Operative Treatment of Cervical Disc Disease, Spondylosis, and OPLL

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Spinal Disorders

- Etiologies of spinal disorders:
  - Congenital
  - Vascular
  - Neoplastic
  - Trauma
  - Infectious
  - Spondyloarthropathy

- Degenerative
  - Radiculopathy from root compression
  - Myelopathy from spinal cord compression
Cervical Spondylosis

- Spondylosis: Degenerative Changes of the spine
  - Proliferative bony and ligamentous changes at disc space --> a disease of movement
  - Occurs at one or more levels
  - Compresses spinal cord producing myelopathy
  - Cervical Spondylotic Myelopathy = CSM
Ossification of the Posterior Longitudinal Ligament (OPLL)

• Disease of unknown etiology (?genetic) causing calcification of the posterior longitudinal ligament
• Typically occurs at level of vertebral body, not at disc space
• More common in Asians
Cervical Disc Herniation

- Symptoms usually shorter in duration than spondylosis
- Protrusion of nucleus pulposus through torn or stretched annulus fibrosus fibers.
Surgical Approaches

• Diseases
  o Cervical spondylosis with myelopathy
  o Cervical disc herniation
  o OPLL

• Surgical Treatments
  o Anterior
    • Anterior Cervical Discectomy and Fusion
    • Cervical Corpectomy
    • Cervical Disc Arthroplasty (artificial disc)
  o Posterior
    • Cervical Laminectomy
    • Laminoplasty
    • Cervical Laminectomy and fusion
71yo woman with hand numbness and wobbly gait

Cervical Myelopathy from C3/4 and C4/5 spinal cord compression, decompression with C3-5 ACDF
Anterior Approach

• Anterior Cervical Discectomy and Fusion (ACDF)
• Advantages:
  o Can treat soft disc herniation or spondylosis
  o Suitable for up to 3 or 4 spinal levels (increasing risk of voice or swallowing complications with increasing number of levels)
  o Very low complication rate
  o Long track record of success “gold standard”
• Disadvantages:
  o Limitation in range of motion from fusion
  o Theoretical increase in adjacent segment degeneration
Multilevel Disease: ACDF

- **Advantages:**
  - Additional screw fixation in intervening body may improve stiffness and likelihood of fusion

- **Disadvantages:**
  - Cannot access pathology behind vertebral body
  - Multiple Graft surfaces need to heal
Why a Corpectomy?

- Corpectomy = removal of entire vertebral body
- Addresses pathology of or behind a vertebral body

25 yof with T1 metastatic renal cell carcinoma
Why a Corpectomy?

Potential benefit of two vs. multiple additional graft surfaces with regard to achieving complete arthrodesis.
Cervical Corpectomy: Incision and Dissection

- Favor transverse over oblique/vertical incision, even for multilevel corpectomy—superior cosmesis
- Use dominant crease if feasible
- Develop the natural plane between trachea-esophagus and carotid sheath to spine
Exposure

• Detach medial border of longus coli muscles and remove protruding anterior osteophytes to be sure midline is appreciated and soft tissue structures are protected.
• Specialized blades or extra hand-held retractors often helpful to protect corners in multi-level corpectomy cases
• Release of ET tube cuff pressure and periodic relaxation of retractor may be beneficial to limit soft tissue compression injury
Discectomy above and below
• Removal of Cartilaginous endplates above and below with either drill or curettes
• Do not remove bony endplate unless needed for decompression to avoid graft subsidence
• My typical decompression is 18mm wide. It is also possible to widen the decompression at the depth and remain 15-16mm more superficial.
• Always carefully study the location of the vertebral arteries on preoperative studies
• Harvest bone from vertebral body with Leksell rongeur
Harvest bone from vertebral body with Leksell rongeur
Use the diamond drill or bone wax to stop bone bleeding.
Finish bone removal

Avoid leaving a “bone island” centrally that will become harder to remove
Remove PLL

Use technique of elevating PLL with a nerve hook and, thus, the Kerrison punch always biting away from the dura. If arterial bleeding from PLL is encountered, it must be coagulated with the bipolar. Venous bleeding is best tamponaded with gelfoam.
Measure defect

- Measure with a few mm of distraction for a snug graft fit. Do not overdistract.
- Don’t forget to measure depth. A 12-14mm graft depth is often perfect, but in a small woman only a 10mm depth may be appropriate.
• Implant Placement
  • Tricortical Autograft (especially in infection)
  • Allograft strut (iliac crest or fibula)
  • Cage (PEEK, titanium, carbon fiber)
  • Distractable cages
Position Your Plate

- static vs. dynamic plate a matter of surgeon preference
- desirable to use smallest plate that fits to avoid encroachment upon neighboring disc space
Integral plate/interbody construct
Cervical corpectomy
Anterior Approach

• Disc Arthroplasty

• Advantages:
  o Preservation of motion
  o Theoretical benefit of retarding adjacent segment degeneration

• Disadvantages
  o Some conflicting data as to whether really prevents adjacent segment degeneration compared with ACDF
  o Imaging with MRI afterward is challenging
  o Not clear if it is suitable for spondylosis or only soft disc herniation
Complications with Multi-level Anterior Decompression

- Anterior procedures for multi-level compression are associated with an increased incidence of complications including graft and plate failure.
Complications with Multi-level Anterior Decompression

And
swallowing/voice dysfunction
Multilevel Disease: Posterior Approach

- The earliest methods used to decompress the cervical spinal cord involved multiple laminectomies without adjunctive fusion.
Poor Outcomes after Simple Laminectomy

- Poor results were often seen after these procedures; neurological deterioration and progressive kyphosis were often seen.
Post Laminectomy

Kyphosis

Post Op

18 months later
Treatment of Multilevel Spondylotic Myelopathy: Reappraisal of the Posterior Approach

- Excellent neurologic outcome comparable to anterior approach
- Technically easier than anterior approach
- Best in lordotic or at least straight alignment—the spinal cord floats back
Treatment of Multilevel Spondylotic Myelopathy:

The Posterior Approach

- Postlaminectomy kyphosis not an issue when instrumentation used
- Speech and swallow dysfunction not an issue
- More postoperative pain (the nuchal musculature is thick)
The Spinal Cord floats back from anterior osteophytes providing an “indirect decompression”
Lateral Disc Herniation: Posterior Approach
Lateral Disc Herniation: Posterior Approach
Bony foraminal stenosis

Left C6 radiculopathy, left C5/6 foraminal stenosis
Foraminotomy
Complications

• Infection
• CSF leak, especially with OPLL
• Neurological Injury
  o Avoid hypotension and excessive distraction, particularly in cases of severe myelopathy with cord atrophy
• C5 palsy
• Vertebral artery injury
• Esophageal perforation
• Swallowing and voice dysfunction (RLN and SLN injuries)
• Horner’s syndrome
• Pseudoarthrosis/hardware failure
Cost Effectiveness of Spinal Surgery

- Spine surgery has been demonstrated to provide excellent value compared with nonoperative care measured in quality adjusted life years (QALYs).

Comparative effectiveness evidence from the spine patient outcomes research trial: surgical versus nonoperative care for spinal stenosis, degenerative spondylolisthesis, and intervertebral disc herniation.


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Abstract
STUDY DESIGN: Cost-effectiveness analysis of a randomized plus observational cohort trial.

OBJECTIVE: Analyze cost-effectiveness of Spine Patient Outcomes Research Trial data over 4 years comparing surgery with nonoperative care for three common diagnoses: spinal stenosis (SPS), degenerative spondylolisthesis (DS), and intervertebral disc herniation (IDH).

SUMMARY OF BACKGROUND DATA: Spine surgery rates continue to rise in the United States, but the safety and economic value of these procedures remain uncertain.

METHODS: Patients with image-confirmed diagnoses were followed in randomized or observational cohorts with data on resource use, productivity, and EuroQol EQ-5D health state values measured at 6 weeks, 3, 6, 12, 24, 36, and 48 months. For each diagnosis, cost per quality-adjusted life year (QALY) gained in 2004 US dollars was estimated for surgery relative to nonoperative care using a societal perspective, with costs and QALYs discounted at 3% per year.

RESULTS: Surgery was performed initially or during the 4-year follow-up among 414 of 634 (65.3%) SPS, 391 of 601 (65.1%) DS, and 789 of 1192 (66.2%) IDH patients. Surgery improved health, with persistent QALY differences observed through 4 years (SPS QALY gain 0.22; 95% confidence interval, CI: 0.15, 0.34; DS QALY gain 0.34, 95% CI: 0.30, 0.47; and IDH QALY gain 0.34, 95% CI: 0.31, 0.38). Costs per QALY gained decreased for SPS from $77,600 at 2 years to $59,400 (95% CI: $37,059, $125,162) at 4 years, for DS from $115,600 to $64,300 per QALY (95% CI: $32,864, $83,117), and for IDH from $34,355 to $20,600 per QALY (95% CI: $4,539, $33,088).

CONCLUSION: Comparative effectiveness evidence for clearly defined diagnostic groups from Spine Patient Outcomes Research Trial shows good value for surgery compared with nonoperative care over 4 years.
Cost-Effectiveness of Single-Level Anterior Cervical Discectomy and Fusion Five Years After Surgery

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Discussion
Cost/QALY for instrumented ACDF
• US$23,500 – US$24,500
• Less than previously reported US$32,560
  • Using decision-analytic model

• Less than cost/QALY threshold of $50,000 - $100,000
  Winkelmeier, 2002

• Less than US per capita GDP
  $47,000
  WHO, 2001

Angevine, 2005
Laupacis, 1992