AAPA/ AAOS Musculoskeletal Galaxy

Upper Extremity and Cervical Spine Physical Exam Techniques

June 22-26, 2022 Denver, CO

THE OHIO STATE UNIVERSITY
WEXNER MEDICAL CENTER

2022 Musculoskeletal Galaxy Denver, CO

Upper Extremity Physical Examination

Stephanie Stradley, MS, ATC, PA-C

June 22-26, 2022

PHYSICAL EXAMINATION

"Same time, every time"

- **INSPECTION**
- **PALPATION**
- **RANGE OF MOTION**
- **SPECIAL TESTS**

THE ELBOW

- 3 Joints
  - Ulnohumeral joint (Hinge joint)
  - Radiohumeral joint (Pivot Joint)
  - Proximal radioulnar joint
- Kinetics
  - Flexion (biceps, brachialis, brachoradialis)
  - Extension (Triceps)
  - Pronation (pronator teres, quadratus)
  - Supination (biceps, supinator)

ELBOW PHYSICAL EXAM

INSPECTION

- Obvious deformity
- Edema
- Ecchymosis
- Lesions/wounds
- Carrying angle (average 13˚ for women, 10˚ for men)

ELBOW PHYSICAL EXAM

PALPATION

Bony prominences

- Distal humerus
- Lateral epicondyle
- Medial epicondyle
- Radial head
- Olecranon

Soft tissue structures

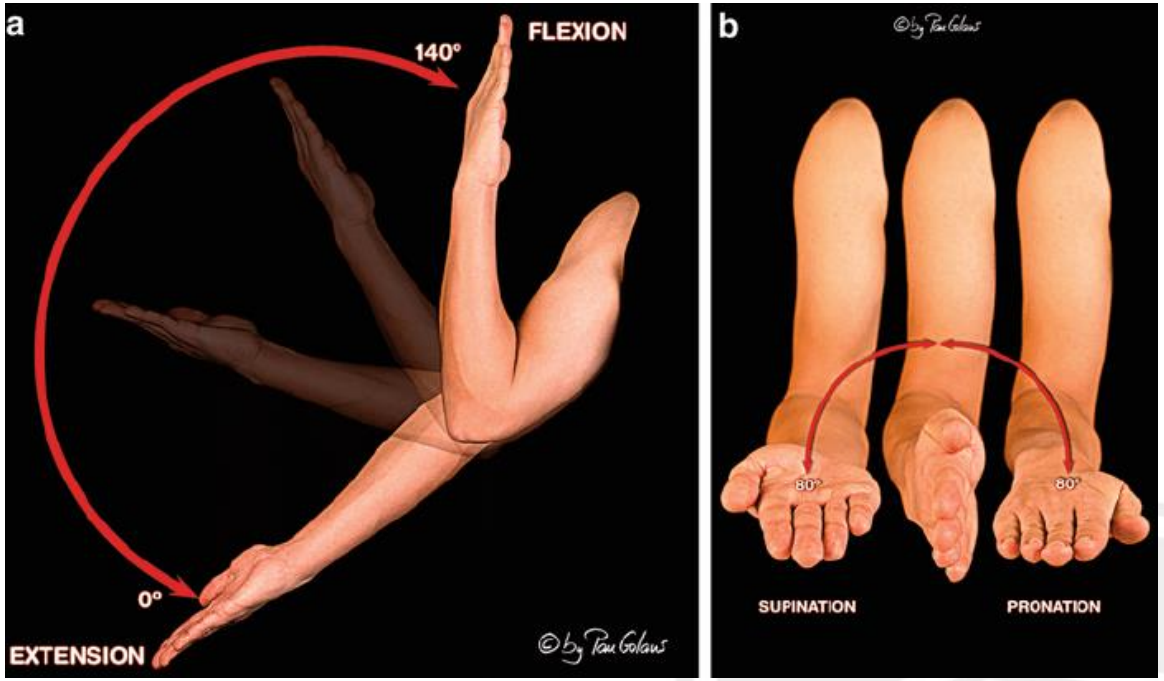
- Distal biceps tendon
- Triceps tendon
- Flexor pronator mass
- Medial collateral ligament
- Lateral ulnar collateral ligament
- Olecranon bursa

ELBOW PHYSICAL EXAM

RANGE OF MOTION

- Active
- Passive
- Always examine bilaterally

- Flexion (130˚-140˚)
- Extension (0˚)
- Pronation (70˚-80˚)
- Supination (80˚-85˚)

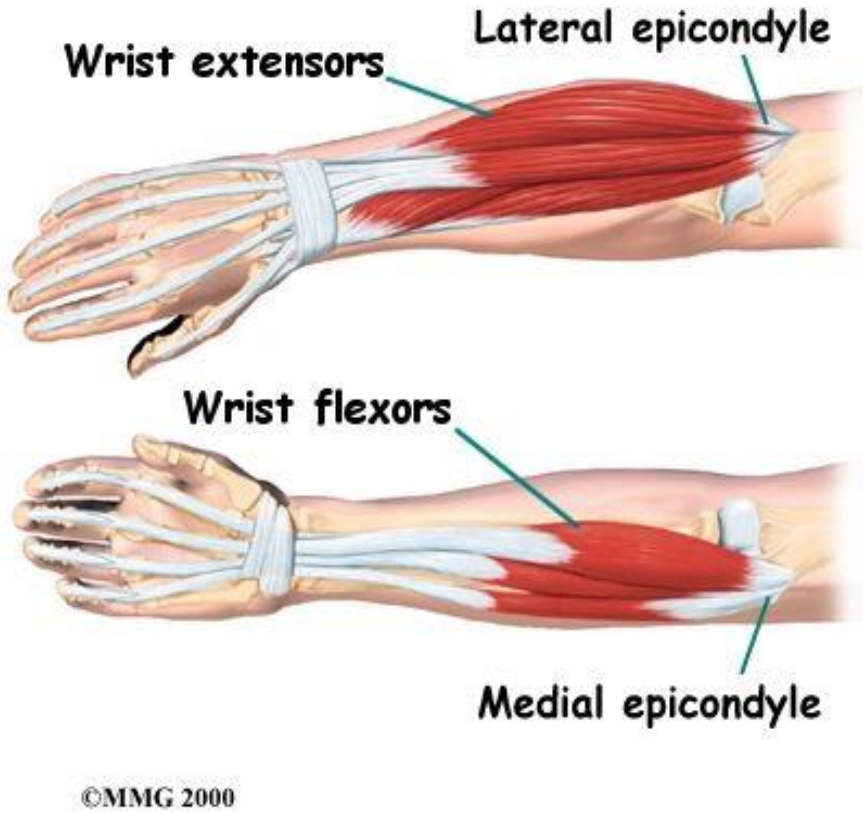


https://www.researchgate.net/profile/Miki_Dalmau-Pastor/publication/278696184/figure/fig6/AS:294296830922756@1447177240220/Range-of-motion-of-the-elbow-joint-a-Flexion-extension-movement-provided-by-the.png

ELBOW PHYSICAL EXAM

STRENGTH

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



https://www.orthobullets.com/shoulder-and-elbow/322131/elbow-physical-exam

ELBOW PHYSICAL EXAM

REFLEX TESTING

Biceps Reflex – C5

Nerve: Musculocutaneous n.

Segment: C5-C6

Brachioradialis Reflex- C6

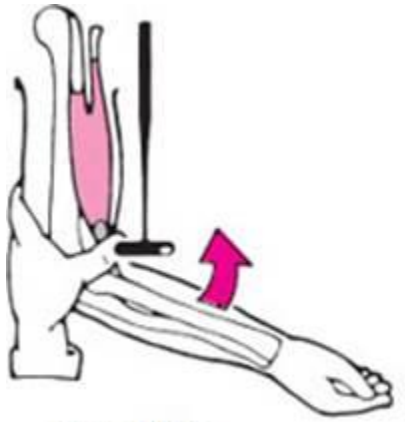
Nerve: Radial n., Musculocutaneous n.

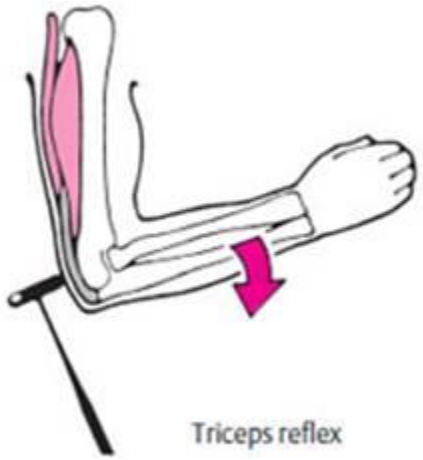
Segment: C5-C6

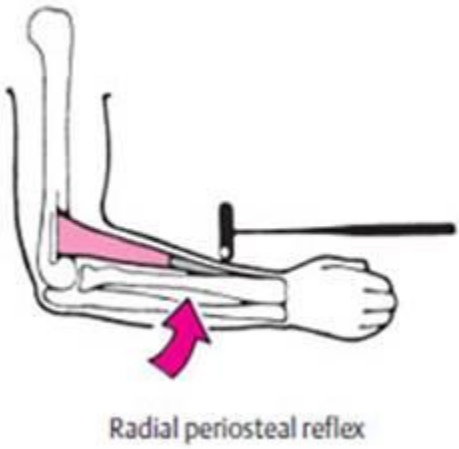
Triceps Reflex – C7

Nerve: Radial n.

Segment: C7-C8







https://doctorlib.info/neurology/fundamentals-neurology/3.html

ELBOW PHYSICAL EXAM

SPECIAL TESTS

- Valgus stress test: Medial (ulnar) collateral ligament (MCL)
- Varus stress test: Lateral ulnar collateral ligament (LUCL)
- Posterolateral Rotatory Instability Test (Pivot Shift Test) or Chair lift test: Lateral ulnar collateral ligament (LUCL)
- Tinel Test: Cubital tunnel syndrome or ulnar nerve compression
- Hook Test: Distal biceps rupture
- Modified Thompson Squeeze test: Triceps rupture
- Resisted wrist & middle finger extension: Lateral epicondylitis
- Resisted wrist flexion: Medial epicondylitis

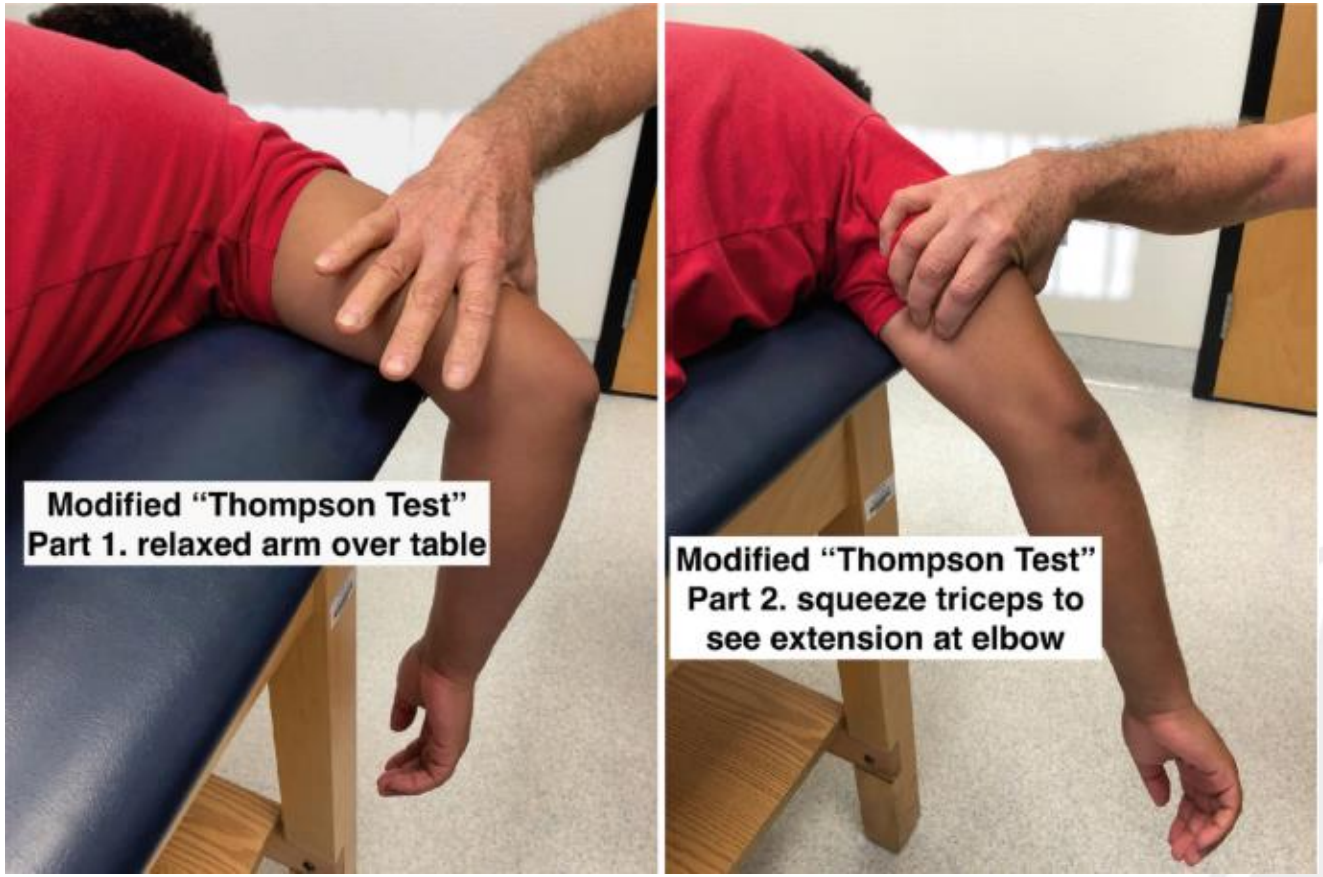
ELBOW PHYSICAL EXAM

Hook Test: Distal biceps rupture

THE JOURNAL OF BONE &JOINT SURGERY d JBJS.ORG VOLUME 92-A d NUMBER 11 d SEPTEMBER 1, 2010:
Distal biceps tendon injuries

ELBOW PHYSICAL EXAM

Modified Thompson Squeeze test: Triceps rupture

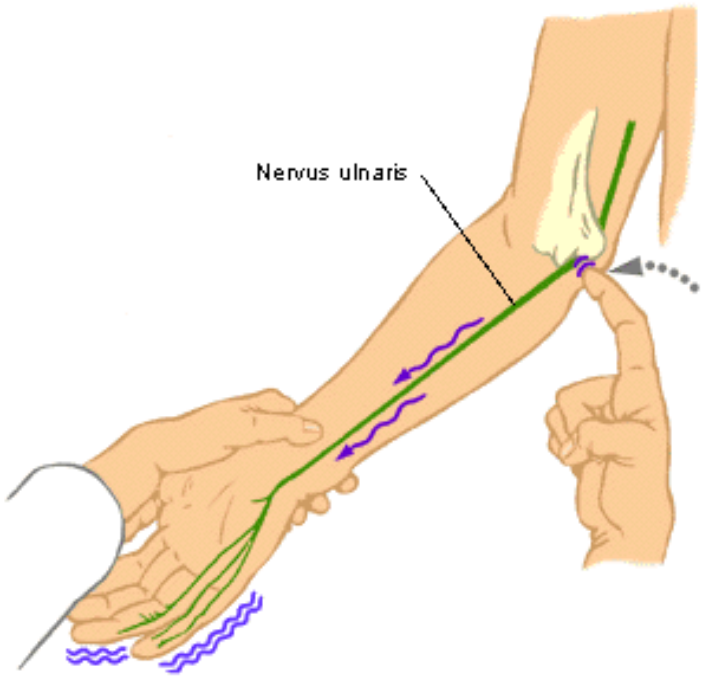


https://link.springer.com/chapter/10.1007/978-3-030-36790-9_34

ELBOW PHYSICAL EXAM

Cubital tunnel syndrome

- Tinel tap test over ulnar groove produces numbness, tingling or electricity that radiates to the small and ring finger
- Elbow flexion test – prolonged elbow flexion evoke numbness and tingling in the small finger



WRIST PHYSICAL EXAM

Same time, every time... Principles are the same, but the exam is more problem-focused

- **INSPECT** for obvious deformity, swelling, skin breakdown, open injury or bruising
- **PALPATE** for bony and soft tissue tenderness
- Test active and passive **RANGE OF MOTION** of the wrist and fingers
- Perform **SPECIAL TESTS** as indicated

WRIST PHYSICAL EXAM

PALPATION – BONY ANATOMY

- Starting point - Lister's tubercle
  - Dorsal surface of the distal radius in line with the web space between the index and middle fingers
- Scapholunate interval
  - Slide fingers 1-2 cm distal to soft depression
- Radial styloid
- Scaphoid
  - Anatomic snuffbox (ulnar deviate the wrist)
- Thumb CMC joint
- Pisiform, hook of hamate
- Ulnar styloid
- DRUJ

R. Srinivas Reddy, J. Compson. Current Orthopaedics (2005) 19, 171–179. Examination of the wrist—surface anatomy of the carpal bones

WRIST PHYSICAL EXAM

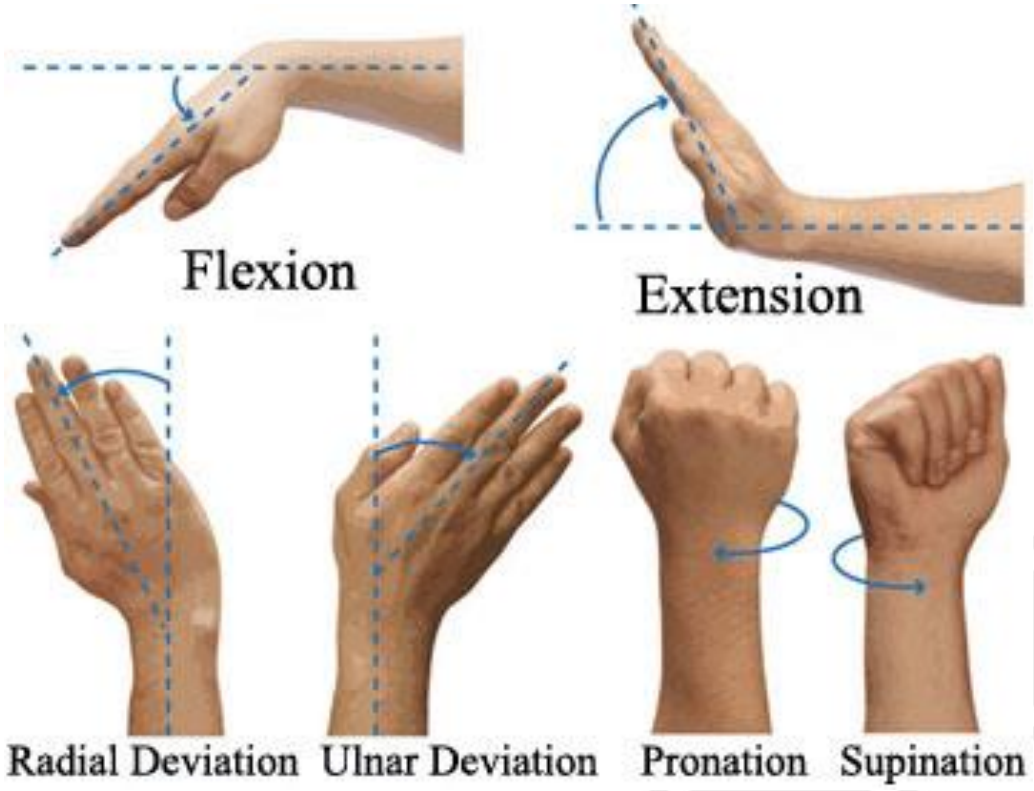
PALPATION – SOFT TISSUE

- Scapholunate ligament
- “Wrist sprain”
  - ECU
  - ECRL/ECRB
  - FCR
  - FCU
- TFCC
  - Ulnar fovea
- First dorsal compartment (APL, EPB tendons) – DeQuervain’s

WRIST PHYSICAL EXAM

RANGE OF MOTION

- Flexion (60˚-80˚)
- Extension (60˚-70˚)
- Pronation (70˚-80˚)
- Supination (80˚-85˚)
- Radial deviation (10˚)
- Ulnar deviation (30˚)



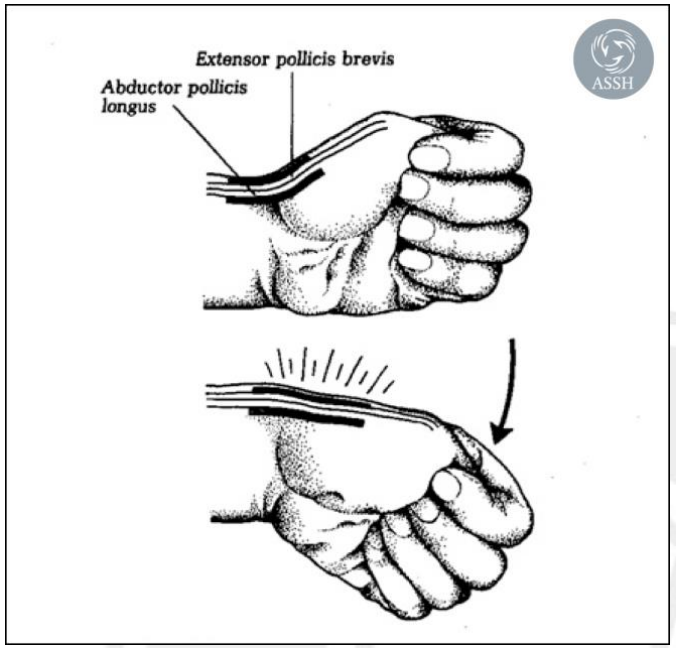
https://www.crossfitinvictus.com/blog/simple-solutions-for-poor-wrist-mobility/

WRIST PHYSICAL EXAM

SPECIAL TESTS

FINKELSTEIN TEST – DeQUERVAIN'S TENOSYNOVITIS

- Radial sided wrist pain worsened by thumb motion or ulnar deviation
- Wrap fingers over thumb and gently ulnar deviate the wrist

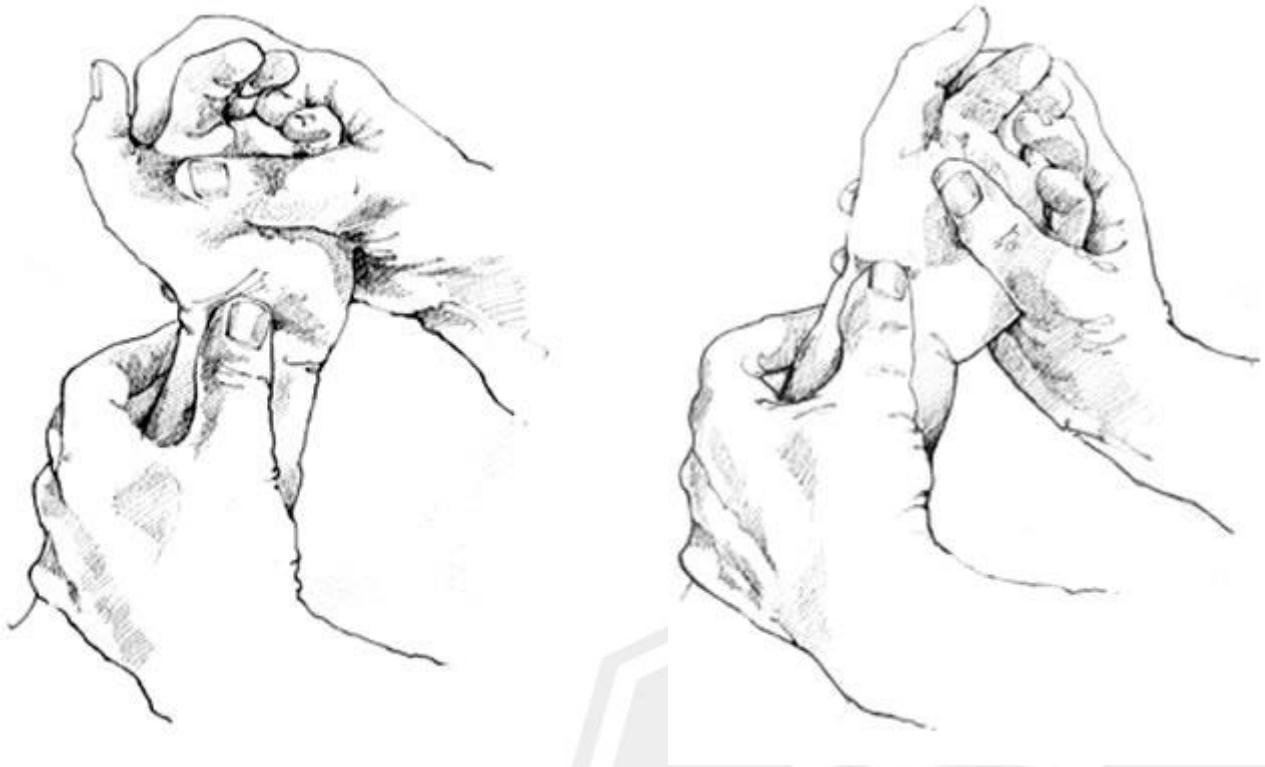


WRIST PHYSICAL EXAM

SPECIAL TESTS

WATSON TEST – SL INJURY

- Place thumb over volar aspect of the distal pole of the scaphoid.
- Maintain constant pressure with thumb as wrist is moved from extension, ulnar deviation to flexion, radial deviation, and back again.
- Dorsal wrist pain or a clunk may indicate instability of scapholunate ligament.



https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.donaldsammut.com%2Fgallery%2Ftesttechnique%2Fwatson-scaphoid-shift-test-1x385%2F&psig=AOvVaw1IsGErz7AE2-27Aj8LIy_k&ust=1651157550025000&source=images&cd=vfe&ved=0CAoQjhxqFwoTCJD4ha2_tPcCFQAAAAAdAAAAABAO

WRIST PHYSICAL EXAM

SPECIAL TESTS

PIANO KEY SIGN – DRUJ INSTABILITY

- Wrist is supported in pronation and the hand is stabilized in the neutral position.
- Force is applied to the head of ulna.

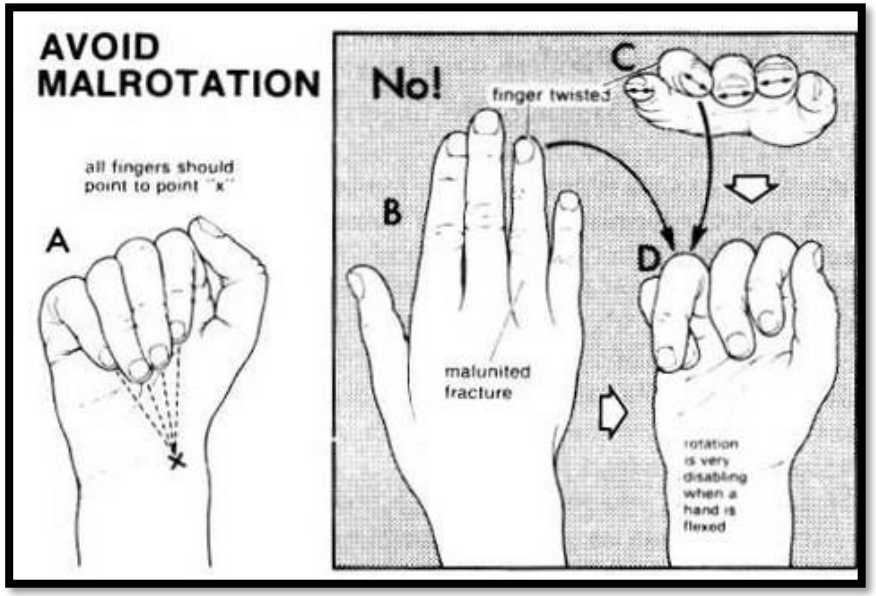
https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.physio-pedia.com%2FPiano_Key_Sign&psig=AOvVaw0mlKbP0fva2nNyoO19DnmS&ust=1651157838281000&source=images&cd=vfe&ved=0CAoQjhxqFwoTCPDnzbrAtPcCFQAAAAAdAAAAABAP

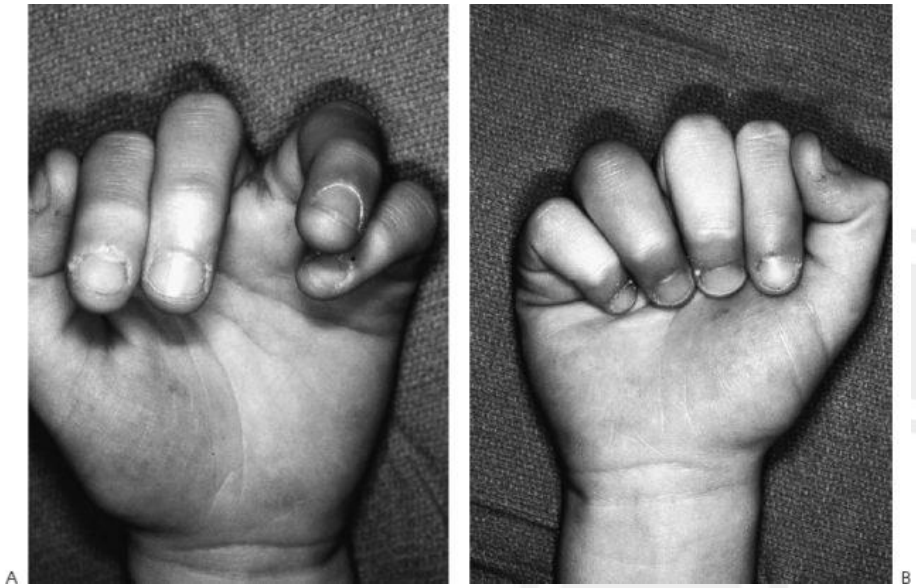
HAND PHYSICAL EXAM

INSPECTION

Observe the cascade of the fingers, observe nailbed

Look for malrotation of fingers, atrophy or wasting of muscles





HAND PHYSICAL EXAM

PALPATION

- Metacarpals
- Phalanges
- Collateral ligaments - fingers
- Thumb UCL/RCL
- Volar plate
- A1 pulleys

HAND PHYSICAL EXAM

RANGE OF MOTION

- “Composite fist”
- Finger MCP (0 – 90)
- Finger PIP (0-100)
- Finger DIP (0-80)
- Thumb MP (0-55 – widely variable)
- Thumb IP (+15-80)
- Abduction/Adduction

HAND PHYSICAL EXAM

SPECIAL TESTS – Evaluating for…

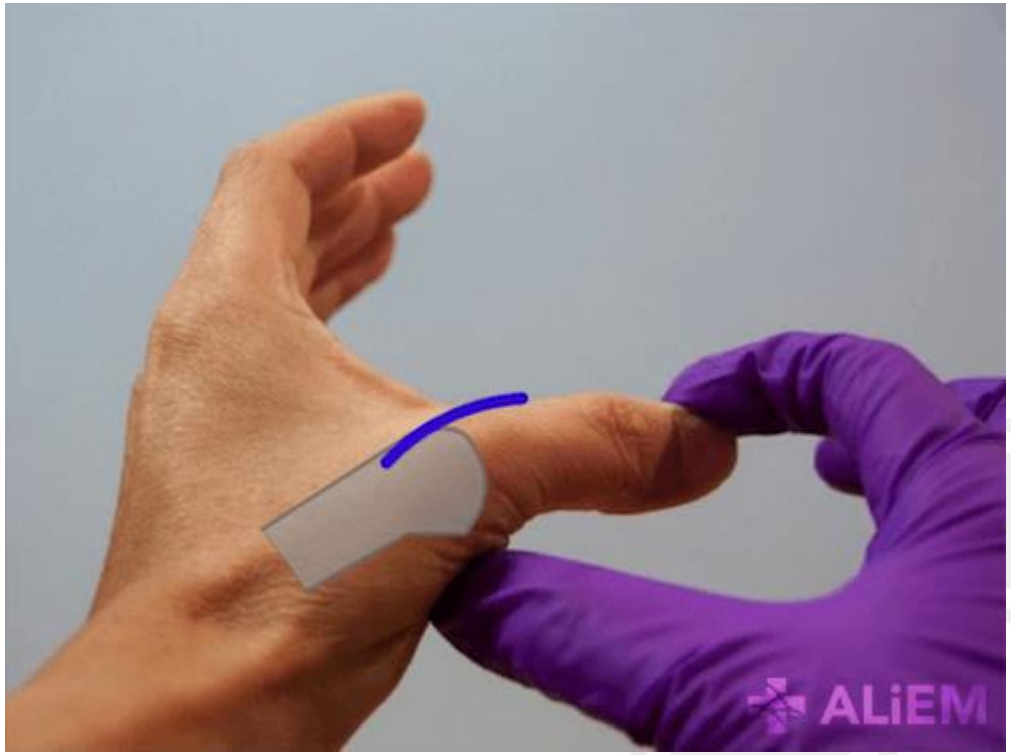
- Joint stability
- Tendon injury
- Nerve compression
- Trigger finger
- Vascular compromise
- Infection

HAND PHYSICAL EXAM

SPECIAL TESTS

THUMB UCL/RCL INJURY

- Apply valgus and varus stress with the joint supported

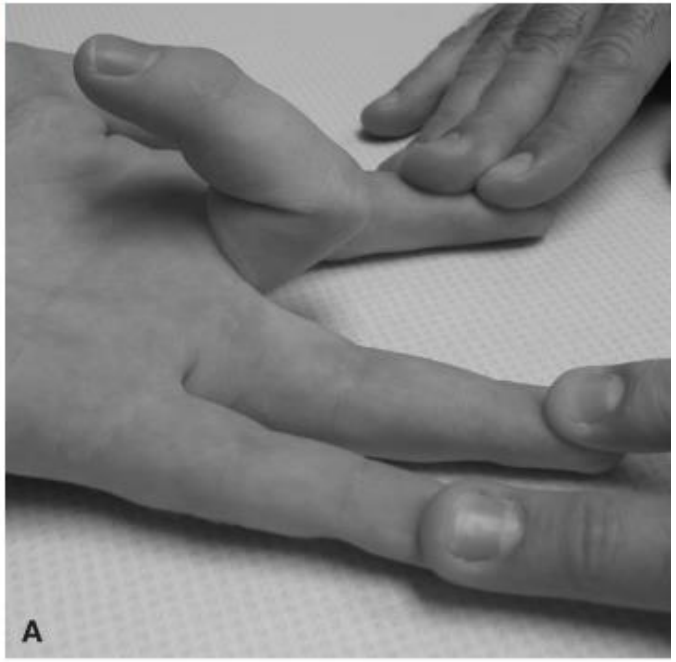


HAND PHYSICAL EXAM

SPECIAL TESTS

TENDON EXAM – FDS/FDP

- Isolate each finger
- 15% of the population has no FDS to the small finger



HAND PHYSICAL EXAM

SPECIAL TESTS

TENDON EXAM – EPL

- Place palm flat and lift thumb off table
- Why can’t you have them just give a thumbs up?
- Extension via thumb intrinsics and adhesions between EPL and EPB. This isolates the EPL

HAND PHYSICAL EXAM

NERVE EXAM - MOTOR

Median – Thumb abduction

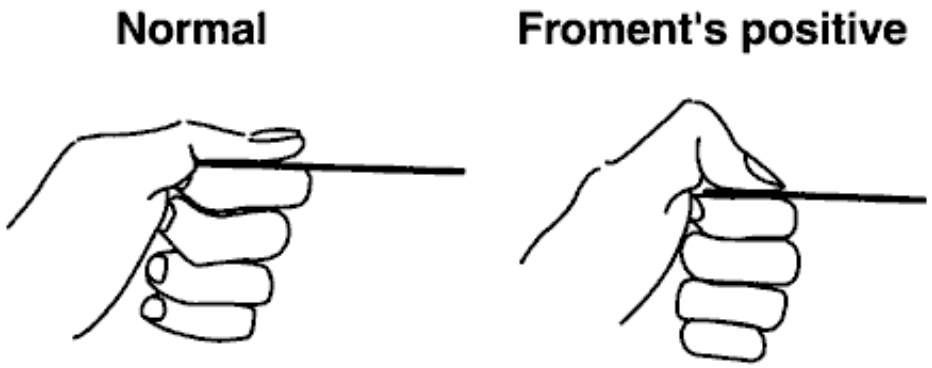
Radial – Wrist extension

Ulnar – Finger abduction, cross fingers

PIN – Thumb extension, MCP extension

AIN – OK sign

Froment’s sign for ulnar nerve:



HAND PHYSICAL EXAM

NERVE EXAM - SENSORY

Sensation

2-point discrimination

Normal = 5mm

>15mm = concern for nerve laceration

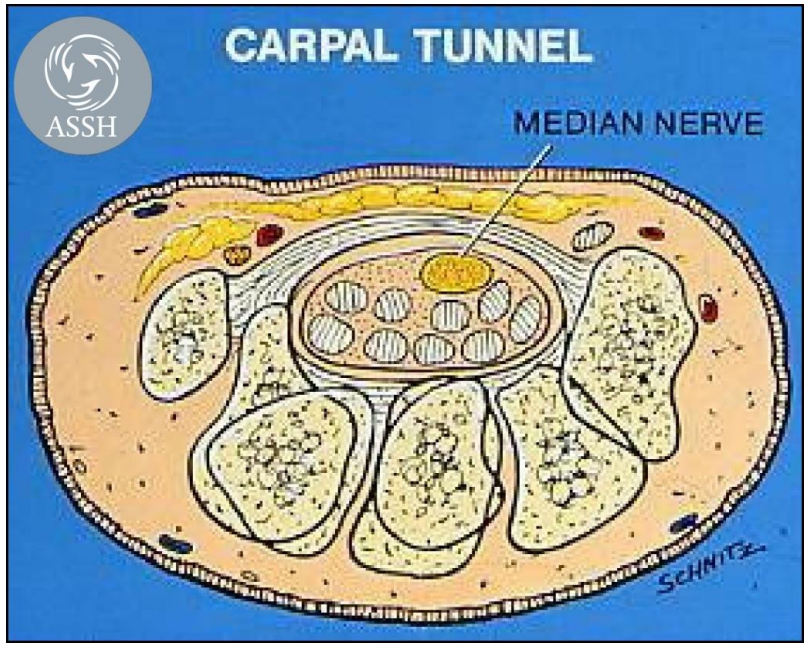
Semmes-Weinstein Monofilaments

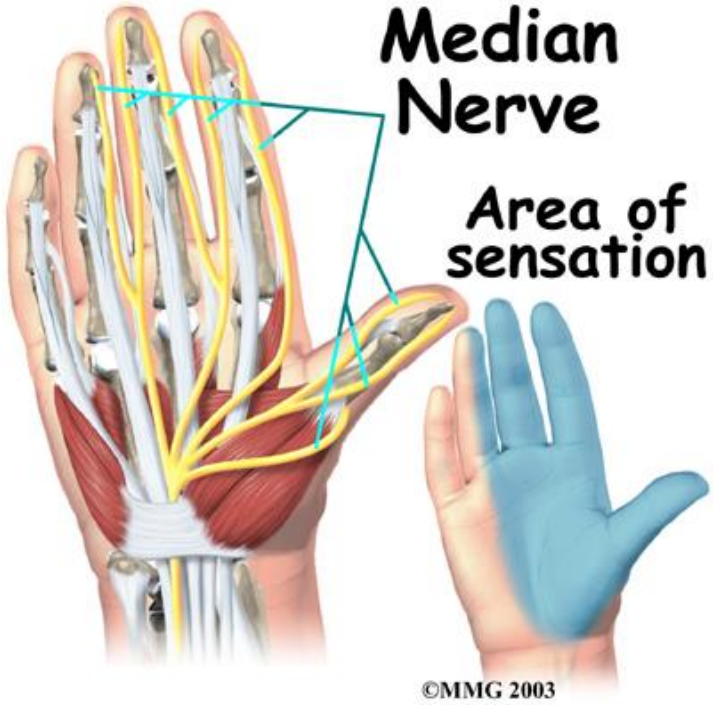
Quantitative test for sensory loss

Normal is green (#2.83, 0.07 force-g)

HAND PHYSICAL EXAM

MEDIAN NERVE ANATOMY AND DISTRIBUTION



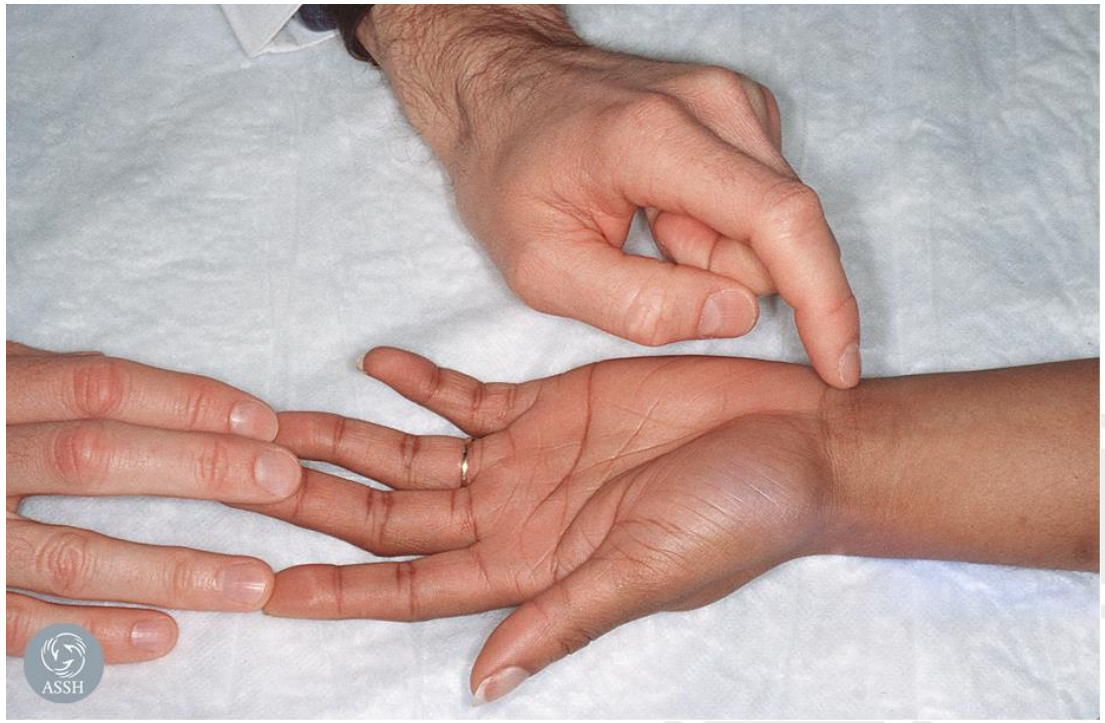


HAND PHYSICAL EXAM

CARPAL TUNNEL EXAM – TINEL TAP TEST

Tinel tap test

- Tap lightly over the median nerve
- Tapping produces numbness, tingling or electricity to the radial digits

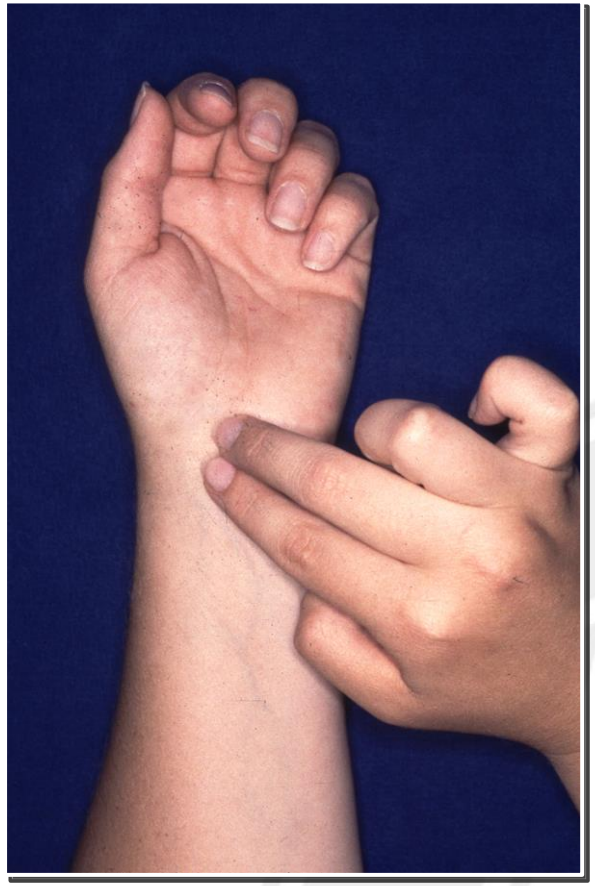


HAND PHYSICAL EXAM

CARPAL TUNNEL EXAM – MEDIAN NERVE COMPRESSION TEST

Augmented Durkan's

- Apply pressure over the median nerve
- Gently flex the wrist
- Hold 30-60 seconds
- Positive test produces numbness and tingling to the radial digits

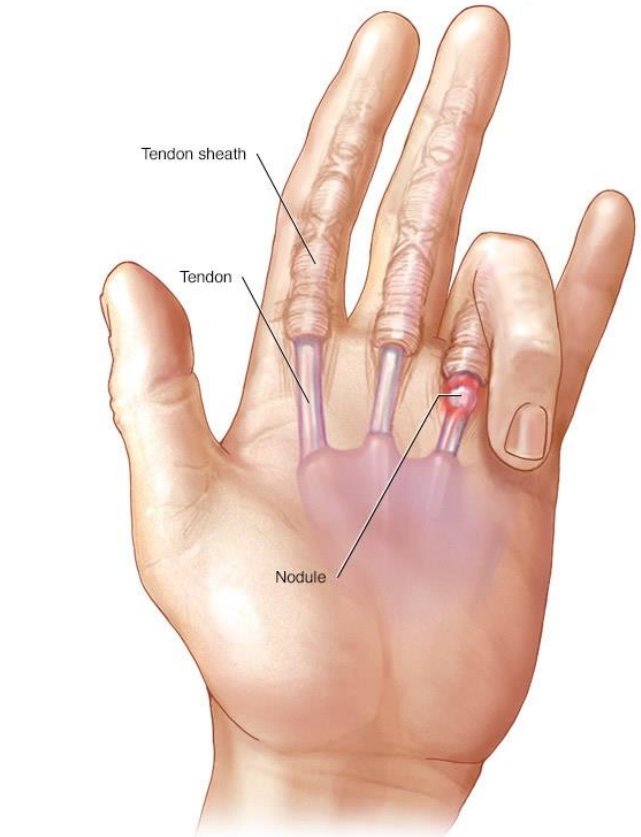


HAND PHYSICAL EXAM

TRIGGER FINGER

TRIGGER FINGER

- Palpate directly over the A1 pulley
- Pain on direct palpation
- Gently flex and extend the finger while palpating the pulley
- Feel for locking or nodular sensation
- Patients can sometimes make the finger lock on its own



HAND PHYSICAL EXAM

VASCULAR COMPROMISE

ALLEN TEST

- Assess for patency of ulnar and radial arteries by occluding the artery one at a time and observing the hand for perfusion

CAPILLARY REFILL

- Compress nailbed until it blanches
- Assess the time it takes for color to return
- Normal cap refill = <2 seconds

HAND PHYSICAL EXAM

INFECTION

KNAVEL'S SIGNS

Cardinal signs of flexor sheath infection

- Affected finger held in slight flexion
- Fusiform swelling over the affected tendon ("sausage digit")
- Tenderness to palpation over the affected tendon
- Pain on passive extension of the affected finger

Physical Exam of the Shoulder

Travis Randolph, MS, ATC, PA-C

West Virginia University Department of Orthopaedics

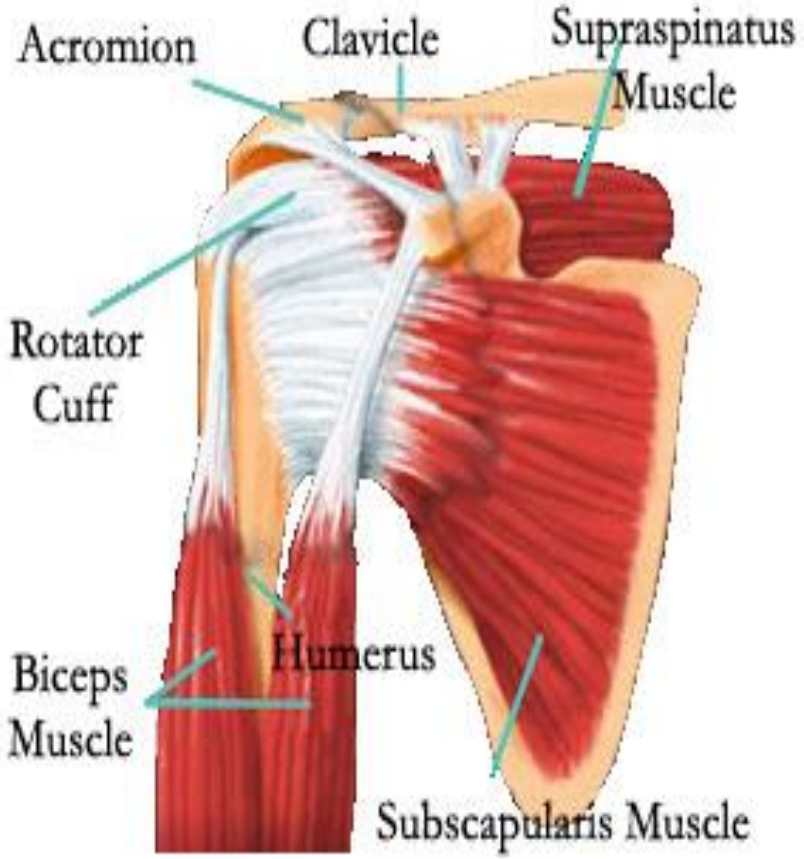
trandolph@hsc.wvu.edu

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

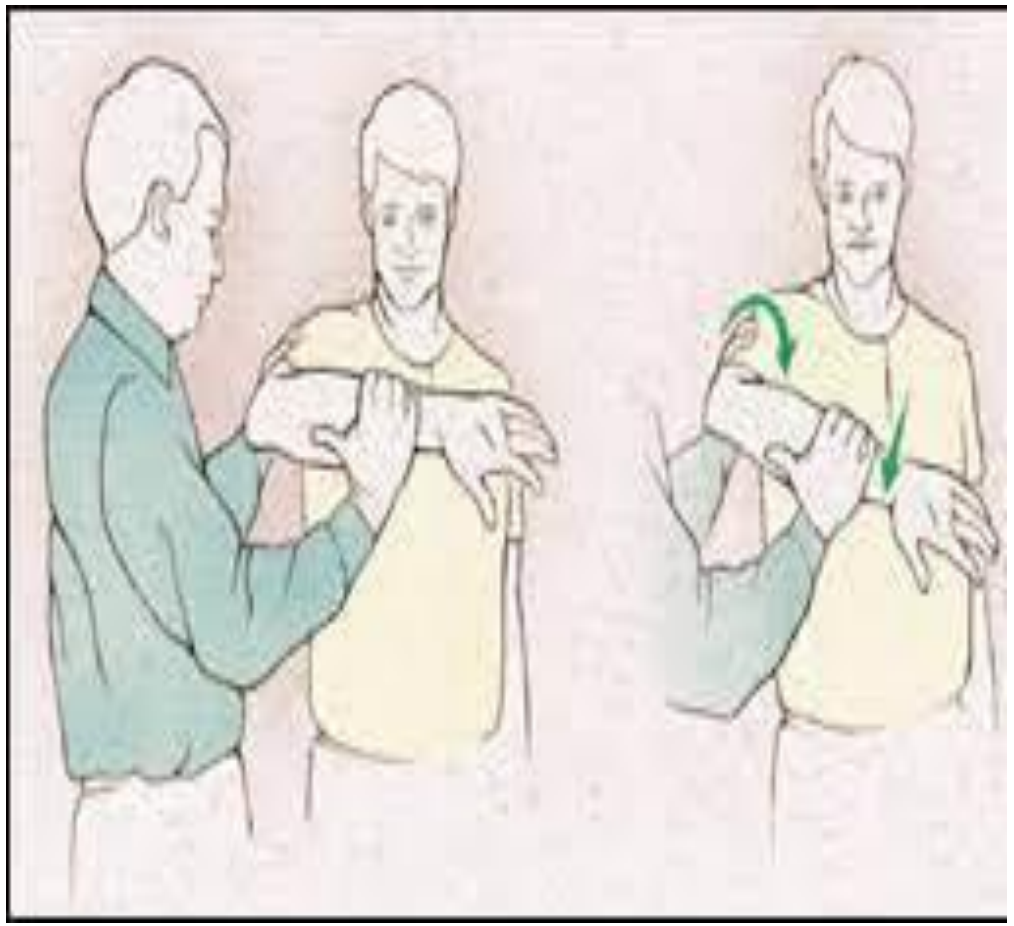
Shoulder Strength Testing

- 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

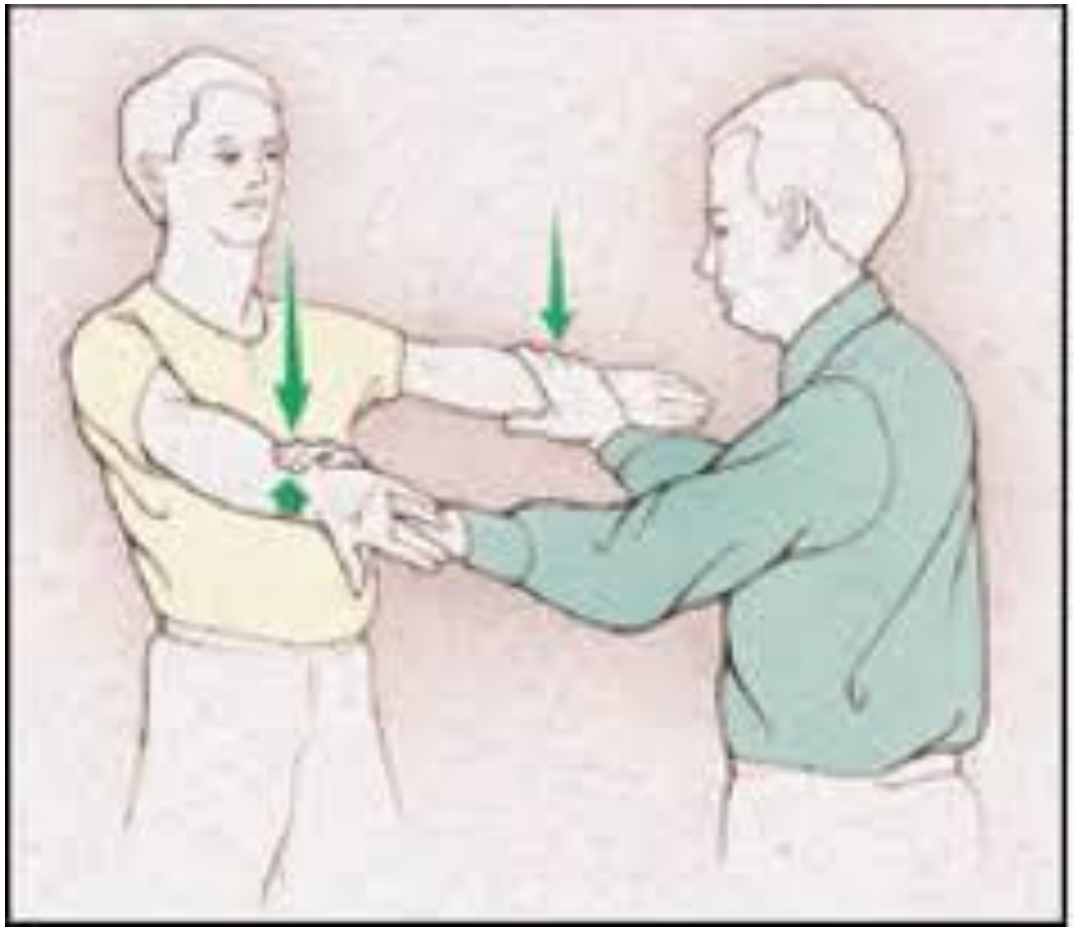
- Rotator Cuff Impingement/ Bursitis
  - Neer: Impingement
  - Hawkins/ Kennedy: Impingement
  - Drop Arm Test:
  - Hornblower's Test

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

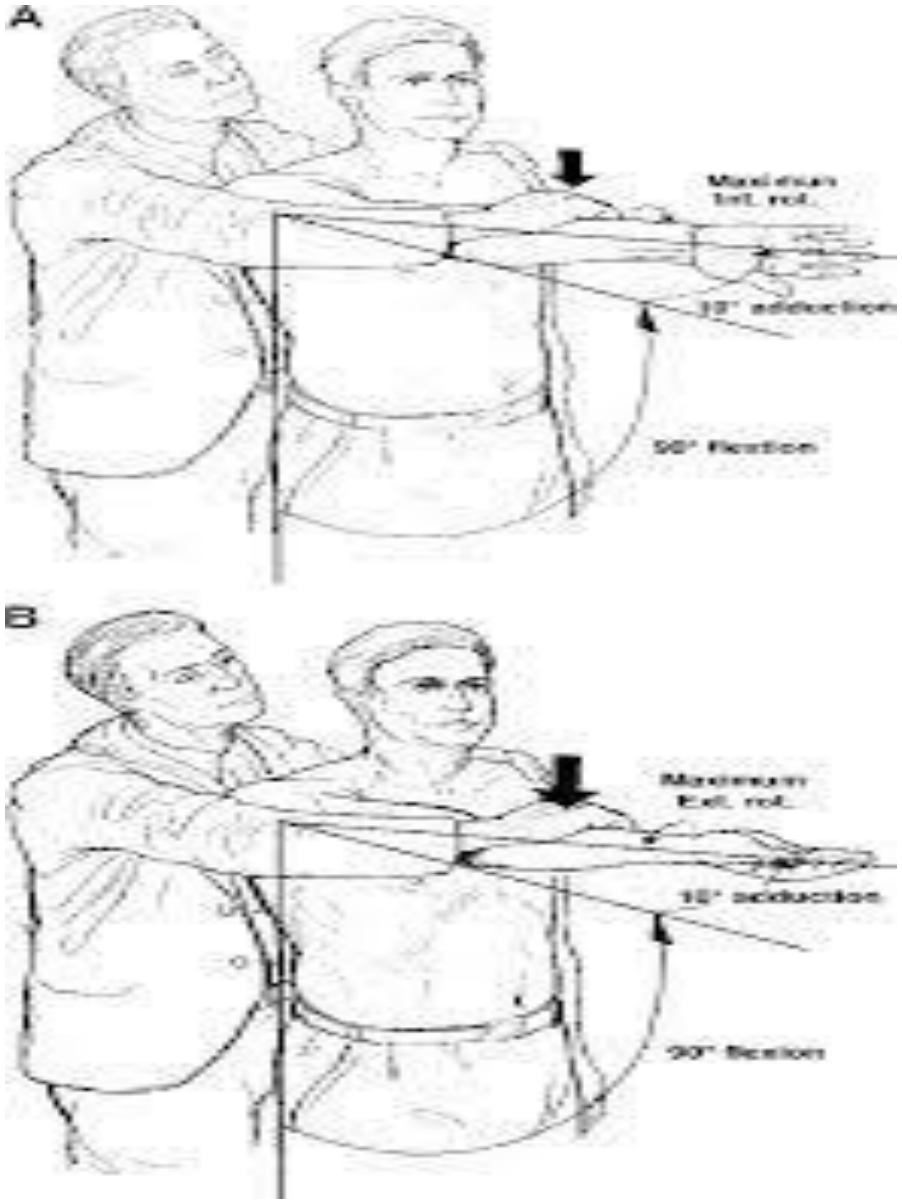
- AC Joint
  - Crossbody Adduction

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



Shoulder Special Test

- Biceps
  - Speed's Test
    - Examiner resists forward flexion of the shoulder with the patient's arm fully extended and forearm prontated
  - 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.

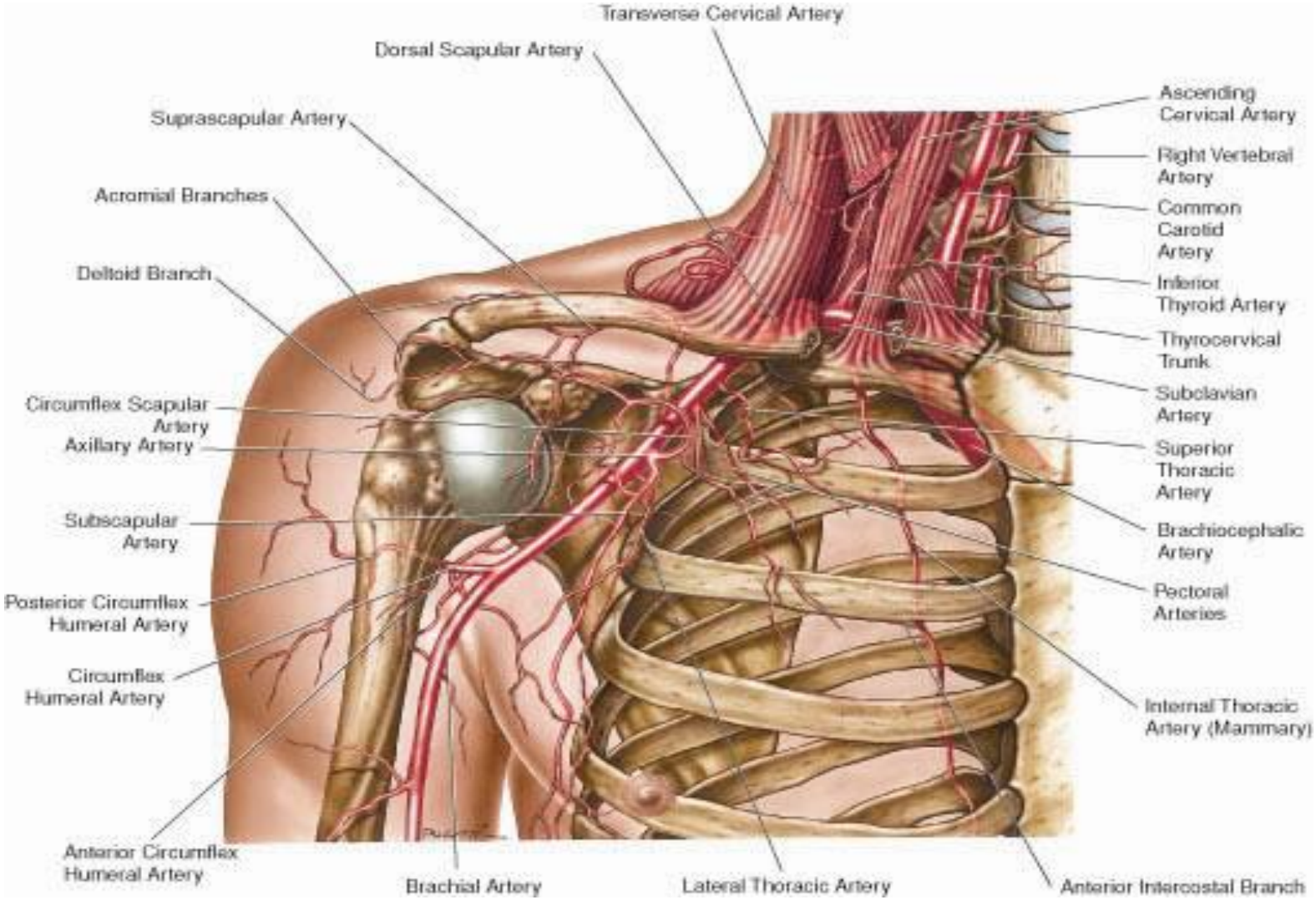
Shoulder Special Test

- 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

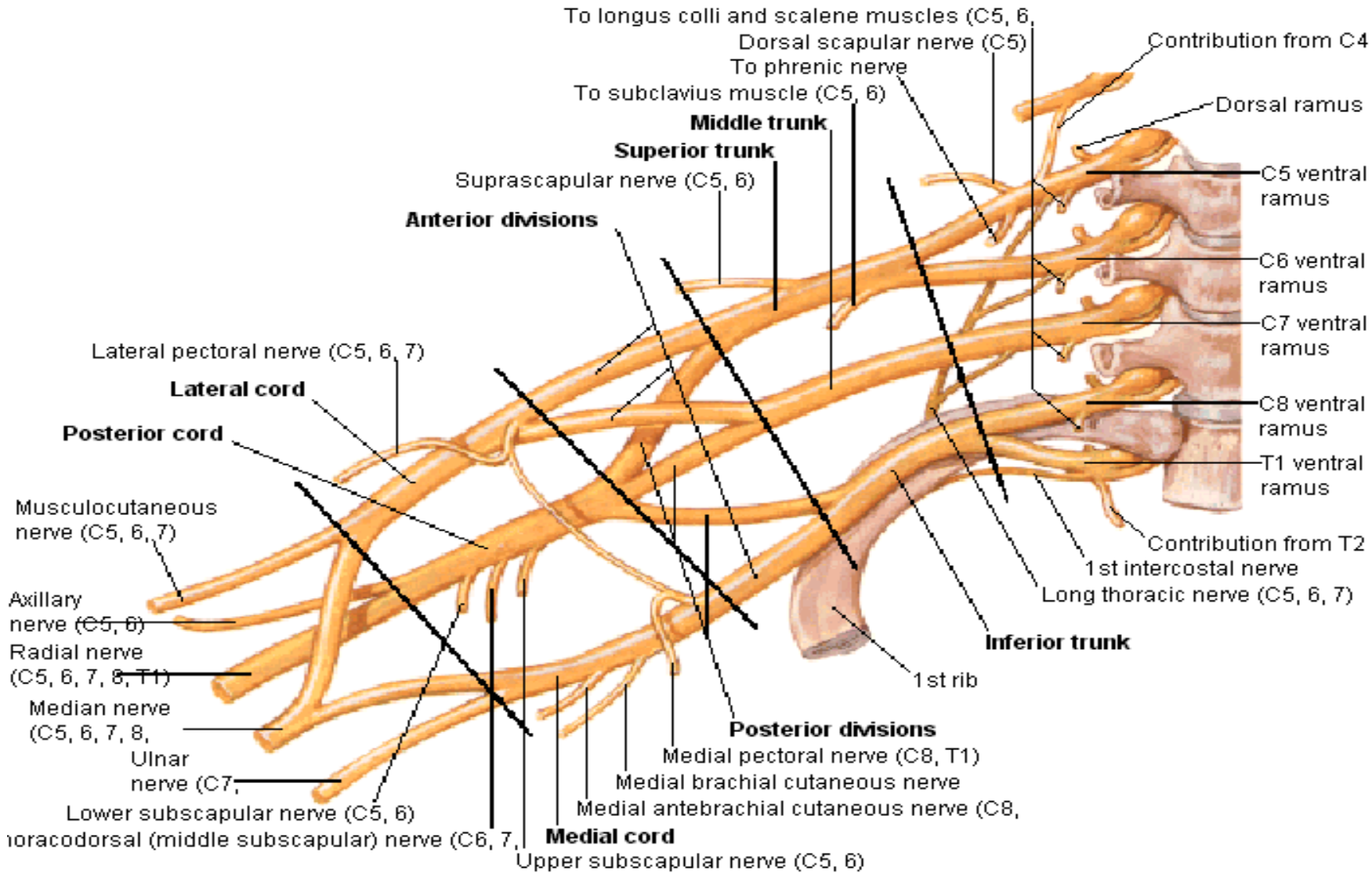


Shoulder Neuro Exam

- 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 Examination of the C-Spine

Jill Fattor MS, PA-C
University of Colorado
Anschutz Medical Campus
Department of Orthopedics
Spine Division
Jill.Fattor@cuanschutz.edu

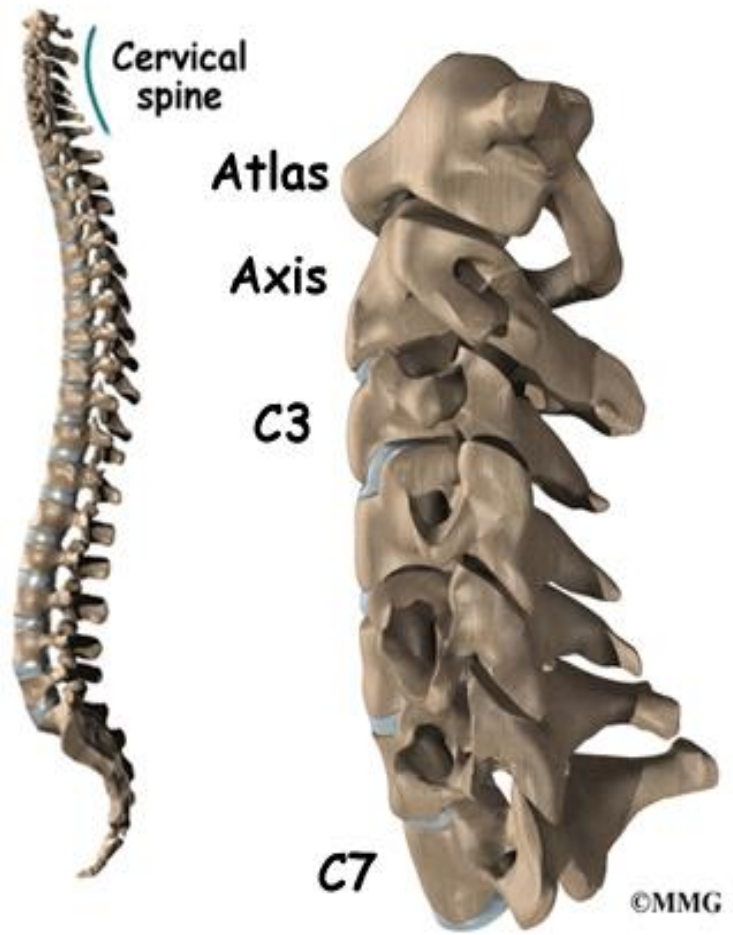
Physical Exam of the Cervical Spine

Goals

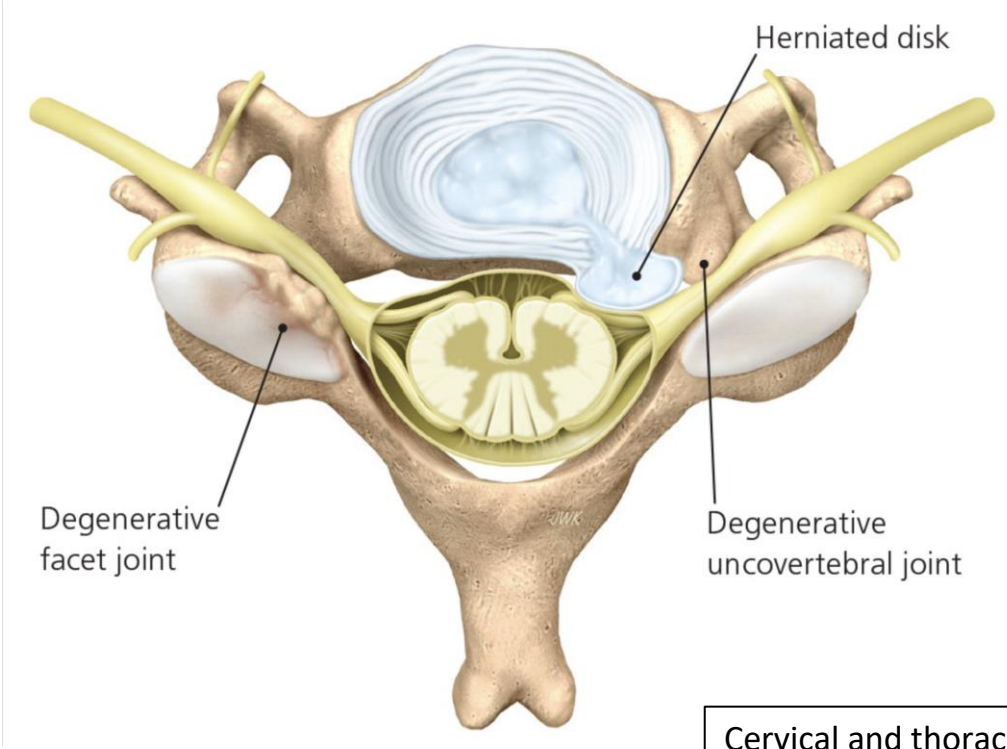
1. **Determine if pain/dysfunction has a cervical cause**
   a. **Musculoskeletal**
   b. **Nerve impingement**
   c. **Spinal Cord dysfunction**
2. **Determine next steps (imaging, referrals)**

General principles of Exam

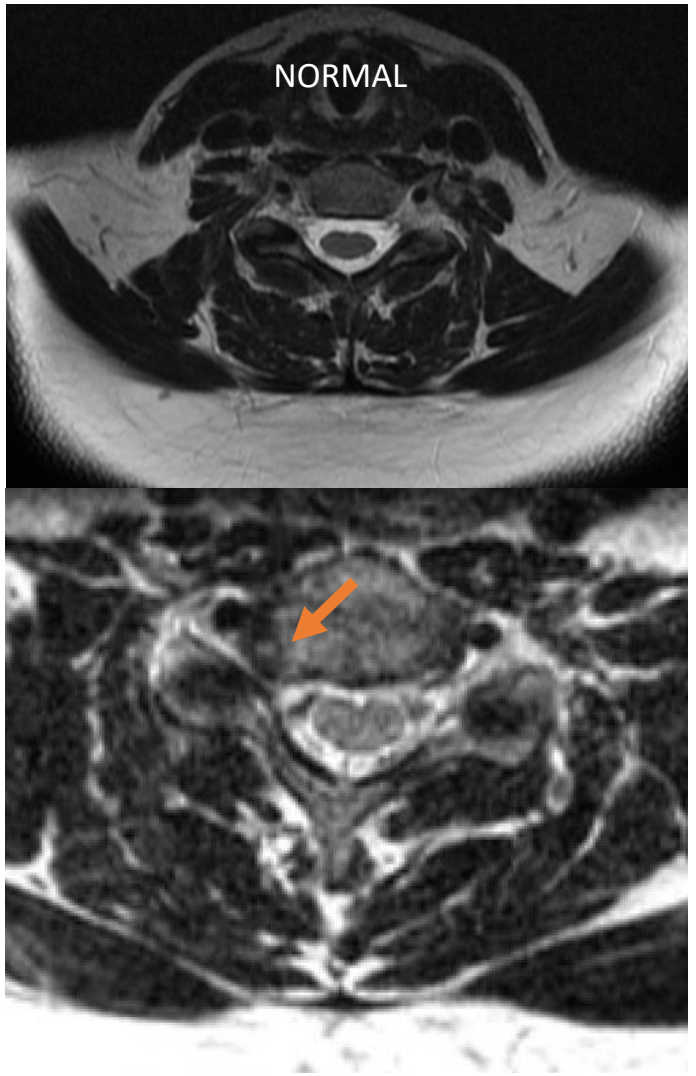
1. Inspection
2. Palpation
3. ROM (neck/shoulder)
4. Neuromuscular testing
   a) Sensory
   b) Motor
   c) DTR
5. Special Testing



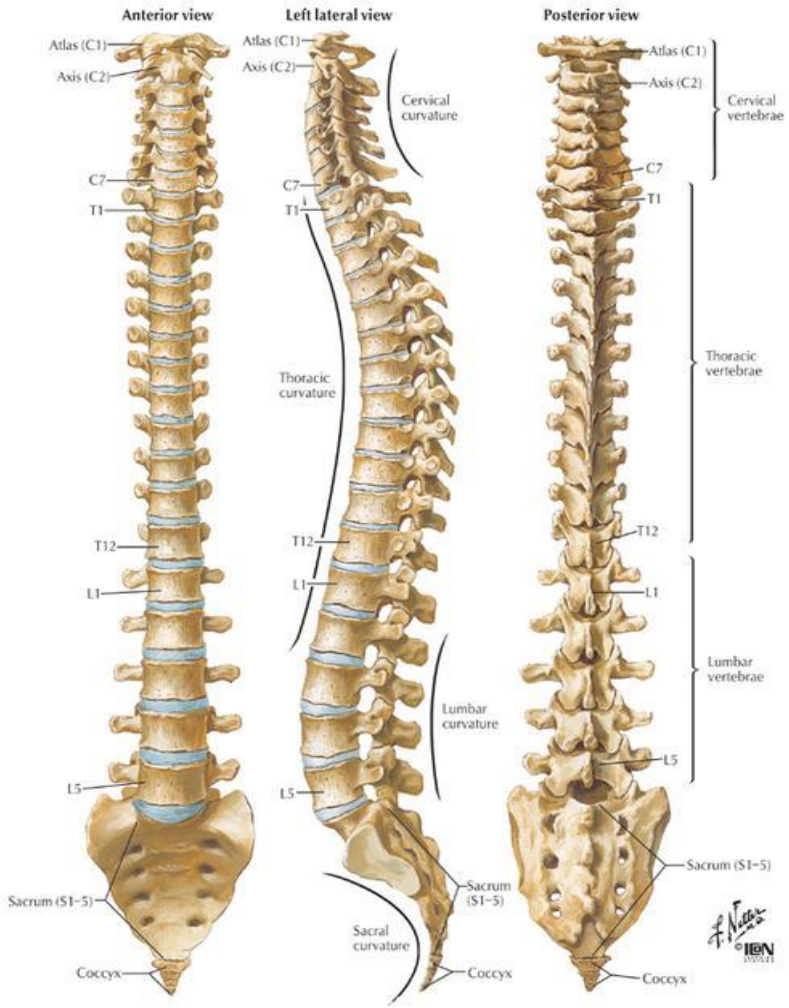
Anatomy - Cervical



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

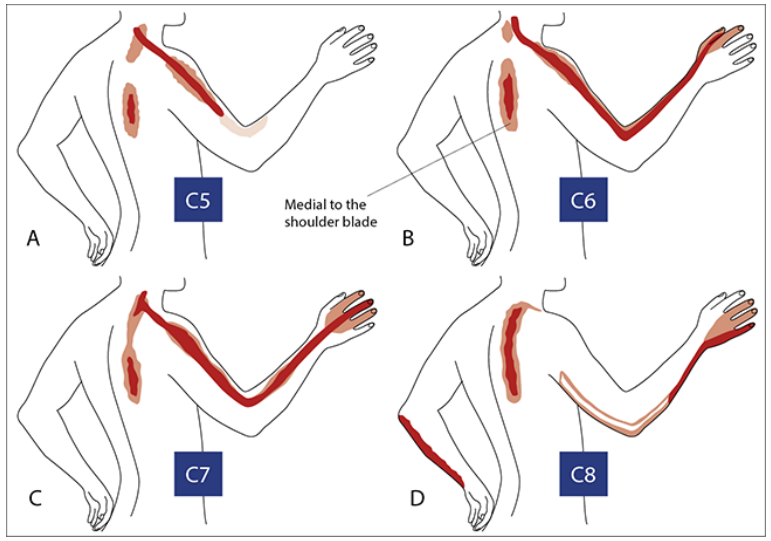
Clinical Presentation – History*

- +/- 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 – myotomal
  - 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
- pteryigium colli (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, 2022

Clinical Presentation – Cervical ROM

Average Active Range of Motion C0–C7 in Separate Decades of Age (N = 30 in Each Group) Measured by 3SPACE ISOTRAK System* and Measured With a CROM-Device†

Age	Movement Direction					
	Flexion	Extension	Side Flexion Left	Side Flexion Right	Rotation Left	Rotation Right
20–29						
Trott *et al*[14] (1996), N = 30	57.4	76.1	45.5	47.6	71.7	78.0
Hole *et al*[15] (1995), N = 24	63.7	81.3	47.1	44.3	74.5	72.4
30–39						
Trott *et al*[14] (1996), N = 30	46.8	64.8	40.3	44.8	71.1	77.5
Hole *et al*[15] (1995), N = 22	58.9	66.3	37.6	36.1	70.3	69.6
40–49						
Trott *et al*[14] (1996), N = 30	47.4	61.2	38.8	39.4	64.2	73.9
Hole *et al*[15] (1995), N = 17	55.6	64.6	36.3	34.3	60.3	65.4
50–59						
Trott *et al*[14] (1996), N = 30	45.1	60.0	32.4	35.4	63.4	70.4
Hole *et al*[15] (1995), N = 17	50.8	58.5	31.9	30.7	61.4	59.5

*Trott et al[14] (1996).
†Hole et al[15] (1995).

SPINE

Normal Values for Cervical Range of Motion

Swinkels, Raymond A. H. M.; Swinkels-Meewisse, Ilse E. J. C. M. Spine39(5):362-367, March 01, 2014. doi: 10.1097/BRS.0000000000000158

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

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

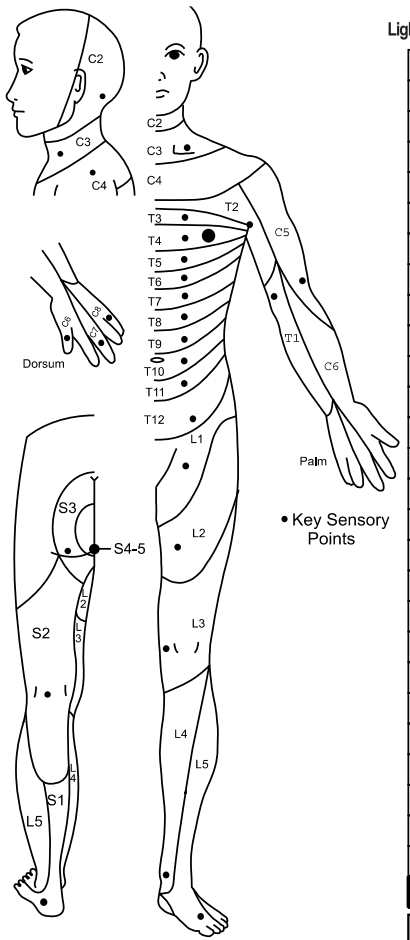
MOTOR KEY MUSCLES		Light Touch (LTR)	Pin Prick (PPR)
	C2		
	C3		
	C4		
Elbow flexors	C5		
Wrist extensors	C6		
Elbow extensors	C7		
Finger flexors	C8		
Finger abductors (little finger)	T1		
	T2		
	T3		
	T4		
	T5		
	T6		
	T7		
	T8		
	T9		
	T10		
	T11		
	T12		
	L1		
Hip flexors	L2		
Knee extensors	L3		
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) ☐



SENSORY KEY SENSORY POINTS		Light Touch (LTL)	Pin Prick (PPL)
	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		
LEFT TOTALS (MAXIMUM)		(56)	(56)	(50)

LEFT

UEL (Upper Extremity Left)

LEL (Lower Extremity Left)

(DAP) Deep Anal Pressure (Yes/No) ☐

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

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.

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

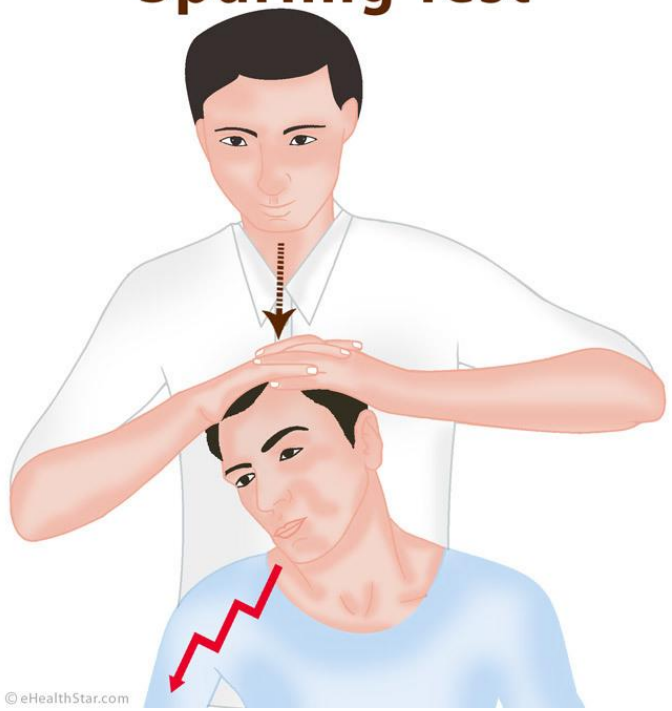
- NINDS Scale (National Institute of Neurological Disorders And Stroke)
  - 0: Absent
  - 1+: Low normal, diminished, trace response
  - 2+: Normal
  - 3+: Brisk, more reflexive than normal (more than one joint moves)
  - 4+: Very brisk, hyper reflexive, with clonus
  - 5+: Sustained clonus

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

Spurling Test



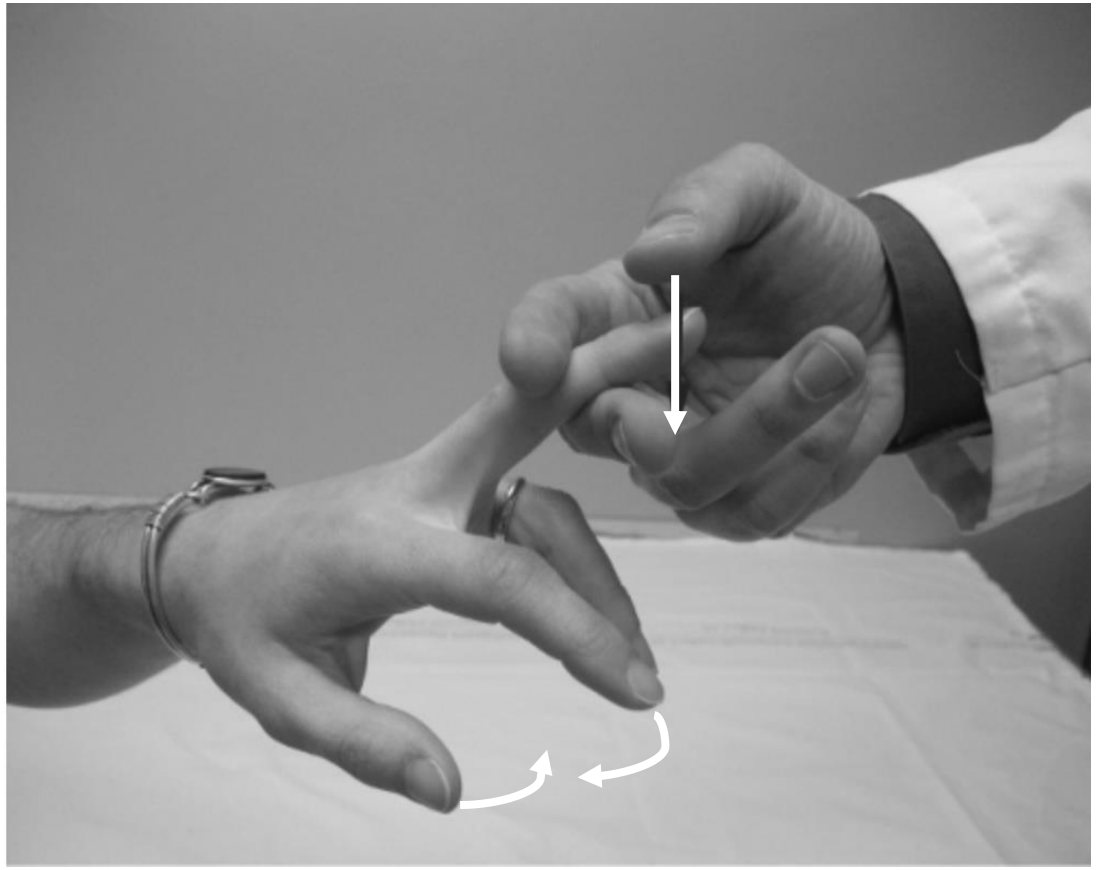
- Lateral flexion and extension of the neck with axial compression
- Positive when it recreates radicular symptoms (pain, numbness, tingling, paresthesia) in the appropriate dermatome
- 30% sensitive and 90%specific

Lhermitte's Sign

- 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



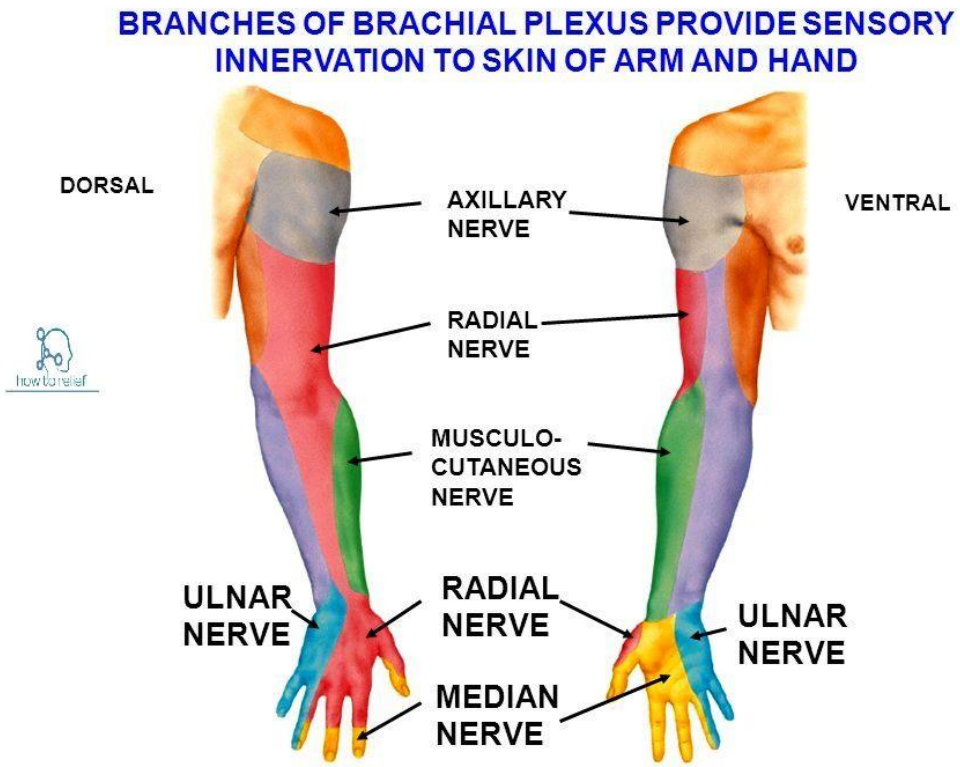
1. Hold middle finger MIP in extension
2. Flick DIP downward

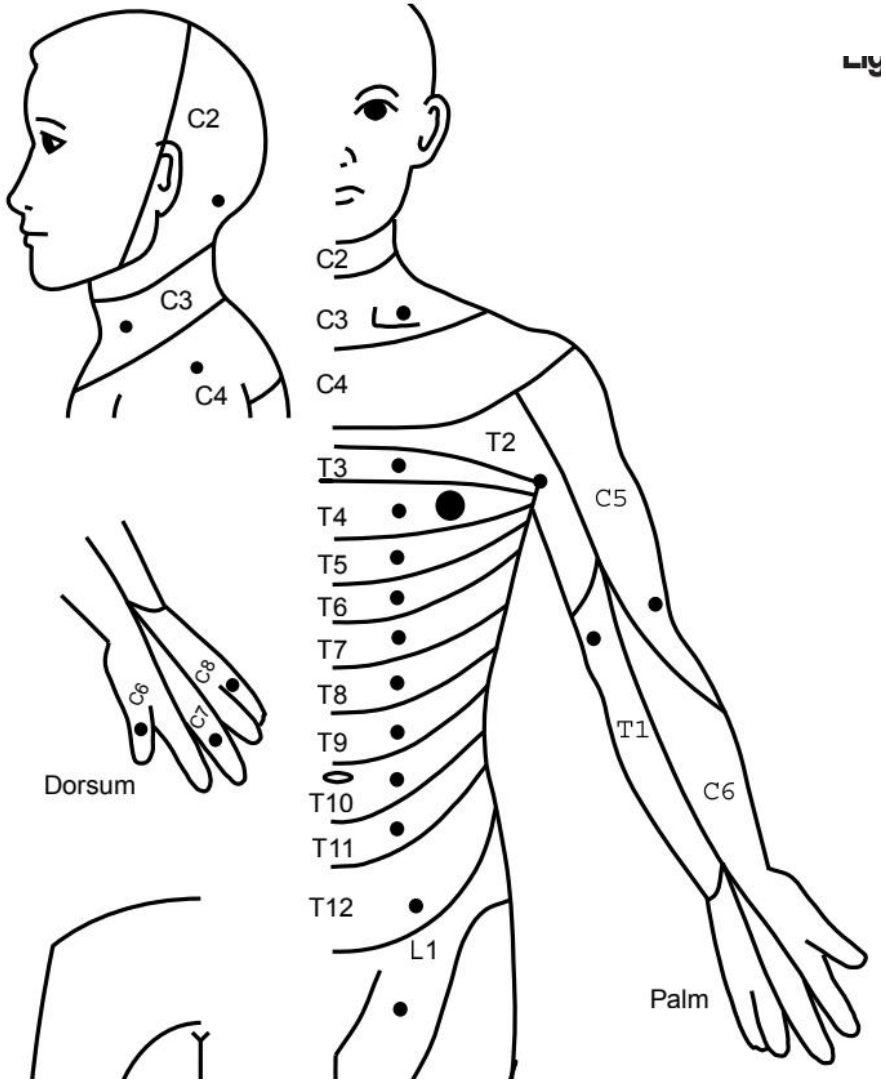
- Positive when index and thumb twitch in flexion
- 15% of people without myelopathy will test positive

https://musculoskeletalkey.com/neck-pain-and-shooting-arm-pain/ (accessed April 18, 2022)

Differential diagnosis

Peripheral Mononeuropathies vs Nerve Root Sensory Maps





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