Cervical Spine Applied Anatomy

Jason Zafereo, PT, OCS, FAAOMPT

Clinical Orthopedic Rehabilitation Education
Objectives

- Discuss concepts relevant to pathophysiology and differential diagnosis for headache
- Discuss concepts relevant to pathophysiology and differential diagnosis for cervical radiculopathy
Objectives

- Discuss concepts relevant to pathophysiology and differential diagnosis for cervical disc and joint disorders
- Discuss concepts relevant to pathophysiology and differential diagnosis for cervical instability
HEADACHE
Pathophysiology of Headache

- Pain referred to TCN from structures innervated by the C1-3 spinal nerves
  - Upper cervical synovial joints
  - Upper cervical muscles
  - C2-3 disc
  - Dura mater of upper SC and posterior cranial fossa
- Pain perceived based on higher center activity
  - Cortex
  - Brainstem
Pathophysiology of Headache

Figure 21.2 Transmission of nociceptive impulses from the trigeminocervical nucleus will be dependent on the level of afferent input from either musculoskeletal or visceral sources as well as the level of descending inhibition. Sensitization of the trigeminocervical nucleus could also lead to peripheral changes in both musculoskeletal and visceral sources of headache.

Key: dPAG = dorsal peri-aqueductal grey matter; HT = hypothalamus; LC = locus coeruleus; vPAG = ventral peri-aqueductal grey matter; RVM = rostro ventromedial medulla; 5-HT = 5-hydroxytryptamine (serotonin); NA = noradrenaline (norepinephrine).

Boyling et al., Grieve's
Modern Manual Therapy:
The Vertebral Column, 2005
Differential Diagnosis of Headache (IHS)

- **Primary Headaches**
  - Tension-type
  - Migraine
  - Cluster
  - Exertional

- **Other Headaches**
  - Neuralgias
  - Central Facial Pain

- **Secondary Headaches**
  - Trauma
  - Vascular
  - Intracranial
  - Substance/Withdrawal
  - Infection
  - Homeostasis
  - Cervical/Cranial
  - Psychiatric
Migraine Headache (IHS)

- Headache attacks lasting 4-72 hours (untreated or unsuccessfully treated)
- Headache has at least two of the following characteristics:
  - unilateral location
  - pulsating quality
  - moderate or severe pain intensity
  - aggravation by or causing avoidance of routine physical activity
- During headache at least one of the following:
  - nausea and/or vomiting
  - photophobia and phonophobia
- Aura consisting of at least one of the following, but no motor weakness:
  - fully reversible visual symptoms including positive features (e.g., flickering lights, spots or lines) and/or negative features (i.e., loss of vision)
  - fully reversible sensory symptoms including positive features (i.e., pins and needles) and/or negative features (i.e., numbness)
  - fully reversible dysphasic speech disturbance
Cluster Headache (IHS)

- Severe or very severe unilateral orbital, supraorbital and/or temporal pain lasting 15-180 minutes if untreated
- Headache is accompanied by at least one of the following:
  - ipsilateral conjunctival injection and/or lacrimation
  - ipsilateral nasal congestion and/or rhinorrhea
  - ipsilateral eyelid edema
  - ipsilateral forehead and facial sweating
  - ipsilateral miosis and/or ptosis
  - a sense of restlessness or agitation
- Attacks have a frequency from one every other day to 8 per day
Occipital Neuralgia (IHS)

- Paroxysmal stabbing pain, with or without persistent aching between paroxysms, in the distribution(s) of the greater, lesser and/or third occipital nerves
- Tenderness over the affected nerve
- Pain is eased temporarily by local anesthetic block of the nerve
Dx Secondary Headaches

- Pre-test likelihood (27%) pts presenting to ER
- Presence of comorbidity*
- Patient’s age > 50*
- Existence of trigger factor*
- Age > 60 with absence of pain in other body parts (neck/back) and diffuse headache of > 24 h duration
- * 9.3 fold increased risk of secondary HA
  - Mert et al, J Headache Pain 2008
RADICULOPATHY
Pathophysiology of Radiculopathy

- Tension event associated with herniated intervertebral disc
- Compression event associated with degenerative disc changes
  - Zygapophyseal joint
  - Uncovertebral joint

- Sizer et al, Pain Practice, 2001
Soft Herniation (C5/6 - C7/T1)

- Degeneration occurs from the inside to outside (similar to lumbar discs)
- Treatment focused on axial decompression
- Irritated posterior longitudinal ligament leads to neck and arm pain
- Pain with sagittal plane movements
Hard Herniation (C2/3 – C4/5)

- Degeneration occurs from the outside to inside
- Smallest A/P diameter and highest uncinate processes C4-6 (Ebraheim et al, Clin Orthop Rel Res, 1997)
- Treatment focused on A/P decompression
- IVF stenosis creates isolated arm pain
- Pain with foraminal closing
LOCAL CERVICAL PAIN
Pathophysiology of Local Cervical Pain

- **Disc disorders**
  - Soft disc herniation C5/6 and C6/7
  - Degenerative disc disease

- **Joint disorders**
  - Zygapophyseal joint
  - Uncovertebral joint
Differential Diagnosis of Disc Disorders

- Soft disc herniation C5/6 and C6/7
  - Acute torticollis positional fault
  - Pain with sagittal plane motions primary
  - Pain with ipsilateral sidebending/rotation secondary
  - Change with Repeated movements
  - Positive Dural tension testing

- Degenerative disc disease
  - Diagnosis of exclusion
  - Reduced cervical lordosis
  - Pain with 3-D motion testing *uncoupled*
Repeated Movements

- McKenzie theory (Stevens and McKenzie 1988)
  - Alteration of gelatinous nucleus position through loading of IVD
  - Requires intact annulus
- Alternate mechanism for effectiveness in cervical spine, possibly neurophysiological (Mercer and Jull 1996)
Dural Testing

- Anchoring of C5-7 roots to sulcus of transverse processes decreases effectiveness of neural testing
- Alternate mechanism for dural testing (Sizer et al 2001)
  - Neck flexion with scapular retraction
  - Tension on T1 root level
Differential Diagnosis of Joint Disorders

- **Zygapophyseal joint**
  - Pain with 3-D motion testing coupled
  - Primary restriction is into rotation

- **Uncovertebral joint**
  - Pain with 3-D motion testing coupled
  - Primary restriction is into sidebending
INSTABILITY
Pathophysiology of Instability

- Degeneration and mechanical injury causes (Panjabi, J Spinal Disord, 1992)
  - Poor posture
  - Repetitive occupational trauma
  - Acute trauma
  - Weakness of cervical musculature

- Increase in neutral zone of a spinal segment
Pathophysiology of Instability

- Healthy versus microtrauma versus macrotrauma (Jull et al 2004)
  - Excessive SCM activation in trauma groups during craniocervical flexion
- Chronic neck pain (Falla 2004)
  - Decreased deep neck flexor activation with SCM overactivation
Cervicothoracic Musculature

- **Global muscles**
  - Upper trapezius/Levator
  - Splenius capitis/cervicis
  - Semispinalis capitis
  - SCM
  - Scalenes

- **Local muscles**
  - Semispinalis cervicis
  - Multifidus
  - Longus colli/capitis (deep neck flexors)
Differential Diagnosis Instability

- Directional Susceptibility to Movement (DSM)
  - Uni-planar motion
    - Extension
    - Flexion
    - Rotation
  - Combined motion
    - Extension-Rotation
      - Most common syndrome (Sahrmann 2011)
    - Flexion-Rotation
Differential Diagnosis Instability

- DSM into extension
  - History of whiplash
  - Older patient
  - Forward head/Increased thoracic kyphosis
  - Pain/Hinge point with cervical extension
  - Weak DNF/Thoracic extensors
  - Stiffness thoracic extension, SCM, scalene
Differential Diagnosis Instability

- DSM into flexion
  - Exaggerated “correct” posture
  - Younger patient
  - Flat thoracic spine
  - Pain with cervical flexion
  - Weak intrinsic neck extensors
  - Stiffness DNF and thoracic flexion
Differential Diagnosis Instability

- Scapula is the key for determining asymmetrical rotation forces on neck
- Patients with rotation syndromes have pain/clicking during rotation/sidebending
- Dominance of scapular elevators create global muscle overuse into the neck, which leads to inhibition of local muscles
- Most common scapular impairment (Sahrmann 2002)
  - Scapular downward rotation
  - Scapular depression
Scapular Downward Rotation/Depression Syndrome

- Compensatory cervical extension with movements of upper extremity
  - Levator scapula creates ipsilateral cervical rotation
  - Upper trapezius creates contralateral cervical rotation
- TOS
- Shoulder impingement
Impairments

- **Tight**
  - Levator scapula* and Rhomboid
  - Pec minor
  - Latissimus major and dorsi

- **Weak**
  - Serratus anterior
  - Lower and Upper* trapezius
Case Review

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Objectives

- Review concepts for history-taking, examination, and treatment planning in the context of a hypothesis-testing framework
- Apply clinical reasoning process to orthopedic patient cases
Patient Cases

- Data collection and hypothesis formation
- Subjective exam
  - History of present illness
    - Onset, Location, Nature, Aggravating/easing, Intensity, Associated symptoms, Timing
  - Functional status
  - Medical History
    - Co-morbidities, radiology, prior treatment, patient goal(s)
Patient Cases

- Hypothesis testing during objective exam and treatment
- Objective exam
  - Impairment: ROM, Palpation for position, Flexibility, MMT
  - Pathology: ROM, Palpation for condition, Neurological exam, Special testing, Resisted testing
- Treatment
  - Pain, Stiffness, Weakness
Patient Cases

● Hypothesis categories
  - Pathology
    ● Contractile/non-contractile
  - Contributing factors
    ● Environmental, Behavioral, Emotional, Physical, Biomechanical
  - Contraindications/precautions
  - Prognosis
    ● Co-morbidities, Flags, Healing phase, Exam findings
  - Management
    ● Yellow flags, Pain, Stiffness, Weakness, Education
Assignment

- Pick a partner
- Pick case 1-2 or 3-4
- Assign roles of patient/therapist
- Therapist: interview, pre-exam pathology hypothesis, verbal exam, post-exam hypotheses (including treatment)
- Switch roles/cases