Lumbar Spondylolisthesis and Spondyloarthropathies

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Lumbar Spondylolisthesis
Definitions

- **spondylosis:**
  - any of various degenerative diseases of the spine

- **spondylolysis:**
  - defect in the pars interarticularis

- **spondylolisthesis:**
  - anterior subluxation of one vertebral
The Pars Interarticularis...

“the portion of the neural arch that connects the lamina with the pedicle, facet joints, and transverse process”
Grading of Spondylolisthesis

- Meyerding:
  - Grade 1 is 0-25%
  - Grade 2 is 25-50%
  - Grade 3 is 50-75%
  - Grade 4 is 75-100%

- Wiltse

**FIGURE 295-9.** The ratio of vertebral displacement to maximal sacral width ($a/A$) can be easily calculated and reported as slip percentage. The posterior osteophytes of L5 are excluded from line a, whereas line A is defined as parallel to the superior end plate of the sacrum. Slip percentage = $a/A \times 100$. 
Lumbosacral angles
Overview

Classification of Spondylolisthesis:

- congenital
- isthmic
- degenerative
- traumatic
- pathologic
- postoperative
Congenital Spondylolisthesis

- failure of posterior elements thought to be of primary consideration
- hypothesized that facet joint dysplasia contributes to congenital spondylolisthesis
  - sagittal vs coronal orientation
- secondary elongation of pars interarticularis with slippage of vertebral bodies
Congenital Spondylolisthesis

- usually occurs before age 20
- may be associated with spina bifida
- if pars is intact and no spina bifida present, this can result in severe spinal stenosis
- high association with scoliosis
Isthmic Spondylolisthesis

• Classification of isthmic spondylolisthesis
  • Subtype A: classic lytic lesion of the pars indicative of a stress fracture
  • Subtype B: elongated but intact isthmus
  • Subtype C: acute fracture of pars interarticularis
  • most commonly at the L5-S1 level
Isthmic Spondylolisthesis

• up to 1/3 are considered to be congenital
  • spina bifida of the sacrum
  • hypoplasia of superior articular facet of the sacrum
  • bilateral (and rarely unilateral) pars defects

• sports related injuries cause progression of fractures (hyperextension mechanism)

• fibrocartilage may form during healing process of fracture = nerve root compression
Isthmic Spondylolisthesis

- Clinical features
  - onset in childhood but patient presents later in life
  - there is usually a precipitating event
  - pain is the typical presenting symptom
    - localized to lumbar area with radiation to buttocks and posterior thighs
    - weight bearing and lifting exacerbate the pain
    - +/- radicular pain from L5 nerve root compression
Isthmic Spondylolisthesis

• Clinical features
  • may feel “step deformity” - L4 neural arch slides anteriorly with the L5 vertebral body
  • if >50% subluxation, may also see lumbosacral kyphosis
  • attempts to maintain sagittal balance by hyperextension through lumbar spine and rotation of pelvis so that sacrum is vertical
Isthmic Spondylolisthesis

• Radiographic features:
  • “Scotty the dog” finding on oblique radiographs
  • Nose: the costal/transverse process
  • Ear: the superior facet
  • Neck: the pars interarticularis
  • Collar: the pars defect (dark on x-ray)
  • Eye: the pedicle seen end on
  • Body: the lamina
  • Hind foot: the spinous process
  • Tail: if pointing straight up superior articular facet and if pointing horizontally is the transverse process of the opposite side
  • Forefoot: the inferior articular process.
Isthmic Spondylolisthesis

- Non-surgical Management
  - analgesics
  - bracing
  - physiotherapy
- Surgical management dependent on the degree of spondylolisthesis and neurological compromise
Isthmic Spondylolisthesis

• Criteria for surgical intervention
  • persistent pain or neurological compromise despite adequate conservative management
  • progression of slip >30%
  • presentation with > grade II slip
  • cosmetic deformity secondary to postural and gait difficulty
Isthmic Spondylolisthesis

- Surgical decompression
  - useful for relief of neurological compromise in ADULTS
  - for children, may in fact cause progression of slip - fusion in situ is more effective!
Isthmic Spondylolisthesis

- Fusion procedures:
  - reduction is not recommended; 20% risk of post reduction neurological injury
  - in situ stabilization is best
  - in children, wires may be used to fixate segment
Degenerative Spondylolisthesis

- Degenerative disc disease commonly leads to spondylolisthesis without spondylolysis.
- Develops as a result of facet arthritis and facet remodeling taking on a more sagittal orientation.
  - Not associated with a neural arch defect.
- Most slips are asymptomatic.
Degenerative Spondylolisthesis

- **Pathogenesis**
  - disc degeneration leading to settling of spinal segment
  - buckling of ligamentum flavum and “microinstability”
  - facet joint anatomy allows for slip
  - followed by spur formation, subchondral sclerosis, hypertrophy of ligaments and hypertrophy of facets.
Degenerative Spondylolisthesis

- Symptoms
  - Radiculopathy (either unilateral or bilateral radiculopathy) by compression of nerve root in lateral recess or foramen
  - +/- mechanical low back pain
  - Neurogenic claudication associated with lumbar spinal stenosis

- usually after age 50

- Levels involved
  - Commonly L4-5
  - Occasionally seen at L3-4
  - Rarely seen at L5-S1

- MRI studies do not support hypothesis that there is motion with flexion/extension in the setting of degenerative spondylolisthesis
Degenerative Spondylolisthesis

- Deficiency of coronal plane portion of facet joints by damage or degenerative disease causing the upper vertebra to slip forward

- Adjacent levels may develop compensatory hyperlordosis with retrolisthesis and contribute to symptoms
Natural History

- of 145 patients with degenerative spondylolisthesis, progression of slip occurred in ~30%
- 76% of patient INITIALLY neurologically intact remained asymptomatic
- if symptomatic 83% went on to have worsening of symptoms
Degenerative Spondylolisthesis

- Indications for surgery
  - persistent or recurrent back and or leg pain or neurogenic claudication despite adequate conservative management
  - progressive neurological deficit
  - bladder or bowel dysfunction
Surgical Management

• mainstay of surgical treatment = DECOMPRESSION

• no consensus about indications for fusion or instrumentation

• goal of fusion: to relieve back pain by eliminating “instability”

• goal of instrumentation: to help with fusion and correct kyphotic deformity

• studies would suggest that instrumentation certainly increases rate of fusion...but ? correlation with patient outcome?
Surgical Management

• ALIF found to be quite useful in younger patients with spondylolisthesis
  • restoration of disc height and reduced nerve compression
  • indirect reduction
  • may not be as useful if osteophytes are present
Surgical Management

• Need for reduction
  • high risk
  • no clear difference in patient outcome with reduction of listhesis
  • however, may improve sagittal balance
Recommendations

- Instrumented fusion if disc height >2mm
- Instrumented fusion if there is kyphotic deformity
- >5mm of motion with flexion/extension warrants instrumentation to achieve fusion
- If listhesis >50%, fusion is warranted
- If decompression requires removal of >50% of facets bilaterally, will require instrumented fusion
- Unclear with reduction is necessary
- Consider anterior interbody fusion where there is >50% listhesis or severe kyphotic deformity
Traumatic Spondylolisthesis

- Traumatic spondylolisthesis is very rare and may be associated with acute fracture of the inferior facets or pars interarticularis
- Acute traumatic spondylosis with spondylolesthesis associated with major trauma
- Probably caused by hyperextension
- Patient presenting with new fracture of the pars interarticularis may have delayed slip months to years later as the disc degenerates under shear loads
Pathologic Spondylolisthesis

- This type can occur following damage to the posterior elements from metastases or metabolic bone disease
- Damage to the pars interarticularis
- Damage more commonly to the pedicle in patients with infections or tumors of the vertebral body
- These slips have also been reported in cases of
  - Infection
  - Paget’s disease
  - Syphilis
  - Albers-Schonberg disease (osteopetrosis)
  - Tuberculosis
  - Giant-cell tumors
Postoperative Spondylolisthesis

- Caused by surgical damage to the facet joint, disk, or pars interarticularis
- Slippage is usually low-grade and very symptomatic
- May progress to 50% of the anterior-posterior diameter of the vertebral body
- ~10% occurrence of post laminectomy spondylolisthesis
- does not occur following discectomy procedures
Postoperative Spondylolisthesis

- Four categories of postsurgical spondylolisthesis and spondylolysis

1. Spondylolisthesis after laminectomy with partial or complete facetectomy for spinal stenosis
   - Risk of slippage increased if displaced on standing flexion extension radiographs is greater than 1.2 mm (0.2 mm in normal patients)
   - Risk increases with number of levels of radical decompression

2. Spondylolisthesis after diskectomy and partial facetectomy
Postoperative Spondylolisthesis

3. Spondylolysis and recurrent disc herniation after diskectomy

4. Spondylolysis after fusion at an adjacent level or coextensive with a previous fusion as part of a pseudoarthrosis
   
   • Spondylolysis acquisita
   
   • Degenerative spondylolisthesis
Spondyloarthropathies
Ankylosing Spondylitis

- chronic inflammatory disease involving synovial and cartilaginous joints
- variable symptomatic course and progressive involvement of the sacroiliac and axial skeletal joints
- seronegative spondyloarthritis
- characterized by enthesopathy, axial skeletal disease, HLA-B27 absence of rheumatoid nodule or rheumatoid factor in the serum
- affects 1% of Caucasians
Ankylosing Spondylitis

- pathogenesis is unknown
- synovitis of joints and enthesitis of tendon attachments
- also characterized by ankylosis of joints and ossification of ligaments surrounding the vertebrae
Ankylosing Spondylitis

- Physical exam:
  - flattening of lumbar spine and loss of lordosis
  - motion limited in hyperextension and lateral bending
  - percussion over sacroiliac joints elicits pain
  - Schobers test, lateral bending, thoracic costovertebral motion monitor progression of disease
Ankylosing Spondylitis

- Laboratory investigations
  - ESR and CRP may be elevated
  - ANA and rheumatoid factor are characteristically absent
  - HLA-B27 testing is positive in 90% of patients with AS
Ankylosing Spondylitis

• Radiographic findings:
  • areas of spine most affected are sacroilia, discovertebral, and costovertebral joints
  • disease ascends from the sacroiliac spine
  • sacroiliitis is bilateral and symmetric in the setting of AS
  • in the final stages, complete obliteration of the joint is observed
Ankylosing Spondylitis

• Spinal fractures:
  • loss of normal flexibility of the spine occurs due to ankylosis
  • brittle spine is prone to fracture
  • most common location of fracture = lower cervical spine
  • identification of fractures complicated by chronic pain
  • atlantoaxial involvement is less common than in patients with RA
Ankylosing Spondylitis

• Non surgical management
  • physiotherapy
  • NSAIDS
• disease modifying drugs eg. TNF inhibitors (etanercept, infliximab)
Ankylosing Spondylitis

• Indications for surgery
  • severe deformity that impedes vision, walking, eating
  • spinal instability related to spondylodiscitis or spinal fracture

• Considerations:
  • bone mineral density is frequently DIMINISHED
  • these patients generally have less reserve and more likely to develop postoperative complications
Ankylosing Spondylitis

• Fractures and Angular deformity
  • fractures are usually transverse in nature and may involve ossified ligaments = instability
  • patients also prone to cervicothoracic kyphosis and kyphosis at any other level
  • require multi-level osteotomies and instrumentation
  • poor bone quality may necessitate anterior-posterior procedures
Rheumatoid Arthritis

• chronic systemic inflammatory disease that causes pain, heat, swelling and destruction of synovial joints

• characteristically involves hands, feet, wrists, elbows, hips, knees, ankles and cervical spine

• diagnosis based on clinical presentation and presence of rheumatoid factor in serum

• pathogenesis is unknown
Rheumatoid Arthritis

- Physical exam
  - joint pain, heat, swelling, tenderness
  - joint involvement is additive and symmetric
  - joints involved include: proximal interphalangeal, carpal-metacarpal, wrist, elbow, hip, knee, ankle and metatarsophalangeal joints
  - cervical spine affected 40-80% of time
Rheumatoid Arthritis

- Cervical subluxation
  - involvement of C1-C2 joint
    - present with neck pain and occipital pain
    - may have sensation of head falling forward with flexion
    - loss of consciousness, incontinence, dysphagia, nvertigo, hemiplegia, dysarthria, nystagmus or peripheral paresthesias.
Rheumatoid Arthritis

• Non-surgical management
  • physical therapy
  • NSAIDS
  • disease modifying drugs (sulfasalazine, hydroxychloroquine)
  • corticosteroids
  • immunosuppressive agents (methotrexate)
Rheumatoid Arthritis

• Surgical considerations
  • treatment is controversial
  • 33% of patients with RA develop myelopathy
  • treatment of neurological dysfunction vs 15% mortality rate and 50% rate of fusion
Rheumatoid Arthritis

• Indications
  • intractable pain
  • neurological deficits
  • vertebral artery compromise
  • spinal cord compression
Rheumatoid Arthritis

• Posterior arthrodesis for reducible atlantoaxial subluxations
  • excessive pannus resection not required

• Irreducible subluxations may require transoral approach and posterior fusion

• cranial settling requires traction followed by transoral approach and posterior fixation
Rheumatoid Arthritis

- techniques for C1-C2 stabilization:
  - Brooks fusion
  - transarticular screws
  - occiptal-cervical arthrodesis