

The Neck or Something Else?

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Double-fellowship Trained Spine Surgeon



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Disclosures

- Dr. Lori Kemper and Dr. Andrew Chung have nothing to disclose

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Objectives

1. The learner will be able to perform a neurologic exam to diagnose cervical radiculopathy
2. The learner will recognize which imaging modalities are most useful for the diagnosis of cervical radiculopathy
3. The learner will be able to effectively formulate a differential diagnosis for upper arm / shoulder pain

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Case 1

Mr. M is a 48-year-old highway maintenance worker. His work typically involves using the **heavy-duty pavement breaker** to open areas of the road for lines to be laid. Recently, he has noted some **pain in the upper right shoulder near the shoulder blade**. He states that he notes some **weakness in the right arm**, and it is even difficult to raise a cigarette to his lips at times. He has also noted some **tingling and numbness in his right thumb and fingertips**.

Mr. M does not take any medications and has no medical conditions to his knowledge. He last saw a doctor 5 years ago when he had a disc herniation at L5. He drinks about a 6 pack of beer a week (on weekends) and he **smokes 1-2 packs of cigarettes a day**.

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Case 1

- Physical Exam:

- TTP of cervical paraspinals, upper / mid trapezius
- Cervical ROM mainly restricted in extension and right rotation
- +Spurling's maneuver, +Shoulder abduction
- 4/5 weakness in biceps, wrist extension
- Mildly diminished sensation R C6 dermatome
- **Negative Hawkins**
- **Negative Durkin's / Tinel's at the wrist**

Rotator cuff?

Carpal tunnel syndrome?

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Cervical Radiculopathy

- Loss of sensory / motor function due to compromised spinal n. or root
- Can be painful or painless
- Prevalence 1-6%
- Peak incidence in 40s and 50s
 - Most common C6-7, C5-6

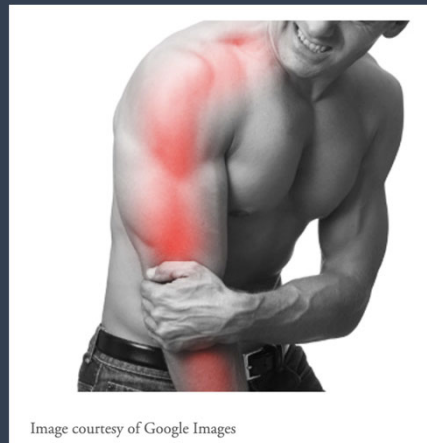


Image courtesy of Google Images

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Cervical Radiculopathy

- Risk factors include:
 - Caucasian
 - Cigarette use
 - Lumbar radiculopathy
 - Heavy manual labor
 - Operating equipment that vibrates

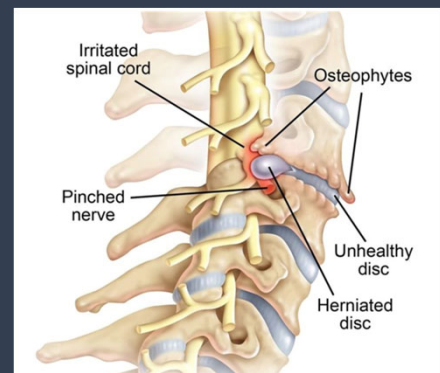


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Cervical Radiculopathy

- **Mechanical** compression and/or **chemical irritation**

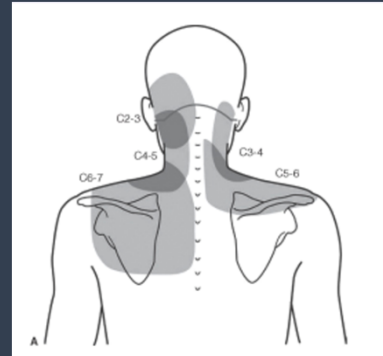
- Etiology:
 - **Spondylosis**
 - Disc herniation
 - Usually posterolateral, “soft disc”



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Cervical Radiculopathy *Pertinent H&P*

- Radicular symptoms, usually unilateral
 - +/- Occipital headache, neck pain, scapular, shoulder pain
 - **Better with arm above head**
- **Presentation is heterogenous**



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Cervical Radiculopathy *Pertinent H&P*

- **Dermatomal distribution may be absent**
- Pain may be atypical:
 - Anterior chest - 10% - “pseudoangina pectoris”
- **Natural history favorable**
 - Self limiting in most cases

> Brain. 1994 Apr;117 (Pt 2):325-35. doi: 10.1093/brain/117.2.325.

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

K Radhakrishnan¹, W J Litchy, W M Leary

Clinical Trial > Spine (Phila Pa 1976). 1999 Mar 15;24(6):591-7. doi: 10.1097/00007632-199903150-00021.

Outcome in patients with cervical radiculopathy. Prospective, multicenter, clinical review

P Sampath¹, M Bendokas, J D C

Review > Spine J. 2014 Aug 1;24(8):1781-9. doi: 10.1016/j.spinee.2014.02.032. Epub 2014 Mar 12.

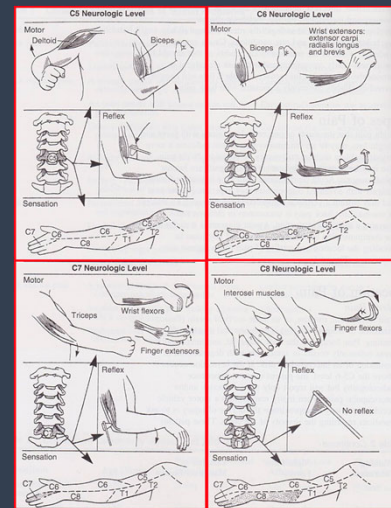
The course and prognostic factors of symptomatic cervical disc herniation with radiculopathy: a systematic review of the literature

Jessica J Wong¹, Pierre Côté², Jarius J Quesnele³, Paula J Stern⁴, Silvano A Mor⁴

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Cervical Radiculopathy *Pertinent H&P*

- Good general exam, neuro exam
- Evaluate for **concomitant myelopathy**
- Evaluate extremity (shoulder, elbow, wrist)
 - Arthritis, tendinopathy, peripheral n. compression



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Spurling's Sign

- Specific (94%)
 - Not sensitive (30%)
- Extension / rotation most important
 - Narrows foramen

Review > Eur Spine J. 2007 Mar;16(3):307-19. doi: 10.1007/s00586-006-0225-6. Epub 2006 Sep 30.

A systematic review of the diagnostic accuracy of provocative tests of the neck for diagnosing cervical radiculopathy

Sidney M Rubinstein¹, Jan J M Pool, Maurits W van Tulder, Ingrid I Riphagen, Henrica C W de Vet



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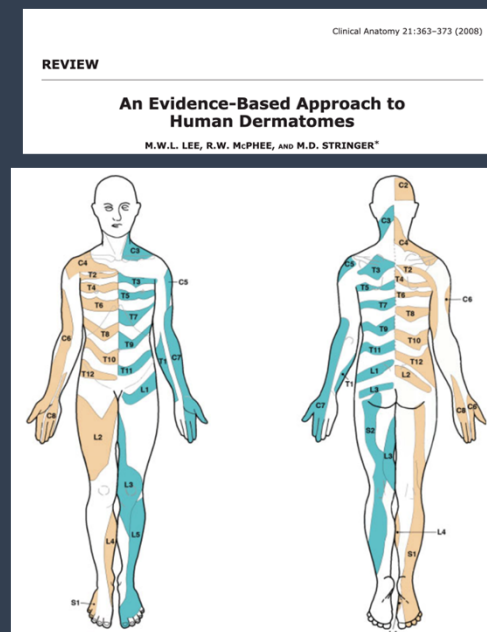
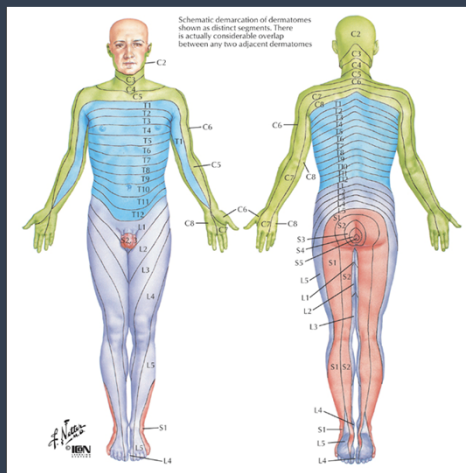
Shoulder abduction sign

- Specific
 - 75-92%
- Sensitivity
 - 17-78%
- Decreases tension on involved nerve



Review > Eur Spine J. 2007 Mar;16(3):307-19. doi: 10.1007/s00586-006-0225-6. Epub 2006 Sep 30.
A systematic review of the diagnostic accuracy of provocative tests of the neck for diagnosing cervical radiculopathy
 Sidney M Rubinstein¹, Jan J M Pool, Maurits W van Tulder, Ingrid I Riphagen, Henrica C W de Vet

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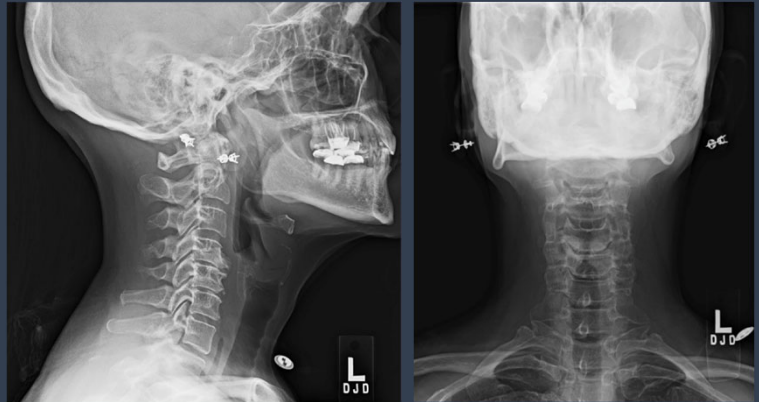


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Cervical Radiculopathy

Pertinent Imaging

- Plain radiographs
 - AP/lateral
 - +/- Flexion / extension
 - Instability

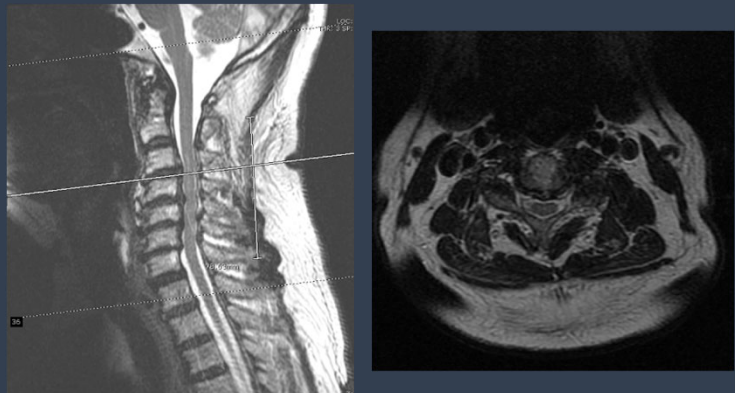


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Cervical Radiculopathy

Pertinent Imaging

- Advanced imaging is typically used to confirm the diagnosis
 - **MRI**
 - CT myelogram
 - If contraindication for MRI
 - +/- CT scan
- EMG/NCV



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Cervical Radiculopathy *Differential*

- Carpal tunnel syndrome
- Cubital tunnel syndrome
- Parsonage turner's syndrome
- Vascular insufficiency
- Thoracic outlet syndrome
- Pancoast tumor



- **Shoulder/elbow/wrist/hand pathology**

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Roentgenographic Findings of the Cervical Spine in Asymptomatic People

DONALD R. GORE, MD, SUSAN B. SEPIC, MS, and GENA M. GARDNER, BS

SPINE • VOLUME 11 • NUMBER 6 • 1986

- Cross-sectional study
- 200 asymptomatic individuals 20-65
- Lateral radiographs obtained
- **95% of men and 70% of women by age 60-65 had at least one degenerative finding**

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Abnormal Magnetic-Resonance Scans of the Cervical Spine in Asymptomatic Subjects

A PROSPECTIVE INVESTIGATION*†

BY SCOTT D. BODEN, M.D.‡, PHILIP R. MCCOWIN, M.D.‡, DAVID O. DAVIS, M.D.‡,
THOMAS S. DINA, M.D.‡, ALEXANDER S. MARK, M.D.‡, AND SAM WIESEL, M.D.§, WASHINGTON, D.C.

From the Departments of Orthopaedic Surgery and Radiology, George Washington University Medical Center, Washington, D.C.

- 63 asymptomatic volunteers
- 19% total with major abnormality
 - 14% < 40 y/o
 - 28% > 40 y/o
- Disc degeneration at 1 level or more in:
 - 25% < 40
 - ~60% > 40

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Treat the patient, not the imaging

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Non-op Management

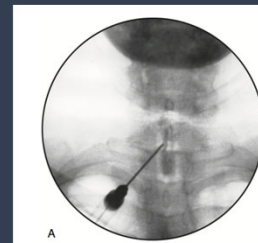
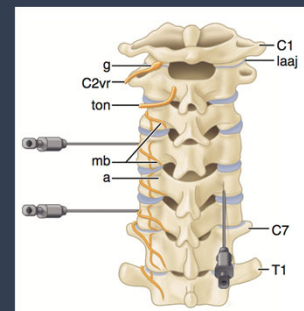
- NSAIDs are first line
- +/- muscle relaxant, steroid taper, nerve pain medications
- Physical therapy, traction
- Complementary Alternative Medicine



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Non-op Management

- **Can be both diagnostic and therapeutic**
- Epidurals
 - Typically interlaminar at C7-T1
 - Transforaminal injections are an option



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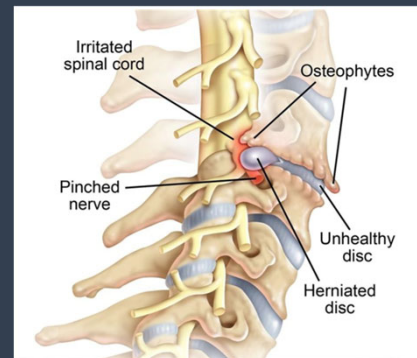
Operative Management *Indication*

- Severe, intractable pain or motor deficits after 6 weeks
- Progressive neurologic deficits

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Operative Management *Approach*

- Determined by location & type of lesion (soft disc, spondylosis, ossification of posterior longitudinal ligament?)
- Options
 - Anterior cervical discectomy & fusion (ACDF)
 - Posterior (key-hole) foraminotomy
 - Cervical total disc arthroplasty



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Operative Management *ACDF*

- Gold standard
- Radiculopathy +/- axial pain
- More anterior based pathology



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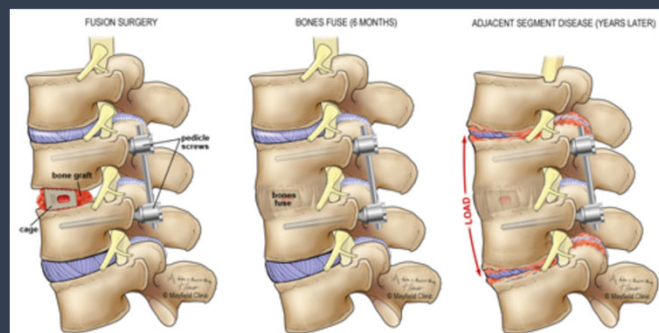
Comparative Study > Spine (Phila Pa 1976). 2015 May 15;40(10):E571-7.
doi: 10.1097/BRS.0000000000000846.

Adjacent segment pathology requiring reoperation after anterior cervical arthrodesis: the influence of smoking, sex, and number of operated levels

> J Bone Joint Surg Am. 1999 Apr;81(4):519-28. doi: 10.2106/00004623-199904000-00009.

Radiculopathy and myelopathy at segments adjacent to the site of a previous anterior cervical arthrodesis

A S Hillbrand¹, G D Carlson, M A Palumbo, P K Jones, H H Bohlman



Theory: Segments adjacent to fusion now have increased load and degenerate faster

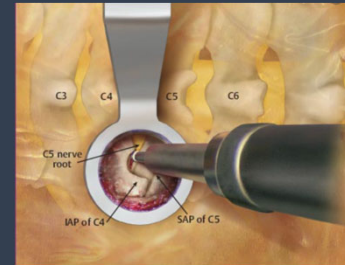
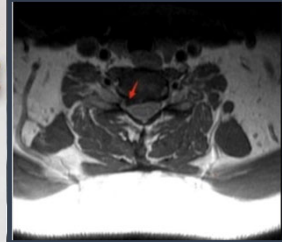
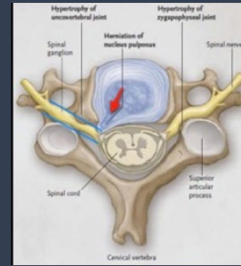
22-25% rate of reoperation at 10 years

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Operative Management *Posterior Foraminotomy*

- Radiculopathy caused by foraminal stenosis
 - Ideally, soft disc
 - Minimal axial neck pain
- Typically performed minimally invasively

**5-6% reoperation rate @ 2-3 years
Vs. 4% in ACDF**



> Spine J. 2015 Jun 1;15(6):1217-43. doi: 10.1016/j.spinee.2015.02.026. Epub 2015 Feb 23.

Reoperation rates after anterior cervical discectomy and fusion versus posterior cervical foraminotomy: a propensity-matched analysis

Daniel Lubelski¹, Andrew T Healy², Michael P Silverstein³, Kall G Abdullah⁴, Nicolas R Thompson⁵, K Daniel Rhee⁶, Michael P Steinmetz⁷, Edward C Benzel⁸, Thomas E Mroz⁹

> Spine J. 2015 May 1;15(5):971-6. doi: 10.1016/j.spinee.2013.05.042. Epub 2013 Jul 17.

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

Timothy Y Wang¹, Daniel Lubelski², Kall G Abdullah³, Michael P Steinmetz⁴, Edward C Benzel⁵, Thomas E Mroz⁶

Review | > J Spine Surg. 2020 Mar;6(1):243-251. doi: 10.21657/jsm.2020.01.06.

Comparison of outcomes following minimally invasive and open posterior cervical foraminotomy: description of minimally invasive technique and review of literature

Andrew Platt¹, Carter S George², John E O'Toole³

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Operative Management *Cervical TDA (Total Disc Arthroplasty)*

- FDA approved 2007
 - Radiculopathy / Myelopathy
 - 1 to 2-level disease (Mobi-C, Prestige)



Cervical Disk Arthroplasty

Koreckij, Theodore D., MD; Gandhi, Sapan D., MD; Park, Daniel K., MD

JAAOS - Journal of the American Academy of Orthopaedic Surgeons, February 1, 2019 - Volume 27 - Issue 3 - p e99-e104

Int Orthop. 2018 Nov 30. doi: 10.1007/s00284-018-4254-7. [Epub ahead of print]

The future of disc surgery and regeneration.

Bauer, Z^{1,2}, Chung, AS³, Abed, A⁴, Wang, JG⁴.

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Operative Management *Cervical TDA – The Reality*

- Preservation of motion
- 1-level cTDA
 - ↓ ASDis (OR 0.5; 95% CI 0.34-0.94 p <0.05)
 - ↓ reoperation (OR 0.31; 95% CI 0.21-0.47 p <0.01)
- **2-level cTDA**
 - **Further improvements**

Cervical Disk Arthroplasty

Koreckij, Theodore D., MD; Gandhi, Sapan D., MD; Park, Daniel K., MD

JAAOS - Journal of the American Academy of Orthopaedic Surgeons; February 1, 2019 - Volume 27 - Issue 3 - p e160-e174

Int Orthop. 2018 Nov 30. doi: 10.1007/s00264-018-4254-7. [Epub ahead of print]

The future of disc surgery and regeneration.

Buizer Z^{1,2}, Chujo AS³, Abedi A⁴, Wang JG⁴.

Review | Global Spine J. 2019 Aug;9(5):559-567. doi: 10.1177/2192568218789115. Epub 2018 Jul 17.

Clinical Outcomes of Treating Cervical Adjacent Segment Disease by Anterior Cervical Discectomy and Fusion Versus Total Disc Replacement: A Systematic Review and Meta-Analysis

Victor M Lu¹, Ralph J Mobbs², Kevin Phan²

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Cervical Radiculopathy - Summary

- The natural history of cervical radiculopathy is favorable
- TDA ↓ ASDis, re-operation rates
 - Effect amplified with 2-levels
- MIS approaches improve short term outcomes



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Case 1 – Mr. M

- Imaging – radiographs, cervical MRI
- Management – operative due to neurologic deficit

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Case 2

Ms. C is a 35-year-old female who was riding on the back of a motorcycle that hit a car when pulling between lanes at a red light. She was thrown off the motorcycle and **landed on her left arm**. She also sustained a concussion. A CT scan of the head and neck, done immediately upon admission to the emergency department showed no evidence of skull or cervical fracture and no bleeding in the head or neck.

She expected that the injury would resolve over the past month, but even though everything else has healed, she still has a limp left arm. She has difficulty raising her left shoulder and is unable to raise her wrist. She is experiencing numbness in the left hand.

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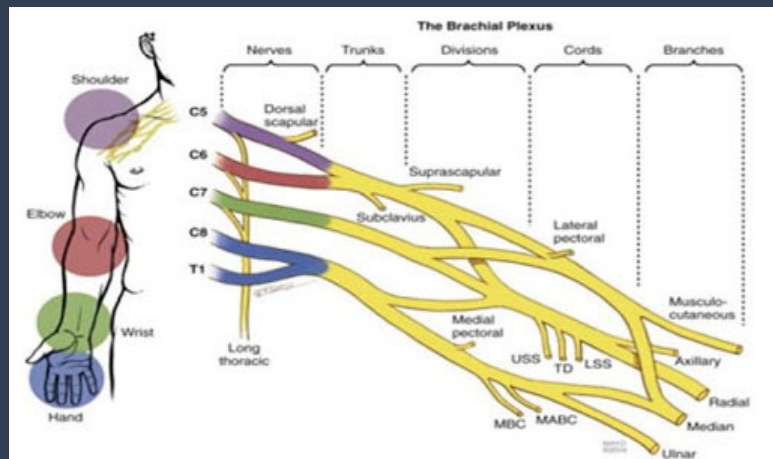
Case 2

- Physical Exam:
 - Cervical ROM normal
 - Notable L-sided weakness shoulder abduction, biceps, triceps, wrist extension
 - Diminished sensation L C5-7 dermatomes
 - Diminished biceps, triceps, brachioradialis reflexes
 - Negative Hawkins
 - Negative Durkin's / Tinel's at the wrist

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Brachial Plexus

- Pre-fixed (C4) – 17.5%
- Post-fixed (T2) – 5%



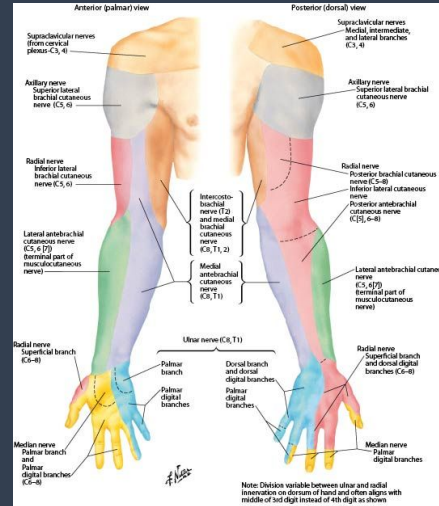
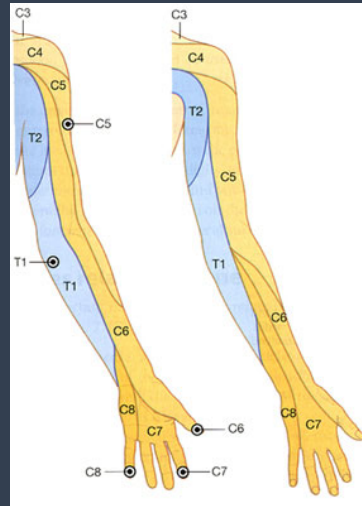
Observational Study | ANZ J Surg. 2017 May;87(5):399-403. doi: 10.1111/ans.13534. Epub 2016 Apr 12.

Anatomical study of prefixed versus postfixed brachial plexuses in adult human cadaver

Edengenet Guday ¹, Asegedech Bekele ¹, Abebe Muche ¹

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Cutaneous Distributions



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Motor Distributions

Primary Motion	Primary Muscle	Innervation	Nerve Root
Scapular stabilization	▶ Serratus	Long thoracic n.	C4
Shoulder abduction	▶ Deltoid	Axillary n.	C5
Shoulder internal rotation	▶ Subscapularis	Subscapular n.	C5
Shoulder external rotation	▶ Infraspinatus	Suprascapular n.	C5
Elbow flexion (palm up)	▶ Biceps & brachialis	Musculocutaneous n.	C5
Elbow flexion (thumb up)	▶ Brachioradialis	Radial n.	C6
Wrist extension	▶ ECRL	Radial n.	C6
Wrist supination	▶ Supinator	Deep branch Radial n.	C6
Elbow extension	▶ Triceps	Radial n.	C7
Wrist flexion	▶ FCR & PL	Median n.	C7
Wrist pronation	▶ PT & PQ	Median n.	C7
MCP & PIP Finger flexion	▶ FDS	Median n.	C8
DIP Finger	▶ FDP	Ulnar n. & AIN	C8
Thumb extension	▶ EPL	PIN	C8
Finger abduction	▶ Interossei	Deep branch Ulnar n.	T1

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Radicular Pain

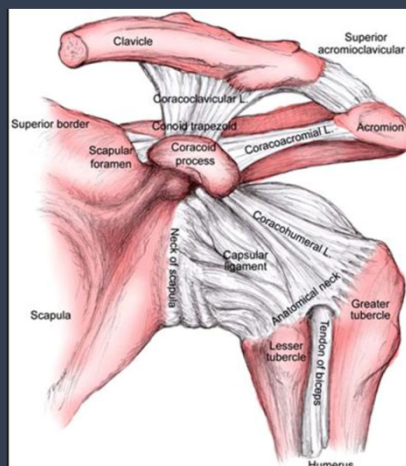
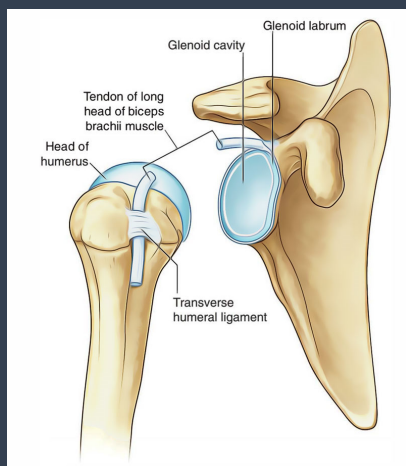
Differential

- Based on Region
 - Spine
 - Shoulder
 - Elbow
 - Forearm
 - Wrist
 - Hand
- Based on Etiology
 - Arthritis / other intra-articular
 - Musculotendinous
 - Ligamentous
 - Bursal
 - Compressive neuropathies
 - Peripheral neuropathy
 - Vascular
 - Tumor
 - Infection

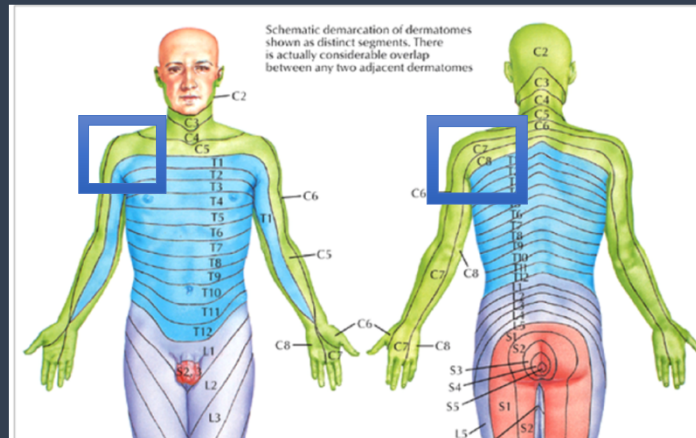
Important to keep in mind, esp. if things don't add up

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Shoulder



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In general, will not refer pain past elbow

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Case 3

Mr. J is a **66-year-old man** who was working on his landscaping and tripped over a hose, falling to the ground. Initially, the swelling in his knee caught his attention, but as that has resolved over the past week, he has noted that he is **unable to fully move his right shoulder**.

He states that he is awakened multiple times every **night** because he has **pain** when he rolls onto his side and is lying on the right arm. The pain starts at the shoulder and **radiates down the side of the arm** and it is **worse** during the day when he tries to **lift the dishes up into the cabinet** after dinner. He also states that he can raise the **arm, but it feels a bit weaker to him**.

He feels a little better after taking ibuprofen, but the pain has not gotten a lot better over the week.

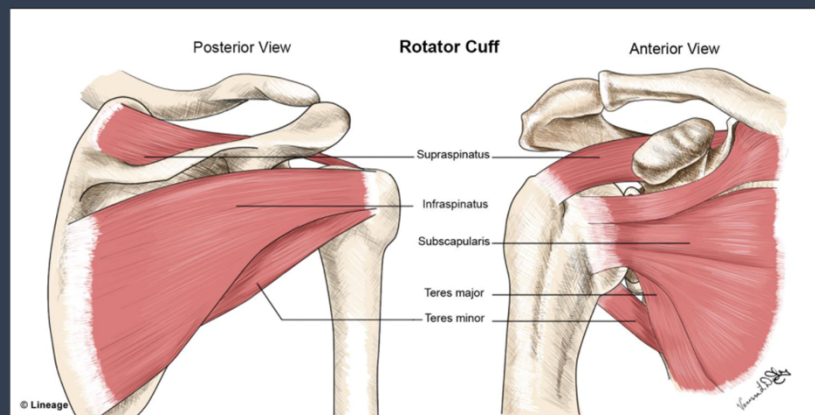
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Case 3

- Physical Exam:
 - Cervical ROM slightly limited due to pain
 - Some giveaway weakness in R shoulder abduction otherwise full strength
 - Normal sensation
 - **Normal reflexes**
 - **Positive Hawkin's, Positive Neer's**
 - **Negative drop-arm**

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Rotator Cuff

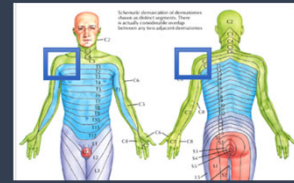


Dynamic stabilizer, assist larger muscle function

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Rotator Cuff Syndrome

- Impingement vs tear
 - Continuum of degenerative changes versus acute, traumatic tear
- **Prevalence**
 - > 60 – 28% have full thickness tear
 - > 70 – 65% have full thickness tear
- Risk Factors:
 - Age, smoking, family hx
- Sx: Pain with **overhead motion, night time pain**



Versus



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Rotator Cuff Syndrome

- Exam:
 - Inspection
 - Range of motion (pain)
 - Shoulder abduction test
 - Hawkins, Neer, Drop-arm
 - DTR / sensation unaffected
 - Weakness abduction/ external rotation



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Rotator Cuff

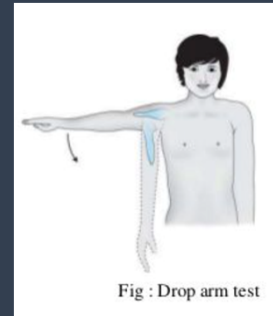
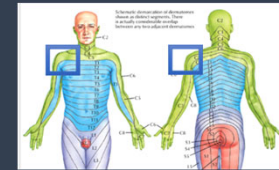
Hawkins-Kennedy Test



Sens 88-92%
Sp - 43-48%

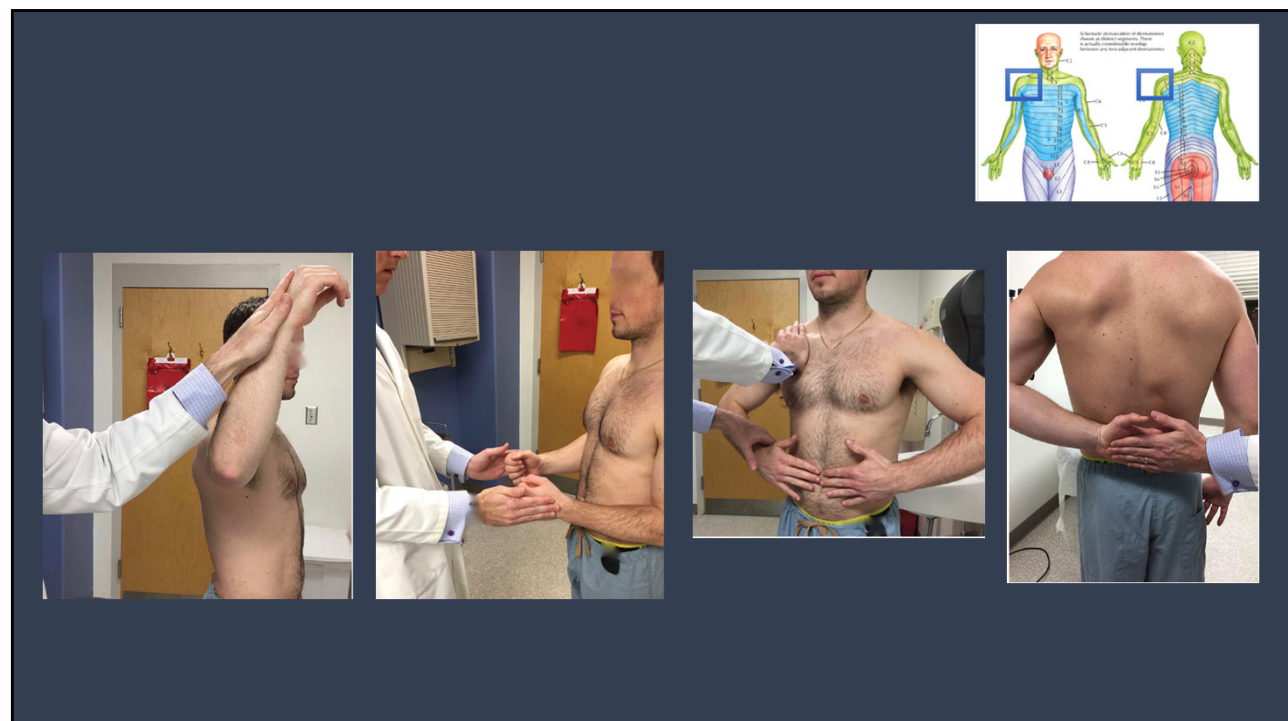


Sens 83-86%
Sp - 47-51%



Sens - 10%
Sp - 98%

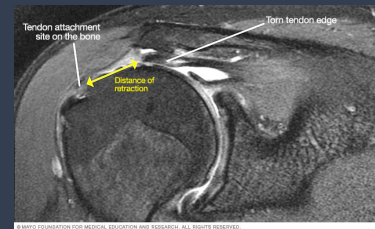
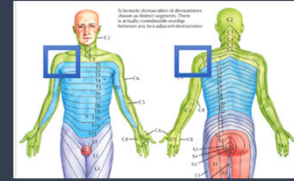
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Rotator Cuff Syndrome

- Diagnosis:
 - MRI
- Non-op Treatment:
 - PT, NSAIDs
 - Subacromial injection - diagnostic / therapeutic
- Operative Treatment:
 - Arthroscopy
 - RTC (Rotator Cuff) repair



Again, beware of false-positives!

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Case 3 - Mr. J

Imaging: right shoulder radiographs, right shoulder MRI

Treatment: non-op first

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Case 4

Mrs. W is a 72-year-old woman who has been suffering with **restricted range of motion in the left shoulder**, which is really annoying her because she is left-handed. She has noted that her left shoulder seems to be higher than the right one and she is having **trouble brushing her hair because of the shoulder pain**, especially when she crosses over to brush the hair on the right side of her head. There is **pain in the shoulder but not in the hand or arm**.

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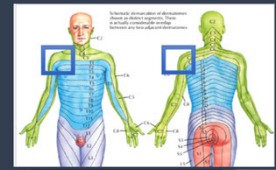
Case 4

- Physical Exam:
 - Cervical ROM slightly limited due to pain
 - Left shoulder ROM limited in all planes of motion with notable associated crepitus
 - Some giveaway weakness in L shoulder abduction otherwise full strength
 - Normal sensation
 - Normal reflexes

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Osteoarthritis *Glenohumeral*

- Glenohumeral
 - Degeneration of articular cartilage
- Etiology:
 - Primary – OA (osteoarthritis)
 - Secondary --- post-traumatic, inflammatory arthritis, osteonecrosis, **cuff-tear arthropathy**
- Prevalence:
 - Age-related, most prevalent > 60 y/o
- Sx: **Shoulder pain, worse w/ motion, stiffness**



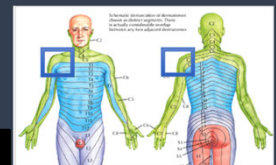
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**Cuff-tear arthropathy
"High-riding" humeral head**



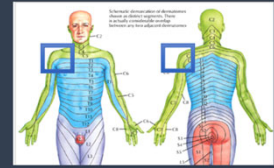
GH (glenohumeral) arthritis



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Osteoarthritis *Glenohumeral*

- Exam:
 - **Inspection**
 - **Range of motion (pain, restricted)**
 - **DTR / sensation unaffected**
 - Weakness abduction/ external rotation
 - **Cuff tear arthropathy**

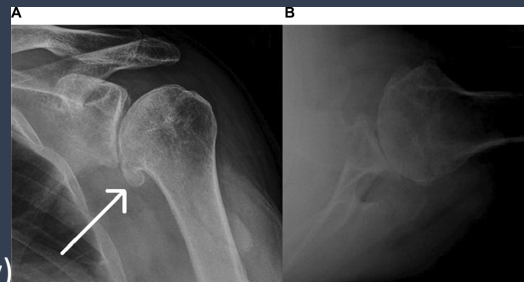
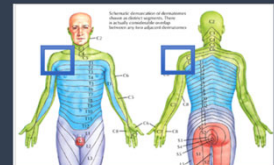


**Pseudoparalysis
With anterosuperior escape**

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Osteoarthritis *Glenohumeral*

- **Diagnosis:**
 - XR AP (Grashey views), axillary, scapular Y
- **Non-op Treatment:**
 - PT, NSAIDs
 - **Glenohumeral injection**
- **Operative Treatment:**
 - Total Shoulder Arthroplasty (TSA)
 - Reverse TSA (cuff tear arthropathy)



Again, beware of false-positives!

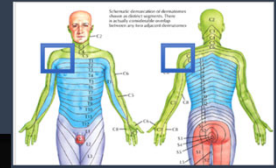
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Reverse TSA



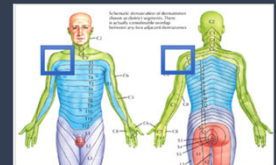
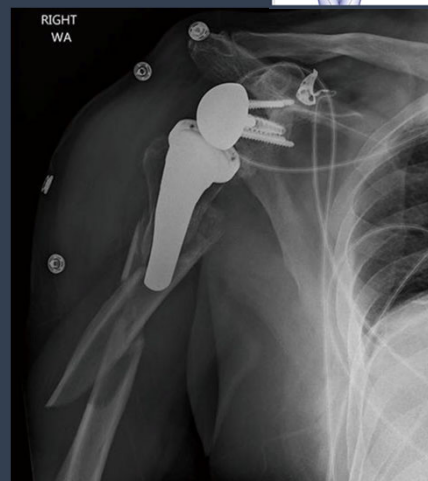
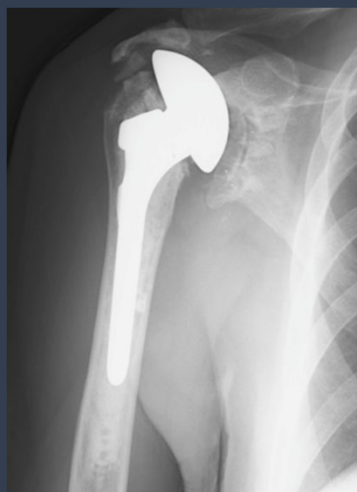
"Anatomic" TSA



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Just because it's replaced....

- Infection
- Fracture
- Loosening



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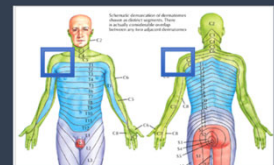
Case 4 – Mrs. W

- Imaging: L shoulder radiographs
- Management: non-op, possible shoulder replacement

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Osteoarthritis *Acromioclavicular arthritis*

- Common in overhead athletes, weightlifters
- Pain with activity
- Exam:
 - Pain with palpation, cross body adduction test
- Diagnosis: XR
- Treatment
 - Nonoperative – PT, NSAIDs, injection
 - Operative - distal clavicle resection

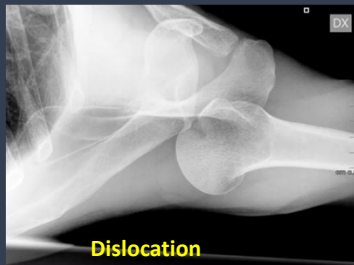
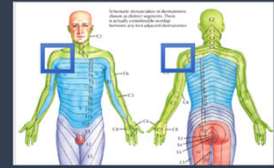


Zanca view

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Shoulder Pathology

- Instability
- Scapulothoracic dyskinesia
- Quadrilateral space syndrome
- Avascular necrosis humeral head
- Calcific tendonitis
- Adhesive Capsulitis



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Summary

- Numerous upper extremity mimickers of cervical radiculopathy exist
- A thorough H&P can aid in the distinction
- Imaging can be misleading
- Diagnostic injections can be very useful

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**There is power
in admitting
what we
don't know**

