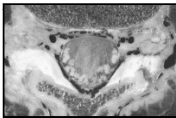


**Lumbar Spinal Stenosis
Foraminal Stenosis**

- Superior Articular Facet Syndrome (SAF)
- Segmental degeneration and dysfunction
- SAP rides up into the foraminal zone

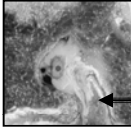
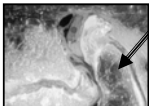



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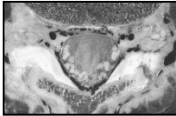
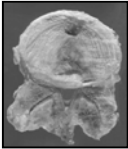



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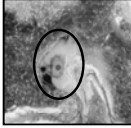
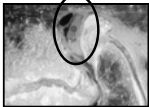



**Lumbar Spinal Stenosis
Foraminal Stenosis**

**Lumbar Spinal Stenosis
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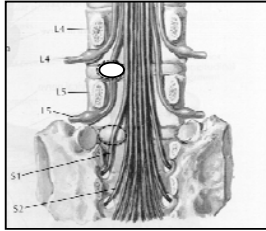
DRG flattened by hypertrophied ligamentum

Lumbar Disc Herniation Epidemiology

- Most commonly at L4-5
- Posterolateral HNP most common (PLL is weakest) CTQ

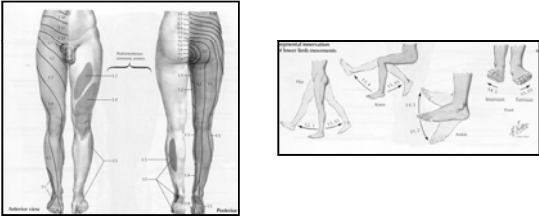
Lumbar Disc Herniation Clinical

- At L4-5:
 - PL disc herniation affects L5 nerve. CTQ
 - Far lateral HNP affects L4 nerve.



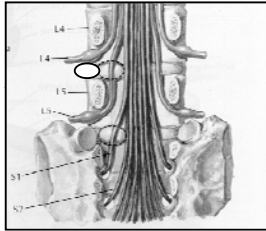
Lumbar Disc Herniation Clinical

YOU MUST KNOW THIS !!!



Lumbar Disc Herniation Clinical


- At L4-5:
 - PL disc herniation affects L5 nerve.
 - Far lateral HNP affects L4 nerve. CTQ




Lumbar Disc Herniation Clinical

- Tension signs
 - Straight leg raise (L4-5, L5-1)
 - Femoral nerve stretch (L2-3, L3-4)
 - Contralateral SLR – Most specific for HNP CTQ

Lumbar Disc Herniation Clinical

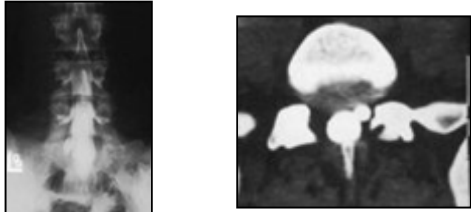


Far lateral HNP



Posterolateral HNP

Lumbar Disc Herniation Clinical



CT myelogram demonstrating
L5-S1 posterolateral HNP


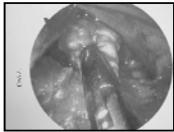
Spondylolisthesis Wiltse Classification

- **Dysplastic (Congenital)**
 - High rate of spina bifida
 - High rate of nerve entrapment

CTQ

Lumbar Disc Herniation Surgical Treatment

- Laminotomy with discectomy
 - Initial results excellent
 - Many patients develop chronic LBP in long term f/u
- Recurrent HNP
 - Fusion ?

Spondylolisthesis Wiltse Classification

- **Isthmic**
 - Early in life
 - Most common at L5-S1
 - Causes L5 radiculopathy (S1 with HNP)
 - Pars defect
 - Elongated
 - Lytic (spondylolysis)
 - Acutely fractured (repeated stress under hyperextension)
 - Note: Unilateral spondylolysis may not lead to slippage.

CTQ

Spondylolisthesis Wiltse Classification

- Dysplastic (Congenital)
- Isthmic
- Degenerative
- Traumatic
- Pathologic

Spondylolisthesis Wiltse Classification

- **Degenerative**
 - Late in life
 - Most common at L4-5
 - L5 nerve usually compressed
 - Females > males
- **Traumatic**
 - Any age
- **Pathologic**

CTQ

Spondylolisthesis Meyerding (1932) Grading

- **Grade 1:** less than 25%
- **Grade 2:** 25 - 50%
- **Grade 3:** 50 - 75%
- **Grade 4:** 75 - 100%
- **Spondyloptosis:** greater than 100%

Spondylolisthesis Diagnosis

- **Xrays**
 - Oblique projection
 - Flexion-Extension
- **SPECT**
 - Best for diagnosing isthmic type
- **CT**

CT Scan: Bilateral pars fractures

Spondylolisthesis Diagnosis

- **Xrays**
 - Oblique projection
 - Flexion-Extension
- **SPECT**
 - Best for diagnosing isthmic type
- **CT**

Spondylolisthesis Sacral Inclination

- Angle formed between :
 - Posterior sacral border
 - Vertical line perpendicular to the floor.

Wiltse, JBJS, 1983.

Spondylolisthesis Diagnosis

- **Xrays**
 - Oblique projection
 - Flexion-Extension
- **SPECT**
 - Best for diagnosing isthmic type
- **CT**

SPECT: Bilateral L5 pars fractures

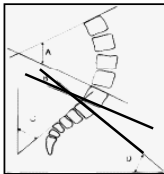
Spondylolisthesis Sacrohorizontal Line

- Sacral 'tilt'. Angle formed between:
 - Cranial border of S1
 - Horizontal line perpendicular to the floor

Wiltse, JBJS, 1983.



Spondylolisthesis Slip Angle

- Angle formed between:
 - Inferior endplate of L5
 - Cranial border of S1



Wiltse, JBJS, 1983.

Spondylolisthesis Surgical Treatment

Pre-op: Grade II/III L5-S1 slip

Post-op: L4-S1 PSF

Spondylolisthesis Indications for Surgery

- Neurologic signs unresponsive to conservative measures
- Slip > 50%

Spondylolisthesis Surgical Treatment

- Slip reduction
 - Improves standing posture
 - Provides anterior column support
 - Lowers non-union rate
 - 5-30% rate of nerve injury (L5 root for L5-S1 slip)

CTQ

Spondylolisthesis Surgical Treatment

- Posterolateral fusion
 - Low grade L5-1 → Fuse L5-S1
 - High grade → Fuse L4-S1
 - +/- Interbody graft

CTQ

Thank You.