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.

*McCrory P et al *Br J Sports Med 2013;47:250–258.*

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

Patricios J, et al. Br J Sports Med 2017;0:1–9

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[5]
- Greater symptom load, HA > 60 hrs, fatigue and fogginess[6]
- Motion sickness and ocular dysfunction[7]
- Migraine History[8]

[5]**Lau et al *Am J Sp Med 2011***

6Makdissi et al Am J Sp Med 2010

7 Kontos, Mucha Data under review

8Kontos A et al AJSM 2013 & Mihalik et al J Neurosurg 2006

Concussion Symptoms By Category

SOMATIC	COGNITIVE	EMOTIONAL	SLEEP
Headache	Feeling mentally foggy	Irritability	Sleeping more than usual
Fuzzy or blurry vision	Feeling slowed down	Sadness	Sleeping less than usual
Dizziness	Difficulty concentrating	Feeling more emotional	Trouble falling asleep
Fatigue	Difficulty remembering	Nervousness or anxiety	
Drowsiness			
Photophobia			
Phonophobia			
Balance problems			
Nausea or vomiting			

Monitor Symptoms at Each Visit

CONCUSSION SYMPTOM SHEET

NAME: _____
I.D.#: _____
DATE: _____

✓ SYMPTOMS	SCORE: 0 = No Symptoms; 1 = Minor; 6 = Severe						
Headache	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Nausea	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Vomiting	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Balance Problems	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Dizziness	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Fatigue	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Trouble falling asleep	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Sleeping more than usual	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Sleeping less than usual	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Drowsiness	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Sensitivity to Light	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Sensitivity to Noise	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Irritability	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Sadness	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Nervousness	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Feeling more emotional	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Numbness or tingling	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Feeling slowed down	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Feeling mentally foggy	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Difficulty concentrating	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Difficulty remembering	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6
Visual problems such as double vision, blurring, etc	❍ 0	❍ 1	❍ 2	❍ 3	❍ 4	❍ 5	❍ 6

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)

Mucha A et al *Am J Sports Med. 2014;42(10): 2479-86*

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

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

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

Clinical Recommendations

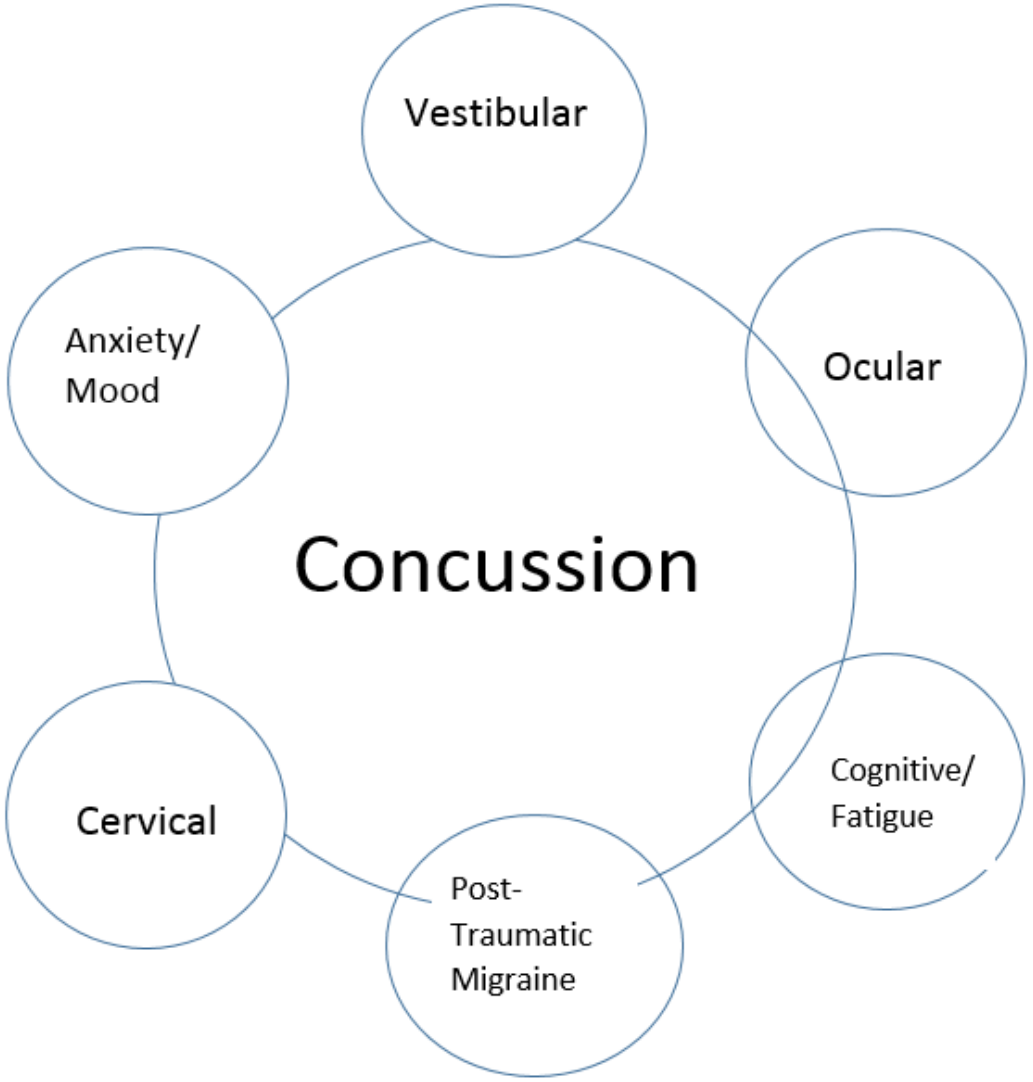
SORT: Strength of Recommendation Taxonomy
A: consistent, good-quality patient-oriented evidence
B: inconsistent or limited-quality patient-oriented evidence
C: consensus, disease-oriented evidence, usual practice, expert opinion, or case series

Clinical Recommendations	SORT Evidence Rating
Instead of a comprehensive neurologic examination after concussion, a focused neurologic and physical examination may be performed	C
Screening ocular examination should include: evaluation of the eyes for nystagmus, saccades, smooth pursuits, and near point of convergence	A
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.	C
If dizziness or imbalance is present, consider orthostatic vital signs	B

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 sxs[2]

[1]Collins MW, Kontos A. *KSST 2014;22(2)235–246*
[2]Kontos A et al Am J Sports Med 2013;41(7):1497-504

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]

[1]Collins M Kontos A et al *Neurosurg 2016;79(6):912-29*
[2] Thomas DG, et al *Pediatrics. 2015;135(2):213-223*
[3] Grool a et al *JAMA2016;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*
[2]*Lynall RC et al Med Sci Sports Exerc 2015*
[3]*Brooks et al 2016 Am J Sports Med*
[4]*Gilbert et al 2016 Sports Health*

Return to Play

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

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 (eg, amitriptyline, trazodone) and nonbenzodiazepine hypnotics (eg, Ambien, Lunesta)
- Avoid neuroleptics (e.g. Seroquel), excess ETOH, anticholinergics (Benadryl), benzos

[1] Broglio et al *Clin Sports Med 34 (2015) 213–231*

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]

[1]Wu A et al J. *Neurotrauma. 2004; 21:1457-67*
[2] Wu A et al *J. Neurotrauma. 2007; 24:1587-95*
[3] Wu A et al *J. Neurotrauma. 2011; 28:2113-22*
[4]Wu A et al *Neurorehabil. Neural Repair. 2011; 25: 332-42*
[5]Ashbaugh A et al Curr Sports Med Rep 2016;15(1): 16- 19

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

* Ashbaugh A et al *Curr Sports Med Rep 2016;15(1): 16-19*

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*

[1] Boglio, SP et al Clin Sp Med 34(2015)213-31
[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

*Broglio, SP et al *Clin Sports Med 34(2015)213-31*

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

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

Adapted from Halstead M et al Pediatrics. 2013;132(5):948-957

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[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[2]

[1]TEAM Collins MW and Kontos AP et al Neurosurg 2016;79(6): 212-19
[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
- Baselined 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
  - Template for office concussion evaluation
- https://www.wiaawi.org/Portals/0/PDF/Health/AcuteConcussionEval.pdf
  - Template for care plan
- https://www.youtube.com/watch?v=E2uF0lcyNps
  - youtube video on VOMS
- Return to School and Learning After Concussion: Tips for Pediatricians
  - Grady MR, Master CL *Pediatr Ann. 2017;46(3):e93-e98*
    - 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
  - Schneider KJ, Leddy J et al. *Br J Sports Med 2017;0:1–7*

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

*Wickwire EM et al *Neurotherapeutics (2016) 13:403–417*

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

Ponsford, J et.al **Fatigue and Sleep Disturbance Following Traumatic Brain Injury—Their Nature, Causes, and Potential Treatments**. Journal of Head Trauma Rehabilitation: May/June 2012

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SCAT3™

Sport Concussion Assessment Tool – 3rd Edition

For use by medical professionals only

Name | Date/Time of Injury: | Date of Assessment: | Examiner:

What is the SCAT3?[1]

The SCAT3 is a standardized tool for evaluating injured athletes for concussion and can be used in athletes aged from 13 years and older. It supersedes the original SCAT and the SCAT2 published in 2005 and 2009, respectively[2]. For younger persons, ages 12 and under, please use the Child SCAT3. The SCAT3 is designed for use by medical professionals. If you are not qualified, please use the Sport Concussion Recognition Tool[1]. Preseason baseline testing with the SCAT3 can be helpful for interpreting post-injury test scores.

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 tool may be freely copied in its current form for distribution to individuals, teams, groups and organizations. Any revision or any reproduction in a digital form requires approval by the Concussion in Sport Group.

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

What is a concussion?

A concussion is a disturbance in brain function caused by a direct or indirect force to the head. It results in a variety of non-specific signs and/or symptoms (some examples listed below) and most often 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), or
- Physical signs (e.g., unsteadiness), or
- Impaired brain function (e.g. confusion) or
- Abnormal behaviour (e.g., change in personality).

SIDELINE ASSESSMENT

Indications for Emergency Management

NOTE: A hit to the head can sometimes be associated with a more serious brain injury. Any of the following warrants consideration of activating emergency procedures and urgent transportation to the nearest hospital:

- Glasgow Coma score less than 15
- Deteriorating mental status
- Potential spinal injury
- Progressive, worsening symptoms or new neurologic 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 participation, be evaluated by a medical professional and **should not be permitted to return to sport the same day** if a concussion is suspected.

Any loss of consciousness?	Y	N
"If so, how long?"		
Balance or motor incoordination (stumbles, slow/laboured movements, etc.)?	Y	N
Disorientation or confusion (inability to respond appropriately to questions)?	Y	N
Loss of memory:	Y	N
"If so, how long?"		
"Before or after the injury?"		
Blank or vacant look:	Y	N
Visible facial injury in combination with any of the above:	Y	N

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
Obeys commands	6
Glasgow Coma score (E + V + M)	of 15

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

2 Maddocks Score[3]

"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)

What venue are we at today?	0	1
Which half is it now?	0	1
Who scored last in this match?	0	1
What team did you play last week/game?	0	1
Did your team win the last game?	0	1
Maddocks score		of 5

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

Notes: Mechanism of injury ("tell me what happened"?):

Any athlete with a suspected concussion should be REMOVED FROM PLAY, medically assessed, monitored for deterioration (i.e., should not be left alone) and should not drive a motor vehicle until cleared to do so by a medical professional. No athlete diagnosed with concussion should be returned to sports participation on the same day.

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BACKGROUND

Name: _____ Date: _____
Examiner: _____
Sport/team/school: _____ Date/time of injury: _____
Age: _____ Gender: ☐ M ☐ F
Years of education completed: _____
Dominant hand: ☐ right ☐ left ☐ neither
How many concussions do you think you have had in the past? _____
When was the most recent concussion? _____
How long was your recovery from the most recent concussion? _____
Have you ever been hospitalized or had medical imaging done for a head injury? ☐ Y ☐ N
Have you ever been diagnosed with headaches or migraines? ☐ Y ☐ N
Do you have a learning disability, dyslexia, ADD/ADHD? ☐ Y ☐ N
Have you ever been diagnosed with depression, anxiety or other psychiatric disorder? ☐ Y ☐ N
Has anyone in your family ever been diagnosed with any of these problems? ☐ Y ☐ N
Are you on any medications? If yes, please list: ☐ Y ☐ N

SCAT3 to be done in resting state. Best done 10 or more minutes post exercise.

SYMPTOM EVALUATION

3 How do you feel?

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

	none	mild		moderate		severe	
Headache	0	1	2	3	4	5	6
"Pressure in head"	0	1	2	3	4	5	6
Neck Pain	0	1	2	3	4	5	6
Nausea or vomiting	0	1	2	3	4	5	6
Dizziness	0	1	2	3	4	5	6
Blurred vision	0	1	2	3	4	5	6
Balance problems	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Feeling like "in a fog"	0	1	2	3	4	5	6
"Don't feel right"	0	1	2	3	4	5	6
Difficulty concentrating	0	1	2	3	4	5	6
Difficulty remembering	0	1	2	3	4	5	6
Fatigue or low energy	0	1	2	3	4	5	6
Confusion	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
Trouble falling asleep	0	1	2	3	4	5	6
More emotional	0	1	2	3	4	5	6
Irritability	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Nervous or Anxious	0	1	2	3	4	5	6

Total number of symptoms (Maximum possible 22) _____
Symptom severity score (Maximum possible 132) _____

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

☐ 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?
Please circle one response
no different | very different | unsure | N/A

Scoring on the SCAT3 should not be used as a stand-alone method to diagnose concussion, measure recovery or make decisions about an athlete's readiness to return to competition after concussion. Since signs and symptoms may evolve over time, it is important to consider repeat evaluation in the acute assessment of concussion.

COGNITIVE & PHYSICAL EVALUATION

4 Cognitive assessment

Standardized Assessment of Concussion (SAC)[1]

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

List	Trial 1		Trial 2		Trial 3		Alternative word list		
elbow	0	1	0	1	0	1	candle	baby	finger
apple	0	1	0	1	0	1	paper	monkey	penny
carpet	0	1	0	1	0	1	sugar	perfume	blanket
saddle	0	1	0	1	0	1	sandwich	sunset	lemon
bubble	0	1	0	1	0	1	wagon	iron	insect
Total									

Immediate memory score total _____ of 15

Concentration: Digits Backward

List	Trial 1		Alternative digit list		
4-9-3	0	1	6-2-9	5-2-6	4-1-5
3-8-1-4	0	1	3-2-7-9	1-7-9-5	4-9-6-8
6-2-9-7-1	0	1	1-5-2-8-6	3-8-5-2-7	6-1-8-4-3
7-1-8-4-6-2	0	1	5-3-9-1-4-8	8-3-1-9-6-4	7-2-4-8-5-6
Total of 4					

Concentration: Month in Reverse Order (1 pt. for entire sequence correct)

Dec-Nov-Oct-Sept-Aug-Jul-Jun-May-Apr-Mar-Feb-Jan	0	1
Concentration score		of 5

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[2]
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[3]
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[4]

Delayed recall score _____ of 5

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INSTRUCTIONS

Words in *italics* throughout the SCAT3 are the instructions given to the athlete by the tester.

Symptom Scale

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

To be completed by the athlete. In situations where the symptom scale is being completed after exercise, it should still be done in a resting state, at least 10 minutes post exercise.
For total number of symptoms, maximum possible is 22.
For Symptom severity score, add all scores in table, maximum possible is 22 x 6 = 132.

SAC[4]

Immediate Memory

"I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order."

Trials 2 & 3:

"I am going to repeat the same list again. Repeat back as many words as you can remember in any order, even if you said the word before."

Complete all 3 trials regardless of score on trial 1 & 2. Read the words at a rate of one per second. **Score 1 pt. for each correct response.** Total score equals sum across all 3 trials. Do not inform the athlete that delayed recall will be tested.

Concentration

Digits backward

"I am going to read you a string of numbers and when I am done, you repeat them back to me backwards, in reverse order of how I read them to you. For example, if I say 7-1-9, you would say 9-1-7."

If correct, go to next string length. If incorrect, read trial 2. **One point possible for each string length**. Stop after incorrect on both trials. The digits should be read at the rate of one per second.

Months in reverse order

"Now tell me the months of the year in reverse order. Start with the last month and go backward. So you'll say December, November ... Go ahead"

1 pt. for entire sequence correct

Delayed Recall

The delayed recall should be performed after completion of the Balance and Coordination Examination.

"Do you remember that list of words I read a few times earlier? Tell me as many words from the list as you can remember in any order."

Score 1 pt. for each correct response

Balance Examination

Modified Balance Error Scoring System (BESS) testing[5]

This balance testing is based on a modified version of the Balance Error Scoring System (BESS)[5]. A stopwatch or watch with a second hand is required for this testing.

"I am now going to test your balance. Please take your shoes off, roll up your pant legs above ankle (if applicable), and remove any ankle taping (if applicable). This test will consist of three twenty second tests with different stances."

(a) Double leg stance:

"The first stance is standing with your feet together with your hands on your hips and with your eyes closed. You should try to maintain stability in that position for 20 seconds. I will be counting the number of times you move out of this position. I will start timing when you are set and have closed your eyes."

(b) Single leg stance:

"If you were to kick a ball, which foot would you use? [This will be the dominant foot] Now stand on your non-dominant foot. The dominant leg should be held in approximately 30 degrees of hip flexion and 45 degrees of knee flexion. Again, you should try to maintain stability for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you stumble out of this position, open your eyes and return to the start position and continue balancing. I will start timing when you are set and have closed your eyes."

(c) Tandem stance:

"Now stand heel-to-toe with your non-dominant foot in back. Your weight should be evenly distributed across both feet. Again, you should try to maintain stability for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you stumble out of this position, open your eyes and return to the start position and continue balancing. I will start timing when you are set and have closed your eyes."

Balance testing – 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

Each of the 20-second trials is scored by counting the errors, or deviations from the proper stance, accumulated by the athlete. The examiner will begin counting errors only after the individual has assumed the proper start position. **The modified BESS is calculated by adding one error point for each error during the three 20-second tests. The maximum total number of errors for any single condition is 10.** If a athlete commits multiple errors simultaneously, only one error is recorded but the athlete should quickly return to the testing position, and counting should resume once subject is set. Subjects that are unable to maintain the testing procedure for a minimum of **five seconds** at the start are assigned the highest possible score, ten, for that testing condition.

OPTION: For further assessment, the same 3 stances can be performed on a surface of medium density foam (e.g., approximately 50cm x 40cm x 6cm).

Tandem Gait[6,7]

Participants are instructed to stand with their feet together behind a starting line (the test is best done with footwear removed). Then, they walk in a forward direction as quickly and as accurately as possible along a 38mm wide (sports tape), 3 meter line with an alternate foot heel-to-toe gait ensuring that they approximate their heel and toe on each step. Once they cross the end of the 3m line, they turn 180 degrees and return to the starting point using the same gait. A total of 4 trials are done and the best time is retained. Athletes should complete the test in 14 seconds. Athletes fail the test if they step off the line, have a separation between their heel and toe, or if they touch or grab the examiner or an object. In this case, the time is not recorded and the trial repeated, if appropriate.

Coordination Examination

Upper limb coordination

Finger-to-nose (FTN) task:

"I am going to test your coordination now. Please sit comfortably on the chair with your eyes open and your arm (either right or left) outstretched (shoulder flexed to 90 degrees and elbow and fingers extended), pointing in front of you. When I give a start signal, I would like you to perform five successive finger to nose repetitions using your index finger to touch the tip of the nose, and then return to the starting position, as quickly and as accurately as possible."

Scoring: 5 correct repetitions in < 4 seconds = 1
Note for testers: Athletes fail the test if they do not touch their nose, do not fully extend their elbow or do not perform five repetitions. **Failure should be scored as 0.**

References & Footnotes

1. This tool has been developed by a group of international experts at the 4th International Consensus meeting on Concussion in Sport held in Zurich, Switzerland in November 2012. The full details of the conference outcomes and the authors of the tool are published in The BJSM Injury Prevention and Health Protection, 2013, Volume 47, Issue 5. The outcome paper will also be simultaneously co-published in other leading biomedical journals with the copyright held by the Concussion in Sport Group, to allow unrestricted distribution, providing no alterations are made.

2. McCrory P et al., Consensus Statement on Concussion in Sport – the 3rd International Conference on Concussion in Sport held in Zurich, November 2008. British Journal of Sports Medicine 2009; 43: i76-89.

3. Maddocks, DL; Dicker, GD; Saling, MM. The assessment of orientation following concussion in athletes. Clinical Journal of Sport Medicine. 1995; 5(1): 32–3.

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6. Schneiders, A.G., Sullivan, S.J., Gray, A., Hammond-Tooke, G.&McCrory, P. Normative values for 16-37 year old subjects for three clinical measures of motor performance used in the assessment of sports concussions. Journal of Science and Medicine in Sport. 2010; 13(2): 196–201.

7. Schneiders, A.G., Sullivan, S.J., Kvarnstrom, J.K., Olsson, M., Yden, T.&Marshall, S.W. The effect of footwear and sports-surface on dynamic neurological screening in sport-related concussion. Journal of Science and Medicine in Sport. 2010; 13(4): 382–386

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ATHLETE INFORMATION

Any athlete suspected of having a concussion should be removed from play, and then seek medical evaluation.

Signs to watch for

Problems could arise over the first 24–48 hours. The athlete should not be left alone and must go to a hospital at once if they:

- Have a headache that gets worse
- Are very drowsy or can't be awakened
- Can't recognize people or places
- Have repeated vomiting
- Behave unusually or seem confused; are very irritable
- Have seizures (arms and legs jerk uncontrollably)
- Have weak or numb arms or legs
- Are unsteady on their feet; have slurred speech

Remember, it is better to be safe.
Consult your doctor after a suspected concussion.

Return to play

Athletes should not be returned to play the same day of injury.
When returning athletes to play, they should be **medically cleared and then follow a stepwise supervised program,** with stages of progression.

For example:

Rehabilitation stage	Functional exercise at each stage of rehabilitation	Objective of each stage
No activity	Physical and cognitive rest	Recovery
Light aerobic exercise	Walking, swimming or stationary cycling keeping intensity 70 % maximum predicted heart rate. No resistance training	Increase heart rate
Sport-specific exercise	Skating drills in ice hockey, running drills in soccer. No head impact activities	Add movement
Non-contact training drills	Progression to more complex training drills, eg passing drills in football and ice hockey. May start progressive resistance training	Exercise, coordination, and cognitive load
Full contact practice	Following medical clearance participate in normal training activities	Restore confidence and assess functional skills by coaching staff
Return to play	Normal game play	

There should be at least 24 hours (or longer) for each stage and if symptoms recur the athlete should rest until they resolve once again and then resume the program at the previous asymptomatic stage. Resistance training should only be added in the later stages.

If the athlete is symptomatic for more than 10 days, then consultation by a medical practitioner who is expert in the management of concussion, is recommended.

Medical clearance should be given before return to play.

Scoring Summary:

Test Domain	Score		
	Date:	Date:	Date:
Number of Symptoms of 22			
Symptom Severity Score of 132			
Orientation of 5			
Immediate Memory of 15			
Concentration of 5			
Delayed Recall of 5			
SAC Total			
BESS (total errors)			
Tandem Gait (seconds)			
Coordination of 1			

Notes:

CONCUSSION INJURY ADVICE

(To be given to the **person monitoring** the concussed athlete)

This patient has received an injury to the head. A careful medical examination has been carried out and no sign of any serious complications has been found. Recovery time is variable across individuals and the patient will need monitoring for a further period by a responsible adult. Your treating physician will provide guidance as to this timeframe.

If you notice any change in behaviour, vomiting, dizziness, worsening headache, double vision or excessive drowsiness, please contact your doctor or the nearest hospital emergency department immediately.

Other important points:

- Rest (physically and mentally), including training or playing sports until symptoms resolve and you are medically cleared
- No alcohol
- No prescription or non-prescription drugs without medical supervision. Specifically:
  - No sleeping tablets
  - Do not use aspirin, anti-inflammatory medication or sedating pain killers
- Do not drive until medically cleared
- Do not train or play sport until medically cleared

Clinic phone number

Patient's name _____

Date/time of injury _____

Date/time of medical review _____

Treating physician _____

Contact details or stamp

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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
Obeys commands	6
Glasgow Coma score (E + V + M)	of 15

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

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SCAT-3

2

Maddocks Score[3]

"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)

What venue are we at today?	0	1
Which half is it now?	0	1
Who scored last in this match?	0	1
What team did you play last week/game?	0	1
Did your team win the last game?	0	1
Maddocks score		of 5

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

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3 How do you feel?

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

	none	mild		moderate		severe	
Headache	0	1	2	3	4	5	6
"Pressure in head"	0	1	2	3	4	5	6
Neck Pain	0	1	2	3	4	5	6
Nausea or vomiting	0	1	2	3	4	5	6
Dizziness	0	1	2	3	4	5	6
Blurred vision	0	1	2	3	4	5	6
Balance problems	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Feeling like "in a fog"	0	1	2	3	4	5	6
"Don't feel right"	0	1	2	3	4	5	6
Difficulty concentrating	0	1	2	3	4	5	6
Difficulty remembering	0	1	2	3	4	5	6
Fatigue or low energy	0	1	2	3	4	5	6
Confusion	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
Trouble falling asleep	0	1	2	3	4	5	6
More emotional	0	1	2	3	4	5	6
Irritability	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Nervous or Anxious	0	1	2	3	4	5	6

Total number of symptoms (Maximum possible 22)

Symptom severity score (Maximum possible 132)

Do the symptoms get worse with physical activity? Y N

Do the symptoms get worse with mental activity? Y N

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?

Please circle one response:

no different	very different	unsure	N/A

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SCAT 3

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

List	Trial 1		Trial 2		Trial 3		Alternative word list		
elbow	0	1	0	1	0	1	candle	baby	finger
apple	0	1	0	1	0	1	paper	monkey	penny
carpet	0	1	0	1	0	1	sugar	perfume	blanket
saddle	0	1	0	1	0	1	sandwich	sunset	lemon
bubble	0	1	0	1	0	1	wagon	iron	insect
Total									
Immediate memory score total									of 15

Concentration: Digits Backward

List	Trial 1		Alternative digit list		
4-9-3	0	1	6-2-9	5-2-6	4-1-5
3-8-1-4	0	1	3-2-7-9	1-7-9-5	4-9-6-8
6-2-9-7-1	0	1	1-5-2-8-6	3-8-5-2-7	6-1-8-4-3
7-1-8-4-6-2	0	1	5-3-9-1-4-8	8-3-1-9-6-4	7-2-4-8-5-6
Total of 4					

Concentration: Month in Reverse Order (1 pt. for entire sequence correct)

Dec-Nov-Oct-Sept-Aug-Jul-Jun-May-Apr-Mar-Feb-Jan	0	1
Concentration score		of 5

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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[5]

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[6,7]

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[4]

Delayed recall score	of 5

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