Spine

Postoperative

Takashi Takahashi
Epidemiology (1998 to 2008)

• Spine Fusion is rapidly growing surgery
  • 2.4x (137%) from 174,223 to 413,171
    • Laminectomy (11.3%)
    • Hip replacement (49.1%)
    • Knee arthroplasty (126.8%)
    • PTCA (38.8%)
    • CABG (-40.1%)

• Mean age: 48.8 → 54.2 years
• Mortality rate: 0.29% → 0.25%
• National Bill: 7.9x
  • 4.3 billion → 33.9 billion

## Why spine fusion?

**TABLE 5. Most Common Primary Diagnoses Prior to Spinal Fusion in Order of Frequency for 2008 in Comparison With 1998 Data**

<table>
<thead>
<tr>
<th>Primary Diagnosis</th>
<th>ICD-9-CM</th>
<th>2008, % (Frequency)</th>
<th>1998, % (Frequency)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degenerative disc disease, lumbar</td>
<td>722.52</td>
<td>13.8 (57,046)</td>
<td>9.1 (15,907)</td>
</tr>
<tr>
<td>Displacement of disc without myelopathy, cervical</td>
<td>722.0</td>
<td>12.2 (50,428)</td>
<td>19.6 (34,122)</td>
</tr>
<tr>
<td>Spinal stenosis, lumbar</td>
<td>724.02</td>
<td>9.0 (37,124)</td>
<td>6.8 (11,774)</td>
</tr>
<tr>
<td>Displacement of disc without myelopathy, lumbar</td>
<td>722.1</td>
<td>8.6 (35,329)</td>
<td>10.6 (18,513)</td>
</tr>
<tr>
<td>Acquired spondylolisthesis</td>
<td>738.4</td>
<td>6.7 (27,776)</td>
<td>6.7 (11,631)</td>
</tr>
<tr>
<td>Spondylosis without myelopathy, cervical</td>
<td>721.0</td>
<td>5.4 (22,396)</td>
<td>5.5 (9677)</td>
</tr>
<tr>
<td>Spondylosis with myelopathy, cervical</td>
<td>721.1</td>
<td>5.3 (21,698)</td>
<td>3.6 (6185)</td>
</tr>
<tr>
<td>Spondylosis without myelopathy, lumbar</td>
<td>721.3</td>
<td>5.1 (21,175)</td>
<td>3.7 (6514)</td>
</tr>
<tr>
<td>Intervertebral disc disorder with myelopathy, cervical</td>
<td>722.71</td>
<td>4.5 (18,670)</td>
<td>3.5 (6065)</td>
</tr>
<tr>
<td>Degenerative disc disease, cervical</td>
<td>722.4</td>
<td>3.5 (14,326)</td>
<td>2.0 (3504)</td>
</tr>
<tr>
<td>Spinal stenosis, cervical</td>
<td>723.0</td>
<td>3.2 (13,224)</td>
<td>1.6 (2839)</td>
</tr>
<tr>
<td>Congenital spondylolisthesis, lumbar</td>
<td>756.12</td>
<td>3.0 (12,284)</td>
<td>2.0 (3471)</td>
</tr>
<tr>
<td>Scoliosis (and kyphoscoliosis), idiopathic</td>
<td>737.3</td>
<td>2.3 (9427)</td>
<td>3.0 (5211)</td>
</tr>
</tbody>
</table>

*% indicates proportion of all spinal fusion (CCS 158) discharges per year. CCS indicates clinical classification software; ICD-9-CM, International Classification of Diseases, Ninth Revision, Clinical Modification.*
ASNR Nomenclature

- Most widely accepted nomenclature standard
- Based on the morphology and pathology
- Lumbar spine disks
- Do **NOT**
  - Imply etiology
  - Suggest type of treatment
  - Distinguish between symptomatic and asymptomatic

http://www.asnr.org/spine_nomenclature
General Classifications

- Normal
- Congenital/developmental variant
- Degenerative/traumatic lesion
- Inflammation/infection
- Neoplasia
- Morphologic variant of unknown significance
Degenerative/Traumatic Lesion

Annular tear

Herniation
- Protrusion
- Extrusion
- Intravertebral

Degeneration
- Spondylosis deformans
- Intervertebral osteochondrosis
Degeneration

- **Spondylosis deformans** *(Age related change)*
  - Affects annulus fibrosus and apophyses

- **Intervertebral osteochondrosis** *(Pathologic)*
  - Affects nucleus pulposus, endplates, and extensive fissuring of the annulus fibrosus
  - Pathologic degeneration
Intervertebral Disk Degeneration
Intervertebral Disk Anatomy

• Outer annulus fibrosus
• Inner annulus fibrosus
• Nucleus pulposus
Outer annulus fibrosus

• Thick lamellae of dense connective tissue (collagen)
Inner annulus fibrosus

- Cartilaginous matrix associated with collagen fibers
Nucleus pulposus

• Amorphous with less fibers, and relatively high glycosaminoglycans and water
Intervertebral Disk Anatomy
Disk Degeneration

- Pfirrmann Grading System

SPINE Volume 26 (2001), Number 17, pp 1873–1878
Modified Pfirrmann Grading System

- Pfirrmann grading system did not prove discriminatory when assessing elderly spine
- 5 level grading → 8 level grading
Annular Tear/Fissure

• Tear of the anular fibrosus inner fibers +/- outer fibers
• Does not imply traumatic etiology
• Tear = Fissure ≠ Rupture
**Anular Tear/Fissure**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Concentric</td>
</tr>
<tr>
<td></td>
<td>Rupture of transverse fibers</td>
</tr>
<tr>
<td></td>
<td>Ovoid/crescent shaped</td>
</tr>
<tr>
<td></td>
<td>Not seen on MR</td>
</tr>
<tr>
<td>II</td>
<td>Radial</td>
</tr>
<tr>
<td></td>
<td>Rupture of longitudinal fibres</td>
</tr>
<tr>
<td></td>
<td>Linear Shape</td>
</tr>
<tr>
<td>III</td>
<td>Transverse</td>
</tr>
<tr>
<td></td>
<td>Rupture of Sharpey’s fibers</td>
</tr>
<tr>
<td></td>
<td>Irregular fluid filled cavities at the periphery of annulus</td>
</tr>
</tbody>
</table>

Concentric Tear

- Delamination type tear between the adjacent lamellae.
- Craniocaudally oriented curvilinear high signal intensity
Transverse Tear

- Tear in one or more layers of the annulus fibrosus at the insertion into the ring apophysis
- Small focus of high signal intensity in the peripheral annulus fibrosus
Transverse Tear

- Gas may accumulate within the tear.
Asymptomatic Annular Tears

• Concentric tear
• Transverse tear
Radial Tear

• Tear extending all layers of the annulus fibrosus from interior to the periphery
• Characteristic of all degenerative IVD
• Mother of all herniation
Symptomatic Radial Tear

• Disk Herniation

• Granulation Tissue Ingrowth
  • Clinically mimic radiculopathy of a herniated disk

• Adjacent inflammation

• Altered Biomechanics (hypothetical)

• Occult spinal stenosis
Radial Tear: Imaging Appearance

• Linear or irregular high signal intensity within annulus
• Dessication of Disc
• Herniation
• Disk height loss and collapse
T2 hyperintensity & Enhancement = Acute?

RESULTS: Annular tears were observed at 29 levels in 18 patients. Two tears developed during the follow-up interval. When contrast-enhanced images were obtained during serial examinations, 10 (100%) of 10 enhancing annular tears persisted on the follow-up contrast-enhanced T1-weighted images (mean interval, 17.2 months; SD, 12.3 months). High signal intensity on T2-weighted MR images was noted in 26 (96%) of 27 tears initially and persisted in 23 (88%) of 26 (mean interval, 21.9 months; SD, 15.0 months).

CONCLUSION: Hyperintensity on T2-weighted MR images and enhancement of annular tears could not be used to determine the tears’ acuity over the range of follow-up provided in this study.

Key Point

• Radial tear is pathologic i.e. intervertebral osteochondrosis.
• Other annular tears (transverse and circumferential) are age related i.e. spondylosis deformans.
Herniation

• General term refers to localized displacement ( <50% of circumference) of disc material beyond the normal margins of the intervertebral disk space.
Protrusion

• “A herniated disc in which the greatest distance, in any plane, between the edges of the disc material beyond the disc space is less than the distance between the edges of the base in the same plane.”
Protrusion

• Focal protrusion (< 25%)
• Broad based protrusion (25-50%)
Extrusion

“ A herniated disc in which, in at least one plane, any one distance between the edges of the disc material beyond the disc space is greater than the distance between the edges of the base in the same plane, or when no continuity exists between the disc material beyond the disc space and that within the disc space.”

Migration

• “Herniated disc in which a portion of extruded disc material is displaced away from the tear in the outer annulus through which it has extruded.”

Sequestration

• “An extruded disc in which a portion of the disc tissue is displaced beyond the outer annulus and maintains no connection by disc tissue with the disc of origin.”

Bulge

• "A disc in which the contour of the outer anulus extends, or appears to extend, in the horizontal (axial) plane beyond the edges of the disc space, over greater than 50% (180 degrees) of the circumference of the disc and usually less than 3mm beyond the edges of the vertebral body apophyses.”
Key Point

• ASNR Terminology for reporting consistency
• ASNR Terms does not imply symptoms
Preoperative Imaging
Vertebral Count

• Up to 50% of neurosurgeons may perform wrong-level spine surgery at some point in their career.

• Counting from C2 is most reliable.

• Lumbar spine is most common site of anatomic variation.

J Neurosurg: Spine / Volume 12 / January 2010
Lumbosacral Transitional Anatomy

- Common 5% to >35%
- Surgical planning
- Potential source of pain (?)
<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>Enlarged L5 transverse process unilaterally (A) or bilaterally (B)</td>
</tr>
<tr>
<td>II</td>
<td>Diarthroidal joint between the enlarged transverse process and the sacrum i.e. pseudoarthrosis unilaterally (A) or bilaterally (B)</td>
</tr>
<tr>
<td>III</td>
<td>Solid fusion unilaterally (A) or bilaterally (B)</td>
</tr>
<tr>
<td>IV</td>
<td>Mixed fusion and pseudoarthrosis</td>
</tr>
</tbody>
</table>
L5 or S1?

- Functional L5 nerve root originates at the most caudal "mobile"
  - For type I and II (pseudoarthrosis), L5
  - For type III (fusion), S1
Bertolotti’s Syndrome

- Pain secondary to the arthritis of the “transverse-sacral pseudoarthrosis”

http://www.radsouce.us/clinic/1312
Imaging Techniques

• Sagittal T2W FSE sequence – Central canal size
  • Cervical Spine
    • Normal: > 13 mm
    • Borderline: 10-13 mm
  • Lumbar spine
    • Normal > 1.5 cm^2 OR
    • AP diameter < 11.5 mm

• CT scan – Foraminal Stenosis

• Upright MRI/Axial loading CT/MR
  • Increased Axial loading to simulate patient’s symptomatic condition

Central Stenosis

• Osteophytes
• Facet arthropathy
• Thickening of the ligaments
• Bulging of the intervertebral discs
# Cervical Canal Stenosis Grading System

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal</td>
</tr>
<tr>
<td>1</td>
<td>Arbitrary subarachnoid space loss exceeding 50%</td>
</tr>
<tr>
<td>2</td>
<td>Cord deformity</td>
</tr>
<tr>
<td>3</td>
<td>Cord signal abnormality</td>
</tr>
</tbody>
</table>

Imaging Techniques

- DWI
- CSF Flow

T2 hyperintensity $\rightarrow$ Reversible
T1 hypointensity $\rightarrow$ Irreversible
Peripheral Stenosis

• Lateral recess stenosis
  • Lumbar (sagittal)
    • Normal: > 5 mm
    • Borderline: 3-4 mm
    • Pathologic stenosis: <= 2 mm

• Foraminal stenosis
  • Changes with body positions at each level (lumbar spine)

• Imaging sensitive but not specific

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<tr>
<td>0 (normal)</td>
<td>Normal</td>
</tr>
<tr>
<td>1 (Mild)</td>
<td>Perineural fat obliteration in two opposing directions, vertical or transverse direction</td>
</tr>
<tr>
<td>2 (Moderate)</td>
<td>Perineural fat obliteration in all four directions without morphologic change, both vertical and transverse directions</td>
</tr>
<tr>
<td>3 (Severe)</td>
<td>Nerve root collapse or morphologic change</td>
</tr>
</tbody>
</table>

Grade 0: Normal

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<td>0 (normal)</td>
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</table>
Grade 1: Mild

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</tr>
</tbody>
</table>
# Grade 2: Moderate

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal</td>
</tr>
<tr>
<td>(normal)</td>
<td></td>
</tr>
<tr>
<td>1 (Mild)</td>
<td>Perineural fat obliteration in two opposing directions, vertical or transverse direction</td>
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<td>3 (Severe)</td>
<td>Nerve root collapse or morphologic change</td>
</tr>
</tbody>
</table>
### Grade 3: Moderate

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal</td>
</tr>
<tr>
<td>1 (Mild)</td>
<td>Perineural fat obliteration in two opposing directions, vertical or transverse direction</td>
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<td>Perineural fat obliteration in all four directions without morphologic change, both vertical and transverse directions</td>
</tr>
<tr>
<td>3 (Severe)</td>
<td>Nerve root collapse or morphologic change</td>
</tr>
</tbody>
</table>
Key Points

• Degree of imaging stenosis ≠ Clinical significance
• Grading Systems for consistent reporting
Types of Surgeries
Stabilization
- Fusion
- Distraction

Decompression

Disc replacement
Decompression

- Laminotomy: Partial removal of the lamina
- Hemilaminectomy (unilateral laminectomy): Removal of a single lamina with exposure limited to one side of the interspinous ligament
- Total laminectomy: Removal of the bilateral lamina along with the spinous process
- Laminoplasty: Expansion of the spinal canal while preserving the dorsal laminar arch
- Pediculectomy: Removal of the pedicle, usually along with the facet as a transpedicular approach and often combined with laminectomy
- Corpectomy: Complete or partial removal of the vertebral body
- Vertebrectomy (spondylectomy): Complete or partial removal of the vertebra
- Foraminotomy: Expansion of the neural foramen, usually via resection of part or all of the facet
- Facetectomy: Resection of part or all of the facet
- Discectomy/microdiscectomy: Removal of herniated disc

## Stabilization

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fusion (spondylodesis)</td>
<td>Uniting portions of the spine via instrumentation and/or graft materials. A variety of approaches can be implemented (anterior, posterior, etc.)</td>
</tr>
<tr>
<td>Distraction</td>
<td>Halo, traction, or interspinous process devices to provide distractive force to vertebral column</td>
</tr>
</tbody>
</table>
Disc Replacement

- Dynamic reconstruction of the intervertebral disc with artificial disc or nucleus pulposus
Cervical Spine
Types of Surgeries

- Anterior cervical discectomy (fusion)
- Anterior cervical corpectomy
- Posterior cervical decompression
- Combined anterior and posterior procedures
Anterior Cervical Discectomy (ACD)

• Single disc level
• Anterior approach
• Purpose: decompress the spinal canal or neuroforamen
• Techniques: Removal of compressive disk herniation and/or disc/osteophyte complex without placement of any interbody bone graft or instrumentation.
• Relatively uncommon now a days
Anterior cervical discectomy and fusion (ACDF/P)

• \( \geq 1 \) levels
• ACD + interbody arthrodesis (fusion)
• Structural graft
  • Autograft
  • Allograft
• Additional plate and screw construct (P)
  • ACDFP
Anterior cervical corpectomy (ACC)

- >= 2 levels
- Purpose: Decompression of the spinal canal/neuroforamen
- Techniques:
  - Disectomy AND
  - Removal of most of the center of one or more vertebral bodies
  - Bone defect reconstruction
    - Fibular strut graft
    - Titanium mesh cage filled with autograft and/or allograft
  - Plate/screw construct
Posterior cervical decompression (PCD)

• >= 1 level
• Approach: Posterior
• Purpose: decompress central canal/neuroforamen
• Techniques
  • Laminectomy and/or foraminotomy
  • Laminoplasty
  • Lateral mass and/or pedicle screw instrumentation
360-degrees/circumferential surgery

- Combined anterior and posterior procedures
Lumbar spine
Surgery Types

- Posterior lumbar interbody fusion (PLIF)
- Transforaminal lumbar interbody fusion (TLIF)
- Anterior lumbar interbody fusion (ALIF)
- Extreme lateral interbody fusion (XLIF)
- Stand alone lumbar interbody fusion (Stalif)
PLIF

• Loss of posterior structural support → posterior fusion instrumentation

• Thecal sacs and nerve roots retraction → Risk of nerve injury

http://www.methodistorthopedics.com/
TLIF

• Reduces amount of surgical muscle resection
• **Minimizes nerve manipulation**
• Limited size of the interbody graft → posterior instrumentation
ALIF

• Through extraperitoneal space → extraperitoneal injury
• Sufficient size of disk access → No posterior instrumentation
  • No posterior paravertebral muscle damage
• No nerve root retraction
• No epidural scar

http://www.medivisuals.com/
XLIF

• Minimally invasive

• First described in 2006 by Drs. Ozgur, Aryan, Pimenta, Taylor from UC Irvine and UCSD

• Avoid incision that traverses through abdomen (vs. ALIF)

• Avoid cutting or disrupting the muscles of the back

XLIF
Interbody graft Types

• Bone graft
  • Bone graft site pain
  • High nonunion rate

• Titanium cage
  • Not fixate the spine well:
    • > L4/L5
    • Spondylolisthesis
    • Multilevel fusion
  • Obscure postoperative imaging

• Carbon fiber or PEEK cage
  • Requires posterior pedicle screws

• Bioabsorbable interbody cage
Postoperative Imaging
Interbody Graft Incorporation

• Radiologic fusion ≠ Clinical Success

• Techniques:
  • Radiography (standard vs. dynamic)
  • CT
  • MRI

• Minimum 6-12 months
  • Up to 24 months
Imaging Finding for fusion

- **Continuity of bone density and bony trabeculae across the interspace**
- Minimal loss of the operated disc space
- < 2-5 degrees of movement at operative site on flexion-extension series
- Presence of sclerotic line between the graft and vertebral bone
  - Remodelling with new bone formation at the junction
- Integrity of the construct with no screw fracture, pullout, or plate buckling
Standard Radiography

• Trabecular bone across the segment
  • Sentinel sign
• Overestimate fusion rate
Dynamic Radiography

- > 1 or >2 mm between spinous processes across the fused segment (C-spine)
  - Specificity 89%
  - Sensitivity 91%
- Change in Cobb’s angle > 2 degrees between flexion and extension (C-spine)
  - Specificity 39%
  - Sensitivity 82%
  - 4 degrees cut off, 100% PPV but very low sensitivity
- USFDA: < 5 degrees of movement (L-spine)
- Significant observer bias → QMA
  - PPV 100%
  - NPV 73%

Radiostereometric Analysis

• 0.8 mm tantalum beads implanted into bone at the time of original surgery
• Biplanar dynamic radiographs
• Using computer, 3D data is calculated
MRI

- No radiation
- Paradoxic effect of high field magnet
CT

• Higher sensitivity than radiographs
• Trabecular continuity

Classification
• Grade I: Complete
• Grade II: Partial fusion
• Grade III: Unipolar pseudoarthrosis
• Grade IV: Bipolar pseudoarthrosis

Radiation Dose

Locked Pseudoarthrosis

• Nonunion within an interbody cage on CT but no radiographic evidence of osteolysis around the implant and no appreciable movement on flexion-extension.
Key Points

• Fusion can take up to 24 months
• CT is the imaging modality of choice for assessing interbody fusion.
Postoperative Complications
Autograft donor site pain

- Iliac crest donor site pain (> 30%)
  - Unicortical = Bicortical
  - Right = left
  - Anterior = posterior

- Infection (0.9%)
Non-union/pseudoarthrosis
Non-union/Pseudoarthrosis

- Single level discectomy alone has a shorter postoperative course.
- More structural support, better fusion rate or less nonunion.
- More levels, higher nonunion rate.

<table>
<thead>
<tr>
<th>Type of Surgery</th>
<th>Total No. of Procedures</th>
<th>Fusion Rates (%)</th>
<th>Pseudarthrosis Rates (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>One Disc Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACD</td>
<td>73</td>
<td>84.9</td>
<td>15.1</td>
</tr>
<tr>
<td>1-level ACDF</td>
<td>1231</td>
<td>92.1</td>
<td>7.9</td>
</tr>
<tr>
<td>1-level ACDFP</td>
<td>359</td>
<td>97.1</td>
<td>2.9</td>
</tr>
<tr>
<td><strong>Two Disc Levels</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-level ACDF</td>
<td>422</td>
<td>79.9</td>
<td>20.1</td>
</tr>
<tr>
<td>2-level ACDFP</td>
<td>184</td>
<td>94.6</td>
<td>5.4</td>
</tr>
<tr>
<td>1-level corpectomy</td>
<td>73</td>
<td>95.9</td>
<td>4.1</td>
</tr>
<tr>
<td>1-level corpectomy with plating</td>
<td>56</td>
<td>92.9</td>
<td>7.1</td>
</tr>
<tr>
<td><strong>Three Disc Levels</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-level ACDF</td>
<td>123</td>
<td>65.0</td>
<td>35.0</td>
</tr>
<tr>
<td>3-level ACDFP</td>
<td>40</td>
<td>82.5</td>
<td>17.4</td>
</tr>
<tr>
<td>2-level corpectomy</td>
<td>88</td>
<td>89.8</td>
<td>10.2</td>
</tr>
<tr>
<td>2-level corpectomy with plating</td>
<td>55</td>
<td>96.2</td>
<td>3.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2,682</td>
<td>89.5</td>
<td>10.5</td>
</tr>
</tbody>
</table>

ACD, Anterior cervical discectomy; ACDF, ACD with fusion; ACDFP, ACD with plating.

Allograft vs Autograft vs Cage

• Allograft = Autograft


• Autograft > Cage

CT Features of Delayed or Failed Fusion

• Lucency around the device margin
• Cystic changes within the endplate
• Linear defects/fracture
• Change in device position
• Subsidence
Non-union
Nonunion
Linear lucency
Cystic change in the endplate
Subsidence

• Fusion device sinking into one or both end of the adjacent vertebral bodies.
Change in position
Periscrew lucency
Screw Fracture
Adjacent Structure Injuries
Vocal Cord Dysfunction

• Vocal cord dysfunction
  • Transient (80-90%)
  • Permanent (10-20%)

Horner’s syndrome

• 0.1 – 4% risk of sympathetic trunk injury

• Risk higher for lower cervical spine surgery
  • Sympathetic trunk lies closer to the medial border of the longus coli at C6 than C3

http://www.studyblue.com/notes(note/n/neck/deck/4588539)
Vascular Injury

• Narrowing
• Occlusion
• Intravascular clot
  • Embolization
• Dissection
• Pseudoaneurysm
• Rupture
Vascular Injury with ALIF

- Aorta
- Inferior vena cava
- Iliac arteries/veins
  - Left common iliac artery
Incidental durotomy

• Unintended tear or injury to the dura during surgery or other invasive procedure

• ~10% of lumbar spine decompression

• Symptoms
  • Postural headache
  • Neurological deficit

• Image Findings
  • Nuclear scintigraphy
  • CT myelography
Structural Complication
Spinal Instability

• Inability to withstand normal movements without development of abnormal subluxation, neurologic dysfunction and/or pain.

• Pathophysiology
  • Loss of posterior tension band
Adjacent level degenerative disc disease

• Definition
  • New or accelerated degeneration of the disc and development or exaggeration of spondylosis at the levels adjacent to the operated level.

• 17% in single level surgery

• 73% in long (4 or 5 level) anterior cervical construct.
Infection
Surgical site infection

• Superficial surgical site infection
  • Infection isolated superficial to the dorsal fascia
  • Purulent discharge or cutaneous dehiscence with positive microbiologic testing

• Deep surgical site infection
  • Imaging evidence of infection deep to the dorsal fascia +/- positive microbial testing

• Acute infection
  • < 30 days of the surgical procedure

• Delayed (late) infection
  • > 10-12 months after surgery (average 27 months)
Infection
Mechanical Complication
Other complications
Epidural hematoma

- Postoperative epidural hematoma is common (58%)
  - Symptomatic postoperative epidural hemorrhage is rare (0.1-0.22%)
- Most prominent in the thoracic spine
Arachnoiditis

- Cause of postoperative symptoms in 6-16%
- Image Findings
  - Empty sac
  - Clumped nerves
  - Mass
  - Arachnoiditis ossificans
Radiculopathy

• Typically starts 4 hours to 6 days
• C5 and C6 motor roots (most common)
• Back to baseline 2 weeks to 3 years (mean, 5.3 months)
• Pathophysiology
  • Unknown
Other complications

• Spinal cord injury (0.2%)
• Dysphagia
  • Temporary (60%)
  • More common in revision surgery (28% vs. 11%)
  • More common in multilevel surgery (18% vs. 10%)
• Esophageal perforation (0.1-0.4%)
• Airway complication (6%)
• Postoperative synovial cyst (1% cause of FBS)
• Postoperative intradural inclusion cyst
Summary

• Increasing numbers of spine surgery.
• Use standard terminologies
• Consider grading system for consistency
• CT is the best imaging modality.
• Type surgery → complication
Thank you