Pre-hospital Evaluation and Management of Pediatric Head and Neck Injury

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Objectives

• Review the initial evaluation and stabilization of the child with suspected head and/or neck injury.

• Discuss which patients qualify for a radiographic workup.

• Discuss acute recognition and treatment of concussion in the child.
Disclosure

• I am a minimalist
  – Do no harm
  – Reduce/prevent pain
  – Reduce/prevent cost
Initial Evaluation

• You know the exam
  – ABCs
  – Cranial nerves
  – Midline tenderness
  – Strength and sensation in all four extremities
  – Reflexes
  – Proprioception/coordination

• You know the precautions
  – At least 3 people
  – Hold c-spine, log roll, etc

• Caveats for athletes
A Brief History Lesson

• Prior to 1970s, pre-hospital care really did not exist.
  – Transport only

• Initial pre-hospital care was extrapolated from in-hospital care and common sense
  – Not evidence-based

• Spine immobilization began because:
  – Some trauma patients had spine injuries
  – Some spine injuries were unstable
  – Movement of the unstable spine seemed to lead to clinical deterioration
  – There seemed to be little downside
What we know now...

- Many EMS protocols are rooted in dogma
- Spinal immobilization has not been shown to prevent secondary spinal cord injury
  - Including c-collars
- C-collars and spine boards do have adverse effects.
  - Pain
  - Respiratory compromise
  - Pressure sores
  - Increased ICP
  - Complicates care
  - Higher rate of radiographs
  - Higher cost of care
Immobilization

- Does this patient need to be immobilized?
  - Not the other way around
- Can we be selective
  - Yes!
  - EMS providers can use simple guidelines to determine which patients are at risk for unstable injuries
- Regardless of your regional protocols, use common sense
  - Neck pain, tenderness, unreliable exam = collar
  - Unreliable exam includes head injury
An example

• Greenville county’s selective immobilization protocol
  – The only in South Carolina
Selective Spinal Immobilization

Neuro Exam: any focal deficit

Yes

SIGNIFICANT mechanism meeting criteria for trauma activation

Yes

Alertness: any alteration in patient's normal

Yes

Intoxications: Any evidence

Yes

Distracting injury (see PEARLS)

Yes

Spinal exam: point of tenderness over the spinal process or pain during ROM

Yes

Spinal immobilization not indicated

B Selective spinal immobilization required (see PEARLS)
PEARLS:

- Full spinal immobilization to include the use of a long spine board should be used judiciously and according to current evidence based practices. Limiting spinal movement may be best achieved in alert patients by application of a rigid cervical collar, securing the patient firmly to a stretcher, and using verbal coaching to limit neck/back movement.
- Care should be used at all times to limit movement of the spine and neck in patients with potential injuries.
- Ambulatory patients that require spinal immobilization can have an appropriately sized cervical collar placed and pivot/sit to the stretcher for securing.
- Non-ambulatory and alert patients can be lifted using a scoop stretcher and a C-collar in lieu of a backboard. The scoop can be removed during transport if causing pain or distress.
- In situations where the patient is still in a vehicle, consider allowing alert and oriented patients to wear a C-collar and extricate themselves to the stretcher.
- **Non-alert patients require full traditional immobilization utilizing either a backboard or scoop.**
- Range of motion should **NOT** be assessed if patient has midline spinal tenderness. Patient’s range of motion should not be assisted. The patient should touch their chin to their chest, extend their neck (look up), and turn their head from side to side (shoulder to shoulder) without spinal process pain. The acronym "**NSAIDS**" should be used to remember the steps in this protocol:
  - **Neurologic exam:** Look for paralysis, focal deficits such as tingling, reduced strength, numbness in an extremity, loss of urethral or sphincter control (incontinence), or priapism.
  - **Significant mechanism of injury** includes high energy events such as ejection, high falls, and abrupt deceleration crashes, blunt trauma to the neck, or extremes of age.
  - **Alertness:** Is patient oriented to person, place, time, and situation? Any change to alertness with this incident? Normal GCS?
  - **Intoxication:** Is there any indication that the person is intoxicated (impaired decision making ability)?
  - **Distracting injury:** A condition thought by the clinician to be producing pain sufficient to distract the patient from a secondary (neck) injury.
  - **Spinal exam:** Look for point tenderness in any spinal process or spinal process tenderness with range of motion.
- Patients with penetrating trauma to the head, neck, or torso and no evidence of spinal injury should not be immobilized on a backboard.
- If experiencing difficulty fitting the C-collar to the patient consider other options such as a towel roll.
Do Selective Protocols work?

  - 861 patients, 504 were transported, 495 with c-collar
  - 3 injuries were missed by protocol, 2 by deviation from the protocol
    - 1 patient had an adverse outcome
    - 2 unstable injuries
    - 4 patients > 67 years old
    - 1 patient < 1 year
  - Conclusion: The selective protocol was 99% sensitive in identifying appropriate patients for immobilization
    - Take caution in extremes of age
How about the backboard?
How about the backboard?

• Recent evidence suggests limited use is best
  – For extrication and transport to stretcher
• Patients with penetrating trauma to head, neck or torso without evidence of spinal cord compromise do NOT need a backboard.
• Appropriate stabilization can be obtained with c-collar and securing patient to EMS stretcher
What is the best extraction technique?

  - Small study
  - Multiple high speed infrared motion analysis cameras and sensors to detect motion of the cervical spine during four different extrication techniques
    - 1) unassisted and unprotected
    - 2) unassisted and protected with a cervical collar
    - 3) assisted and protected with a cervical collar
    - 4) assisted and protected with a cervical collar and Kendrick Extrication Device
  - Winner: #2
All this talk about adults... What about kids?

- Pediatric spine injuries are incredibly rare
  - 1.6% of children admitted to trauma centers
  - Very difficult to study

- Insufficient evidence to universally recommend selective protocols

- Children who can communicate adequately can be managed in the same manner as adults
  - Based on studies from EDs
So who does need immobilization?

• If they don’t need an X-ray, they should not be immobilized
  – Corollary: Just because they are immobilized does not mean that they need an X-ray

• Who needs imaging?
  – NEXUS
  – Canadian C-spine rules
  – PCARN
  – Canadian Head CT Rules
  – New Orleans Criteria
NEXUS Criteria

• National Emergency X-Radiation Utilization Study
• Do not need imaging in the absence of:
  – Midline c-spine tenderness
  – Focal neurologic deficit
  – Altered mental status
  – Intoxication
  – Painful distracting injury
• Strengths
  – Huge study, 34,000+ patients
  – 99% sensitivity for detecting c-spine injury
• Weaknesses
  – Only 2.5% were 8 years old or younger
  – None younger than 2 years old
# Canadian C-Spine Rule

1. **Any high-risk factor that mandates radiographs?**
   - If yes, obtain radiographs.
   - If no, proceed to #2.

   - a) Age greater than or equal to 65
   - b) Dangerous mechanism
     - i. Fall from > 3 ft or 5 stairs
     - ii. Axial load to head (e.g. driving)
     - iii. MVC high speed (>100km/h), rollover, ejection
     - iv. Motorized recreational vehicle
     - v. Bicycle crash
   - c) Paresthesias in extremities

2. **Any low risk factor that allows safe assessment of range of motion?**
   - If yes, proceed to #3.
   - If no, obtain radiographs.

   - a) Simple rear-end MVC with the following exclusions:
     - i. pushed into oncoming traffic
     - ii. hit by large truck or bus
     - iii. rollover
     - iv. hit by high speed vehicle
   - b) Sitting position in ED
   - c) Ambulatory at time
   - d) Delay in onset of neck pain
   - e) Absence of midline cervical spine tenderness

3. **Able to actively rotate neck?**
   - If yes, no radiographs are necessary.
   - If no, obtain radiographs.

   - 45 degrees to each side
Canadian C-Spine Rule

• Strengths
  – Another large study
  – Claimed 100% sensitivity
  – Performed better in the one comparison study

• Weaknesses
  – Not designed or intended for children
  – Comparison study performed by CCSR investigators
NEXUS versus CCSR

• Bottom Line:
  – They are both effective, probably equally so
  – Use either one

“THIS TOWN AIN’T BIG ENOUGH FOR BOTH OF US...”
Take Home Point

• If they are non-tender, do not have a focal deficit, and your exam is reliable, they do not need X-rays/immobilization.
All this neck talk makes my head hurt...
Canadian Head CT Rules

High risk (for neurological intervention)
- GCS score <15 at 2h after injury
- Suspected open or depressed skull fractures
- Any sign of basal skull fracture (hemotympanum, ‘raccoon’ eyes, cerebrospinal fluid otorrhea/rhinorhrea, Battle’s sign)
- Vomiting ≥ two episodes
- Age ≥ 65 years

Medium risk (for brain injury on CT)
- Amnesia before impact >30 min
- Dangerous mechanism (pedestrian struck by motor vehicle, occupant ejected from motor vehicle, fall from height >3 feet or five stairs)

Exclusion criteria: Neurologic deficit, seizure, bleeding diathesis or oral anticoagulants
Canadian Head CT Rules

• Strengths
  – 3121 patients
  – High risk criteria: 100% sensitive for clinically important brain injury
  – Medium risk criteria: 98.4% sensitive
  – Can significantly decrease CT utilization

• Weaknesses
  – No kids
  – Somewhat complicated to use
New Orleans Criteria

Patients with minor head injury should undergo CT in the presence of one or more of the following seven clinical findings:

- Headache
- Vomiting
- Age over 60 years
- Drug or alcohol intoxication
- Deficits in short term memory
- Physical evidence of trauma above the clavicles
- Seizure

• Strengths
  – 520 patients age 3-97
  – Favorable validation studies
  – Easy to use

• Weaknesses
  – Nebulus #6
  – Was less specific and had lower PPV and NPV vs CHCR
PECARN Criteria

• Pediatric Emergency Care Applied Research Network
  – 42,412 children <18
  – 376 clinically significant brain injuries
  – 60 (0.1%) underwent surgery
  – From this database, extrapolated the following criteria
A. Under 2 years
- GCS=14 or other signs of altered mental status
- Palpable skull fracture

Yes → 4.4% risk ciTBI → CT recommended

No
- Occipital or parietal or temporal scalp hematoma
- History of loss of consciousness ≥ 5 seconds
- Severe mechanism of injury*
- Not acting normally per parent

Yes → 0.9% risk ciTBI → CT versus observation

No → CT not recommended → <0.02% risk ciTBI

B. 2 years or older
- GCS=14 or other signs of altered mental status
- Signs of basilar skull fracture

Yes → 4.3% risk ciTBI → CT recommended

No
- History of loss of consciousness
- History of vomiting
- Severe mechanism of injury*
- Severe headache

Yes → 0.9% risk ciTBI → CT versus observation

No → CT not recommended → <0.05% risk ciTBI
PECARN Criteria

• Strengths
  – Huge study of pediatric patients

• Weaknesses
  – Relatively complicated
  – Not yet validated
  • One study performed did not find decrease in CT rate, but had incredibly low CT rate to begin with
So why do we care about imaging?

• Cancer risk
  – Risk due to single CT brain: 1/4000
• Discomfort
• Higher cost
• Longer length of stay
Can I observe patients?

• Yes

• Boston Study
  – 1,369 patients designated into low, intermediate, high risk based on PECARN criteria
  – 28% of high risk, 60% of intermediate risk, 45% of low risk patients were observed
  – 34% of patients not observed were scanned
  – Only 5% of observed patients were scanned
    • 4 of those 32 patients had brain injury (none of which were clinically important)
      – <1% of all observed patients
  – No adverse outcomes in other observed patients
  – Observed kids had longer length of stay
    • 3.2 vs 2.3 hours
Take Home Point

• There is no substitute for clinical judgement, but there are lots of tools/criteria to guide your decision-making.
OK, they don’t need imaging or transport. I’m done right...

- Of course not.

- CONSIDER CONCUSSION
Concussion

• General definition:
  – subset of traumatic brain injury
  – a complex physiologic process affecting the brain induced by trauma
    • A functional deficit, not a structural one
  – temporary neurologic and/or cognitive impairment
  – can be due to direct or indirect force
  – usually associated with the acute onset of symptoms but symptoms may evolve over minutes to hours
Concussion

• Symptoms
  – Essentially any neuropsychiatric complaint
    • Somatic: headache, nausea/vomiting
    • Cognitive: difficulty concentrating, fogginess
    • Behavioral: irritability, emotional change
    • Proprioceptive: balance problems, ataxia
    • Sleep disturbance
  – Symptoms may be delayed

• Physical Exam
  – Usually normal
  – Amnesia, emotional lability, ataxia, photophobia
Concussion

• Initial Treatment
  – Physical and cognitive rest until symptom free
  – No return to “sport” on the same day
  – Refer to concussion specialist or primary physician for further instructions/guidance
What can I do with a single encounter?

• Diagnose
• Educate
  – Limit morbidity and mortality
    • Second impact syndrome
    • Chronic Traumatic Encephalopathy
What diagnostic tools do we have?

- SCAT3
- Child-SCAT3
  - Brief neuropsych test assessing attention and memory
- BESS testing
  - balance
Child-SCAT3

- Sports Concussion Assessment Tool
  - Age 5-12

1. **Glasgow coma scale (GCS)**
   - Best eye response (E)
     - No eye opening: 1
     - Eye opening in response to pain: 2
     - Eye opening to speech: 3
     - Eyes opening spontaneously: 4
   - Best verbal response (V)
     - No verbal response: 1
     - Incomprehensible sounds: 2
     - Inappropriate words: 3
     - Confused: 4
     - Oriented: 5
   - Best motor response (M)
     - No motor response: 1
     - Extension to pain: 2
     - Abnormal flexion to pain: 3
     - Flexion/Withdrawal to pain: 4
     - Localizes to pain: 5
     - Obey's commands: 6
   - Glasgow Coma Score (E + V + M) of 15

2. **Sideline Assessment – child-Maddocks Score**
   - I am going to ask you a few questions, please listen carefully and give your best effort.
   - Modified Maddocks questions (1 point for each correct answer)
     - Where are we at now?: 0
     - Is it before or after lunch?: 0
     - What did you have last lesson/class?: 0
     - What is your teacher’s name?: 0
   - child-Maddocks score of 4

Child-Maddocks score is for sideline diagnosis of concussion only and is not used for serial testing.
### Child report

<table>
<thead>
<tr>
<th></th>
<th>never</th>
<th>rarely</th>
<th>sometimes</th>
<th>often</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have trouble paying attention</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I get distracted easily</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have a hard time concentrating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have problems remembering what people tell me</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have problems following directions</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I daydream too much</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I get confused</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I forget things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have problems finishing things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have trouble figuring things out</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>It’s hard for me to learn new things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have headaches</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I feel dizzy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I feel like the room is spinning</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I feel like I’m going to faint</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Things are blurry when I look at them</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I see double</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I feel sick to my stomach</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I get tired a lot</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I get tired easily</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total number of symptoms** (Maximum possible 20)

**Symptom severity score** (Maximum possible 20 x 3 = 60)

- self rated
- clinician interview
- self rated and clinician monitored

### Parent report

<table>
<thead>
<tr>
<th>Issue</th>
<th>never</th>
<th>rarely</th>
<th>sometimes</th>
<th>often</th>
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</thead>
<tbody>
<tr>
<td>The child has trouble sustaining attention</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>is easily distracted</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has difficulty concentrating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has problems remembering what he/she is told</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has difficulty following directions</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>tends to daydream</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>gets confused</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>is forgetful</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has difficulty completing tasks</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has poor problem solving skills</td>
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<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has problems learning</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has headaches</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>feels dizzy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has a feeling that the room is spinning</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>feels faint</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has blurred vision</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has double vision</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>experiences nausea</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>gets tired a lot</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>gets tired easily</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total number of symptoms** (Maximum possible 20)

**Symptom severity score** (Maximum possible 20 x 3 = 60)

- Do the symptoms get worse with physical activity? Y N
- Do the symptoms get worse with mental activity? Y N

**Overall rating** for parent/teacher/coach/carer to answer:
- How different is the child acting compared to his/her usual self?

**Please circle one response:**
- no different
- very different
- unsure
- N/A

Name of person completing Parent-report: 
Relationship to child of person completing Parent-report: 

[Other fields for notes and signatures]
Cognitive assessment
Standardized Assessment of Concussion – Child Version (SAC-C) 4

Orientation (1 point for each correct answer)
What month is it? 0
What is the date today? 0
What is the day of the week? 0
What year is it? 0
Orientation score of 4

Immediate memory
<table>
<thead>
<tr>
<th>List</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Alternative word list</th>
</tr>
</thead>
<tbody>
<tr>
<td>elbow</td>
<td>0 1 0 1</td>
<td>0 1</td>
<td>0 1</td>
<td>candle baby finger</td>
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<tr>
<td>apple</td>
<td>0 1 0 1</td>
<td>paper</td>
<td>monkey</td>
<td>penny</td>
</tr>
<tr>
<td>carpet</td>
<td>0 1 0 1</td>
<td>sugar</td>
<td>perfume</td>
<td>blanket</td>
</tr>
<tr>
<td>saddle</td>
<td>0 1 0 1</td>
<td>sandwich</td>
<td>sunset</td>
<td>lemon</td>
</tr>
<tr>
<td>bubble</td>
<td>0 1 0 1</td>
<td>wagon</td>
<td>iron</td>
<td>insect</td>
</tr>
</tbody>
</table>

Immediate memory score total of 15

Concentration: Digits Backward
<table>
<thead>
<tr>
<th>List</th>
<th>Trial 1</th>
<th>Alternative digit list</th>
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</thead>
<tbody>
<tr>
<td>6-2</td>
<td>0 1</td>
<td>4-1 4-9</td>
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<tr>
<td>4-9-3</td>
<td>0 1</td>
<td>6-2-9 5-2-6 4-1-5</td>
</tr>
<tr>
<td>3-8-1-4</td>
<td>0 1</td>
<td>3-2-7-9 1-7-9-5 4-9-6-8</td>
</tr>
<tr>
<td>6-2-9-7-1</td>
<td>0 1</td>
<td>1-5-2-8-6 3-8-5-2-7 6-1-8-4-3</td>
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<tr>
<td>7-1-8-4-6-2</td>
<td>0 1</td>
<td>5-3-9-1-4-8 8-3-1-9-6-4 7-2-4-8-5-6</td>
</tr>
</tbody>
</table>

Total of 5

Concentration: Days in Reverse Order (1 pt. for entire sequence correct)
Sunday-Saturday-Friday-Thursday-Wednesday-Tuesday-Monday

Concentration score of 6

Neck Examination:
- Range of motion
- Tenderness
- Upper and lower limb sensation & strength

Balance examination
Do one or both of the following tests.
Footwear (shoes, barefoot, braces, tape, etc.)
Modified Balance Error Scoring System (BESS) testing
Which foot was tested (i.e. which is the non-dominant foot) Left Right
Testing surface (hard floor, field, etc.)
Condition
- Double leg stance: Errors
- Tandem stance (non-dominant foot at back): Errors

Tandem gait
- Time taken to complete (best of 4 trials): seconds
  If child attempted, but unable to complete tandem gait, mark here

Coordination examination
Upper limb coordination
Which arm was tested: Left Right
Coordination score of 1

SAC Delayed Recall
Delayed recall score of 5
**BESS**

- Balance Error Scoring System

<table>
<thead>
<tr>
<th>NAME:</th>
<th>BESS SCORE CARD</th>
<th>FIRM Surface</th>
<th>FOAM Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(# errors)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Double Leg Stance</td>
<td>(feet together)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Siingle Leg Stance</td>
<td>(non-dominant foot)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tandem Stance</td>
<td>(non-dom foot in back)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Scores:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BESS TOTAL:</th>
<th>Test Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ L □ R</td>
<td></td>
</tr>
</tbody>
</table>
How do we use these?

• With our athletes, we have a baseline for comparison
• Still worthwhile to guide assessment
  – Most uninjured individuals score 25 or higher on SCAT3

• A “normal” SCAT3 score does not rule out concussion
Concussion and C-spine

• If you cannot get a reliable exam, place a c-collar
Take Home Point

- Consider concussion, and when suspected, educate the patient/parent, instruct them to rest, and call their physician.
Summary

- Selective immobilization guidelines are available, safe, and effective

- There are tools available to help determine who needs a workup

- Don’t forget concussion!
References

• Haut ER et al. Spine immobilization in penetrating trauma: more harm than good? J Trauma. 2010 Jan;68(1):115-20
Case 1

- 4 yo female restrained rear passenger in a car seat in low energy MVC without roll-over or ejection. Pt complaining of headache

- Exam: Patient is walking hand-in-hand with Mom, crying.
  - GCS 15
  - No neuro deficits
  - No c-spine tenderness
Case 1

• NEXUS
  – Midline c-spine tenderness
  – Focal neurologic deficit
  – Altered mental status
  – Intoxication
  – Painful distracting injury
Case 1

- Canadian C-spine Rule

<table>
<thead>
<tr>
<th>High risk (for neurological intervention)</th>
<th>Medium risk (for brain injury on CT)</th>
<th>Exclusion criteria: Neurologic deficit, seizure, bleeding diathesis or oral anticoagulants</th>
</tr>
</thead>
<tbody>
<tr>
<td>- GCS score &lt;15 at 2h after injury</td>
<td>- Amnesia before impact &gt;30 min</td>
<td></td>
</tr>
<tr>
<td>- Suspected open or depressed skull fractures</td>
<td>- Dangerous mechanism (pedestrian struck by motor vehicle, occupant ejected from motor vehicle, fall from height &gt;3 feet or five stairs)</td>
<td></td>
</tr>
</tbody>
</table>
Case 1

A. Under 2 years
- GCS=14 or other signs of altered mental status
- Palpable skull fracture

  Yes 4.4% risk ciTBI  CT recommended

  No

- Occipital or parietal or temporal scalp hematoma
- History of loss of consciousness ≥ 5 seconds
- Severe mechanism of injury*
- Not acting normally per parent

  Yes 0.9% risk ciTBI  CT versus observation

  No

  CT not recommended <0.02% risk ciTBI

B. 2 years or older
- GCS=14 or other signs of altered mental status
- Signs of basilar skull fracture

  Yes 4.3% risk ciTBI  CT recommended

  No

- History of loss of consciousness
- History of vomiting
- Severe mechanism of injury*
- Severe headache

  Yes 0.9% risk ciTBI  CT versus observation

  No

  CT not recommended <0.05% risk ciTBI
Case 1

• What would you do?

• What happened?
  – Patient not immobilized
  – Allowed to ride with Mom on stretcher to ED
  – Observed for 2 hours
  – Headache resolved
  – Discharged home, doing well at 2 weeks
Case 2

- 14 year old soccer player went head to head with opponent
- Assisted off field
- Reports dizziness, dying to go back in
- Initial exam:
  - A&Ox3
  - GCS 15
  - No focal deficits
  - No c-spine tenderness
## Case 2

### Glasgow coma scale (GCS)

<table>
<thead>
<tr>
<th>Best eye response (E)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No eye opening</td>
<td>1</td>
</tr>
<tr>
<td>Eye opening in response to pain</td>
<td>2</td>
</tr>
<tr>
<td>Eye opening to speech</td>
<td>3</td>
</tr>
<tr>
<td>Eyes opening spontaneously</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Best verbal response (V)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No verbal response</td>
<td>1</td>
</tr>
<tr>
<td>Incomprehensible sounds</td>
<td>2</td>
</tr>
<tr>
<td>Inappropriate words</td>
<td>3</td>
</tr>
<tr>
<td>Confused</td>
<td>4</td>
</tr>
<tr>
<td>Oriented</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Best motor response (M)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No motor response</td>
<td>1</td>
</tr>
<tr>
<td>Extension to pain</td>
<td>2</td>
</tr>
<tr>
<td>Abnormal flexion to pain</td>
<td>3</td>
</tr>
<tr>
<td>Flexion/Withdrawal to pain</td>
<td>4</td>
</tr>
<tr>
<td>Localizes to pain</td>
<td>5</td>
</tr>
<tr>
<td>Obeyes commands</td>
<td>6</td>
</tr>
</tbody>
</table>

**Glasgow Coma score (E + V + M)**

GCS should be recorded for all athletes in case of subsequent deterioration.

### Sideline Assessment – child-Maddocks Score

```
“I am going to ask you a few questions, please listen carefully and give your best effort.”
```

Modified Maddocks questions (1 point for each correct answer)

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where are we at now?</td>
<td>0</td>
</tr>
<tr>
<td>Is it before or after lunch?</td>
<td>0</td>
</tr>
<tr>
<td>What did you have last lesson/class?</td>
<td>0</td>
</tr>
<tr>
<td>What is your teacher’s name?</td>
<td>0</td>
</tr>
</tbody>
</table>

**child-Maddocks score**

Child-Maddocks score is for sideline diagnosis of concussion only and is not used for serial testing.
### Child report

<table>
<thead>
<tr>
<th>Name:</th>
<th>never</th>
<th>rarely</th>
<th>sometimes</th>
<th>often</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have trouble paying attention</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I get distracted easily</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have a hard time concentrating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have problems remembering what people tell me</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have problems following directions</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I daydream too much</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I get confused</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I forget things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have problems finishing things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have trouble figuring things out</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>It’s hard for me to learn new things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have headaches</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I feel dizzy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I feel like the room is spinning</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I feel like I’m going to faint</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Things are blurry when I look at them</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I see double</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I feel sick to my stomach</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I get tired a lot</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I get tired easily</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total number of symptoms** (Maximum possible 20)  
**Symptom severity score** (Maximum possible 20 x 3 = 60)

---

### Parent report

<table>
<thead>
<tr>
<th>The child</th>
<th>never</th>
<th>rarely</th>
<th>sometimes</th>
<th>often</th>
</tr>
</thead>
<tbody>
<tr>
<td>has trouble sustaining attention</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>is easily distracted</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has difficulty concentrating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has problems remembering what he/she is told</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has difficulty following directions</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>tends to daydream</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>gets confused</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>is forgetful</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has difficulty completing tasks</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has poor problem solving skills</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has problems learning</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has headaches</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>feels dizzy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has a feeling that the room is spinning</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>feels faint</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has blurred vision</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has double vision</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>experiences nausea</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>gets tired a lot</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>gets tired easily</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total number of symptoms** (Maximum possible 20)  
**Symptom severity score** (Maximum possible 20 x 3 = 60)
## Case 2

### Cognitive Assessment

#### Standardized Assessment of Concussion – Child Version (SAC-C)

<table>
<thead>
<tr>
<th>Orientation (1 point for each correct answer)</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>What month is it?</td>
<td>0</td>
</tr>
<tr>
<td>What is the date today?</td>
<td>0</td>
</tr>
<tr>
<td>What is the day of the week?</td>
<td>0</td>
</tr>
<tr>
<td>What year is it?</td>
<td>0</td>
</tr>
<tr>
<td>Orientation score</td>
<td>1 of 4</td>
</tr>
</tbody>
</table>

#### Immediate Memory

<table>
<thead>
<tr>
<th>List</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Alternative word list</th>
</tr>
</thead>
<tbody>
<tr>
<td>elbow</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>candle</td>
</tr>
<tr>
<td>apple</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>paper</td>
</tr>
<tr>
<td>carpet</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>sugar</td>
</tr>
<tr>
<td>saddle</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>sandwich</td>
</tr>
<tr>
<td>bubble</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>wagon</td>
</tr>
</tbody>
</table>

**Total Immediate memory score total:** 1 of 15

<table>
<thead>
<tr>
<th>Concentration: Digits Backward</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>List</td>
<td></td>
</tr>
<tr>
<td>6-2</td>
<td>0</td>
</tr>
<tr>
<td>4-9-3</td>
<td>0</td>
</tr>
<tr>
<td>3-8-1-4</td>
<td>0</td>
</tr>
<tr>
<td>6-2-9-7-1</td>
<td>0</td>
</tr>
<tr>
<td>7-1-8-4-6-2</td>
<td>0</td>
</tr>
</tbody>
</table>

**Total of 5**

<table>
<thead>
<tr>
<th>Concentration: Days in Reverse Order (1 pt. for entire sequence correct)</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunday-Saturday-Friday-Thursday-Wednesday-Tuesday-Monday</td>
<td>0</td>
</tr>
</tbody>
</table>

**Concentration score:** 1 of 6

### Neck Examination

- Range of motion
- Tenderness
- Upper and lower limb sensation & strength

**Findings:**

### Balance Examination

- Do one or both of the following tests.
- Footwear (shoes, barefoot, braces, tape, etc.)

**Modified Balance Error Scoring System (BESS) testing**

- Which foot was tested (i.e. which is the non-dominant foot): Left [ ] Right [ ]
- Testing surface (hard floor, field, etc.)

**Condition**

- Double leg stance: [ ] Errors
- Tandem stance (non-dominant foot at back): [ ] Errors
- Tandem gait:
  - Time taken to complete (best of 4 trials): _______ seconds
  - If child attempted, but unable to complete tandem gait, mark here [ ]

### Coordination Examination

- Upper limb coordination

**Which arm was tested:** Left [ ] Right [ ]

**Coordination score:** 1 of 1

### SAC Delayed Recall

- Delayed recall score

**Score:** 1 of 5
Case 2

• Score: 27/30

• What do you do?

• SIT THEM OUT!!

• Re-evaluation 10-15 minutes later
  – Now somewhat confused
  – Score 21/30
Case 2

• What do you do now?
  – ED?
  – Immobilize
  – Backboard?

• What was done?
  – Patient was laid flat, c-collar placed
  – Backboard used
  – Imaging in ED negative, patient admitted overnight
  – Doing well at 2 weeks, reports a good experience except pain from 3 hours on the board