AAPA/ AAOS Musculoskeletal Galaxy

Upper Extremity and Cervical Spine Physical Exam Techniques

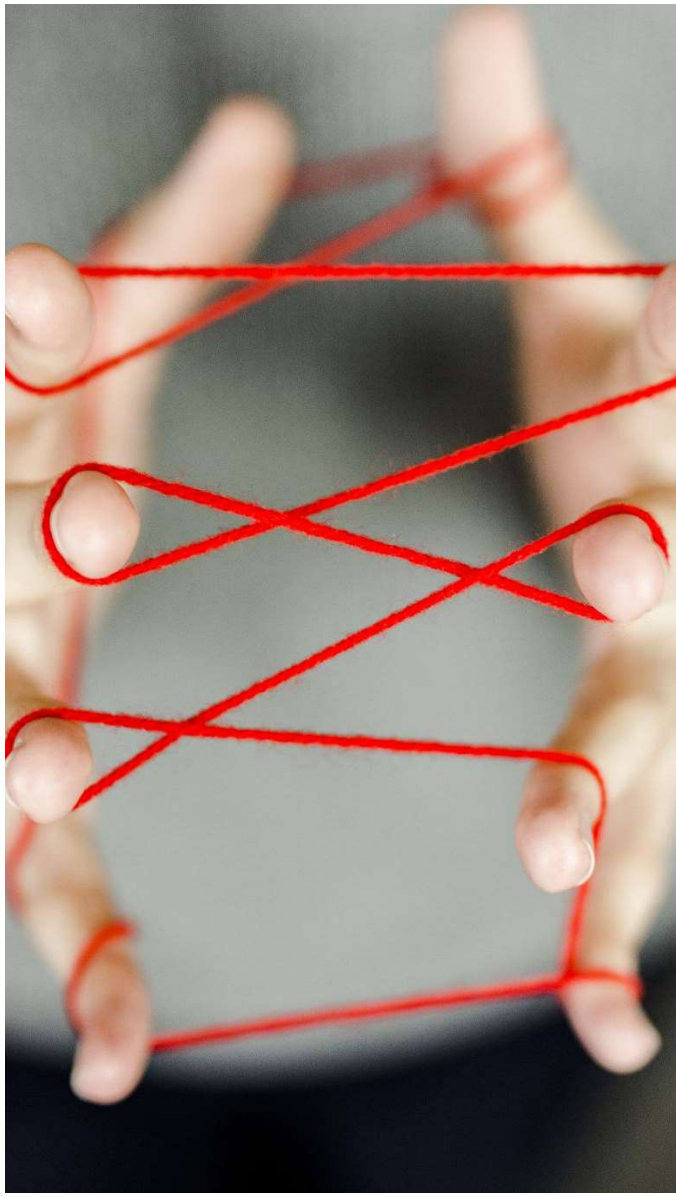
June 5-9, 2024 Portland, OR

Hand/ Wrist/ Elbow Physical Exam

- Inspection
- Palpation
- Range of Motion
- Neurovascular Examination
- Special Tests

HAND/Wrist/elbow PHYSICAL EXAM- INSPECTION

- Lacerations
- Atrophy
- Abrasions
- Edema
- Deformities
- Erythema/Drainage
- Incision sites
- Masses
- Elbow Carrying Angle (average 13 degrees for women and 10 degrees for men)

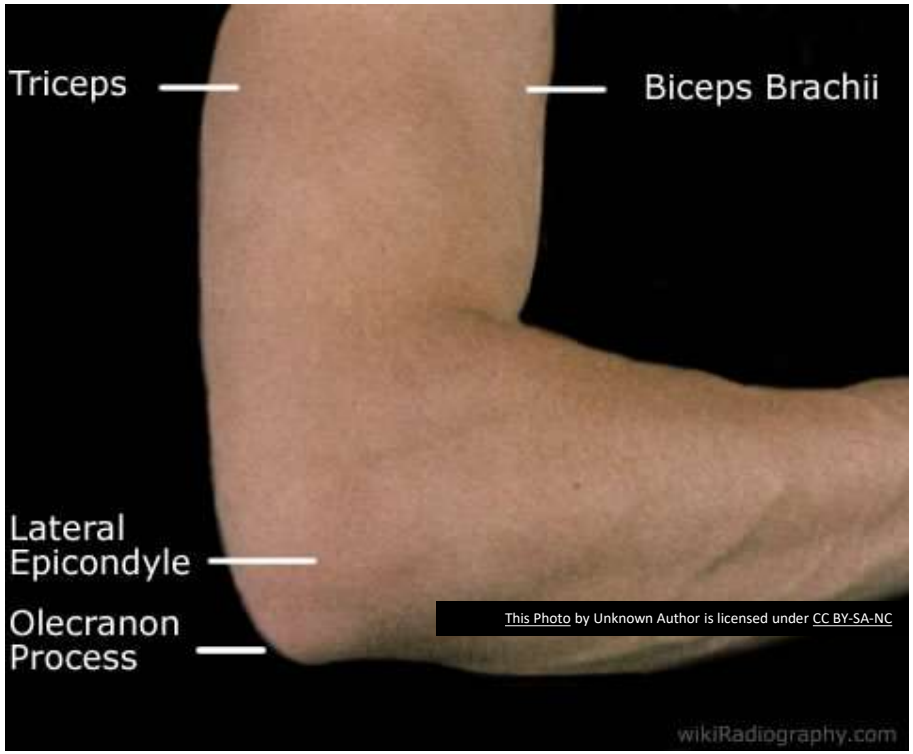


HAND/wrist PHYSICAL EXAM-Palpation

- Common areas patients may have tenderness:
  - Distal Radius
  - Snuffbox
  - Scapholunate interval
  - First carpometacarpal joint (CMC joint)
  - A1 pulley of the flexor tendons
  - Proximal Interphalangeal joint (PIP) joint
  - Distal Interphalangeal joint (DIP) joint
  - Triangular Fibrocartilage Complex (TFCC)
  - Radial/Ulnar collateral Ligaments of the fingers
  - First Extensor Dorsal Compartment
  - DRUJ

Elbow Physical Exam- Palpation

- Medial Epicondyle
- Lateral Epicondyle
- Olecranon/Olecranon bursa
- Distal biceps tendon
- Radial head
- Common Extensor Muscles
- Brachial artery
- Triceps insertion



HAND PHYSICAL EXAM- Range of motion (ROM)

- Check for active and passive ROM. Check for ability to make a full composite fist.
  - **Finger Normal ROM**
- MCP: 0° extension to 85° of flexion
- PIP: 0° extension to 110° of flexion
- DIP: 0° extension to 65° of flexion
- Thumb MCP: 0° extension to 55°
  - of flexion (widely variable)
- Thumb IP: +15 hyperextension to 80 °
  - of flexion
  - Abduction and Adduction

Wrist PHYSICAL EXAM- Range of motion (ROM

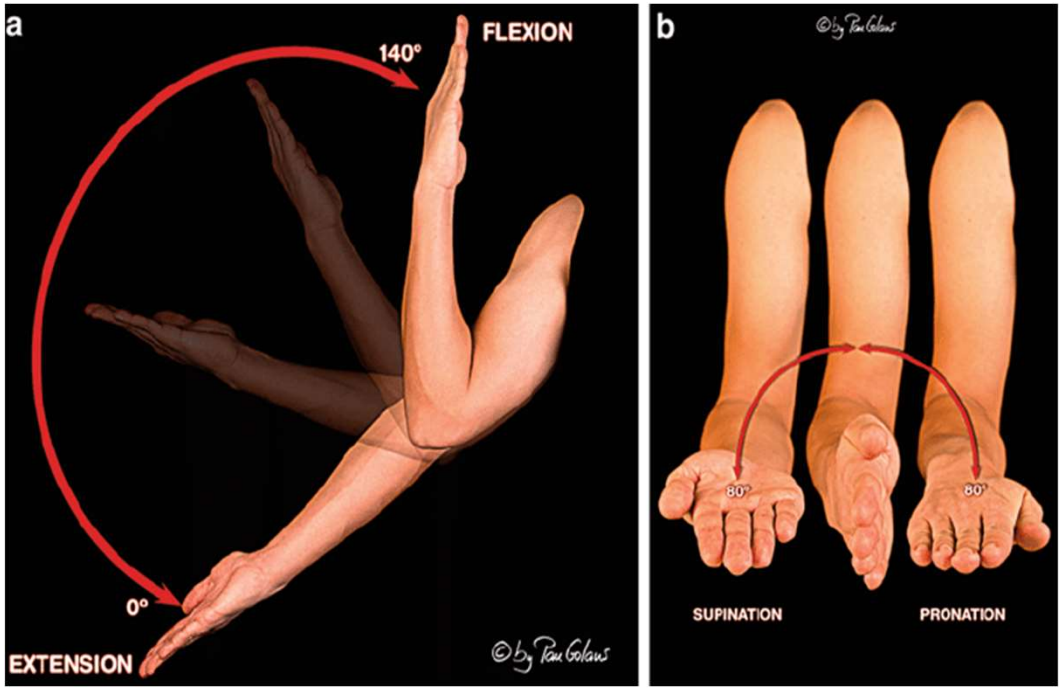
- Check for active and passive ROM.

Wrist Normal ROM

- Extension: 80 degrees
- Flexion: 70 degrees
- Ulnar Deviation: 30 degrees
- Radial Deviation: 20 degrees

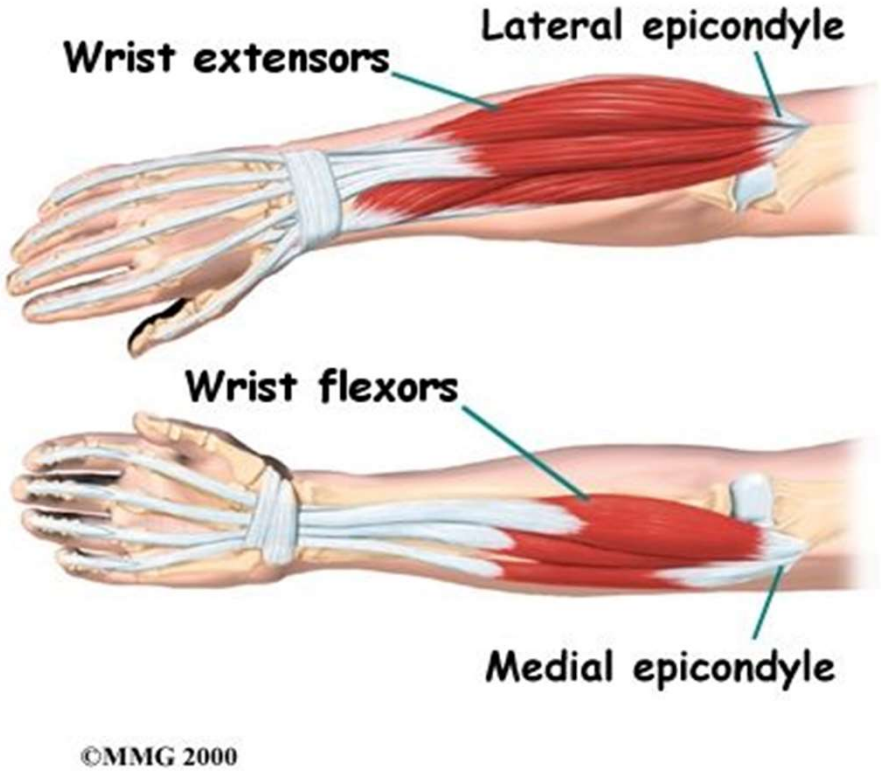
Elbow PHYSICAL EXAM- Range of motion (ROM)

- Check for active and passive ROM.
- Check for mechanical blocks and crepitus.
  - **Elbow Normal ROM**
  - Extension 0 degrees
  - Flexion 130-140 degrees
  - Supination 80-90 degrees
  - Pronation 80-90 degrees
  - *functional: 50 degrees pronation, 50degrees supination
  - *functional extension/ flexion: 30-130 degrees



Elbow physical exam- Strength Exam

- •Flexion, C5-C6
  - •Full supination (biceps)
  - •Neutral (brachioradialis)
- •Extension (triceps), C7-C8
- •Supination (biceps), C6
- •Pronation (flexor-pronator mass),C7-C8
- •Wrist Extension (ECRL, ECRB, ECU), C6-C8
- •Wrist Flexion (FCR, FCU), C6-C8

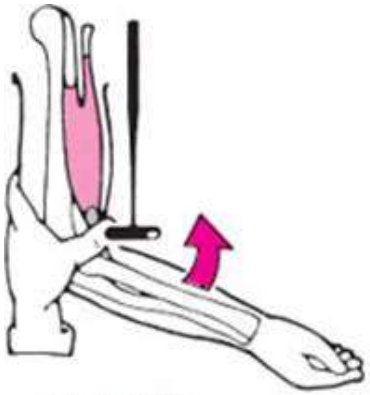


ELBOW PHYSICAL EXAM- REFLEX TESTING

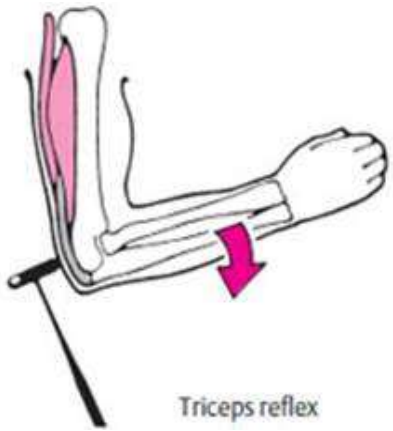
- Biceps Reflex –C5

  Nerve: Musculocutaneous n.

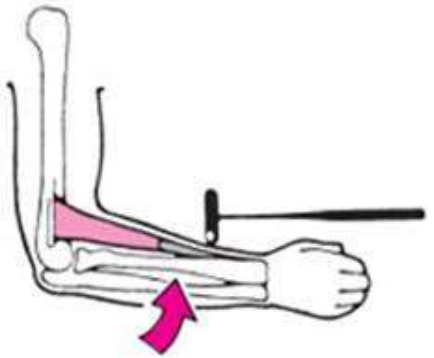
  - Segment: C5-C6
- Brachioradialis Reflex-C6
  - Nerve: Radial n., Musculocutaneous n.
  - Segment: C5-C6
- Triceps Reflex –C7
  - Nerve: Radial n.
  - Segment: C7-C8



Biceps reflex



Triceps reflex

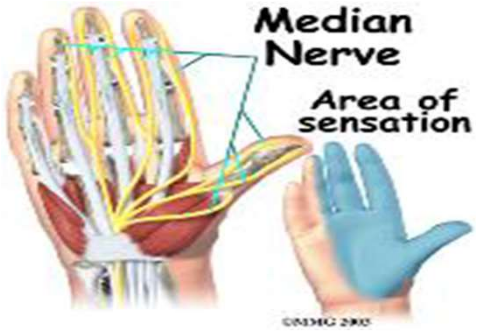


Radial periosteal reflex

HAND PHYSICAL EXAM-Neurovascular examination

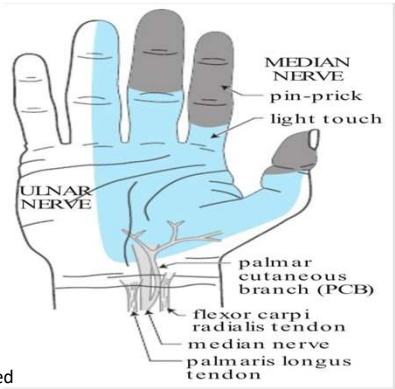
Median nerve

- Location: Carpal Tunnel
- Tests: Tinel, Phalen, Durkan test
- Median nerve provides sensation to the thumb, index, middle, and radial half of the ring finger.



Ulnar Nerve

- Location: Guyon Canal/Medial Epicondyle
- Tests: Tinel test directly over nerve, Froment's test, Wartenburg's test, Resisted finger abduction



HAND PHYSICAL EXAM-Neurovascular examination

Superficial sensory radial nerve

- Location: Radial Styloid
- Tests: Tinel Test

Radial and ulnar artery

- Location: At volar wrist
- Tests: Palpate the pulse of each artery, check for capillary refill to digits, and Allen test for dominance/perfusion

Elbow/wrist PHYSICAL EXAM-Neurovascular examination

Brachial artery

- Location: medial brachium
- Palpate pulse

Posterior interosseous Nerve

- Location: Test strength distally at wrist and hand
- Tests: Resisted wrist extension, finger extension, thumb extension

Elbow PHYSICAL EXAM-Neurovascular examination

Radial nerve

- Location: triceps
- Tests: resisted elbow extension

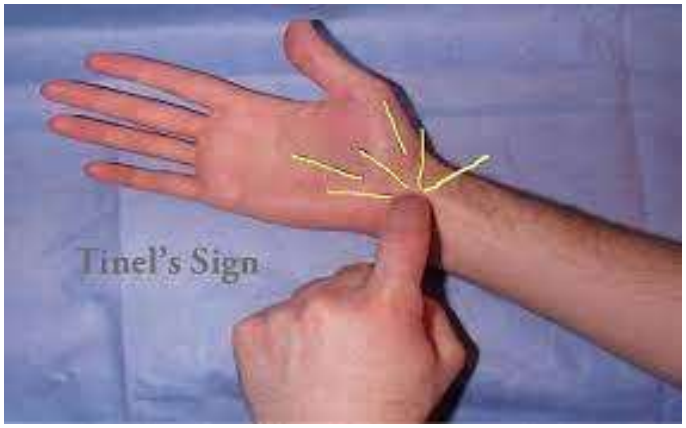
Hand/Wrist Physical exam- Special Tests

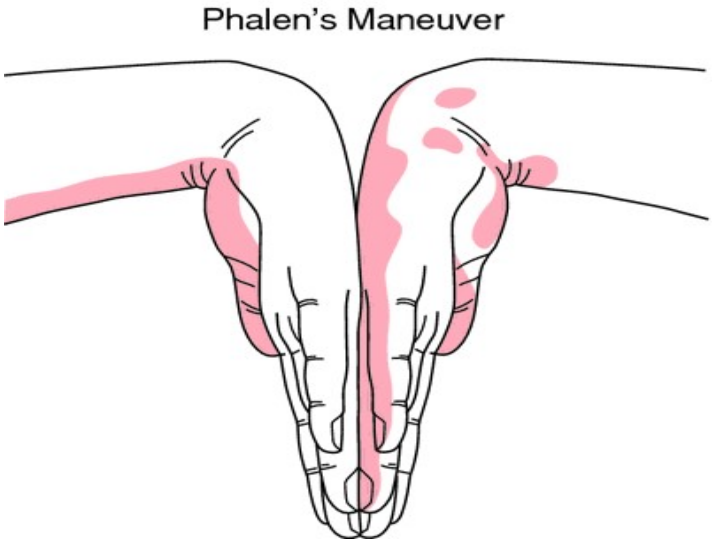
- Carpal Tunnel Syndrome
- Ulnar Neuropathy/Cubital Tunnel Syndrome
- Scapholunate Ligament Injury/Instability
- DeQuervain's Tenosynovitis
- Scaphoid Fracture
- Triangular Fibrocartilage Tear
- Extensor Tendon Central slip rupture or lacation
- Radial/Ulnar Artery Injury, Thrombosis or Dominance
- Trigger Finger

SPECIAL TESTS: <u>CARPAL TUNNEL SYNDROME</u>

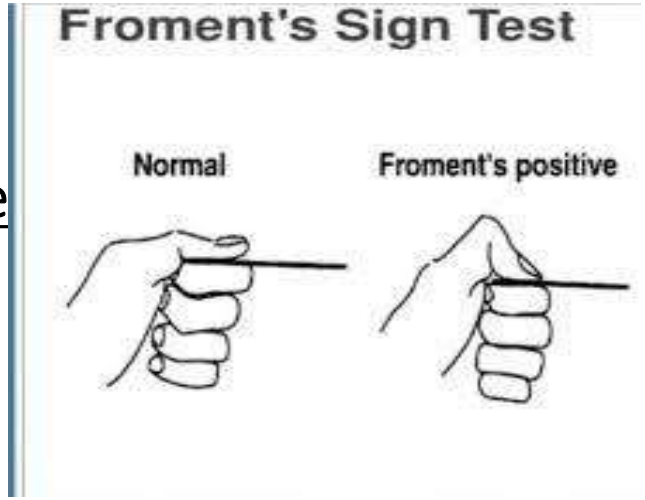
TESTS:

1. TINEL'S SIGN
2. PHALEN'S TEST
3. DURKAN'S TEST



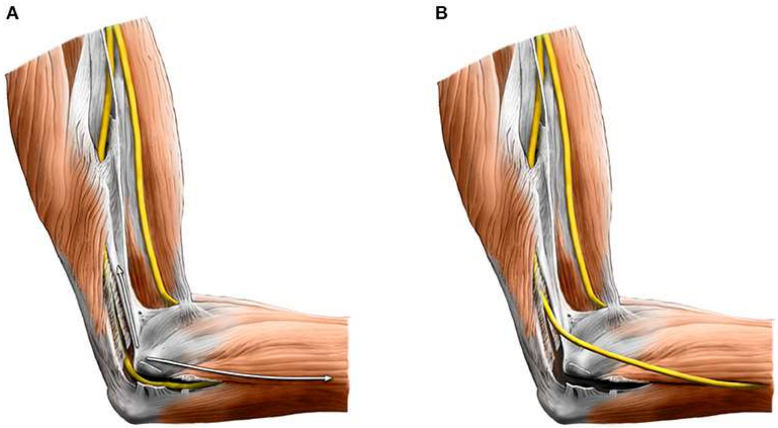


Special tests:
ulnar Neuropathy/ cubital tunnel syndrome



TESTS:

1. Tinel's Sign
2. Froment's Sign
3. Wartenburg's Sign



Special tests:
Scapholunate injury /instability

TESTS:

1. Watson's Scaphoid Shift Test

- Description:
- Place your thumb firmly on the patient's volar wrist at the scaphoid tubercle and apply pressure. With the other hand, move the patient's wrist from ulnar to radial deviation.
- Positive sign if a clunk is palpated and pain is present.
- Clunk can be present if the scaphoid is dissociated from the lunate because of SLL tear and it hits against the lip of the dorsal radius.

SPECIAL TESTS: <u>Dequervain's tenosynovitis</u>

TESTS:

1. Finkelstein's Test

- Description:
- Thumb is placed into the palm , and the wrist is ulnarly deviated.
-
- Severe pain with this maneuver is a positive test.

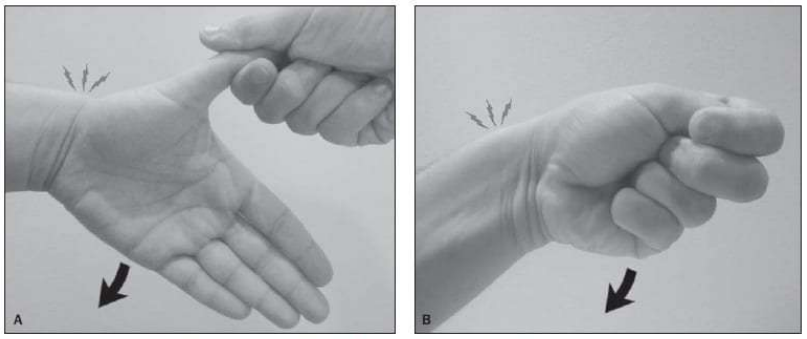


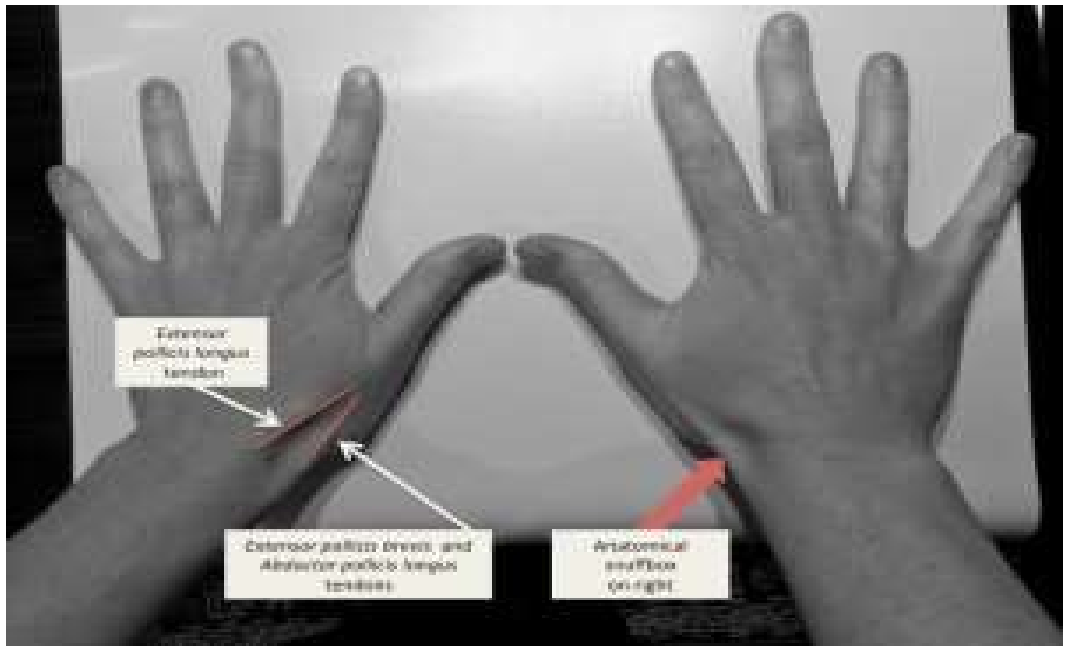
Figure 1. Tests utilized for clinical diagnosis of tenosynovitis of the first extensor compartment. **A:** Finkelstein's test, which consists in holding the patient's thumb while the hand is forced into ulnar deviation. **B:** Eichoff's test, which consists in grasping the thumb in the palm of the hand while the wrist is ulnar deviated. Both tests are positive in the presence of pain over the radial styloid process during the ulnar deviation of the wrist. The tests names were not confused or equivocally written, for surprise of those who equivocally describe the maneuver of grasping the thumb in the palm of the hand as Finkelstein's test.

SPECIAL TESTS:
<u>Scaphoid fracture</u>

TESTS:

1. Anatomic Snuffbox Tenderness

- Description:
- Tenderness to palpation at the radial aspect of the wrist near the base of the thumb.



Special Tests:
Triangular fibrocartilage Complex tear (TFCC)

TESTS:

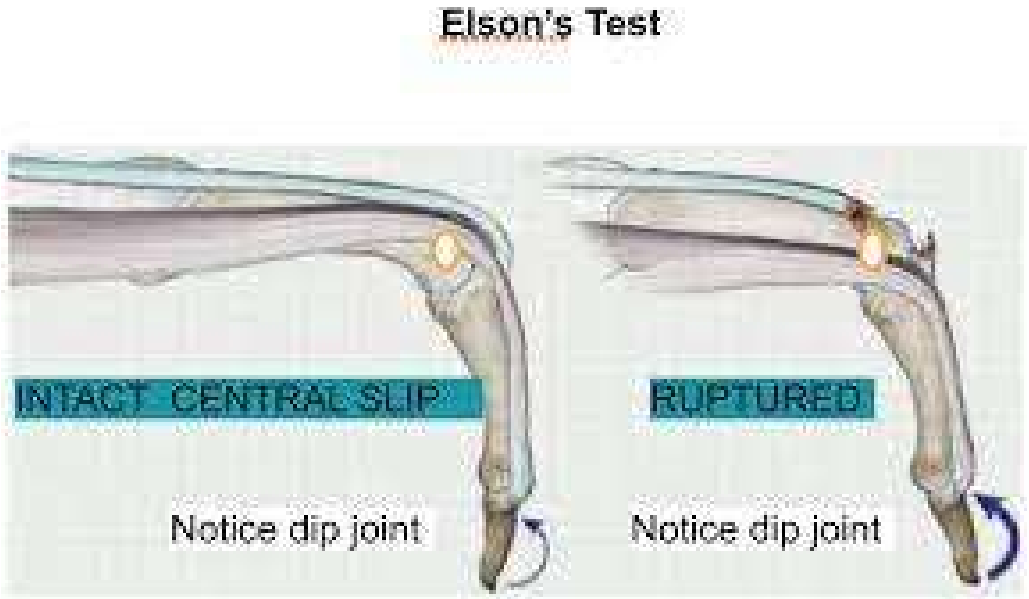
1. Fovea Sign- Positive if pain occurs.
2. ECU Synergy Test- This test

Helps differentiate TFCC tears from ECU tendinitis. If positive, more likely ECU tendinitis

Special tests:
Extensor tendon central slip rupture /laceration

TESTS:

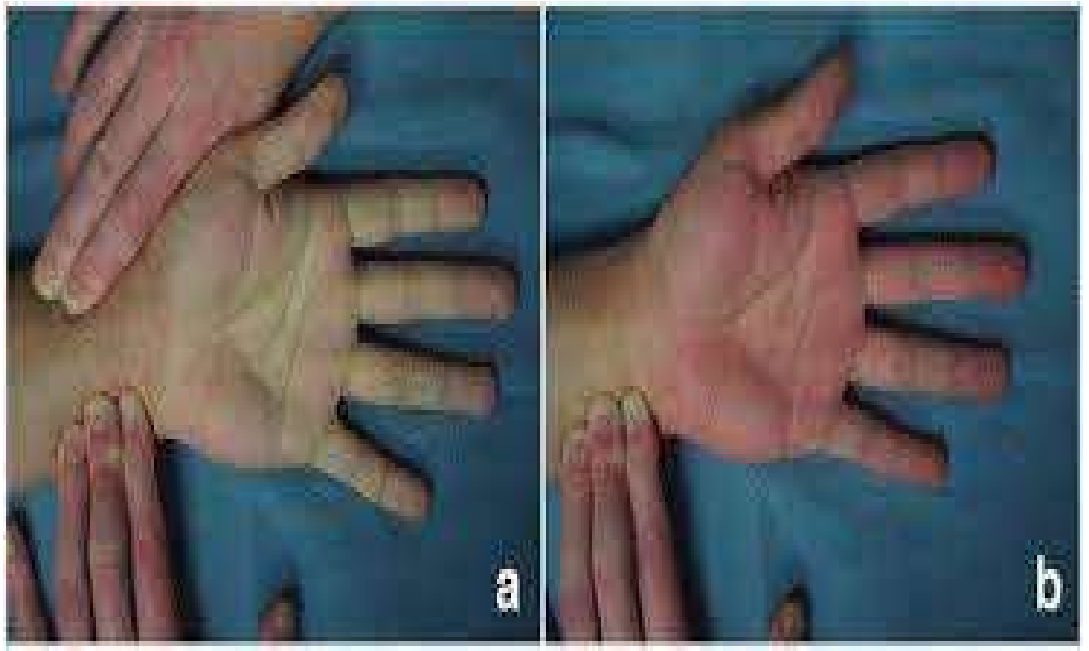
1. Elson's Test: Rest patient's hand on a table with finger flexed at the PIP joint over the edge of the table at 90 degrees. The patient will attempt to extend at the PIP joint. If the DIP joint is supple on extension, the central slip is intact. If the DIP joint is rigid during extension, the central slip is likely ruptured.



Special tests: <u>Radial/ulnar artery injury, thrombosis</u>

TESTS:

1. Allen Test: Use both thumbs to place pressure over both the radial and ulnar arteries at the wrist. The patient will open and close the fist to exsanguinate venous system. Then release the thumb over the radial artery side and observes for reperfusion, then repeat test to the ulnar side.



Special tests: Trigger Finger

Palpate over the volar aspect of the proximal aspect of the MCP joint of the finger. This should be at the level of the A1 pulley. With one finger over the A1 pulley, ask patient to flex and extend the digit in an attempt for triggering to occur. Sometimes you must passively flex the finger to feel catching. Also palpable for an A1 nodule.

Elbow physical exam- Special tests

- Medial/lateral Collateral Ligament Sprains/instability
- Distal Biceps Tendon Rupture
- Triceps Rupture
- Medial/ Lateral Epicondylitis

Special tests: Medial/Lateral Collateral Ligament

- Varus and Valgus Testing
  - **Valgus Stress Testing**: Evaluates for the **ulnar collateral ligament**.
    - Place one hand on the lateral aspect of the patient's distal humerus and place the other hand on the patient's medial distal forearm. Stabilize the arm with the arm bent to about 30 degrees of flexion. Apply valgus stress to the UCL. Positive test if patient has pain, instability or apprehension.

Special tests: Medial/Lateral Collateral Ligament

- Varus and Valgus Testing
  - **Varus Stress Testing**: Evaluates for the **Lateral Collateral Ligament**
    - Place one hand on the medial aspect of the patient's distal humerus and the other hand is placed on the patient's lateral distal forearm. Stabilize the arm in about 30 degrees of flexion. Apply varus stress to the LCL. Positive test if patient has pain, instability, or apprehension.

Special tests: Lateral Collateral Ligament

- **Lateral Pivot Shift Test:**
  - Testing for the lateral UCL (LUCL) for posterolateral rotary instability (PLRI).
  - The patient will lie supine on a table with their arm overhead. As the examiner, you should stand at the head of the bed. First, place hand on the posterolateral aspect of the patient's elbow and grasp the medial/lateral epicondyles. Apply axial/valgus force to the elbow joint while the elbow is flexed and the forearm is supinated. Positive test will show pain, apprehension, a clunk is palpated, or a dislocation occurs.

  - ** Some patients may not allow this to occur due to guarding and may require the patient to be sedated.

Special tests: Distal biceps tendon rupture

- **Hook Test:**
- Attempt to hook the distal biceps tendon with the index finger while the patient flexes with the forearm supinated. Positive test occurs when the tendon is non-palpable and the hook cannot be performed.

Special tests: Lateral / Medial Epicondylitis

- Pain with resisted wrist extension (lateral epicondylitis)/flexion (medial epicondylitis)

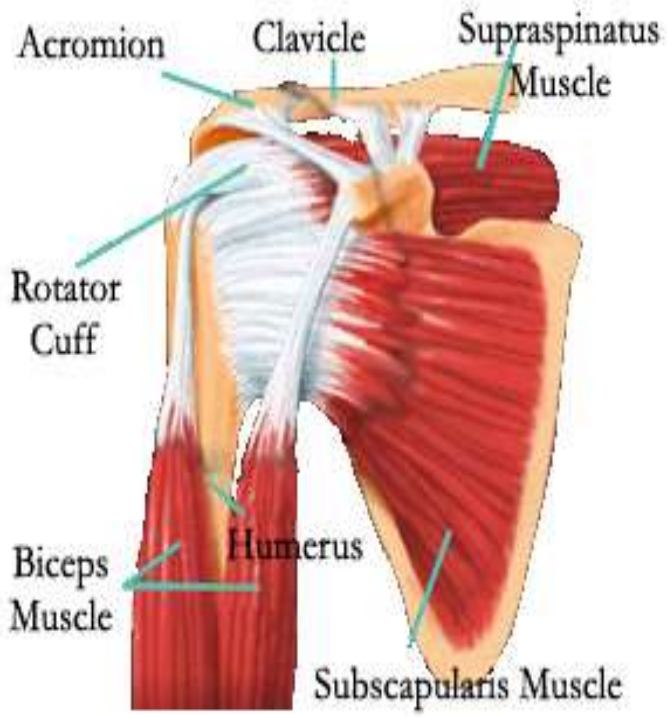
Shoulder Physical Exam

History: Subjective Complaints

- Age/ Occupation/ Hand Dominance/ Sports
- Mechanism of Injury (MOI)
- Previous injury or surgery on shoulder
- Provocative or Alleviating movements
- Location, rating (0-10), quality of pain
- Night pain (common complaint with RTC tears)
- Paresthesia

Shoulder Exams

- Inspection/ Palpation
- Range of Motion
  - Adhesive Capsulitis: AROM = PROM
- Strength Test
- Neurovascular Test
  - Shoulder vs C-spine pathology?
- Special Test



Shoulder Inspection

- Evaluate shoulder movements when patient moves during exam, shakes hand, removes shirt
- Assess for deformities or malalignment (biceps rupture, AC separation, pec rupture, scapula winging, rounded shoulder posture, sulcus, scoliosis, kyphosis)
- Look for any scars, abrasions, ecchymosis, swelling, muscle atrophy (Deltoid- Axillary N.)
- Be sure to compare to contralateral shoulder!

Shoulder Palpation

Bony Landmarks

- AC Joint/ Clavicle/ SC Joint
- Acromion
- Greater Tuberosity
- Bicipital Groove
- Lesser Tuberosity
- Coracoid Process
- Sternum
- Scapula
  - Superior Medial/ Inferior Angle
  - Scapular Spine

Soft Tissue Structures

- Trapezius Muscle
- Long Head of Biceps
- Pectoralis Muscle
- Deltoid
- Axilla/ Lymph nodes
- Subacromial/ Subdeltoid Bursa
- Rotator Cuff
  - Supraspinatus
  - Infraspinatus
  - Teres Minor
  - Subscapularis

Shoulder Range of Motion

- Evaluate both AROM and PROM (feel end point)
- Flexion- 180 degrees
- Extension- 45 degrees
- Internal Rotation- 55 degrees (vertebral level)
- External Rotation- 40-45 degrees
- Abduction- 90 degrees
- Adduction

Shoulder Strength Testing

Manual Muscle Grading (+/-)

5 Normal: Complete ROM against gravity with full resistance

4 Good: Complete ROM against gravity with some resistance

3- Fair: Complete ROM against gravity

2- Poor: Complete ROM with gravity eliminated

1- Trace: Evidence of slight contractility, no joint motion

0- Zero: No evidence of contractility

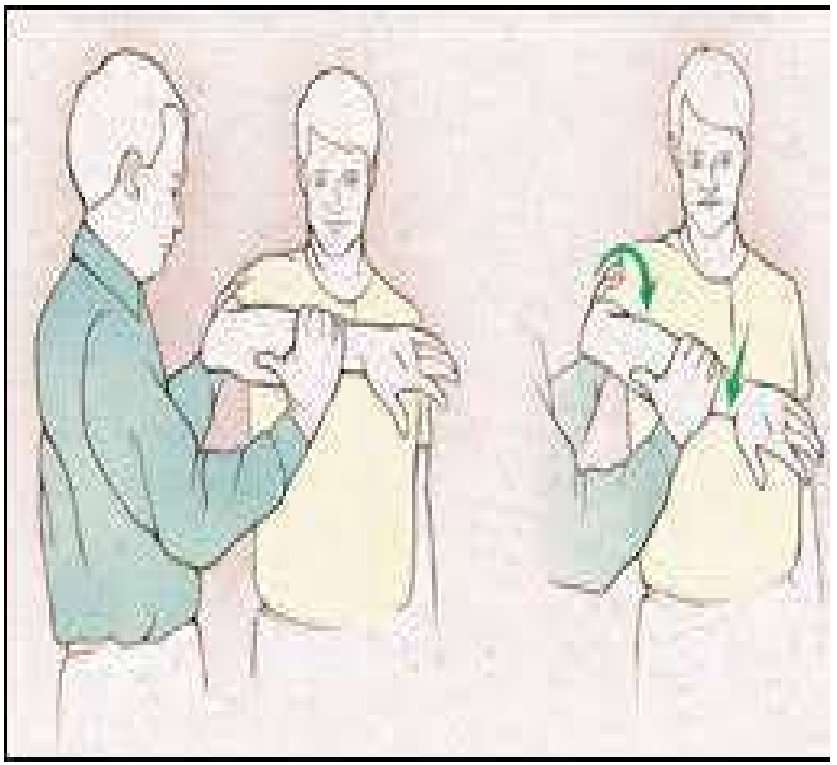
Shoulder Strength Testing

- Flexion: Anterior Deltoid/ Coracobrachialis
- Extension: Latissimus Dorsi/ Teres Major/ Posterior Deltoid
- Internal Rotation: Subscap/ Pec Major
- External Rotation: Infraspinatus/ Teres Minor
- Abduction: Middle Deltoid/ Supraspinatus
- Adduction: Pec Major/ Latissimus Dorsi
- Scapular Retraction: Rhomboid Major/ Minor
- Scapular Protraction: Serratus Anterior

Shoulder Special Test

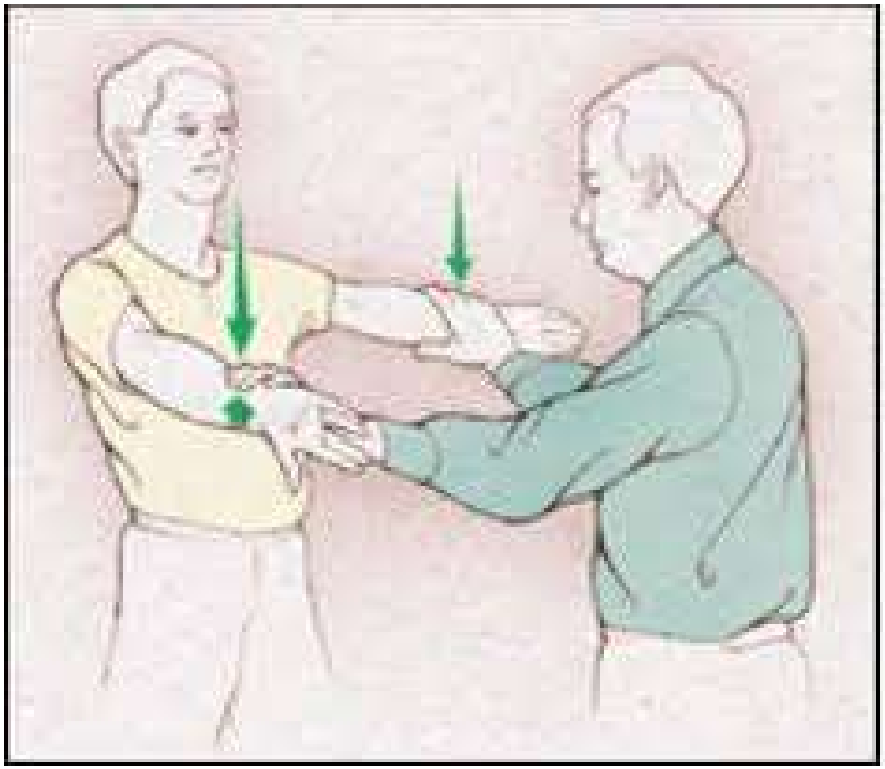
- Rotator Cuff Impingement/ Bursitis
  - Neer: Impingement
  - Hawkins/ Kennedy: Impingement
  - Drop Arm Test:
  - Hornblower's Test

Hawkins-Kennedy



Shoulder Special Test

- Rotator Cuff/ Impingement
  - Jobe's/ Empty Can Test: Supraspinatus



Shoulder Special Test

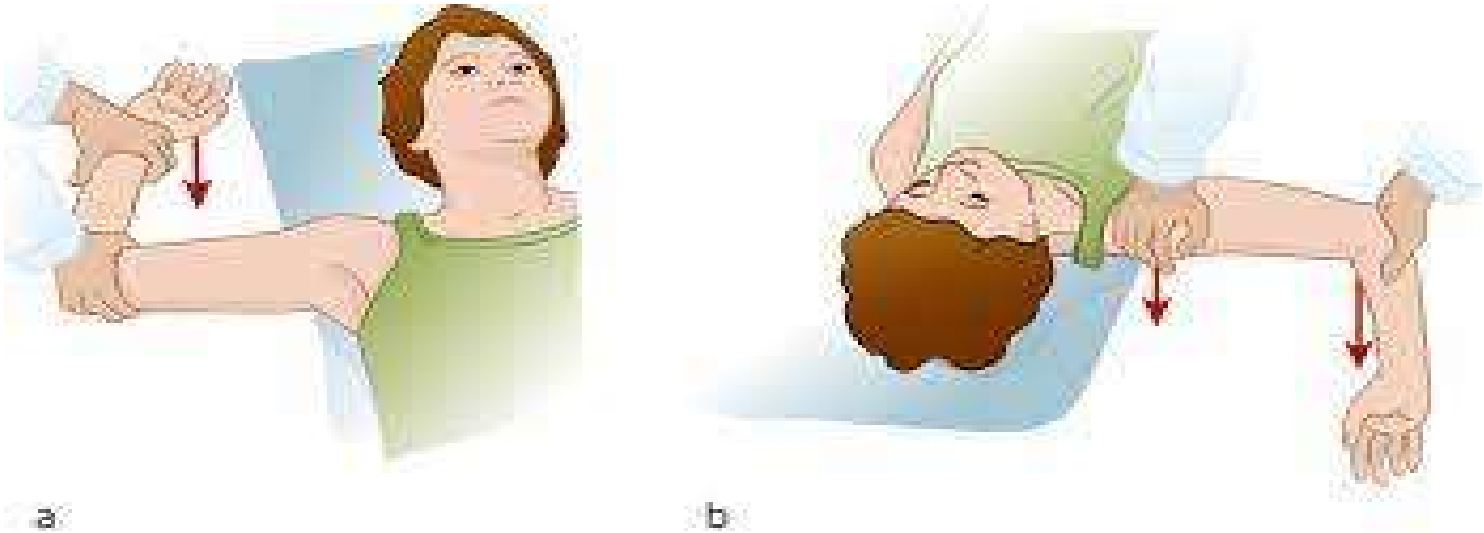
- Rotator Cuff Impingement/ Bursitis
  - Bear Hug/ Belly Press/ Lift Off Test: Subscapularis

Shoulder Special Test

- AC Joint
  - Crossbody Adduction

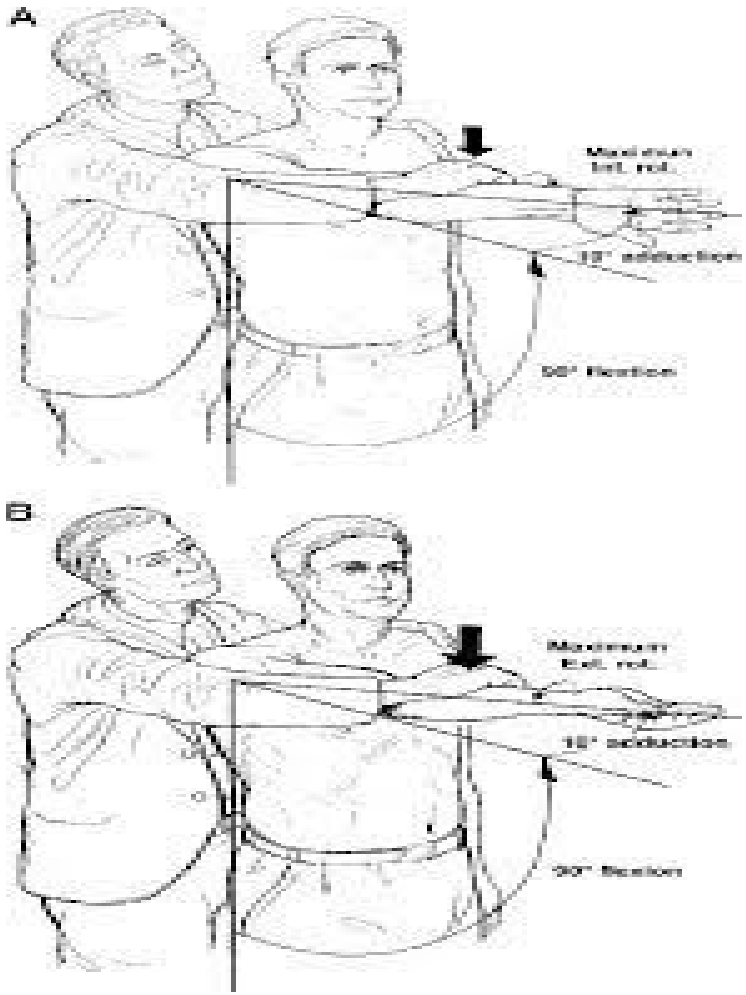
Shoulder Special Test

- Instability
  - Apprehension and Relocation Test
  - Sulcus Sign
  - Crank/ Jerk for posterior/ Load and Shift Test



Shoulder Special Test

- Labral Test/ Biceps
  - O'Brien's Test
  - Positive Test- pain with forearm pronated and pushing up against resistance that is alleviated with forearm in supinated position



Shoulder Special Test

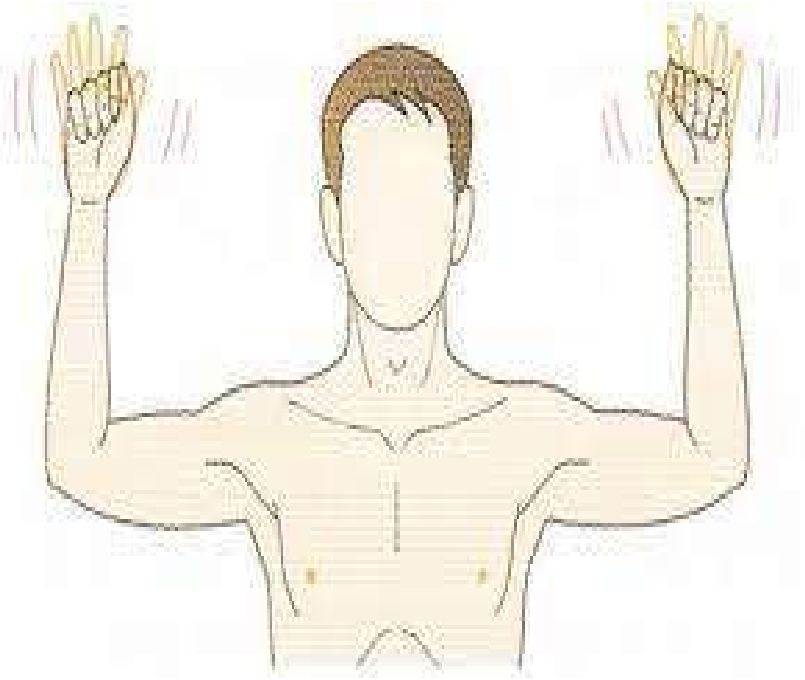
- Biceps
  - Speed's Test
    - Examiner resists forward flexion of the shoulder with the patient's arm fully extended and forearm supinated
  - Yergason Test
    - With the patient's elbow flexed to 90 degrees and forearm pronated, the examiner resists supination while the patient externally rotates the arm against resistance. During this movement, the biceps tendon is palpated in the bicipital groove to assess for the tendon popping out of the groove.

Shoulder Special Test

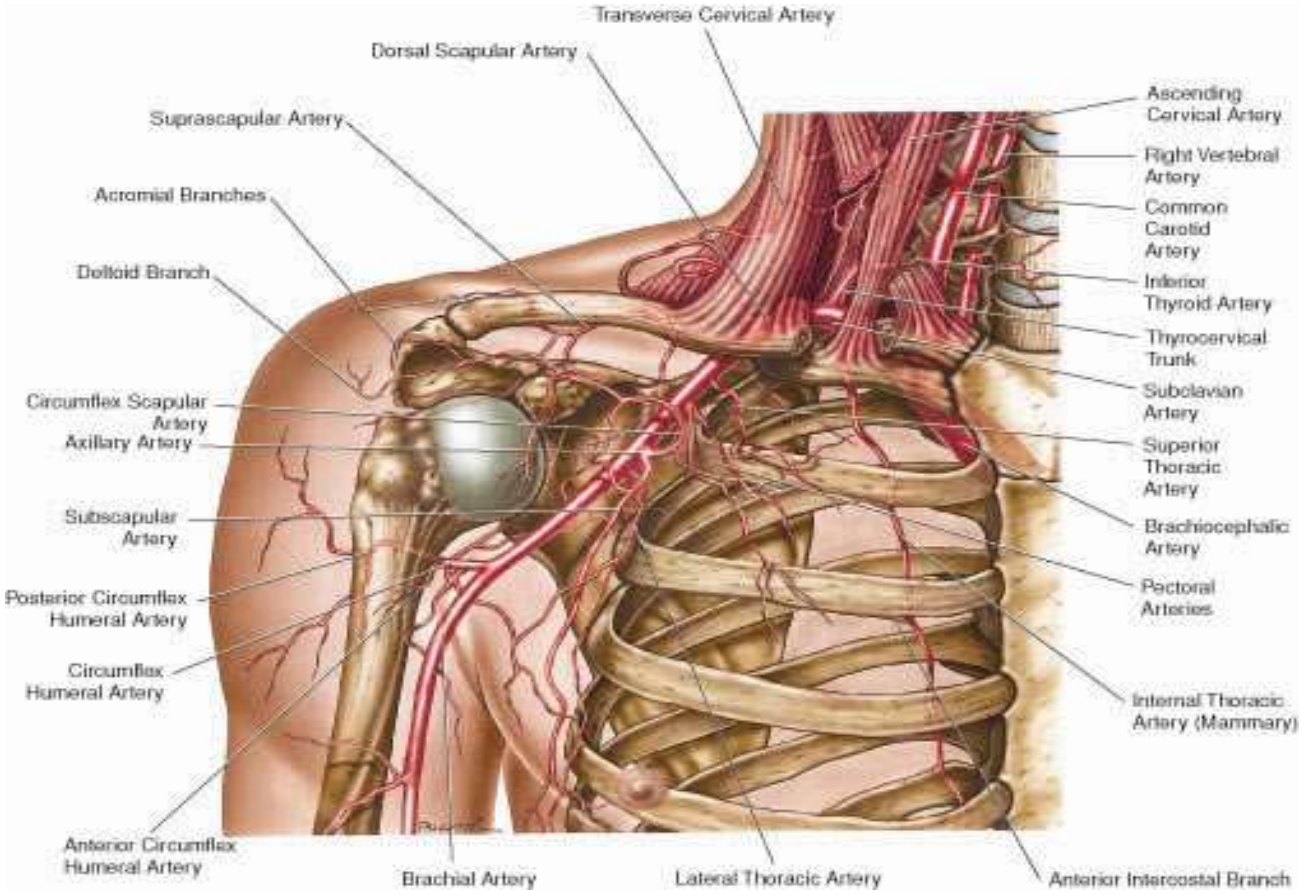
- Thoracic Outlet Syndrome
  - Roos/ EAST Test
  - Adson: extend arm, lateral rotate head toward affected side, deep breath and hold, diminished pulse

Vascular Exam: Brachial and Radial Artery

Roos Test



Shoulder Vascular Anatomy

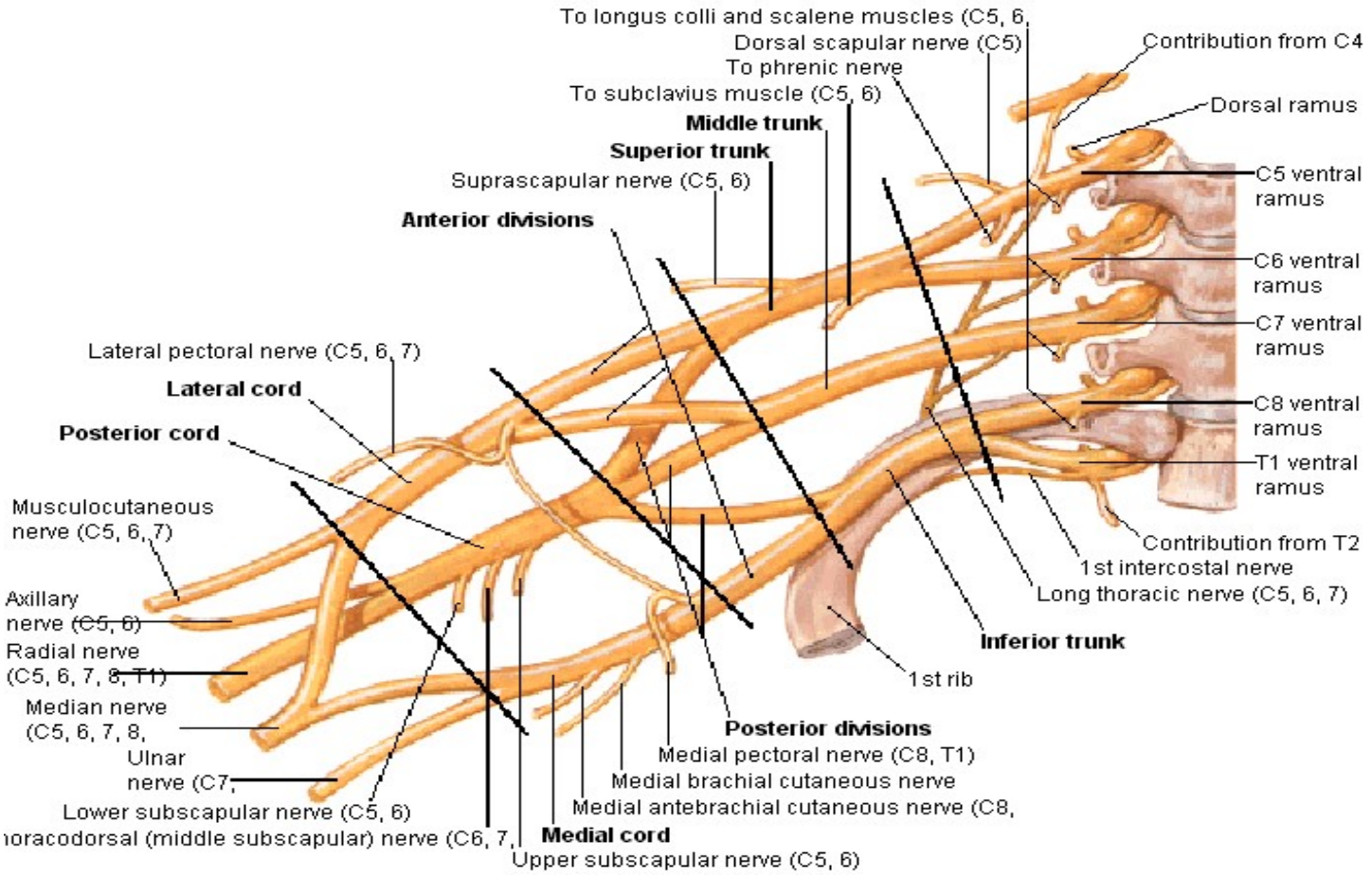


Shoulder Neuro Exam

- Deltoid: C5-C6/ Axillary Nerve
- Supraspinatus: C5-C6/ Suprascapular Nerve
- Infraspinatus: C5-C6/ Suprascapular Nerve
- Trapezius: Spinal Accessory N/ Cranial Nerve XI
- Rhomboids: C5/ Dorsal Scapular Nerve
- Serratus Anterior: C5, C6, C7/ Long Thoracic N.

- Reflex/ Sensation: Refer to C-spine exam

Brachial Plexus



Physical Exam of the Cervical Spine

- History
  - Symptoms:
    - pain, paresthesias, weakness
    - onset, frequency, severity
  - Prior treatment, medication, surgery
  - Demographics, work-related injury
  - Trauma/Mechanism of Injury

- Imaging/Diagnostics
  - X-ray, MRI, CT scan
  - EMG/NCS, Injections

- Physical exam
  - Inspection, Palpation
  - Motor, sensory, reflexes
  - Range of Motion, Provocation
  - Rectal exam

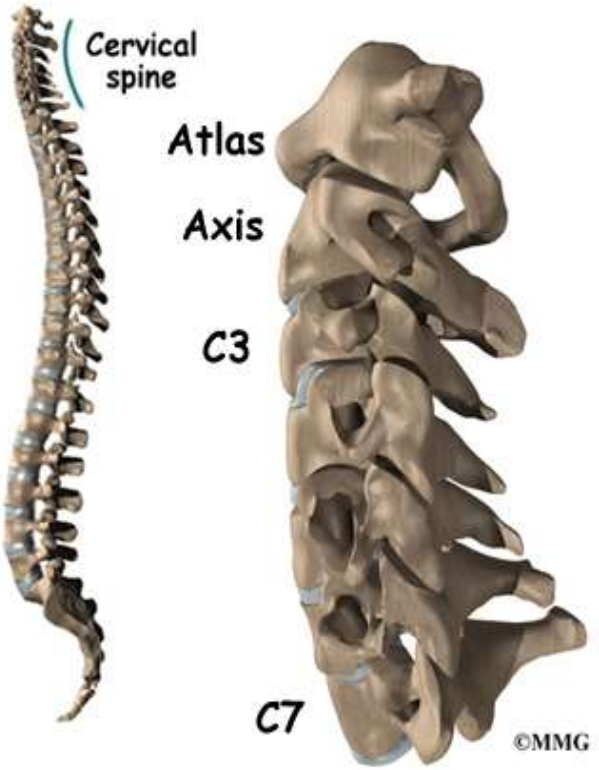
Physical Exam of the Cervical Spine

Goals

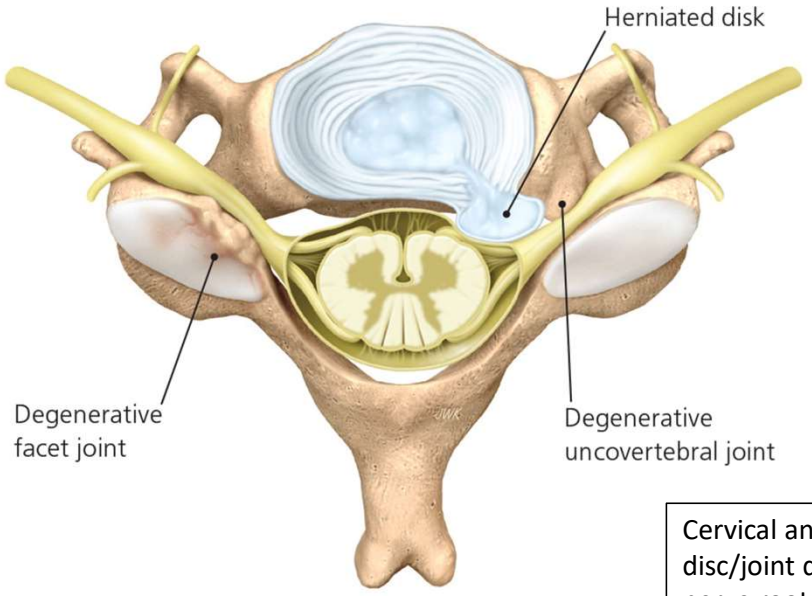
1. **Determine if pain/dysfunction has a cervical cause**
   a. **Musculoskeletal**
   b. **Nerve impingement**
   c. **Spinal Cord dysfunction**
2. **Determine next steps (imaging, referrals)**

General principles of Exam

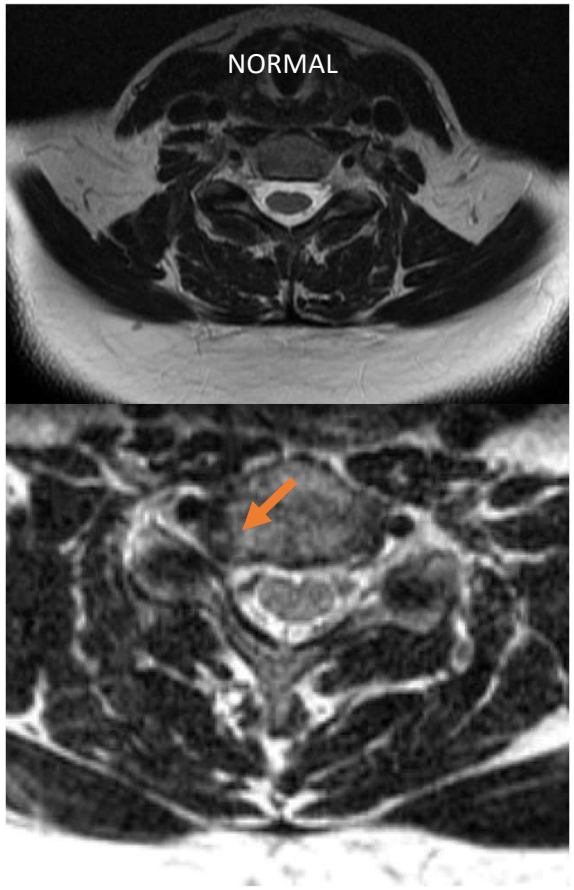
1. Inspection
2. Palpation
3. ROM (neck/shoulder)
4. Neuromuscular testing
   a) Sensory
   b) Motor
   c) DTR
5. Special Testing



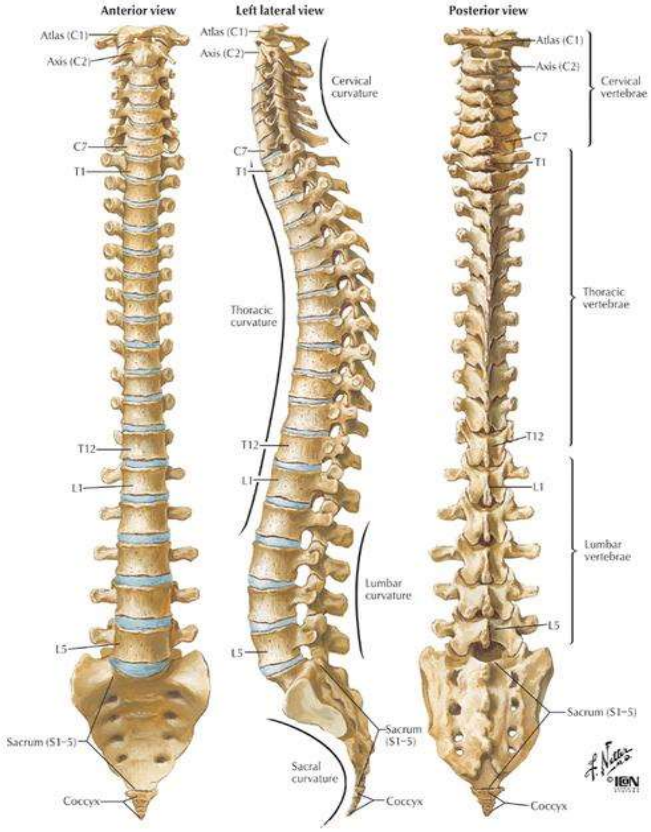
Anatomy - Cervical



Cervical and thoracic disc/joint disease affect nerve roots at the **same** level. Or can abut/compress the spinal cord.



Spinal Nerves



8 Cervical: Upper Extremity

- Nerves named for the vertebra below
- C8 exits the spine between C7 and T1

12 Thoracic: Ribs

- nerves named for vertebra above

5 Lumbar: Lower Extremity

- nerves named for vertebra above

5 Sacral: Pelvic organs

- nerves named for vertebra above

1 Coccygeal - vestigial

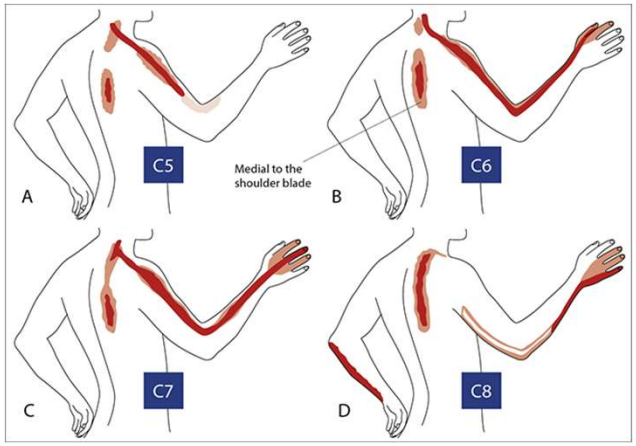
Clinical Presentation – History*

- +/- Hx of mechanism of injury
  - MVA (whiplash)
  - Fall
  - nothing
- Neck pain variable (+/-)
- Sensory symptoms
  - Pain in distribution of the nerve root, cervical less reliable mapping
  - Dull deep aching pain – myotome
  - Pins and needles – usually distal
  - Electric/burning/zapping - entire arm
- Can have muscle spasms to try to stabilize injured joint
  - neck, upper back
- Motor symptoms
  - According to innervation
  - All joints have at least two nerve roots, therefore unusual to have complete paralysis of a joint from a radiculopathy
- Interferes with sleep/work
- Pain with stretching the nerve
  - Upper cervical nerve roots issues will have patient present with arm on top of head
  - Lower cervical nerve roots with arm against body
  - I can't wash my hair; I can't put my hair in a ponytail

Clinical Presentation- Physical Exam

- Inspection
  - Observe patient
  - ROM of shoulders and neck
- Palpation
- Neurological Exam is WNL or…
  - Reduced sensation or paresthesia with light touch
  - Weakness
  - Guarding = “give away strength”
  - Reduced reflexes in Radiculopathy
  - Increased reflexes in myelopathy
- Special tests
  - Spurling’s Test for radiculopathy
  - Testing for differential diagnosis
- Upper motor neuron findings ?
  - +Hoffman’s – normal15%
  - Lhermitte’s sign
  - More than 3 beats of Ankle clonus
  - Babinski – upgoing
  - Abnormal Tandem gait
  - Unsteady Romberg’s
  - DTR 3+
  - Abnormal Rapid alternating movements

Clinical Presentation – Inspection



Patient Preferred positioning
- Bakody sign = hand on head reduces symptoms (C4-6)
- Lower cervical irritation = arm across abdomen

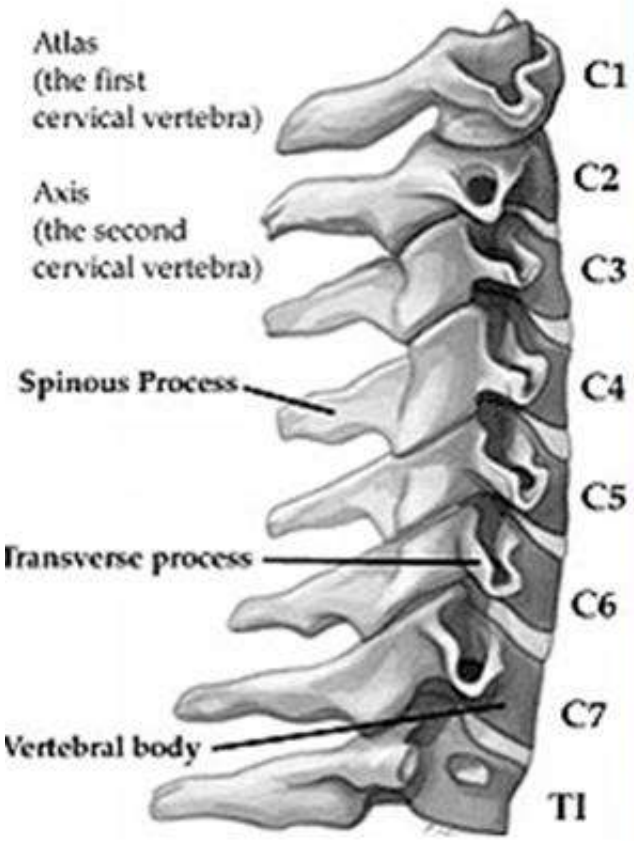
Atrophy
- Usually, upper motor neuron

Asymmetry – Scoliosis
- Shoulder symmetry
- scapula
- rib hump
- pterygium coli (webbed neck, Klippel-Feil Syndrome, Turner Syndrome)
- congenital torticollis

Skin
- operative scars
- skin lesions-café au lait spots-neurofibromatosis
- rash (shingles)

Graphic: https://smartypance.com/radiculopathy-rapid-review/ (accessed April 18, 2023

Clinical Presentation – Cervical ROM



	Bifid Spinous Process	Transverse Foramen / Vert?	Flexion/ Extension	Rotation	Lateral Bend
Occiput-C1			50	4	8
C1 (Atlas)	None	Yes / Yes	10	50	0
C2 (Axis)	Yes	Yes / Yes			
C3	Yes	Yes / Yes	50 (10/level)	50 (10/level)	60 (12/level)
C4	Yes	Yes / Yes			
C5	Yes	Yes / Yes			
C6	Yes	Yes / Yes			
C7 (VP)	No (95%)	Yes / No			
Total Motion			110	100	68

https://www.orthobullets.com/spine/2069/cervical-spine-anatomy, Accessed March 29, 2023

Clinical Presentation – Palpation

- Non spinal causes of neck pain
  - Lymphadenopathy
  - Thyroid gland
  - Parotid glands
- Muscular tension/tenderness
  - Generally, paraspinals on ipsilateral side of pathology
- Axial neck tenderness
  - C2 and C7 main muscle attachments, can have midline tenderness at these levels (can indicate shoulder pathology)
  - None specific
  - Landmarks:

Noah **T**old **M**aria**H** **T**o **T**ry **C**ervical **C**ounting

C1 - Nose
C2 - Teeth
C3 - Mandible/hyoid
C4 - Thyroid (above)
C5 - Thyroid (below)
C6 - Cricoid (above)
C7 - Cricoid (below)

Clinical Presentation- Neurological Testing

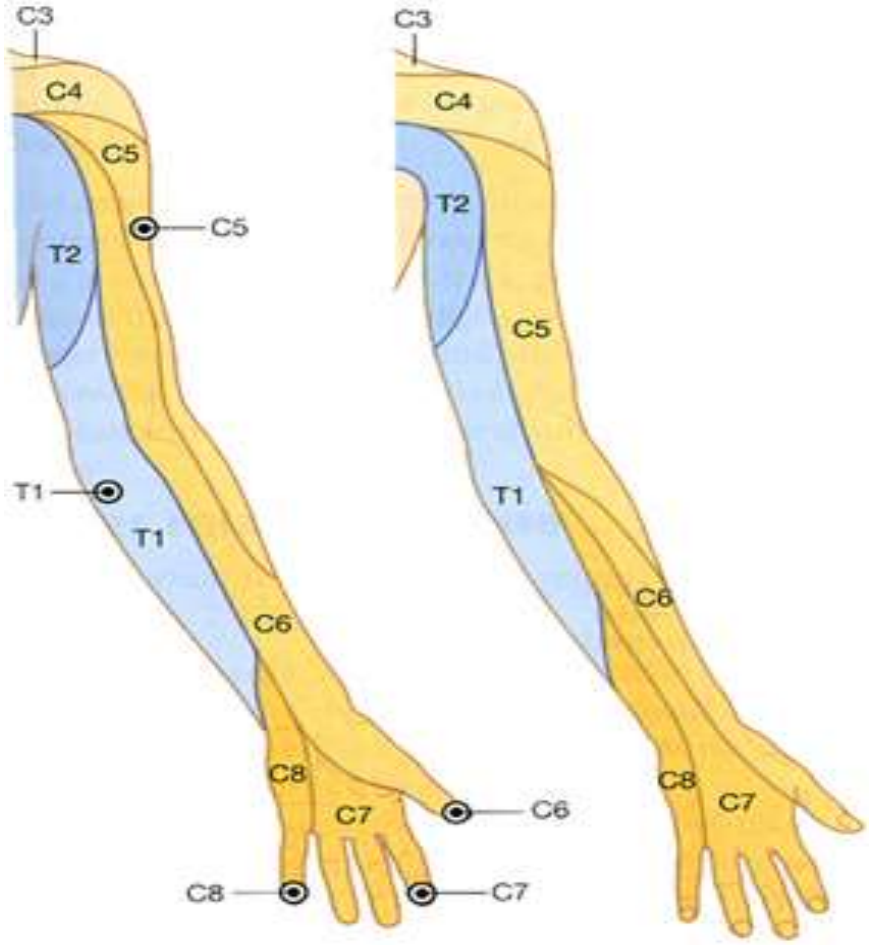
Root	Disc Level	Motor	Sensory	Reflex*
C5	C4-5	Deltoid, Biceps	clavicle, lateral upper arm	Biceps
C6	C5-6	Biceps, wrist extensors	Lateral forearm, thumb, index, 1/2 middle fingers	brachioradialis
C7	C6-7	Wrist flexion, finger extensors, triceps	middle finger	triceps
C8	C7-T1	Finger flexors, interossei	medial forearm ring and little finger	none
T1	T1-2	Interossei (finger abduction)	medial arm	none

*DTR is most common neurological deficit in radiculopathy

PE of the Cervical Spine

Sensory Dermatomes

- C5 Lateral forearm
- C6 Thumb
- C7 Middle finger
- C8 Small finger
- T1 Medial forearm



INTERNATIONAL STANDARDS FOR NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY (ISNCSCI)

ASIA — American Spinal Injury Association

ISCOS — International Spinal Cord Society

Patient Name _____ Date/Time of Exam _____

Examiner Name _____ Signature _____

RIGHT

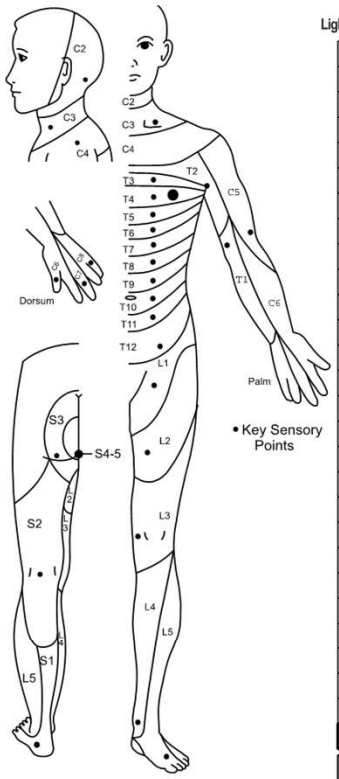
MOTOR KEY MUSCLES		Light Touch (LTR)	Pin Prick (PPR)
	C2		
	C3		
	C4		
Elbow flexors	C5		
Wrist extensors	C6		
Elbow extensors	C7		
Finger flexors	C8		
Finger abductors (little finger)	T1		
	T2		
	T3		
	T4		
	T5		
	T6		
	T7		
	T8		
	T9		
	T10		
	T11		
	T12		
	L1		
Hip flexors	L2		
Knee extensors	L3		
Ankle dorsiflexors	L4		
Long toe extensors	L5		
Ankle plantar flexors	S1		
	S2		
	S3		
	S4-5		
RIGHT TOTALS			
(MAXIMUM)		*(50)*	*(56)*	*(56)*

UER (Upper Extremity Right)

LER (Lower Extremity Right)

Comments *(Non-key Muscle? Reason for NT? Pain? Non-SCI condition?):*

(VAC) Voluntary Anal Contraction (Yes/No) ☐



LEFT

SENSORY KEY SENSORY POINTS Light Touch (LTL)	Pin Prick (PPL)	MOTOR KEY MUSCLES	
		C2	
		C3	
		C4	
		C5	*Elbow flexors*
		C6	*Wrist extensors*
		C7	*Elbow extensors*
		C8	*Finger flexors*
		T1	*Finger abductors (little finger)*
		T2	
		T3	
		T4	
		T5	
		T6	
		T7	
		T8	
		T9	
		T10	
		T11	
		T12	
		L1	
		L2	*Hip flexors*
		L3	*Knee extensors*
		L4	*Ankle dorsiflexors*
		L5	*Long toe extensors*
		S1	*Ankle plantar flexors*
		S2	
		S3	
		S4-5	
		LEFT TOTALS	
(56)	*(56)*	**(MAXIMUM)** *(50)*	

UEL (Upper Extremity Left)

LEL (Lower Extremity Left)

MOTOR (SCORING ON REVERSE SIDE)

0 = Total paralysis
1 = Palpable or visible contraction
2 = Active movement, gravity eliminated
3 = Active movement, against gravity
4 = Active movement, against some resistance
5 = Active movement, against full resistance
NT = Not testable
0, 1*, 2*, 3*, 4*, NT* = Non-SCI condition present*

SENSORY (SCORING ON REVERSE SIDE)

0 = Absent *NT = Not testable*
1 = Altered *0*, 1*, NT* = Non-SCI condition present*
2 = Normal

☐ *(DAP) Deep Anal Pressure (Yes/No)*

MOTOR SUBSCORES

UER ☐ +UEL ☐ = *UEMS TOTAL* ☐ (MAX 25 / 25 / 50)

LER ☐ + LEL ☐ = *LEMS TOTAL* ☐ (MAX 25 / 25 / 50)

SENSORY SUBSCORES

LTR ☐ + LTL ☐ = *LT TOTAL* ☐ (MAX 56 / 56 / 112)

PPR ☐ + PPL ☐ = *PP TOTAL* ☐ (MAX 56 / 56 / 112)

NEUROLOGICAL LEVELS
Steps 1- 6 for classification as on reverse

	R	L
1. SENSORY	☐	☐
2. MOTOR	☐	☐

3. NEUROLOGICAL LEVEL OF INJURY (NLI) ☐

4. COMPLETE OR INCOMPLETE? ☐
Incomplete = Any sensory or motor function in S4-5

5. ASIA IMPAIRMENT SCALE (AIS) ☐

(In injuries with absent motor OR sensory function in S4-5 only)

6. ZONE OF PARTIAL PRESERVATION
Most caudal levels with any innervation

	R	L
SENSORY	☐	☐
MOTOR	☐	☐

REV 04/19

Muscle Function Grading

0 = Total paralysis

1 = Palpable or visible contraction

2 = Active movement, full range of motion (ROM) with gravity eliminated

3 = Active movement, full ROM against gravity

4 = Active movement, full ROM against gravity and moderate resistance in a muscle specific position

5 = (Normal) active movement, full ROM against gravity and full resistance in a functional muscle position expected from an otherwise unimpaired person

NT = Not testable (i.e. due to immobilization, severe pain such that the patient cannot be graded, amputation of limb, or contracture of > 50% of the normal ROM)

0*, 1*, 2*, 3*, 4*, NT* = Non-SCI condition present [a]

Sensory Grading

0 = Absent **1** = Altered, either decreased/impaired sensation or hypersensitivity

2 = Normal **NT** = Not testable

0*, 1*, NT* = Non-SCI condition present [a]

[a] Note: Abnormal motor and sensory scores should be tagged with a '*' to indicate an impairment due to a non-SCI condition. The non-SCI condition should be explained in the comments box together with information about how the score is rated for classification purposes (at least normal / not normal for classification).

When to Test Non-Key Muscles:

In a patient with an apparent AIS B classification, non-key muscle functions more than 3 levels below the motor level on each side should be tested to most accurately classify the injury (differentiate between AIS B and C).

Movement	Root level
Shoulder: Flexion, extension, adbuction, adduction, internal and external rotation **Elbow:** Supination	C5
Elbow: Pronation **Wrist:** Flexion	C6
Finger: Flexion at proximal joint, extension **Thumb:** Flexion, extension and abduction in plane of thumb	C7
Finger: Flexion at MCP joint **Thumb:** Opposition, adduction and abduction perpendicular to palm	C8
Finger: Abduction of the index finger	T1
Hip: Adduction	L2
Hip: External rotation	L3
Hip: Extension, abduction, internal rotation **Knee:** Flexion **Ankle:** Inversion and eversion **Toe:** MP and IP extension	L4
Hallux and Toe: DIP and PIP flexion and abduction	L5
Hallux: Adduction	S1

ASIA Impairment Scale (AIS)

A = Complete. No sensory or motor function is preserved in the sacral segments S4-5.

B = Sensory Incomplete. Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-5 (light touch or pin prick at S4-5 or deep anal pressure) AND no motor function is preserved more than three levels below the motor level on either side of the body.

C = Motor Incomplete. Motor function is preserved at the most caudal sacral segments for voluntary anal contraction (VAC) OR the patient meets the criteria for sensory incomplete status (sensory function preserved at the most caudal sacral segments S4-5 by LT, PP or DAP), and has some sparing of motor function more than three levels below the ipsilateral motor level on either side of the body. (This includes key or non-key muscle functions to determine motor incomplete status.) For AIS C – less than half of key muscle functions below the single NLI have a muscle grade ≥ 3.

D = Motor Incomplete. Motor incomplete status as defined above, with at least half (half or more) of key muscle functions below the single NLI having a muscle grade ≥ 3.

E = Normal. If sensation and motor function as tested with the ISNCSCI are graded as normal in all segments, and the patient had prior deficits, then the AIS grade is E. Someone without an initial SCI does not receive an AIS grade.

Using ND: To document the sensory, motor and NLI levels, the ASIA Impairment Scale grade, and/or the zone of partial preservation (ZPP) when they are unable to be determined based on the examination results.

ASIA
AMERICAN SPINAL INJURY ASSOCIATION

INTERNATIONAL STANDARDS FOR NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY

ISCOS
INTERNATIONAL SPINAL CORD SOCIETY

Steps in Classification

The following order is recommended for determining the classification of individuals with SCI.

1. Determine sensory levels for right and left sides.
The sensory level is the most caudal, intact dermatome for both pin prick and light touch sensation.

2. Determine motor levels for right and left sides.
Defined by the lowest key muscle function that has a grade of at least 3 (on supine testing), providing the key muscle functions represented by segments above that level are judged to be intact (graded as a 5).
Note: in regions where there is no myotome to test, the motor level is presumed to be the same as the sensory level, if testable motor function above that level is also normal.

3. Determine the neurological level of injury (NLI).
This refers to the most caudal segment of the cord with intact sensation and antigravity (3 or more) muscle function strength, provided that there is normal (intact) sensory and motor function rostrally respectively.
The NLI is the most cephalad of the sensory and motor levels determined in steps 1 and 2.

4. Determine whether the injury is Complete or Incomplete.
(i.e. absence or presence of sacral sparing)
*If voluntary anal contraction = **No** AND all S4-5 sensory scores = **0** AND deep anal pressure = **No**, then injury is **Complete**.*
*Otherwise, injury is **Incomplete**.*

5. Determine ASIA Impairment Scale (AIS) Grade.
Is injury Complete? If YES, AIS=A
NO ↓
Is injury Motor Complete? If YES, AIS=B
NO ↓ (No=voluntary anal contraction OR motor function more than three levels below the motor level on a given side, if the patient has sensory incomplete classification)

Are at least half (half or more) of the key muscles below the neurological level of injury graded 3 or better?
NO ↓ AIS=C **YES ↓ AIS=D**

If sensation and motor function is normal in all segments, AIS=E
Note: AIS E is used in follow-up testing when an individual with a documented SCI has recovered normal function. If at initial testing no deficits are found, the individual is neurologically intact and the ASIA Impairment Scale does not apply.

6. Determine the zone of partial preservation (ZPP).
The ZPP is used only in injuries with absent motor (no VAC) OR sensory function (no DAP, no LT and no PP sensation) in the lowest sacral segments S4-5, and refers to those dermatomes and myotomes caudal to the sensory and motor levels that remain partially innervated. With sacral sparing of sensory function, the sensory ZPP is not applicable and therefore "NA" is recorded in the block of the worksheet. Accordingly, if VAC is present, the motor ZPP is not applicable and is noted as "NA".

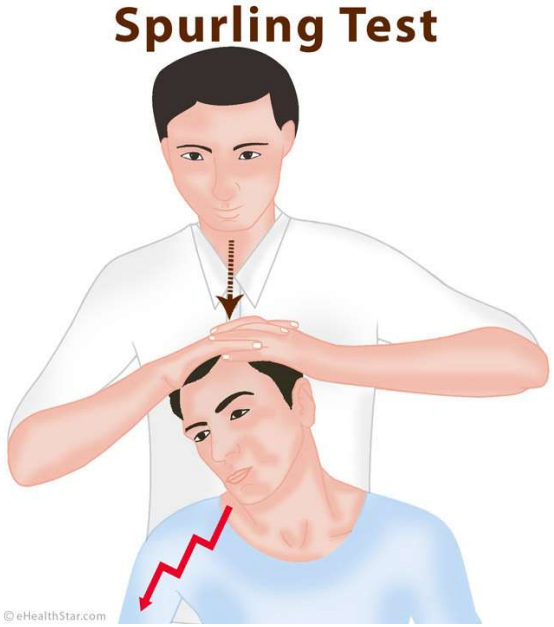
Deep Tendon Reflexes

- NINDS Scale (National Institute of Neurological Disorders And Stroke)
  0: Absent
  1+: Low normal, diminished, trace response
  2+: Normal
  3+: Brisk, more reflexive than normal (more than one joint moves)
  4+: Very brisk, hyper reflexive, with clonus
  5+: Sustained clonus

Special Testing

- Spurling Maneuver - Evaluates nerve root compression in foramen
- Upper Motor Neuron testing
  - Hoffman's Test
  - Lhermitte’s sign
  - Tandem Gait
  - Rapid alternating movement
  - Babinski’s
- Testing of the Upper Extremity may be helpful
  - Shoulder impingement
  - Phalen’s for CTS
  - Tinel’s for ulnar neuropathy and median nerve neuropathy
  - Rotator Cuff Pathology
  - Etc.

Physical Exam Special Testing

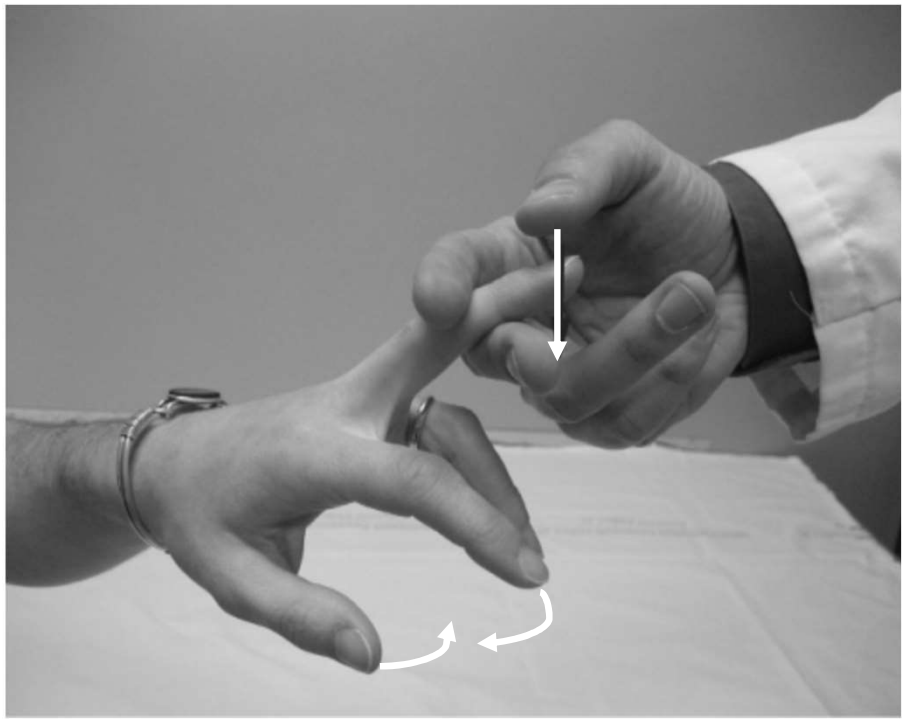


- Lateral flexion and extension of the neck with axial compression
- Positive when it recreates radicular symptoms (pain, numbness, tingling, paresthesia) in the appropriate dermatome
- 30% sensitive and 90%specific

- Full flexion of cervical spine
- Positive when this results in electric shock sensation down arms, spine, and/or legs
- indicates **spinal cord dysfunction**
- Not sensitive, but highly specific

https://physio-study.com/spurling-test/ (accessed April 18, 2022)

Physical Exam Special Testing
Hoffman's test



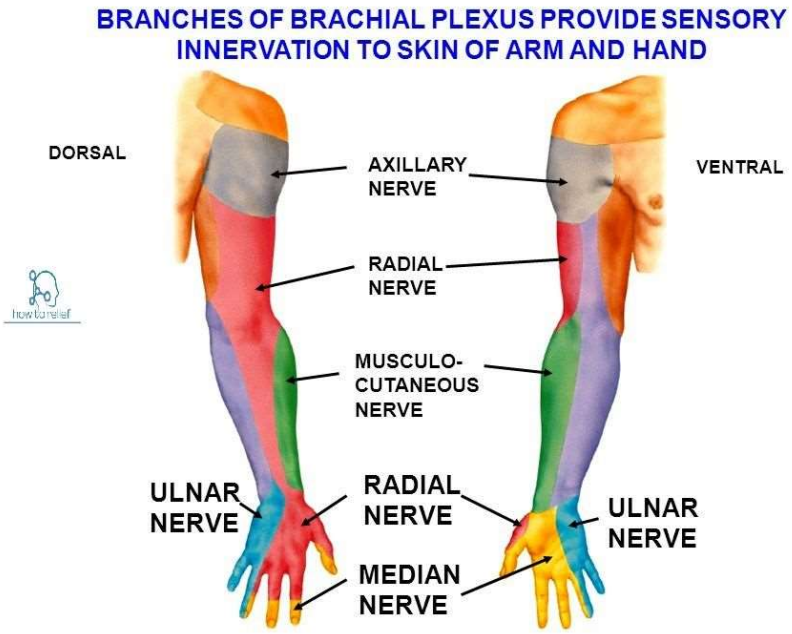
1. Hold middle finger MIP in extension
2. Flick DIP downward

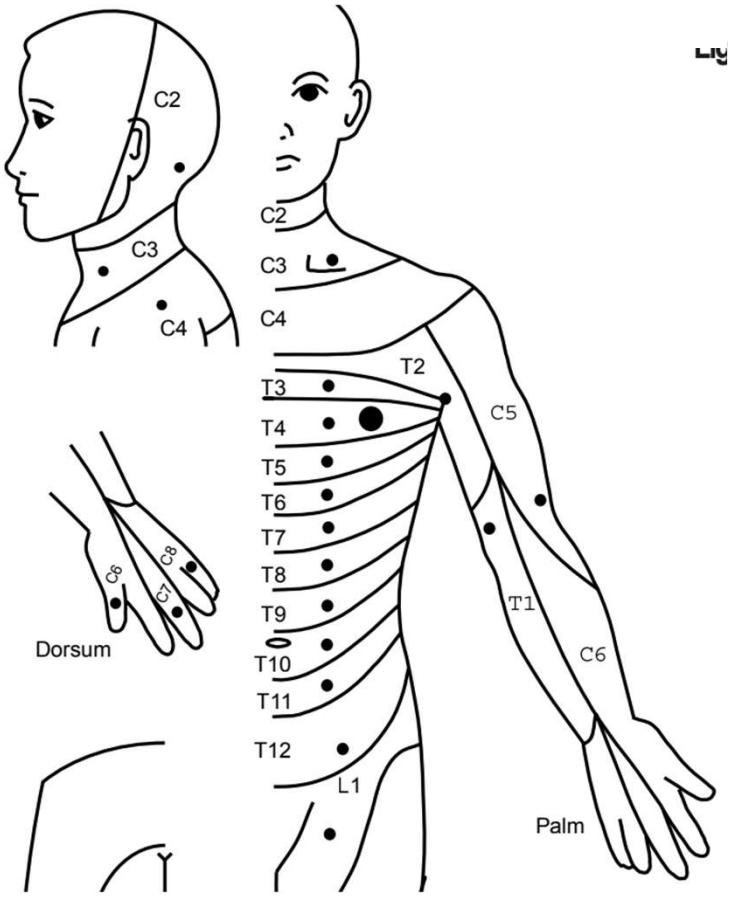
- Positive when index and thumb twitch in flexion
- 15% of people without myelopathy will test positive

https://musculoskeletalkey.com/neck-pain-and-shooting-arm-pain/ (accessed April 18, 2023)

Differential diagnosis

Peripheral Mononeuropathies vs Nerve Root Sensory Maps





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