Concussion Rehabilitation

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KAISER PERMANENTE ORTHOPAEDIC/SPORTS REHABILITATION FELLOWS
Outline

- Pathophysiology
- Sideline Assessment
- Important Subjective Questions and Symptom Categories
- 4 main Assessment/Treatment categories
- Objective Tests including VOMS
- Early/Late Management
- Return to Sport
Mild Traumatic Brain Injuries (MTBIs), otherwise known as concussions
If Unconscious, assume unstable spine and immobilize
- Needs to go to emergency room for imaging

If Conscious, remove from emotion of the game before assessing
- Cervical Spine ROM
- Standardized Assessment of Concussion (SAC)
  - Short-term/long-term memory
  - Orientation questions
  - Concentration assessment
- If no symptom response, physically exert athlete and reassess for symptoms
- If positive for possible concussion based off signs and symptoms, hold athlete from participation for remainder of day
Detailed Subjective

- Obtain specific details on type of symptoms and provoking factors
- Most commonly noted symptoms is headache, assess history of HA or migraine prior to injury.
- Assess changes in hearing, ringing in ears, fullness in ears
- Assess difficulty swallowing, changes in speech, or double vision
- Symptoms may be rapid in onset or may be delayed

- Symptoms predicting prognosis…
- If loss of consciousness or vomiting were not present on the day of injury, more likely to recover in <7 days.
- If Dizziness present on day of injury, increased likelihood of prolonged recovery >6 times more likely to take longer than 3 weeks to recover
- If resting symptoms present >3 days after injury, increased likelihood of protracted recovery
- Symptoms most likely to indicate prolonged recovery are Dizziness, amnesia and fogginess
Four general symptom categories:

- **Vestibular**
  - PT vestibular evaluation and treatment
  - Help settle symptoms

- **Ocular**
  - Treated primarily by neuro-ophthalmologists or PTs
  - Treatment to focus on repeated stress (exposure to visual stimulus) and recoveries
  - For these patients, avoid dark rooms for rest as coming out of dark rooms can be harsh

- **Cognitive**
  - Managed primarily by psychology
  - Work on memory tasks or dual-tasking
  - Cognitive breaks

- **Migrainous**
  - Primarily managed medically
  - Treat any other symptoms overlayed from other categories
Be Objective

- Detailed Neurologic Exam
  - Cranial Nerve testing
  - UE/LE Dermatomes and Myotomes
- Neurocognitive testing:
  - SCAT3 used in clinic
  - Schools often use ImPACT computer based test
- Balance: Balance Error scoring system (BESS)
- Visual Occulomotor screen (VOMS)
What is the SCAT3?

The SCAT3 is a standardized tool for evaluating injured athletes for concussion and extends the time frame from 12 hours and 1 day to 1 week after injury. It is not intended to be used by non-athletes. It is not a substitute for other clinical tests, such as the NSE or the SAC. The SCAT3 is designed to assist in the diagnosis and management of concussions. The SCAT3 should be used by healthcare providers and athletic trainers to assist in the diagnosis and management of concussions. The SCAT3 should be used in conjunction with other clinical tests, such as the NSE or the SAC. The SCAT3 is not intended to be used by non-athletes. It is not a substitute for other clinical tests, such as the NSE or the SAC.

Symptom Evaluation

How do you feel?

You should score yourself on the following parameters, based on how you feel now:

- **Headache**
  - None (0)
  - Mild (1)
  - Moderate (2)
  - Severe (3)
- **Nausea or vomiting**
  - None (0)
  - Mild (1)
  - Moderate (2)
  - Severe (3)
- **Temperature**
  - Normal (0)
  - Mild (1)
  - Moderate (2)
  - Severe (3)
- **Balance**
  - Normal (0)
  - Mild (1)
  - Moderate (2)
  - Severe (3)
- **Vision**
  - Normal (0)
  - Mild (1)
  - Moderate (2)
  - Severe (3)
- **Fatigue**
  - Normal (0)
  - Mild (1)
  - Moderate (2)
  - Severe (3)
- **Dizziness**
  - Normal (0)
  - Mild (1)
  - Moderate (2)
  - Severe (3)
- **Mental fatigue**
  - Normal (0)
  - Mild (1)
  - Moderate (2)
  - Severe (3)

The total score range is 0 to 12. A score of 0 to 3 indicates no significant injury. A score of 4 to 6 indicates a possible injury. A score of 7 or more indicates a probable injury. The SCAT3 should be used in conjunction with other clinical tests, such as the NSE or the SAC. The SCAT3 is not intended to be used by non-athletes. It is not a substitute for other clinical tests, such as the NSE or the SAC.

Cognitive & Physical Evaluation

Cognitive assessment

**Standardized Assessment of Concussion (SAC)°**

- **0 points (total score)**
  - What month is it?
  - What is the day today?
  - What is the day of the month?
  - What year is it?
  - What time do you need to reach T1?

- **Orientation score**
  - Immediate memory
    - Name: __________
    - Date: __________
    - 1-2-3-4-5
  - Immediatetly recall (3-4-5-6-7)

- **Inappropriate memory score total**
  - Concentration (Right-Backward)
    - 4-3-2-1
  - Concentration (Left-Forward)
    - 4-3-2-1
  - Total (L-R)

**Neck Examination**

**Range of motion**
- Hyperextension: Up to 5 cm
- Hyperflexion: Up to 5 cm

**Balance examination**

- **Footprint**
  - Flat foot:
  - High arch:
  - Flat foot:
  - High arch:
  - Flat foot:
  - High arch:

**Coordinated eye movements**

- **Right**
  - Left:
  - Up:
  - Down:

**Reflexes**

- **Deep**
  - Achilles:
  - Patellar:

**SAC Delayed Recall**

**Delayed recall score**

- **Left hand**
  - __________
  - __________
  - __________
  - __________

- **Right hand**
  - __________
  - __________
  - __________
  - __________

- **Total score**
  - __________

Any athlete with a suspected concusion should be REMOVED from play, medically assessed, monitored for deterioration, and returned to play only if the athlete is asymptomatic. The athlete should be kept out of contact sports until cleared to do so by a medical professional. No athlete diagnosed with concussion should be returned to sports participation on the day of injury.
Concussion Baseline Testing

ImPACT®
Immediate Post-Concussion Assessment and Cognitive Testing

Computer-Based Neurocognitive Testing

Reaction Time
Processing Speed
Visual Memory
Verbal Memory

What ImPACT Is and Isn’t:

- IS a useful and reliable/valid concussion management program.
- IS a tool to help determine recovery from injury.
- IS a tool to help manage concussion (e.g., return to exertion, return to academics, return to play).
- IS a tool to help communicate post-concussion status to coaches, parents, clinicians.
- IS NOT a substitute for medical evaluation / treatment.
## Balance Error Scoring System (BESS)
(Guskiewicz)

### Balance Error Scoring System – Types of Errors
1. Hands lifted off iliac crest
2. Opening eyes
3. Step, stumble, or fall
4. Moving hip into > 30 degrees abduction
5. Lifting forefoot or heel
6. Remaining out of test position >5 sec

The BESS is calculated by adding one error point for each error during the 6 20-second tests.

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

**BESS TOTAL:**

Which foot was tested: □ Left □ Right (i.e. which is the **non-dominant** foot)
Vestibular/Ocular Motor Screening (VOMS)

Quick screen of 5 common clinical tests:
- 1. Smooth Pursuit
- 2. Horizontal and Vertical Saccades
- 3. Convergence
- 4. Horizontal and Vertical Vestibular Ocular Reflex (VOR)
- 5. Visual Motion Sensitivity (VMS)

Following each assessment in the VOMS, patient rate the following symptoms 0 (none) to 10 (severe):
- Headache
- Dizziness
- Nausea
- Fogginess

Convergence is also assessed on near point of convergence (NPC) distance:
- Normal ≤5cm
Nystagmus can be a result of any disorder that results in the decreased or abnormal function of the VOR.

Abnormal VOR allows/makes the eyes drift to one side, followed by a central compensatory jerk of the eyes.

- Can be horizontal—with peripheral UVH
- Can be vertical—with central disorders
- Can have vertical or horizontal AND rotational component—with BPPV
VOMS

Convergence

Horizontal and Vertical Smooth Pursuits

Horizontal and Vertical VOR

Horizontal and Vertical Saccades

Visual Motion Sensitivity
### UPMC Vestibular/Ocular-Motor Screening (VOMS) for Concussion

<table>
<thead>
<tr>
<th>Vestibular/Ocular Motor Test:</th>
<th>Not Tested</th>
<th>Headache 0-10</th>
<th>Dizziness 0-10</th>
<th>Nausea 0-10</th>
<th>Fogginess 0-10</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASLINE SYMPTOMS:</td>
<td>N/A</td>
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<tr>
<td>Smooth Pursuits</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Saccades – Horizontal</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Saccades – Vertical</td>
<td></td>
<td></td>
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<tr>
<td>Convergence (Near Point)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(Near Point in cm): Measure 1: _____ Measure 2: _____ Measure 3: _____</td>
</tr>
<tr>
<td>VOR – Horizontal</td>
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<tr>
<td>VOR – Vertical</td>
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<tr>
<td>Visual Motion Sensitivity Test</td>
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</tbody>
</table>

*Mucha et al, 2014*
Tests for VOR

- **Static and Dynamic Visual Acuity**
  - Allows us to see clearly when our head moves
  - Measure static acuity first
  - Dynamic: Tilt head forward 30 deg and move head at 2 Hz (2 side to side cycles per sec)
  - Note line pt. can accurately read all letters
  - >2 line change in score indicates vestibular impairment

- **Head thrust test:**
  - Maintain stable gaze with head movement
  - Specificity is 100%; Sensitivity 35% but if you tilt head 30 deg increases sensitivity
  - hold zygomatic arches, not mandible
  - high velocity but only about 15 deg rotation
  - Random!
Early Management

- Education is KEY: “May feel worse before you feel better”
  - Patient
  - Family
  - Trainer/Coaches

- Prognosis: provide estimate of expected recovery times (adults heal faster)
  - 2-3 days for adults
  - 7-10 days for college athletes
  - 14-21 days for high school athletes
  - 28-35 days for middle school athletes

- Refer to MD or ED if symptoms worsen: HA, seizures, visual disturbances, N/T, extremity weakness, drowsiness
Early Management

- HA: Can take anti-inflammatory to help with pain
- Environment: screen time, bright lights, crowds
- Sleep: important for healing, consider routine bedtime, wake up time
  - if troubled: consider over-the-counter med’s such as melatonin or Benadryl
Dizziness: Vestibular Interventions

- Adaptation: Improve gaze stability by increasing the gain of the VOR
- Habituation: Reduce sensitivity through repeated exposure
- Substitution: Use of other strategies to replace lost or compromised function
- Balance & Gait
- Optokinetic Stimulation: busy background videos/simulations
- Repositioning Maneuvers (For BPPV)
Vestibular adaptation exercises

- X1 viewing exercises:
  - Head moving while visually fixating on a stationary target
  - Hold or place letter/target, i.e. X, at ~2 to 3 feet away at eye level
  - Turn head side to side or up and down 20–30° in either direction
  - Maintain target clear and stable
  - Provoke dizziness

- X2 viewing exercises:
  - Head moving while visually fixating on a moving target
  - Hold a business card with a letter, i.e. X, at arms length (or have someone else hold the card for you)
  - Turn head side to side or up and down 10-15° in either direction while moving the target in the opposite direction
  - Maintain clarity of target
  - Provoke dizziness

Goal: 1-2 minute of continuous gaze stability exercise, 3x in a row, 3 times/day
Vestibular habituation exercises

- A long-term reduction in the pathologic response to a specific movement (noxious stimuli), brought about by repeated exposure to the provocative stimulus
- Have the patient complete a motion that creates dizziness
- Wait for the dizziness to end plus 40-60 seconds
- Repeat motion 5-10x
- Treatment considerations
  - 2-3 Motions/movements that are moderately stimulating
  - Number of repetitions (5-10 repetitions)
  - Frequency (3-5 times each day)
Vestibular substitution exercises

- **Visual Fixation on Stationary Object**
  - X1 viewing at slow speed to increase use of cervico-ocular reflex and central pre-programming

- **Active Eye Movements Between 2 Targets**
  - Facilitates use of saccadic or smooth pursuit strategies and central pre-programming
  - Hold 2 targets at eye level 10-12 inches apart, head in midline
  - Move eyes to one target
  - Maintain eyes on target and turn head to same target
  - Shift eyes to 2nd target
  - Move head to 2nd target
  - Repeat in opposite direction

- **Remembered/Imaginary Targets**
  - Improve voluntary control and central pre-programming
  - Place target directly in front of patient
  - While looking at the target, close eyes
  - Slowly turn head away while imagining the target
  - Have them open their eyes and verify still focused on the target adjust gaze if necessary
  - Repeat in multiple directions and at variable speeds
Late management

- Failed test becomes treatment
- Progress by incorporating other treatment categories:
  - Balance: SLS, unstable surface
  - Ocular: busy background, near vs far vision
  - Cognition: count backwards, dual tasking etc..
- DO NOT push patient past symptoms: best to stop at symptom onset
  - HA, dizziness, nausea, fogginess
Return to Sport

**Traumatic head injuries**

A concussion occurs when a blow to the head results in the brain slamming against the skull.

**Impact**

- **Concussion**: Brain collides with skull, which can cause bruising, torn tissues and swelling.
- **Symptoms**: Headache, dizziness, confusion, nausea, difficulty hearing and seeing, lack of concentration

**Second impact syndrome**

- **Brain swells**: Massive swelling of brain
- **Skull**: Cuts off flow of fresh blood to brain

**Blood flow**

**SOURCE**: American Academy of Neurology, U.S. Centers for Disease Control and Prevention, KRT

**State Journal**
1. Symptoms Resolution:
   - They must feel completely normal
   - Ask coach or Athletic Trainer if patient seems back to normal
   - Ask parents or siblings if they are back to normal

2. Normal Neurologic Exam:
   - Cranial Nerves, VOMS, and balance tests

3. Neurocognitive testing results returned to baseline
   - E.g. ImPACT results

4. Exertion
   - Graduated physical activity with no return of symptoms
New Technology for concussion prevention: Q collar
Symptoms are more than just a headache so make sure to ask about each one and dig into them.

Early management is focused on managing patient symptoms and screening for any other serious complications.

Late management can be categorized into one of 4 categories: Vestibular, Ocular, Cognitive, Migrainous.

VOMS is not only a great assessment tool but can also help direct your treatment.

Be objective especially when it comes to return to work/play where outside pressures may try to influence clinical judgment.
Resources

- CDC Heads-up to Healthcare Providers
  - https://www.cdc.gov/headsup/providers/index.html
  - FREE – PDFs, online concussion courses, discharge criteria, progressive activity handouts

- Medbridge
  - Concussion courses for CEUs – Free as Kaiser PTs
  - Patient Education – Concussion video/handout

- SCAT 3
  - PDF of inventory or can be done online
Selected References

- Arnold T. Concussion in Sport: SCS Prep Course. lecture presented at the: Medbridge Education; June 1, 2019.

