



Best Practices in Cervical Spine Treatment

Chairperson: Tony Tannoury, MD

Monday, March 28th, 2022

8:30-9:25am



Chadi Tannoury, MD

Medical Director, Orthopedics – BMC
Associate Professor -Orthopaedic Spine
Director, Spine Research
Co-Director of Spine Fellowship
Boston Medical Center

Neck Session

Radiculopathy & Myelopathy:
Treatment Algorithm

15 min

Disclosure

- I have something to Disclose (Website)

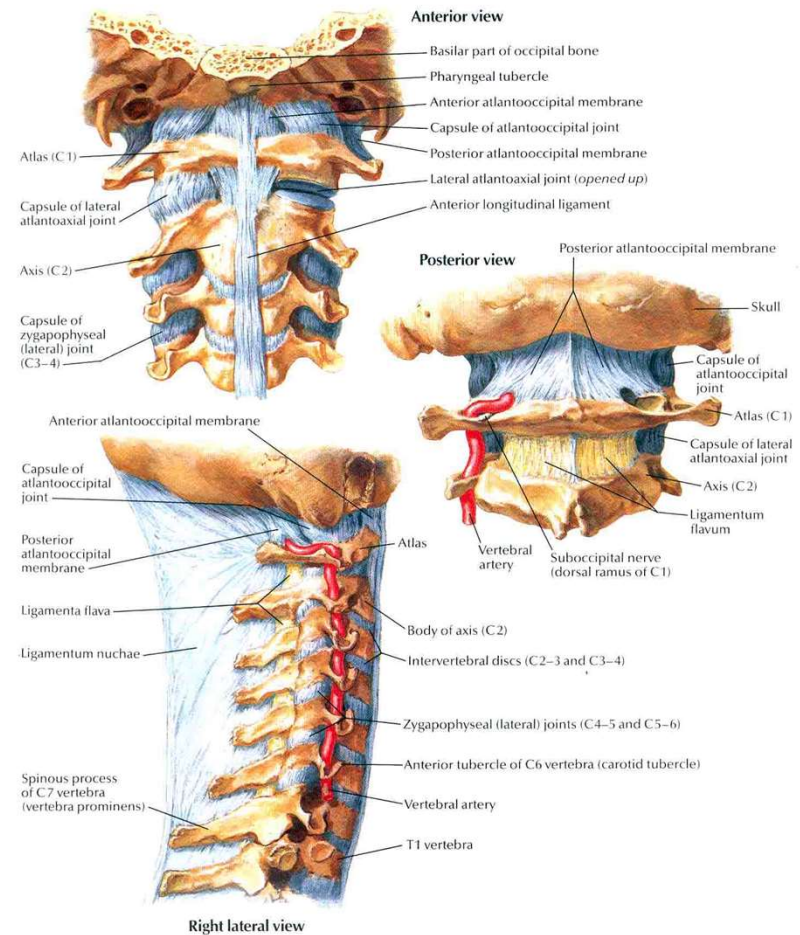
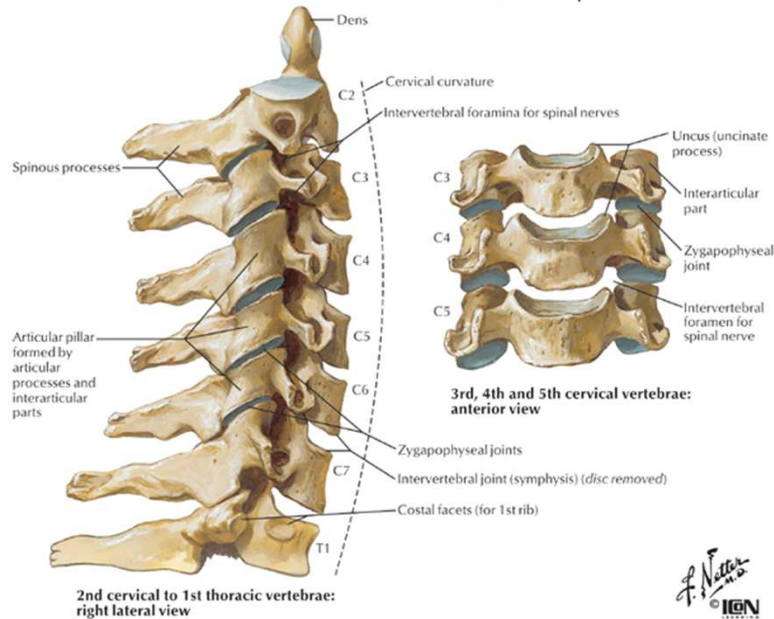
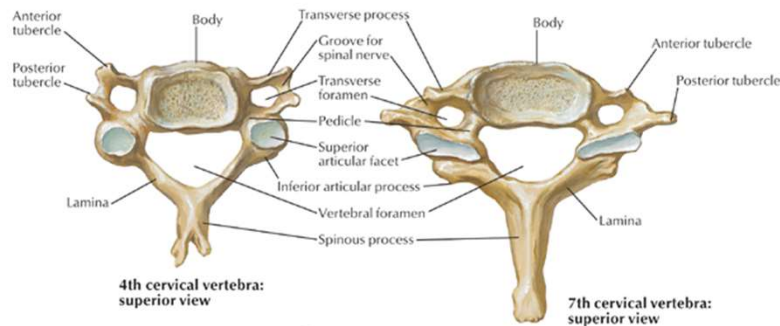
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**Work Related Injuries
Workshop**

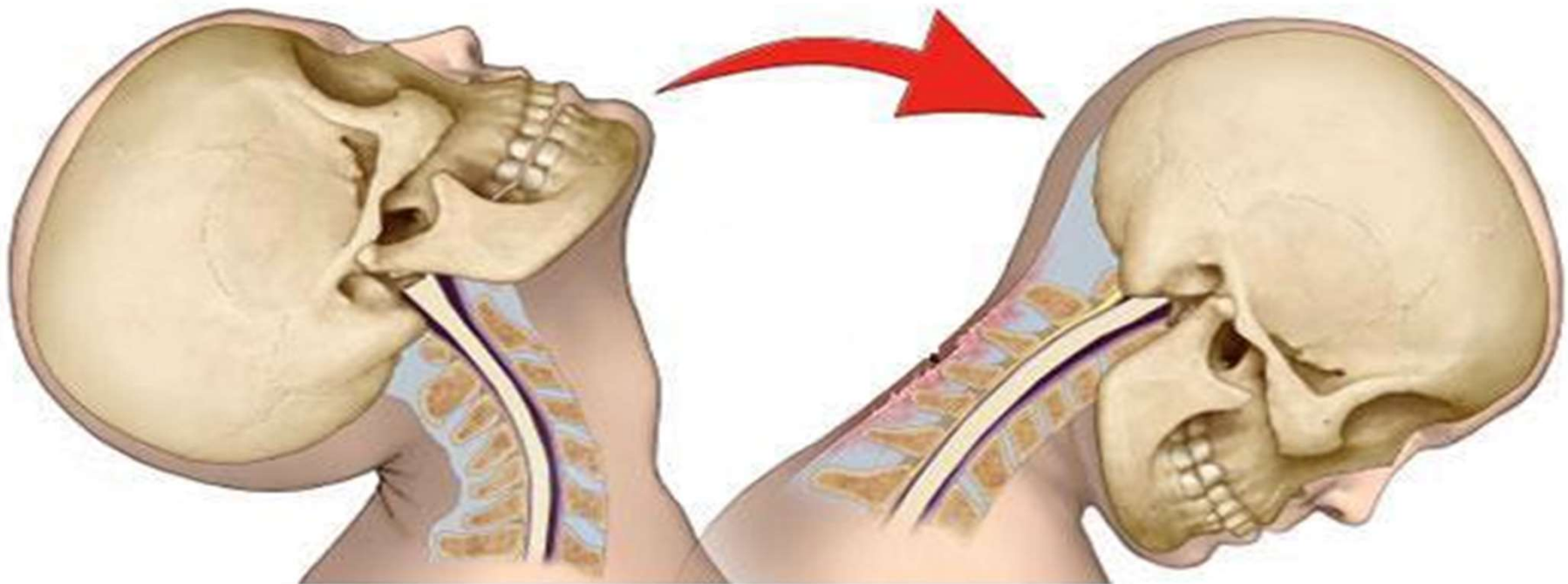
Anatomy

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Work Related Injuries
Workshop



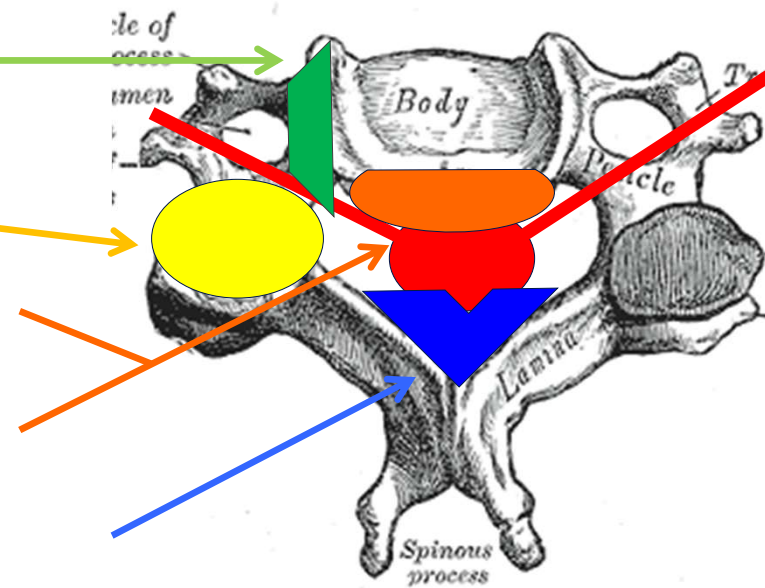
Cervical Sprain / Whiplash



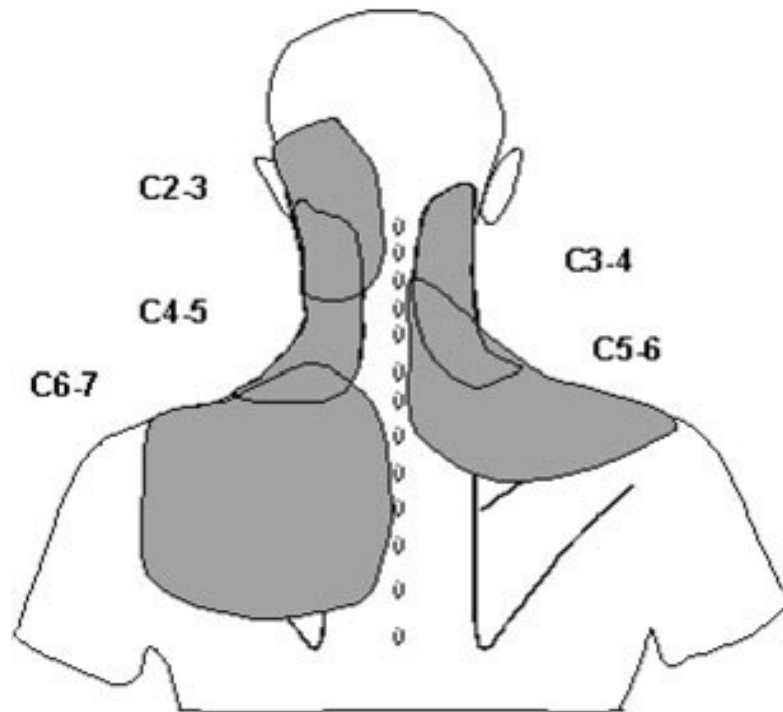
Spondylosis - Pathophysiology:

- Direct Mechanical compression NRoot/Cord:

- Uncus joint
- Facet joint
- Disk Osteophyte Complex
- Disc Herniation - OPLL
- Infolding Ligamentum flavum

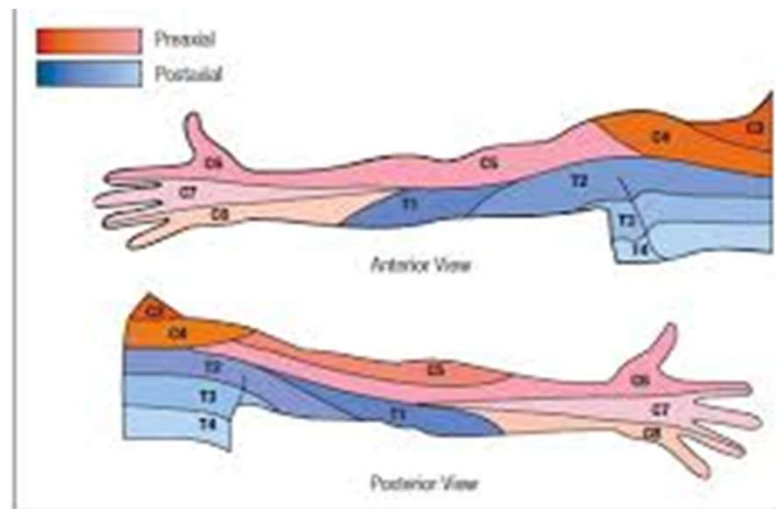


Discogenic Pain (Spondylosis)



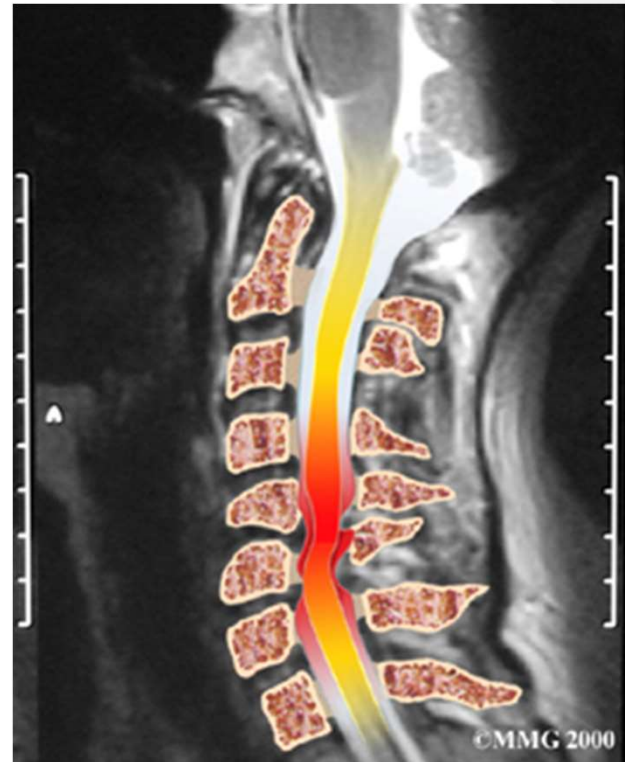
Cervical Radiculopathy

- PINCHEd NERVE
- Pain is often accentuated by maneuvers that stretch the involved nerve root. Some examples include:
 - Coughing
 - Sneezing
 - Reaching



Spinal Cord Compression: Myelopathy

- Neck Pain
- UE:
 - Weakness/N/T
 - Clumsiness
 - Dexterity – Fine motor skills
- LE:
 - Loss of Balance
 - Frequent Falls
 - Gait disturbances



MANAGEMENT

- Axial Neck Pain (without neurologic deficits: Whiplash/Spondylosis):
 - Typically conservative Management (PT/NSAIDs/Ice-Heat/Rest)
 - Trigger point injections? Facet block? RFA?
- Arm Pain: Radiculopathy
 - PT/ Traction / Injections
 - Surgery: if conservative management fails
- Myelopathy:
 - Early – Mild/stable: Conservative
 - Progressive, Mod – Severe: Surgery

Surgical Options - Terminology

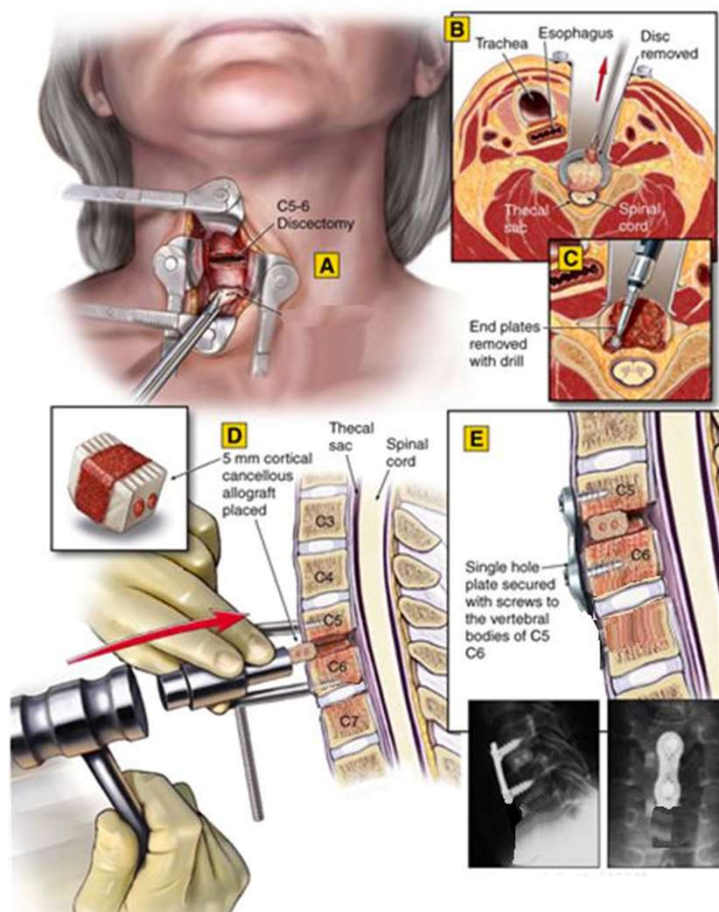
- Anterior cervical discectomy and fusion (ACDF)
- Anterior cervical corpectomy and fusion (ACCF)
- Cervical disk arthropasty – replacement (cTDR)

- Posterior cervical laminotomy - Foraminotomy
- Posterior cervical laminectomy & Fusion
- Posterior cervical laminoplasty

ACDF

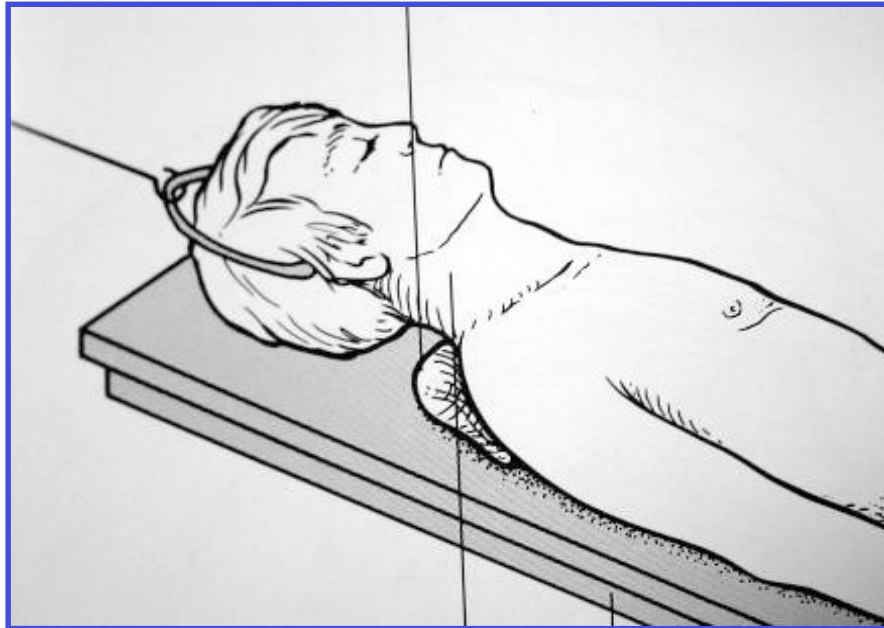
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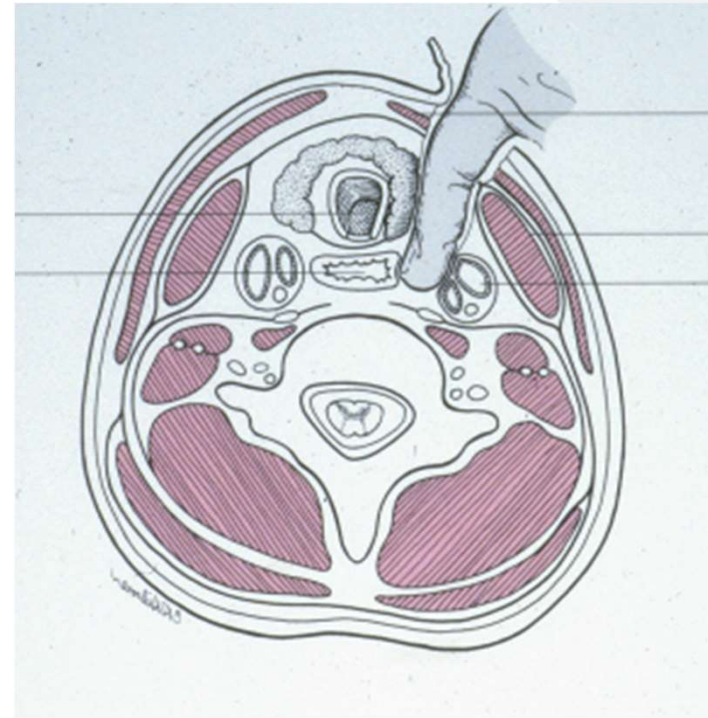
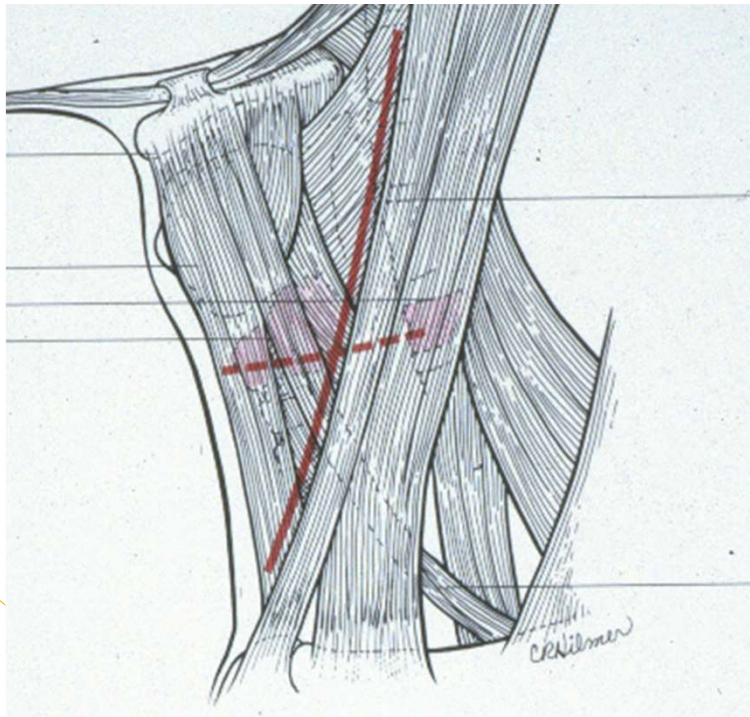


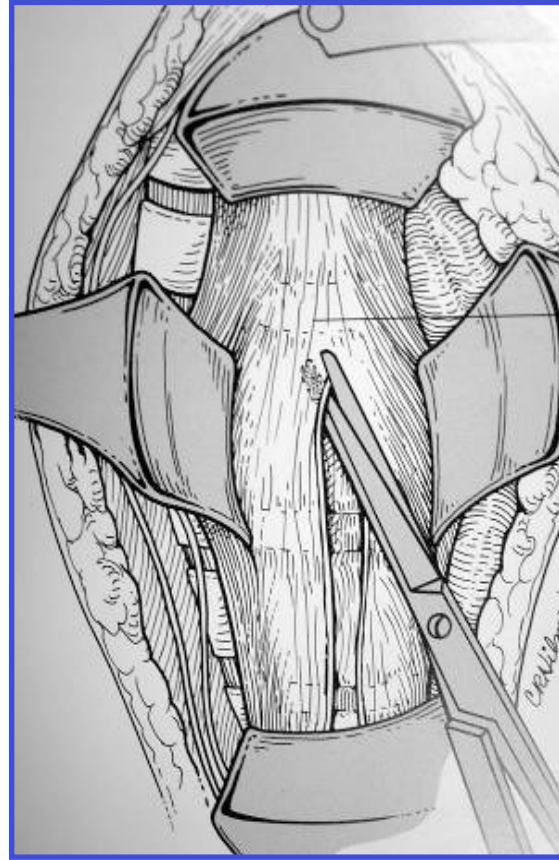
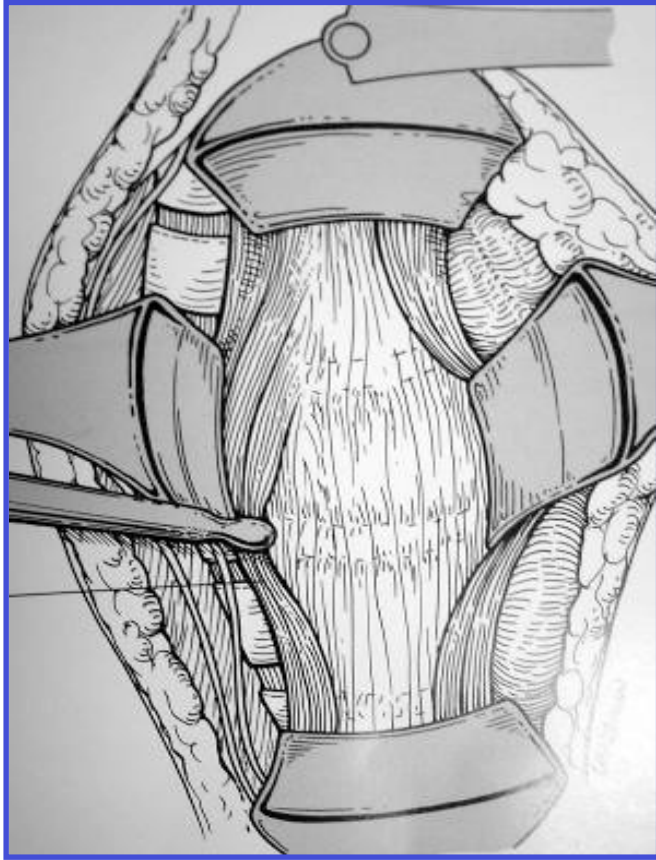
Positioning and Anatomy

- Mild Neck extension



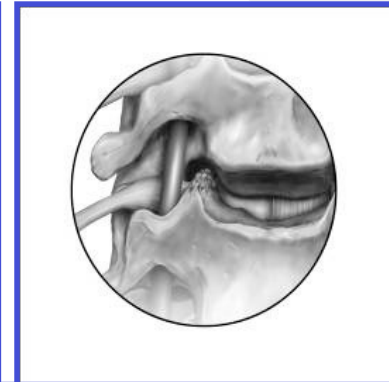
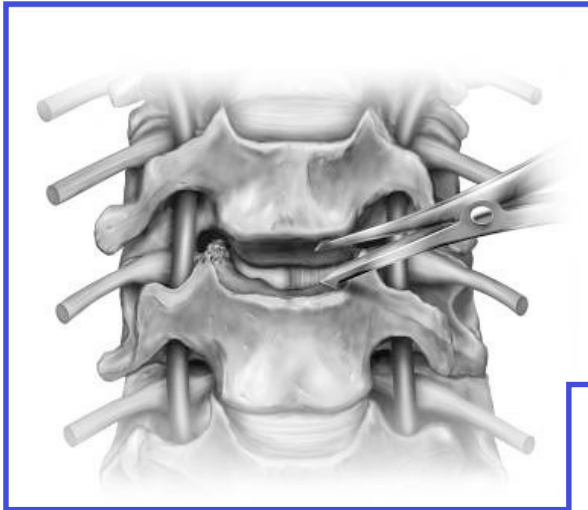
Anatomy



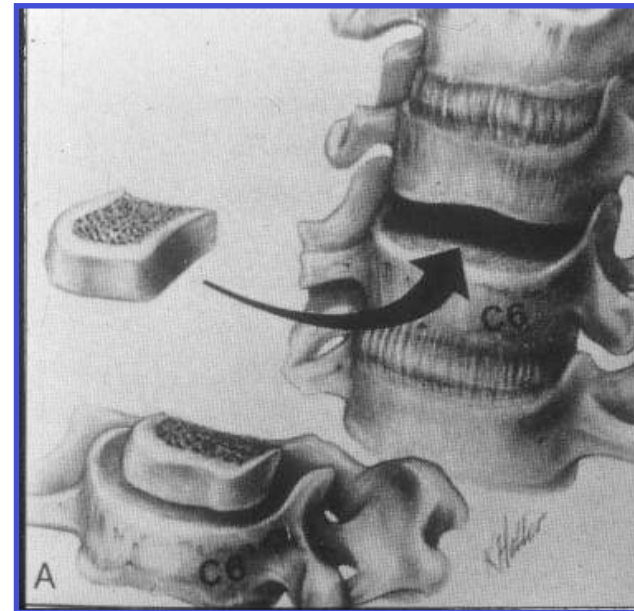
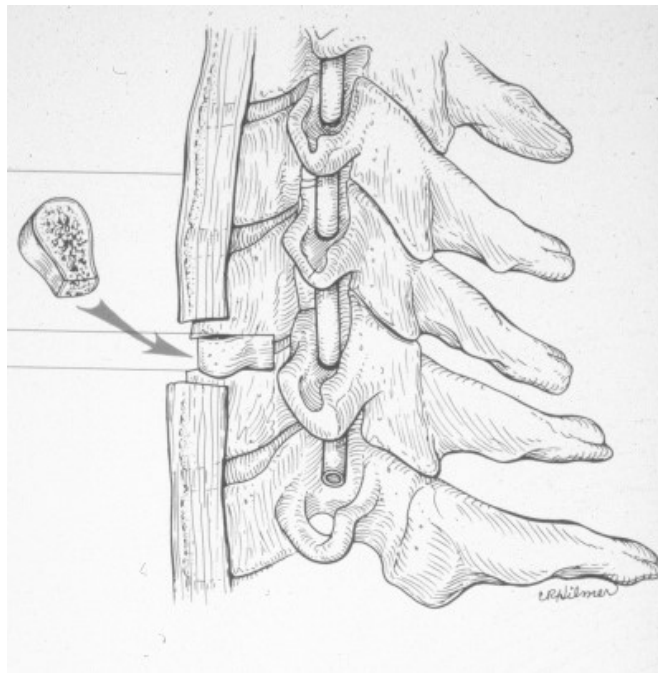


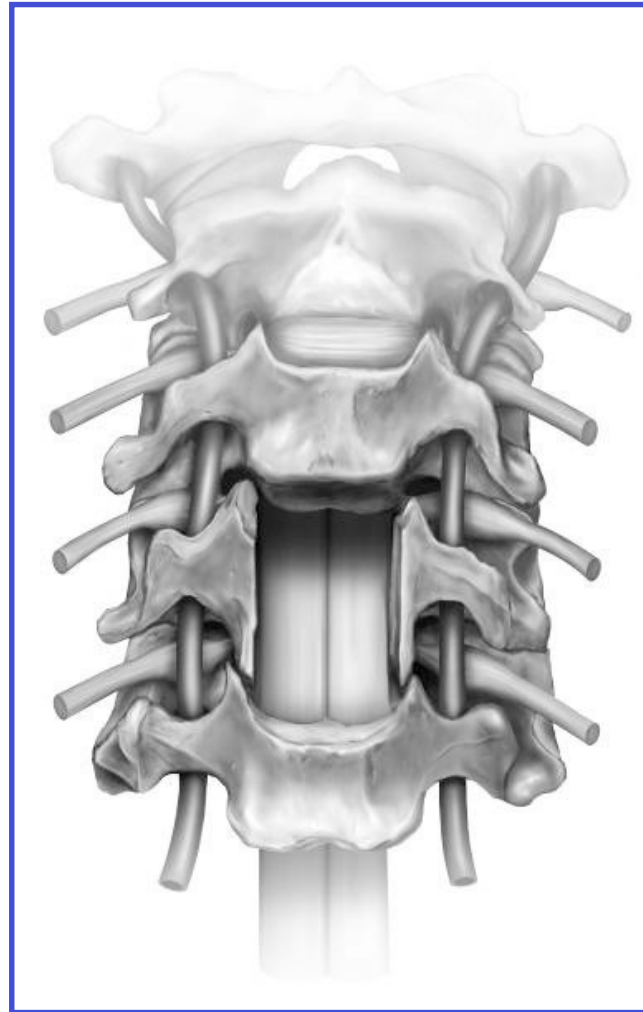
Discectomy and Decompression

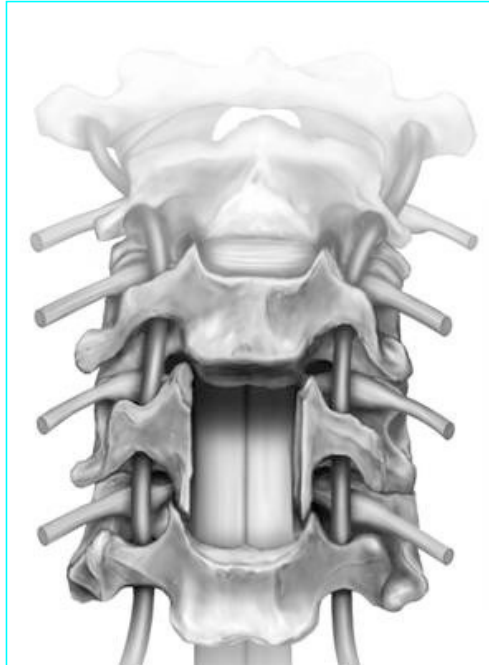
- HT: 5-10mm
- W: 10-15mm
- Depth: 12-17mm



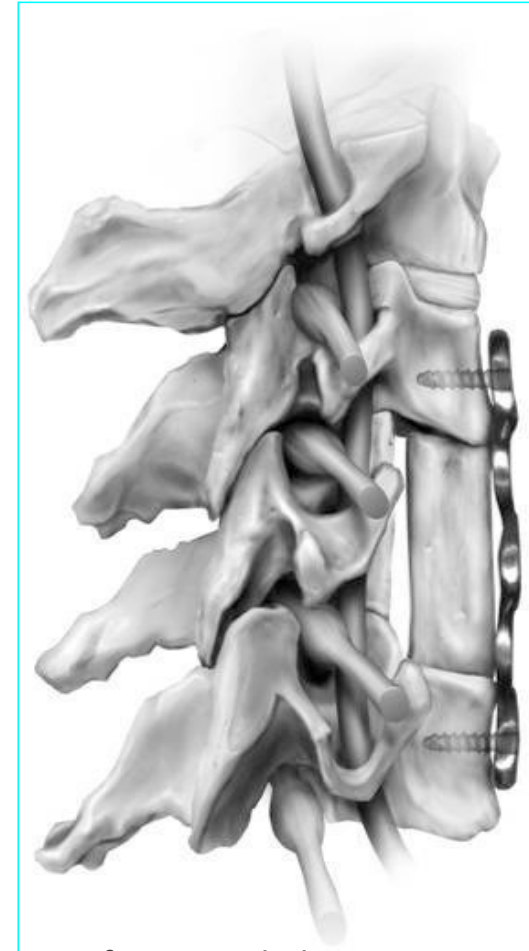
Bone Graft Placement





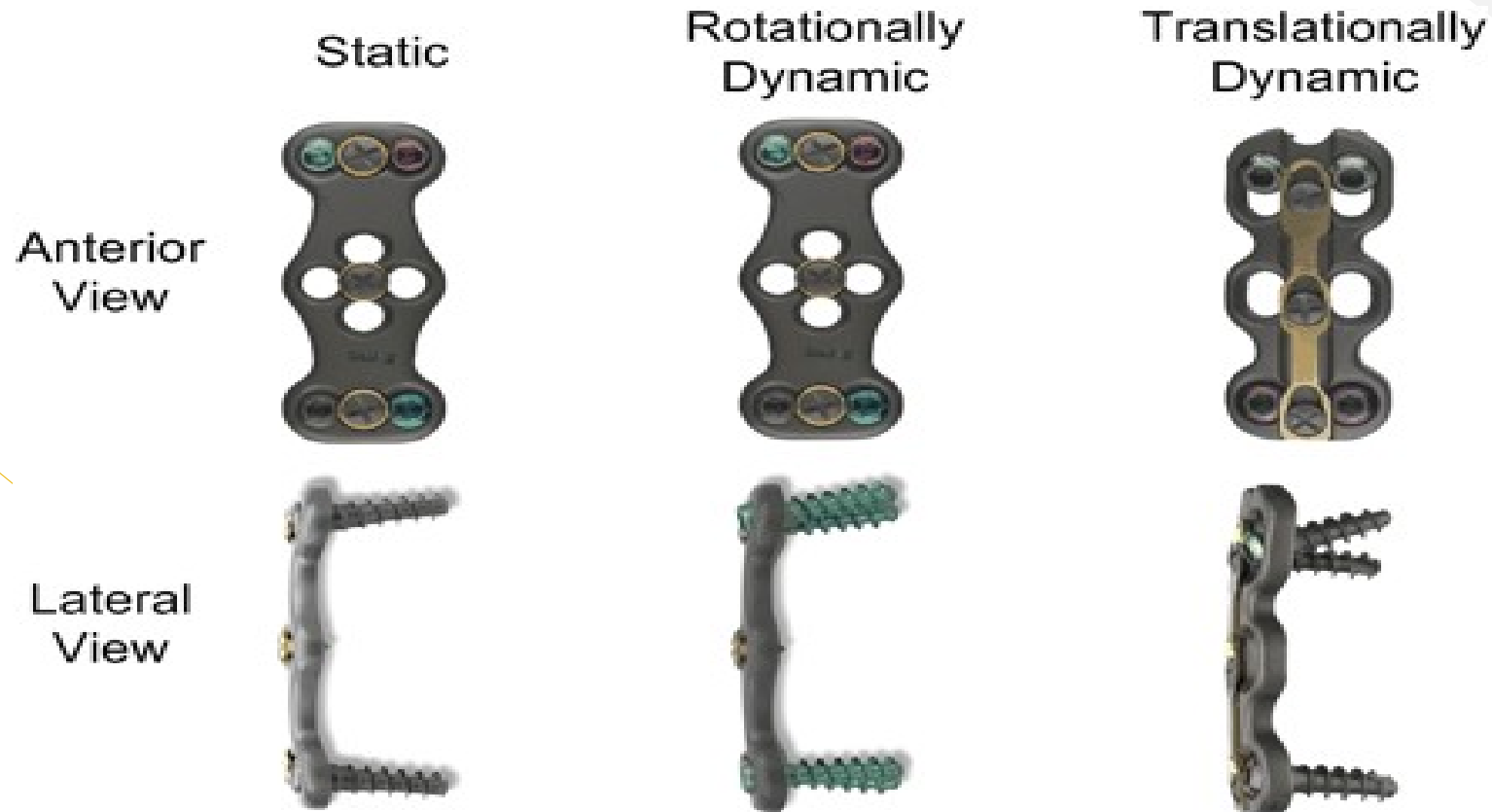


corpectomy



fusion and plating

Anterior Plating



Cervical Disc Arthroplasty

- Artificial disc replacement
- Preserves ROM
- Decrease risk of adjacent DD
 - ***Decrease Reoperation rate***
 - 1 level: ACDF 17.3% vs cTDR 4.5%
 - 2 level: ACDF 21% vs. cTDR 7.3%



Jackson JNS 2016 (5 yr f-up)

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**Work Related Injuries
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45 y F with C7 radiculopathy





Posterior Cervical Options

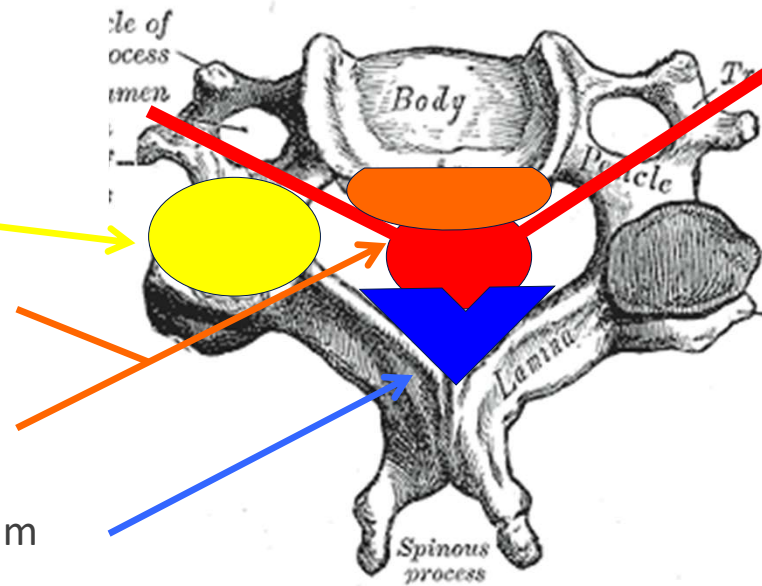
Radiculopathy/ Myelopathy - Pathophysiology:

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- Direct Mechanical compression NRoot/Cord:

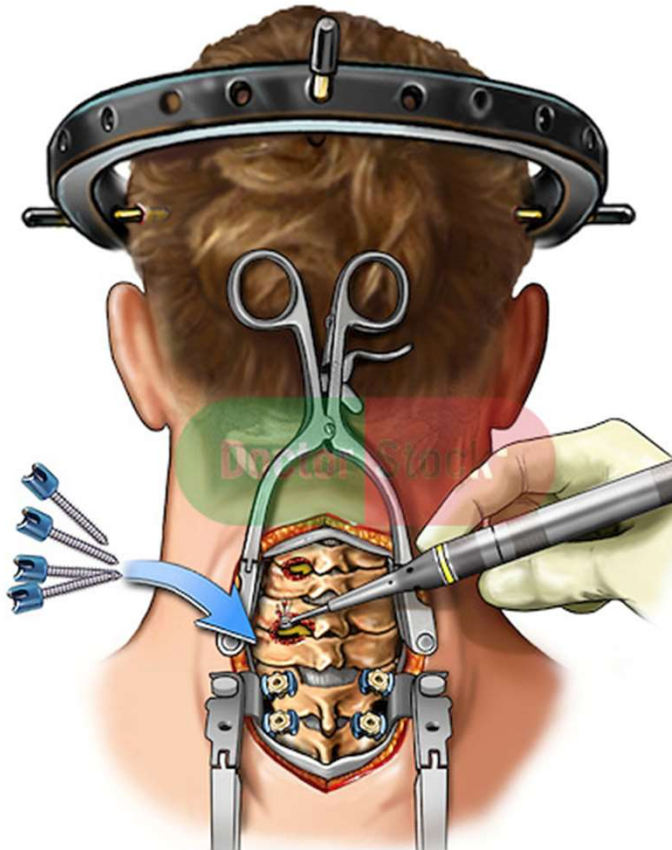
- Facet joint
- Disk Osteophyte Complex
- OPLL
- Infolding Ligamentum flavum



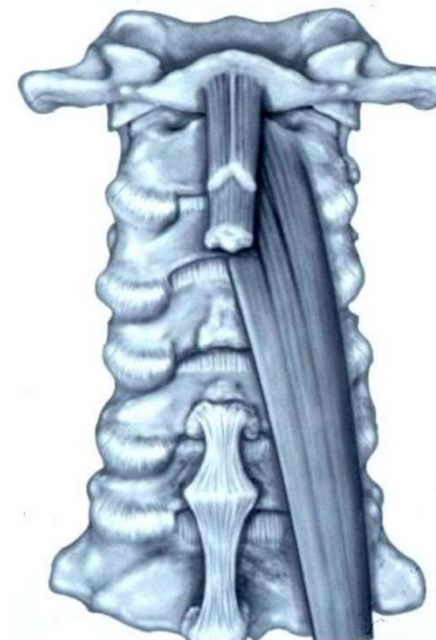
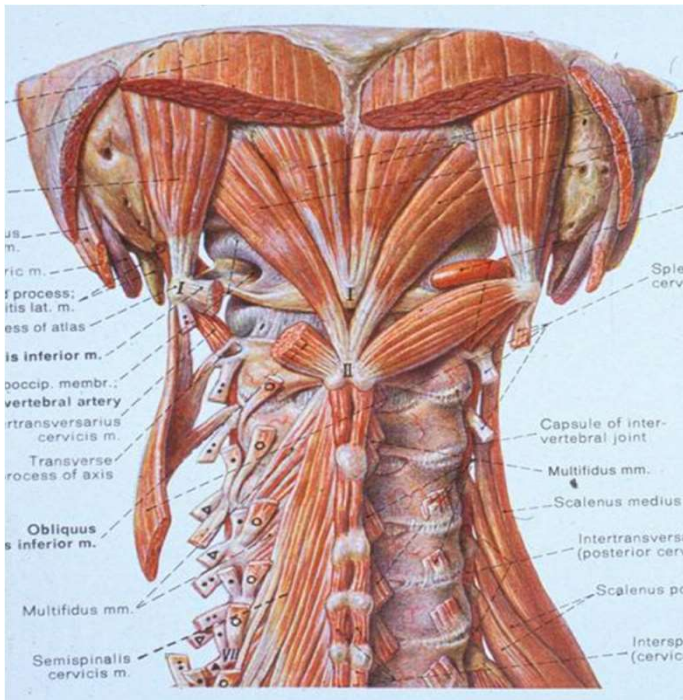
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Cervical Foraminotomy



Not tissue preserving!

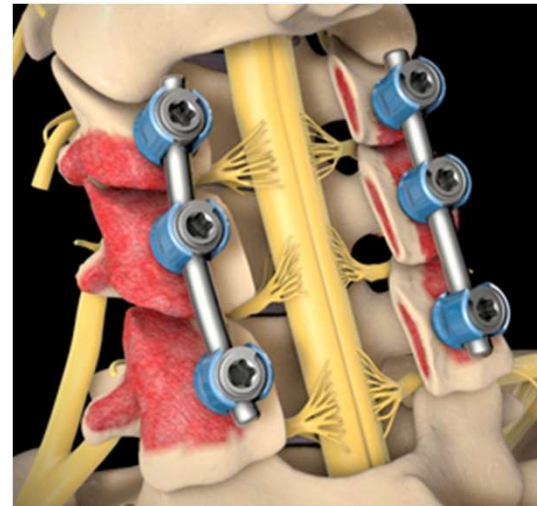
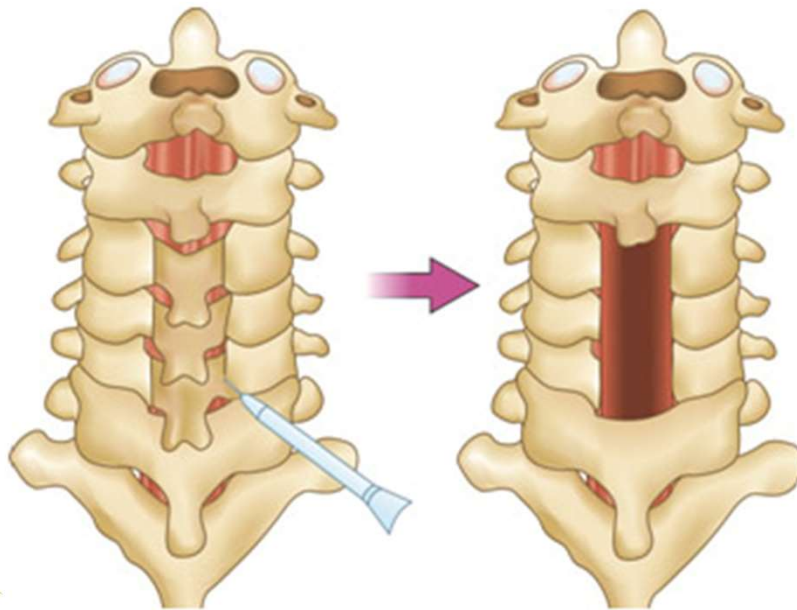


Multifidus is destroyed !!

Cervical laminectomy and fusion

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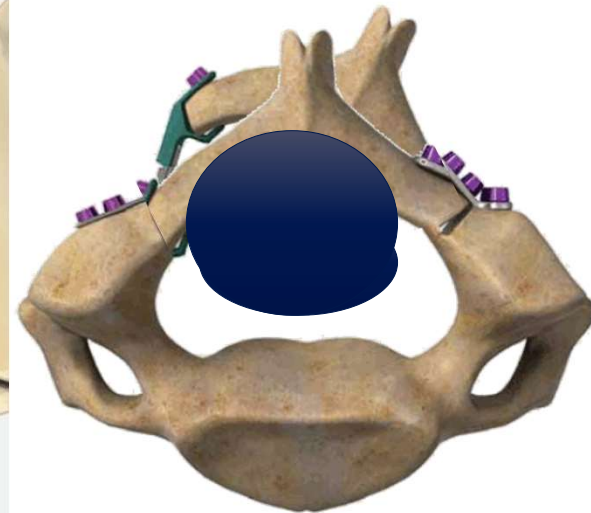
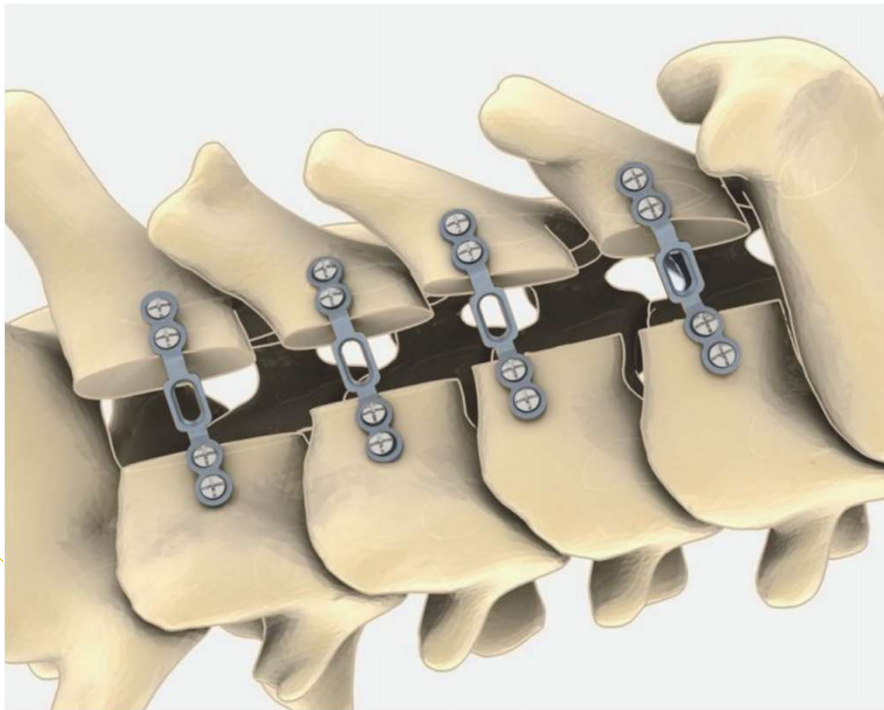
Work Related Injuries
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Cervical Laminoplasty



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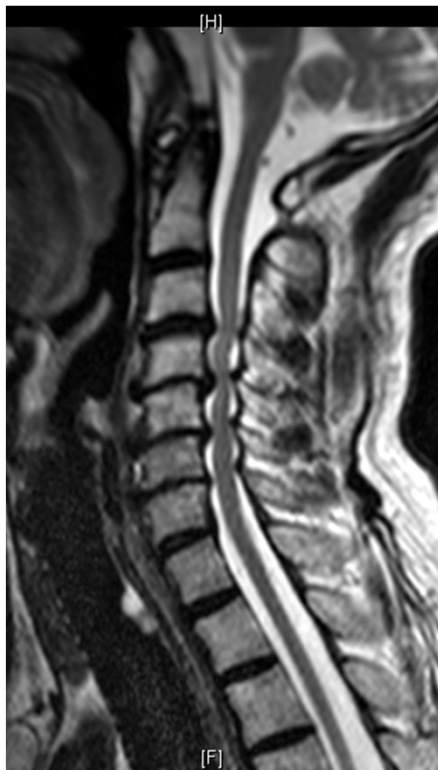
**Work Related Injuries
Workshop**



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**Work Related Injuries
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56 y M w Myelopathy



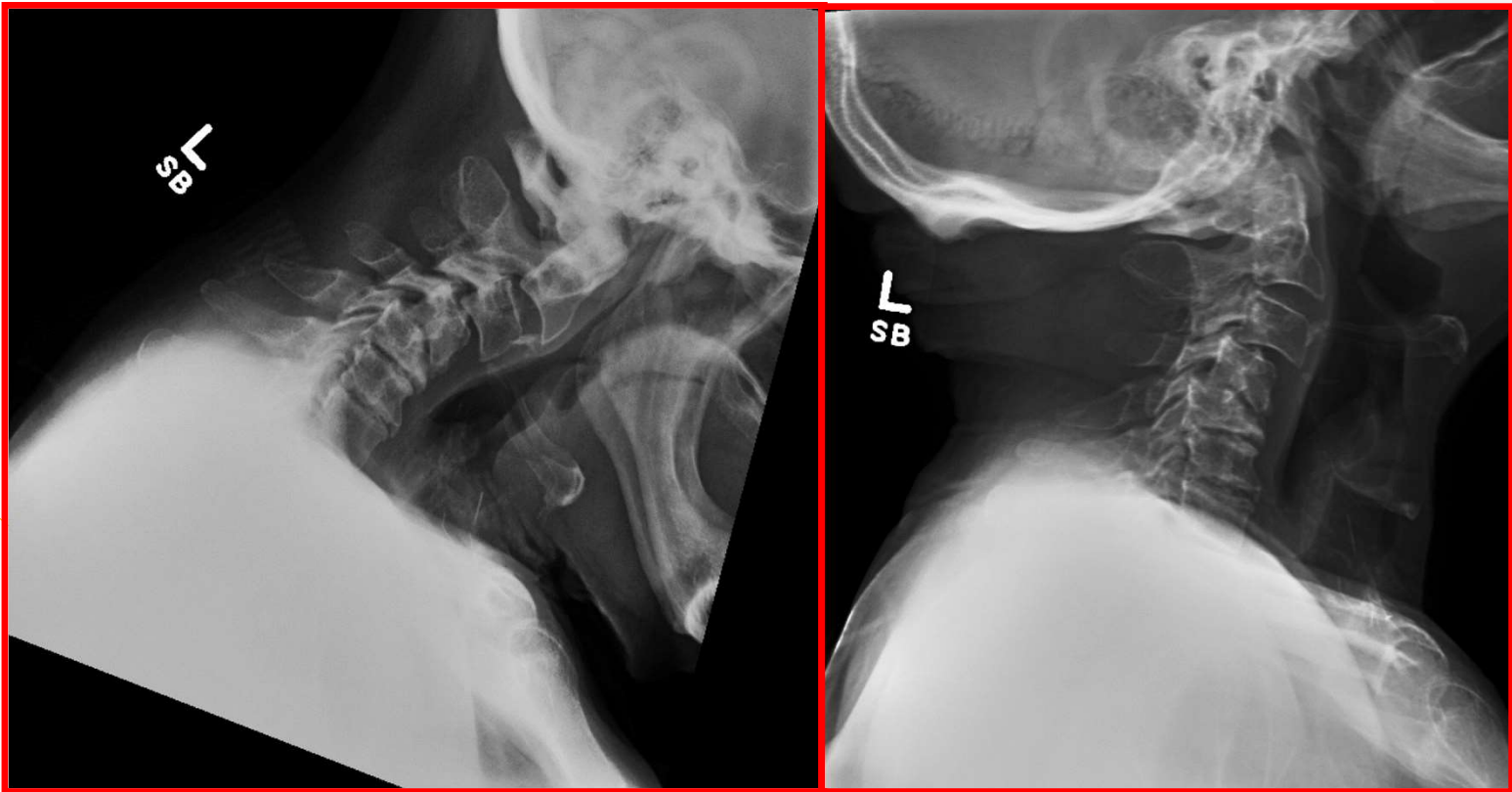


Combined Ant-Post CF

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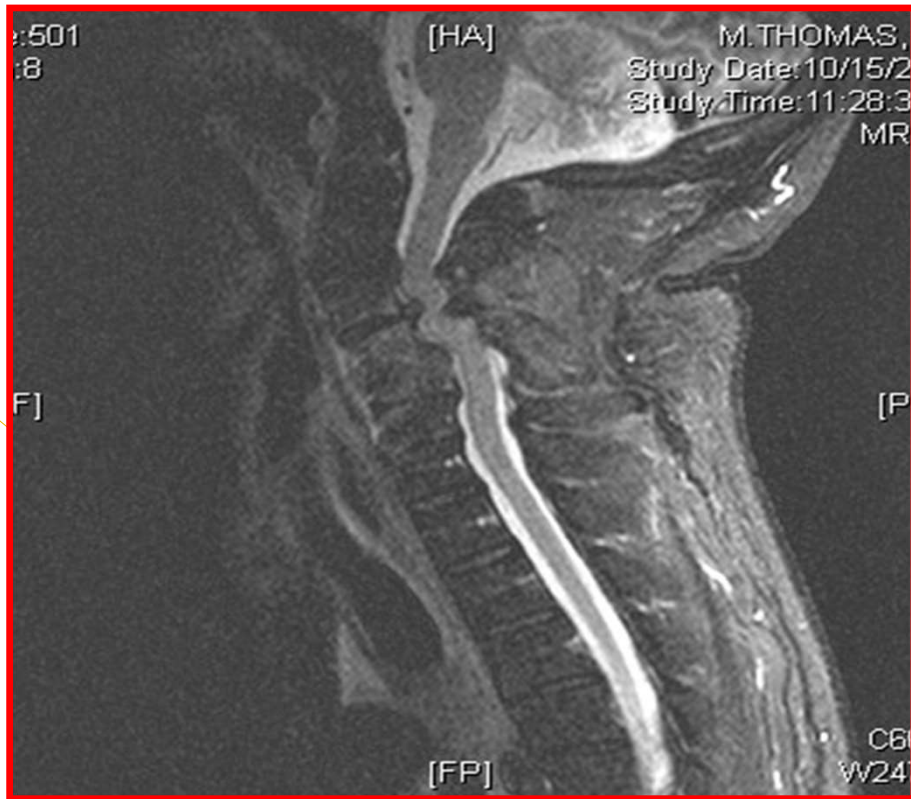
**Work Related Injuries
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60 y M w severe myelopathy

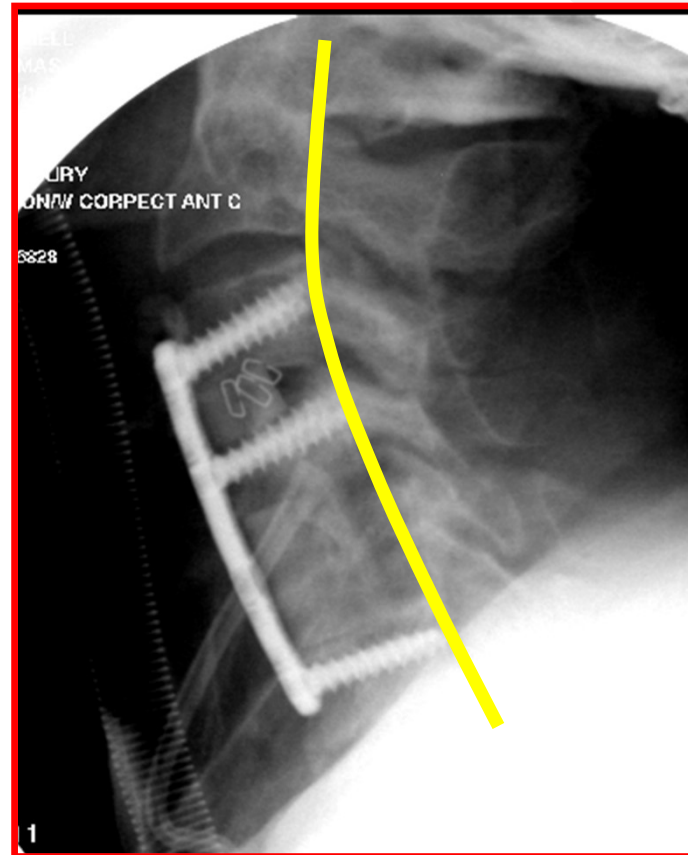


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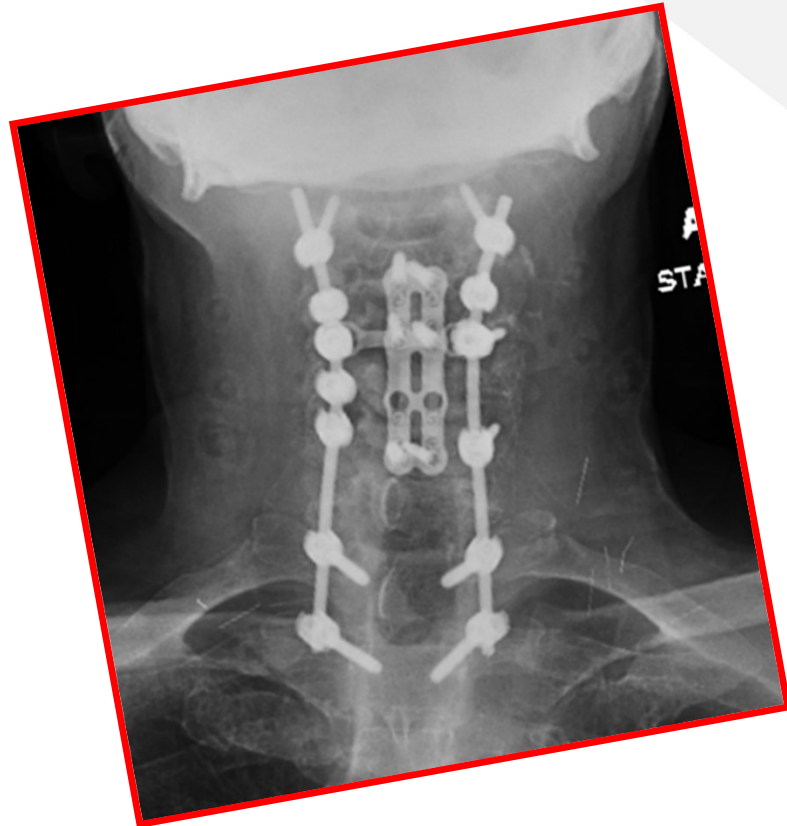
Stage I: Corpec C5-ACCF C3-6



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**Work Related Injuries
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Stage II – Post Lami Fusion





CONCLUSION

UNDERSTANDING Pathology & Treatment

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**Work Related Injuries
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- Cervical Whiplash:
- Cervical Spondylosis:

UNDERSTANDING Pathology & Treatment

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Work Related Injuries
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- Cervical Whiplash: Conservative
- Cervical Spondylosis: Conservative

UNDERSTANDING Pathology & Treatment

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**Work Related Injuries
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- Cervical Whiplash: Conservative
- Cervical Spondylosis: Conservative
- Cervical Radiculopathy:
- Cervical Myelopathy:

UNDERSTANDING Pathology & Treatment

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**Work Related Injuries
Workshop**

- Cervical Whiplash: Conservative
- Cervical Spondylosis: Conservative
- Cervical Radiculopathy:
 - Conservative Rx: 8-12 weeks
 - Surgery if failure of conservative Rx
- Cervical Myelopathy:
 - Conservative if mild-stable
 - Surgery if progressive

UNDERSTANDING Pathology & Treatment

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**Work Related Injuries
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- Cervical Whiplash: Conservative
- Cervical Spondylosis: Conservative
- Cervical Radiculopathy:
 - Conservative Rx: 8-12 weeks
 - Surgery if failure of conservative Rx
- Cervical Myelopathy:
 - Conservative if mild-stable
 - Surgery if progressive
- Anterior:
 - ACDF/ACCF
 - cTDR
 - Anterior fixation

UNDERSTANDING Pathology & Treatment

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Work Related Injuries
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- Cervical Whiplash: Conservative
- Cervical Spondylosis: Conservative
- Cervical Radiculopathy:
 - Conservative Rx: 8-12 weeks
 - Surgery if failure of conservative Rx
- Cervical Myelopathy:
 - Conservative if mild-stable
 - Surgery if progressive
- Anterior:
 - ACDF/ACCF
 - cTDR
 - Anterior fixation
- Posterior:
 - Laminectomy/foraminotomy +/- Fusion
 - Laminoplasty
 - Instrumentation – fusion (Fracture stabilization)
- Combined

Questions

- Q1: What is the medical terminology of a pinched nerve in the neck?
- Q2: What is the medical terminology of a pinched spinal cord in the neck?

- A1: Cervical Radiculopathy
- A2: Cervical Myelopathy

Thank You



Chadi.Tannoury@bmc.org



Risks & Complications of Cervical Epidural Steriod Injections

Review of Literature

Ian Rivera-Colon, MD

About Us

Ian A Rivera-Colon, MD

- Anesthesiology Residency - St. Josephs Hospital, NJ Mount Sinai School Of Medicine
- Pain Management Fellowship – The Mount Sinai Hospital, NY
- Anesthesiologist - Steward Physician Group
- Pain Management Specialist – Private Practice, CEO
- Cape Cod Canna Doc – Private Practice, CEO



Complications of cervical epidural steroid injections

Review recent reports of morbidity and mortality attributed to the various types of cervical epidural steroid injections

- Major complications included; epidural hematomas, infection (abscess/meningitis), increased neurological deficits due to intramedullary (quadriparesis/quadriplegia), and intravascular injections (e.g., vertebral artery injections leading to cord, brain stem, and cerebellar strokes)
- Injections leading to strokes were typically attributed to the particulate steroid matter (e.g., within the methylprednisolone injection solution) that embolized into the distal arterial branches.

Articles on CESI

2004-2013

Author (YEAR)	Event	Procedure performed	Complications	
Tiso (2004)	Cerebellar infarct	Right C5-6 transforaminal CESI	Subdural paralysis stroke from intra-arterial injection of steroid particles	
Ludwig (2005)	Cervical Cord Stroke	Left C6 transforaminal CESI	Paralysis Left upper extremity and bilateral lower extremities	
Scanlon (2007)	8 Brain and spinal cord stroke	Transforaminal Cervical epidural steroid injection	78 Adverse effects: 16 vertebrobasilar brain strokes 112 cervical cord strokes 2 Both Brain and cord stroke	Embolism of particulate steroids
Epstein (2013)	Adverse Events morbidity/mortality of cervical injections performed by various pain management specialists	Cervical and Lumbar epidural steroid injections CESI, TF CESI, LESI, TF LESI	CSF leak 6% Headache 28% Death, Infection, abscess, paralysis	Arachnoiditis 16% Stroke 11.6% Blindness, Hematomas, Seizures

Complications of cervical epidural steroid injections

2004, Tiso *et al.*

- Patient with a C5-C6 disc herniation on MR;
- following a C5-C6 TF-CESI, he developed a massive cord/brain stem/cerebellar infarct
- attributed to an intraarterial injection with resultant embolization of *particulate steroids*

Tiso RL, Cutler T, Catania JA, Whalen K
Spine J. 2004 Jul-Aug; 4(4):468-74.



Complications of cervical epidural steroid injections

2005, Ludwig and Burns

- 53-year-old male who developed left upper and bilateral lower extremity quadriparesis 15 min following a left C6 TF-CESI performed under fluoroscopy
- attributed to an intravascular injection (e.g., embolization of *particular steroids*; this resulting in permanent paralysis)

Ludwig MA, Burns SP
Spine (Phila Pa 1976). 2005 May 15; 30(10):E266-8

Complications of cervical epidural steroid injections

Scanlon *et al.* (2007)

- Surveyed US physician members of the American Pain Society [e.g., 21.4% response rate (287 of 1340)], they identified 78 complications of TF-CESI
- 16 vertebrobasilar brain infarcts,
- 12 cervical spinal cord infarcts,
- and 2 combined brain/spinal cord infarcts:
- 13 of these patients sustained fatal injuries

Scanlon GC, Moeller-Bertram T, Romanowsky SM, Wallace MS
Spine (Phila Pa 1976). 2007 May 15; 32(11):1249-56



Complications of cervical epidural steroid injections

Scanlon *et al.* (2007)

- Observation;
- TF-CESIs correlated with an unacceptably high incidence of complications that included; intraarterial injections/strokes/embolism

Scanlon GC, Moeller-Bertram T, Romanowsky SM, Wallace MS
Spine (Phila Pa 1976). 2007 May 15; 32(11):1249-56



Articles on Cervical ESI

2007-2018

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Work Related Injuries
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Author (YEAR)	Cervical			
Landers (2017)	Spinal Cord Injury	Attempted cervical interlaminar epidural steroid injection		
Zhang (2017)	Neck Pain elevated WBC _ Cervical Epidural Abscess	Cervical ESI	MR Confirmed C6-T8	Rapid diagnosis and treatment with IV antibiotics
Smith (2017)	14,247 Admissions over 8 years	1182 CESI 4617 LESI	7 haemorrhages 3 infections 3 Dural penetrations	Anticoagulation increased risk
Schneider (2018)	Complications of CESI C TFESI C IL ESI	Aberrant needle placement	Stroke, hematoma, Abscess, intramedullary injection	Most common Adverse event; Pain, vasovagal event
Sanders (2018)	Epidural hematoma	79 y/o M ICESI	Did not stop ASA 81 mg prophylaxis for MI	Post-operative hematoma

[Surg Neurol Int.](#) 2018; 9: 86.



Complications of cervical epidural steroid injections

2013, Epstein

- Summarized the morbidity/mortality of cervical injections performed by various pain management specialists (e.g. radiologists, physiatrists, or anesthesiologists)
- Noteworthy, was the lack of training for all three specialists in how to perform a neurological examination, and for the latter two, how to interpret neuroradiological studies (e.g. MR/CT)



Complications of cervical epidural steroid injections

2013, the Center for Disease Control

- Center for Disease Control (CDC) reported that contaminated steroids resulted in 25 deaths (many due to Aspergillosis), with an added 337 patients sickened, and a total of 14,000 exposed



Complications of cervical epidural steroid injections

2013, Center for Disease Control

- spinal fluid leaks (0.4–6%),
- positional headaches (28%),
- adhesive arachnoiditis (6–16%),
- intravascular injections/stroke (7.9–11.6%),
- hydrocephalus, air embolism, urinary retention, allergic reactions, blindness, neurological deficits/paralysis, hematomas, seizures, and death.



Complications of cervical epidural steroid injections

Landers (2017)

- presented a patient who, immediately following an ICESI, became quadriplegic due to an intramedullary injection

Landers MH
Pain Med. 2018 Apr 1; 19(4):652-657



Complications of cervical epidural steroid injections

Schneider *et al.* (2018)

- CESI contributed not only to intramedullary and intravascular injections, leading to embolic infarcts (e.g., from particulate steroids),
- hematomas,
- abscesses,
- vertebral artery dissections,
- pain,
- side effects of steroids,
- and vasovagal reactions

Schneider BJ, Maybin S, Sturos E
Phys Med Rehabil Clin N Am. 2018 Feb; 29(1):155-169



Summary

Major complications of Cervical epidural steroid injections included:

- epidural hematomas,
- infection (abscess/meningitis),
- increased neurological deficits due to intramedullary injection (quadriparesis/quadriplegia),
- intravascular injections (e.g., vertebral artery injections leading to cord, brain stem, and cerebellar strokes)
- Injections leading to strokes were typically attributed to the particulate steroid matter (e.g., within the methylprednisolone injection solution) that embolized into the distal arterial branches.



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Work Related Injuries
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Case Discussion

Dr. Tony Tannoury

46/F works in catering business

- Tripped and fell going downstairs
- Presented with BUE weakness and numbness/parasthesias
- PMH: Not significant
- PSH: Not significant
- BMI: 29.5
- Current everyday smoker: 0.5 PPD

Physical Exam:

C-Collar in place

MOTOR	C5	C6	C7	C8	T1
LEFT	2-	1	1	1	1
RIGHT	2-	1	1	1	1

SENSORY	C5	C6	C7	C8	T1
LEFT	1	1	1	1	1
RIGHT	1	1	1	1	1

MOTOR	L2	L3	L4	L5	S1
LEFT	4	5	5	5	5
RIGHT	4	5	5	5	5

SENSORY	L2	L3	L4	L5	S1
LEFT	2	2	2	2	2
RIGHT	2	2	2	2	2

X-rays

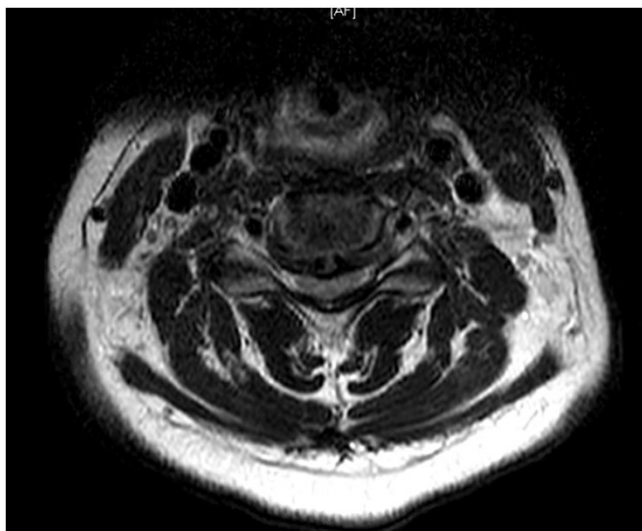


46/F

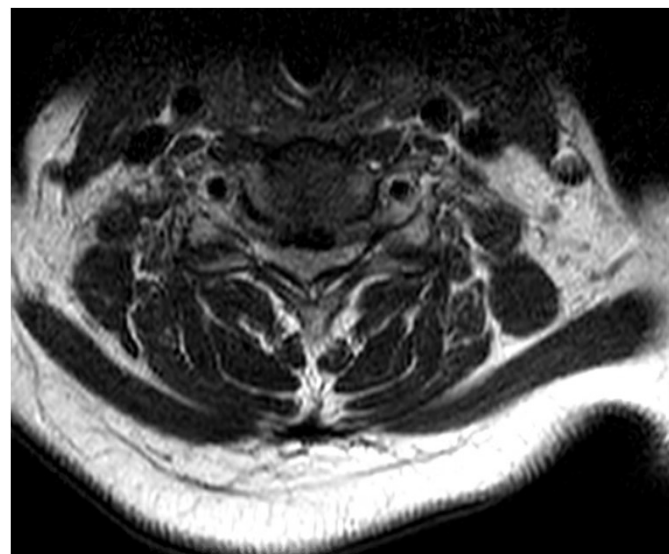
- Tripped and fell going downstairs
- Presented with BUE weakness and numbness/parasthesias
- No other injuries
- PMH: Not significant
- PSH: Not significant
- BMI: 29.5
- Current everyday smoker: 0.5 PPD

CT scan and MRI

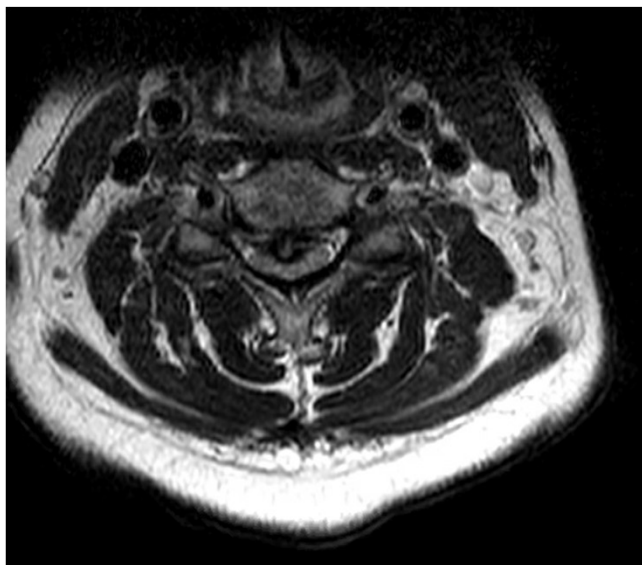




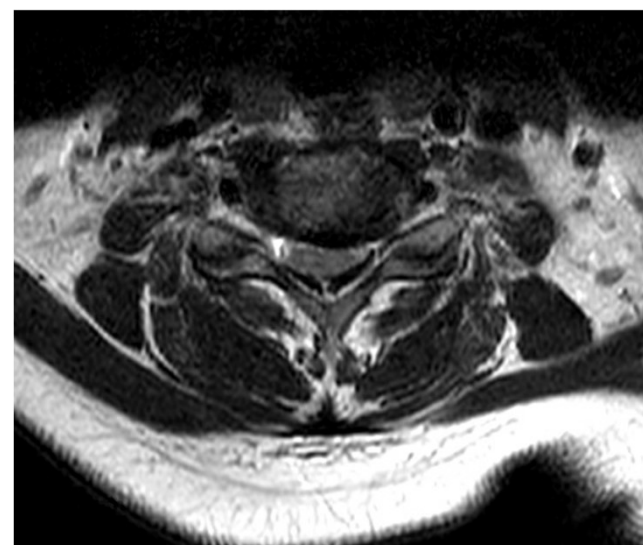
C4-5



C5-6



**Behind
C5-
Superior
half**



C6-7

C5 and C6 Corpectomy, C4-C7 fusion with fibular allograft



Post-op

- Dc to acute rehab on POD3
- Motor improvement, exam on dc-

MOTOR*	C5	C6	C7	C8	T1
LEFT	4	3	4	4	4
RIGHT	4	4	4	4	4

SENSORY	C5	C6	C7	C8	T1
LEFT	1	1	1	1	1
RIGHT	1	1	1	1	1