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Cervical Radiculopathy: Role of the Posterior approach

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DISCLOSURES

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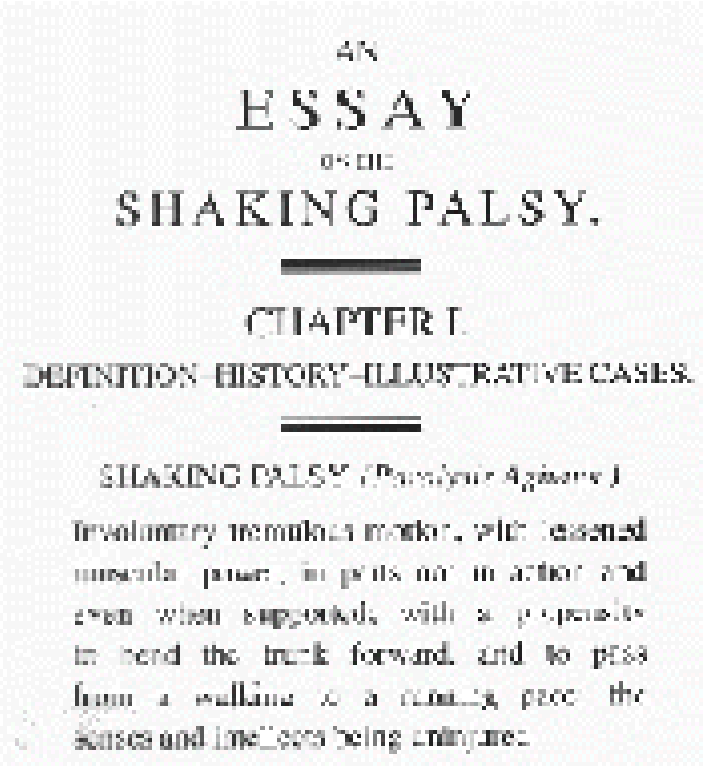
Disclosures:

Consulting: NuVasive, Medicrea, Innovasis
Research Support: CSRS, Zimmer Biomet

(

History of Cervical Radiculopathy



AN

ESSAY

ON THE

SHAKING PALSY.

CHAPTER I.

DEFINITION. HISTORY.—ILLUSTRATIVE CASES.

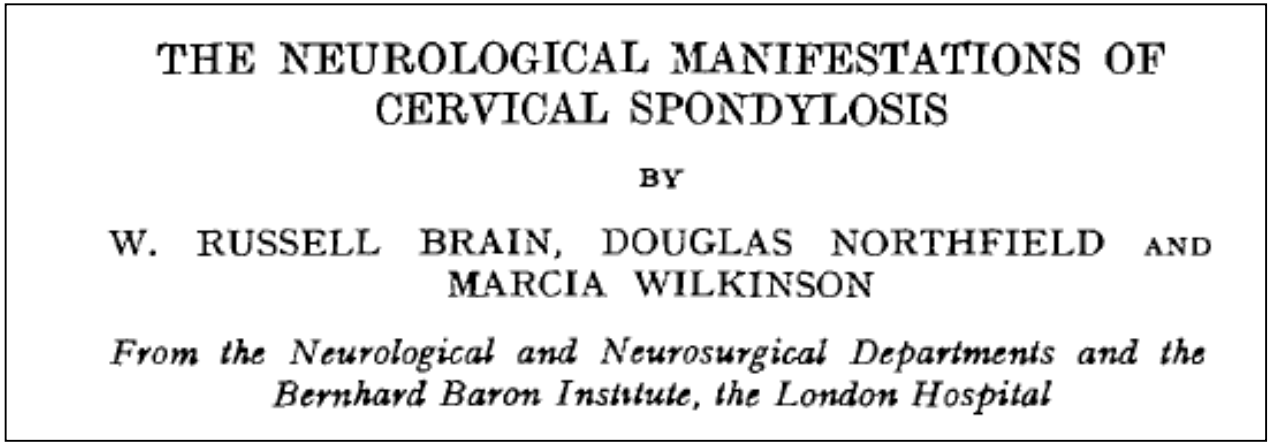
SHAKING PALSY. (*Paralysis Agitans.*)

Involuntary tremulous motion, with lessened muscular power, in parts not in action and even when supported; with a propensity to bend the trunk forward, and to pass from a walking to a running pace: the senses and intellects being entire.

- Parkinson. *An Essay on the Shaking Palsy*. 1817

History of Cervical Radiculopathy

- Earliest descriptions of cervical ‘spondylitis’
  - Strumpell (1888), Marie (1898), von Beckteren (1899)
    - Inferred infectious or inflammatory etiology



THE NEUROLOGICAL MANIFESTATIONS OF CERVICAL SPONDYLOSIS

BY

W. RUSSELL BRAIN, DOUGLAS NORTHFIELD AND MARCIA WILKINSON

From the Neurological and Neurosurgical Departments and the Bernhard Baron Institute, the London Hospital

Brain et al. Brain 1952

- Redefined etiology and pathophysiology
- Coined the term cervical ‘spondylosis’

Epidemiology of Cervical Radiculopathy

Brain (1994), **117**, 325–335

Epidemiology of cervical radiculopathy
A population-based study from Rochester, Minnesota, 1976 through 1990

Kurupath Radhakrishnan,[1,2*] William J. Litchy,[1] W. Michael O'Fallon[3] and Leonard T. Kurland[2]

Radhakrishnan et al. Brain 1994

- Prevalence 83 per 100,000
  - C7 – 46.3%
  - C6 – 17.6%
  - C5, 6 – 10.3%
  - C6,7 – 8.4%
  - C5 – 6.6%
  - C8 – 6.2%
- 21.9% disc protrusion alone
- 68.4% spondylosis + disc
- 26% had Surgery

Epidemiology of Cervical Radiculopathy

Brain (1994), **117**, 325–335

Epidemiology of cervical radiculopathy
A population-based study from Rochester, Minnesota, 1976 through 1990

Kurupath Radhakrishnan,[1,2*] William J. Litchy,[1] W. Michael O'Fallon[3] and Leonard T. Kurland[2]

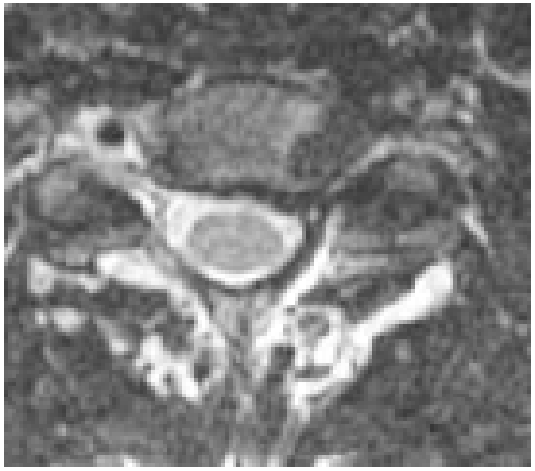
- Presenting symptoms
  - 90% paraesthesias
  - 84% hypoactive reflexes
  - 64% motor deficit
  - 33% sensory deficit
  - 15% subjective weakness

Radhakrishnan et al. Brain 1994

Pathophysiology

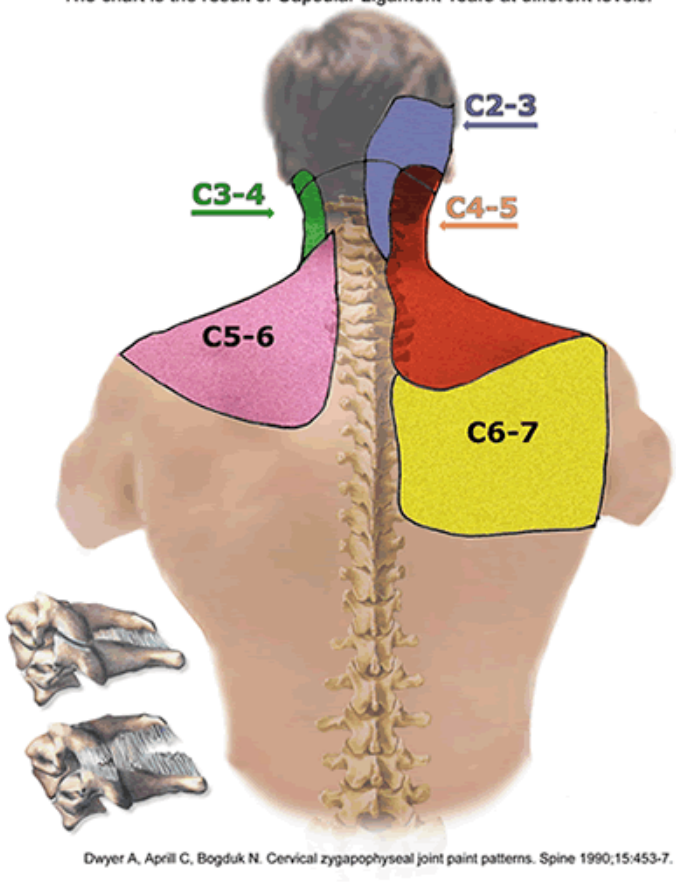
Cervical Radiculopathy

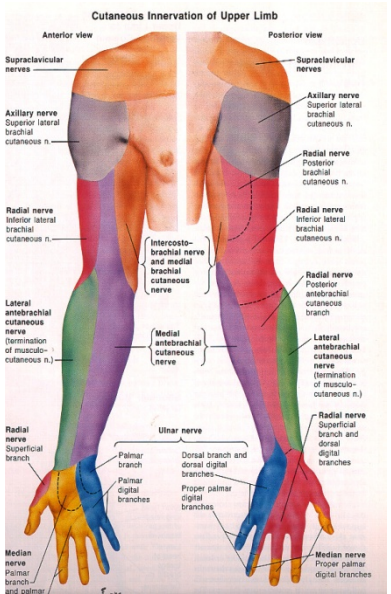
- **Foraminal changes**
  - Osteophytes
    - Uncovertebral or Facet joints
  - Disc herniation
    - Central or Lateral extrusion
  - Combination

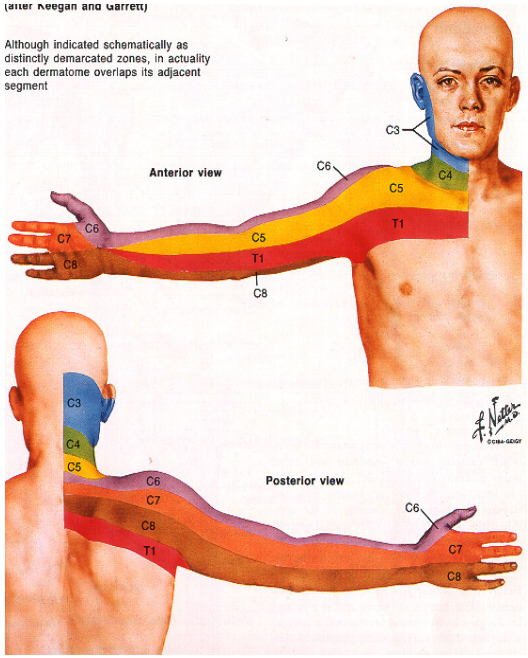


Clinical Presentation

History







Presentation Cervical Radiculopathy

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NEUROSURGERY
Vol. 13, No. 5, 1983
Printed in U.S.A.

Posterior-Lateral Foraminotomy as an Exclusive Operative Technique for Cervical Radiculopathy: A Review of 846 Consecutively Operated Cases

Charles M. Henderson, M.D., Robert G. Hennessy, M.D., Henry M. Shuey, Jr., M.D., and E. Grant Shackelford, B.S.

Division of Neurological Surgery and Department of Data Processing, St. Agnes Hospital, and Division of Neurological Surgery, University of Maryland Hospital, Baltimore, Maryland

Henderson et al. Neurosurgery 1983

- Clinical presentation in 736 pts
  - 99.4% Arm pain
  - 85.2% Sensory deficit
  - 79.7% Neck pain
  - 68% Motor deficit
- Atypical Symptoms
  - 52.5% scapular pain
  - 17.8% anterior chest pain
  - 9.7% headache

Presentation Cervical Radiculopathy

0148-396X/83/1305-0504$02.00/0
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Henderson et al. Neurosurgery 1983

- 736 PCF over 17 years
- All surgeries in sitting position
- 96% relief of preop arm pain
- 98% relief of preop motor deficit
- 91% good/excellent results

- 14% required 2nd surgery
  - 3% for recurrent radic
- No difference in results between hard, soft discs
- 9.4 weeks return to work
- 1.5% minor compications
- No deaths or air embolisms

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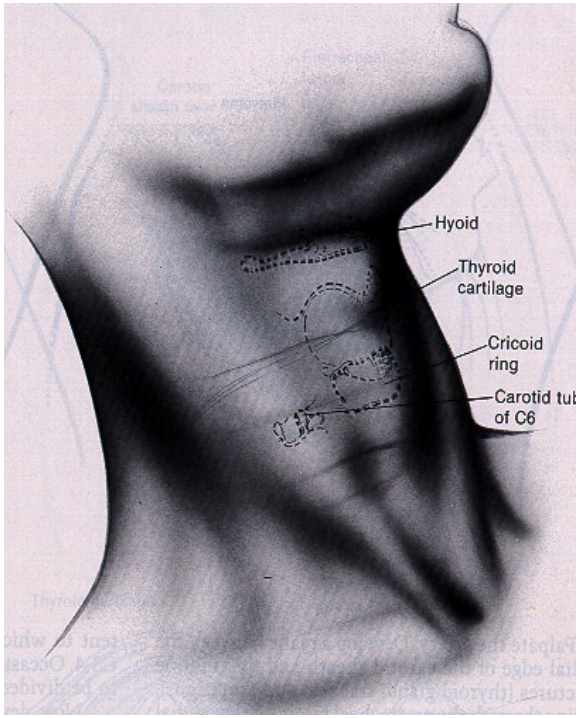
SURGICAL INDICATIONS

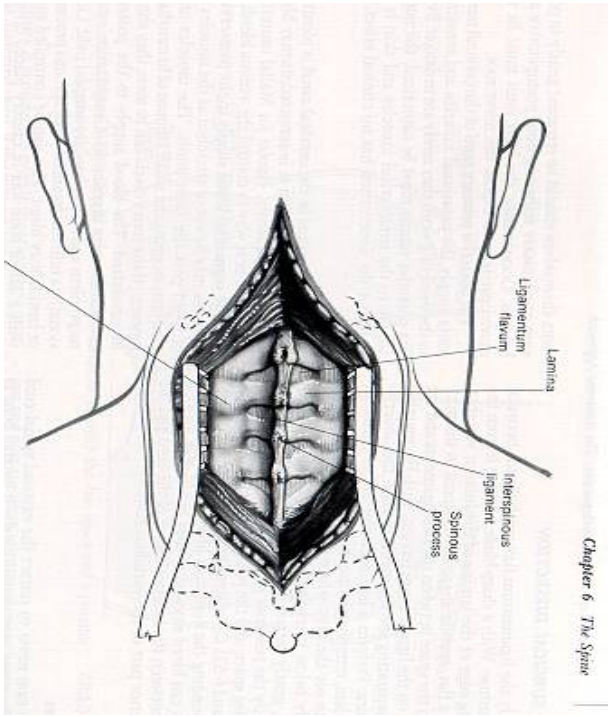
- **Failed conservative treatment >6 wks**
- **Instability**
  - Spondylolisthesis
  - Retrolisthesis
- **Deformity of spine w/ radicular symptoms**
- **Progressive neurological deficit**
- **Disabling motor weakness**
  - Deltoid/wrist palsy
- **Cervical myelopathy / myeloradiculopathy**

Surgical Treatment Options

- Anterior Approach

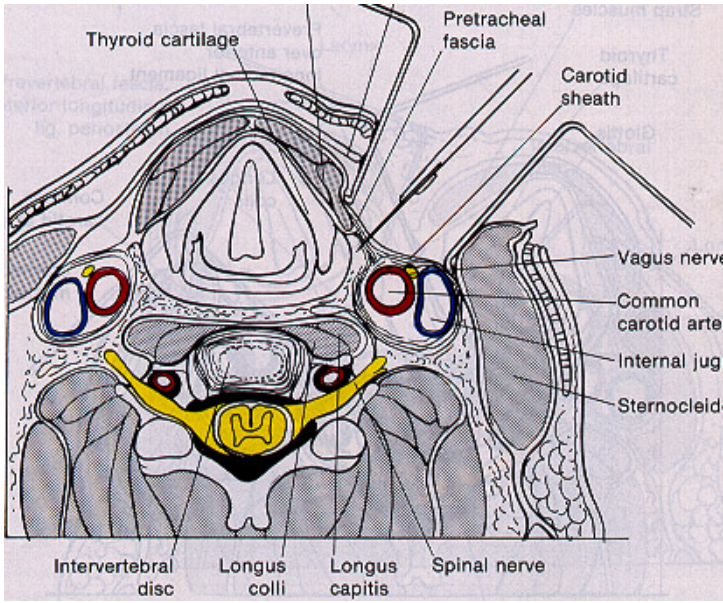


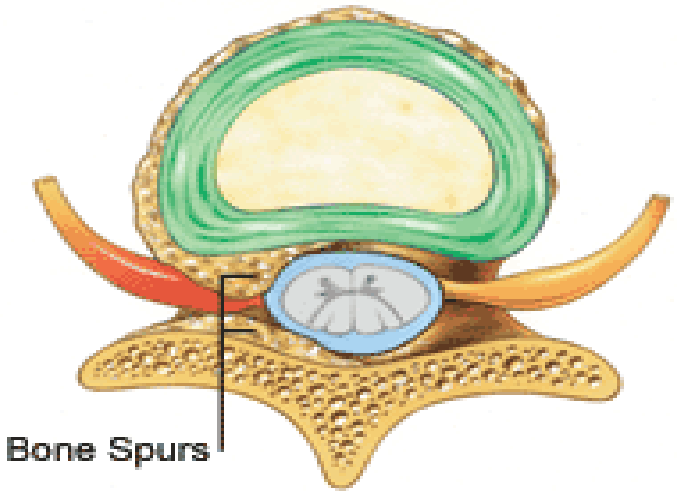
- Posterior Approach



Anterior Approach: Cervical Radiculopathy

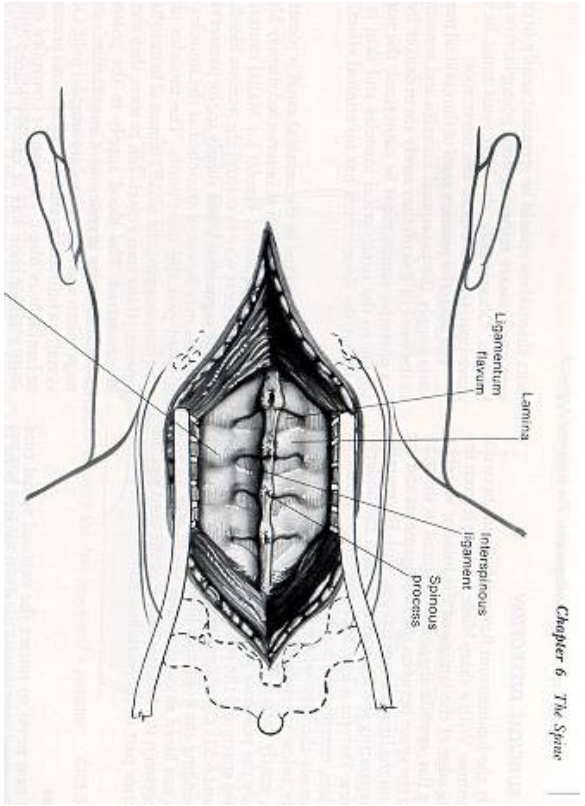
- **Decompression of spinal canal and foramen**
  - Direct disc excision
  - Indirect distraction by graft placement
- **Indicated for**
  - Cervical kyphosis
  - Lateral or central disc herniations
  - Single or multiple levels
    - (usually <4 levels)
- **Advantages**
  - Address lesions w/o manipulating nerve roots
  - Access to both central and lateral herniations





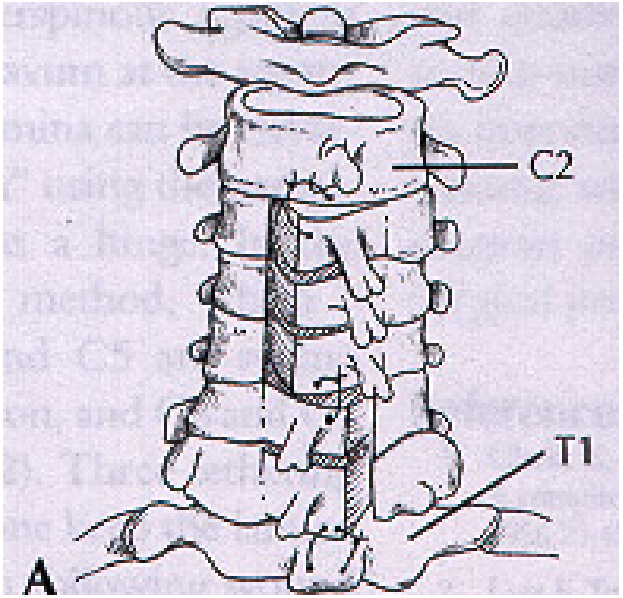
Posterior Approach: Cervical Radiculopathy

- **Described two decades before anterior approach popularized**
- **Indications**
  - Lateral soft disc herniation or disc osteophytes
  - Midline spondylotic myelopathy
  - Radiculopathy without neck pain
  - Singers or patients in whom vocal cord paralysis is problematic
- **Advantages**
  - Motion preserving
    - (smokers, ?athletes)

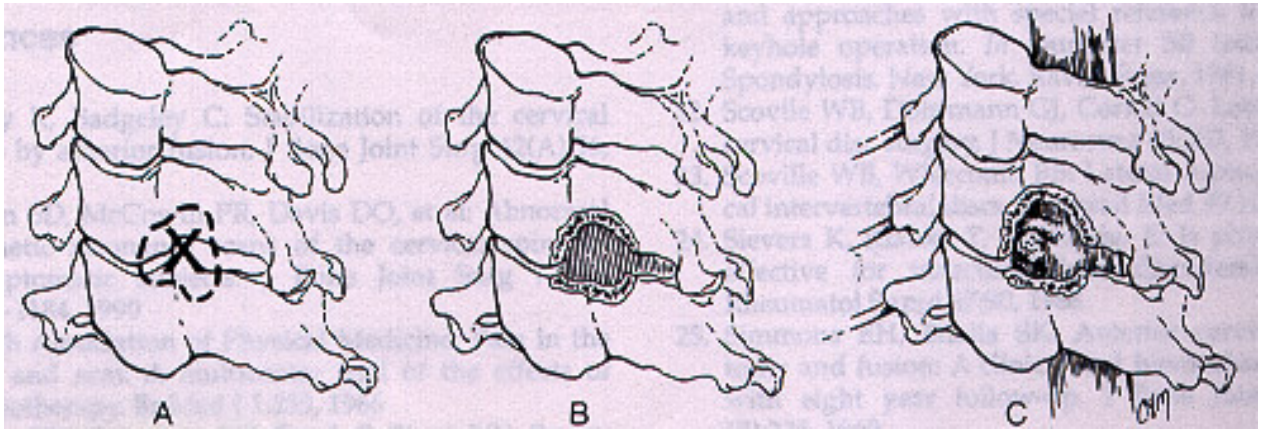


Posterior Approach: Cervical Radiculopathy

- **Laminoplasty**
  - Central Stenosis

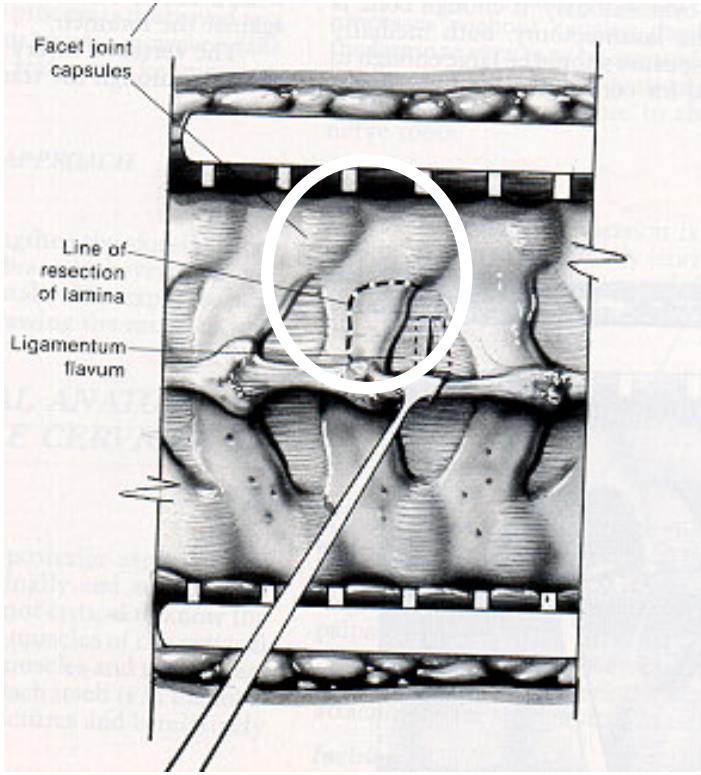


- **Keyhole foraminotomy**
  - Lateral discs



Posterior Cervical Foraminotomy

- **Posterior laminoforaminotomy**
  - Midline Incision vs MIS tube
  - Resect medial facet & part of lamina
- **If herniated material is present**
  - Nerve root is retracted and disk fragments removed



Posterior Approach

Raynor et al J Neurosurg 1985

Instability with Excessive Facet Joint Removal

- 50% Facets removed
- 5mm nerve root exposure
- Spinal stability intact

- 70% Facets removed
- 8-10mm nerve root exposure
- Significant increase in spinal instability

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ANTERIOR VERSUS POSTERIOR

- **ACDF**
  - Visualize lesions w/o manipulating nerve roots
  - Access to both central and lateral herniations
- **PCF**
  - Avoids complications/loss of motion from fusion
  - Direct decompression of neural elements
  - Reduced postop immobilization time

Clinical Outcomes

Surgical Management of Cervical Soft Disc Herniation

A Comparison Between the Anterior and Posterior Approach

HARRY N. HERKOWITZ, MD,* LAWRENCE T. KURZ, MD,† and DAVID P. OVERHOLT, MD‡

Herkowitz et al. *Spine* 1990

- **Anterior vs Posterior approaches for purely lateral disc herniations**
  - 16 PCF vs 28 ACDF (Robinson horseshoe graft)
- **no statistical difference found**
  - 94% good/excellent results in ACDF 75% good/excellent results in PCF

LITERATURE: PCF VS ACDF

Comparison of Anterior Cervical Discectomy and Fusion versus Posterior Cervical Foraminotomy in the Treatment of Cervical Radiculopathy: A Systematic Review

Wei-jun Liu, MD[1], Ling Hu, MD[2], Po-Hsin Chou, MD[3], Jun-wen Wang, MD[1], Wu-sheng Kan, MD[1]

[1]*Department of Orthopaedics, Pu Ai Hospital, Tongji Medical College, Huazhong University of Science and Technology and* [2]*Department of Anesthesiology, Tianyou Hospital, Wuhan University of Science and Technology, Wuhan, China and* [3]*Department of Orthopaedics and Traumatology, Taipei Veterans General, Hospital School of Medicine, National Yang-Ming University, Taipei, Taiwan*

Liu et al. *Orthop Surg* 2016

- Meta-analysis of 10 studies: 3 PRCT, 7 Retro

TABLE 2 Quality of included studies according to the GRADE approach

Study	Design	Selection bias	Performance bias	Attrition bias	Detection bias	Quality of evidence	Recommendation
Ruetten *et al.*[7]	RCT	No	No	Yes	No	High	Strong
Wirth *et al.*[16]	RCT	No	No	No	Yes	Moderate	Strong
Herkowitz *et al.*[15]	RCT	Yes	No	No	Yes	Moderate	Strong
Selvanathan *et al.*[4]	RCoS	Yes	Yes	Yes	No	Very low	Weak
Lubelski *et al.*[3]	RCoS	No	Yes	No	No	Moderate	Strong
Cho *et al.*[19]	RCoS	Yes	Yes	No	No	Very low	Weak
Korinth *et al.*[13]	RCoS	Yes	Yes	No	No	Very low	Weak
Mansfield *et al.*[20]	RCoS	Yes	Yes	No	Yes	Very low	Weak
Alvin *et al.*[18]	RCoS	Yes	Yes	No	Yes	Very low	Weak
Tumialán *et al.*[17]	RCoS	Yes	Yes	No	Yes	Very low	Weak

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LITERATURE: PCF VS ACDF

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Liu et al. *Orthop Surg* 2016

- Complication rate: 7% ACDF group, 4% PCF group
- Reoperation rate: 4% ACDF group, 6% PCF group within 2y
- No difference in clinical outcome
- PCF preserved range of motion of the operated segment
- Average cost lower for PCF group

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LITERATURE: PCF VS ACDF

Risk-Factor Analysis of Adjacent-Segment Pathology Requiring Surgery Following Anterior, Posterior, Fusion, and Nonfusion Cervical Spine Operations

Survivorship Analysis of 1358 Patients

Jae Chul Lee, MD, Sang-Hun Lee, MD, Colleen Peters, MA, and K. Daniel Riew, MD

Lee et al. *JBJS Am* 2014

- 1038 ACDF, 32 CDR, 69 PCF,
- Surgery for ASD 2.3% / year overall

Literature: PCF vs ACDF

Risk-Factor Analysis of Adjacent-Segment Pathology Requiring Surgery Following Anterior, Pos Fusion, and Nonfusion Cervical Spine Ope

Survivorship Analysis of 1358 Patients

Jae Chul Lee, MD, Sang-Hun Lee, MD, Colleen Peters, MA, and K. Daniel Riew, MD

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Survivorship curves

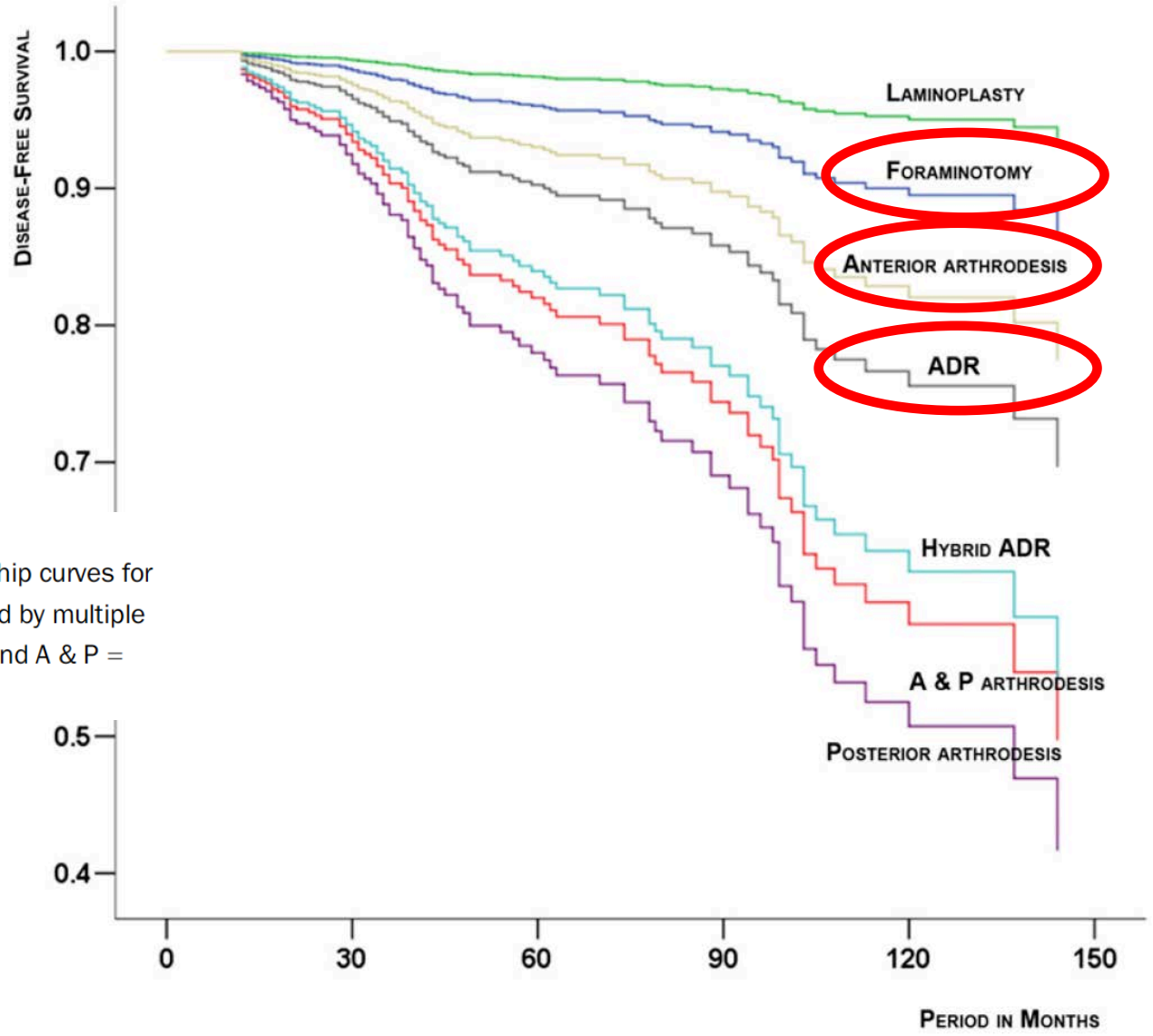

Fig. 2

Cox proportional-hazards regression survivorship curves for each type of cervical spine operation corrected by multiple variables. ADR = artificial disc replacement, and A & P = combined anterior and posterior.

LITERATURE: PCF VS ACDF

The Difference in Clinical Outcomes After Anterior Cervical Fusion, Disk Replacement, and Foraminotomy in Professional Athletes

Harry T. Mai, MD, Danielle S. Chun, MD,* Andrew D. Schneider, MD,* Andrew C. Hecht, MD,† Joseph C. Maroon, MD,‡ and Wellington K. Hsu, MD**

Mai et al. *Clin Spine Surg* 2018

TABLE 3. Performance-based Outcomes After Surgical Treatment for CDH

Characteristics	ACDF (n = 86)	PF (n = 13)	*P*†
Reoperation rate	5 (5.8%)	6 (46.2%)	**< 0.001**
Return to play	61 (70.9%)	12 (92.3%)	**0.035**
Return after surgery (d)	366.6 (± 225.4)	238.3 (± 115.6)	**0.031**
Career length—total (y)	7.9 (± 3.6)	8.3 (± 5.0)	0.702
Career length—after surgery (y)	2.0 (± 2.0)	3.4 (± 3.1)	0.098
Change in performance	−7.7% (± 3.6)	−7.3% (± 5.1)	0.413

- PCF had greater return to play, faster return to sport
- Higher reoperation rate 46% vs 5.8%

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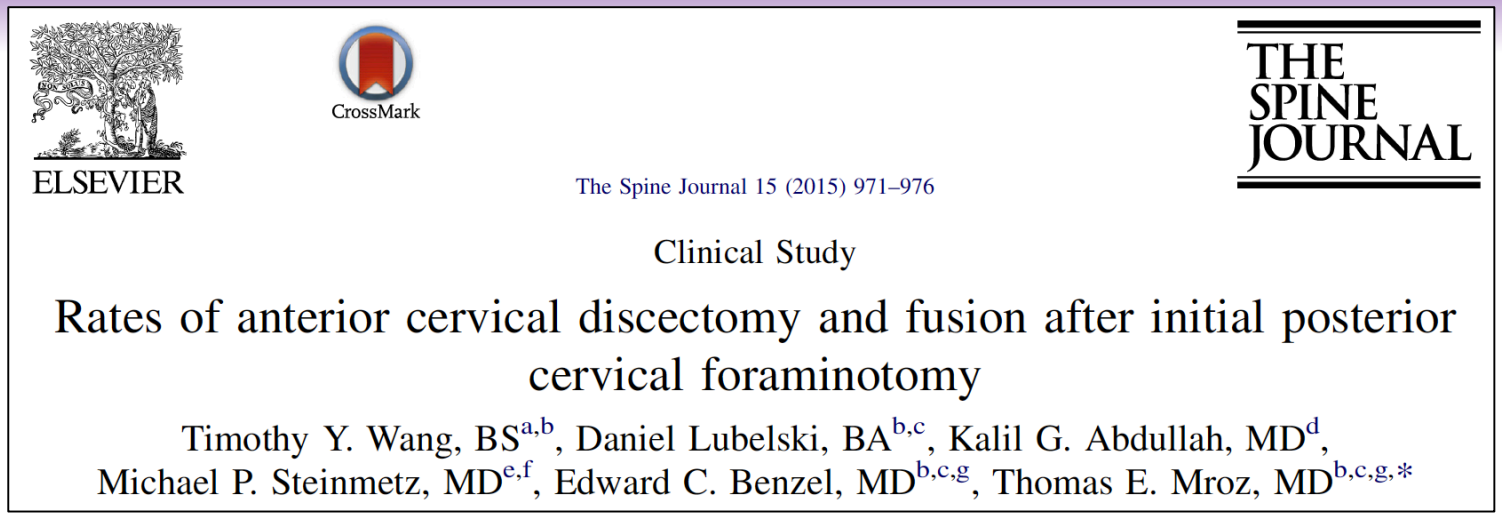
LITERATURE: PCF VS ACDF



ELSEVIER

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The Spine Journal 15 (2015) 971–976

THE SPINE JOURNAL

Clinical Study

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

Timothy Y. Wang, BS[a,b], Daniel Lubelski, BA[b,c], Kalil G. Abdullah, MD[d], Michael P. Steinmetz, MD[e,f], Edward C. Benzel, MD[b,c,g], Thomas E. Mroz, MD[b,c,g,*]

Wang et al. *TSJ* 2015

- 178 PCF, avg f/u 32 mo
- 5% underwent ACDF revision at index level
- Those revised were significantly younger (25 vs 35 years), had lower BMI (25 vs 29), and more likely on anxiolytic (56% vs. 22%) or antidepressants (67% vs. 27%)

Cost-Utility Analysis of Anterior Cervical Discectomy and Fusion With Plating (ACDFP) Versus Posterior Cervical Foraminotomy (PCF) for Patients With Single-level Cervical Radiculopathy at 1-Year Follow-up

Matthew D. Alvin, MBA, MA,† Daniel Lubelski, BA,*‡ Kalil G. Abdullah, MD,§ Robert G. Whitmore, MD,§ Edward C. Benzel, MD,*‡‖ and Thomas E. Mroz, MD*‡‖*

Alvin et al. *Clin Spine Surg* 2016

- 1-year cost-utility ratio:
  - PCF $79,856/QALY vs ACDF $131,951/QALY (P<0.01)
- 1-year ICER was negative for ACDF
  - ACDFP was dominated by PCF

LITERATURE

Percutaneous posterior cervical fusion with the DTRAX Facet System for single-level radiculopathy: results in 60 patients

Clinical article

BRUCE M. MCCORMACK, M.D.,[1] RAFAEL C. BUNDOC, M.D.,[2] MARIO R. VER, M.D.,[3] JOSE MANUEL F. IGNACIO, M.D.,[4] SIGURD H. BERVEN, M.D.,[5] AND EDWARD F. EYSTER, M.D.[1]

McCormack et al. *JNS-S* 2013

- 60 patients DTRAX facet fusion
- 93% facet fusion at 1y by CT
- 1.6° loss of lordosis at index level
- Improved VAS and NDI from 2 wk – 1y

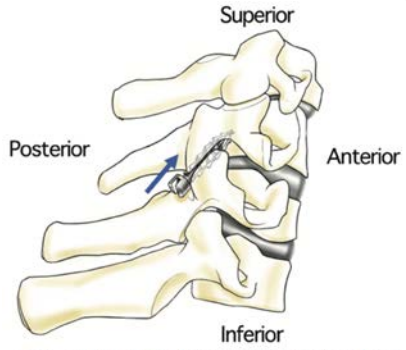


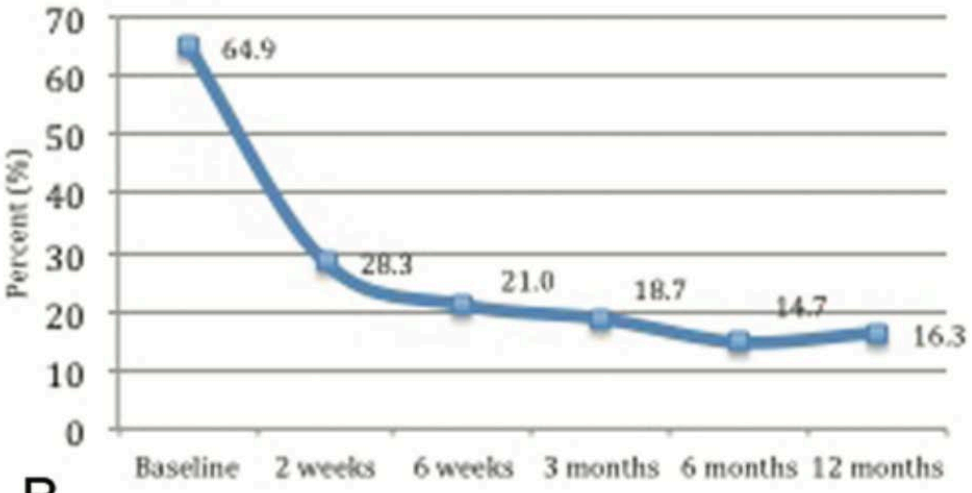
FIG. 3. Schematic showing the DTRAX device implanted in the cer-

Percutaneous posterior cervical fusion with the DTRAX Facet System for single-level radiculopathy: results in 60 patients

Clinical article

BRUCE M. MCCORMACK, M.D.,[1] RAFAEL C. BUNDOC, M.D.,[2] MARIO R. VER, M.D.,[3] JOSE MANUEL F. IGNACIO, M.D.,[4] SIGURD H. BERVEN, M.D.,[5] AND EDWARD F. EYSTER, M.D.[1]

A



B

McCormack et al. *JNS-S* 2013

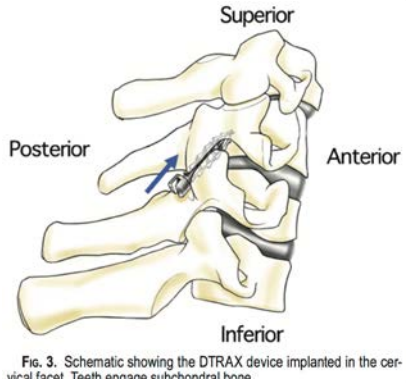


FIG. 3. Schematic showing the DTRAX device implanted in the cervical facet. Teeth engage subchondral bone.

- 1y

LITERATURE

ORIGINAL ARTICLE - SPINE

Clinical and radiological results of posterior cervical foraminotomy at two or three levels: a 3-year follow-up

Dong Geun Lee[1] · Choon Keun Park[1] · Dong Chan Lee[2]

Lee et al. *Acta Neurochir* 2017

- 42 patients 2 or 3 level radiculopathy with multilevel PCF
- NDI improvement of 19%
- 1 pt with postop instability
- 1 pt with post laminotomy kyphosis

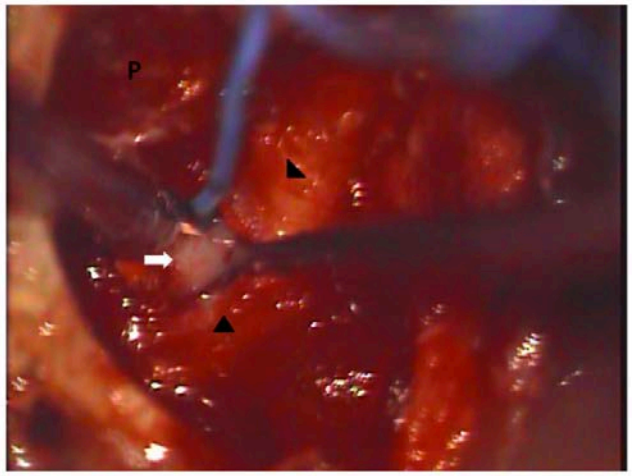


Fig. 1 Separate motor root (*white arrow*) locating the ventral portion of the sensory root (*black arrow*) and sensory root (*P* pedicle)

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Dong Geun Lee[1] · Choon Keun Park[1] · Dong Chan Lee[2]

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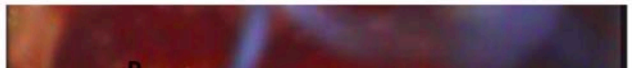

No. of patients	Characteristics	Level	Preop VAS	Last f/u VAS	Preop NDI score	Last f/u NDI score
1	C5 palsy	2 levels	5	6	22	28
1	Focal instability	3 levels	2	4	6	16
1	Post laminectomy kyphosis	2 levels	6	7	33	35

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CASE: MULTILEVEL CERVICAL RADICULOPATHY

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HISTORY

- 72 year old female
- Primary complaints:
  - Left arm weakness
  - Constant aching neck pain
  - Pain radiates in both shoulders and the right scapula
  - Intermittent pain radiating down below the elbow on left
  - Additional complaint of low back pain for many years

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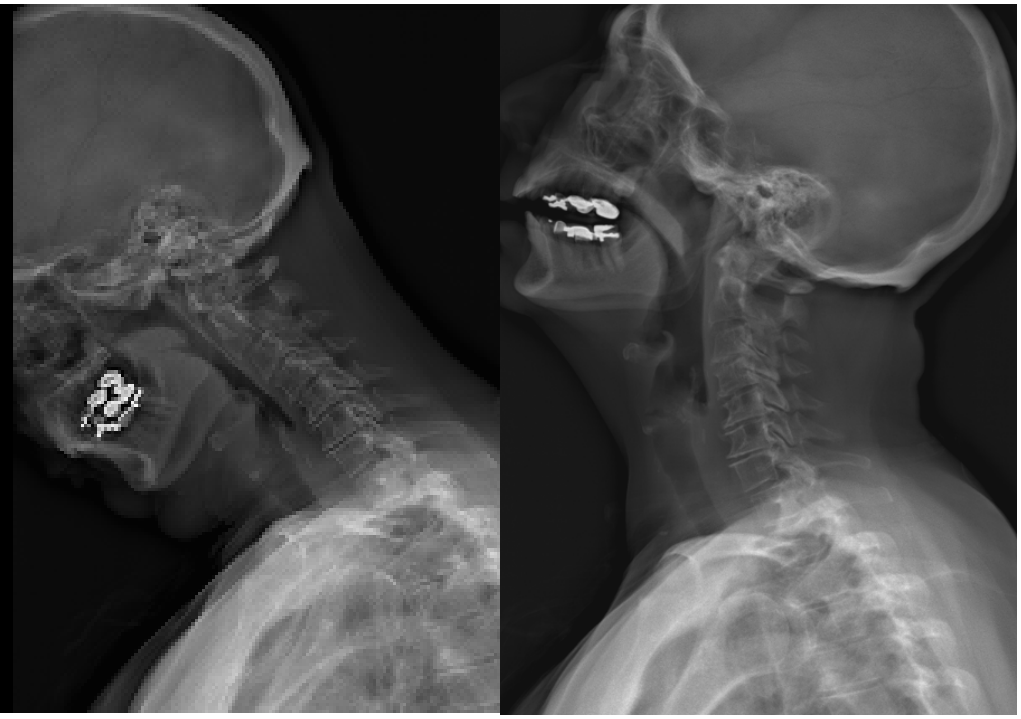
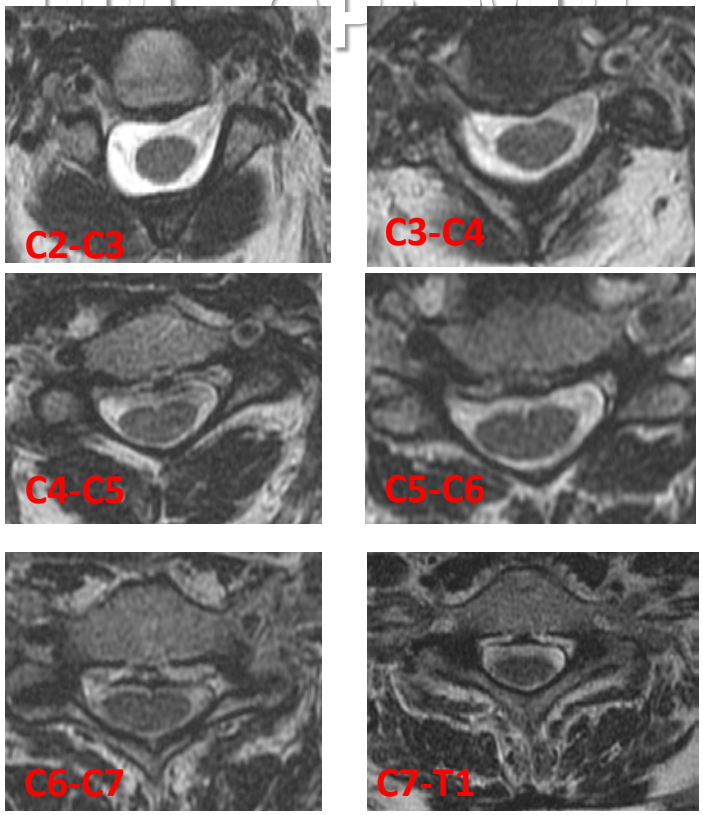
PHYSICAL EXAM



- ROM with pain at the extremes
- 4/5 strength left deltoid, triceps
- No shoulder impingement
- Sensation diminished left dorsal forearm
- Diminished left triceps reflex

Right

Left



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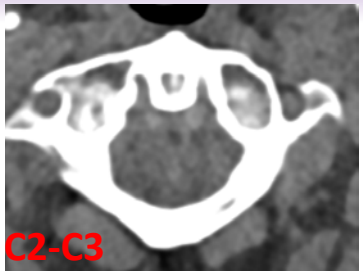
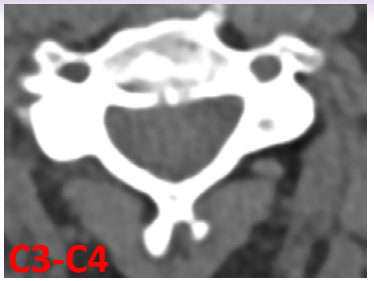
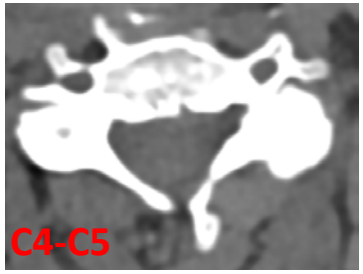
PRE-OP: CT

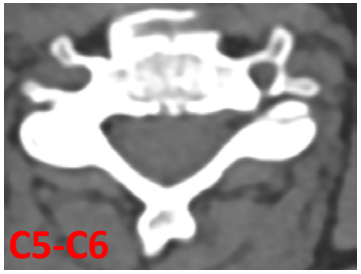
Right

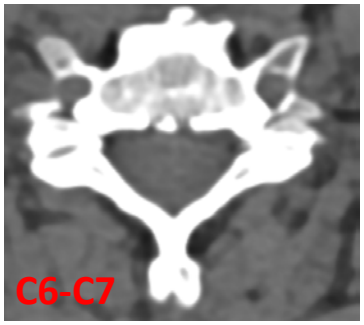
Left

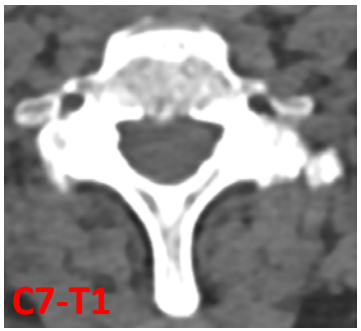




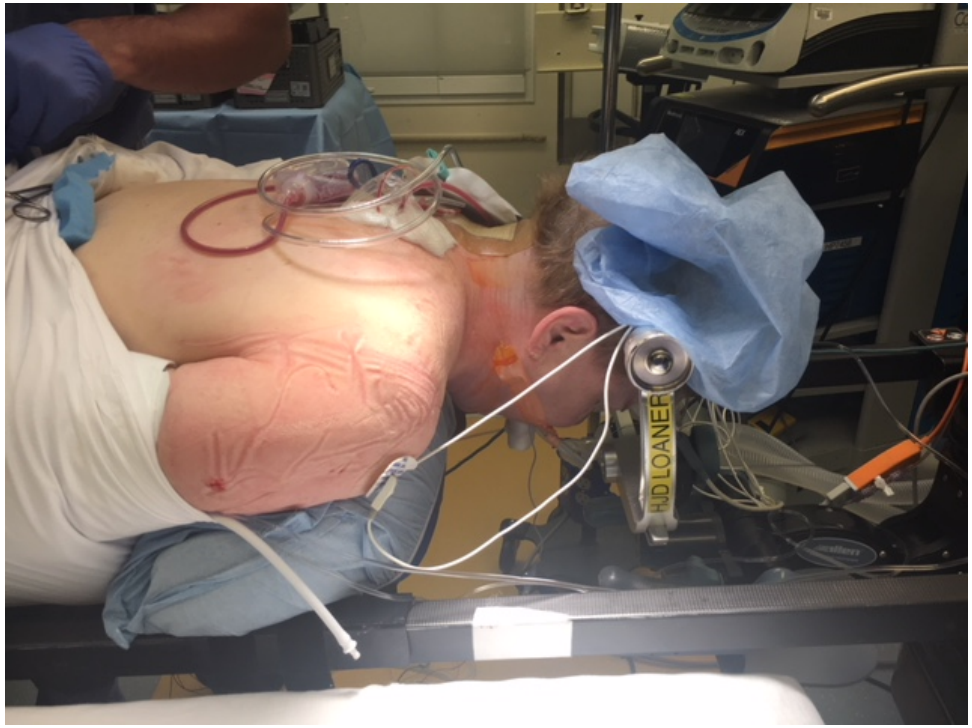








SURGERY



- Posterior cervical fusion with instrumentation C2-T1
- Laminectomy C4-C7
- Laminotomies:
  - Bilateral C4-5,
  - Left C5-6, C6-7

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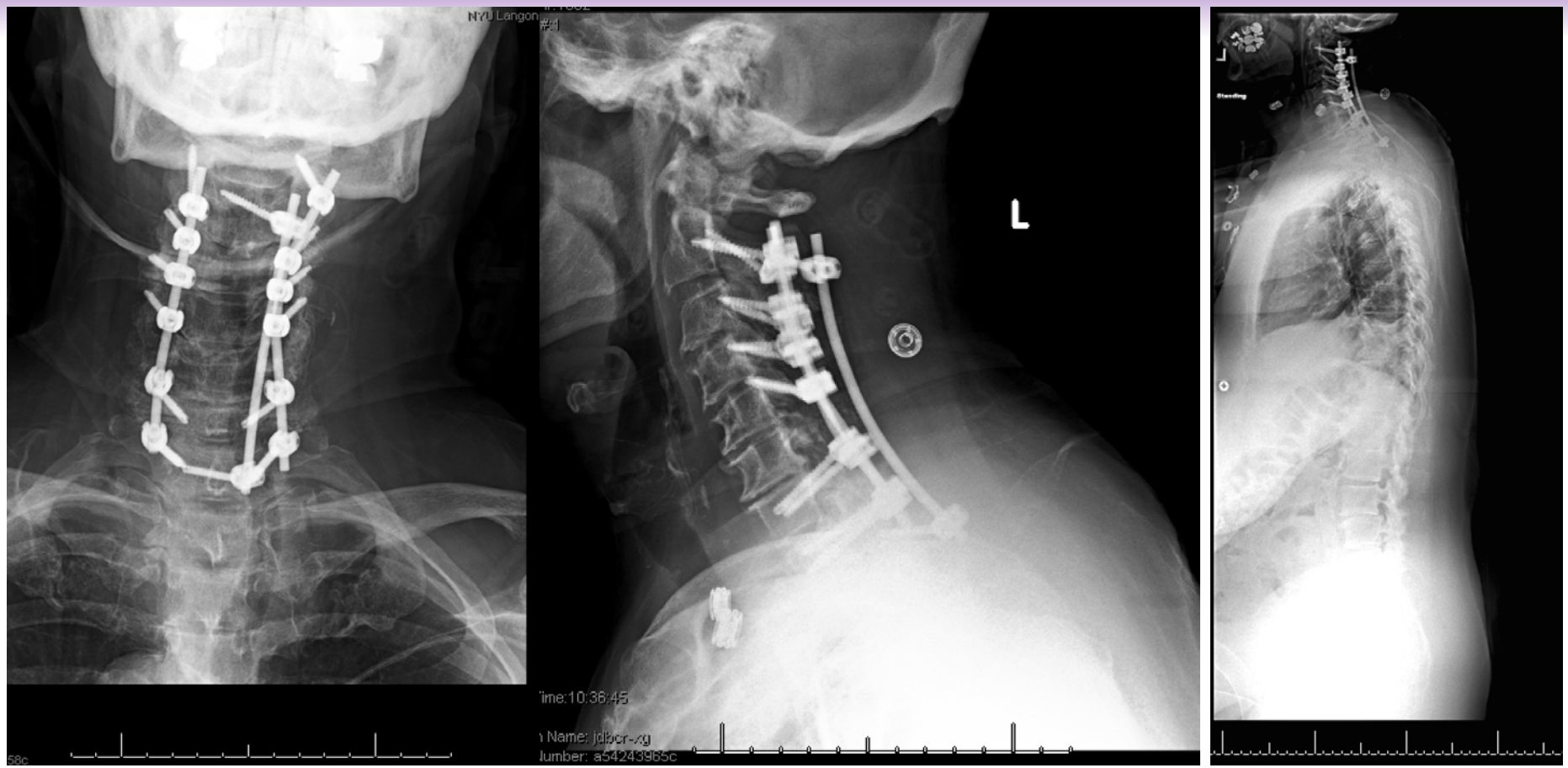

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Thank You