Head-Injuries Annual Update

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Helping athletes achieve their maximum performance naturally

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Disclosure

- FICS makes every effort to provide contemporary information.
- FICS desires to build the best of the best in International Sports Chiropractic.
- FICS and their instructors are vetted by the FICS Education Commission, composed of academic members and leaders from most regions of the planet.
- The information instructed today has been established and approved by the FICS Education Commission.
- FICS will not be held liable for any injuries as a result of today's instruction.

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Objectives:

- Impact of Head Injuries in Healthcare
- Head Injury Pathophysiology
- Sideline Examination and Red Flags
- Best-Practices Clinical Examination
- Return-to-Academics and Return-to-Sport
- Injury Prevention Strategies

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Concussion Occurrences

(Harmon et al, 2019)

- Motor vehicle accidents the leading cause of concussions
- Nearly 3.8 million concussions occur in the USA alone per year during competitive sports and recreational activities
- Up to 50% of concussions occur may go unreported.
- Concussion rates have doubled in the last decade with an estimated 750 000 pediatric acute concussion visits to EDs occurring annually in the USA. (Zemek et al, 2016)

Concussion Epidemiology

(Harmon et al, 2019)

- Concussion is common in:
  - organised sport
  - non-traditional recreational activity
    - eg extreme, individual
  - routine ADLs
- Estimated 1.0–1.8 million SRCs per year in the 0–18 years age range
  - a subset of about 400 000 SRCs in high school athletes

Consensus statement

American Medical Society for Sports Medicine position statement on concussion in sport

Kimberly G Harmon,[1] James R Clugston,[2] Katherine Dec,[3] Brian Hainline,[4] Stanley Herring,[5] Shawn F Kane,[6] Anthony P Kontos,[7] John J Leddy,[8] Michael McCrea,[9] Sourav K Poddar,[10] Margot Putukian,[11,12] Julie C Wilson,[13] William O Roberts[14]

Concussion Epidemiology

(Harmon et al, 2019)

- Numbers are limited, or not available for:
  - recreational or club sports
  - activities such as bicycling, skiing, snowboarding, skateboarding, the fighting arts
  - or for youth/early adolescent athletes.
- It is estimated that over 50% of concussions in high school-aged youth are not related to organised sports
  - only 20% are related to organised school team sports.
- Between 2% and 15% of athletes participating in organised sports will suffer a concussion during one season

Consensus statement

American Medical Society for Sports Medicine position statement on concussion in sport

Kimberly G Harmon,[1] James R Clugston,[2] Katherine Dec,[3] Brian Hainline,[4] Stanley Herring,[5] Shawn F Kane,[6] Anthony P Kontos,[7] John J Leddy,[8] Michael McCrea,[9] Sourav K Poddar,[10] Margot Putukian,[11,12] Julie C Wilson,[13] William O Roberts[14]

ABSTRACT

Sport-related concussion (SRC) is a common injury in recreational and organised sport. Over the past 30 years, there has been significant progress in our scientific understanding of SRC, which in turn has driven the development of clinical guidelines for diagnosis, assessment and management of SRC. In addition to a growing need for knowledgeable healthcare professionals to provide evidence-based care for athletes with SRC, media attention and legislation have created awareness and, in some cases, fear about many issues and unknowns surrounding SRC. The American Medical Society for Sports Medicine (AMSSM) formed a writing group to review the existing literature on SRC, update its previous position statement, and to address current evidence and knowledge gaps regarding SRC. The absence of definitive outcomes-based data is challenging and requires relying on the best available evidence integrated with clinical experience and patient values. This statement reviews the definition, pathophysiology and epidemiology of SRC, the diagnosis and management of both acute and persistent concussion symptoms, the short-term and long-term risks of SRC and repetitive head impact exposure, SRC prevention strategies, and potential future directions for SRC research. The AMSSM is committed to best clinical practices, evidence-based research and educational initiatives that positively impact the health and safety of athletes.

BACKGROUND AND PURPOSE

The American Medical Society for Sports Medicine (AMSSM) represents over 3800 sports medicine physicians who have completed specialty training in sports medicine after a residency programme in family medicine, internal medicine, paediatrics, emergency medicine, or physical medicine and rehabilitation, many of whom have extensive expertise in concussion evaluation and management, including serving as sideline team physicians at all levels of sport. Sport-related concussion (SRC) is an important topic for sports medicine physicians and there is a rapidly expanding knowledge base in this area. SRC has become a focus of both public concern and media attention. The purpose of this statement is to provide a narrative review of the existing literature and best practices to assist healthcare providers with the evaluation and management of SRC, and to establish the level of evidence, current knowledge gaps and areas requiring additional research. The first AMSSM position statement on SRC was published in 2013 and this is an update to that statement.[1]

WRITING GROUP SELECTION AND PROCESS

The AMSSM Board of Directors appointed the chair (KGH) to assemble a writing group that was carefully selected to include a balanced panel of sports medicine physicians experienced in sideline and office evaluation and management of SRC, actively engaged in SRC research, and with demonstrated leadership in the area of SRC. Select subspecialty experts were invited to provide diverse viewpoints. Select members of the board, the publications committee and writing group were surveyed to determine topics of interest for the statement and generate an initial outline. Systematic reviews were used as primary literature sources when available. The writing group engaged in conference calls, review of the literature and written communication prior to an in-person meeting in Chicago, Illinois, on 9–10 February 2018. There were additional conference calls, emails and iterations of the outline and manuscript to produce the final document. This document uses the Strength of Recommendation Taxonomy to grade level of evidence[2] (table 1).

WHO SHOULD EVALUATE AND MANAGE SRC?

The clinical care, including assessment and management, of athletes with SRC is ideally performed by healthcare professionals with appropriate training and experience. Sports medicine physicians are uniquely trained to provide care along the continuum of SRC from the acute evaluation through return to learn and return to sport, and to manage both complications of SRC and coexisting medical issues. While the majority of SRCs resolve within 1–4 weeks, athletes with complicated or prolonged recovery may require a multidisciplinary team with specific expertise across the scope of concussion management. (C)

DEFINITION OF CONCUSSION

Concussion is defined as a traumatically induced transient disturbance of brain function that involves a complex pathophysiological process.[3] Concussion is a subset of mild traumatic brain injury which is classified based on acute injury characteristics at the less severe end of the brain injury spectrum.[4] The clinical signs and symptoms of concussion cannot be otherwise explained by drug, alcohol, medication use, or other injuries (such as cervical injuries or peripheral vestibular dysfunction) or other comorbidities (psychological or medical conditions).[5 6]

Check for updates

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Current Concussion Definition

(McCrory et al, 2017)

- International Conference on Concussion in Sports is an international consortium that meets every four years to discuss updated research on concussion.
  - *"Sport related concussion is a traumatic brain injury induced by biomechanical forces...*
  - *SRC may be caused either by a direct blow to the head, face, neck or elsewhere on the body with an impulsive force transmitted to the head.*

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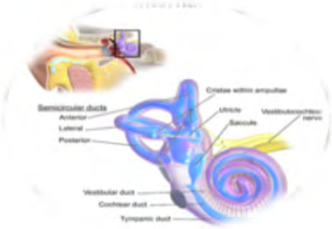
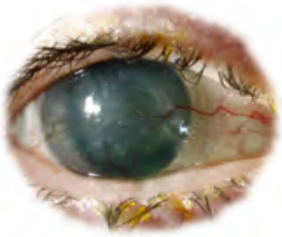
Current Concussion Definition

(McCrory et al, 2017)

The clinical signs and symptoms cannot be explained by drug, alcohol, or medication use, other injuries (such as cervical injuries, peripheral vestibular dysfunction, etc) or other comorbidities (eg, psychological factors or coexisting medical conditions).





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mTBI vs Concussion

(McCrory et al, 2017)

- mTBI Possible Symptoms
  - Loss of consciousness
  - Headache
  - Speech Problems
  - Photophobia
  - Mood Changes

- mTBI Conditions
  - Concussion
  - Contusion
  - Penetration Injury

Both the 5th International Conference on Concussion in Sport held in Berlin and other sources emphasize the need to make a clear distinction between mTBI and concussion since not all cases of mTBI are concussive

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Concussion Pathophysiology (Giza et al, 2017)

The exact pathophysiology that causes the wide spectrum of signs and symptoms associated with a concussion is not fully understood.

Most pathophysiological knowledge comes from extrapolating upon animal research studies

Generalized/theorized as a force delivered to the brain (directly or indirectly) that causes stretching of the neuronal cell membranes and axons leading to dysfunction.

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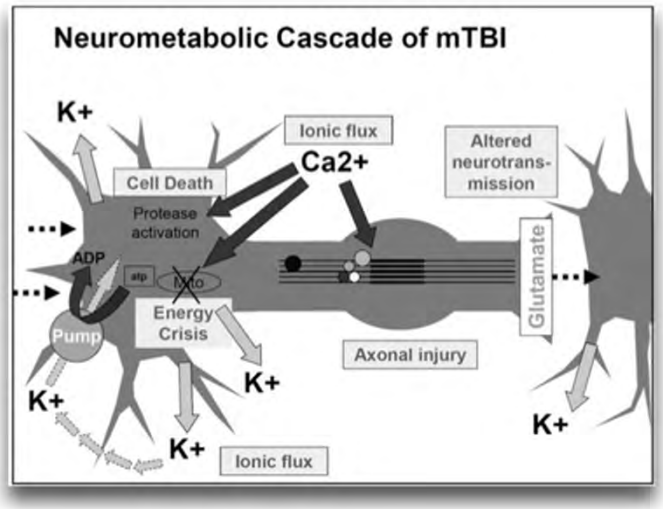
Neurometabolic Cascade of Concussion

(Giza & Hovda, 2014)

1. Ionic Flux and Glutamate Release
2. Energy Crisis
3. Cytoskeletal Damage
4. Axonal Dysfunction
5. Altered Neurotransmission
6. Inflammation
7. Cell Death



References: [7, 8, 12, 26]

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Neurometabolic Cascade of Concussion

(Giza & Hovda, 2014)

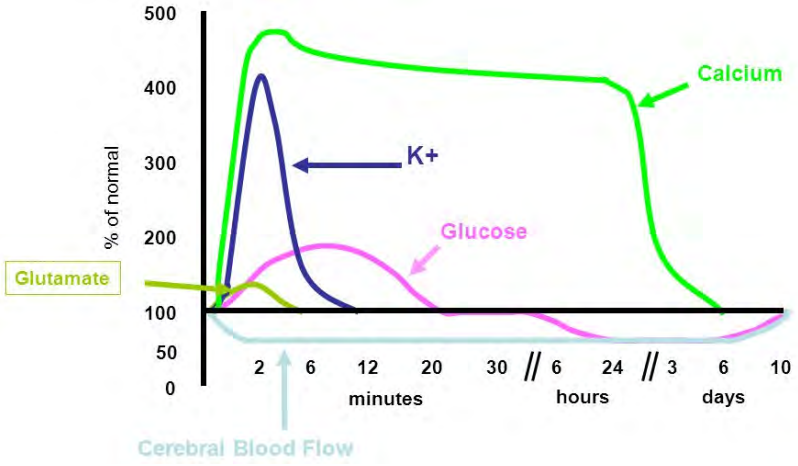

Image taken from: https://slideplayer.com/slide/6990331/

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Associated Signs and Symptoms

- Most Common Symptoms:
  - Headache
  - Dizziness
- 22 Possible Symptoms
- SCAT 5 Office or Off-Field Assessment
  - Step 2: Symptom Evaluation
  - *Aka,* Post Concussion Symptom Scale

	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
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
Trouble falling asleep (if applicable)	0	1	2	3	4	5	6
Total number of symptoms:							of 22
Symptom severity score:							of 132

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Approximately 80-90% of athletes that sustain concussions report clinical recovery of symptoms (Harmon et al, 2012)

- 10-14 days in adults
- 4 weeks in children

(McCrory et al, 2017)

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(McCrory et al, 2017)

- The Berlin expert consensus is that use of the term **'persistent symptoms'** following SRC should reflect **failure of normal clinical recovery**
- That is, symptoms that persist beyond expected time frames
  - **>10–14 days in adults**
  - **>4 weeks in children**

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(McCrory et al, 2017)

- 'Persistent symptoms' **does not reflect a single pathophysiological entity**
- Describes a constellation of non-specific post-traumatic symptoms that **may be linked to coexisting and/or confounding factors**

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(McCrory et al, 2017)

- **A detailed multimodal clinical assessment is required** to identify specific primary and secondary pathologies that may be contributing to persisting post-traumatic symptoms.
- **At a minimum**, the assessment should include:
  - **comprehensive history**
  - **focused physical examination**
  - **special tests where indicated**

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Sideline Evaluation

Sideline Examination and Red Flags

Best-Practices Clinical Examination

Return-to-Academics and Return-to-Sport

Injury Prevention Strategies

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Sideline Evaluation (McCrory et al, 2017)

SCAT5: Standard Concussion Assessment Tool 5

- Endorsed and created by the 5th International Concussion Symposium
- Possesses neurophysiological tests, cranial nerve testing, balance testing, and symptoms scoring
- Sensitive for SRC sideline screening
- Loss of utility after 3-5 days, but symptom scoring clinically useful to track symptomatology


BJSM Online First, published on April 26, 2017 as 10.1136/bjsports-2017-097506SCAT5

SCAT5 SPORT CONCUSSION ASSESSMENT TOOL – 5TH EDITION

DEVELOPED BY THE CONCUSSION IN SPORT GROUP

FOR USE BY MEDICAL PROFESSIONALS ONLY

WHAT IS THE SCAT5?

Recognise and Remove

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Sideline Evaluation (McCrory et al, 2017)

Child SCAT5: Standard Concussion Assessment Tool

- Endorsed and created by the 5th International Concussion Symposium
- Possesses neurophysiological tests, cranial nerve testing, balance testing, and symptoms scoring
- Sensitive for SRC sideline screening
- Loss of utility after 3-5 days, but symptom scoring clinically useful to track symptomatology

SCAT5

(McCrory et al, 2017)

- Free evidence based tool
- Only equipment needed is a watch or timer
- Not a "gold standard"
  - **A minimum standard**
- For use by medical professionals
  - *need to be trained in its use*
- **NOT a diagnostic tool to be "passed" or "failed"**
  - Facilitates medical assessment
- **Should not be the sole basis for making a diagnosis**


IMMEDIATE OR ON-FIELD ASSESSMENT

STEP 1: RED FLAGS

RED FLAGS:

- Neck pain or tenderness
- Double vision
- Weakness or tingling/burning in arms or legs
- Severe or increasing headache
- Seizure or convulsion
- Loss of consciousness
- Deteriorating conscious state
- Vomiting
- Increasingly restless, agitated or combative

STEP 2: OBSERVABLE SIGNS

STEP 3: MEMORY ASSESSMENT MADDOCKS QUESTIONS[2]

STEP 4: EXAMINATION GLASGOW COMA SCALE (GCS)[3]

CERVICAL SPINE ASSESSMENT

In a patient who is not lucid or fully conscious, a cervical spine injury should be assumed until proven otherwise.

Immediate or On-Field Assessment

(McCrory et al, 2017)

- Basic first aid principles (with attention to the cervical spine) in any player who is unconscious

- **Recognise** the injury
- **Remove** from play
- **Refer** for medical assessment

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Step 1: RED FLAGS (McCrory et al, 2017)

- Neck pain or tenderness
- Double vision
- Weakness or tingling/burning in arms or legs
- Severe of increasing headache
- Seizure or convulsion
- Loss of consciousness
- Deteriorating conscious state
- Vomiting
- Increasingly restless, agitated or combative

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Step 2: Observable Signs

(McCrory et al, 2017)

- Initial observations – own & others (parents, trainers, video, etc)
  - **Loss of consciousness** (including "no protective action/rag doll")
  - **Impact seizures or tonic posturing**
  - **Motor incoordination** (unsteady, staggers, etc)
  - **Confusion** (failed Maddock's questions), impaired memory, or abnormal behavior
- Not present in all cases!
  - e.g. LOC ~ 10%

Image taken from: https://www.flickr.com/photos/virtualsugar/4084734655

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Step 3: Maddocks Questions

(McCrory et al, 2017)

- Memory assessment
- *"First, tell me what happened?"*
- Note: Appropriate sport specific questions may be substituted

Image taken from:
https://thenewdaily.com.au/sport/sport-focus/2017/07/28/concussion-tests/

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Step 4: Glasgow Coma Scale

(McCrory et al, 2017)

STEP 4: EXAMINATION
GLASGOW COMA SCALE (GCS)[3]

Time of assessment			
Date of assessment			
Best eye response (E)			
No eye opening	1	1	1
Eye opening in response to pain	2	2	2
Eye opening to speech	3	3	3
Eyes opening spontaneously	4	4	4
Best verbal response (V)			
No verbal response	1	1	1
Incomprehensible sounds	2	2	2
Inappropriate words	3	3	3
Confused	4	4	4
Oriented	5	5	5
Best motor response (M)			
No motor response	1	1	1
Extension to pain	2	2	2
Abnormal flexion to pain	3	3	3
Flexion / Withdrawal to pain	4	4	4
Localizes to pain	5	5	5
Obeys commands	6	6	6
Glasgow Coma score (E + V + M)			

Video taken from:
https://www.ems1.com/ems-products/education/videos/how-to-perform-the-glasgow-coma-scale-assessment-GyRQfuXVold6HIYe/

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Step 4: Cervical Spine Assessment

(McCrory et al, 2017)

CERVICAL SPINE ASSESSMENT

Does the athlete report that their neck is pain free at rest?	Y	N
If there is NO neck pain at rest, does the athlete have a full range of ACTIVE pain free movement?	Y	N
Is the limb strength and sensation normal?	Y	N

In a patient who is not lucid or fully conscious, a cervical spine injury should be assumed until proven otherwise.

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Imaging (McCrory et al, 2017)

"SRC may result in neuropathological changes, but the acute clinical signs and symptoms largely reflect a functional disturbance rather than a structural injury and, as such, no abnormality is seen on standard structural neuroimaging studies." -5th International Conference on Concussion

A concussion will demonstrate no abnormal changes on x-ray, computerized tomography (CT), or magnetic resonance imaging (MRI).

Should be utilized to exclude any red flag symptoms but should not be used in all patients who present with head trauma.

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Indications for Imaging (Stiell et al, 2001; Stiell et al, 2002)

Acute- The Canadian Cervical Spine	Acute - Canadian CT Head Rule	Delayed symptomatology
• <u>High Risk Factors Present?</u> 1. Age > 65 2. Dangerous Mechanism of Injury (i.e. fall > 1m or 5 stairs, axial load to head, high-speed motor vehicle accident, motorized recreational vehicle, bicycle collision) 3. Paresthesias in extremities • <u>Low Risk Factors that allow safe assessment of range of motion?</u> 1. Simple rear-end motor accident 2. Normal sitting posture in emergency department 3. Ambulatory at any time since injury 4. Delayed onset of neck pain and absence of midline tenderness • <u>Is the patient able to actively rotate the neck > 45 degrees to the right and the left?</u>	• GCS score <15 at 2 h after injury • Suspected open or depressed skull fracture • Any sign of basal skull fracture (haemotympanum, 'racoon' eyes, • Cerebrospinal fluid otorrhoea/rhinorrhoea, Battle's sign) • Vomiting two episodes • Age 65 years • Medium risk (for brain injury on CT) • Amnesia before impact >30 min • Dangerous mechanism (pedestrian struck by motor vehicle, • Occupant ejected from motor vehicle, fall from height >3 feet or five stairs) • Minor head injury is defined as witnessed loss of consciousness, definite • amnesia, or witnessed disorientation in a patients with a GCS score of 13–15.	• Advanced imaging is suggesting the brain is physiologically not recovering for >30 days (one recent paper suggesting 45 days)

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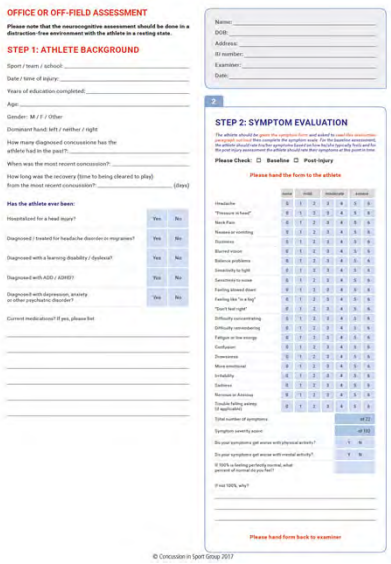
Immediate or On-Field Assessment

(McCrory et al, 2017)

- Any player who manifests signs or symptoms of a SRC should be removed from play for examination.
- Sideline evaluations are rapid screening assessments intended to screen for a suspected SRC, not produce a definitive diagnosis
- Future, in-depth clinical evaluations should be completed to determine the underlying condition causing player signs and symptoms.


OFFICE OR OFF-FIELD ASSESSMENT

Please note that the neurocognitive assessment should be done in a distraction-free environment with the athlete in a resting state.

STEP 1: ATHLETE BACKGROUND

Sport / team / school: _____

Date / time of injury: _____

Years of education completed: _____

Age: _____

Gender: M / F / Other

Dominant hand: left / neither / right

How many diagnosed concussions has the athlete had in the past? _____

When was the most recent concussion? _____

How long was the recovery (time to being cleared to play) from the most recent concussion? _____ (days)

Has the athlete ever been:

Hospitalized for a head injury?	Yes	No
Diagnosed / treated for headache disorder in migraines?	Yes	No
Diagnosed with a learning disability / dyslexia?	Yes	No
Diagnosed with ADD / ADHD?	Yes	No
Diagnosed with depression, anxiety or other psychiatric disorder?	Yes	No

Current medications? If yes, please list

_____

_____

_____

_____

_____

_____

Name: _____

DOB: _____

Address: _____

ID number: _____

Examiner: _____

Date: _____

2

STEP 2: SYMPTOM EVALUATION

The athlete should be given the symptom form and asked to read the instructions. The athlete should rate his/her symptoms based on how he/she typically feels and fill in the baseline assessment. For the post-injury assessment the athlete should rate their symptoms at this point in time.

Please Check: ☐ Baseline ☐ Post-injury

Please hand the form to the athlete

	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
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
Trouble falling asleep (if applicable)	0	1	2	3	4	5	6
Total number of symptoms							of 22
Symptom severity score							of 132
Do your symptoms get worse with physical activity?							Y N
Do your symptoms get worse with mental activity?							Y N

If 100% is feeling perfectly normal, what percent of normal do you feel? _____

If not 100%, why? _____

_____

_____

_____

Please hand form back to examiner

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Office or Off-Field Assessment

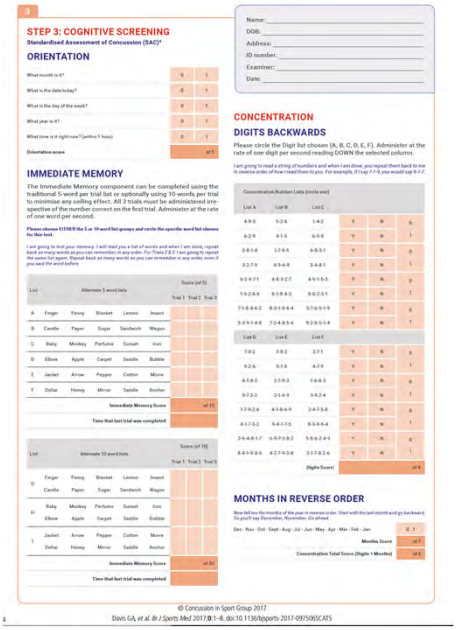
(McCrory et al, 2017)

- The neurocognitive assessment should be done in a distraction-free environment with the athlete in a resting state
- Step 1: Athlete Background
- Step 2: Symptom Evaluation

Step 3: Cognitive Screening

(McCrory et al, 2017)

- Standardized Assessment of Concussion (SAC)
  - Orientation
  - Immediate Memory
  - Digits Backwards
  - Months in Reverse Order



STEP 3: COGNITIVE SCREENING

Standardised Assessment of Concussion (SAC)*

ORIENTATION

IMMEDIATE MEMORY

CONCENTRATION

DIGITS BACKWARDS

MONTHS IN REVERSE ORDER

Step 4: Neurological Screen

(McCrory et al, 2017)

STEP 4: NEUROLOGICAL SCREEN

See the instruction sheet (page 7) for details of test administration and scoring of the tests.

Can the patient read aloud (e.g. symptom check-list) and follow instructions without difficulty?	Y	N
Does the patient have a full range of pain-free PASSIVE cervical spine movement?	Y	N
Without moving their head or neck, can the patient look side-to-side and up-and-down without double vision?	Y	N
Can the patient perform the finger nose coordination test normally?	Y	N
Can the patient perform tandem gait normally?	Y	N

BALANCE EXAMINATION

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

Which foot was tested (i.e. which is the non-dominant foot) ☐ Left ☐ Right

Testing surface (hard floor, field, etc.) _____

Footwear (shoes, barefoot, braces, tape, etc.) _____

Condition	Errors
Double leg stance	of 10
Single leg stance (non-dominant foot)	of 10
Tandem stance (non-dominant foot at the back)	of 10
Total Errors	of 30

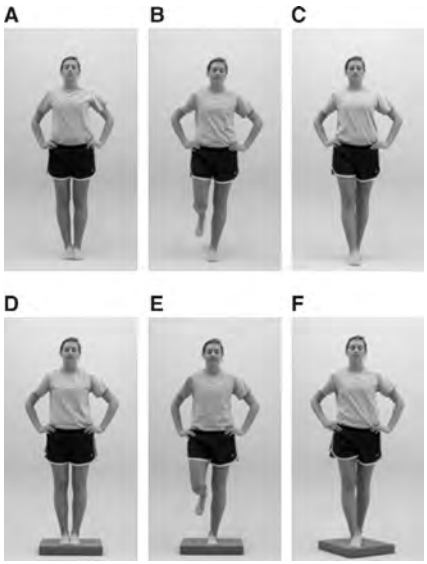


Image taken from: https://www.researchgate.net/figure/Balance-Error-Scoring-System-BESS-performed-on-the-firm-surface-A-C-and-the-foam_fig1_26775223

Step 5: Delayed Recall

(McCrory et al, 2017)

The delayed recall should be performed after 5 minutes have elapsed since the end of the Immediate Recall section. Score 1 pt. for each correct response.

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.

Time Started _____

Please record each word correctly recalled. Total score equals number of words recalled.

_____

_____

_____

Total number of words recalled accurately: _____ of 5 or _____ of 10

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Step 6: Decision

(McCrory et al, 2017)

STEP 6: DECISION

Domain	Date & time of assessment:		
Symptom number (of 22)			
Symptom severity score (of 132)			
Orientation (of 5)			
Immediate memory	of 15 of 30	of 15 of 30	of 15 of 30
Concentration (of 5)			
Neuro exam	Normal Abnormal	Normal Abnormal	Normal Abnormal
Balance errors (of 30)			
Delayed Recall	of 5 of 10	of 5 of 10	of 5 of 10

Date and time of injury: _____

If the athlete is known to you prior to their injury, are they different from their usual self?
☐ **Yes** ☐ **No** ☐ **Unsure** ☐ **Not Applicable**
(If different, describe why in the clinical notes section)

Concussion Diagnosed?
☐ **Yes** ☐ **No** ☐ **Unsure** ☐ **Not Applicable**

If re-testing, has the athlete improved?
☐ **Yes** ☐ **No** ☐ **Unsure** ☐ **Not Applicable**

I am a physician or licensed healthcare professional and I have personally administered or supervised the administration of this SCAT5.

Signature: _____

Name: _____

Title: _____

Registration number (if applicable): _____

Date: _____

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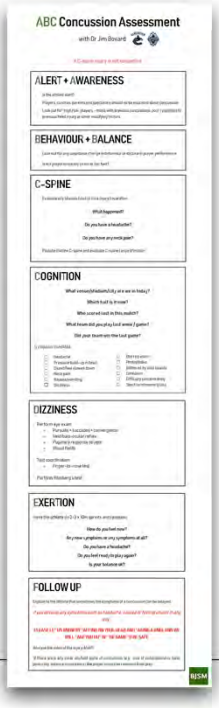
ABC Concussion Assessment

(Bovard, 2019)

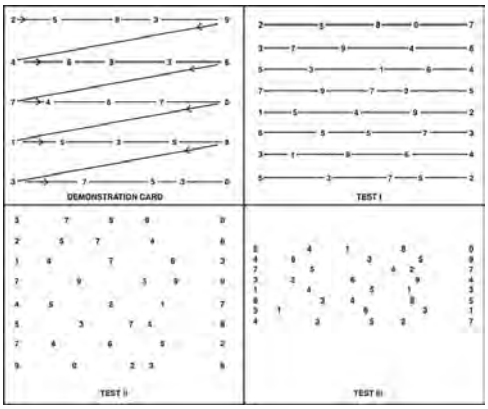
- **A**lert + **A**wareness
- **B**ehaviour + **B**alance
- **C**-Spine + **C**ognition
- **D**izziness
- **E**xertion
- **F**ollow up

Taken from:
https://blogs.bmj.com/bjsm/2019/05/13/assessing-concussion-as-easy-as-abc-dr-jim-bovard-episode-380/



King-Devick Test:

- Requires baseline test for comparison to be utilized
- Effective and sensitive for Head-Injury Screening Tool
  - Does not possess balance, memory, or functional testing.
  - Not clinically sufficient for concussion diagnosis



Clinical Examination

Best-Practices Clinical Examination

Return-to-Sport and Return-to-Academics

Injury Prevention Strategies

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"Understanding the pathophysiology of concussion proves especially critical for the 20–30% of concussed patients who develop persistent postconcussion symptoms (PPCS)."

- Callaway & Kosofsky, 2019

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Correlated Systems Evaluation (McCrory et al, 2017)

Research has demonstrated a complex relationship with the brain, cervical spine, vestibuloocular system, temporomandibular joint, and numerous other structures related to the signs and symptoms

Berlin consensus and similar research demonstrating common associated signs and symptoms with concussions, whiplash associated disorders, vestibuloocular disorders etc. at the time of head injury

Any system involved with signs and symptoms experience by patient should be thoroughly investigated in a clinical environment

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Correlated Systems Evaluation (McCrory et al, 2017)

Cervical:	Vestibular:	Oculomotor:	Temporo-mandibular joint:
• Neck pain • headache • dizziness • gait instability • fogginess • gaze stability • difficulty with saccades • body coordination • balance issues	• Dizziness • vertigo • headache • posture imbalance • difficulty focusing • gait alterations • smooth pursuit difficulty	• Blurry vision • imbalance • Convergence / accommodation errors • smooth pursuit errors • difficulty performing saccades	• Headaches • neck pain • jaw pain

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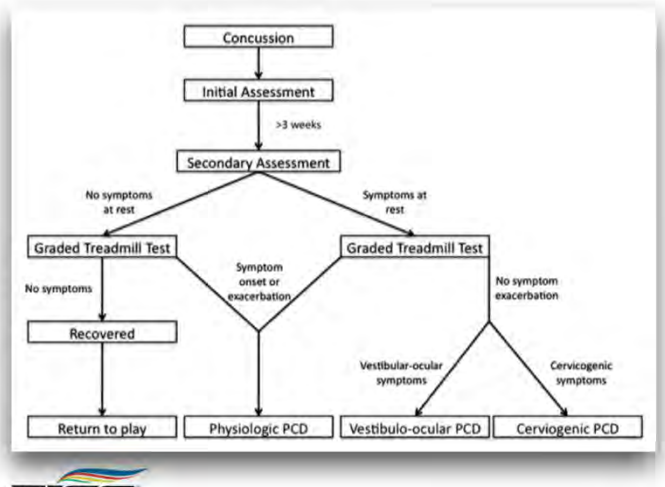
Clinical Examination
Multi-system Injury / Impairment

(McCrory et al, 2017; Quartman-Yates et al, 2020)

- Neurological
  - including specific screens for vision, auditory, sensory processing, and motor control and coordination impairments
- Mental Status/Cognition
- **Autonomic / Exertional Intolerance Impairments**
- **Vestibulo-oculomotor impairments**
- Postural Stability/Balance
- **Cervical Musculoskeletal/Sensorimotor Impairments**

Clinical Examination
Multi-system Injury / Impairment

(Makdissi et al, 2017; Ellis et al 2015)



- Clinical examinations that may help distinguish between patients with 1º or 2º causes of persistent post concussive symptoms include:
  - **Exercise tolerance (Autonomic Dysfunction)**
    - e.g. BCTT
  - **Vestibular and oculomotor function**
    - e.g VOMS
  - **Cervical spine**
    - e.g. deep neck flexor endurance, JPE, SPNT

Autonomic / Exertional Intolerance Impairments
Buffalo Concussion Treadmill Test

(Clausen et al, 2016; Kozlowski et al, 2013; Leddy et al, 2013)

- Patient to walk on a treadmill initially set at **3.4 mph (5.5 km/h) at a 0.0º incline**
  - Speed can be altered if needed (increase speed a little to comfort for taller or athletic persons, and reduce the speed for shorter or sedentary persons)
- **Each minute, increase the incline grade by 1º**
- **Each minute record HR, Rating of Perceived Exhaustion** (RPE, Borg Scale) and **assess the presence of symptoms**. (Borg, 1982)
  - HR alone is sufficient (Leddy et al, 2013)
- Once treadmill reaches maximum incline (e.g. 12º or 15º) speed is increased by 0.4 mph (0.6 km/h) each minute
- **Continue until patients reach maximum exertion (RPE 19.5)**, OR have **onset of new symptoms**, OR **exacerbation of symptoms (>3/10)**, OR **patient reports an inability to continue the test safely**
- Upon test termination, immediately record final measurements

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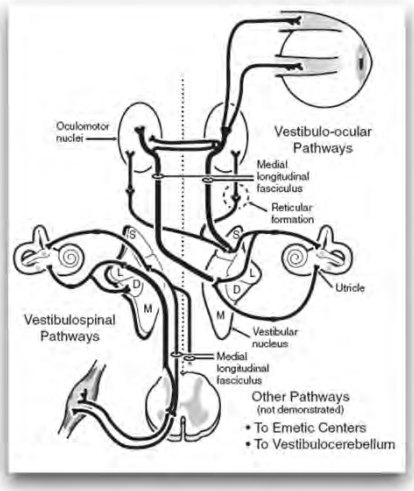
Vestibulo-oculomotor Impairments
Vestibular/Ocular Motor Screening (VOMS) for Concussion

(Harmon et al, 2019)

- The Vestibular/Ocular Motor Screening (**VOMS**) tool **offers a brief, standardised way to assess vestibular-ocular function**
- It is an **evaluation of symptom provocation** with smooth pursuits, saccades, the vestibular ocular reflex, vestibular motion sensitivity and convergence distance



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VOMS for Concussion

(Mucha et al, 2014)

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

- **Record:** Headache, Dizziness, Nausea and Fogginess on 0-10 scale **prior to screening**
- **Record:** Headache, Dizziness, Nausea and Fogginess ratings **after each test**

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VOMS – Smooth Pursuits

(Mucha et al, 2014)

- Patient is instructed to maintain focus on a target (3 ft. from patient) as the examiner moves the target smoothly in the horizontal direction 1.5 ft. to the right and left of midline.
  - Target moved at a rate of ~2 seconds from one-side-to-the-other
- Perform 2 repetitions
- Repeat the test in a vertical direction
  - **Record:**
    - Headache, Dizziness, Nausea & Fogginess ratings after the test
  - **Observe for:**
    - Saccadic eye movements; Evidence of a cranial nerve deficit. (Ellis et al, 2015)

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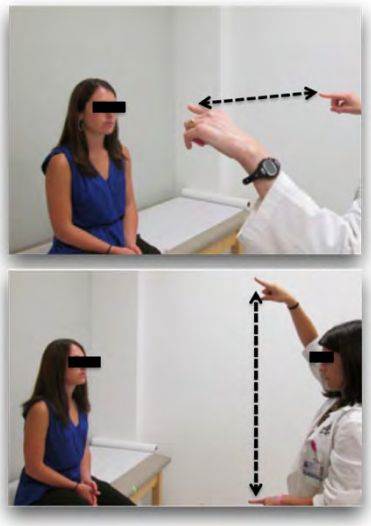
VOMS – Saccades

(Mucha et al, 2014)



- The examiner holds two single targets (fingertips) *horizontally* at a distance of 3 ft. from the patient, and 1.5 ft. to the right and 1.5 ft. to the left of midline
- Instruct the patient to move their eyes as quickly as possible from target to target
- Perform 10 repetitions
- Repeat for *Vertical Saccades*
  - **Record:**
    - Headache, Dizziness, Nausea & Fogginess ratings after each test
  - **Observe for:**
    - Overshooting; > 2 saccadic corrections; Gross dysconjugate eye movements (Ellis et al, 2015)

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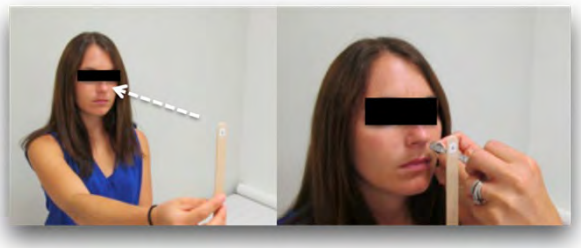
VOMS – Near Point Convergence

(Mucha et al, 2014)

- The patient focuses on a small target at arm's length and slowly brings it toward the tip of their nose.
- The patient is instructed to stop moving the target when they see two distinct images or when the examiner observes an outward deviation of one eye.
  - Blurring of the image is ignored.



- Measure distance in cm. between target and the tip of nose
  - Repeat and record 3 times
  - **Record:**
    - Headache, Dizziness, Nausea & Fogginess ratings after the test
  - **Observe for:**
    - Inability of the eyes to converge; convergence >6cm.

(Corwin et al, 2018; Bin Zahid et al, 2018)

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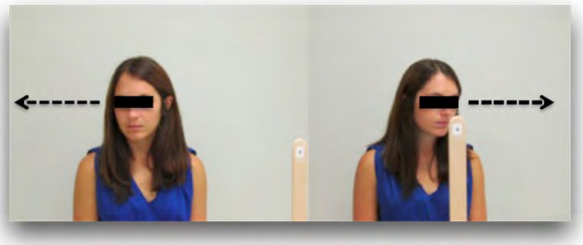
VOMS – VOR

(Mucha et al, 2014)



- Examiner holds a target in front of the patient in midline at a distance of 3 ft.
- The patient is asked to rotate their head *horizontally* while maintaining focus on the target.
  - The head is moved at an amplitude of 20º to each side and a metronome 180 bpm to ensure the speed of rotation (one beat in each direction).
- Perform 10 repetitions
- Repeat for *Vertical VOR*
  - **Record:**
    - Headache, Dizziness, Nausea & Fogginess ratings after the test
  - **Observe for:**
    - Ability to maintain gaze stability (Casa Della et al, 2014)

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VOMS – Visual Motion Sensitivity

(Mucha et al, 2014)

- The patient stands with feet shoulder width apart (facing a busy area of the clinic) with their arm outstretched and focusing on their thumb.
- Maintaining focus on their thumb, the patient rotates - together as a unit - their head, eyes and trunk at an amplitude of 80º to the right and left.
- A metronome 50 bpm to ensure the speed of rotation (one beat in each direction).

Perform 5 repetitions

- **Record:**
  - Headache, Dizziness, Nausea & Fogginess ratings after the test

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VOMS for Concussion

(Mucha et al, 2014)

Concussion Identification:

- Any individual VOMS test with a total symptom score ≥2
  - OR
- NPC distance of ≥5 cm

- The **VOR, VMS, and NPC distance components** of the VOMS **in combination are clinically useful in identifying concussions.**
- Abnormal findings or provocation of symptoms with any test may indicate dysfunction
  - …and should trigger a **referral to the appropriate health care professional for more detailed assessment and management.**

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"…it is important to emphasize that the VOMS was not designed as a comprehensive tool for vestibular and oculomotor function and may not encompass all of the screening strategies necessary to examine all aspects of vestibular and oculomotor dysfunction. Therefore, it may be useful as a screening tool, but is not appropriate as a replacement for a comprehensive vestibular and oculomotor assessment."

- Quartman-Yartes et al, 2020

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Different Forces, Different Systems

(Treleaven, 2017)

- **When higher forces or a direct blow to the head occur**, additional injuries, such as **concussion and/or damage to the CNS or visual or peripheral vestibular apparatus, are more likely**
- Up to 35% of **those with traumatic neck pain associated with higher forces may have peripheral vestibular damage** (eg, BPPV, damage to the endolymphatic sac, or a perilymph fistula).
- **Injuries induced by axial rotation** versus linear acceleration during the accident **may result in different types of neuro-otological injury.**

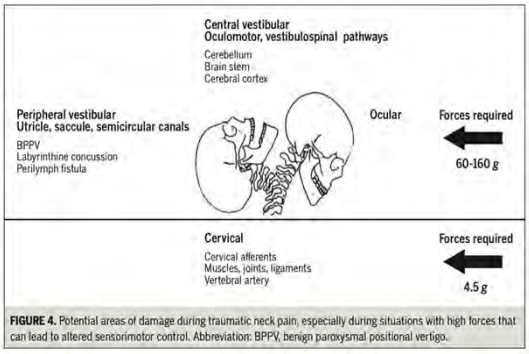


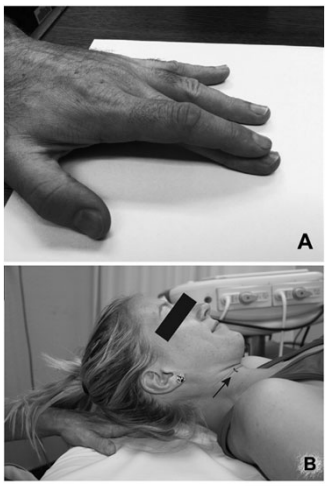
FIGURE 4. Potential areas of damage during traumatic neck pain, especially during situations with high forces that can lead to altered sensorimotor control. Abbreviation: BPPV, benign paroxysmal positional vertigo.

Cervical Musculoskeletal / Sensorimotor Impairments

Deep Neck Flexor Endurance Test

(Domenech et al, 2011; Schneider et al, 2018; Schneider, 2019)

- The patient is in a crook lying position with their head resting on the table
- Instruct the patient to perform cranio-cervical flexion ("chin tuck"), lift their head 2 finger widths off the table and hold this position for as long as possible
  - To fatigue or pain
- Stop the test if the patient's occiput touches your hand for more than 1-sec, or they have a loss of chin skin folds (from losing the chin tuck)



Cervical Musculoskeletal / Sensorimotor Impairments

Cervical Proprioception

(Jull et al, 2013; Hides et al, 2017; Treleaven, 2017)

Cervical Joint Position Error (JPE) Testing

- The patient is seated in a chair with a back support, with a headband with laser centred on the forehead. The patient is seated 90 cm from a wall and is instructed to sit with their head in their natural resting position
- Ask the patient to close their eyes – or use a blindfold – and memorize the position.
- Instruct the patient to perform full cervical rotation, then return their head to the start position.
  - The patient is to verbally indicate when they perceive they have returned to their start position - Record position
  - Give no feedback on accuracy
  - The practitioner manually adjusts the persons head to match original starting position.
- Repeat 6 times alternately to each side
  - Calculate the average for the left and right trials

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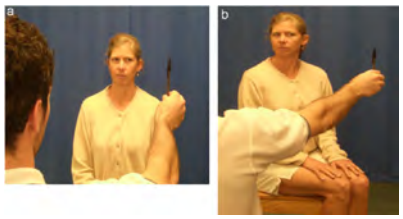
Cervical Musculoskeletal / Sensorimotor Impairments

Smooth Pursuit Neck Torsion Test

(Treleaven, 2017; Treleaven, 2008)

- Ask patient to follow a slow moving target with their eyes while keeping their head still
  - The target is moved ~20º/sec through a visual angle of 40º
- Perform with head and trunk in neutral
- Perform with 'neck torsion'
  - head neutral, trunk rotated 45° left
  - head neutral, trunk rotated 45º right
- **Note differences in neck torsion positions compared to neutral position:**
  - Catch up saccades
    - Particularly when target crosses midline
  - Symptom reproduction in 'neck torsion'



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CSPR for Dizziness post mTBI

(Hammerle et al, 2019)

- ***"Results suggest that patients with dizziness after mTBI and who had abnormal CSP assessments (JPE and/or SPNT) responded better to CSPR compared with those who received VRT"***

- Exclusion criteria included any patients who had:
  - **clear peripheral vestibular or consistent central signs on clinical vestibulo-ocular testing** with or without visual suppression.

Retrospective Review: Effectiveness of Cervical Proprioception Retraining for Dizziness After Mild Traumatic Brain Injury in a Military Population With Abnormal Cervical Proprioception

Miriam Hammerle, PT,[a] Alicia A. Swan, PhD,[b] Jeremy T. Nelson, PhD,[c] and Julia M. Treleaven, PhD[d]

ABSTRACT

Objective: This study aimed to assess the outcomes of 2 treatments for patients with dizziness after mild traumatic brain injury (mTBI) who demonstrate abnormal cervical spine proprioception (CSP).

Methods: A retrospective records review was conducted on the medical charts of patients treated for dizziness after mTBI who received either standard care (vestibular rehabilitation therapy [VRT]) or cervical spine proprioceptive retraining (CSPR) from 2009 to 2013. All patients included in the analysis were active-duty military with recurring dizziness after mTBI who had at least 1 abnormal CSP test. Patients were excluded for dizziness with a clear peripheral vestibular or central symptom origin, incomplete data, or no CSP assessment, or if both treatments were administered. Forty-eight total patients were included in the final dataset (22 VRT; 26 CSPR). Traditional VRT was compared with CSPR when abnormal CSP tests were present, regardless of the presence or absence of neck pain. A clinician review of records was used to determine improvement of dizziness based on patient reports of symptoms at discharge evaluation (ie, no symptoms for at least 2 weeks).

Results: Patients who received CSPR were 30 times more likely to report improvement in dizziness symptoms compared with those who received VRT (adjusted odds ratio: 30.12; 95% confidence interval: 4.44-204.26, $P < .001$) when abnormal CSP tests were present. Patients with dizziness over 1 year were significantly less likely to improve.

Conclusion: These results suggest that patients with dizziness after mTBI and who had abnormal CSP assessments responded better to CSPR compared with those who received VRT. (J Manipulative Physiol Ther 2019;42:399-406)

Key Indexing Terms: *Dizziness; Brain Concussion; Neck Pain; Cervicalgia; Vertigo; Postural Balance; Kinesthesis*

INTRODUCTION

Mild traumatic brain injury (mTBI) makes up 86% of brain injuries that US military personnel have sustained between 2000 and 2018.[1] Although most symptoms after mTBI resolve within 2 weeks, several can persist, including dizziness.[2]

Dizziness that occurs after mTBI is not heterogeneous, presenting with varied characteristics and several potential sources and mechanisms, including the inner ear, the brain, the cervical spine, and/or the integration of afferent input and tuning within the sensorimotor control system.[3,4]

Traditionally, vestibular rehabilitation therapy (VRT) aimed at central or peripheral vestibular origins has been used to treat persistent dizziness after mTBI.[5,6] but recent attention has examined the possible role of the cervical spine in postconcussive dizziness.[7,8] Dizziness after mTBI has been shown to improve when manual therapy and specific sensorimotor control exercises for the cervical spine were added to standard care VRT.[7,8] Further, a growing body of

Chiropractor's Role In Management

Chiropractors are well suited for evaluating signs and symptoms associated with concussion

- Throughout evaluation and treatment of cervical spine complaints with spinal manipulation, soft tissue modalities, and exercises
- Utilization of advance imaging to exclude cerebral hemorrhages, cervical instability, and others immediate concerns
- Implementation of Return-to-Academics and Return-to-Sport protocols
- Implementation of aerobic, and strength and conditioning protocols

Chiropractor's Role In Management

Signs and symptoms should be comanaged with proper healthcare providers.

With appropriate training, chiropractors may help manage related:

- vestibulo-ocular conditions
- Neurological conditions

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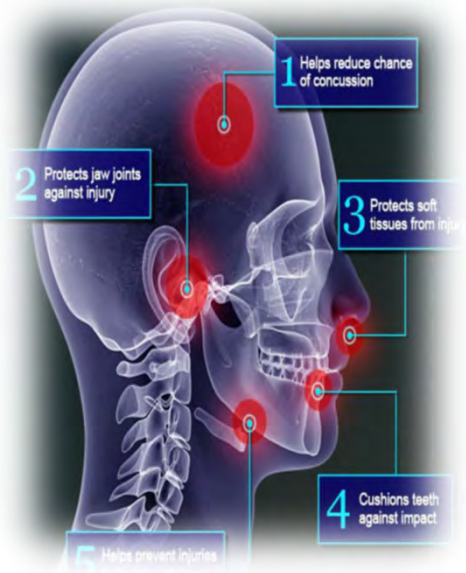

Return-to-Academics and Return-to-Sport

Injury Prevention Strategies

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Graduated Return-to-School

(McCrory et al, 2017)

Table 2 Graduated return-to-school strategy

Stage	Aim	Activity	Goal of each step
1	Daily activities at home that do not give the child symptoms	Typical activities of the child during the day as long as they do not increase symptoms (eg, reading, texting, screen time). Start with 5–15 min at a time and gradually build up	Gradual return to typical activities
2	School activities	Homework, reading or other cognitive activities outside of the classroom	Increase tolerance to cognitive work
3	Return to school part-time	Gradual introduction of schoolwork. May need to start with a partial school day or with increased breaks during the day	Increase academic activities
4	Return to school full time	Gradually progress school activities until a full day can be tolerated	Return to full academic activities and catch up on missed work

- Children and adolescents **should not return to sport until** they have **successfully returned to school.**
- However, **early introduction of symptom-limited physical activity is appropriate**.

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Graduated Return-to-Sport

(McCrory et al, 2017)

Table 1 Graduated return-to-sport (RTS) strategy

Stage	Aim	Activity	Goal of each step
1	Symptom-limited activity	Daily activities that do not provoke symptoms	Gradual reintroduction of work/school activities
2	Light aerobic exercise	Walking or stationary cycling at slow to medium pace. No resistance training	Increase heart rate
3	Sport-specific exercise	Running or skating drills. No head impact activities	Add movement
4	Non-contact training drills	Harder training drills, eg, passing drills. May start progressive resistance training	Exercise, coordination and increased thinking
5	Full contact practice	Following medical clearance, participate in normal training activities	Restore confidence and assess functional skills by coaching staff
6	Return to sport	Normal game play	

NOTE: An initial period of 24–48 hours of both relative physical rest and cognitive rest is recommended before beginning the RTS progression.
There should be at least 24 hours (or longer) for each step of the progression. If any symptoms worsen during exercise, the athlete should go back to the previous step.
Resistance training should be added only in the later stages (stage 3 or 4 at the earliest). If symptoms are persistent (eg, more than 10–14 days in adults or more than 1 month in children), the athlete should be referred to a healthcare professional who is an expert in the management of concussion.

- Premature return to play is a risk factor for complications
- **No return to play before clinically recovered**

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New: Rest, Recovery, Graded Loading Program (with monitoring)

(AFL Concussion Working Group Scientific Committee, 2021)

Focus	Goal	Requirements to move to next stage
Rest		
Rest	• Help speed up recovery	• Complete physical and cognitive rest in the first 24 – 48 hours
Recovery		
Symptom limited activity	• Two days of activities that do not provoke symptoms	• No concussion-related symptoms at rest or with physical or brain activity for at least 1 day and the player has successfully returned to work/school • The player should also have a medical clearance (e.g. physiotherapist, sports trainer, first aider) to confirm that the player has had no concussion-related symptoms for at least 1 day
Graded Loading – individual program		
Light / moderate aerobic exercise	• Light / moderate aerobic exercise (e.g. walking, jogging, cycling at slow to medium pace) • No resistance training	• Remain completely free of any concussion-related symptoms
Recovery day		
Sport-specific exercise	• Increased intensity (e.g. running at an increased heart rate) and duration of activity • Add sports specific drills (e.g. goal kick, stationary handball) • Commence light resistance training	• Remain completely free of any concussion-related symptoms • The player should also have a medical clearance (e.g. physiotherapist, sports trainer, first aider) to confirm that the player has had no concussion-related symptoms for at least 1 day
Recovery day		
Graded Loading – full team training		
Limited contact training	• Return to full team training – non-contact except drills with incidental contact (incl. tackling)	• Remain completely free of any concussion-related symptoms • Player confident to return to full contact training
Recovery day		
Clearance by a medical doctor is required before returning to the final full contact training session and competitive contact sport		
Full contact training	• Full team training	• Remain completely free of any concussion-related symptoms • Player confident to participate in a match
Recovery day		
Return to Play		

Injury Prevention Strategies Assessment

(Benson et al, 2013; Daveshvar et al, 2015)

Helmets

- Demonstrated to reduce skull fracture and contact injuries
- No definitive reduction in concussion occurrences

Injury Prevention Strategies Assessment

(Benson et al, 2013; Daveshvar et al, 2015)

Mouth Guards

- Demonstrate the effective reduction of dental and jaw injuries
- No definitive reduction in concussion occurrences

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Injury Prevention Strategies Assessment (Collins et al 2014; Benson et al, 2013)

Strength and Conditioning

- Data suggests increased neck strength may reduce rate of concussion
  - High school athletes appear to benefit from increased neck strength
  - Research results mixed on effect of neck strength on the professional level

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Injury Prevention Strategies Assessment (Collins et al 2014; Benson et al, 2013)

Neck strengthening and conditioning beneficial for the recovery of cervical associated symptoms in concussion and post-concussion syndrome

- Deep neck flexor endurance test

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Injury Prevention Strategies Assessment (Clark et al, 2015)

Dynamic Vision Training:

- University of Cincinnati has done preliminary research on utilizing dynamic ocular training to improve vision processing, speed of processing, eye hand coordination, visual fields, ocular motor performance, and overall awareness.
- University of Cincinnati athletes have had a subjective decrease in concussion sustained over the past six years since implementation began
- Research being conducted to demonstrate utility of these programs

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Questions?

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Doctors working at international events need to update their head injury module every 2 years to remain current.

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