The Postsurgical Spine
PCCF Homecoming 2017
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US Spine Market
• North American spine surgery devices market is expected to grow at a 7.5 percent compound annual growth rate by 2019
• Spinal fusion devices have the biggest grasp on the market, with spinal fixation devices experiencing the fastest growth.
• U.S. spinal implant market—
  – Currently valued around $5 billion
  – Expected to grow at a compound annual growth rate of 2.4 percent for the next 10 years
  – $6.4 billion by 2024.
• The U.S. spine surgery market is $12 billion -- ...

What Does this Mean to You?
• You have patients and will see new patients who are post-surgical.
• You need to have a functional awareness of spine surgeries to be able to care for this population.
Understanding Surgery Begins with a Good History

- Presentation – pre (initial pathology) and post surgery?
- Surgical procedure?
- Time between surgery and imaging?

The Postsurgical Spine - Things to do on Imaging:

- Identify location and integrity of surgical implants
- Evaluate success of decompression procedures
- Assess fusion status
- Identify postoperative complications

Types of Spine Surgery

- Decompressive
- Deformity correction
- Stabilization/fusion
- Lesion excision procedures (tumor excision, infection debridement, abscess drainage)

http://spinal-deformity-surgeon.com/
Fusion – Surgical Approaches
What does it tell us?

• Posterior – decompression and fusion
• Anterior - An anterior surgical approach is used when the patient’s pain is discogenic and decompression is not necessary.
• There are others...

Decompressive Procedures

• Two major reasons
  – Disc herniation/discectomy
  – Spinal stenosis
• Three major types
  – Laminotomy
  – Laminectomy
  – Laminectomy with facetectomy

http://neurosurgery.ufl.edu/residency/about-us/clinical-specialties/spine-surgery/

https://www.indicure.com/images/
MRI Following Laminectomy

- Laminectomy defect
  - Best evaluated on T1-weighted axial images
  - Should correspond to the level of disease on the preoperative imaging study
- Disruption of the paraspinal muscles
- Edema of the adjacent soft tissues
- Dural sac
  - may protrude toward the laminectomy defect and
  - should not be mistaken for a pseudomeningocele
Remote cerebral and cerebellar hemorrhage after massive cerebrospinal fluid leakage.


Medial Facetectomy

http://files.abstractsonline.com/CTRL/16/8/a37/606/af4/494/995/98c/0f1/0a4/90e/7e/g3238_2.jpg
Spinal Stabilization and Fusion Procedures

- Address:
  - degenerative disc disease
  - spondylolisthesis
  - trauma
  - tumors
  - infection

Surgical Hardware

- Used to:
  - stabilize the spine
  - maintain anatomic alignment
  - replace excised components
Rods and screws

- Thoracic and lumbar spine usually use transpedicular screws
- Screws traverse the pedicle and enter the vertebral body
- No consensus on the optimal length of transpedicular screws
- Tip of the screw should not breach the anterior vertebral body cortex, except for the sacrum

Evaluating Post Operative Procedures

- Postsurgical changes involving the osseous structures - best appreciated on CT (bone window).
- For most other purposes MRI is superior - better appreciation of the relationship between:
  - osseous structures
  - adjacent soft tissues
  - spinal cord
  - nerve roots

Metastasis to the occipitocervical junction: A case report and review of the literature.
Pedicle Screw Placement

- Optimal placement:
  - Screw traverses the central portion of the pedicle
  - parallel to the vertebral endplate
- Complications:
  - Medial angulation may lead to disruption of the medial cortex of the pedicle and nerve root irritation.
  - Lateral angulation
    - Especially important in the cervical spine
    - Screw may traverse the transverse foramen and potentially compromise the vertebral artery.
    - Screws traversing the anterior cortex of the vertebral body, sometimes abutting the aorta.

Suboptimal Screw Placement

Optimal Pedicle Screw Placement
Screw Placement

- Anterior plate and screw fixation - screws may overpenetrate and lead to dural, cord, or nerve root injury
- Such complications can be avoided by using:
  - intraoperative fluoroscopy
  - pedicle screw electrical stimulation to confirm appropriate screw positioning

Interbody spacers

- Solid or openwork structures placed in the intervertebral disc space after discectomy
- Titanium, carbon fiber, polyetheretherketone, or bone graft
- Often filled with bone graft material
- Purpose - to promote fusion while maintaining alignment and spinal column support
Cage Subsidence – Interbody Spacers

Vertical plane - some subsidence is expected and may allow for better fusion.

Excessive subsidence = loss of intervertebral spacing with neural foraminal stenosis and possible radiculopathy

Interbody Spacers

• Most contain radiopaque markers
• A posterior marker located approximately 2 mm anterior to the posterior edge of the adjacent vertebral body indicates the spacer is in a good position.
• Important complications:
  – retropulsion
  – cage subsidence

Well Positioned Interbody Spacers
Interbody Spacers

- Monitor spacer position in both the horizontal and the vertical planes on serial imaging studies
- Horizontal plane - good position - a posterior marker located approximately 2 mm anterior to the posterior edge of the adjacent vertebral body

Malpositioned Interbody Spacers

Interspinous Fixation
Imaging of Spinal Stenosis

- Degenerative lumbar spinal stenosis – condition in which there is diminished space available for the neural and vascular elements in the lumbar spine secondary to degenerative changes in the spinal canal. (North American Spine Society 2011)

Symptoms of Lumbar Stenosis

- Back pain 95%
- Claudication 90%
- Leg Pain 71%
- Lower Extremity Weakness 33%
- Voiding disturbances 12%

Causes of Lumbar Stenosis

- Congenital
  - Short Pedicles (esp. L3)
- Acquired
  - Degenerative conditions are major cause (patients > 65)
    - Disc narrowing
    - Disc bulging and endplate osteophytes
    - Posterior joints
    - LIGAMENTUM FLAVUM
Neural Foraminal Stenosis

Extension narrows the neural foramen. Flexion increases neural foramen area.

Extension positions narrowing neural foramen result in decreased action potentials due to increased intraforaminal pressure causing venous congestion and associated decreased nerve function. Maus

Ligamentum Flavum – a dynamic problem

- Ligamentum flavum
  - thickening, buckling – 50% of stenosis at L3, and 85% at L4 on dynamic imaging

Khalil, et al.

Extreme Lateral Interbody Fusion

Adjacent Segment Disease

- Due to:
  - Shift in the weight-bearing load away from the fused segments to the adjacent levels
  - Reduction in overall flexibility and motion of the spine
- Increased stress at the perisurgical levels leads to premature degenerative changes
- May progress to spinal stenosis requiring further operative management
Disc arthroplasty

- Performed in cases where pain is thought to originate from disc degeneration without neural involvement
- Involves removal of the diseased disc and replacement with an artificial disc
- Main purpose - to relieve pain while restoring normal disc space motion.
- Contraindications include:
  - facet joint degeneration
  - prior infection
  - spinal segment instability.

[http://www.fda.gov/](http://www.fda.gov/)

Lumbar Total Disc Prosthesis


Lumbar Total Disc Prosthesis

Implant Loosening

- Osseous resorption around the anchoring screws.
- Increased lucency adjacent to the surgical implants.

Implant Loosening

- Allows increased motion, which results in a positive feedback cycle of progressive resorption and increased motion.
- Eventually destroys adjacent osseous structures with failure of implant due to fractures or screw pullout.
- Hardware fracture or dislodgment is often associated with instability, possibly with pseudoarthrosis.
- Implant failure is crucial to detect because timely diagnosis may prevent exacerbatation of the underlying pathologic condition and allow for surgical repair.

Zero-profile Anterior Fixation with...

Implant Fracture

Fractured hardware may not be displaced, making detection of such a complication more difficult.

Reherniation vs. Epidural Fibrosis

- Epidural fibrosis/scarring
  - later development that may be observed in the postoperative spine
  - may impinge on the thecal sac and mimic reherniation.
- To differentiate requires intravenous contrast
  - Epidural scar
    - Intermediate signal with irregular margins
    - heterogeneous early enhancement
  - A recurrent disc herniation
    - low signal
    - smooth margins
    - no early contrast enhancement.

Disc vs. Scar
Frank Reherniations

• When a recurrent or residual disc herniation is present, it is not necessarily symptomatic.
• Asymptomatic post surgical patients
  – residual or recurrent disc herniation in 24% of patients at the operated level within 6 weeks of surgery.
  – In 16% of these asymptomatic patients - mild to moderate mass effect on the dural sac
  – 5% had severe compression of the dural sac.
• Herniated disc fragments can regress spontaneously over time.

Foreign body

• Modern surgical sponges contain a radiopaque filament (barium sulfate).
  – allows for detection on CT and plain films.
  – filament is neither magnetic nor paramagnetic and therefore cannot be detected on MRI
• Intraoperative sponge counts are critical in detecting retained foreign body
• MRI
  – A lesion composed of cotton-like material shows low signal on T1 and T2-weighted images
  – a small area of central high T2 signal may be present if there is central necrosis
• With intravenous contrast - peripherally enhancing mass (peripheral inflammatory foreign body reaction?)
Foreign Body – MRI
Spinal Textiloma

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4115950/pdf/kmj-30-4-422.pdf

Gauze and Fibrotic Tissue

http://radnet.bidmc.harvard.edu/fetalatlas/appendicies/Artifacts/Artifacts.html
Failed Back Surgery - Spine surgery complications

- Early
  - Postoperative fluid collection:
    - Hematoma
    - Seroma
    - Pseudomeningocele
  - Operative injury
    - Fracture
    - Neural injury
    - Vascular injury

- Late
  - Inflammation
    - Arachnoiditis
    - Radiculitis
  - Infection - Spondylodiscitis
  - Acceleration of degenerative disease - adjacent level disease
  - Instrumentation failure - fractured screw or rod
  - Fusion failure - pseudoarthrosis

Diagnostic Imaging Cases

- For the time remaining we will explore cases likely to present in chiropractic offices with diagnostic imaging and clinical correlation in grand rounds style.
- We will review interesting and challenging diagnostic imaging cases of spine applying information from the lecture to their interpretation

Thank You.

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