Office Evaluation of Concussion

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Objectives

• Be aware that concussion is a diverse injury
• Become familiar with the role of the vestibular and ocular systems in concussive injuries
• Be aware that concussion treatment is active and can begin early in the course of recovery
Disclosure

• I have no financial relationships with any company
Definition

• Concussion is a brain injury and is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces. Several common features that incorporate clinical, pathologic, and biomechanical injury constructs that may be utilized in defining the nature of a concussive head injury include:

  1. Concussion may be caused by a direct blow to the head, face, neck, or elsewhere on the body with an “impulsive” force transmitted to the head.

  2. Concussion typically results in the rapid onset of short-lived impairment of neurologic function that resolves spontaneously. However, in some cases, symptoms and signs may evolve over a number of minutes to hours.

  3. Concussion may result in neuropathologic changes, but the acute clinical symptoms largely reflect a functional disturbance rather than a structural injury, and as such, no abnormality is seen on standard structural neuroimaging studies.

  4. Concussion results in a graded set of clinical symptoms that may or may not involve loss of consciousness. Resolution of the clinical and cognitive symptoms typically follows a sequential course. However, it is important to note that in some cases symptoms may be prolonged.

Symptoms
Immediate signs and symptoms

- HA (71%)*
- Feeling slow (58%)*
- Concentration (57%)*
- Dizziness (55%)
- Foggy (53%)*
- Fatigue (50%)*
- Double/blurry vision (49%)
- Photophobia (47%)*
- Memory dysfunction (43%)*
- Balance (43%)*

- Vacant stare
- Delayed verbal expression
- Inability to focus attention
- Disorientation
- Slurred or incoherent
- Gross observable incoordination
- Emotionality out of proportion to circumstances
- Memory deficits
- LOC

*Lovell, Collins et al, 2004
Acute Concussion Evaluation Tools

Sideline evaluation
• SCAT-3
• SAC
• ACE- sideline version
• BESS testing
• King-Devick

In-Office evaluation
• Comprehensive neurologic eval
• Acute Concussion Evaluation (ACE) checklist- physician/clinician office version and care plan
Best test to diagnose a concussion?

• Conclusion
  • An evidence-based recommendation for any individual screening test or protocol is not possible.
  • The SCAT the most well-established and rigorously developed instrument available for sideline assessment
  • Video review
  • Serial examinations needed to detect concussion
  • King-Devick—needs more testing
  • Impact sensor systems for real-time concussion screening—no evidence

Immediate vs Delayed Removal from SRC

- Asken et al. *J Ath Training 2016*
  - Athletes with a delayed removal (12.3 ±12.2 days) from play after concussion take longer to recover than athletes immediately removed (6.8 ± 2.6 days)
    - At one week 70% Immediate removal back vs 40% Delayed
    - At 15 days approx 98% Immediate removal athletes back vs 84% Delayed
Immediate vs Delayed Removal from SRC

• Eblin R et al *Pediatrics* 2016
  • Compared young athletes recovery after SRC between those who were removed immediately and those who continued to play.
  • The mean number of days from date of injury to medical clearance was 44.4 ± 36.0 days (range, 10–164 days) for the PLAYED group compared with 22.0 ± 18.7 days (range, 8–88 days) for the REMOVED group.
  • Athletes in the PLAYED group were 8.80 times more likely to experience a protracted recovery (21 days) compared with athletes in the REMOVED group.
In Office Evaluation
History

• Mechanism of Injury
• Risk Factors
• Concussion domains
  • Sleep
  • Mood
  • Somatic
  • Cognitive
• Symptom score
Questions to ask

- How many previous head injuries has the athlete sustained?
- How did the injuries occur?
- What were/are the symptoms?
- How long did symptoms last?
- Amnesia?
- How long was the athlete withheld from practice?
- Did the athlete miss competition?
- Difficulty in class? Academic performance?
- How long until felt 100% normal?
- Are there other “dings”, hits to the head or dazed episodes that have not been considered a concussion?
Predictors of Prolonged Recovery

• LOC, PTA $^1$
  • LOC not a predictor in other studies
• Pre-injury psychiatric history e.g. anxiety $^2$
• Female $^2$
• Younger athletes especially with history of multiple concussions $^3$
• ADHD/ADD and migraines, complicate dx and tx of concussions $^4$

$^1$McCrea et al J Intl Neuro Society 2012
$^2$Ponsford J et al Neuropsych 2012
$^3$Collins M et al Neurosurg 2002
$^4$Harmon K et al Br J Sp Med 2013
Predictors of Prolonged Recovery- cont

• Dizziness- 6.3 x greater risk for protracted (>21 days) recovery\textsuperscript{5}
• Greater symptom load, HA > 60 hrs, fatigue and fogginess\textsuperscript{6}
• Motion sickness and ocular dysfunction\textsuperscript{7}
• Migraine History\textsuperscript{8}

\textsuperscript{5}Lau et al Am J Sp Med 2011
\textsuperscript{6}Makdissi et al Am J Sp Med 2010
\textsuperscript{7}Kontos, Mucha Data under review
\textsuperscript{8}Kontos A et al AJSM 2013 & Mihalik et al J Neurosurg 2006
## Concussion Symptoms By Category

<table>
<thead>
<tr>
<th>SOMATIC</th>
<th>COGNITIVE</th>
<th>EMOTIONAL</th>
<th>SLEEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>Feeling mentally foggy</td>
<td>Irritability</td>
<td>Sleeping more than usual</td>
</tr>
<tr>
<td>Fuzzy or blurry vision</td>
<td>Feeling slowed down</td>
<td>Sadness</td>
<td>Sleeping less than usual</td>
</tr>
<tr>
<td>Dizziness</td>
<td>Difficulty concentrating</td>
<td>Feeling more emotional</td>
<td>Trouble falling asleep</td>
</tr>
<tr>
<td>Fatigue</td>
<td>Difficulty remembering</td>
<td>Nervousness or anxiety</td>
<td></td>
</tr>
<tr>
<td>Drowsiness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photophobia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phonophobia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balance problems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nausea or vomiting</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Monitor Symptoms at Each Visit

**CONCUSSION SYMPTOM SHEET**

<table>
<thead>
<tr>
<th>SYMPTOMS</th>
<th><strong>SCORE</strong>: 0 = No Symptoms; 1 = Minor; 5 = Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Nausea</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Vomiting</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Balance Problems</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Dizziness</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Fatigue</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Trouble falling asleep</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Sleeping more than usual</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
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<tr>
<td>Sleeping less than usual</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Drowsiness</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Sensitivity to Light</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Sensitivity to Noise</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Irritability</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Sadness</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Nervousness</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Feeling more emotional</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Numbness or tingling</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Feeling pulled down</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Feeling emotionally ready</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Difficulty concentrating</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Difficulty remembering</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
<tr>
<td>Visual problems such as double vision, blurring, etc.</td>
<td>🗓️ 0 🗓️ 1 🗓️ 2 🗓️ 3 🗓️ 4 🗓️ 5 🗓️ 6 🗓️ 8</td>
</tr>
</tbody>
</table>

**COMMENTS**

______________________________________
Vestibular Dysfunction*

• Dizziness, vertigo, and altered balance
• Associated with prolonged symptoms, higher risk of PCS, and more disability
• Treated mainly with vestibular rehabilitation

* Matuszak JM et al Sp Health 2016;8(3):260-269
Vestibular Evaluation*

• Screening questions
  • Do busy environments increase your dizziness or fogginess
  • Does looking up/down/turning your head make you dizzy?
  • Do quick movements bring on your symptoms?
  • Do you have increased symptoms while riding in a car?
  • Do you get blurred or fuzzy vision while reading?

*Collins, MW Knee Surg Sports Traumatol Arthros 2014
Ocular Evaluation*

• Up to 40% of TBI patients suffer from visual dysfunction, such as reduced near point of convergence, poor accommodation, and oculomotor tracking abnormalities.

• Vision difficulties or dysfunction may interfere with return to school because of the high visual demands, especially with reading and computer use, end-day fatigue.

• Many causes of vision dysfunction can be treated with vision therapy.

* Matuszak JM et al Sp Health 2016;8(3):260-269
Physical Examination

• **VS-**
  • If abnormal may be due to autonomic dysregulation

• **Psyche eval-**
  • Attitude, eye contact, motor behavior, mood, affect, speech, thought

• **Neurocognitive assessment**
  • Short and delayed recall of 3-5 words
  • Reverse numbers up to 7
  • Serial 7s
  • WORLD backwards
  • Months of the year backwards
Vestibular Ocular Motor Screen (VOMS)


https://www.youtube.com/watch?v=E2uF0lcyNps
Balance Testing

• Romberg

• Balance Error Scoring System (BESS)
  • Feet together
  • Double stance dominant foot forward
  • Single stance non-dominant leg
  • Errors
    • 1) Open eyes 2) Feet break contact with ground 3) Hands off hips 4) Moving hip into > 30 degrees abduction 5) Unable to regain starting position after 5 sec 6) Step, stumble, or fall
## Evidence-Based In-Office Physical Examination of Concussion

<table>
<thead>
<tr>
<th>Examination</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vital signs including orthostatics</td>
<td>0.21</td>
<td>0.75-0.90</td>
</tr>
<tr>
<td>Neurological exam</td>
<td>0.61</td>
<td>1.0</td>
</tr>
<tr>
<td>Cranial nerve assessment</td>
<td>0.22</td>
<td>0.95</td>
</tr>
<tr>
<td>Manual muscle testing and reflexes</td>
<td>0.20-0.30</td>
<td>1.0</td>
</tr>
<tr>
<td>Balance testing</td>
<td>0.34</td>
<td>0.56</td>
</tr>
<tr>
<td>Vestibular-ocular exam</td>
<td>0.60</td>
<td>0.70</td>
</tr>
<tr>
<td>History + balance + vestibular testing</td>
<td>0.80-1.0</td>
<td>0.83</td>
</tr>
</tbody>
</table>

Matuszak JM et al *Sports Health* 2016;8(3): 260-269  
Resch JE et *BMJ Open Sport Exerc Med* 2016;2(1)
Clinical Recommendations

**SORT: Strength of Recommendation Taxonomy**
- **A:** consistent, good-quality patient-oriented evidence
- **B:** inconsistent or limited-quality patient-oriented evidence
- **C:** consensus, disease-oriented evidence, usual practice, expert opinion, or case series

<table>
<thead>
<tr>
<th>Clinical Recommendations</th>
<th>SORT Evidence Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instead of a comprehensive neurologic examination after concussion, a focused neurologic and physical examination may be performed</td>
<td>C</td>
</tr>
<tr>
<td>Screening ocular examination should include: evaluation of the eyes for nystagmus, saccades, smooth pursuits, and near point of convergence</td>
<td>A</td>
</tr>
<tr>
<td>Fundoscopy for evaluation of papilledema is probably of low yield in the concussion evaluation and may be reserved for cases where there is clinical concern.</td>
<td>C</td>
</tr>
<tr>
<td>If dizziness or imbalance is present, consider orthostatic vital signs</td>
<td>B</td>
</tr>
</tbody>
</table>

Matuszak JM et al *Sports Health* 2016;8(3): 260-269
Treatment
Concussion Clinical Trajectories

Adapted from: Collins MW, Kontos A. KSST 2014;22(2)235–246
Vestibular trajectory

- Dizziness, fogginess, nausea, anxiety, and overstimulation in more complex environments.
- Symptoms worse when in busier, more stimulating environments.
- Rapid head or body movements may exacerbate symptoms.
- May have increase in vestibular symptoms while in school or at work, with a decrease when at home.
Oculomotor

- Difficulties with visually based classes, and difficulties with focus.
- Difficulties with extended time in front of computer screens or while reading.
- Full days of school or work may intensify symptoms, with an overall decrease in symptoms over the weekend.
- Headache may be exacerbated by extended time reading or working on the computer.
- Blurred or double vision.
- Difficulty seeing the board in school, or reading text on the television.
- Difficulties in visually based classes, such as math and science.
Cognitive/Fatigue

• Fatigue, decreased energy levels, non-specific headache, and potential sleep disruption
• Increase in symptoms towards the end of the day.
• Questions regarding perceived difficulties concentrating, or focusing on school/work projects
Post-traumatic migraine

• Migrainous HA, photophobia, phonophobia, dizziness
• HA are intermittent, although in more severe cases, the headache may be chronic and consistent\(^1\)
• May be exacerbated by increased stress, sleep dysregulation, anxiety or emotional changes, and dietary triggers\(^1\)
• 7.3 x risk for prolonged recovery > 21 days compared to athletes without headache\(^2\)
• Same athletes with PTM 2.6 x risk for protracted recoveries than athletes with HA, but no migraine-based sx\(^2\)

\(^1\)Collins MW, Kontos A. KSST 2014;22(2)235–246
Cervical

• Headache and neck pain

• Asking about the onset and course of daily headaches will help to identify triggers.

• When cervical involvement is suspected, a careful assessment by a certified physical therapist is warranted.
Anxiety and mood

• Overall increase in anxiety, including ruminative thoughts, hypervigilance, feelings of being overwhelmed, sadness, and/or hopelessness

• Sleep disturbance that is sometimes caused by an inability to quiet their minds, or simply stop thinking and worrying
How we Currently Manage Concussions

REST

- Physical Rest
- Cognitive Rest
Treatment- Rest

• Why rest?
  • Mitigates postconcussion symptoms\(^1\)
  • Rest might promote recovery by minimizing energy demands during hemodynamic and neurometabolic restoration following concussion\(^1\)
  • Athletes are at an increased risk for first 7–10 days after the initial concussion\(^2\)
  • Evidence from clinical studies does not support the efficacy of prescribing complete rest for more than a few days after SRC\(^3\)

\(^1\)Schneider KJ, et al BJSM 2017;0:1–7
\(^2\)McCrea M, Guskiewicz K et al Neurosurgery 2009;65:876–83
\(^3\)Schneider Kj et al BJSM 2017;0:1-7
Treatment- Rest

• What is rest?
  • Initial rest OK, but not prolonged “strict brain rest” social isolation, anxiety, and problems with self-esteem, as well as potential loss of academic standing in students, exacerbation of symptoms, physical deconditioning, school delays, and other academic problems related to accumulating workload

1 Schneider KJ, et al *BJSM 2017;0:1–7*
How Much Rest?

- Studies suggest that too little and too much physical and cognitive rest may delay recovery, whereas an initial brief period of rest may be beneficial.¹

- 5 days of strict rest after injury resulted in longer symptom duration and a higher number of symptoms compared with usual care.²

- Among children and adolescents aged 5 to 18 years (48% sx’atic) with acute concussion, participation in physical activity within 7 days of acute injury compared with no physical activity was associated with lower risk of PPCS at 28 days.³

³ Grool a et al JAMA 2016;316(23):2404-14
Prior to activity

- Educate the patient and get their consent to begin a progression
- Sleep correction
- Initial rest and avoid exacerbating activities
- Control known risk factors
- Treat areas of deficits found during eval
Early Addition of Sports Specific Activity

• Introduce CV conditioning early
• Then work into activities that exacerbate symptoms
• Then allow them to recover
• Importance of adding sport back early
• Add sport without risk of contact
• Progressing adding sport back even with symptoms as long as symptoms do not increase
Treatment

• Sport trains oculomotor, vestibular, reaction time and cognitive systems

• Psychological benefit of not isolating

• Don’t shut down areas that do not exacerbate symptoms
  • If can do easy cardio exercise without increase in sxs- allow
  • If the can read and work on computer- allow
Justification for Early Treatment

- MLB had lower batting average and slugging percentage, and on-base percentage in two weeks after RTP from SRC vs player on bereavement/paternity athletes\(^1\)
- 2.02 x increase risk of lower extremity injury after RTP\(^2\)
- College athletes with concussion with higher risk of non-contact LE strain/sprain\(^3\)
- Increased risk of LE injuries by end of intercollegiate careers\(^4\)

\(^1\)Wasserman EB et al Am J Sports Med 2015
\(^4\)Gilbert et al 2016 Sports Health
## Return to Play

<table>
<thead>
<tr>
<th>Stage</th>
<th>Activity</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. No activity</td>
<td>Complete physical rest- no symptoms at rest before advance RTP</td>
<td>Recovery</td>
</tr>
<tr>
<td>2. Light aerobic exercise</td>
<td>Walking, swimming, aerobic exercise up to 70% max predicted HR, no resistance training</td>
<td>Increase HR</td>
</tr>
<tr>
<td>3. Sport-specific exercise</td>
<td>Sport-specific exercise such as skating and running drills, no head impacts</td>
<td>Add movement</td>
</tr>
<tr>
<td>4. Noncontact training drills</td>
<td>Progress to complex drills; add resistance training</td>
<td>Exercise coordination, add cognitive load</td>
</tr>
<tr>
<td>5. Full contact practice</td>
<td>Normal practice after cleared by medical personnel</td>
<td>Restore confidence and timing, allow assessment of functional skills</td>
</tr>
<tr>
<td>6. Return to play</td>
<td>Normal game play</td>
<td>Full return to play</td>
</tr>
</tbody>
</table>

Adapted from Halstead M et al *Pediatrics* 2013;132(5):948-957)
Multidisciplinary Treatment Team

- Typically a primary care physician
- Neurologist
- Neurosurgeon
- PMR
- Clinical neuropsychologist
- Physical or vestibular therapist
- ATC
- Optometrist or ophthalmologist
- Speech and language pathologist
- Clinical or sport psychology professional
- Occupational therapist
Sleep

• Needs to be addressed early since there is often a sleep overlay that permeates across each clinical subtype of SRC.
• Melatonin together with basic sleep hygiene can help regulate circadian rhythms and promote better sleep-wake cycling
• Antidepressants (e.g., amitriptyline, trazodone) and nonbenzodiazepine hypnotics (e.g., Ambien, Lunesta)
• Avoid neuroleptics (e.g. Seroquel), excess ETOH, anticholinergics (Benadryl), benzos

Sleep

• Glymphatic system
  • Functional waste clearance pathway for vertebrates
  • Cleanses brain of toxic molecules
  • Helps control flow of CSF
  • Facilitates brainwide distribution of glucose, lipids, AA, growth factors
  • Efficient elimination of soluble proteins and metabolites
  • Functions mainly during sleep and is disengaged during wakefulness

Xie et al Science October 18, 2013 DOI: 10.1126/science.1241224
Sleep Assessment

• Do you fall asleep easily?
  • Is this normal for you?

• Do you wake up in the middle of the night?
  • Is this normal for you?

• Can you fall back to sleep easily if you wake up at night?
  • Is this normal for you?

• Are you waking up in the morning at your normal time?

• Do you feel refreshed when you wake up in the morning?
  • Is this normal for you?

• Are you having nightmares?
  • Is this normal for you?

• Are you having unusual body movements at night?
  • Is this normal for you?
Nutrition
Omega-3 Fatty Acids (O3FA)

• O3FA prior to concussion:
  • Neuroprotective (preserves neuroplasticity, learning, motor control (rats)\(^1\)
  • ↓ biomarkers and apoptosis (rats)\(^2\)
  • Provides resistance to oxidative stress seen after concussion (rats)\(^3\)

• O3FA after concussion:
  • Helps maintain genomic stability and cellular homeostasis (rats)\(^4\)

• No human studies of high level of evidence to confirm animal studies\(^5\)

\(^2\) Wu A et al *J. Neurotrauma.* 2007; 24:1587-95
\(^3\) Wu A et al *J. Neurotrauma.* 2011; 28:2113-22
Other Nutraceuticals*

- Curcumin (tumeric)
- Resveratrol antioxidant (one human study in progress)
- Melatonin neuroprotective and regulates circadian rhythms (one human study ends in 2019)
- Creatine- human data shows promise
- Vitamin C, D and E

Treatment-Cognitive/Fatigue

• Reducing demands from both a cognitive and physical perspective
• Sxs worse at end of the day
• Regulated sleep schedule diet, hydration, stress
• Exercise - low level
• Pharmacological treatment in the form of neurostimulants, particularly amantadine; methylphenidate, Adderall
• Melatonin, zolpidem, and eszopiclone

Collins MW, Kontos A. KSST 2014;22(2)235–246

2 Reddy C et al J Head Trauma Rehabil;28(4)260–265
Anxiety/mood

• Exercise can be a critical treatment
• Increased exertion will not only serve as an emotional release, but helps decrease arousal
• Need structure and this type of regimented schedule will help to regulate autonomic functioning and again, speed recovery
• Amitriptyline, SSRI, SNRI if not better with activity
• Klonopin if vestibular component?
• Psychotherapy

Broglio, SP et al Clin Sports Med 2015; 34; 213-31
Collins MW, Kontos A. KSST 2014;22(2)235–246
Post-traumatic migraine

• Tricyclic and SSRI antidepressants, anticonvulsants (eg, topiramate, gabapentin, valproic acid), or β-blockers.
• Abortive therapies include triptans (eg, Imitrex, Maxalt)
• Increased cardiovascular activity
• Despite anecdotal evidence regarding the effectiveness of these treatments, there are no empirical studies of the effectiveness of these medications in athletes with SRC

Cervical

• PT
  • Biofeedback
  • Manual therapy
  • Trigger point injections
  • Modalities
  • Range of Motion/Muscle Stretching,
  • Endurance and Activation
  • Physical Conditioning

• Medications
Oculomotor

• Specifically trained neuro-optometrist or other vision therapy provider is preferable.
• Audiobooks to reduce reading requirements
• Adults- frequent computer breaks
Vestibular

• Comprehensive vestibular evaluation and physical therapy
• Benzos may help with severe vestibular dysfunction symptoms triggered by vestibular overstimulation
Return to School
## Return to Learn

<table>
<thead>
<tr>
<th>Signs/Symptoms</th>
<th>Potential Adjustments in School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>Frequent breaks</td>
</tr>
<tr>
<td></td>
<td>Identify aggravators and reduce exposure</td>
</tr>
<tr>
<td></td>
<td>Plan rest and quiet time in school (nurse’s office)</td>
</tr>
<tr>
<td>Dizziness</td>
<td>Allow student to place head down</td>
</tr>
<tr>
<td></td>
<td>Allow student to avoid crowded hallways</td>
</tr>
<tr>
<td>Visual Symptoms</td>
<td>Reduce exposure to computers, videos, smart boards</td>
</tr>
<tr>
<td></td>
<td>Reduce brightness of screens</td>
</tr>
<tr>
<td></td>
<td>Audiotapes of books</td>
</tr>
<tr>
<td>Noise Sensitivity</td>
<td>Lunch in a quiet area</td>
</tr>
<tr>
<td></td>
<td>No band, choir, or shop classes</td>
</tr>
<tr>
<td></td>
<td>No noisy gyms, earplugs</td>
</tr>
<tr>
<td>Difficulty Concentrating</td>
<td>Extra time to complete tasks</td>
</tr>
<tr>
<td></td>
<td>Oral test taking or reduce number of written tests to one per day</td>
</tr>
<tr>
<td>Sleep Disturbances</td>
<td>Allow for late start and/or shortened day</td>
</tr>
<tr>
<td></td>
<td>Allow rest breaks</td>
</tr>
</tbody>
</table>

Other Accommodations

• Photophobia-
  • Avoid sun, wear sunglasses, diminish brightness of computer

• Fogginess-
  • Watch videos, TV, etc for shorter period of time

• Cognitive deficit/Fatigue
  • Avoid reading for prolonged periods
Other Accommodations

• Dizziness-
  • Avoid over-stimulating peripheries and large areas with people, driving a car
    • Vestibular issues- decrease early VOR overstimulation by wearing hooded sweatshirt?

• Anxiety
  • Don’t isolate, normalize feelings, exercise

• Oculomotor
  • Enlarge font and move away from screen
Return To Work\textsuperscript{1}

- Evidence-based systematic protocols for return to work after concussion do not currently exist
- Clinical recommendations for returning employees are provided on the ACE Care Plan-Work version in the CDC Heads Up to Healthcare Providers including schedule considerations (eg, shortened workday, more frequent breaks) and safety considerations (eg, not lifting heavy loads, operating risky machinery\textsuperscript{2}

\textsuperscript{1}TEAM Collins MW and Kontos AP et al Neurosurg 2016;79(6): 212-19
\textsuperscript{2}Centers for Disease Control and Prevention. HEADS UP to Providers. 2015 Available at: http://www.cdc.gov/headsup/providers/index.html.
A Brief Word About.......
Hoped to have this information for you

- 5th International Consensus Conference on Concussion in Sport
  - October 27-28
  - Berlin, Germany
State concussion law

• SB 1521
  • Education and notification of the risk of injury through training and/or concussion information sheet
  • Remove the injured athlete from play
  • Obtain permission to RTP
    • RTP only after at least 24 hours and after evaluation by a health professional
Biomarkers

- **Acute**
  - UCH-L1 (neuronal cell body damage)
  - GFAP (glial injury)
  - SBDP 150 (axonal injury)

- **Subacute**
  - SBDP 120 (axonal injury)
  - CNPase (demyelination)
  - MAP2 (dendritic injury)

- **Chronic**
  - BA 0293
Neurocognitive Testing

**Pros**
- More objective measure of testing
- Baseline data before concussion
- Recovery and RTP can be decided more objectively

**Cons**
- Gaming the system
- Cost
- Time
- Availability
- Training
Useful Resources

• [https://www.cdc.gov/headsup/pdfs/providers/ace-a.pdf](https://www.cdc.gov/headsup/pdfs/providers/ace-a.pdf)
  • Template for office concussion evaluation

• [https://www.wiaawi.org/Portals/0/PDF/Health/AcuteConcussionEval.pdf](https://www.wiaawi.org/Portals/0/PDF/Health/AcuteConcussionEval.pdf)
  • Template for care plan

• [https://www.youtube.com/watch?v=E2uF0NcyNps](https://www.youtube.com/watch?v=E2uF0NcyNps)
  • Youtube video on VOMS

• Return to School and Learning After Concussion: Tips for Pediatricians
    • Good information on various accommodations

• Targeted Evaluation and Active Management Approaches to Treating Concussion
  • Collins MW, Kontos AP et al Neurosurg 2016;79(6):912-929

• Rest and treatment/rehabilitation following sport-related concussion: a systematic review
Sleep*

• Concussions can cause
  • Sleep fragmentation, delayed sleep onset, increased awakenings and time awake during the night, and reduced sleep efficiency
  • Injuries, depression, anxiety can all affect sleep
  • Insomnia and Circadian Dysregulation
  • For example, mTBI is frequently associated with significant autonomic dysregulation and alterations in normal circadian patterns
  • Head injuries and neurotrauma may affect normal melatonin production

Sleep

• Brain regions and systems regulating arousal, alertness, attention and sleep are vulnerable to TBI\(^1\)

• Asso with anxiety, depression and pain, but does not account for all sleeping disorder after concussion\(^1\)

• Peds pts with perceived sleep disturbance reported greater number of concussion sx and lower neurocognitive function\(^2\)

\(^1\)Ponsford J et al *J of Head Trauma Rehab: May/June 2012*

\(^2\)Kostyun RO et al *Am J Sports Med Dec 2014*
Sleep Recommendations
“Good Sleep Hygiene”

Good Sleep Habit
• Bedroom should be comfortable, quiet, dark and have a comfortable temperature
• Light music or fan in room can help with consistent noise
• Avoid bright light exposure near bedtime
• Avoid caffeine in afternoon or evening (Energy drinks, Soda, coffee, tea etc)
• Avoid tobacco
• Avoid eating or drinking for 2 hours before bed.
• Use the bathroom before you go to bed
• Follow a relaxing, calming bedtime routine.
• Go to bed and wake up at the same time every day, even on weekends.
• With concussion attempt to extend sleeping some on both ends Go to bed a little earlier sleep a little later?
• Do not sleep or nap for an extended time during the day.
• Avoid visual stimuli from electronics (Phone, computer, tablet) for an hour before your going to bed

https://dvbic.dcoe.mil/resources/management-sleep-disturbances

**What is the SCAT3?**

The SCAT3 is a standardized tool for evaluating injured athletes for concussion and can be used in athletes aged 12 years and older. It supersedes the original SCAT and the SCAT2, published in 2015 and 2010, respectively. For younger persons, ages 12 and under, please use the FSI-SCAT. The SCAT3 is designed for use by medical professionals. If you are not qualified, please use the Sport Concussion Assessment Tool. Pressure-based testing with the SCAT3 can be helpful for interpreting post-injury testing results.

Specific instructions for use of the SCAT3 are provided on page 3. If you are not familiar with the SCAT3, please read through these instructions carefully. This test may be heavily relied on in court or for disputes between athlete, teams, groups, or organizations. Any variation on any of these rules is not approved by the Concussion in Sport Group (CISG).

CISG: The diagnosis of concussion is a clinical judgment, ideally made by a medical professional. The SCAT3 should not be used solely to evaluate or exclude the diagnosis of concussion in the absence of clinical judgment. An athlete may have a concussion even if the SCAT3 is "normal."  

What is a concussion?  
A concussion is a brain injury that occurs when a direct or indirect force to the head results in a variety of non-specific signs and symptoms (some examples follow). Most often, it does not involve loss of consciousness. Concussion should be suspected in the presence of any one or more of the following:
- Symptoms (e.g., headache),
- Physical signs (e.g., vomiting),
- Impaired behavior (e.g., confusion),
- Abnormal sleep (e.g., change in personality).  

**SIDELINE ASSESSMENT**

**Indications for Emergency Management**

**CISG:** A hit to the head can sometimes be associated with a more serious brain injury. For any of the following wounds, consider consulting a team physician or emergency room physician:
- Glasgow coma scale < 15
- Delirium or amnesic state
- Immediate memory loss
- Propagation, worsening, symptoms or new head signs

**Potential signs of concussion?**

If any of the following signs are observed after a direct or indirect blow to the head, the athlete should stop playing, be evaluated by a medical professional, and should not be permitted to return to sports the day of the concussion.

Any loss of consciousness:
- "If you lose consciousness":
- Balance or motor incoordination (double vision, disorientation, etc.)
- Disorientation or confusion (inability to answer questions accurately)
- Loss of memory:
- "Do you have a headache?"

Any athlete with a suspected concussion should be REMOVED FROM PLAY and medically assessed, monitored for deterioration (e.g., should not be left closed and should not drive a motor vehicle until cleared to do so by a medical professional). For athletes diag-

---

**Glasgow coma scale (GCS)**

<table>
<thead>
<tr>
<th>Eye opening response</th>
<th>Motor response</th>
<th>Verbal response</th>
</tr>
</thead>
<tbody>
<tr>
<td>No eye opening</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Eye opening to pain</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Eye opening to speech</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Eye opening to conversation</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Best verbal response</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>No verbal response</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Inappropriate words</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Confused</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Oriented</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Best motor response</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Motor response</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Extension to pain</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Respiratory arrest</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Loss of consciousness</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Glasgow coma score (GCS)</td>
<td>5 (or X + M)</td>
<td>5 (or X + M)</td>
</tr>
</tbody>
</table>

---

**Maddocks Score**

I am going to ask you a few questions, please listen carefully and give your best effort:

<table>
<thead>
<tr>
<th>Question</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>What time is it now?</td>
<td>0</td>
</tr>
<tr>
<td>Which is it now?</td>
<td>0</td>
</tr>
<tr>
<td>When was last you fell?</td>
<td>0</td>
</tr>
<tr>
<td>When you last you fell?</td>
<td>0</td>
</tr>
<tr>
<td>What was your last at the game?</td>
<td>0</td>
</tr>
<tr>
<td>Maddocks score</td>
<td>6</td>
</tr>
</tbody>
</table>

---

**Name:** [Insert name]

---

Any athlete with a suspected concussion should be REMOVED FROM PLAY. Medical assessment, monitored for deterioration (e.g., should not be left closed and should not drive a motor vehicle until cleared to do so by a medical professional). For athletes diag-
**BACKGROUND**

- **Name**
- **Date**
- **Examiner**
- **Examiner's details**
- **Lapse of time since last injury**
- **Age**
- **Gender**
- **Number of exhaustive training sessions**
- **Examiners' details**
- **Number of exhaustive training sessions**

**SYMPTOM EVALUATION**

**How do you feel?**

- **Fatigue**
- **Headache**
- **Nausea or vomiting**
- **Constipation**
- **Diabetes**
- **Amnesia**
- **Loss of consciousness**
- **Anterior chest pain**
- **Back pain**
- **Bladder urge**
- **Numbness or paresthesias in hands or legs**
- **Visual disturbances**
- **Tinnitus**
- **Difficult concentrating**
- **Inability to remember**
- **Dizziness**
- **Dizziness on turning**
- **Vertigo**
- **Loss of appetite**
- **Nausea**
- **Drowsiness**
- **Difficulty sleeping**
- **Bite**
- **Wound**
- **Bruise**
- **Administered concussion**
- **Other symptoms**

**Cognitive & Physical Evaluation**

**Cognitive assessment**

<table>
<thead>
<tr>
<th>Subtest</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroop test</td>
<td></td>
</tr>
<tr>
<td>Trail Making Test (Parts A &amp; B)</td>
<td></td>
</tr>
<tr>
<td>Digit Span</td>
<td></td>
</tr>
</tbody>
</table>

**Motor evaluation**

<table>
<thead>
<tr>
<th>Test</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Touch Homer test</td>
<td></td>
</tr>
<tr>
<td>Rapid alternating movements</td>
<td></td>
</tr>
<tr>
<td>Finger-to-nose test</td>
<td></td>
</tr>
</tbody>
</table>

**Balance examination**

<table>
<thead>
<tr>
<th>Test</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Star Excursion balance test</td>
<td></td>
</tr>
<tr>
<td>One-leg balance test</td>
<td></td>
</tr>
</tbody>
</table>

**Coordination examination**

<table>
<thead>
<tr>
<th>Test</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nine-hole peg test</td>
<td></td>
</tr>
<tr>
<td>Finger-to-finger test (left to right)</td>
<td></td>
</tr>
<tr>
<td>Finger-to-finger test (right to left)</td>
<td></td>
</tr>
</tbody>
</table>

**SAC Delayed Recall**

<table>
<thead>
<tr>
<th>Score</th>
<th></th>
</tr>
</thead>
</table>
ATHLETE INFORMATION

Any athlete contacted of having a concussion should be removed from play and have a medical evaluation.

Signs to watch for:

- A headache that gets worse
- Ask any question or he has difficulty
- Dizziness or bizarre behavior
- Nausea or vomiting
- Seizure
- Blurred vision
- Faint or pale color
- Hard to wake up
- Drowsy
- Confused

Notes:

Consult your doctor after a suspected concussion.

Return to play:

Athlete should be returned only if the same sign or signs are not present and the patient is fully aware of the condition and can describe the symptoms.

For example:

- Normal behavior
- Normal responses to request
- Normal walking and moving
- Normal level of agitation
- No other symptoms
- No memory loss

There should be at least 24 hours for each stage and if symptoms recur the athlete should rest and then increase the level of activity in this previous asymptomatic stage. Full recovery should only be allowed to the last stage.

If the athlete is asymptomatic for more than 7 days, then consultation with a medical practitioner who is expert in the management of concussions is recommended.

Medical clearance should be given before return to play.

CONCUSSION INJURY ADVICE

(For those who are unsure if they have a concussion)

The athlete has been removed from the game. A careful medical examination has been performed and no signs of a serious concussion have been found. Recovery time is variable across individuals. If the athlete has an injury for which immediate medical attention is necessary, the team medical professional should notify the nearest hospital emergency department immediately.

Other important points:

- Do not drink alcohol.
- Do not take any over-the-counter drugs or medications.
- Do not play sports or participate in any physical activity.
- Do not drive for at least 24 hours.
- Do not play any music to help with the recovery.

Clinic phone number
## 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>Obey commands</td>
<td>6</td>
</tr>
</tbody>
</table>

### Glasgow Coma score (E + V + M) of 15

GCS should be recorded for all athletes in case of subsequent deterioration.
### 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>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>What venue are we at today?</td>
<td>0/1</td>
</tr>
<tr>
<td>Which half is it now?</td>
<td>0/1</td>
</tr>
<tr>
<td>Who scored last in this match?</td>
<td>0/1</td>
</tr>
<tr>
<td>What team did you play last week/game?</td>
<td>0/1</td>
</tr>
<tr>
<td>Did your team win the last game?</td>
<td>0/1</td>
</tr>
</tbody>
</table>

**Maddocks score**

Maddocks score is validated for sideline diagnosis of concussion only and is not used for serial testing.

Permission Granted by British Journal of Sports Medicine
### How do you feel?

"You should score yourself on the following symptoms, based on how you feel now."

<table>
<thead>
<tr>
<th>Symptom</th>
<th>none</th>
<th>mild</th>
<th>moderate</th>
<th>severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>&quot;Pressure in head&quot;</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Neck Pain</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Nausea or vomiting</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Dizziness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Blurred vision</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Balance problems</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sensitivity to light</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sensitivity to noise</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Feeling slowed down</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Feeling like &quot;in a fog&quot;</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>&quot;Don’t feel right&quot;</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Difficulty concentrating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Difficulty remembering</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Fatigue or low energy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Confusion</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Drowsiness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Trouble falling asleep</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>More emotional</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Irritability</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sadness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Nervous or Anxious</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Total number of symptoms (Maximum possible 22)

<table>
<thead>
<tr>
<th>Symptom severity score (Maximum possible 132)</th>
</tr>
</thead>
</table>

Do the symptoms get worse with physical activity?  
Do the symptoms get worse with mental activity?  

- self rated  
- self rated and clinician monitored  
- clinician interview  
- self rated with parent input  

Overall rating: If you know the athlete well prior to the injury, how different is the athlete acting compared to his/her usual self?  

- no different  
- very different  
- unsure  
- N/A  

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### Orientation (1 point for each correct answer)
- What month is it? 0/1
- What is the date today? 0/1
- What is the day of the week? 0/1
- What year is it? 0/1
- What time is it right now? (within 1 hour) 0/1

**Orientation score of 5**

### 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 baby finger</td>
</tr>
<tr>
<td>apple</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>paper monkey penny</td>
</tr>
<tr>
<td>carpet</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>sugar perfume blanket</td>
</tr>
<tr>
<td>saddle</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>sandwich sunset lemon</td>
</tr>
<tr>
<td>bubble</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>wagon iron insect</td>
</tr>
</tbody>
</table>

**Total Immediate memory score total of 15**

### Concentration: Digits Backward

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

**Total of 4**

### Concentration: Month in Reverse Order (1 pt. for entire sequence correct)
- Dec-Nov-Oct-Sep-Aug-Jul-Jun-May-Apr-Mar-Feb-Jan 0/1

**Concentration score of 5**
SCAT

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

Findings:

6 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
- Single leg stance (non-dominant foot):
- Errors
- Tandem stance (non-dominant foot at back):
- Errors

And/or
- Tandem gait:
  - Time (best of 4 trials): _______ seconds

7 Coordination examination
- Upper limb coordination
- Which arm was tested:
- Left
- Right

Coordination score:
- of 1

8 SAC Delayed Recall
- Delayed recall score:
- of 5