Orthopaedic Physical Exam Techniques: Stop Pulling My Leg and Twisting My Arm!

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Disclosures

• No Financial Disclosures



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 - <u>PALPATION</u>



- 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 - <u>Range of motion (ROM)</u>

- 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 - <u>Range of motion (ROM)</u>

• 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 - <u>Range of motion (ROM)</u>

- 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, 50 degrees 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 - <u>REFLEX TESTING</u>

- 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





Hand Physical Exam - <u>Neurovascular examination</u>

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 - <u>Neurovascular examination</u>

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 - <u>Neurovascular examination</u>

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 - <u>Neurovascular examination</u>

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 laceration
- Radial/Ulnar Artery Injury, Thrombosis or Dominance
- Trigger Finger



Hand/ Wrist Special Tests: Carpal Tunnel Syndrome

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

Froment's Sign Test Normal Froment's positive









Special Tests: <u>Scapholunate Injury /Instability</u>

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: Dequervain's Tenosynovitis

Tests: 1. Finkelstein's Test



Figure 1. Tests utilized for clinical diagnosis of tenosynovitis of the first extensor compartment. At: 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.

• Description:

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



Special Test: <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.

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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



Synergy Test





Special Tests: Extensor Tendon Central Slip Rupture /Laceration

Tests:

1. <u>Elson's Test</u>: 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: Radial/ Ulnar Artery Injury, Thrombosis

Tests:

 <u>Allen Test</u>: 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: <u>Trigger Finger</u>

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
- Pain with resisted wrist 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 va C enine net
 - 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



Hawkins-Kennedy

Rotator Cuff Impingement/ Bursitis

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





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





Rotator Cuff Impingement/ Bursitis

• Bear Hug/ Belly Press/ Lift Off Test: Subscapularis





AC Joint

Crossbody Adduction





Instability

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





- 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.

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

• <u>History</u>

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





Cervical Spine - Anatomy



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



Cervical Spine 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

Cervical Spine 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



Cervical Spine 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
- o scapula
- \circ rib hump
- pterygium coli (webbed neck, Klippel-Feil Syndrome, Turner Syndrome)
- o congenital torticollis

Skin

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

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

Cervical Spine Presentation – Cervical ROM

Atlas (the first cervical vertebra)		Bifid Spinous Process	Transverse Foramen / Vert?	Flexion/ Extension	Rotation	Lateral Bend
Axis C2	Occiput-C1			50	4	8
(the second cervical vertebra) C3	C1 (Atlas)	None	Yes / Yes	10		
	C2 (Axis)	Yes	Yes / Yes	10	50	0
Spinous Process	C3	Yes	Yes / Yes			
C5	C4	Yes	Yes / Yes	<mark>50</mark> (10/level)	<mark>50</mark> (10/level)	<mark>60</mark> (12/level)
Transverse process	C5	Yes	Yes / Yes			
	C6	Yes	Yes / Yes			
Vertebral body C7	C7 (VP)	No (95%)	Yes / No			
TI	Total Motion			110	100	68

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



Cervical Spine Presentation – Palpation

Non spinal causes of neck pain

- Lymphadenopathy
- Thyroid gland
- Parotid glands
- Muscular tension/tenderness

- C1 Nose C2 - Teeth
- C3 Mandible/hyoid
- C4 Thyroid (above)
- C5 Thyroid (below)
- C6 Cricoid (above)
- C7 Cricoid (below)
- 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 Told MariaH To Try Cervical Counting



Cervical Spine 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



Physical Exam of the Cervical Spine Sensory Dermatomes

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





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

 ${\bf 5}$ = (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 *

Sensory Grading

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

2 = Normal NT = Not testable

0*, 1*, NT* = Non-SCI condition present °

"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 dassification 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, adduction, adduction, internal and external rotation Elbow: Supination	C5	
Elbow: Pronation Wrist: Flaxion	C6	
Finger: Flexion at proximal joint, extension Thumb: Flexion, extension and abduction in plane of thum	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.



INTERNATIONAL STANDARDS FOR NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY



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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 intract (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.

 Determine ASIA Impairment Scale (AIS) Grade. Is injury <u>Complete</u>? If YES, AIS=A

NO L

Is injury Motor Complete? If YES, AIS=B

 (No=voluntary anal contraction OR motor function more than three levels below the <u>motor</u> <u>lavel</u> 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?



If sensation and motor function is normal in all segments, AIS=E Note: AIS E is used in follow-up festing when an individual with a documented SCI has recovered normal function. If at initial leating 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 secral segments S4-5, and refers to those dematomes and myotomes causals to the sensory and motor levels that remain partially innervated. With secral 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



Cervical Spine 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

Cervical 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

Lhermitte's Sign



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

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

Cervical 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)



Cervical Spine - Differential diagnosis Peripheral Mononeuropathies vs Nerve Root Sensory Maps







Lumbar Spine & Lower Extremity Physical Exam



Lumbar Spine - History

<u>Location</u>

Localized, radiation, radicular symptoms, numbness, paresthesias

<u>Duration</u>

Trauma, inciting event, falls, injuries, MVA, etc.

<u>Quality</u>

Constant, intermittent, character

<u>Severity</u> Alleviating or aggravating factor

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<u>History</u> Prior episodes, history of back issues, CA, tumors, surgery, IV drug use, etc.





Lumbar Spine - Red Flags

- Pain that does no improve with laying down
- Accompanying fever or chills
- Known history of CA, especially prostate, breast and lung (These often metastasize to bone)
- Osteoporosis
- Neurological defects (saddle anesthesia) Loss of bowel or bladder function
- Focal weakness





Lumbar Spine - Inspection/ Observation

Standing Posture

- 1. Asymmetry
 - ASIS levels Spinal deformity
 - Hyperlordosis
 - Kyphosis
 - Scoliosis
- 2. Muscle tone/bulk
 - Atrophy
- 3. Abnormal skin folds Skin
- Changes: Ecchymosis
- 4. Lacerations
- 5. Gait analysis: Antalgic
- 6. Toe and heel walking

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Observe the patient rise from a sit to stand, then walk toward and away from examiner.



Lumbar Spine - Palpation

- Palpate for midline and paraspinal muscle tenderness
- Muscle spasms
- Step-deformity









Lumbar Spine - Range of Motion

Active

a.Forward flexion 40-60°
b.Extension: 20-35°
c.Lateral flexion/side bending (left and right): 15-20°
d.Rotation (left and right): 3-18°








Lumbar Spine - Motor Testing

Scale for muscle power

- 0 = no muscle contraction visible
- 1 = muscle contraction is possible with gravity eliminated
- 2 = active joint movement is possible with gravity eliminated
- 3 = movement can overcome gravity but not resistance
- 4 = can overcome gravity and move against some resistance
- 5 = full and normal power against resistance

Myotomes

- L2, L3 hip flexion
- L3, L4 knee extension
- L4, L5 ankle dorsiflexion
- L5, S1 great toe extension, ankle eversion
- S1, S2 ankle plantar flexion





Lumbar Spine - Sensation

- L1 groin
- L2 upper thigh
- L3 knee
- L4 medial leg
- L5 lateral leg, medial side of the dorsum of the foot
- S1 lateral aspect of foot, heel and sole
- S2 posterior thigh
- S3-S5 concentric rings around
- anus (outermost is S3)





Lumbar Spine - Deep Tendon Reflexes (DTRs)

Grading

0 = absent 1+ = hypoactive 2+ = normal 3+ = hyperactive without clonus 4+ = hyperactive with clonus

Locations

Patellar – L3, L4 Achilles – S1, S2 Plantar – Babinski



- 1. <u>Babinski</u> with a sharp object stroke lateral aspect of sole of each foot, come across the ball of the foot medially
 - a. Positive (Abnormal) = up-going
 - b. Negative (Normal) = down-going
- 2. <u>Clonus</u> if reflexes are hyperactive (3+); Support knee in partly flexed position and quickly dorsiflex foot and observe for rhythmic clonic movements
 - a. Positive (abnormal)- Upper Motor Neuron Pathology
 - b. A few beats of non-sustained transient clonus may be considered "normal"

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Lumbar Spine - Neural Tests

Straight Leg Raise (SLR) Supine or seated Knee extended, flex hip until pain Positive = radiating pain @ 30-70 degrees





Babinski

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Hip Evaluation & Screening

Assess for fixed flexion deformity

Hip IR/ ER in 90 degrees of hip flexion



FABER Test





Lower Extremity - Vascular Assessment

Peripheral pulses

- 1. Femoral
- 2. Popliteal
- 3. Dorsalis pedis
- 4. Posterior tibial

Observation

- Edema
- Discoloration venous stasis
- Hair changes
- Varicosities

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Hip & Pelvis



Hip & Pelvis: Inspection

<u>Anterior</u>: Pelvic height/symmetry

Lateral: L/S lordosis Pelvic tilt "Flat Back" L-spine spasm "Sway Back" Listhesis Weak core, anterior hip contracture

Posterior: Scoliosis





Hip & Pelvis: Gait

Trendelenburg Gait: Weak Gluteus Medius

"Pigeon Toed" vs "Duck Foot"





Hip & Pelvis: Bony Palpation



ASIS(Anterior Superior Iliac Spine) Iliac Crest Greater Trochanter PSIS(Posterior Superior Iliac Spine) SI Joint Ischial Tuberosity



Hip & Pelvis: Soft Tissue

Inguinal Ligament Sartorius Adductors Rectus Femoris Trochanteric Bursa Gluteus Medius Proximal Hamstrings





Hip & Pelvis: ROM

Hip Flexion: 120-135
Hip Extension: 30
Hip Abduction: 20-40
Hip Adduction: 30
Hip Internal Rotation: 30
Hip External Rotation: 45





Hip & Pelvis: Neuro Exam



Sensory: T 12 – L 2

Motor: Gluteal Nerves Femoral Nerve Obturator Nerve



Hip & Pelvis: Think Zones

Anterior:

Intra-Articular Arthritis/ AVN Labral Tear Femoral Acetabular Impingement Femoral Neck stress fracture

Extra-Articular

Snapping Hip Rectus Femoris Injury

Groin Strain/ Osteitis Pubis/ Sports Hernia

Signs and Symptoms:

- Groin Pain
- Loss of Motion Injury
- Decrease Strength
- Palpable Snapping Tenderness Ecchymosis
- Edema
- Radiating to Medial Thigh/Knee



Hip & Pelvis: Think Zones

Lateral:

Trochanteric bursitis/ IT Band Syndrome Gluteus Medius Tear Signs and Symptoms:

- Tender to Palpation (TTP)
 Trendelenburg Gait
- Weakness with Resisted Abduction Pain/Positive Ober's Test



Hip & Pelvis: Think Zones

Posterior:

SI Dysfunction Lumbar Etiology (Facets vs Disk herniation) Sciatica Proximal Hamstring Injury

Signs and Symptoms:

- TTP
- Limited ROM
- Radiculopathy
- Injury
- Ecchymosis
- Edema



Hip & Pelvis: Special Test

Supine Hip Extension



FABER Test





Hip & Pelvis: Special Test

FADIR Test: Forced Adduction/Internal Rotation





Knee Exam



Knee - Palpable Landmarks



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- Quadriceps Tendon
- Patella
- Patellar Tendon
- Tibial Tubercle
- Joint Lines
- Iliotibial Band
- Biceps Femoris
- Semimembranosus
- Pes Anserine

Knee - Physical Examination

- History! History! History!
- Inspection:
 - Deformity Soft tissue and Bone
 - Ecchymosis
 - -Swelling/Effusion
 - -Edema
- Palpation:
 - Go through palpable Landmarks
- Range of Motion
- Ability to perform a Straight Leg Raise

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Knee - Physical Examination

Neurovascular

- Motor
 - Knee Extension: Femoral Nerve (L2-4)
 - Knee Flexion: Tibial (L4-S3) and Peroneal (L4-S3)
 - Foot Plantarflexion: Tibial Nerve (S1)
 - Foot Dorsiflexion: Deep Peroneal Nerve (L4)
 - Hallux Dorsiflexion: Superficial Peroneal Nerve (L5)



Knee - Physical Examination

Special Tests

- Patellar Apprehension
- -JSign
- Lachman, Anterior Drawer, Pivot Shift test
- Posterior Drawer, Reverse Pivot, Posterior Sag
- Valgus and Varus Stress



Knee – Patella Instability

Patella Apprehension Test

 Positive with apprehension (defensive muscle contraction) on lateral patellar displacement

J Sign

 Performed with active flexion and extension of knee









Knee – ACL

Lachman Test

- Knee flexed to 15-30 degrees; stabilize femur and apply anterior directed force to the tibia
- More reliable than Anterior Drawer to assess ACL
- Assess for anterior tibial translation (laxity) and endpoint (firm vs soft)
- Ensure hamstrings are relaxed to minimize guarding





Knee - ACL

Anterior Drawer

- Knee is flexed to 90 degrees and foot is fixed on table
- Both hands on proximal tibia with thumbs at joint line and apply anterior directed force to tibia
- Assess amount of translation compared to contralateral knee





Knee - PCL

Posterior Drawer

- Knee is flexed to 90 degrees and foot is fixed on table
- Posterior directed force through the proximal tibia
- Assess posterior translation compared to other knee
- Posterior Sag Sign
- Quad activation test





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Knee - MCL

Valgus Stress Test

- Tests integrity of the Medial Collateral Ligament
- Apply a medial-directed force to the lateral aspect of the knee
- Test in full extension and 30 degrees of knee flexion





Knee - LCL

Varus Stress Test

- Tests integrity of the Lateral Collateral Ligament
- Apply a lateral-directed force to the medial aspect of the knee
- Test in full extension and 30 degrees of knee flexion





Knee - Meniscus

McMurray's Test

- Attempting to pinch the meniscus between the femoral condyle and tibia
- Place one hand over the joint line and the other hand on patient's heel
- Start with knee flexed and slowly extend knee with valgus directed force and external rotation of the tibia to stress medial meniscus
- Start with knee flexed and slowly extend knee with a varus directed force and internal rotation of the tibia to stress lateral meniscus
- POSITIVE: reproducible clunk



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Knee - Meniscus

Apley's Grind Test

- Patient in a prone position with knee flexed to 90 degrees; Examiner compresses the flexed knee joint while applying internal/ external rotation forces through knee joint
- Pain may be alleviated with Apley's Distraction

Thessaly Test

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- Single leg dynamic loading with knee flexed to 20 degrees; patient actively rotates medially and laterally
- Positive with locking/ catching over joint





Knee - Common Pathology

AQLtear

- MCLtear
- Meniscus Tear
- Patellar Dislocation
- Patellar and Quadriceps Tendon Rupture
- Osgood Schlatter
- Patella Fracture
- Tibial Plateau Fracture



Foot & Ankle



Foot & Ankle: Inspection

Pes Planus - flat feet Pes Cavus – high arch Bunions Edema Deformity





Foot & Ankle: Gait



Pronation Supination Drop Foot



Foot & Ankle: Bony Palpation

Lateral Malleolus Medial Malleolus Calcaneus Base of 5th Metatarsal Metatarsal Shafts Navicular Sesamoids




Foot & Ankle: Soft Tissue



Achilles Lateral Ligaments Medial Ligaments Syndesmosis Anterior/Posterior Tibial Tendons Extensors Tendons Flexors Tendons



Foot & Ankle: ROM

Dorsi Flexion: 25 Plantar Flexion: 50 Inversion: 5-10 Eversion: 5 Forefoot Adduction: 20 Forefoot Abduction: 10





Foot & Ankle: Neuro



Nerve Roots: L4 – S1

Motor: Dorsiflex: L4-5 Plantarflex: L5-S1 Sensory: Medial: L4 Dorsum: L5 Lateral/Posterior: S1 Reflexes: Achilles'Reflex: S1



Foot & Ankle: Vascular



Dorsal Pedal Artery

Posterior Tibial Artery



Foot & Ankle: Special Tests

Anterior Drawer



Dorsi-Flexion/ Eversion Test





Foot & Ankle: Special Tests

Thompson's Test



Homan's sign





Foot & Ankle: Most Common /Don't Miss

Most Common:

- Lateral Ankle Sprain
 - -Tender laterally
 - Soft tissue edema
 - Anterior drawer
 - Pain/laxity
 - Inversion Injury

Get x-rays

Don't Miss:

- Syndesmosis Injury
 - Tender Medially and Syndesmosis
 - Soft tissue edema
- + Dorsi-flexion/Eversion Test -Tenderness at Proximal fibula

Get weight bearing x-rays if possible



Foot & Ankle: Most Common /Don't Miss

Don't Miss:

- Lisfranc Injury
- Pain in mid foot dorsal/medial -Pain with weight bearing
- Pain with resisted dorsi/plantar flexion
 - Soft tissue edema
- Forceful dorsi/plantar flexion injury
 - Drop something on foot

Most Common:

- Achille's Rupture
 - Pain at Achilles'
 - Palpable defect
 - Felt a pop
 - Weakness/Absent plantar
 - flexion Jumping
 - Forced dorsi-flexion



References

- Hoppenfeld SA, Physical Examination of the Spine and Extremities, 1976
- Musculoskeletal Key, Physical Examination of the Cervical Spinehttps://musculoskeletalkey.com/physical-examination-ofthe-cervical-spine/
- TeachMe Orthopadics, Cervical Spine Anatomy and Examination , July 7, 2022 https://teachmeorthopedics.info/cervical-spineanatomy-and-examination/
- Sabri AS, Physical Examination of the Spine, Core Curriculum V5, Orthopaedic Trauma Association, https://ota.org/sites/files/202106/Spine%201%20Physical%20Ex am%20of%20the%20Spine.pdf







