



# The Case for Posterior Foraminotomy



Michael Y. Wang, MD  
Professor

Departments of Neurological Surgery & Rehab Medicine  
The Miller School of Medicine at the  
University of Miami

---

---

---

---

---

---

---

---



## Disclosure

- Consultant: Depuy Spine
- Royalties: Depuy Spine  
Springer Publishing  
Quality Medical Publishing
- Stock: Innovative Surgical Devices  
Spinicity
- Grants: Department of Defense

---

---

---

---

---

---

---

---



## Today's Case



---

---

---

---

---

---

---

---

## Thanks Sheeraz !



This is a perfect case for a posterior foraminotomy:

1. Young patient
2. Unilateral symptoms
3. Single level
4. Minimal neck pain
5. No abnormal alignment
6. No abnormal motion

---

---

---

---

---

---

---

---



### Pro

*No approach problems*

*No need to stabilize*

*Decreased adjacent level disease*

### Con

*Possibility of recurrence*

*No treatment of instability*

*Unilateral treatment*

*Interrupts neck musculature*

---

---

---

---

---

---

---

---

## Is it Effective?




---

---

---

---

---

---

---

---

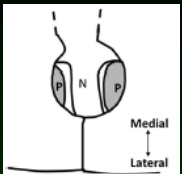


**RESEARCH ARTICLE** Open Access

**Tandem keyhole foraminotomy in the treatment of cervical radiculopathy: retrospective review of 35 cases**

Shashank Patel, Anil Kumar, Anand, Howard, Vinayak, Verma, Kiran, Shrinani, Naveen, Rajeev, Vikram, Suresh, Anand, Srinivasan, Suresh

**Abstract**  
 There has been an upsurge regarding the needs of low-back/neck/limb pain patients. The purpose of this study was to report clinical and radiographic outcomes of minimally-invasive tandem keyhole foraminotomy for cervical radiculopathy. **Background:** There has been an upsurge regarding the needs of low-back/neck/limb pain patients. The purpose of this study was to report clinical and radiographic outcomes of minimally-invasive tandem keyhole foraminotomy for cervical radiculopathy. **Methods:** The authors conducted a retrospective review of 35 cases treated by a single surgeon using 2 1/2" tubular approach, with all patients maintaining postoperative analgesia and no inpatient care needed post-surgery. **Results:** Patients presented with various levels of cervical radiculopathy, including C5/6, C6/7, C7/T1, and C4/5. The mean age was 53.4 years (range 45-74 years). The mean duration of symptoms was 24 months (range 1-60 months). The mean level of pain was 7.5 (range 3-10). The mean time to surgery was 12 months (range 3-24 months). The mean duration of follow-up was 18 months (range 3-36 months). The mean rate of pain relief was 88% at 3 months and 97% at final follow-up. There were no complications reported in any of the cases.



35 patients

1. 99 minutes
2. 55 g Blood loss
3. 88% had relief at 3 months
4. 97% had relief at final F/U

---

---

---

---

---

---

---

---

---

---

## What About MIS?



---

---

---

---

---

---

---

---

---


---

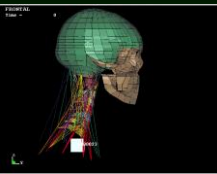
## What About the Posterior Approach ?

Standard open techniques require extensive disruption of dorsal musculoligamentous resulting in :

- Incision-related pain*
- Devitalization of neck musculature*
- Poor cosmesis*
- Interruption of the posterior "dynamic tension band"*

Minimal access approaches attempt to overcome these drawbacks of conventional open surgery





Finite element analysis

---

---

---

---

---

---

---

---

---

---



### Tubular Dilator Retractors



1. Utilizes serial expansion of muscles over a guide wire
2. Spreads muscles instead of cutting them
3. Final dilation to 16 mm to 24 mm in diameter
4. Serves essentially as an access port

---

---

---

---

---

---

---

---



### “Mom...look what I did through the Tube !”

Minimally invasive techniques are being used for:

1. Odontoid screw fixation
2. Transarticular screw placement
3. C1-2 Harms techniques
4. Tumor removal
5. Laminectomy
6. Trans-facet fixation

---

---

---

---

---

---

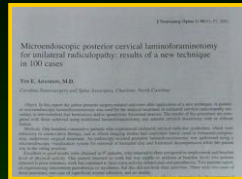
---

---



### Cervical Foraminotomy

- 100 consecutive patients undergoing minimally invasive cervical foraminotomy
- 97 patients reported as “good” or “excellent” results
- Typical discharge home in 3 hours
- 60 patients able to return to work within one week.
- Two dural tears
- One wound infection




---

---

---

---

---

---

---

---

Journal Pre-proof  
Journal Pre-proof

**Table 4. Changes of pain degree after operation (VAS)**

Variable	Group 1	Group 2	P value
<b>VAS of radicular pain</b>			
Preoperative (range)	7.4 (6-10)	7.3 (6-10)	NS
1 day after operation (range)	2.9 (1-4)	3.0 (1-4)	NS
5 day after operation (range)	3.4 (1-5)	3.2 (1-4)	NS
4 wk after operation (range)	2.2 (0-4)	2.3 (1-4)	NS
3 mon after operation (range)	1.9 (0-3)	1.8 (0-3)	NS
6 mon after operation (range)	1.8 (0-3)	1.7 (0-3)	NS
12 mon after operation (range)	1.7 (0-3)	1.8 (0-3)	NS
24 mon after operation (range)	1.6 (0-3)	1.7 (0-3)	NS
<b>VAS of neck pain</b>			
Preoperative (range)	2.9 (1-4)	3.0 (1-5)	NS
1 day after operation (range)	5.9 (4-8)	4.7 (3-7)	<0.05
5 day after operation (range)	5.8 (4-8)	4.5 (3-7)	<0.05
4 wk after operation (range)	4.4 (2-6)	3.5 (2-6)	<0.05
3 mon after operation (range)	2.1 (1-4)	2.0 (0-4)	NS
6 mon after operation (range)	1.4 (0-4)	1.5 (0-3)	NS
12 mon after operation (range)	1.5 (0-4)	1.4 (0-3)	NS
24 mon after operation (range)	1.4 (0-3)	1.4 (0-3)	NS

---

---

---

---

---

---

---

---

---

---

---

---

# What is the Rate of Reoperation or Adjacent Disease?

---

---

---

---

---

---

---

---

---

---

---

---

ELSEVIER

The Spine Journal • 2013

**THE SPINE JOURNAL**

**Clinical Study**

**Rates of anterior cervical discectomy and fusion after initial posterior cervical foraminotomy**

Timothy Y. Wang, BS<sup>1,2</sup>, Daniel Lubelski, BA<sup>1,3</sup>, Khalil G. Abdullah, MD<sup>4</sup>, Michael P. Steinmetz, MD<sup>5</sup>, Edward C. Benzel, MD<sup>6,7</sup>, Thomas E. Mroz, MD<sup>8,9,10</sup>

<sup>1</sup>Ohio State University School of Medicine, 6800 27th, Columbus, OH 43203, USA  
<sup>2</sup>Center for Spine Health, Cleveland Clinic, 9500 Euclid Ave., Cleveland, OH 44195, USA  
<sup>3</sup>Cerner College of Medicine, Cleveland Clinic, 9500 Euclid Ave., Cleveland, OH 44195, USA  
<sup>4</sup>Department of Neurosurgery, Hospital of the University of Pennsylvania, 3409 Spruce St., Philadelphia, PA 19104, USA  
<sup>5</sup>School of Medicine, Case Western Reserve University, 10900 Euclid Ave., Cleveland, OH 44106, USA  
<sup>6</sup>Department of Neurosurgery, Montefiore Medical Center, 2500 Montross Ave., Cleveland, OH 44105, USA  
<sup>7</sup>Department of Neurological Surgery, Cleveland Clinic, 9500 Euclid Ave., Cleveland, OH 44195, USA  
 Received 14 December 2012; accepted 22 May 2013

---

---

---

---

---

---

---

---

---

---

---

---

- 178 patient followed a mean of 31.7 months
- 9 (5%) of patients underwent reoperation at index level
- Associated factors: young, thin, anxious patients

---

---

---

---

---

---

---

---

---

---

---

---

**University of Miami**

**THE SUNSHINE JOURNAL**

Volume 18 Number 1 • February 2014

**Complications, outcomes, and need for fusion after minimally invasive posterior cervical foraminotomy and microdiscectomy**

Richard G. Fessler, MD, PhD, Sheraz A. Qureshi, MD, PhD, Richard G. Fessler, MD, PhD, Yakov Galanter, MD, Raquel Hager, MD, PhD

**70 patients:**

1. No secondary intervention
2. 5 patients had ACDF
3. ACDF was a mean of 44 months later
4. 1.1% per year same level
5. 0.9% per year adjacent level surgery



**University of Miami**

**Biomechanical Effects in vivo**

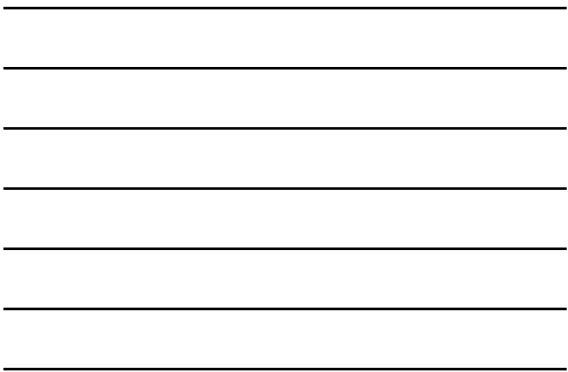
**CLINICAL ARTICLE**

Long Term Effect on Adjacent Segment Motion after Posterior Cervical Foraminotomy

Tack Geun Choi, Young Bang Kim, Seung Won Park

**Figure:** A line graph showing the change in Range of Motion (ROM) for Preoperative and Last follow-up for PCE (Posterior Cervical Extension) and ACDF (Anterior Cervical Discectomy and Fusion). The Y-axis represents ROM in degrees, ranging from 0 to 14. The X-axis shows Preoperative and Last. PCE shows a decrease in ROM from approximately 12.5 to 11.5 degrees. ACDF shows a decrease in ROM from approximately 12.5 to 10.5 degrees.

Group	Preoperative ROM (degrees)	Last ROM (degrees)
PCE	~12.5	~11.5
ACDF	~12.5	~10.5



**University of Miami**

**Cost Utility Analysis**

**Alvin, et al (JSDT)**


**The Cleveland Clinic experience w/ foraminotomy:**

- 45 ACDF vs 25 foraminotomy patients
- Assessed with VAS, NDI, EQ-5D & PHQ-9
- Both groups showed improved outcomes and MCID
- At one year, foraminotomy was more cost effective

ACDF	\$131,951 / QALY
Foraminotomy	\$ 79,856 / QALY



## Military Experience



Management of unilateral cervical radiculopathy in the military: the cost effectiveness of posterior cervical foraminotomy compared with anterior cervical discectomy and fusion

Lee M. Tetzlaff, LCDR, MC, USN, Ross P. Pincus, M.D., LT, MC, USN, and Wayne H. Gurr, M.D., CDR, MC, USN  
 Department of Neurosurgery, Naval Medical Center San Diego, California

	ACDF	Foraminotomy
Number of patients	19	19
Mean Age	39.3	41.5
OR Time	151.6	153.9
Blood Loss	32.6	39.7
Complications	2	0
Direct Costs	10,078	3,570
Return to work (weeks)	19.6	4.8

---

---

---

---

---


---

---


---

---

---



## Foraminotomy has been around for over 50 years, so what does the future hold?



---

---

---

---

---

---


---

---

---

---

## Use of smaller tubes




Spine, Volume 33, Number 9, 19 May 2008  
©2008 Lippincott Williams & Wilkins

Full-Endoscopic Cervical Posterior Foraminotomy for the Operation of Lateral Disc Herniations Using 5.9-mm Endoscopes  
 A Prospective, Randomized, Controlled Study

Sebastian Rietton, MD, PhD,\* Martin Komp, MD, PhD,\* Harry Mark, MD,† and Georgios Godolias, MD‡

- Randomized trial of ACDF vs. Foraminotomy
- N=175 with f/u 2 years
- Dx: Radiculopathy
- 6 complications, 3 revisions
- 87.4% resolution of symptoms
- No difference between groups



---

---

---

---

---

---

---


---

---

---

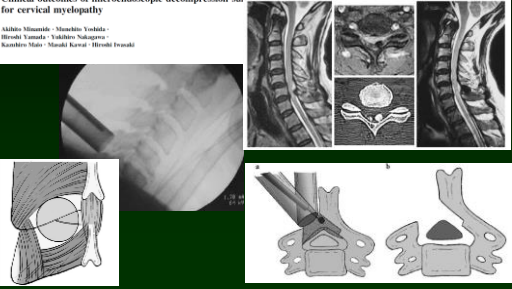


## Central Canal Decompression



Int. Spine J. (2013) 24(4):457-461  
 DOI: 10.1007/s00381-013-2113-9  
**ORIGINAL ARTICLE**

**Clinical outcomes of microendoscopic decompression surgery for cervical myelopathy**  
 Akhito Yamada · Masahito Yoshida · Hiroaki Yamada · Yoshitaka Sakaguchi · Kazuhiko Maeno · Masaki Kawai · Hiroshi Iwasaki




---

---

---

---


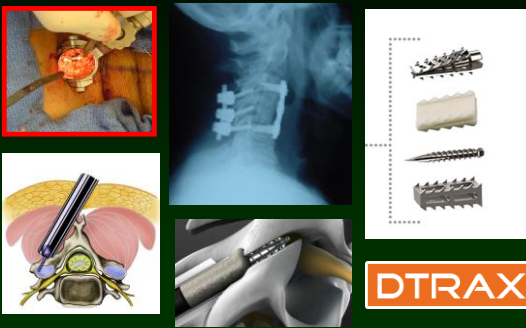
---

---

---

---

## Minimally Invasive Fusion

**DTRAX**

---

---

---

---

---

---

---

---




**! Thank You !**

---

---

---

---

---

---

---

---

## Cervical Radiculopathy: Case Based Debate

CERVICAL TDR



Pierce D. Nunley MD  
Director, Spine Institute of Louisiana  
Assistant Professor, Louisiana State University



---

---

---

---

---

---

---

---

## Disclosures

- Research Funding
  - LDR Spine
- Speaker's Bureau
  - LDR Spine
  - K2M



---

---

---

---

---

---

---

---

## History

Smith and Robinson introduced anterior cervical discectomy and arthrodesis in 1958 as a surgical option for the management of cervical disc disorders.

*Smith GW, Robinson RA. The treatment of certain cervical spine disorders by anterior removal of the intervertebral disc and interbody fusion. J Bone Joint Surg Am. 1958; 40: 607-24*

ACDF has gained acceptance as standard of care for patients with persistent radicular and/or myelopathic symptoms that have failed to improve with conservative treatments.

*Rao RD, Carrier BL, Albert TJ et al. Degenerative cervical spondylosis: clinical syndromes, pathogenesis and management. J Bone Joint Surg Am 2007; 89: 1360-78*



---

---

---

---

---

---

---

---

## ASP – Adjacent Segment Pathology

As longer term results became available, the outcome studies increasingly focused on the adverse effects of this procedure.

### Radiculopathy and Myelopathy at Segments Adjacent to the Site of a Previous Anterior Cervical Arthrodesis

ALAN S. HILBRAND, GREGORY D. CARLSON, MARK A. PALUMBO, PAUL K. JONES and HENRY H. BOHLMAN  
*J Bone Joint Surg Am.* 1999;81:519-28.

20-32% of patients undergoing ACDF would develop ASP during the next 10 years



---

---

---

---

---

---

---

---

---

---

The concern that spinal fusion may be a contributing factor to accelerated ASP led to increased interest in “motion preservation”

Journal of Spinal Disorders & Techniques  
Vol. 15, No. 7, pp. 411-419  
© 2003 Lippincott Williams & Wilkins, Inc., Philadelphia

### Internal Stress Distribution in Cervical Intervertebral Discs

The Influence of an Artificial Cervical Joint and Simulated Anterior Intervertebral Fusion

Crispin C. Wigfield, \*Daniel Skrzypiec, †Andre Jackowski, and \*Mike A. Adams

Similar stress profiles were recorded from intact specimens and those with the artificial joint inserted.

The artificial joint resulted in reduced stresses in the annulus compared with spines with a simulated fusion.



---

---

---

---

---

---

---

---

---

---

## Rationale

- This immediately led the scientists and surgeons to focus their attention towards developing alternative procedures to ACDF
- The concept of “**motion preservation technology**” was thus born and subsequently led to the development of **cervical total disc replacement (c-TDR)**.
- Since then several total disc arthroplasty implants have been used for treating cervical degenerative disc disease and the clinical outcomes have been published in the literature.



---

---

---

---

---

---

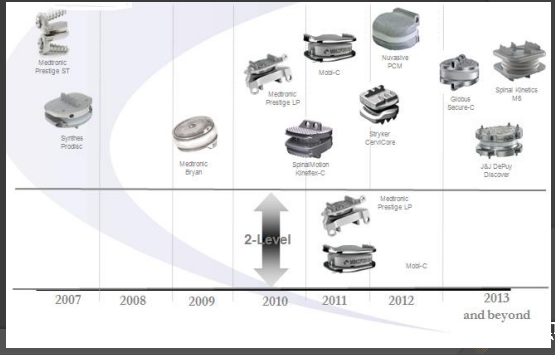
---

---

---

---

### FDA Clearance of Cervical Discs in U.S.




---

---

---

---

---

---

---

---

---

---

---

---

- Garrido BJ, Taha TA and Sasso R. Clinical outcomes of Bryan cervical disc arthroplasty: a prospective, randomized, controlled, single site trial with 48-month follow-up. *J Spinal Disord Tech.* 2010 Aug; 23(6):367-71
- Quan GM, Vital J, Hanson S. Eight -year clinical and radiological follow-up of the Bryan cervical disc arthroplasty. *Spine* 2011; 36(8): 639-646
- Sasso RC, Anderson PA, Riew KD and Heller JG. Results of cervical arthroplasty compared with anterior discectomy and fusion: Four-year clinical outcomes in prospective randomized controlled trial. *J Bone Joint Surg Am* 2011; 93: 1684-92
- Coric D, Nunley PD, Guyer RD, Mustane D et al. Prospective randomized multicenter study of cervical arthroplasty: 269 patients from the Kinflex/C artificial disc investigational device exemption study with a minimum 2-year follow-up. *J Neurosurg: Spine/ June 24, 2011; epub ahead of print*
- Huppert J, Beaurain J, Steib JP and Bernard P et al. Comparison between single and multi-level patients: clinical and radiological outcomes 2 years after cervical disc replacement. *Eur Spine J.* 2011; Sep 20(9): 1417-26
- Zechmeister J, Winkler R, Mad P. Artificial total disc replacement versus fusion for the cervical spine: a systematic review). *Eur. Spine J.* 2011; 20(2): 177-84




---

---

---

---

---

---

---

---

---

---

---

---

A review of the published literature raises the following basic questions:

- Are the short or long term clinical outcomes better in patients with disc replacement as compared to ACDF?
- Is there a significant difference in the incidence of Clinical adjacent segment pathology (CASP) after the two procedures?
- Is there a strong, evidence-based rationale to perform total disc replacement instead of ACDF?
- Are there specific patient subsets in which either of the procedures may provide better longer term outcomes (index level or adjacent segment disease)?




---

---

---

---

---

---

---

---

---

---

---

---

## Primary Outcome Comparisons

### Problems

1. the longest published follow-up period for total disc replacement is about 8 years
2. Most of the published data for total disc replacement consists of patients with one or two level disease
3. The data for total disc replacement is usually gathered from the patients who have participated in the randomized controlled trials (RCT) for particular implants. *(Such trials have very stringent inclusion/exclusion criteria for selecting patients and are often criticized as not representing the general patient population.)*




---

---

---

---

---

---

---

---

## ACDF Outcomes

### Problems

1. Most published results of the ACDF procedure are retrospective and/or anecdotal from experience of a single surgeon or institution, (class III studies at best.)
2. The outcome instruments used and success criteria used for the ACDF studies have varied according to the different authors' judgment and tools available at the time of data acquisition.




---

---

---

---

---

---

---

---

## Bottom Line

- ❖ Comparable success rates for both procedures at the average follow-up of 2-4 years
- ❖ Clearly established the non-inferiority of the TDR procedure to the ACDF.
- ❖ Questionable rationale for utilizing TDR as an alternative to the fusion procedure\*\*.

\*\* Bartels RHMA, Donk R and VerBeek ALM. No justification for cervical disc prostheses in clinical practice: a meta-analysis of randomized controlled trials. *Neurosurgery*, 66(6): 1153-1160; 2010




---

---

---

---

---

---

---

---

## Adjacent Segment Pathology (CASP)

Hilibrand's follow-up study: Admitted that the scientific literature was unclear whether the ASP is a result of the spinal fusion with iatrogenic motion restriction or whether it represented a progression of the natural history of degeneration

*Hilibrand AS, Robbins M: Adjacent segment degeneration and adjacent segment disease: the consequences of spinal fusion? Spine J 2004; 4: 190S-194S*

The primary end points of TDR clinical trials are focused on improvements in patient's symptoms attributable to the index-level.

The published results are mostly focused on the outcomes at 24-month follow-up, the period being too short to assess ASD.



---

---

---

---

---

---

---

---

---

---

## Our Experience



Total disc arthroplasty is equivalent to ACDF for providing relief from symptoms

The risk of developing adjacent segment degeneration is equivalent after both procedures but is significantly higher in patients with concurrent DDD in lumbar spine.



---

---

---

---

---

---

---

---

---

---

## Our Experience



At a projected follow-up of up to 54 months, the risk of developing symptomatic adjacent segment disease (CASP) does not significantly vary between patients receiving total disc arthroplasty or anterior fusion.

Other factors including bone mineral density and presence of concurrent lumbar degeneration have a more significant effect in the incidence of adjacent segment degeneration.



---

---

---

---

---

---

---

---

---

---

Comparison of artificial cervical arthroplasty versus anterior cervical discectomy and fusion for one-level cervical degenerative disc disease: a meta-analysis of randomized controlled trials.

Luo, et al - Eur J Orthop Surg Traumatol - Jul 2014

- 13 RCT's, 24 month f/u
- Statistical significant improvement TDR over ACDF in
  - Neurological Success
  - Secondary Surgical Procedures
  - VAS – Neck & Arm
- NDI – Statistically similar




---

---

---

---

---

---

---

---

---

---

Artificial cervical disc arthroplasty versus anterior cervical discectomy and fusion: a systematic review  
Mroz, et al SPINE 25:1 2014

“Level I evidence suggests that artificial cervical disc arthroplasty has relatively low complication, reoperation, and heterotopic ossification rates and that quality of life measures such as Neck Disability Index, visual analogue scale, and Short Form 36 (SF36) significantly improved ....”




---

---

---

---

---

---

---

---

---

---

Two-level Total Disc Replacement with Mobi-C® Cervical Artificial Disc versus Anterior Discectomy and Fusion: A Prospective, Randomized, Controlled Multicenter Clinical Trial with 4 Year Follow-up Results  
Davis RJ, Nunley PD, et al J. of Neurosurgery – Spine 2014

N=389 f/u 4-7 years

Patients receiving treatment with TDR at TWO LEVELS had statistically significantly greater improvement than ACDF for:

- NDI
- SF-12 PCS
- Patient Satisfaction
- Overall Success
- Revision Surgeries
- Radiographic ASP




---

---

---

---

---

---

---

---

---

---

## Cervical TDR vs Foraminotomy

- ⦿ Patient Symptoms
  - Radiculopathy vs Neck Pain
  - Myelopathy?
- ⦿ Radiological Considerations
  - Central vs Peripheral
  - Soft vs Hard
  - Adjacent Segements
- ⦿ Long Term Consequences
  - Bridge Burning?




---

---

---

---

---

---

---

---

Long-term patient outcomes after posterior cervical foraminotomy: an analysis of 151 cases  
 Bydon, et al – J Neursurgery Spine 15:1-5 2014

- ⦿ n=151, f/u 4 to 15 years
- ⦿ Reoperation Rates:
  - 18.3% f/u > 2 years
  - 24.3% f/u > 10 years
- ⦿ “Patients with no preoperative neck pain had the lowest rates of revision surgery after PCF.”




---

---

---

---

---

---

---

---

Reoperation Rates After Anterior Cervical Discectomy and Fusion vs Posterior Cervical Foraminotomy: A Propensity Matched Analysis.  
 Mroz, et al Neurosurgery 2014

- ⦿ N=790, f/u 2 – 6 years
- ⦿ Reoperation rate at the index level was:
  - 4.8% for the ACDF
  - 6.4% for the PCF group (p = 0.7),




---

---

---

---

---

---

---

---



Cervical arthroplasty after previous surgery: results of treating 24 discs in 15 patients.  
Sekhon et al - J Neurosurg Spine. 2005 Nov;3(5):335-41.

“provided encouraging early clinical results, although patients with preoperative hypermobility should be treated with caution. Issues such as accelerated device-related wear and the use of arthroplasty after aggressive facetectomy resection will need further study”



---

---

---

---

---

---

---

---

The Effect of Posterior Decompressive Procedures on Segmental Range of Motion Following Cervical Total Disc Arthroplasty.  
Patwardhan AG, et al - SPINE June 2014

- Human Cadaver Biomechanical Study
- Unilateral Hemilaminotomy MAY be safe, but warned against cyclic loading in In-Vivo state
- Bilateral Hemi and Laminectomy UNSTABLE

By performing Hemilaminotomy, what FUTURE are we relegating our patients to?



---

---

---

---

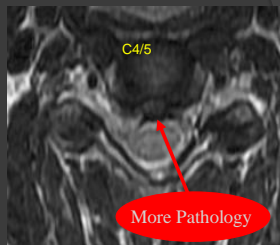
---

---

---

---

### Debate Case



---

---

---

---

---

---

---

---

## Conclusions

- c-TDR is a safe and efficacious procedure for the indications of cervical myeloradiculopathy in appropriately selected patients
- c-TDR at two levels has shown superiority over 2 level ACDF (Class I Evidence)
- PCF may lead to as many or more revision surgeries as well as prevent conversion to c-TDR
- THEREFORE: c-TDR is the best choice



---

---

---

---

---

---

---

---

Thank You!



---

---

---

---

---

---

---

---

## For Single Level Disease With Radiculopathy, ACDF is the Best Option

Todd J. Albert, MD  
Surgeon-in-Chief and Medical Director  
Korein-Wilson Professor  
Hospital for Special Surgery  
Chairman, Department of Orthopaedic Surgery  
Weill Cornell Medical College  
NY, NY



---

---

---

---

---

---

---

---

### Todd J Albert, MD DISCLOSURES INDUSTRY

(c, e) DePuy, Biomet; (d) Vertech, In Vivo Therapeutics, Paradigm Spine, Biomerix, Breakaway Imaging, Crosstree, Invuity, Pioneer, Gentis, ASIP, PMIG; (e) Facetlink

\* a) Research or institutional support received; b) Miscellaneous non-income support (e.g., equipment or services), commercially derived honoraria, or other non-research related funding (e.g., paid travel); c) Royalties; d) Stock or stock options held; e) Employee or Consultant; n) Nothing of value received

#### EXTERNAL ADVISORY ROLE

SIC HSS  
MAB – United Healthcare  
CSRS – Past President  
SRS- BOD  
IMAST Past Chair  
AQA – Chair Development Committee



---

---

---

---

---

---

---

---

## Agenda

- ACDF Has a Long Track Record of Outstanding Outcome
- CDA Data Cannot Be Trusted
- Laminoforaminotomy Not Ideal



---

---

---

---

---

---

---

---

## ACDF

### Pathophysiology of Cervical Spondylosis

- Disc dehydration
- Altered biomechanics
- Annular disruption
- Herniated disc
- Spondylotic compression



HOSPITAL WHERE THE WISE CLINICAL SPECIAL SURGEONS TO GET BACK IN THE GAME

---

---

---

---

---

---

---

---

## ACDF for Radiculopathy

### Good Solution For All Possible Causes of Radiculopathy

- Direct nerve root compression
  - soft disc herniation
  - spondylosis (osteophyte formation)
- Foraminal stenosis (disc degeneration)
- Dynamic nerve root compression

HOSPITAL WHERE THE WISE CLINICAL SPECIAL SURGEONS TO GET BACK IN THE GAME

---

---

---

---

---

---

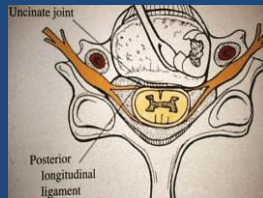
---

---

## ACDF for Radiculopathy

### Logic of Anterior Surgery

- Direct decompression
- Excellent visualization
- No manipulation of neural elements



HOSPITAL WHERE THE WISE CLINICAL SPECIAL SURGEONS TO GET BACK IN THE GAME

***"Where the pathology is!"***

---

---

---

---

---

---

---

---

## ACDF for Radiculopathy

### Benefits of Procedure

- Directly remove pathology
- Distraction → indirect decompression
- Eliminates motion = ↓ root irritation (ACDF only)

HOSPITAL WHERE THE WISE CHOOSE TO GET BACK TO THE GAME  
CRITICAL DISTINCTION SPECIAL SURGERY

---

---

---

---

---

---

---

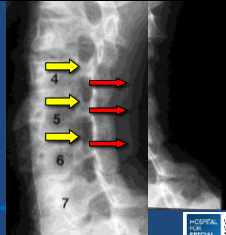
---

## ACDF for Radiculopathy

### Arrests Progression of Cervical Spondylosis

### CRITICAL DISTINCTION

- Eliminates motion
- Removes arthritic stimulus
- Regression of osteophytes



HOSPITAL WHERE THE WISE CHOOSE TO GET BACK TO THE GAME  
CRITICAL DISTINCTION SPECIAL SURGERY

---

---

---

---

---

---

---

---

## Adjacent Segment Disease

Reoperation Rate Lowest In Patients With Most Fusion Levels

- Contradicts Theory That Fusion → ASD

Length of fusion

- ← single level = 18%
- ← multilevel = 12%



HOSPITAL WHERE THE WISE CHOOSE TO GET BACK TO THE GAME  
CRITICAL DISTINCTION SPECIAL SURGERY

Hilibrand et al., (*Am*), 1999 *JBJS*

---

---

---

---

---

---

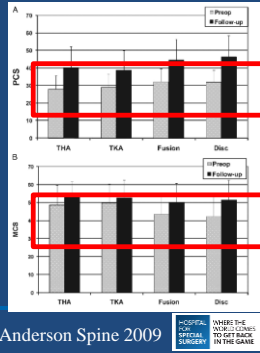
---

---

## ACDF Effective, Safe, Procedure

Proven Outcome

Comparable to Hip/Knee Replacement



---

---

---

---

---

---

---

---

---

---

## ACDF Improves Sagittal Balance

ACDF Corrects Kyphosis

- Uchida JNS 2009
- Song JBJS Br 2010
- Shamji Spine 2013

Important Factor Anterior Reconstruction

- Kyphosis → Poor Outcome

Ferch JNS Spine 2004  
Kawakami JSDT 1999  
Villavicencio Neurosurgery 2011  
Gum AJO 2012

- Kyphosis → Increased Incidence of ASD

Faldini CORR 2011  
Hansen Spine 2012  
Park MS Spine 2014

- Sagittal Balance Associated with Myelopathy

Smith Spine 2013

HOSPITAL WHERE THE SPECIAL SURGEON TO GET BACK IN THE GAME

---

---

---

---

---

---

---

---

---

---

## Agenda

- ACDF Has a Long Track Record of Outstanding Outcome
- **CDA Data Cannot Be Trusted**
- Laminoforaminotomy Not Ideal

HOSPITAL WHERE THE SPECIAL SURGEON TO GET BACK IN THE GAME

---

---

---

---

---

---

---

---

---

---

### My Opponent Will Cite Data Supporting CDA

- Try To Create **Mass Confusion** With Charts, Tables, and Meta Analyses
  - ProDisc C 5 Year Results
    - Zigler JE Spine 2013
  - Prestige 7 Year Results
    - Burkus JNS 2014

**DON'T BELIEVE IT**  
**REOPERATION RATES SUSPECT**  
**UNDERREPORTING COMPLICATIONS**  
**NOT ALL CDAs Do Well**




---

---

---

---

---

---

---

---

---

---

### Reoperation Data Is Unreliable

- Reoperation Rates at the same institution different for ACDF patients in the control arm of an IDE study (9%) versus outside of IDE study (2.1%)




---

---

---

---

---

---

---

---

---

---

### CDA Patients Highly Selected

- Only 43% percentage of patients are candidates for CDA
  - Auerbach Spine 2008
- **Cannot extrapolate CDA results to general population**




---

---

---

---

---

---

---

---

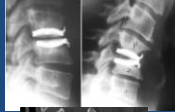
---

---

### Reports of CDA Complications Increasing

- Early
  - Dislocation
- Late
  - Osteolysis
  - Subsidence

Tsermoulas Br J Neurosurg 2013



Where Are These Complications In IDE Study Data?

Hacker Spine 2013

HOSPITAL WHERE THE WISE CHOOSE TO GET BACK TO THE GAME SPECIAL SURGERY

---

---

---

---

---

---

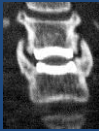
---

---

### Other Late Complications

- Wear Osteolysis
- Ossification

Tumilian Spine 2011



Where Are These Complications In IDE Study Data?

HOSPITAL WHERE THE WISE CHOOSE TO GET BACK TO THE GAME SPECIAL SURGERY

---

---

---

---

---

---

---

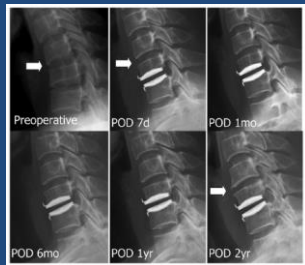
---

### ASD Occurs After CDA

9/72 Adjacent Segment Degeneration (12.5%)

Bryan No Industry Funding

Yi Surg Neurol 2009



HOSPITAL WHERE THE WISE CHOOSE TO GET BACK TO THE GAME SPECIAL SURGERY

---

---

---

---

---

---

---

---



### Same Segment Disease After CDA



Yi Surg  
Neurol 2009

Where Are These  
Complications In  
IDE Study Data?

HOSPITAL WHERE THE  
SPECIAL SURGEON WOULD GO  
TO GET BACK IN THE GAME

---

---

---

---

---

---

---

---

### Not All CDAs Do Well

- Review of Discover Data
- Decreased Disk Height → Poor Outcome
- Excessive Lordosis → Poor Outcome

Rihn JSDT 2014

HOSPITAL WHERE THE  
SPECIAL SURGEON WOULD GO  
TO GET BACK IN THE GAME

---

---

---

---

---

---

---

---

### Laminoforaminotomy

- High Neurological Injury
- High Reoperation Rate
- Kyphosing

HOSPITAL WHERE THE  
SPECIAL SURGEON WOULD GO  
TO GET BACK IN THE GAME

---

---

---

---

---

---

---

---

## Laminoforaminotomy

- Neurological Injury
  - 2.3% Palsy
    - Choi World Neurosurgery 2013
  - 2.1% Palsy
- But if you are part of that 2% it's a big deal  
Jagannathan JNS 2009



COFPA WHERE THE WISE MEN GO TO GET BACK TO THE GAME SPECIAL SURGERY

---

---

---

---

---

---

---

---

---

---

## High Reoperation After Laminoforaminotomy

- N=790, Cleveland Clinic, n=627 ACDF, 163 PCF
- 2 year reop rate (p=0.7)
- ACDF 4.8%
- PCF 6.4%

Lubelski Neurosurgery 2014

COFPA WHERE THE WISE MEN GO TO GET BACK TO THE GAME SPECIAL SURGERY

---

---

---

---

---

---

---

---

---

---

## Laminoforaminotomy Kyphosing Procedure

- N=162, UVA, Postop Kyphosis 20% of Patients at 5 Years
  - Jagannathan JNS 2009

TABLE 6: Factors related to postoperative deformity and instability

Factor	Postop Deformity (33 patients)			Postop Instability (8 patients)		
	Hazard Ratio	95% CI	p Value	Hazard Ratio	95% CI	p Value
age >60	1.32	0.62-2.45	0.01*	1.42	0.29-1.00	0.23
age <60	2.23	0.96-1.08	0.23	4.32	0.28-4.15	0.39
surgical level						0.54
postop laminectomy						0.43
postop surgery						0.09
postop segmental alignment						0.15
postop segmental alignment						0.64
postop focal alignment	1.23	0.58-1.05	0.59	3.32	0.62-2.45	0.29
indication for surgery	1.32	0.12-1.12	0.43	0.21	0.23-2.23	0.34

\* Statistically significant difference.

Laminoforaminotomy → Flat Neck Deformity

COFPA WHERE THE WISE MEN GO TO GET BACK TO THE GAME SPECIAL SURGERY

---

---

---

---

---

---

---

---

---

---

### Progressive Kyphosis After Laminoforaminotomy

- Described Even In Paper Favorable to Laminoforaminotomy
- Had to Be Rescued with ACDF

Jagannathan JNS 2009



2-years Postop

10-years Postop

HOSPITAL WHERE THE WISE CHOOSE SPECIAL SURGERY TO GET BACK IN THE GAME

---

---

---

---

---

---

---

---

### Summary

- ACDF Great, Safe, Effective Durable Procedure
- Need More Independent Verification of CDA Data
- Laminoforaminotomy Potential To Be Cost Effective

HOSPITAL WHERE THE WISE CHOOSE SPECIAL SURGERY TO GET BACK IN THE GAME

---

---

---

---

---

---

---

---

### Conclusion

- Need Better Understanding of the Drivers of Outcome of Cervical Surgery
  - Sagittal Balance?
  - Fusion Rate?
  - Motion?
  - Reoperation Rate?

HOSPITAL WHERE THE WISE CHOOSE SPECIAL SURGERY TO GET BACK IN THE GAME

---

---

---

---

---

---

---

---

# Thank You



©OSPFA WHERE THE  
MUSIC LEADS  
US BACK  
TO THE GAME

---

---

---

---

---

---

---

---

# Current Surgical Strategies for Cervical Radiculopathy

Sheeraz Qureshi, MD,MBA  
 Associate Professor,  
 Orthopaedic Surgery  
 Spinal Surgery, Mount Sinai  
 Hospital  
 Icahn School of Medicine at  
 Mount Sinai  
 Co-Director, Spinal Surgery  
 Fellowship




---

---

---

---

---

---

---

---

## Disclosures

1. **Committee Appointments**
  - 1. AACE Educational Committee
  - 2. AACE Research Committee
  - 3. Mount Sinai Health Services Committee
  - 4. AACE Surgery Committee
  - 5. AACE Committee
2. **Journals**
  - 1. Spine (Editorial Board)
  - 2. Spine (Reviewer)
  - 3. Spinal Cord (Editorial Board)
3. **Royalties**
  - 1. None
4. **Consulting**
  - 1. Medtronic
  - 2. DJO
  - 3. Zimmer
  - 4. Synthes
5. **Teaching**
  - 1. Medtronic
  - 2. Synthes
  - 3. DJO
6. **Advisory Boards**
  - 1. Spinal Research Advisory Board
  - 2. Spinal Research Advisory Board
  - 3. AACE Medical Board of Directors
  - 4. American Spinal Society Fellowship Board




---

---

---

---

---

---

---

---

## Increasingly Common Problem

**Spine** EPIDEMIOLOGY  
SPINE, Volume 39, Number 18, pp 3270-3273  
 ©2014 Lippincott Williams & Wilkins

**Epidemiological Trends in Cervical Spine Surgery for Degenerative Diseases Between 2002 and 2009**  
Quillen, D; D'Angelo, D; C'Neenan, J; Harding, M; F. Alqaib, A; Patel, M; F. Maguire, A; Peltou, B; S. G. and Kevin Singh, MD, PhD

**TABLE 1. Total Procedure Counts, Demographics, and Outcomes of Cervical Spine Surgery From 2002–2009\***

Cervical Procedures (Weighted)	1,323,979
<b>Total Count (Unweighted)</b>	<b>273,396</b>
ACF	219,444
PCF	23,321
PCD	30,631

---

---

---

---

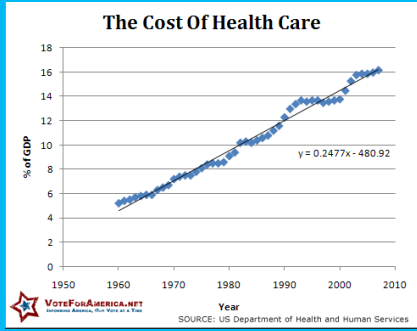
---

---

---

---

## Economic Crisis



---

---

---

---

---

---

---

---

---

---

## What is Value?

- ▶ “Goalposts around which we define outcomes”



---

---

---

---

---

---

---

---

---

---

## The Past ...

- ▶ Spine surgery outcomes
  - Technical concepts
    - Fusion Rates
    - Complications



---

---

---

---

---

---

---

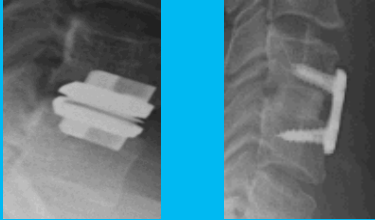
---

---

---

## The Past ...

- ▶ Goal of surgery
  - Technically successful procedure



---

---

---

---

---

---

---

---

## Outcomes Measures

Review Article

### Patient-reported Outcome Measures in Spine Surgery

Abstract

The ultimate goals of intervention for spinal pathology are to improve the patient's quality of life, restore function, and relieve pain. Traditional clinician-based assessments typically fall short of

McCormick et al, 2013, JAAOS



---

---

---

---

---

---

---

---

## The Surgeon's Task

- ▶ Choose the procedure that results in the best possible outcome for the patient



---

---

---

---

---

---

---

---

## Emphasis

- ▶ Cost
- ▶ Cost Effectiveness
- ▶ Value



---

---

---

---

---

---

---

---

## How is Value Defined

- ▶ Value
  - Quality of an intervention divided by the cost measured over time
- ▶ Key factors
  - Quality
  - Cost
  - Time



---

---

---

---

---

---

---

---

## Obligation

- ▶ Goal of healthcare is NOT simply to achieve lowest cost treatment for given pathology



---

---

---

---

---

---

---

---



# What's the CHEAPEST treatment?

- ▶ NSAIDs
- ▶ Tylenol
- ▶ PT
- ▶ Home exercise program
- ▶ Injections




---

---

---

---

---

---

---

---

---

---

J Neurosurg Spine 10(3):476-479, 2014  
© AANS, 2014

Health state utility of patients with single-level cervical degenerative disc disease: comparison of anterior discectomy and fusion with cervical disc arthroplasty

Clinical article

**Sherraz A. Qureshi, M.D., M.B.A., V. Vanni Gor, B.A., Steven McAnass, M.D., Steven M. Korman, M.D., Andrew C. Hickey, M.D., Ross B. Stein, M.D., and Theodor G. Fehlings, M.D., PhD\***

Department of Orthopaedic Surgery, The Mount Sinai Medical Center, New York, New York  
Department of Surgery, Cedars-Sinai Medical Center, Los Angeles, California, and Department of Neurology, University of Toronto, Toronto, Canada

**Complications, outcomes, and need for fusion after minimally invasive posterior cervical foraminotomy and microdiscectomy**

**Branko Skovrlj, MD†, Yakov Golopinsky, MD†, Raquel Hauer, MD†, Richard G. Fessler, MD, PhD‡, Sherraz A. Qureshi, MD\***

\*Department of Neurosurgery, Mount Sinai School of Medicine, I. Cantor & Lee Plaza, Box 136, New York, NY 10028, USA  
†Department of Neurosurgery, Karolinska University Hospital, S-141 86, Stockholm, Sweden  
‡Department of Orthopaedics, Cedars-Sinai Medical Center, 8635, Wilshire Blvd, Los Angeles, CA 90048, USA  
Received 5 July 2013; revised 14 November 2013; accepted 28 January 2014

The Spine Journal • (2014)

ELSEVIER

THE SPINE JOURNAL

© 2014 Mount Sinai Hospital, Mount Sinai School of Medicine. Department of Orthopaedic Surgery, New York, New York

---

J Neurosurg Spine 10(3):546-554, 2013  
© AANS, 2013

Cost Effectiveness Studies in Spine Surgeries: A Narrative Review

Young Liu, BA†, Sherraz Qureshi, MD, MBA\* †

Cost-effectiveness analysis: comparing single-level cervical disc replacement and single-level anterior cervical discectomy and fusion

Clinical article

**Sherraz A. Qureshi, M.D., M.B.A., Steven McAnass, M.D., Vanni Gor, B.A., Steven M. Korman, M.D., and Andrew C. Hickey, M.D.**

Mount Sinai Hospital, Mount Sinai School of Medicine, Department of Orthopaedic Surgery, New York, New York

---

---

---

---

---

---

---

---

---

---

## Case

1. 37 year old right hand dominant attorney with 4 week history of right upper extremity pain, numbness, and mild weakness
2. Attempted oral steroid with minimal relief only and currently doing PT
3. Physical exam confirms positive Spurling's on the right, with 4+/5 weakness of deltoid and biceps
4. No physical exam findings of spinal cord irritation




---

---

---

---

---

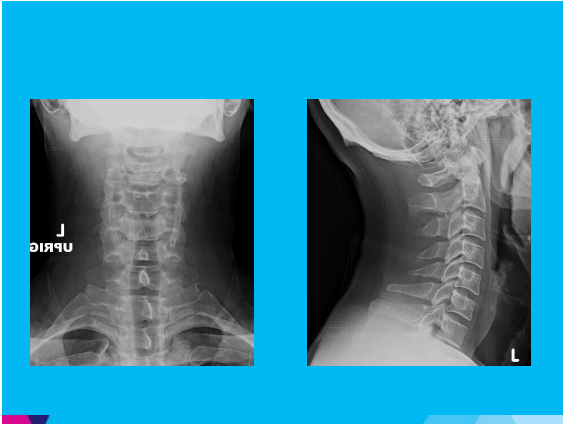
---

---

---

---

---



---

---

---

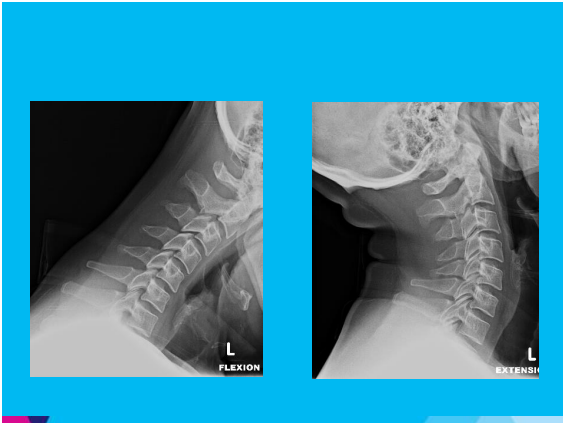
---

---

---

---

---



---

---

---

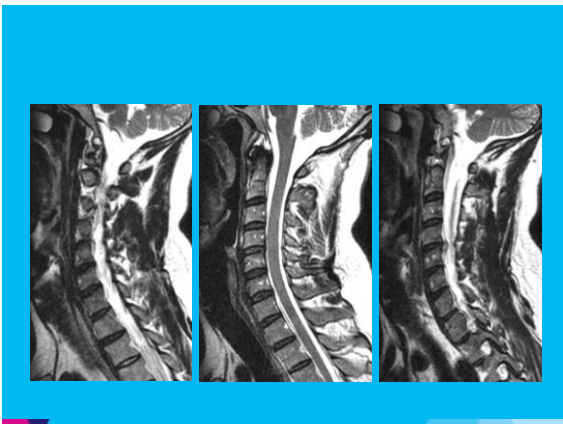
---

---

---

---

---



---

---

---

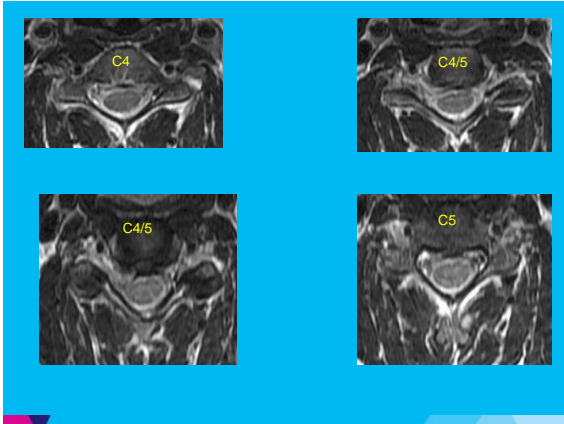
---

---

---

---

---



---

---

---

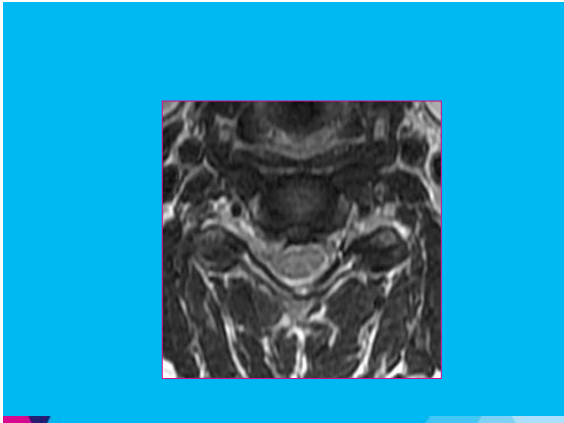
---

---

---

---

---



---

---

---

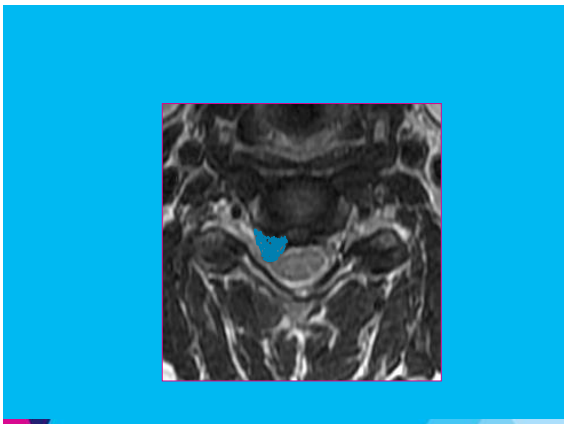
---

---

---

---

---



---

---

---

---

---

---

---

---

## Esteemed Faculty

Mike Wang



Pierce Nunley



Todd Albert



---

---

---

---

---

---

---

---



Photo Courtesy: The Humane Society

---

---

---

---

---

---

---

---

## Case

1. 37 year old right hand dominant attorney with 4 week history of right upper extremity pain, numbness, and mild weakness
2. Attempted oral steroid with minimal relief only and currently doing PT
3. Physical exam confirms positive Spurling's on the right, with 4+/5 weakness of deltoid and biceps
4. No physical exam findings of spinal cord irritation



---

---

---

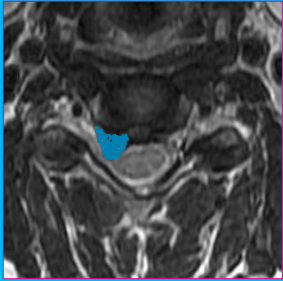
---

---

---

---

---



---

---

---

---

---

---

---

---

## What Would You Do?

1. ACDF
2. CDR
3. PCF



---

---

---

---

---

---

---

---