Lumbar Spondylolisthesis

Moderators – Dr S.S. Kale
Dr Deepak Agrawal

Presentation by – Dr Vipin K. Gupta
Q1. Spondylolysis is

1. Unilateral defect in pars interarticularis without vertebral slippage
2. Bilateral defect in pars interarticularis without vertebral slippage
3. Unilateral defect in pars interarticularis with vertebral slippage
4. Bilateral defect in pars interarticularis with vertebral slippage
Q2. Spondyloptosis is

1. Slippage of the L5 vertebra in which the entire vertebral body of L5 is located below the top of S1

2. Slippage of the L5 vertebra in which 75% of the vertebral body of L5 is located below the top of S1

3. Slippage of the L5 vertebra in which 50% of the vertebral body of L5 is located below the top of S1

4. Slippage of the L5 vertebra in which 25% of the vertebral body of L5 is located below the top of S1
Q3. Dysplastic type of Spondylolisthesis is

1. Acquired
2. Traumatic
3. Pathologic
4. Developmental
Q4. The incidence of Spondylolisthesis is approximately

1. 1% in all adults
2. 3% in all adults
3. 6% in all adults and constant
4. 8% in all adults and increases by 1% for every decade of life
Q5. The “Scottie dog” appearance of posterior spinal elements on X-ray in Spondylolysis is best seen in

1. AP view
2. Lateral view standing
3. Oblique view
4. Lateral view supine
Q6. The options for treatment of Spondylolysis in children are

1. Intertransverse (Lateral) fusion
2. Direct repair of pars interarticularis
3. Non-operative treatment
4. All of the above
Q7. Best fusion rates are achieved in listhesis with

1. Posterior-lateral fusion without implants
2. Posterior-lateral fusion with implants
3. Circumferential fusions (including Interbody fusions)
4. No difference in fusion rates in all procedures
Q8. Degenerative listhesis occurs most frequently at

1. L5-S1
2. L4-L5
3. L3-L4
4. L4-L5 and L5-S1 occur with the same frequency
Q9. Non-spinal disorders which can mimic the signs and symptoms of degenerative listhesis are all except

1. Degenerative arthritis of Unilateral Hip joint
2. Degenerative arthritis of Bilateral Hip joint
3. Peripheral vascular disease
4. All of the above
Q10. In a patient with degenerative Grade II L4/L5 listhesis with persistent leg pain, progressive neurological deficit, and significant reduction in quality of life, the treatment of choice is

1. Decompression
2. Decompression and posterior fusion without instrumentation
3. Decompression and posterior fusion with instrumentation
4. Decompression and posterior fusion with instrumentation with interbody fusion
Spondylolisthesis

- Anterior subluxation of one vertebral body on another
- Usually L5 on S1, occasionally L4 on L5
- Degenerative: L4 on L5, then L4-3, and L5-S1
History

- Herbineaux, Belgian obstetrician in 1782
- Kilian 1854 - Spondylolisthesis

  *spondylos* (vertebra) and *olisthanein* (to slip)

- 1950, Macnab – spondylolisthesis with an intact neural arch
- 1955, Newman – degenerative spondylolisthesis
- 1976, Wiltse et al – classification
Spondylolysis Vs Spondylolisthesis
Frequency

- Isthmic type in 5% based on autopsy study
- Degenerative spondylolisthesis in 5.8% of men and 9.1% of women
- Isthmic type most common in males and degenerative most common in females
- Racial: spondylolysis seen in up to 50% of Eskimos
ANATOMY

- Facet joint in coronal plane -
  - Inferior articular process (upper vertebra) located posteriorly
  - Superior articular process (lower body) located anteriorly.
- Prevents forward movement
- Locks in the superior vertebra relative to the inferior vertebra

![Diagram of spinal anatomy](image-url)
Anatomy

- Articular Processes
  - Orientation of articular processes critical for spinal motion
- Lumbar facets are biplanar
  - General orientation is 45 deg from sagittal or frontal plane
  - 90 deg from transverse plane
- Anterior aspect in frontal plane
  - Resists anterior shear
- Posterior aspect in sagittal plane
  - Resists rotation
Center of gravity of the human body is anterior to the spine - exerts a forward slipping force on the spine, especially at the L5-S1 level

Anteriorly located center of gravity causes a rotating movement, with the axis of rotation oriented transversely at the L5-S1 level

- In severe spondylolisthesis, a kyphotic deformity also develops
Resistance to Listhesis

- Pair of pars joints
- Intact posterior neural arch
- Pedicle
- Normal bone resilience preventing stretch of the pedicle
- Intervertebral disc binding the vertebral bodies
- And the ligaments and muscles
Classification

- Wiltse Classification – etiology based
- Marchetti – Bartolozzi classification
Wiltse Classification

I. Dysplastic (congenital)

II. Isthmic
   - A. Lytic-fatigue fracture of the pars.
   - B. Elongated but intact pars.
   - C. Acute fracture of pars (not to be confused with "traumatic" [see IV]).

III. Degenerative (pseudospondylolisthesis)

IV. Post Traumatic (fracture of the bony hooks other then pars)

V. Pathologic

Classification based on etiology but it does not predict prognosis and likelihood of progression
## Marchetti – Bartolozzi Classification

### Table 1: Marchetti and Bartolozzi classification for spondylolisthesis

<table>
<thead>
<tr>
<th>Acquired Traumatic</th>
<th>Developmental High Dysplastic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Fracture</td>
<td>With Lysis</td>
</tr>
<tr>
<td>Stress Fracture</td>
<td>With Elongation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Post Surgical</th>
<th>Low Dysplastic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td>With Lysis</td>
</tr>
<tr>
<td>Indirect</td>
<td>With Elongation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pathologic</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td></td>
</tr>
<tr>
<td>Systemic</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Degenerative</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td></td>
</tr>
</tbody>
</table>
1. DEVELOPMENTAL (20%) : in children
   - DYSPLASTIC FEATURES PRESENT IN VERTEBRAE
   - POST.DEFECT-IN LAMINA, FACET, PARS
   - ANT.DEFECT-IN DISC, SACRAL DOME

2. ACQUIRED:
   - IN ADULTS
   - ARCHITECTURE OF VERTEBRAL ELEMENTS IS NORMAL
   - NOT AS PROGRESSIVE AS DYSPLASTIC
High Dysplastic
- Significant LS kyphosis
- Trapezoid L5 (wedge L5)
- Hypoplastic transverse processes
- Doming of sacrum
- Verticalisation of sacrum
- High chances of progression

Low dysplastic (only post. elements dysplastic)
- Normal LS profile
- Rectangular L5
- Flat upper end plate of sacrum
- No significant verticalisation
- Facets - axial or sagittal orientation
- A/W Spina bifida
Isthmic Spondylolisthesis

- Most common cause of spondylolisthesis
- Occurs in young people
- Affects *pars interarticularis* - the junction of the pedicle and lamina, where the articular and transverse processes arise

**CAUSE**
- Genetic (54% prevalence in Eskimos and 12% pts has first degree relative)
- Mechanical - High-risk activities include gymnastics (11%), rowing, tennis, wrestling, weightlifting, and football

*Isthmic defects are due to successive fatigue fractures in genetically predisposed individual.*
SUBTYPES OF ISTHMIC

- **Wiltse**
  1. **Subtype A**: fatigue fracture of pars w/o complete separation of bone
  2. **Subtype B**: elongated pars due to recurrent fracture and healing
  3. **Subtype C**: acute fracture of pars
Pathophysiology

- Physiologic response:
  1. Facet hypertrophy
  2. Healing around pars
     - Cartilage
     - Fibrous tissue
  3. Narrowing canal
  4. COMPRESSION!!
Degenerative Spondylolisthesis

- There is no defect in the pars.
- The posterior arch is intact.
- Slip is never great.
- Osteoarthritic changes develop in the facet joints.
- Erosive changes lead to abnormal alignment of the articular surfaces.
- Deficient coronal portions of the facet and narrow lamina.
- Abnormalities of the ligamentous structures and loss of disc height.
- Excessive mobility in lumbar motion segment (usually L4/L5) following degenerative changes.
Degenerative Spondylolisthesis

Found in:
- 5.8% of men
- 9.1% of women
- 3 times greater in African American women

Most are asymptomatic

Greater incidence in females:
- Ligamentous laxity
- Pregnancy
- Less lumbosacral lordosis
- Increased sacralization of L5

Asian population overall incidence is 8.7%

- Single level in 66%
- Multiple levels in 34%
- Anterolisthesis in 70% cases, which were predominant at L4–L5 in women
- Retrolisthesis was found in 30% predominant in L2–L3 and equal in both sexes

Primary symptoms are from:

- Lateral recess stenosis – from forward slippage of the inferior articulating process.

- Disc herniation – contributes to central stenosis caused by intact neural arch.

Nerve root below pedicle of subluxated vertebra is compressed.
Traumatic

- Rare
- A/W - major trauma ? hyperextension
  - pars is normal
  - fractures occur as a result of excessive force
  - Fracture of pedicle/facets
  - ligament and disc injury
  - Clearly defined edges after trauma
  - If x ray after trauma show spondylolysis and sclerotic margins than it is old
Pathological

- Alteration of bone tissue results in loss of ability of bony hook to maintain alignment
- 2 subtypes:
  - Generalized - widespread changes e.g. osteopetrosis, osteomalacia, pagets disease
  - Localized - tumors (primary/secondary), infection
- Most difficult of all types to treat.
  - Treat underlying cause
  - Surgical fixation. Difficult to obtain with impaired bony healing
Post-Surgical spondylolisthesis

- Damage to facet joint, disc or pars
- Low grade slip but very symptomatic
- Mostly after decompressive laminectomy with partial or complete facetectomy
- After discectomy and partial facetectomy
  - Axial load on facet joint increases
  - Increases translational and rotational movement in sagittal plane
- Spondylolysis after fusion at adjacent level or discectomy at adjacent caudal level - spondylolysis acquisita
Clinical Presentation

- Mechanical Back Pain
  - Worse with activity
  - Better with rest
- Leg Pain
  - Radicular
  - Neurogenic Claudication
    - Aches, fatigue, tiredness
    - Better with forward flexion
- Bowel, Bladder Function

Degree of vertebral slip does not directly correlate with the amount of pain
Low back pain, and sciatica 62%
Sciatica only 7%
Low back pain only 31%
Most common signs:
- Positive SLR test, 12%
- L5 sensory deficit, 13%
PRINCIPLES OF MANAGEMENT

Symptoms are very important as management depends upon these

*Compressive symptoms* - decompression

*Mechanical symptoms* – stabilization
Examination findings

- Isthmic and dysplastic type-
  - Palpable step-off of lumbar spinous processes.
  - In severe cases bodies may be palpable through abdominal wall.
  - Exaggerated lumbar lordosis.
  - Tight hamstrings in younger patients
  - Stooped posture with flexion at hip and knees with waddling gait.
  - SLR may be positive
Imaging

- **X-rays:**
  1. Lateral - flex./ext.
  2. Oblique
     - Integrity of the pars “Scotty Dog”

PARS IS SEEN AS NECK OF SCOTTIE DOG AND DEFECT AS COLLAR OF DOG
**Meyerding’s Scale**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Amount of Subluxation (Taillard)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade I</td>
<td>&lt;25%</td>
</tr>
<tr>
<td>Grade II</td>
<td>25-50%</td>
</tr>
<tr>
<td>Grade III</td>
<td>50-75%</td>
</tr>
<tr>
<td>Grade IV</td>
<td>75-100%</td>
</tr>
<tr>
<td>Grade V</td>
<td>&gt;100%</td>
</tr>
</tbody>
</table>

(Spondyloptosis)

Anterior Displacement
SAGITTAL ROTATION

- Angle between anterior margin of L5 and post. Margin of S1
- Measures rotational listhesis.
- BEST predictor of instability and progression

SACRAL ROUNDED:
percentage of superior end plate of sacrum deformed, usually at anterior margin.

It is sign of instability and represents barrier to reduction.

\[
\frac{a}{b} \times 100 = \% \text{ of rounding}
\]
- **LUMBAR INDEX (Wedging of the Olisthetic Vertebra)** - posterior height of body /ant.ht.

- **SACRAL INCLINATION**: angle between vertical and posterior margin of S1.
Imaging

- **CT scan**
  - Evaluate bony pathology
  - Spondylolysis diagnosed by “incomplete ring” sign (ring of cortical bone should be present on at least one axial cut in normal vertebra with intact arch)
  - Best test to diagnose pseudoarthrosis after failed fusion
CT myelography:
- Good quality dynamic scans can be obtained.
- Bony anatomy is better defined
- In already instrumented cases

MRI: evaluate soft tissue pathology
- Nerve compression
- Spinal compression
- Sagittal image demonstrate pars defect.
- Assess disc herniation
SPECT:

- Inconclusive x-rays despite high clinical suspicion
- May be positive for pars injury that is radiographically inapparent.
- Acute vs. chronic
Conservative Treatment

1. NSAIDS
2. Weight loss
3. Steroid injections
   - Acute phase
   - Not for long term use
4. Bracing
5. Physical therapy:
   - Physiotherapy
   - Aerobic conditioning
Conservative Treatment

- 1- to 2-day period of rest followed by a short course of anti-inflammatory medications
- If symptoms persist beyond 1–2 weeks, physical therapy can be applied.

Leonid et al, Diagnosis and conservative management of degenerative lumbar spondylolisthesis. Eur Spine J (2008) 17:327–335

- Stationary bicycling is an excellent exercise because it promotes
  - spine flexion,
  - deconstriction of the thecal sac.
  - avoid the wear and tear associated with impact aerobic exercise such as running

Conservative Treatment

Swimming, walking, and elliptical machines are other good alternatives for cardiovascular exercise, albeit there is no evidence of their value for DS


Opioids and muscle relaxants have not been shown to be more effective than acetaminophen and NSAIDs in well-controlled studies


Epidural steroids may offer short-term relief but long-term prospective studies do not show a lasting effect
## Flexion/extension strengthening exercises

<table>
<thead>
<tr>
<th></th>
<th>Flexon</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pain</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 months</td>
<td>27%</td>
<td>67%</td>
</tr>
<tr>
<td>3 yrs</td>
<td>19%</td>
<td>67%</td>
</tr>
<tr>
<td><strong>Inability to work</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 months</td>
<td>32%</td>
<td>61%</td>
</tr>
<tr>
<td>3 yrs</td>
<td>24%</td>
<td>61%</td>
</tr>
<tr>
<td><strong>Overall recovery rate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 months</td>
<td>58%</td>
<td>6%</td>
</tr>
<tr>
<td>3 yrs</td>
<td>62%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Conservative Treatment

Spondyloysis/Spondyloisthesis Exercises

- Pelvic tilt
- Dead bug
- Quadripped arm/leg raises
- Piriformis stretch
- Partial curl
- A.
- B.
- All-fours-to-heels sit
Operative Management: Indications

- 10-15% will fail conservative therapy (minimum of 3 months)

- Absolute indications:
  - Progressive weakness
  - Cauda Equina-type symptoms

- Myelopathy, radiculopathy or neurogenic claudication

- Radiographically documented instability
Surgery vs. Conservative Management

Surgery *Versus* Conservative Management in Adult Isthmic Spondylolisthesis

A Prospective Randomized Study: Part 1

Hans Möller, MD, and Rune Hedlund, MD, PhD

SPINE Volume 25, Number 13, pp 1711–1715

©2000, Lippincott Williams & Wilkins, Inc.
Functional outcome (pain reduction and DRI) was better in the surgically treated group than in the exercise group at both the 1-year and 2-year follow-up assessments (p<0.01).
Surgery vs. Conservative Mgmt

Surgery vs. Non-Operative Treatment for Lumbar Degenerative Spondylolisthesis; 4 year result in the Spine Patient Outcome Research Trial (SPORT) Randomized and Observational cohorts

Compared with patients treated non-operatively, patients in whom degenerative spondylolisthesis and associated spinal stenosis are treated surgically maintain substantially greater pain relief and improvement in function for four years

Surgical Intervention

❖ GOALS:
1. Stabilization
2. Decompression of neural elements
3. Both
Points to be assessed:
- Operative approach
- Whether to perform decompression or not
- Whether to perform fusion or not
- Whether to perform fixation or not
- What type of fusion and fixation?
Degenerative Lumbar Spondylolisthesis with Spinal Stenosis

A Prospective Study Comparing Decompression with Decompression and Intertransverse Process Arthrodesis*†

By Harry N. Herkowitz, M.D.‡, and Lawrence T. Kurz, M.D.‡, Royal Oak, Michigan

From the Section of Spine Surgery, Department of Orthopaedic Surgery, William Beaumont Hospital, Royal Oak

• 50 pts with a clinical diagnosis of degenerative spondylolisthesis and spinal stenosis who were unresponsive to an adequate course of conservative therapy
• Randomized to decompressive laminectomy (n=25) alone or decompressive laminectomy and bilateral intertransverse process arthrodesis (n=25)
Spondylolisthesis increased postoperatively in 96 versus 28 percent.

Markedly improved clinical outcome was found in patients who underwent fusion.

Although the pseudoarthrosis rate was 36%, clinical results were good or excellent for all patients who underwent fusion.

<table>
<thead>
<tr>
<th>TABLE I</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DATA ON THE FIFTY PATIENTS</strong></td>
</tr>
<tr>
<td><strong>Arthrodesis (N = 25)</strong></td>
</tr>
<tr>
<td><strong>Result</strong></td>
</tr>
<tr>
<td>Excellent</td>
</tr>
<tr>
<td>Good</td>
</tr>
<tr>
<td>Fair</td>
</tr>
<tr>
<td>Poor</td>
</tr>
</tbody>
</table>

**Mean scores for pain (points)**

| **Arthrodesis (N = 25)** | **No Arthrodesis (N = 25)** |
| **Back** | **Preop.** | **Postop.** | **Preop.** | **Postop.** |
| Excellent | 3.3 | 1.3 | 2.9* | 2.5† |
| Good | 4.3 | 1.0 | 4.0* | 1.7 |
| Mean height of disc space (mm) | 6.8 | 5.7 | 7.4 | 5.8 |
| Mean olisthesis (mm) | 4.8 | 5.3 | 5.3 | 7.9‡ |
| Mean olisthesis on flexion and extension (mm) | 2.8 | 0.1 | 3.4 | 5.8 |
| Mean vertebral motion (degrees) | 9.3 | 4.2 | 9.6 | 12.8‡ |

* The patients who had not had an arthrodesis had significantly more pain in the low back and lower limbs at the most recent follow-up evaluation.

† P < 0.01 (chi-square test).
‡ P = 0.002 (Student t test).
Fusion: Indications

- Decompression with $\geq$ Grade II Spondylolisthesis
- After repeated discectomies
- Unstable ($>10$ degrees on flex-ex films)
- Established mechanical back pain
- Post-Bilateral facetectomy

- Controversial: Decompression with Grade I, suggestive mechanical back pain, unilateral facetectomy
68 patients randomized to
- Decompression and arthrodesis
- Decompression and arthrodesis and instrumentation

Instrumentation: segmental transpedicular screws

Average follow-up of two years
### Fischgrund et al: Rate of Fusion

<table>
<thead>
<tr>
<th></th>
<th>Instrumentation (N = 35)</th>
<th>No Instrumentation (N = 33)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preoperative</td>
<td>Postoperative</td>
</tr>
<tr>
<td><strong>Result</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>20 (57%)</td>
<td>16 (48%)</td>
</tr>
<tr>
<td>Good</td>
<td>7 (21%)</td>
<td>12 (36%)</td>
</tr>
<tr>
<td>Fair</td>
<td>4 (12%)</td>
<td>1 (3%)</td>
</tr>
<tr>
<td>Poor</td>
<td>4 (12%)</td>
<td>4 (12%)</td>
</tr>
<tr>
<td>Mean scores for pain (points)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Lower limbs</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Mean olisthesis (mm)</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Mean sagittal motion on flexion and extension (mm)</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Mean angulation (°)</td>
<td>9</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Successful Arthrodesis</th>
<th>Pseudarthrosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrumentation</td>
<td>29 (83%)</td>
<td>6 (18%)</td>
</tr>
<tr>
<td>No instrumentation</td>
<td>15 (45%)</td>
<td>18 (55%)</td>
</tr>
<tr>
<td>Preoperative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olisthesis (mm)</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Angulation (°)</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Motion (mm)</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Postoperative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olisthesis (mm)</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Angulation (°)</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Motion (mm)</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>
Fischgrund et al: Results

- Clinical outcome was excellent or good in 76% of the patients with instrumentation and in 85% of those without instrumentation ($P = 0.45$).

- Successful arthrodesis occurred in 82% of the instrumented cases versus 45% of the non-instrumented cases ($P = 0.0015$).

- In patients undergoing single-level posterolateral fusion for degenerative spondylolisthesis with spinal stenosis, the use of pedicle screws may lead to a higher fusion rate, but clinical outcome shows no improvement in pain in the back and lower limbs.
47 patients prospectively studied

Underwent Posterior decompression and bilateral posterolateral arthrodesis with autogenous bone graft.

Follow up from 5 to 14 years: fusion or pseudoarthrosis, clinical analysis

Clinical outcome was excellent to good in 86% of patients with a solid arthrodesis and 56% in patients with a pseudoarthrosis (p=0.01)
31 RCTs identified
- Conflicting evidence of clinical effectiveness of fusion
- 8 trials addressed whether instrumentation improves the outcome of posterolateral fusion
- There is moderate evidence that instrumentation improves the fusion rate
- There is conflicting evidence that instrumentation improves clinical outcomes
**Figure 1.** Instrumented posterolateral fusion versus graft only: a likelihood of fusion.
### Review:
Surgery for degenerative lumbar spondylosis

### Comparison:
INSTRUMENTED POSTEROLATERAL FUSION vs GRAFT ONLY (mixed disease)

### Outcome:
Good clinical outcome

<table>
<thead>
<tr>
<th>Study or sub-category</th>
<th>Instrumented n/N</th>
<th>Graft only n/N</th>
<th>OR (random) 95% CI</th>
<th>Weight %</th>
<th>OR (random) 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridwell 1993</td>
<td>20/24</td>
<td>3/10</td>
<td>7.24 (2.08, 65.59)</td>
<td>11.67</td>
<td></td>
</tr>
<tr>
<td>McGuire 1995</td>
<td>10/13</td>
<td>7/14</td>
<td>7.84 (0.63, 17.77)</td>
<td>5.98</td>
<td></td>
</tr>
<tr>
<td>Zelicki 1993</td>
<td>67/72</td>
<td>36/51</td>
<td>12.81 (1.88, 16.61)</td>
<td>11.18</td>
<td></td>
</tr>
<tr>
<td>Fleischtrach 1997</td>
<td>27/35</td>
<td>86/33</td>
<td>11.18 (0.18, 2.07)</td>
<td>11.95</td>
<td></td>
</tr>
<tr>
<td>Thomsen 1997</td>
<td>52/63</td>
<td>49/66</td>
<td>15.97 (0.70, 3.85)</td>
<td>15.97</td>
<td></td>
</tr>
<tr>
<td>France 1999</td>
<td>21/37</td>
<td>16/33</td>
<td>14.17 (0.43, 2.81)</td>
<td>14.17</td>
<td></td>
</tr>
<tr>
<td>Moller 2000</td>
<td>31/37</td>
<td>25/39</td>
<td>12.57 (0.89, 8.08)</td>
<td>12.57</td>
<td></td>
</tr>
<tr>
<td>Frittm 2001</td>
<td>41/60</td>
<td>40/67</td>
<td>17.32 (0.70, 3.03)</td>
<td>17.32</td>
<td></td>
</tr>
</tbody>
</table>

Total (95% CI): 341/312

Total events: 280 (Instrumented), 206 (Graft only)

Test for heterogeneity: Chi² = 14.07, df = 7 (P = 0.05), I² = 50.3%

Test for overall effect: Z = 2.58 (P = 0.010)

---

**Figure 2.** Instrumented posterolateral fusion versus graft only: a likelihood of good outcome.
Significantly better (P < 0.05) functional outcome in relation to daily activities in the instrumented group when neural decompression had been performed.

Global patients' satisfaction was 82% in the instrumented group versus 74% in the non-instrumented group (not significant).

Significant symptoms from misplacement of pedicle screws were seen in 4.8% of the instrumented patients.
Karsten et al: Conclusions

- Lumbar posterolateral fusion with pedicle screw fixation increases the operation time, blood loss, and reoperation rate, and leads to a significant risk of nerve injury.

- A gain in functional outcome was found in the daily activity category in patients with instrumentation and supplementary neural decompression.

- The results of this study do not justify the general use of pedicle screw fixation alone as an adjunct to posterolateral lumbar fusion.
SPORT TRIAL

Degenerative Spondylolisthesis

Does Fusion Methods Influence outcome? 4 yr
Result of Spine pt Outcome trial (SPINE vol 34,number 21,2009)

PLF Vs PPS Vs PPS + INTERBODY FUSION (360°)

At 4 yrs there was no difference in health related quality of life outcomes, satisfaction and bothersome scores.
Surgical Management

- Depends upon
  - Symptoms
  - Grade
  - Etiology

Decision to operate depends upon symptoms and which operation to perform depends upon other two factors.
Management

- For management pts can be divided into 3 group
  - Group I – children and adolescents
  - Group II – adults
  - Group III – age > 40 years
- Groups further subdivided into
  - A – low grade (I,II)
  - B – high grade (III,IV and V)
Group I - A

- No symptoms – follow up
- Symptomatic
  - **Conservative management**
    - Slip < 25% - no need to restrict activity
    - Slip > 25%
  - **Surgical management**
    - Posterolateral fusion
Group I - B

- Indications
  - Slip > 50% in symptomatic and asymptomatic pts
  - Progression of symptoms
- Slippage of less then 50% - single level fusion
- Slip > 50% - extend fusion to one level above
- Isolated decompression without fusion is contraindicated in children
- Role of instrumentation is controversial
Group II - A

- Surgery when conservative management fails
- Fusion with or without decompression
- Only decompression not recommended
- Fusion
  - Posterolateral intertransverse fusion (PLF)
  - Anterior Lumbar interbody fusion (ALIF)
- instrumentation ????
Group II - B

- No symptoms and slip is more – conservative (as chances of progression are low in adults and they have a sagitally balanced deformity)
- Fusion with instrumentation is recommended
  - PLIF
  - TLIF
  - ALIF
- Reduction ???
  - When there is significant sagittal imbalance
  - Partial reduction is sufficient
  - Partial reduction of slip angle is more important than translation reduction.
Group III – A and B

- Degenerative spondylolisthesis
- Rarely exceeds grade I and II
- Surgery
  - Decompression
  - Fusion
  - Instrumentation
Group III – A and B

- Indications of fusion and instrumentation
  - Preoperative factors
    - Disc height – preoperative disc height > 2 mm
    - Degree of kyphosis – (N – sagittal angle at L4-L5 is 8 to 17 degree
    - Degree of instability – 5 mm in flexion-extension x rays
    - Degree of listhesis - > 50%
    - Previous laminectomy
    - Adjacent segment disease
Intraoperative factors

- Extent of decompression
  - >50% facet excision on each side
  - Total facet excision on any side
  - Discectomy + partial removal of the facets

- Correction of listhesis

- Available bone stock
Type and extent of instrumentation

- Posterior pedicle screw only
  - Adequate in most cases
  - Unilateral is as good as bilateral
  - Multi-level fusion then bilateral screws to be placed

- Interbody fusion
  - Correction of listhesis
  - > grade II slip
  - Recurrent cases
AIIMS Data

- Pedicel screw fixation in lumbar spondylolisthesis – 5 year retrospective study – 2007
- Total patients – 30
- Degenerative spondylolisthesis
  - 46.7%
  - Mean age – 44.5 yrs
  - L4 – L5 level – 64.2% cases
  - 57% - women
- Isthmic – 36.7%, mean age – 37 yrs and 54% were women and L5S1 level was most common (63.6%)
AllMS Data

- Symptoms
  - Back ache – 76%
  - Radicular symptoms – 80%
  - Neurogenic claudication – 36%
  - Bowel/bladder – 10%

- Mean duration of surgery was 5 hrs and blood loss was 950ml
- Symptomatic relief in almost all patients with backache and radicular pain
- Dural tear – 20% with 6.7% having CSF leak
- Malpositioning of the screw – 10% and implant failure in 2.5%
- Follow up range 2-36 months
Thanks ....