Outcome Measures

- **Neck Disability Index (NDI)**
  - Reliable & Valid & Responsive (Vernon et al. 1991; Young et al. 2009)
  - Higher scores = greater neck-related disability
  - Range 0-100% (0-50 points)
  - MDC: 10-11% (Cleland et al. 2006; Pool et al. 2007; Young et al. 2009)
  - MCID: 14%
  - See handout

- **Whiplash Specific Disability Questionnaire (WDQ)** (Willis et al. 2004; Pinfold et al. 2004)
  - Assesses both physical & psychosocial impact
  - Reliable & Valid & Responsive
  - Higher scores = greater negative impact
  - Range: 0-130 points
  - MDC: 15 points
  - See handout

- **Patient-Specific Functional Scale (PSFS)**
  - Pt rates activities 0-10 (inability-level prior to injury)
  - Reliable & Valid (Westaway et al. 1998)
  - Excellent responsiveness (Cleland et al. 2006)
  - MDC: 2.1 points (Cleland et al. 2006)
  - MCID: 2 points (Cleland et al. 2006)
  - See handout

- **Neck-FABQ**
  - Modified from the LBP-FABQ
  - Reliable & Valid for neck pain (Lee et al. 2006)
  - 2 sub-scales
    - Physical Activity (0-24)
    - Work (0-42)
  - See handout
Outcome Measures

- **Global Rating of Change (GROC)** (Jaeschke et al, 1989)
  - 15 point global rating scale
  - -7 (a very great deal worse)
  - +7 (a very great deal better)
  - +4 to +5 = 'moderate' change in pt status
  - +6 to +7 = 'large' change in pt status

- **Imaging Needed?** (ICF Guidelines, 2008)
  - Canadian C-Spine Rule
    - 67 → 50% ↓ in unnecessary radiographs
  - Presentation inconsistent
  - Failure to progress

  Age ≥ 14 years; 99-100% sensitive

Alternate to Canadian C-Spine Rule

- One easy mnemonic for the criteria
  - NSAID
  - Neuro Deficit
  - Spinal Tenderness (Midline)
  - Altered Mental Status/Level of Consciousness
  - Intoxication
  - Distracting Injury

  Painful Distracting Injury: Including, but not limited to:
  - long bone fracture
  - visceral injury requiring surgical consultation
  - large laceration
  - lip laceration
  - or any injury causing acute functional impairment.

Statistics Review

- **Sensitivity**: test’s ability to correctly classify pts with the d/o of interest (true +s)
- **Specificity**: test’s ability to correctly classify pts without the d/o of interest (true -s)
- **LR**: likelihood that a test was observed in a person with the condition compared to a person without the condition.
  - where <.10 (large) to 1 (negligible)
  - + LR: likelihood that a + test was obtained in a person with the condition compared to a person without the condition.
  - where 1 (negligible) to >10 (large)
- **Predictive Value**: ability of dx test to correctly determine the proportion of pts with the disease from all pts with positive test results
- **Predictive Value**: ability of dx test to correctly determine the proportion of pts without the disease from all pts with negative test results

Vertebral Artery Test (Review)

- **Stress test for vertebral basilar insufficiency (VBI)**
  - **Sx:**
    - Dizziness (vertigo, light-headedness)
    - Nausea/vomiting
    - Diplopia/blurred vision/nystagmus
    - LOC
    - Facial numbness
    - HA
    - Dysarthria

  Poor & inconsistent findings
  - sensitivity
  - specificity
  - negative LR
  - positive LR
**Vertebral Artery Preliminary Tests (Review)**
- Patient is sitting. Sustain cervical extension for 10 seconds.
- Sustain Rotation (L and R) 10 seconds
- IF POSITIVE STOP; no combined provocative positions
- If negative, progress to standard position (extension + rotation).

**Vertebral Artery Standard Test (Review)**
- Patient is supine. Sustain cervical extension for 10 seconds.
- Sustain Rotation (L and R) for 10 seconds
- Combine Extension with Rotation (L and R) for 10 seconds.
- Always test the patient in the **manipulation** position (IFOMPT Consensus Document, 2012)
- IF POSITIVE STOP, do not manipulate!

**Modified Vertebral Artery Test**
- Suspect BPPV & want to check for VBI prior to Dix-Hallpike maneuver
  - Seated
  - Lean forward & rest elbows on thighs
  - Neck extension
  - Rotate head 45 degrees & hold 60 sec
  - Repeat to opposite side

**Instability**

**Alar Ligament Stress Test (Using Rotation)**
- L-alar ligament controls R axial rotation
- Whiplash-associated d/o
- Stabilize C2 SP with pincer grasp, initiate rotation
- >20-30° without movement is positive test
- Perform in 3 planes due to anatomical variation?
**Sharp–Purser Test**

- Tests transverse ligament
- Neck in semi flexion
- Palm of one hand on forehead
- Index finger on Spinous process C2
- Posterior force through forehead

**Positive:**
- Large posterior translation
- ↓ sx
- Audible clunk

Reliability: variable (Catryse et al 1997)
Sensitivity:
- 69% (>3 mm laxity)
- 89% (>4 mm laxity)
Specificity: 96% (> 3 mm laxity)
LR: .32
+LR: 17.3

**Transverse Ligament Test**

- Pressure to post. arch of C1 in slight cervical flex
- Head & C1 move ant. on c-spine (passive protraction)
- Hold 10-20 seconds

**Positive:**
- SX other than local pain or soreness (i.e. lump in throat)
- Absence of firm end feel

Valid (Osmotherly et al 2012)

**Distraction Test for Tectorial Membrane**

- Assesses for laxity of tectorial membrane
- Supine
- Fixate axis with lumbrical grip
- Distract occip until end feel
- Neural spine (some perform with slight flexion)

**Positive:**
- SX reproduction
- > 1 mm distraction

Valid (Osmotherly et al 2012)

**Cervical Distraction**

- Nerve Root Compression
- Radicular pain is decreased, test is positive

**Cervical Compression Test**

- Pressure downward on head
- Test is positive if pain is evoked
Spurling’s A (Review) (Wainner et al 2003)
- Seated
- Cervical Ipsilateral SB
- 7 kg of compression applied
- Sx reproduction? (i.e., pain, paresthesias, numbness)

**Reliable**
- Sensitivity: .50
- Specificity: .86
- LR: .58
- +LR: 3.5

Spurling’s B (Wainner et al 2003)
- Seated
- Extension
- Sidebending & Rotation to the ipsilateral side
- 7 kg of axial pressure applied
- Sx reproduction? (i.e., pain, paresthesias, numbness)

**Reliable**
- Sensitivity: .50
- Specificity: .74
- LR: .67
- +LR: 1.9

Upper Limb Tension Test A (Wainner et al 2003)
- Scapular Depression
- Shoulder Abduction
- Forearm supination; wrist & finger extension
- Shoulder ER
- Elbow Extension
- Contralateral SB

**Reliable**
- Sensitivity: .50
- Specificity: .86
- LR: .58
- +LR: 3.5

Upper Limb Tension Testing B (Wainner et al 2003)
- Supine
- Shoulder: 30° ABD
- Introduce:
  - Scapular Depression
  - Shoulder JR
  - Elbow Extension
  - Wrist and Finger Flexion
  - Contralateral cervical SB

**Positive:**
- Sx reproduced
- Contralateral SB ↑ sx or ipsilateral SB ↓ sx

Shoulder Abduction Test (i.e. Bakody’s Sign) (Wainner et al 2003)
- Cervical Radiculopathy? (C4-6)
- Most common nerve root compression at C5-6
- Seated
- Assess resting sx
- Place arm on head
- Positive:
  - ↓ in sx

Reliability slight-fair agreement between examiners
**T1 Nerve Root Stretch Test**
- Shoulder ABD to 90°
- Elbow FLEX to 90°
- Pronate forearm until hand faces outward
- Hand behind head
- Positive:
  - Pain in scapular area: T1
  - Sx in C8 distribution: ulnar nerve

**Valsalva Test** (ICF Guidelines, 2008)
- Suspected cervical radiculopathy
- Pt bears down without exhaling to increase intrathecal pressure
- Positive test: elicits L1, 2 sx
- Instructions:
  - Take a breath and hold 2-3 sec while attempting to exhale

**L’hermitte’s Sign** (Barber Chair Sign)
- Spinal Cord Irritation
- Long Sitting
- Examiner flexes head
- Positive:
  - Sharp pain down spine & into upper or lower extremities
  - NOTE: Also shown in sitting with cervical flexion

**Cervical Myelopathy Diagnostic Cluster** (Cook et al 2010)
- 5 TESTS
  - Gait deviation
  - + Hoffman’s***
  - Inverted supinator sign***
  - Babinski test
  - Age > 45 years

**10-Second Step Test** (Yukawa et al 2008)
- Cervical Myelopathy
  - # steps in 10 sec
    - Thigh parallel to floor, hip & knee flexion of 90°
    - No external support
- Cervical myelopathy average: 10+/− 5 steps
- Controls: 19+/− 3 steps
- Cut-point: 12.8 steps
- NOTE: # steps ↓ with age
Cranial Cervical Flexion Test

- Supine, hook-lying
- Head in neutral (use towel roll)
- Pressure device fills void between lordotic curve & table (i.e., BP cuff, Chattanooga Stabilizer®)
- Inflate to 20 mmHg
- Pt gently nods head in 5 stages (22, 24, 26, 28, 30 mmHg)
- 10 sec holds
- 10 sec rest between stages
- Stop test if substitution occurs or pressure ↓ by > 20%

Activation Score: pressure achieved & held 10 seconds (mmHg)
Performance Index: Increase in pressure X # reps
Reliable: asymptomatic individuals
Valid: not tested
Abnormal Response
- Unable to generate an ↑ in pressure of ≥ 6 mmHg
- Unable to hold X 10 sec
- Substitutions

Pts with cervical strains/sprains & headaches have abnormal tests (i.e., decreased holding times) (ICF Guidelines, 2008)
Pts with chronic neck pain have worst performances on the test when compared to asymptomatic subjects (Chiu et al. 2005)
Pts with only chronic neck pain are able to produce 2-4 mm Hg (Uhlig et al. 1995)
Can use BP cuff as biofeedback in training deep neck flexors

Neck Flexor Muscle Endurance Test

- Supine, hook-lying
- Chin maximally retracted
- Pt lifts head & neck 1 inch off table
- Chin remains retracted to head
- Pt focuses on skin fold or places a finger in the space
- Record time in sec
- STOP test if:
  - Skin fold is separated
  - Pt's head touches PT hand > 1 sec

In a study by Harris et al. (2001) subjects with and without neck pain performed this test. Twelve subjects (6 at baseline, and subjects without neck pain) were tested again 1 week later.
Reliability:
Subjects without neck pain:
ICC (1,1) = 0.82 p < 0.01 SEM 0.8 - 1.0 seconds
 ICC (1,2) = 0.67 to 0.79, ICC (2,1) = 0.55 - 0.66
Subjects with neck pain:
ICC (1,1) = 0.82 SEM 1.15 seconds
Test results:
Subjects without neck pain: Mean 38.35 seconds (SD=10.4)
Subjects with neck pain: Mean 24.1 seconds (SD=11.3)
Cervicogenic Headaches

Headache Impact Test (HIT-6)
(Kosinski et al 2003; Yang et al 2011)
- Measures the impact of HAs on everyday life
- Reliable & Valid & Responsive
- Higher scores indicate a negative impact
- Range 36-78 points
- Cut-points:
  - <50: little → no impact on life
  - 50-55: some impact
  - 56-59: substantial impact
  - 60+: severe impact
- See handout

Headache Disability Inventory
(Jacobson et al 1994; Moraska et al 2008)
- Self-report of difficulties secondary to HAs
- Reliable & Valid
- TOTAL score & 2 categories: Emotional & Functional
- 25 items
- Range: 0-100
- Item scored: 0 (no), 2 (sometimes), 4 (yes)
- Interpretation: TOTAL score
  - 2-32 points: mild
  - 33-59 points: moderate
  - 60+: severe
- MDC: 2-29 points
- See handout

Dizziness Handicap Inventory (DHI)
- Reliable & Valid & Responsive (vestibular population)
- Higher scores indicate a handicap secondary to dizziness
- >10: examination by vestibular specialist is warranted
- Includes function, emotional, & physical component questions
- 25 items
- Range: 0-100
- Item scored: 0 (never), 2 (sometimes), 4 (always)
- Interpretation:
  - 0-54 points: mild handicap
  - 55-69 points: moderate handicap
  - 70+: severe handicap
- SEM: 6.2 points; MDC: 17.18 points; MCID: 18 points
- See handout

Activities-Specific Balance Confidence Scale (ABC)
- Measure of confidence in performing various ambulatory activities without falling
- Reliable & Valid & Responsive (geriatrics)
- 16 items
- Range: 0% (no confidence) → 100% (complete confidence)
- SEM: 1.20%
- Scores < 67% indicates a risk for falling; can accurately classify people who fall 84% of the time
- See handout

Supplemental Self-Report Outcome Measures
Neck Pain ICF Treatment Guidelines, 2008

**Classification (ICF Guidelines, 2008)**

- **Cervicalgia/Pain in Thoracic Spine**
  - Age < 50 years
  - Neck pain < 12 weeks
  - Neck sx only
  - Decreased cervical ROM
  
  “neck pain with mobility deficits”

**Classification (ICF Guidelines, 2008)**

- **Spondylosis with Radiculopathy/Cervical Disc Disorder with Radiculopathy**
  - UE sx
    - Spurlings, ULTT, and Distraction Tests +
    - ↓ cervical rotation to involved side (< 60 deg)
    - Signs of nerve root compression
    - Success with reducing UE sx with exam & intervention
  
  “neck pain with radiating pain”

**Classification (ICF Guidelines, 2008)**

- **Sprain/Strain of Cervical Spine**
  - Neck pain > 12 weeks
  - Coordination/strength/endurance deficits (i.e. neck, SA, MT, LT)
  - Flexibility deficits (i.e. scalenes, UT, levator scap, pects)
  - Abnormal cranial cervical flexion test*
  - Abnormal deep flexor endurance test*
  - Ergonomic inefficiencies with repetitive activities
  
  “neck pain with movement coordination impairments”

*new special tests

**Classification (ICF Guidelines, 2008)**

- **Headache/Cranio-cervical Syndrome**
  - Unilateral HA with neck/suboccipital sx aggravated by head movements
  - HA provocation with soft tissue/joint assessment
  - ↓ cervical ROM
  - ↓ cervical joint mobility
  - Abnormal cranial cervical flexion test*
  
  “neck pain with HA”

*new special test

**Treatment Recommendations (ICF Guidelines, 2008)**

Recommendation: Clinicians should consider utilizing cervical manipulation and mobilization procedures, thrust and non-thrust, to reduce neck pain and headache. Combining cervical manipulation and mobilization with exercise is more effective for reducing neck pain, headache, and disability than manipulation and mobilization alone.
Treatment Recommendations (ICF Guidelines, 2008)

C Recommendation: Thoracic spine thrust manipulation can be used for patients with primary complaints of neck pain. Thoracic spine thrust manipulation can also be used for reducing pain and disability in patients with neck and neck-related arm pain.

Side-lying OA Traction Manipulation

- Side-lying, neck neutral
- Cradle head on forearm with hand under chin
- Slight SB & Slight Rot of head toward cradle hand
- Manipulation hand hypothenar eminence placed at occiput (not mastoid)
- Forearm parallel to table along pt's thorax
  - Take care not to depress the shoulder
  - Take up slack
  - Pre-manipulative pause, adverse signs/no?
  - Small amplitude thrust

Cervical Treatment Techniques

A Recommendation: Clinicians should consider the use of coordination, strengthening, and endurance exercises to reduce neck pain and headache.

B Recommendation: Clinicians should consider the use of mechanical intermittent cervical traction, combined with other interventions such as manual therapy and strengthening exercises, for reducing pain and disability in patients with neck and neck-related arm pain.

C Recommendation: Flexibility exercises can be used for patients with neck symptoms. Examination and targeted flexibility exercises for the following muscles are suggested: anterior/medial/posterior scalenes, upper trapezius, levator scapulae, pectoralis minor, and pectoralis major.

B Recommendation: To improve the recovery in patients with whiplash-associated disorder, clinicians should (1) educate the patient that early return to normal, non-provocative pre-accident activities is important, and (2) provide reassurance to the patient that good prognosis and full recovery commonly occurs.

Recommendation: Specific repeated movements or procedures to promote centralization are not more beneficial in reducing disability when compared to other forms of interventions.
Upper Cervical Mobilizations through Jaw

- Supine
- Develop NVC with pt
  - i.e. hand up = STOP
- Place lower cervical spine in neutral
- Place stabilizing hand on back of head
- Place the lateral border of your 2nd finger & medial border of your thumb across the jaw
- Apply a posterior force through the jaw
- Mobilize using the appropriate grade

Neuropraxia (LeBanc 1992)

- Mild peripheral nerve injury
- Transient conduction block of sensory/motor function
- No structural damage
- MOI: Nerve trunk manipulation, nerve traction, or nerve compression
- Recovery: 1 week → 2 months
- Presentation: paresthesias

Axonotmesis (LeBanc 1992)

- Axonal injury with subsequent degeneration/regeneration
  - No disruption of endoneurial sheath, perineurium, or epineurium
- MOI: traction or compression injury
- Recovery: 2-4 months → 12 months
- Presentation: initial anesthesia → paresthesias as recovery begins

Neurotmesis (LeBanc 1992)

- Severe disruption of connective tissue components of nerve trunk
- Compromise of sensory & functional recovery
- MOI: traction, compression, avulsion injury, chemical injury, or complete disruption of nerve trunk
- Prognosis poor; recovery is never complete
- Presentation: anesthesia → paresthesias?
  - Neuropathic responses:
    - Allodynia
    - Hyperpathia
    - Hypersensitivity
    - Chronic pain

Table 1. Adaptation of Sunderland’s Classification of Nerve Injury

<table>
<thead>
<tr>
<th>Neuropraxia</th>
<th>Axonotmesis</th>
<th>Neurotmesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neuropraxia</td>
<td>Complete</td>
<td>Complete</td>
</tr>
<tr>
<td>Sensory loss</td>
<td>Partial</td>
<td>Complete</td>
</tr>
<tr>
<td>Motor loss</td>
<td>Spastic</td>
<td>Absent</td>
</tr>
<tr>
<td>Nerve conduction disorder</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Fibrillation on EMG</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>Recovery</td>
<td>Rapid</td>
<td>Complete</td>
</tr>
</tbody>
</table>
Cervical Cord Neurapraxia

- **Definition**: Transient neurological deficit following cervical SC trauma
- **Prevalence**: 1.3-6/10,000 athletes
  - Football highest risk
- Can occur during non-sports-related trauma
- Most common MOI: hyperextension
- **Signs/Sx**
  - Sensory
    - Paresthesias (burning, numbness, tingling)
    - BUE, BLE, hemi, quad
  - Motor
    - Weakness → complete paresis
  - Similar pattern to sensory
- **Grading System based on sx duration** (Torg et al 1997)
  - Grade I: < 15 minutes (most common)
  - Grade II: 15 minutes → 24 hours
  - Grade III: > 24 hours
- Associated with cervical spinal stenosis in adult athletes
  - But not pediatrics
  - Associated with ↑ mobility
- **↑ of SC contact with bony elements**
- Recurrence common in older adults

“Burners” or “Stingers”

- **DEFINITION**: Transient neurological event characterized by pain/paresthesias in a single UE following a blow to the neck or shoulder (Castro et al 2003)
  - Rarely neck pain (Safran 2004)
  - Burning, tingling, or numbness in circumferential distribution rather than dermatomal pattern (Hershman 1990)
- **Other MOI**
  - Maximal closing
  - Direct blow to supraclavicular region (i.e. Erb’s point)

“Burners” or “Stingers” (Safran 2004, Review; Kasow & Curl 2006)

- Controversy as to whether cervical nn root or brachial plexus injury
- Injury incidence
  - 30-50% over HS, college, professional football career
  - 65% of collegiate player will experience over their 4-year career
- Most are neurapraxia or neuroapraxia/axonotmesis
- Most commonly involve C5 & C6
- Only 5-10% persistent hours → weeks
“Burners” or “Stingers” (Safran 2004)

- Prolonged sx
  - Rest, removal from play, NSAIDs, PT
    » RTS: full, pain-free ROM neck/shoulder, full & symmetrical neck/shoulder strength
  - MRI: nerve root injury
  - EMG studies
    » Localize site of nn injury & degree of damage (Wilbourn 1986)
    » Abnormalities take 3 weeks to appear
    » Persistent muscle weakness at 72 hours post-injury
    » Correlated to EMG findings at 4 weeks (Speer & Bassett 1990)
    » EMG results can remain abnormal up to 4 yrs

Prevention (Safran 2004)

- Prevention of Recurrences
  - Appropriate shoulder pad fit
  - Review/modify tackling technique (more upright)
    » Avoid dropping the shoulder
    » Avoid rotating the head/neck
    » Avoid spearing