Disclosure Statements

• The statements and opinions contained in this program are solely those of the presenter.
• Treatment options and tools presented are some of many that are available.
• All individuals in control of content disclosed no relevant financial relationships.
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Course Description

Learn assessment and rehabilitation techniques for the cervical spine post-concussion. You will learn how and when to initiate treatment for cervical spine involvement and tools and assessments that a PT can use to examine neck pain.

Course Objectives: At the end of the course, attendees should be able to:
• Review use of available assessment tools and results that may indicate cervical spine involvement.
• List useful tests during a clinical exam and their relation to concussion.
• Identify basic intervention strategies for the cervical spine and how and when to initiate treatment.
Speaker Biography

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DiSepio Institute for Rural Health and Wellness

• Became Board Certified as an Orthopaedic Clinical Specialist in 2009
• Earned DPT from Temple University in 2013
• Serves as the Director of the DiSepio Center for Rehabilitation, which is housed on campus in the DiSepio Institute for Rural Health and Wellness
• Also serves as Director of Saint Francis University’s Orthopaedic Physical Therapy Residency program
• Is integrally involved in baseline and post injury testing and post injury rehabilitation
• Carries active caseload of patients experiencing prolonged recovery from concussion
Establishing Clinical Trajectories in Concussion Management

- Vestibular
- Ocular
- Cognitive/fatigue
- Post-traumatic migraine
- Cervical
- Anxiety/mood
The Cervical Spine Clinical Trajectory - Mechanism of Injury

• Forces encountered by the head during concussion are often translated to the cervical spine as well

• In addition to concussion, the MOI may also cause injury to the cervical structures
  • Spinal ligaments
  • Soft tissue injuries
  • The intervertebral disc
  • Vertebral arteries
  • The upper thoracic and TMJ regions should also be considered and screened

• May result in whiplash-associated disorder
Whiplash-Associated Disorder

• Presentation overlaps concussion
• 25% of patients have persistent symptoms lasting over 3 months
• Imaging normal in most circumstances
The Cervical Spine Clinical Trajectory - Clinical Presentation

- **Injury to the cervical spine may result in:**
  - Cervicogenic headaches
  - Decreased postural control
  - Decreased proprioceptive awareness
  - Decreased neuromuscular control of head movements
  - Dizziness/disequilibrium
  - Vestibulo-ocular disturbances
    - Oculomotor control
    - Smooth pursuits, gaze stability, blurred vision
    - Head/eye coordination

- **Gait disturbances**

- **Concentration difficulties**
Cervicogenic Dizziness

- Cervical proprioceptive input is processed along with visual and vestibular input
  - Cervico-ocular reflex
  - Vestibulo-ocular reflex

- **Dysfunction may impact:**
  - Head position/postural control
  - Oculomotor control
  - Vestibular function

- Upper cervical dysfunction is most common

- Must differentiate from specific vestibular dysfunction
Cervicogenic Headaches

• Pain referral from the upper cervical spine joints

• Cervicogenic HA presentation
  • Typically unilateral but can be bilateral
  • Provoked by neck movements or sustained positions
  • Aching, throbbing, spreads to eyes and frontal area
  • May present with photo/phonophobia, nausea, vomiting, dizziness, difficulty swallowing, blurred vision
  • Associated w/ decreased c-spine ROM, hypomobility

• Differential diagnosis
  • Tension headaches
  • Migraine without aura
The Cervical Trajectory: What May Standard Post-Concussion Assessments Show?

**VOMS**
- Increased headache and/or dizziness with smooth pursuits, VOR, convergence

**ImPACT**
- Abnormal Visual Motor Speed composite

**PCSS**
- Headache, nausea, dizziness, fatigue, numbness/tingling, visual problems

**Exertion**
- Not limited by cardiovascular threshold
- Headache may improve initially but return at higher intensity
Patient Examination

• Thorough history
  • Concussion history
    • # of concussions
    • Recovery process for each

• Mechanism of injury and progression of symptoms

• Current symptoms
  • What makes symptoms worse
  • Activity tolerance: (cognitive and physical)
Level 1 Assessment

• Is the patient appropriate for physical therapy?

• R/O findings that would require immediate referral
  • More severe brain injury
  • Cervical Spine injury
Level 1 Assessment

Signs of a more severe brain injury that may require immediate referral:

- Worsening headache
- Very drowsy or cannot be awakened
- Not recognizing people/places
- Repeated vomiting
- Confusion or very irritable
- Seizures
- Weakness or numbness in extremities
- Unsteadiness or slurred speech
Evaluating the Cervical Spine
Is the Patient Appropriate for PT?
Red Flags

• Spinal Fracture
  • History of major trauma
  • Severe ROM restrictions

• Canadian C-Spine Rule

• NEXUS Criteria
Canadian C-Spine Rule: When are Radiographs Indicated?

- ≥ 1 high risk factor
  - >65 years old
  - Paresthesias in extremities
  - Dangerous mechanism of injury
    - Fall from > 1 meter, MVA a speed > 60 mph or with rollover or ejection, bicycle collision, recreational vehicle accident
  - Inability to access ROM
    - Patient unable to sit, ambulate, onset immediate, midline cervical tenderness, other high risk MVA
  - Patient unable to actively rotate 45° bilaterally

- Radiographs indicated if any of these are present
  - Sensitivity 99%, Specificity: 45%
Canadian C-spine Rule: Exclusion Criteria

- Non-trauma cases.
- Glasgow Coma Scale < 15
- Unstable Vital Signs
- Age < 16 years.
- Acute paralysis.
- Known vertebral disease.
- Previous c-spine surgery.
- *Rule has only been validated in the adult population
NEXUS Criteria

Used to R/O vertebral fracture without imaging

- Can imaging be safely avoided?

Imaging not indicated if:

- No focal neurological deficit
- No midline spine tenderness
- No altered level of consciousness
- No intoxication
- No distracting injury present

Sensitivity of >99%

No age cut-offs (validation study was 1-101 y.o.)

- Sensitivity may be reduced >65 y.o.)
Is the Patient Appropriate for PT?  
Red Flags-Cervical Myelopathy

- Central cord compression leading to a cascade of neurological symptoms.

- Etiology is generally cervical stenosis from spondylosis.
  - Can be trauma/swelling

- Several imaging modalities used to determine the diameter of the cervical canal including CT and MRI.

- Cervical stenosis is found in asymptomatic patients on MRI.
Is the Patient Appropriate for PT?

Red Flags

Cervical Myelopathy Signs and Symptoms

• Sensory disturbance in hands
• Muscle wasting of intrinsics
• Unsteady gait
• Positive UMN signs
• Hyperreflexia
• Bowel and bladder disturbance
• Multisegmental weakness and/or sensory changes
Cervical Myelopathy Test Cluster (Cook 2010)

- Gait deviation.
- +Babinski test.
- +Hoffman’s test.
- Inverted supinator sign.
- Age > 45.

- 3 of 5 positive tests: + LR = 30.9.
- 0-1 positive tests: -LR = 0.18, Sen. = .94.
Other Conditions of the Spinal Cord

Cervical Cord Neuropraxia

• Essentially a concussion of the spinal cord

• Brief disturbance of sensation and/or ability to move
  • May last from a few seconds to 24 hours
Cervical Instability

• History of Trauma, whiplash.

• Patient reports difficulty holding up their head.

• Bilateral paresthesia's or other signs of cord compression.
Instability Screening Bottom Line

• Not well studied in the literature
• Cardinal signs and symptoms should warrant referral.
• Take extra care after whiplash and trauma.
• Test upper cervical instability prior to performing manual therapy in the C-spine.
Summary: Cervical Instability

Imaging warranted with Red Flag findings.
- History of trauma
- Headache, dizziness, neurological signs.
- Physical examination findings

- MRI-upper cervical ligamentous signal intensity changes may not be related to recent whiplash injury.

- Correlate imaging with clinical findings.
Examination of Neck Pain

Self report questionnaires

- Neck Medical Screening Questionnaire
  - Screen for red flags and psychosocial factors
- Numeric pain scale and/or pain diagram
- Neck Disability Index
  - MDC = 9%
  - May not be adequate for low levels of disability
- Patient specific functional scale
  - MDC = 1 (mechanical pain/no radiculopathy)
  - MDC = 2 (pts with cervical radiculopathy)
- FABQ
  - More studies for LBP, may be risk factor for prolonged disability in pts with neck pain
- Post Concussion Symptom Scale (PCSS)
Examination of Neck Pain

Upper Quarter Screen
• Suggested for all patients with symptoms that extend distal to the AC joint or if origin of symptoms unclear
• TMJ should also be screened

Postural Assessment
• Investigate the effects of sustained positions on symptom presentation
Examination of Neck Pain

Neurological Testing

LMN signs:
• Diminished or absent DTR’s
• Decreased sensation
• Muscle weakness (myotomal)

UMN signs:
• Hyperreflexia of UE and LE
• Sensory changes in a non-dermatomal pattern
• Clonus
• Positive Hoffmann or Babinski
• Inverted Supinator Sign
• Weakness below level of compression
• Bowel/bladder disturbances
• Clumsiness or gait disturbance
Examination of Neck Pain

Ligamentous Instability Testing

Alar Ligament test

- Alar ligament stabilizes atlanto-occipital complex
  - Pt supine, stabilize axis with pad of thumb adjacent to spinous process
  - Therapist side bends pts head to opposite side
  - Spinous process should immediately move into thumb
  - Delay or lag suggests injury/laxity
Examination of Neck Pain

Ligamentous instability testing

Sharp-Purser test
• Tests integrity of cruciform ligament (transverse lig of dens)
• Identifies subluxation of atlas on axis
  • Pt seated, neck in 20-30 deg flexion, PT places palm over forehead while supporting spinous process of axis
  • PT applies posterior shearing force
  • Test positive if head slides posterior, meaning it relocated
  • A clunk may be heard/felt
Examination of Neck Pain

AROM assessment
- C spine: all planes of motion
- Upper thoracic assessment

Screening for TOS
- Especially indicated for pts w/ peripheralizing symptoms with contralateral sidebending.
- All tests in literature have low sensitivity/specificity
  - Combination of tests increases accuracy of diagnosis
    - Roos, Adsons, etc
    - Soft tissue assessment
    - 1st rib assessment
Examination of Neck Pain

Vertebrobasilar insufficiency testing
• Screening prior to manual therapy is standard
  • But also controversial

Tests:
• Seated AROM
  • Observe for vertigo, tinnitus, dizziness, visual-perceptual problems, fainting
• Pre-manipulative hold
  • Pt in tx position, count back from 15
  • Monitor for dizziness, diplopia, dysarthria, nystagmus, other cranial nerve symptoms
• Minimized deKleyn Test
  • Pt supine, head supported by PT off table
    • PT passively rotates R/L, then ext w/ R/L rotation
    • Monitor for above signs and symptoms as pt counts back from 15
• Any positive test requires medical referral
Examination of Neck Pain

Joint Mobility Assessment

Joints to Assess:

- Fist rib
- Atlanto-occipital joint
- Atlanto-axial joint
- Lower C-spine (C2-C7)
- Upper thoracic spine (T1-T5)
Joint Mobility Assessment

First Rib:

- **Cervical rotation lateral flexion test**
  - Patient seated, rotate head maximally away from side tested
  - C-Spine then flexed (ear to sternum)
  - Results compared to opposite side (+ positive if different)
Joint Mobility Assessment

Atlanto-Occipital Joint

- **Primary motion is flexion/extension**
  - Assessed w/ pt supine
  - Rotate head ~30°, apply ant/post glide (flex/extend head)
  - Assess for amount and quality of motion, compare side/side
Joint Mobility Assessment

Atlanto-axial joint

- Primary motion is rotation (flexion rotation test)
  - Pt supine, passively flex neck maximally, then rotate
  - Assess amount and quality of motion, compare side/side
Joint Mobility Assessment

- Lower C-spine (C2-C7)
  - Assessed via side-glide movement
    - Pt supine, neck in neutral.
    - Glide bilaterally at each segment
      - Motion compared to opposite side
      - Pain provocation also recorded
  - May also be assessed via a spring test (also useful for thoracic spine)
    - Pt prone, use thumbs to apply central and unilateral P/A pressure
Upper Cervical Spine and Headaches

- Flexion Rotation test showed average unilateral rotation of 27.6 degrees for headache patients, and 44.7 degrees for non-symptomatic controls.
- Flexion rotation test has Sensitivity of 91%, and Specificity of 90%.
- Severity of headache is not correlated to degree of ROM restriction.
- Side of C1 C2 restriction correlated with side of headache (Hall and Robinson, 2004).
Examination of Neck Pain

Assessment of Muscle Length

• Latissimus dorsi
• Pec Minor
• Levator scapulae, splenius cervicis, posterior scalenes
• Upper trapezius and SCM
• Anterior and middle scalene
• Serratus Anterior
• Pec Major
• Sub-occipitals
Examination of Neck Pain

Assessment of Muscle Strength and Endurance

• Deep Cervical Flexor Endurance Test
• Cranio-cervical Flexor Endurance Test
• Neck Extensor Endurance Test
Testing for Proprioceptive Awareness

• Joint Position Error/Head Repositioning Accuracy Test (cervicocephalic kinesthetic sensibility)

• Equipment
  • Laser pointer, target, blindfold
Joint Position Error/Head Repositioning Accuracy Test

Procedure

• Patient positioned 90 cm from target (available online)
• Patient wears laser mounted to head with vision occluded
• Patient positioned at center target and instructed to remember position
• Clinician passively moves head to desired position and holds 2 seconds, then patient is asked to return to center position (distance from center recorded)
  • 3 trials each completed for left rotation, right rotation, flexion, extension
ICF Classification system proposed by Clinical Practice Guidelines

- Neck pain with mobility deficits
- Neck pain with headaches
- Neck pain with movement coordination impairments
- Neck pain with radiating pain

- Clinical Practice Guidelines available free at JOSPT.org
# Neck Pain With Headaches

<table>
<thead>
<tr>
<th>Findings</th>
<th>Treatment</th>
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<tbody>
<tr>
<td>• Unilateral HA preceded by neck pain</td>
<td>• Mobilization/manipulation</td>
</tr>
<tr>
<td>• HA triggered by neck movement or position</td>
<td>• Particular attention to upper c-spine</td>
</tr>
<tr>
<td>• HA elicited by pressure on posterior neck (muscle or joint)</td>
<td>• Soft tissue mobilization</td>
</tr>
<tr>
<td>• Restricted ROM and/or joint mobility</td>
<td>• Strengthening</td>
</tr>
<tr>
<td>• Restricted upper cervical mobility</td>
<td>• POSTURAL EDUCATION</td>
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Neck Pain With Movement Coordination Impairments

Findings

• Lower pain and disability scores
• Longer duration of symptoms
• No nerve root compression or centralization/peripheralization with ROM
• General flexibility and strength deficits
• Weakness due to learned pain avoidance (not neuro)
• Postural abnormalities/ergonomic inefficiencies during activities

Treatment

• Strengthening and endurance exercise for neck and upper quarter
• Proprioceptive and dynamic resistive training
• Aerobic conditioning
Treatment of Cervical Spine Involvement

• Posture education

• Manual therapy
  • Soft tissue techniques
  • A/O mobilization
  • A/A mobilization
  • Lower cervical joint mobilizations

• Targeted stretching/strengthening

• Proprioception training
A/O Mobilization

• Manual Joint mobilization
  • Assessment becomes the treatment

• Self mobilization
A/A Mobilization

• Muscle Energy Technique
• Self mobilization
Lower Cervical Joint Mobilizations

- Central and unilateral P/A mobs
- Side glides
- Other specific mobilization techniques
Cervical Proprioception Exercises

- Starts with posture correction and cervical stabilization exercises
- Get creative with exercise progression
  - Alphabet/picture tracing, maze w/ laser, search for target exercises
Cervical Trajectory: A Summary of Relevant Research

• For cervicogenic headaches, a combination of manual therapy and exercise has been shown to be more effective than a passive approach (Hurwitz et al. Spine 2008)(Jull et al. Spine 2002)

• For patients with c/o persistent dizziness, neck pain, and/or headaches
  • a tx program of general exercises (AROM, stretching, posture re-ed, and exertion), vestibular rehab, and cervical physical therapy was 10.27 times more likely to result in patient returning to play in 8 wks than with general exercise alone
Summary

• The cervical clinical trajectory should be considered and investigated in concussion management

• The cervical spine can influence a variety of post concussion symptoms including headaches, dizziness, and vestibular-ocular function

• A thorough clinical exam as well as ImPACT scores, VOMS, and exertional tolerance should be considered in determining clinical trajectory(ies)

• If cervical involvement is suspected, early intervention should be considered to facilitate recovery