Neck and Shoulder Pain Evaluation and Management

Diane W. Braza, MD
Chair and Professor, PM&R
Medical College of Wisconsin
OBJECTIVES

- Outline a comprehensive differential diagnoses for neck and shoulder pain
- Discuss physical exam signs which guide diagnostic testing and development of a treatment plan
- Review new treatment approaches for management of neck and shoulder pain
PATIENT SCENARIO

- 64 yr old female presents with acute right sided neck pain extending into the right shoulder for 4 weeks. Symptoms occurred after she lifted her mother’s walker overhead into the trunk of her SUV
  - Pain is severe, rated as 9/10
  - Pain is burning, stabbing, and aching
  - Neck pain extends into the right anterolateral shoulder, aggravated by all arm movements
  - Numbness and tingling occur frequently in the right 4 & 5th fingers
  - Hand weakness reported especially when trying to turn keys to start car or open a door
- PMH notable for OA, anxiety & fibromyalgia
PATIENT SCENARIO

• She is a full time caregiver for her aging parents
• ROS: she endorses significant stress related to financial concerns and parents declining health
• PE
  - Normal cervical lordosis
  - Diffuse palpation tenderness over cervical spinous processes, cervical paraspinal muscles, right upper trapezius, & right AC joint
  - Apparent muscle spasm over right levator scapula and upper trapezius
  - Reflexes: Bilateral biceps, triceps and brachioradialis ¼, patella ¾, achilles ¼
  - Sensation intact C5-T1 dermatomes
  - Hoffman’s positive bilaterally
PATIENT SCENARIO

- Physical Exam
  - Painful and restricted cervical AROM in all planes
    - Right rotation ~40 degrees, left rotation ~50 degrees
  - AROM and PROM of right shoulder reduced, limited by pain
    - ~90 degrees of abduction and flexion
    - 50% range in ER/IR
    - Strength 4/5 shoulder abduction/flexion/IR & ER, 5/5 elbow flexion & extension, 5/5 wrist flexion and extension, 5/5 finger abduction and DIP flexion
  - No muscle atrophy
  - Positive right Spurling’s
DIFFERENTIAL DIAGNOSES

- Cervical strain
- Cervical HNP/ exacerbation of DDD
- Exacerbation of underlying facet arthropathy
- Cervical radiculopathy
- Brachial plexopathy/ brachial neuritis
- Cervical myeloradiculopathy
- Cervical Dystonia
- Exacerbation of fibromyalgia
- Rotator cuff tear
- Impingement syndrome
- Shoulder instability
- Labral Tear
- Axillary neuropathy
# PHYSICAL EXAM

## TABLE 5.1  Key Reflexes, Muscle Group, and Sensory Point Testing in Cervical Radiculopathy

<table>
<thead>
<tr>
<th>Root</th>
<th>Reflex</th>
<th>Key Muscle group (Neck and Arm)</th>
<th>Key Sensation point</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2</td>
<td>Normal reflexes</td>
<td>Neck flexion</td>
<td>1 cm lateral to occipital protuberance</td>
</tr>
<tr>
<td>C3</td>
<td>Normal reflexes</td>
<td>Neck extension and lateral flexion</td>
<td>Supraclavicular fossa, midclavicle line</td>
</tr>
<tr>
<td>C4</td>
<td>Normal reflexes</td>
<td>Shoulder elevation</td>
<td>Skin over acromioclavicular joint</td>
</tr>
<tr>
<td>C5</td>
<td>Diminished biceps deep tendon reflex</td>
<td>Elbow flexor</td>
<td>Radial side of the antecubital fossa</td>
</tr>
<tr>
<td>C6</td>
<td>Diminished brachioradialis deep tendon reflex</td>
<td>Wrist extension</td>
<td>Dorsal surface, proximal phalanx of the thumb</td>
</tr>
<tr>
<td>C7</td>
<td>Diminished triceps deep tendon reflex</td>
<td>Elbow extension</td>
<td>Dorsal surface, proximal phalanx of the 3rd digit</td>
</tr>
<tr>
<td>C8</td>
<td>Normal reflexes</td>
<td>Long finger flexors</td>
<td>Dorsal surface, proximal phalanx of the 5th digit</td>
</tr>
</tbody>
</table>

Muscles commonly Involved in Cervical Strain

- Semispinalis cervicis
- Spinalis capitis
- Longissimus cervicis
- Splenius cervicis
- Semispinalis capitis
- Trapezius
- Rhomboids
- Scalenes
# KEY FINDINGS ON HISTORY AND PE

## TABLE 1

<table>
<thead>
<tr>
<th>FINDING</th>
<th>PROBABLE DIAGNOSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scapular winging, trauma, recent viral illness</td>
<td>Serratus anterior or trapezius dysfunction</td>
</tr>
<tr>
<td>Seizure and inability to passively or actively rotate</td>
<td>Posterior shoulder dislocation</td>
</tr>
<tr>
<td>affected arm externally</td>
<td></td>
</tr>
<tr>
<td>Supraspinatus/Infraspinatus wasting</td>
<td>Rotator cuff tear, suprascapular nerve entrapment</td>
</tr>
<tr>
<td>Pain radiating below elbow; decreased cervical range of motion</td>
<td>Cervical disc disease</td>
</tr>
<tr>
<td>Shoulder pain in throwing athletes, anterior</td>
<td>Glenohumeral joint instability</td>
</tr>
<tr>
<td>glenohumeral joint pain and impingement</td>
<td></td>
</tr>
<tr>
<td>Pain or &quot;clunking&quot; sound with overhead motion</td>
<td>Labral disorder</td>
</tr>
</tbody>
</table>

**FIGURE 4.**

Infraspinatus/teres minor examination. The patient attempts to externally rotate the arms against resistance while the arms are at the sides and the elbows are flexed to 90 degrees.

SHOULDER EVALUATION


TABLE 2

<table>
<thead>
<tr>
<th>TEST</th>
<th>MANEUVER</th>
<th>DIAGNOSIS SUGGESTED BY POSITIVE RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apelly scratch test</td>
<td>Patient touches superior and inferior aspects of opposite scapula</td>
<td>Loss of range of motion rotator cuff problem</td>
</tr>
<tr>
<td>Neer's sign</td>
<td>Arm in full flexion</td>
<td>Subacromial impingement</td>
</tr>
<tr>
<td>Hawkins' test</td>
<td>Forward flexion of the shoulder to 90 degrees and internal rotation</td>
<td>Supraspinatus tendon impingement</td>
</tr>
<tr>
<td>Drop-arm test</td>
<td>Arm lowered slowly to waist</td>
<td>Rotator cuff tear</td>
</tr>
<tr>
<td>Cross-arm test</td>
<td>Forward elevation to 90 degrees and active adduction</td>
<td>Acromioclavicular joint arthritis</td>
</tr>
<tr>
<td>Spurling's test</td>
<td>Spine extended with head rotated to affected shoulder while axially loaded</td>
<td>Cervical nerve root disorder</td>
</tr>
<tr>
<td>Apprehension test</td>
<td>Anterior pressure on the humerus with external rotation</td>
<td>Anterior glenohumeral instability</td>
</tr>
<tr>
<td>Relocation test</td>
<td>Postererior force on humerus while externally rotating the arm</td>
<td>Anterior glenohumeral instability</td>
</tr>
<tr>
<td>Sulcus sign</td>
<td>Pulling downarm on elbow or wrist</td>
<td>Inferior glenohumeral instability</td>
</tr>
<tr>
<td>Yergason test</td>
<td>Elbow flexed to 90 degrees with forearm pronated</td>
<td>Biceps tendon instability or tendinosis</td>
</tr>
<tr>
<td>Speed's maneuver</td>
<td>Elbow flexed 20 to 30 degrees and lowerarm supinated</td>
<td>Biceps tendon instability or tendinosis</td>
</tr>
<tr>
<td>&quot;Clark&quot; sign</td>
<td>Rotation of loaded shoulder from extension to forward flexion</td>
<td>Labral disorder</td>
</tr>
</tbody>
</table>

FIGURE 5.

Neer's test for impingement of the rotator cuff tendons under the coracocromial arch. The arm is fully pronated and placed in forced flexion.

FIGURE 6.

Hawkins' test for subacromial impingement or rotator cuff tendinitis. The arm is forward elevated to 90 degrees, then forcibly internally rotated.
BIOPSYCHOSOCIAL PHENOMENON

- Significant psychosocial factors (anxiety, depression, work/ performance stressors) play a role in the management of LBP/ Neck pain and disability prevention.
CERVICAL STRAIN

- Cervical sprain or strain typically refers to acute pain arising from injured soft tissues of the neck, including muscles, tendons, and ligaments.
- Symptoms include nonradiating neck pain, neck stiffness, fatigue, and worsening of symptoms with cervical range of motion. The pain often extends into the trapezius region or interscapular region. Headache, probably the most common associated symptom, originates in the occiput region and radiates frontally.
- Paresthesias, radiating arm pain, dysphagia, visual symptoms, auditory symptoms, and dizziness may be reported.
- PE: decreased or painful cervical range of motion
  - Tenderness of the cervical paraspinal, trapezius, occiput, or anterior cervical (i.e., sternocleidomastoid) muscles
  - Normal neurologic exam
CERVICAL DEGENERATIVE DISEASE

• Genetics, aging, and attrition and trauma may all play an important role.
• Disc degeneration results in altered, abnormal load distribution, which in turn leads to a cascade of structural changes that affect the various components of the spinal column.
• These structural changes may change spinal posture and stability and may compromise neural function.
• Two large groups of patients can be recognized:
  - patients whose main complaint is limited to axial pain
    o complain of stiffness and pain in the cervical spine.
  - patients with radicular pain
CERVICAL HNP WITH RADICULOPATHY

- Cervical radiculopathy is defined as dysfunction of a cervical nerve root resulting in painful neck, arm, and associated sensory, motor, and reflex abnormality.
- Involvement of the ventral root of the spinal nerve would result in motor weakness, and involvement of dorsal root of the spinal nerve would result in sensory deficits.

| C2 | Sternocleidomastoid, rectus capitis, longus colli |
| C3 | Trapezius, splenius capitis |
| C4 | Trapezius, levator scapulae |
| C5 | Deltoid, biceps, supraspinatus, infraspinatus |
| C6 | Wrist extensors, biceps, brachioradialis, supinator |
| C7 | Wrist flexors, triceps |
| C8 | Thumb extensor and adductors. Wrist ulnar deviators, flexor digitorum superficialis |
CERVICAL FACET ARTHROPATHY

• Symptoms
  - Unilateral NP without radiation into UEs
  - Pain often worsens with neck extension and rotation
  - Pain referral patterns

• Physical Exam
  - Palpation tenderness best performed in supine
    - C2 spinous process is first protuberance below occiput
    - C7 spinous process is largest and most palpable
  - Palpate ~ 1.3 – 2.5 cm lateral to spinous process
  - Normal neurologic exam
  - Normal UE PROM/ AROM

Differential Diagnoses:
- Degenerative disc disease
- Myofascial pain syndrome
- Internal disc disruption
- Disc herniation
- Cervical stenosis
- Cervical radiculopathy or myelopathy
- Spondylolysis
- Tumor
- Infection
- Osteoid osteoma
SYMPTOMATIC CERVICAL FACET ARTHROPATHY

• Paired synovial joints
• Coronal oblique orientation allows greater flexion, extension and lateral bending
• Etiology
  - Degenerative
  - Post-traumatic (acceleration/ deceleration)
  - Adjacent segment degenerative changes (above/ below level of fusion)
• Primary pain generator in ~25% patients with chronic neck pain
• Often associated with HA
• C2-3 and C5-6 cited as most commonly affected
CERVICAL SPONDYLOTIC MYELOPATHY

- Frequently encountered in middle-aged and elderly patients
  - Both males and females impacted
- Progress degenerative changes of the spine involves discs, facet joints, joints of Luschka, ligamentum flavum and lamina resulting in gradual encroachment of the spinal canal with spinal cord compromise
- C4-C7 are most common
- Normal AP dimension 17-18 mm
- Spinal stenosis AP dimension ~10 mm
CSM

- Encroaching structures may also compress anterior spinal artery, resulting in spinal cord ischemia beyond compression site
- Demyelination, myelomalacia, cord atrophy
- Dynamic instability can result in anterolisthesis or retrolisthesis
CSM SYMPTOMS

- Present with combination of UMN symptoms in the lower extremities and LMN symptoms in the upper extremities
  - Gait dysfunction results from a combination of factors
    - Ataxia due to impaired joint proprioception
    - Hypertonicity
    - Weakness
    - Muscle control deficiencies
  - Impaired vibration and joint position sense is attributed to compression of the posterior columns.
  - Symptoms related to the upper extremities are mostly the result of fine motor coordination deficits
  - Bilateral hand numbness
CSM CLINICAL PEARLS ON PHYSICAL EXAM

- Wide based gait
- LE hyperreflexia, clonus
- Weakness and atrophy of intrinsic hand muscles
- Reduced fine motor control
- +Lhermitte’s sign
- Proximal muscle weakness
- +Hoffman’s response
- Altered single limb stance & tandem gait

Differential Diagnosis

- Amyotrophic lateral sclerosis
- Multifocal motor neuropathy
- Multiple sclerosis
- Syringomyelia
- Peripheral neuropathy
DIAGNOSTIC TESTING

- Plain X-rays
- CT
- MRI
- NM Bone SPECT scan
- Gold Standard for evaluation of symptomatic facet arthropathy is fluoroscopically guided medial branch blocks
  - Medial branches of dorsal rami supply nociceptive fibers to the facet joints
  - High false positives with single block
- MSK Ultrasound
- EMG / NCS testing
NECK PAIN GUIDELINES

EXAMINATION – OUTCOME MEASURES

Clinicians should use validated self-report questionnaires for patients with neck pain, to identify a patient's baseline status and to monitor changes relative to pain, function, disability, and psycho-social functioning.

EXAMINATION – ACTIVITY LIMITATIONS AND PARTICIPATION MEASURES

Clinicians should utilize easily reproducible activity limitation and participation restriction measures associated with the patient's neck pain to assess the changes in the patient's level of function over the episode of care.

DIAGNOSIS/CLASSIFICATION

Clinicians should use motion limitations in the cervical and upper thoracic regions, presence of cervicogenic headache, history of trauma, and referred or radiating pain into an upper extremity as useful clinical findings for classifying a patient with neck pain into the following categories:

- Neck pain with mobility deficits
- Neck pain with movement coordination impairments (including whiplash-associated disorder [WAD])
- Neck pain with headaches (cervicogenic headache)
- Neck pain with radiating pain (radicular)

Neck Pain: Revision 2017

Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Orthopaedic Section of the American Physical Therapy Association


knowledge changing life
NECK PAIN GUIDELINES

Evaluation/Intervention Component 1: Intervention strategies for patients with neck pain

<table>
<thead>
<tr>
<th>Neck Pain With Mobility Difficulties</th>
<th>Neck Pain With Movement Coordination Impairments (MO)</th>
<th>Neck Pain With Muscle Weakness (Cervicothoracic)</th>
<th>Neck Pain With Bulging Disc (Radicular)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute</td>
<td>Acute</td>
<td>Acute</td>
<td>Acute</td>
</tr>
<tr>
<td>• Thoracic manipulation</td>
<td>• Thoracic manipulation</td>
<td>• Thoracic manipulation</td>
<td>• Thoracic manipulation</td>
</tr>
<tr>
<td>• Cervical mobilization or manipulation</td>
<td>• Cervical mobilization or manipulation</td>
<td>• Cervical mobilization or manipulation</td>
<td>• Cervical mobilization or manipulation</td>
</tr>
<tr>
<td>• Cervical ROM, stretching, and dynamic strengthening exercise</td>
<td>• Cervical ROM, stretching, and dynamic strengthening exercise</td>
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<td>• Cervical ROM, stretching, and dynamic strengthening exercise</td>
</tr>
<tr>
<td>• Advice to cease active plus home cervical ROM and dynamic exercise</td>
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<td>• Advice to cease active plus home cervical ROM and dynamic exercise</td>
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EVIDENCE BASED GUIDELINES

Practical Applications

• Forty-one RCTs were used to develop 11 treatment recommendations.
• Recommendations were made for acute neck pain using exercise and a multimodal approach to manipulation, mobilization.
• Recommendations were also made for chronic neck pain using manipulation, mobilization, and exercise and multimodal approaches to manipulation, manual therapy, exercise and massage.

Evidence based Guidelines for the Chiropractic Treatment of adults with Neck pain
TREATMENT STAGES

- Acute phase is directed at pain reduction, control of inflammation and spasm, and prevention of deconditioning
  - local icing, NSAIDs, +/- muscle relaxant
  - For radiculopathy, consider short course of oral steroid, neuromodulating medication, cervical traction, activity modification
  - Postural reeducation
    - Ex. Avoid neck hyperextension/ overhead activities with extension aggravated NP
    - Drink with a straw
    - Adjust monitor height
    - Face the shower while shampooing
  - Gentle mobilization and stretching
  - Isometric neck exercises (preserve neck muscle strength and tone)
  - Low level aerobic conditioning
Restorative Phase is directed toward normalizing range of motion, correcting biomechanical deficits, enhancing flexibility, strengthening torso and extremity muscles. When muscles contract optimally, spine stabilization occurs.

- Optimize posture
- Improve neuromuscular control in both static and dynamic positions
- Various methods are available to improve joint and soft tissue flexibility
- Manipulation and mobilization may be helpful
- An active stretching and strengthening program will result in more permanent and lasting improvement
- Maintain/ enhance cardiovascular conditioning
TREATMENT STAGES

• Maintenance Phase is directed toward sport/activity specific training
  - consolidation of previous exercises with progression to complex multiplanar movements replicating sport/activity
  - continued aerobic training, postural correction, and flexibility exercises
  - Cessation of medication management
CERVICOGENIC HEADACHE

- For chronic cervicogenic headache
  - moderate quality evidence supports static-dynamic cervico-scapulothoracic strengthening/endurance exercises including pressure biofeedback immediate post treatment and probably improves pain, function and global perceived effect at long-term follow-up.
  - Low grade evidence supports sustained natural apophyseal glides (SNAG) exercises.
ADDITIONAL TREATMENT OPTIONS

• Dry Needling
• Acupuncture
• Cervical Dystonia
  - Neurotoxin injections
PATIENT MANAGEMENT

- Diagnostic Testing – EMG/ NCS, Cervical MRI
- Right shoulder US guided evaluation
  - Subacromial bursal fluid, mild supraspinatus and infraspinatus tendonitis without tear
  - US guided subacromial bursal lidocaine and corticosteroid injection
- PT to include shoulder and neck ROM, soft tissue mobilization, manual traction, progressive cervical and UE strengthening exercises
  - Given LE hyperreflexia and documented cervical stenosis without myelomalacia, chiropractic treatment deferred
- Neuromodulating medication (Gabapentin)
- Recommended antidepressant therapy (Duloxetine)
- Significant improvement over 4 months with restoration of UE AROM and strength
TAKE HOME POINTS

• Pathoanatomical features should guide Differential Diagnoses
• Utilize existing guidelines and appropriateness criteria in clinical decision making for imaging studies for neck pain and shoulder pain in the acute and chronic stages
• Use validated self-report questionnaires for patients with neck pain to identify a patient’s baseline status and to monitor changes relative to pain, function, disability, and psychosocial functioning
• Guidelines strongly suggest combining patient education, manual treatment approaches with therapeutic exercises
• Ensure patient compliance with exercises
REFERENCES


PETER R. BLANPIED, PT, PhD • ANITA R. GROSS, PT, MSc • JAMES M. ELLIOTT, PT, PhD • LAURIE LEE DEVANEY, PT, MScDEREK CLEWLEY, DPT • DAVID M. WALTON, PT, PhD • CHERYL SPARKS, PT, PhD • ERIC K. ROBERTSON, PT, DPT. Neck Pain: Revision 2017 Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Orthopaedic Section of the American Physical Therapy Association. J Orthop Sports Phys Ther. 2017;47(7):A1-A83.

Victoria Misailidou PT, MSc,a,b, Paraskevi Malliou PhDc, Anastasia Beneka PhDd, Alexandros Karagiannidis PT, MSe, Georgios Godolias MD, PhD. Assessment of patients with neck pain: a review of definitions, selection criteria, and measurement tools. Journal of Chiropractic Medicine (2010) 9, 49–59.
