

# Lumbar Spondylolisthesis and Spondyloarthropathies

Presented by Dr. Perry Dhaliwal, PGY-3  
Neurosurgery Teaching Rounds  
University of Calgary  
March 27th, 2009

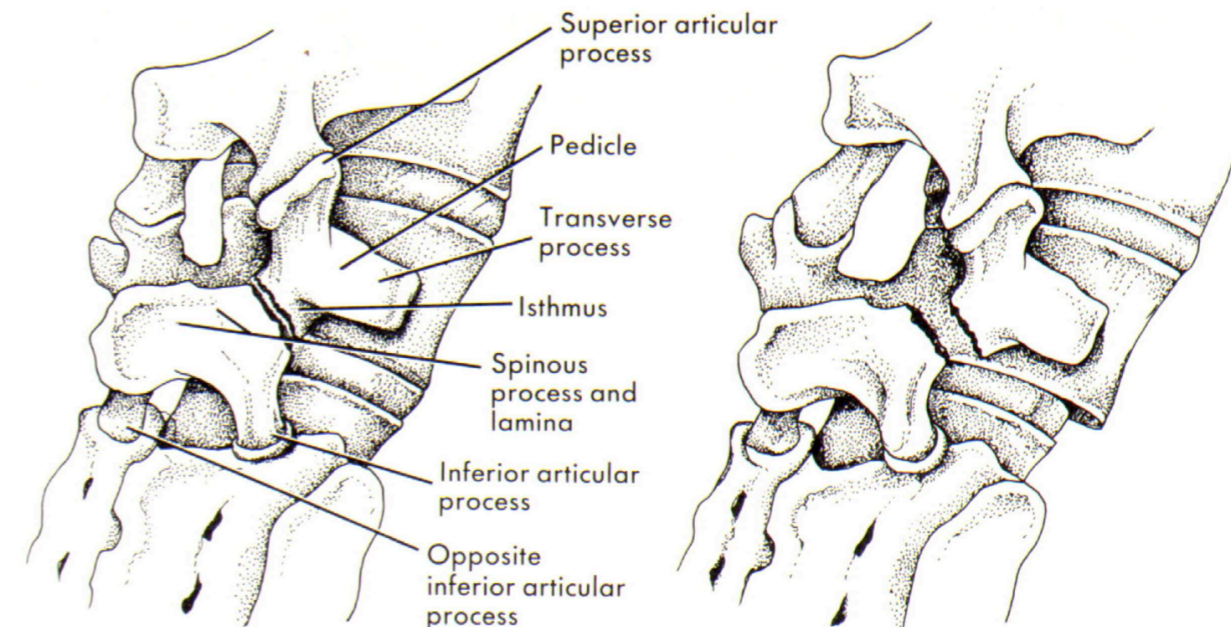
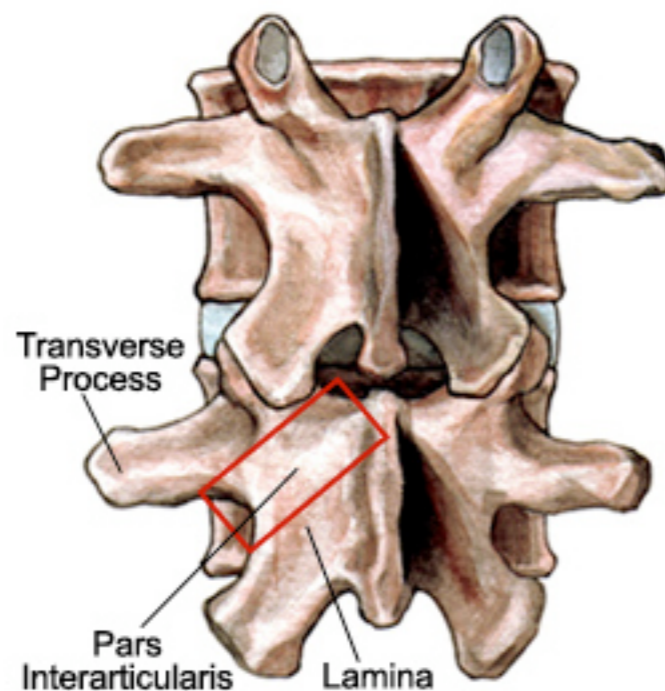
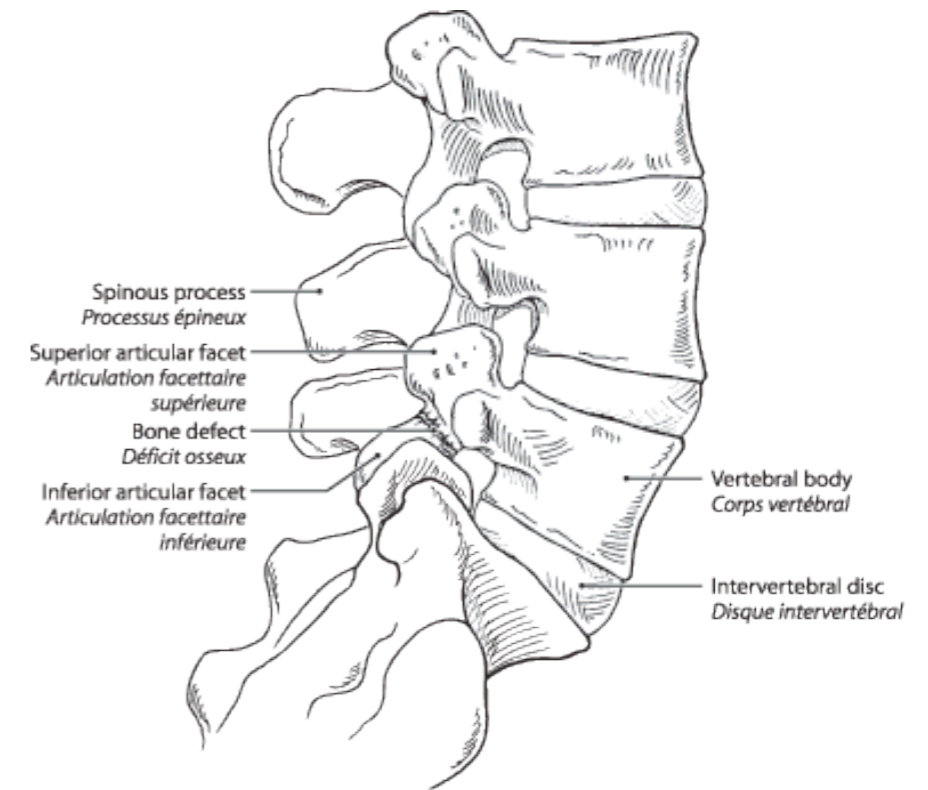
# Lumbar Spondylolisthesis

# 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

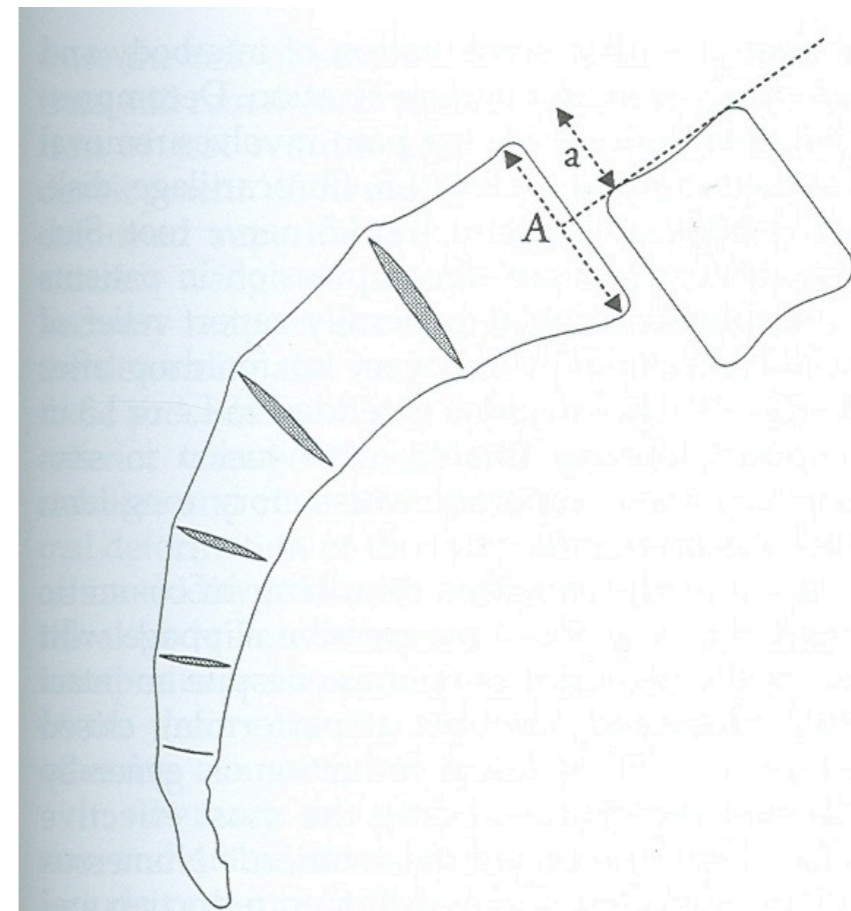
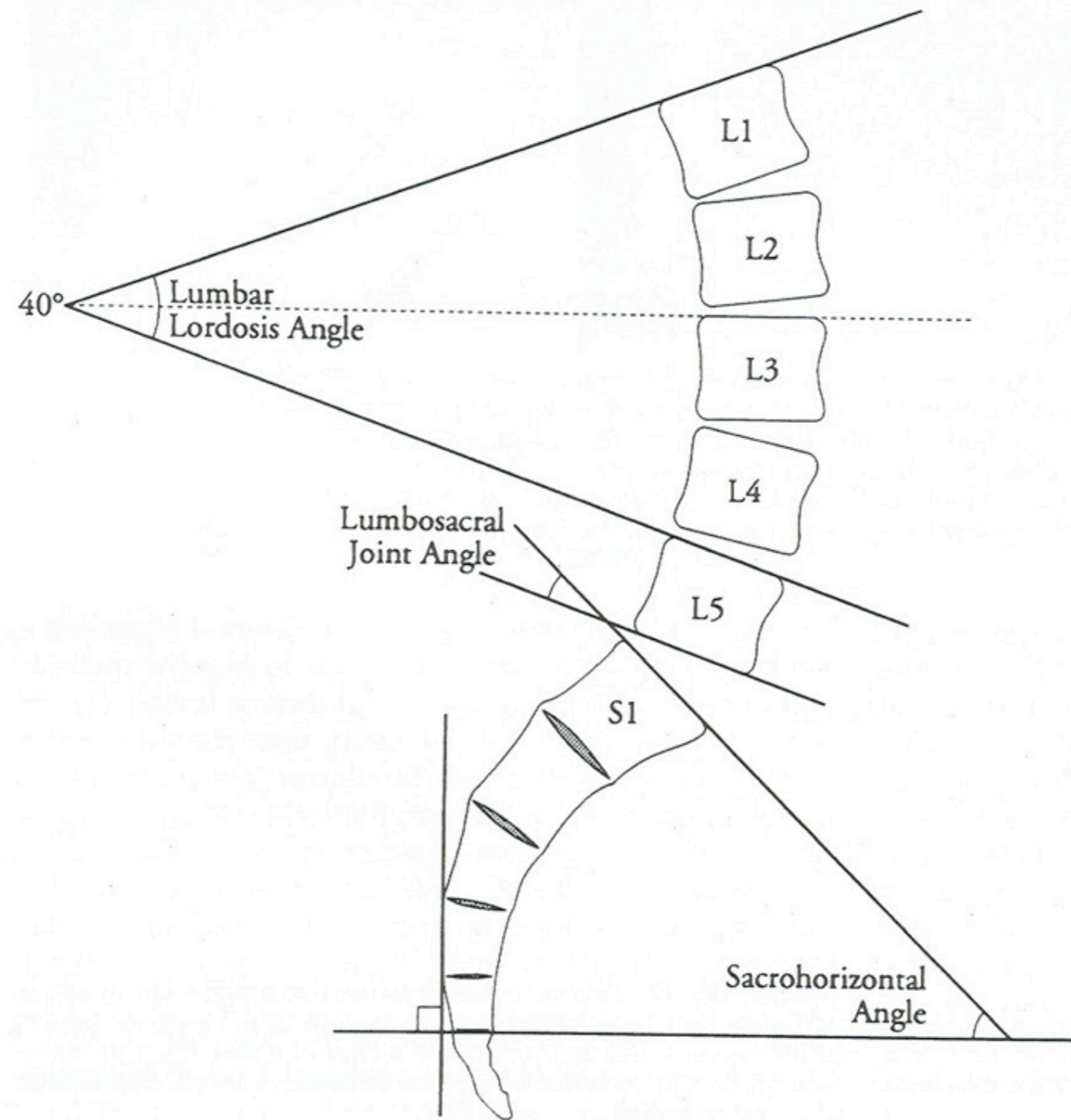


FIGURE 295-9. The ratio of vertebral displacement to maximal sacral width ( $a/A$ ) can be easily calculated and reported as *slip percentage*. The posterior osteophytes of L5 are excluded from line  $a$ , whereas line  $A$  is defined as parallel to the superior end plate of the sacrum. Slip percentage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

# 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

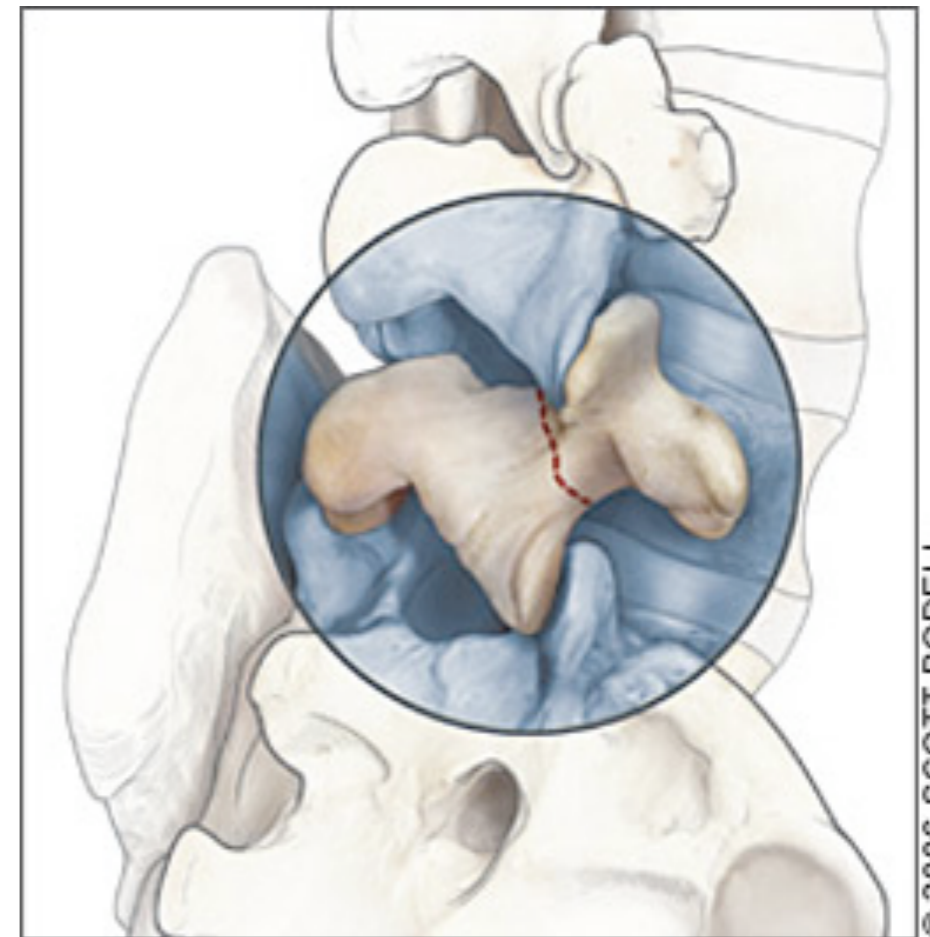
- Clinical features
  - onset in childhood but patient presents later in life
  - there is usually a precipitating event
  - pain is the typical presenting symptom
    - localized to lumbar area with radiation to buttocks and posterior thighs
    - weight bearing and lifting exacerbate the pain
    -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

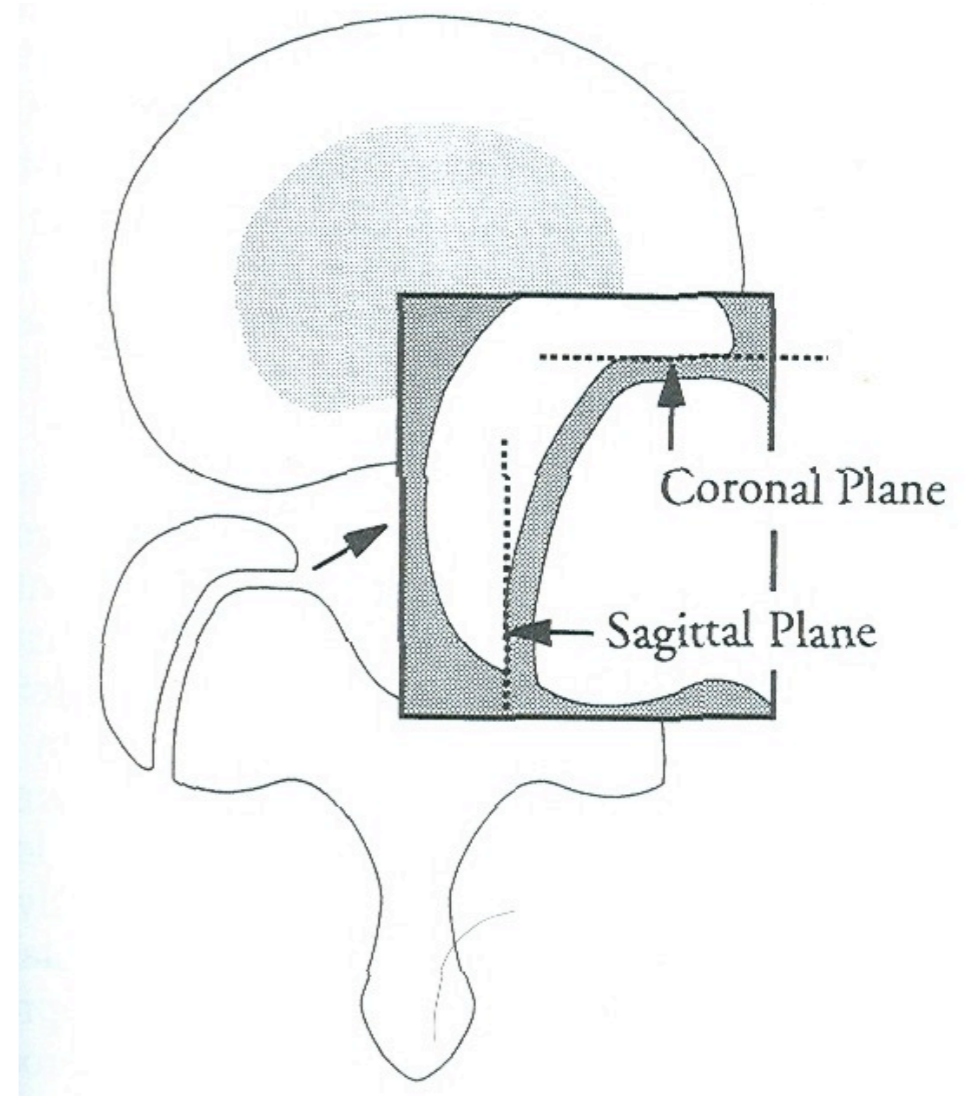
- Levels involved

- **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 spondylolithesis, 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  $>2\text{mm}$
- instrumented fusion if there is kyphotic deformity
- $>5\text{mm}$  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 discectomy
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 occiptial 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
  - occipital-cervical arthrodesis