Cervical Myelopathy
Which Approach Will Work?

William F. Donaldson III MD

- Executive Vice Chair for clinical services
- Professor and Chief Division of Spinal Surgery
- Department of Orthopaedic Surgery
- University of Pittsburgh Medical Center
Primary Goal:
- 1. Improvement / Preservation of Neurological function by spinal cord decompression

Secondary Goals:
- 1. Prevention or correction of deformity
- 2. Maintain or improve spinal stability
- 3. Avoid morbidity

Rao et al. JBJS 2006
Important Questions to Make the Decision

1. Location of Compression? Ant vs Post
2. How many levels of compression?
3. Alignment? Lordotic vs. Kyphotic
4. Presence of congenital stenosis?
5. Presence of instability?
6. Axial neck pain?
7. Fusion Potential? Smoker?
8. Prior Surgery Location?
9. Is the deformity Rigid or Flexible?

Rao et al. JBJS 2006
Prospective cohort study evaluating the efficacy of different surgical techniques to decompress spinal cord in CSM

N=280 patients (mild-31.6%, Mod-39.6%, severe 29.9%) and (ant-60%, post-35%, combo- 5%)

85.4% fu/ evaluated by mJOA, Nurick grade, SF-36, NDI

All groups (mild, mod, sev) improved significantly despite severity in terms of outcomes with exception of the mild group in terms of mJOA score

No difference ant, post, and ant/post in terms of outcome scores

Outcomes maintained for 2 yrs
Systematic review of the literature on Surgical treatment of CSM and OPLL

- Divided by <5yr fu and >5yr fu for ant and post tx
- <5yr- ant surgery significantly better neurological outcomes but after 5 yrs showed no difference
- Ant surgery also significantly better in OPLL with canal stenosis ≥60% with final mJOA
- <5ys ant surgery has significantly higher complication rate
- All studies class 3, and difficult to study ant vs post due to heterogeneous mix of techniques
Prospective cohort study evaluating complications based on anterior vs posterior

Overall perioperative complication rate- 15.6%, late- 4.4%

Ant-11%, post-19%, ant/post-37%* (only combo approach reached significance)

Age & OR time associated with ↑ complication rate

Posterior was associated with ↑ infection (4.7% vs. 0.6%) but not C5 radiculopathy

Ant and Ant/post associated w dysphagia (2.3% &21.2%)
Approaches

- **Anterior Alone**
  - Minimal fixed deformities
  - Short segments
  - Cord decompression necessary

- **Posterior Alone**
  - Indicated when deformity is relatively flexible in neutral or <13 degrees kyphosis
  - Get dynamic flexion/extension films
  - Minimal Cord compression (or rely on “dorsal drift”)

- **Combined Anterior/Posterior**
  - Rigid deformities
  - Larger more significant deformities
  - Concurrent cord compression anterior and posterior
  - Cervical-Thoracic Junctions
Anterior Techniques

- Anterior Discectomy Fusion
- Hemi-corpectomy Fusion
- Single Corpectomy Fusion
- Corpectomy/Discectomy Hybrid
- Multi-Level Corpectomy
  - 2 Level Corpectomy (3 Disc Levels)
  - 3 Level Corpectomy (4 Disc Levels)
- Anterior/Posterior Combined Approaches
Smith Robinson technique most popular for ACDF

DANGER: Over-distraction during discectomy in Myelopathic patients (use SSEPs)
Corpectomy may be safer
ACDF
Uncovertebral Spur Resection
 +/- PLL Resection
3 Level ACDF

Pre Op  Post Op  1 year FU
ACDF: the good and the bad

ADVANTAGES:
- Safe/familiar
- Deformity correction
- Instability correction
- Directly removes offending pathology
- Improves axial neck pain
- Stable biomechanically

DISADVANTAGES:
- Dysphagia/dysphonia
- Possible adjacent segment degeneration (2.9%/yr)*
- Can not address congenital stenosis or posterior compressive pathology
- Motion loss
- Can not access pathology behind vertebral body
- Higher pseudarthrosis rate 11-40%

*Hilibrand et al. (2009)
Corpectomy/Discectomy Hybrid
Anterior Corpectomy Fusion C4-7
Anterior Discectomy Fusion C7-T1
INDICATIONS:

- Retrovertebral compressive pathology
- Multiple levels of stenosis
- OPLL with ≥ 60% canal compromise*

CONTRAINDICATIONS:

- Posterior compressive elements/congenital stenosis
- Prior anterior surgery relative

Liu et al. Eur Spine J (2011)
**BENEFITS:**
- Direct removal of anterior pathology
- Access to space behind vertebral body
- Axial pain relief
- Deformity correction (kyphotic spine)

**DISADVANTAGES:**
- Technically demanding
- Increased blood loss
- Higher complication rate
- Decreased motion
- Graft related complications (up to 20% graft kick out)
- Dysphagia/dysphonia
- Increased failure rate with more levels
## Laminectomy & fusion Indications/Contraindications

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<sup>1</sup> Suda et al. 2003
Laminectomy & Fusion +/-

**ADVANTAGES**

- Can address posterior compressive pathology and congenital stenosis
- Improves axial neck pain
- Can address instability
- Can be used in the setting of dynamic kyphosis

**DISADVANTAGES**

- Higher complication rate
- Decreased range of motion
- Higher cost
- C5 radiculopathy*

* C5 radiculopathy may be just as common in anterior surgery as posterior surgery
- 62 yo male
  - s/p C3-7 lami/fusion
    - 10 years ago
  - Now with recurrent fine motor/balance problems
Baba et al. (1996) - Lordosis = posterior cord migration and posterior cord migration correlated with better neurologic recovery (no kyphosis in study).

Kawakami et al. (2002) - No correlation between kyphotic cervical spine and outcome but did correlate apex posterior and straight spinal cord with worse neurologic outcome.

Chiba et al. (2006) - OPLL in the setting of kyphosis have worse neurologic outcome with laminoplasty.

Suda et al. (2003) - Kyphosis greater than 13° portends worse outcome, below 13° kyphosis no correlation to worse neurologic outcomes.

A word on Kyphosis and Posterior Surgery...
## Laminoplasty Indications/Contraindications

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Laminoplasty +/-

ADVANTAGES

- Improved neck range of motion
- Reduced cost compared to lami-fusion (⅓ implant cost)
- Avoids fusion related issues
- Lower complication rate
- Lower rate of Adjacent level disease (JBJS Nov 2014)

DISADVANTAGES

- Neck pain (6-60%)\(^1\)
- Technically difficult
- C5 radiculopathy\(^*\)

6 Months Post Op Laminoplasty
Laminoplasty vs laminectomy and fusion vs anterior fusion

- **Systematic review:**
  Laminoplasty has a significantly higher incidence of bothersome neck pain.

- **Heller et al**
  Equivalent neurologic functional recovery (Nurick and self report)
  No Difference in neck pain
  Laminectomy and fusion had 2x amount of complications
  ACCF- higher blood loss, hospital stay
  Complications: ACCF- 61% vs LP-7.6% (p<0.05)
Combined Anterior and Posterior Approaches

- Generally better correction of deformities
- Anterior decompression advantages
- Posterior osteotomies and facetectomies also allow for added correction
- Higher Fusion rates
- More morbidity, bigger surgery
- Higher Adjacent level disease?

- Useful for most larger kyphotic deformities
Kyphosis with Myelopathy

Anterior Corpectomy
Posterior Fusion
Original MRI Prior to Laminectomy
Post-laminectomy Kyphosis
1 year Postop
2 years
Xrays 6 Month Post-op
Generally for AS patients at cervical thoracic junction with fixed deformity

- Wide laminectomy C7-T1
- Protect the C8 root
- Facetectomies can also allow for segmental correction with instrumentation
- Good tool for further correction
Part 3 and Post OP
Conclusions

**Anterior Approach**
Anterior disease or Anterior Cord Compression
1-2 level disease with mild kyphosis

**Posterior Approach**
Posterior or concentric disease with lordotic spine
<13 degrees kyphosis or flexible into lordosis

**Combined A/P Approach**
>13 degrees Kyphosis
Deformity cases
Unstable cases
Multi level corpectomies
Poor bone quality
Thank You
What Could Possibly Go Wrong?
Reports of up to 35-40% Complications with long anterior plates alone (Vacarro et.al) Disastrous Complications Cited (Riew et.al)
Poor Carpentry or Fixation
pseudarthrosis

CSF Leak
Vocal Cord Paralysis

Hematoma /Edema Respiratory Distress
Dysphagia
Esophageal Injury
Esophageal perforation and Mediastinitis
Systematic review of literature

Laminoplasty as a treatment for CSM has:
- Fewer complications
- Possibly greater range of motion
- Similar neurologic recovery compared with ACDF, multilevel CORP, and LAMI-fusion

Laminoplasty has a significantly higher incidence of bothersome neck pain.
- Retrospective matched cohort
- N=26, 2 groups= Laminoplasty (n=13) vs. laminectomy and fusion (n=13) with 2 year average fu
- Equivalent neurologic functional recovery (Nurick and self report)
- No Difference in neck pain
- Laminectomy and fusion had 2x amount of complications (p<.05)
Retrospective review of patients treated posteriorly for CSM

N=56, 2 groups Laminoplasty vs. laminectomy and fusion with 42 mo average fu

Laminoplasty has lower cost and reoperation rate and neck pain did not change pre to post-op

Laminectomy and fusion significantly improved neck pain but was more expensive and had higher complication rate
Retrospective matched cohort

N=26, 2 groups: Laminoplasty (n=13) vs. ACCF (n=13) with 40 and 49 mo fu respectively

Equivalent neurologic functional recovery (Nurick and self report)

No Difference in neck pain, Neck ROM 38% LP vs. 57% ACCF

ACCF - higher blood loss, hospital stay

Complications: ACCF - 61% vs LP - 7.6% (p<0.05)
Cervical surgical techniques for the treatment of cervical spondyloptic myelopathy

Praveen V. Mummaneni, M.D., Michael G. Kaiser, M.D., Paul G. Matz, M.D., Paul A. Anderson, M.D., Michael W. Groff, M.D., Robert F. Heary, M.D., Langston T. Holly, M.D., Timothy C. Ryken, M.D., Tanvir F. Choudhri, M.D., Edward J. Vresilovic, M.D., Ph.D., and Daniel K. Resnick, M.D.

- Systematic review of literature for different surgical treatments of CSM
- ACDF vs ACCF for multilevel CSM
  - Equivalent rates of neurologic recovery
  - Similar fusion rates with use of anterior plate
  - Complication rates not reviewed

J Neurosurg Spine 11:130–141, 2009
Revision Posterior Approach - Requirements

- Mainly for flexible deformities
- No anterior pathology or cord compression
- Reasonable bone stock posteriorly
- Reduction mainly through traction and positioning
  - Gardner Wells tongs
  - Mayfield tongs
  - Lateral Xrays for confirmation of reduction
Stenosis, Kyphosis and prior ACDF

Neutral  Flexion  Extension
1 year Post op
Possibly “Got away with it”
Post GW traction x2 days: ML
Anterior Corpectomy
Part 2: ACDF C2-5
Part 2: C2-5 ACDF