Grade 2-3 Spondylolisthesis: Deformity or Not

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Deformity Considerations of Spondylolisthesis Grade II-III

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Tunnel View
Classification of Spondylolisthesis (Wiltse)

TYPE I. DYSPLASTIC (CONGENITAL)
Malformation of LS joint

TYPE II. ISTHMIC

TYPE III. DEGENERATIVE

TYPE IV. TRAUMATIC

TYPE V. PATHOLOGIC

Grading/Slip Angle

Spondylolisthesis

% SLIPPAGE - Meyerding
Grade 1   0-25%
Grade 2   25-50%
Grade 3   50-75%
Grade 4   >75%

SLIP ANGLE - rotational relationship between LS and S1
- normally 0% or less

Grading/Classification for spondylolisthesis -
- Not useful for surgical treatment indications

Spondylolisthesis

- Low grade / High grade
- Slip progression
  - Related to:
    - Spina Bifida Occulta
    - Younger patients – growth spurt / puberty
    - Greater amount of initial slip
    - Increased slip angle
    - High PI

Slip Progression

- Slip progression (Adult) -
  - low-grade slips
    - rarely worsens, even after 40+ years of follow-up.
    - symptomatic in only 10% of patients
  - high-grade slips
    - progress in many cases
      - 60% of patients with slips Meyerding grade 2 or greater persistent daily symptoms

Normal Sag. Balance: Interplay of Spine and Pelvic Parameters
Sagittal Balance

- Normal Sagittal Alignment
  - Influenced by combination of cervical, thoracic, lumbar and spino pelvic alignment
  - Ideal SVA is less than +/- 5 cm

Spinal Alignment

- Lumbar Lordosis (LL) L1-S1
  - Mean 62° ± 10 degrees
  - Closely correlated to PI

- Thoracic Kyphosis T4-T12
  - 39° ± 10 degrees

Pelvic Parameters

Pelvic parameters consist of
Pelvic Incidence (PI)
Pelvic Tilt (PT)
Sacral Slope (SS)
Spino Pelvic Parameters

- Pelvic Incidence
  - Angle between the perpendicular line at the mid point of the sacral endplate and the line joining the HA
  - Morphologic parameter that is indicative of pelvic shape
  - 55 ± or -11 degrees


Relationship of PI and Spondylolisthesis

- PI
  - Increases linearly in spondylolisthesis
    - According to the severity of slippage
  - High PI = increased sagittal curves

Spinal Alignment

- Pelvic Tilt
  - Vertical line through HA and a line joining HA to the center of the sacral endplate
  - 13 ± or -6 degrees
  - Represents spatial position of the pelvis (rotation of pelvis around femoral heads)
  - Increase in PT: pelvic retroversion
    - Kyphotic deformity
Pelvic Tilt

- SVA increases, the result is a compensatory increase in PT
- SVA vs pelvic tilt
  - Negative SVA (<0) – average PT = 10°
  - Neutral SVA (0-5 cm) – average PT = 16°
  - Positive SVA (> 5 cm) – average PT = 21°


Increasing PT to maintain neutral

Compensating SVA → increase in PT → greater energy expenditure and greater disability


Sacral Slope

- S1 endplate
- Horizontal Reference - complimentary to PT
Summary of pelvic parameters by age

<table>
<thead>
<tr>
<th>Age Group (in Years)</th>
<th>Pelvic Incidence (°)</th>
<th>Pelvic Tilt (°)</th>
<th>Sacral Slope (°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-40</td>
<td>52 ± 10</td>
<td>13 ± 7</td>
<td>30 ± 9</td>
</tr>
<tr>
<td>41-60</td>
<td>52 ± 9</td>
<td>14 ± 6</td>
<td>40 ± 7</td>
</tr>
<tr>
<td>≥70</td>
<td>51 ± 9</td>
<td>10 ± 9</td>
<td>36 ± 9</td>
</tr>
</tbody>
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Spondylolisthesis effect on Sagittal Balance
PI, SS, and PT

- adults the normal values are 51.8°, 39.7° and 12.1°.¹²

Spinal Alignment

- Compensatory Mechanisms for Sagittal Imbalance
  - Flexible spine
    - Increased Lumbar Lordosis
  - Less thoracic kyphosis
  - Hyperextension of hips
    - Pelvic retroversion
    - PT increases
  - Flexed knees and ankles

- Spondylolisthesis
  - Sagittal balance achieved by:
    - Hyperlordosis
    - Greater vertical tilt of the sacrum
TREATMENT OF SPONDYLOLISTHESIS - Surgical

SURGICAL INDICATIONS
- persistent / recurrent major symptoms
- high grade slip (>30-50%) or high slip angle (40-50 degrees)
- progressive slip >25-50% even when asymptomatic
- progressive neurological deficit
Grade III-IV slip => conservative care rarely successful

Spondylolysis/Spondylolisthesis

- Decisions include the following:
  - Levels to include in fusion.
  - Slip reduction versus in situ fusion.
  - Posterolateral versus interbody fusion versus circumferential fusion.
  - If neurologic symptoms are present, a decompression should be included with the fusion.

Deformity Surgery - Grade 2-3 Spondylolisthesis

- Arthrodesis -
  - Optimal arthrodesis technique controversial
  - Circumferential - Anterior / Posterior (360, TLIF, PLIF)
    - Best at reducing deformity
    - highest fusion rates - 88-98%
    - Better outcome than PLF 2 yr fu
    - PLIF, TLIF avoid anterior morbidity
Reduction of listhesis controversial
– High grade slip
  – In situ fusion: does not treat sacropelvic deformity
    – Slip angle may progress
  • Reduction
    – Improves sagittal balance, restores spinopelvic balance
    – Improves slip angle or LS incidence; decrease compensatory lordosis
    – Increases bone fusion area
    – May reduce adjacent level degeneration by improving alignment
    – Improve fusion rate
    – Higher rate of neurological injury

Case 3
• 17 yo healthy female
• Active
• No hx of injury
• Onset of progressive worsening LBP and leg pain
DM

- 51-year-old female
- Long history of spine issues
- upper and lower back pain “for years”
- pelvic and buttock with numbness and tingling
- lower back pain much worse over the last four months
- Hx of insitu Spinal fusion L3-S1 grade 3 spondylolisthesis, 1984
DM

- Age 51
  - She states “My back is deformed”
  - muscle spasms in abdominal and back area
  - does not sleep well, never feels comfortable
  - pain is aggravated with walking, standing, activity in general and stooping/bending
  - relieved with lying down
  - frequently awakened from sleep and frequently kept from sleeping due to pain

DM

Lumbar Lordosis = 67
Summary

- Pelvic anatomy has direct influence on local and global balance
- Spinopelvic balance needs to be assessed in grade 2-3 spondylolisthesis
- Extent of Surgical treatment not clear

Clear and Compelling Evidence

- Spondylolisthesis Grade 2/3 is a spinal deformity and overall spinal and spinopelvic balance can be significantly affected and needs to be evaluated