Concussion Management Guidelines for Certified Athletic Therapists in Quebec

Corporation des Thérapeutes du Sport du Québec

Quebec Corporation of Athletic Therapists

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Acknowledgements

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The CTSQ wishes to acknowledge and thank the authors who worked tirelessly in creating and delivering this document. In alphabetical order, the authors are:

Laurie-Ann C. Berrigan, MSc, CAT(C)
John Boulay, B.Sc., EMT, DO, CAT(C)
Philippe Fait, PhD, ATC, CAT(C)
Laura Leslie, B.Sc., DO, CAT(C)
Jennifer Ann Scott, B.Sc., CSCS, CAT(C)

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This document will be reviewed and revised on an annual basis in order to remain current. The CTSQ will have all of the links within this document on their webpage available for download.

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Introduction

Background

In the fall of 2013 the *Corporation des Thérapeutes du Sport du Québec* (CTSQ) mandated an ad hoc committee on concussion standards to provide a document describing the current standards for concussion and head trauma management. The goal was to ensure that Athletic Therapists (ATs) continue to provide the highest standard of care for their patients through the provision of a unified standard of response to concussions.

The overreaching desire of the CTSQ and this committee is to prevent possible patient mismanagement, unnecessary suffering, and to inspire a positive effect on both the injured individual and their support network.

The committee conducted thorough research, review, and clarification of current internationally recognized concussion management standards and guidelines. These guidelines were found in peer-reviewed sports medicine scientific literature. The resultant document is a thorough representation of concussion management standards as they currently exist, and should serve as the standard of care for all ATs practicing in the province of Quebec. The document may also serve as a guideline for other healthcare professionals or persons who provide care to individuals who have sustained a concussion. These guidelines are appropriate for the treatment of children, young adults and adults. The document will be reviewed and revised on an ongoing and regular basis in order to remain current

The Athletic Therapists Scope of Practice

Certified Athletic Therapists are front line health care professionals. As per the Quebec government decree, effective May 30th 2012, “Athletic Therapists are skilled in emergency response, clinical assessment and rehabilitation as well as return to play of any and all musculoskeletal injuries”. [1]

This statement illustrates that ATs, in accordance with the highest standard of care, are trained and prepared to provide the emergency assessment, treatment, ongoing monitoring, and return to play decision making associated with a concussion or mild traumatic brain injury (mTBI) while following age appropriate guidelines. As such, ATs are well suited to provide post-concussive care to athletes at the recreational, elite and professional level. They can also provide acute care services and facilitate active rehabilitation for an athlete’s safe return to play.

ATs are prepared to manage an athlete with a suspected concussion/mTBI at either a sports venue or as a patient in a clinical setting or training room. It is essential that these first encounters be dealt with expeditiously using methods based on the highest standard of healthcare.

Concussion Interpretation

It should be understood that the terms concussion and mTBI are interchangeable. In sports and everyday life, the term concussion is widely used and accepted as being a minor injury relative to a Traumatic Brain Injury (TBI). Whereas, a concussion is in fact a mild traumatic brain injury, it is important that it be understood as such. [2] It is important that ATs, athletes, patients, and their support network understand the significance of the word "concussion". This interpretation should raise awareness and increase caution and compliancy during the treatment and rehabilitation process required after injury.

While the long-term effects of concussion mismanagement are unknown, it is clear that short-term mismanagement following a concussion leads to an increase in symptoms and delays in recovery. [3]

TBIs can be characterized as diffuse or focal. The diffuse type would refer to an injury where there has been a widespread disruption of neurological function caused by shearing of neuronal connections. Depending on the area of the brain that is affected, the injury can result in a wide range of deficits, which can include, but are not limited to, changes in personality, loss of speech, inability to comprehend speech, motor impairment, and attention and/or memory deficits. The focal type refers to injuries that are more localized and potentially life threatening such as injuries with intracranial bleeding. [4, 5, 6]

It is important to note than any direct or indirect head injury can also be associated to a traumatic brain injury of varying severity and as such, a proper brain injury assessment as per these guidelines should be performed.

Consensus Model for Concussion Management

Every four years, international experts meet to discuss advances in sport concussion management. Their latest consensus statement, titled *The 4th International Conference in Concussion in Sport* . was held in Zurich (November 2012).

This consensus statement provides details on modalities and emergency care when it comes to concussions. Various groups also provide guidelines when it comes to concussions, however the CTSQ recommends following the guidelines outlined from the International Conference on Concussion in Sport, which reflect up-to-date research findings. [7]

The CTSQ advocates the use of a more conservative management approach due to the complexity of concussions, the nature of the injury, the current literature and various other factors revolving around this particular condition such as age, maturation and medical history. Each case must therefore be evaluated individually and the management strategy should take into account all factors.

Glossary

Active rest: A term used in the return-to-play (RTP) guidelines meaning that the person is still not permitted to participate in the return-to-learn (R2L) protocol and/or the RTP protocol. The person, however, is permitted to participate in activities of daily living that do not produce or exacerbate any concussion symptoms.

Acute: In the field, an injury is considered to be in the acute phase from the moment of injury until 72 hours post injury. In a clinical setting, during the treatment and recovery, the acute phase is up until 7 to 10 days post injury.

Age category: With respect to the currently available tools within these guidelines

- **Child:** As per the Quebec law; any person under the age of 18.
- **Adolescent & Young adult:** Any person between the ages of 13-25, including 25, as per brain maturation for current standards and management procedure in the province of Quebec.
- **Adult**: Any person over the age of 25 years old. [8, 9]

Child SCAT3: An evaluation tool for concussions specifically for children under 12 years of age. [10]

Complete rest: The absence of any and all cognitive or physical activity or stimulation.

Concussion: See definition for Mild Traumatic Brain Injury (mTBI). [11]

Coup-Contrecoup, Whiplash: A term used to describe a direct or indirect injury to the head/neck caused by a sudden, forceful head/neck movement followed by subsequent forceful head/neck movements in the opposite direction. These movements can occur in flexion/extension, side-bending and rotation.

Diagnosis: An act reserved for physicians to identify an injury or disease based on testing, and signs and symptoms.

Diffuse axonal injury: Type of concussion where there is a widespread disruption of neurological function caused by shearing of neuronal connections. [4, 5, 6]

Focal: The tissue damage resulting in injury is more localized and potentially life threatening. [4, 5, 6]

Glasgow Coma Scale (GCS): A tool used to assess and quantify a person's level of consciousness/responsiveness. [7]

Mechanism of Injury (MOI): The events leading up to the injury, which caused the injury to occur.

Mild traumatic brain injury (mTBI): A mTBI is an acute brain injury resulting from direct or indirect mechanical energy to the head from external physical forces. Operational criteria for clinical identification include:

a. One or more of the following: confusion or disorientation, loss of consciousness for 30 minutes or less, post-traumatic amnesia for less than 24 hours, and/or other transient neurological abnormalities such as focal signs, seizure, and intracranial lesion not requiring surgery
b. Glasgow Coma Scale score of 13–15 after 30 minutes post-injury or later upon presentation for healthcare. These manifestations of mTBI must not be due to drugs, alcohol, medications, other injuries or treatment for other injuries (e.g. systemic injuries, facial injuries or intubation), caused by other problems (e.g. psychological trauma, language barrier or coexisting medical conditions) or caused by a penetrating craniocerebral injury. [12]

Rehabilitation: The process of healing from an injury or disease through various forms of therapy.

Return-to-Play (RTP): Stepwise guideline for gradual return to participation in a particular activity after a concussion.

Sport Concussion Assessment Tool 3 (SCAT3): A concussion evaluation tool for individuals 13 years of age and older. [11, 12]

Signs: Any objective evidence of disease or injury that is observed by the health practitioner that may or may not have been noticed by the patient.

Slow-to-recover: Any athlete or individual who has sustained a concussion who is still symptomatic for a minimum of four weeks (28 days) after the injury. [13]

Symptoms: A characteristic of a disease or injury that is experienced and described by the patient to the health practitioner and is not visible to the health practitioner. [11]

Traumatic brain injury (TBI): A TBI is a non-degenerative non-congenital insult to the brain, resulting from direct or indirect mechanical energy to the head from external physical forces causing trauma and possibly leading to temporary or permanent impairment of cognitive, physical and psychosocial functions, with an associated altered state of consciousness. It includes the overall spectrum of all severities, from mild concussions to severe. [11, 12]

1. Concussion Assessment Guidelines

1.1 On Field Assessment

1.1.1.Suggested Evaluation Tools

(Please see the references section for e-links)

- SCAT3: 13 years old and over [11] – Appendix 1
- Child SCAT3: 5-12years old [10] – Appendix 2
- Graded Symptom Checklist (GSC) [11] – Appendix 3
- Cranial Nerve Assessment [14, 15] – Appendix 4
- Glasgow Coma Scale (GCS) [11] – Appendix 5

Mechanism of Injury

1.1.2 Assessment Procedure

Use the SCAT3 as part of the screening tools to help determine "Recognize & Remove" concussion signs.

1) MOI
   a) Determination of the mechanism of injury (MOI) is important for establishing what potential structures may be involved. The two most common types of MOI are from a direct hit to anywhere on the head, or from a whiplash type motion. These are also known as coup and contrecoup injuries. The coup usually produces injury on the same side of the impact. The contrecoup injury is a result of the head continuing to move after a sudden stop in the movement of the body, usually producing injury on the opposite side. Either MOI can cause injury and concussion and there is no evidence indicating which type is worse or which has different or more severe symptoms.

2) Spinal precautions in effect
   a) Manually stabilize head and neck

3) Perform Primary Survey to identify red flags for ambulance transport.
   a) Primary Survey
      i) Determine level of consciousness, airways, breathing and circulation
      ii) UABCd/UCABd (U includes non-scored GCS)

4) Non-scored GCS is performed during determination of unconsciousness in the primary survey: (GCS - refer to appendix 5)
      (1) Evaluate level of consciousness
         (a) Ask: What happened? (Do eyes open if they were closed? Do they respond verbally or move?)
         (b) Say: Open your eyes. (Do they open their eyes? Move?)

(c) Ask: Where does it hurt? (Do they respond verbally?)
(d) Say: Move your fingers? (Do they move their fingers?)
NOTE: If no response with first 2 questions, go to pain stimulation.
(e) Invoke pain: Pinch triceps and/or nail bed (Do they open eyes? Moan? Localize? Withdraw? Decorticate? Decerebrate?)
NOTE: If no response at all: Glasgow= 3/15

5) Initiate Emergency Response Plan (ERP) as required [16]

6) Deal with any first aid/emergency care issues

7) Determine chief complaint and MOI

8) Perform secondary survey to rule out life/limb threatening injuries as per MOI if known.
   a) Secondary Survey includes:
      i) SAMPLE, full body scan, vitals, GCS baseline score
      ii) Determine if concussion signs present:
         (1) Somatic, cognitive or emotional changes? Behavioural changes? Cognitive impairment? (LOC, balance/motor coordination issues, disorientation, confusion, memory loss, blank vacant stare, visible facial injury?)
      iii) Cranial nerves easily assessed on field:
         (1) II. Optic - visual acuity
         (2) III. Oculomotor - pupil reaction
         (3) IV. Trochlear - eye movements
         (4) VII. Facial - smile, grimace

NOTE: If red flags are present during primary/secondary survey, the athlete should be immobilized and transported to the hospital via ambulance. [17] If serious injuries are present without red flags during the primary/secondary survey, activate the ERP. [16]

RED FLAGS INCLUDE:

- Loss of consciousness
- Deterioration of neurological function
- Decreasing level of consciousness
- Decrease or irregularity of ventilatory rate
- Decrease or irregularity of pulse
- Unequal, dilated or unreactive pupils
- Signs and symptoms associated with spine and/or skull fracture or bleeding
- Mental status changes; lethargy, difficulty staying awake, confusion, agitation, etc.

- Seizure activity, initial lucid (asymptomatic) interval, then presentation of rapid progressing symptoms

NOTE: If the athlete is conscious, alert, and has no red flags indicating serious head injury or need for spinal immobilization, the athlete can make their own way off the field, and the concussion assessment may continue on the sideline.

1.2 Sideline Assessment

For field care situations, the evaluation may be continued on the sideline where the athlete is constantly monitored and re-assessed (serial assessment) for changes every 5 minutes. A quiet room would be ideal, but not always realistic.

IMPORTANT

The athlete should not be left alone during the initial 4 hours post injury.

The initial sideline assessment always focuses on trying to rule out a more serious injury in a timely fashion in the midst of competition. Once GCS is scored, signs and symptoms of concussion are recorded. After monitoring and a rest period of at least 10 minutes, further SCAT testing is done which includes symptom severity, and neurocognitive and physical evaluations.

IMPORTANT

The rest period is necessary to avoid influence of exertion or fatigue. [10. 11]

Thereafter, a sideline assessment is similar to a clinic visit, where it is safe to move the athlete to complete a more thorough evaluation, or when an athlete presents him/herself to the AT during or after a game to seek help for head injury.

1.2.1 Evaluations tools for the sideline assessment

(Please see the references section for e-links.)

- SCAT3: 13 years old and over 11 – Appendix 1
- Child SCAT3: 5-12 years old 10 – Appendix 2
- Graded Symptom Checklist (GSC) 11 – Appendix 3
- Cranial Nerve Assessment 14, 15 – Appendix 4
- Glasgow Coma Scale (GCS) [11] – Appendix 5
  - NOTE: repeat GCS every 5 minutes for first 15 minutes post trauma if score is 13-14/15
- Maddocks Score
- Background and concussion history

NOTE: The following are to be done at resting state (at least 10 minutes post exercise)

- Symptom evaluation
- Cognitive & physical evaluation
- Neck examination
- Balance examination
- Coordination examination
- Standardized Assessment of Concussion (SAC)
- Delayed recall

NOTE: Regardless of the assessment tool chosen, it should include the following criteria:

- History and observation (note MOI)
- Orientation (time – space) and memory
- Level of consciousness
- Signs and symptoms (see Table 1)
- Cognitive function
- Cranial nerve function (see Appendix 4)
- Balance
- Coordination

1.2.2 Evaluation procedure

Document SCAT3 findings at time of injury and compare with baseline if available.

Complete GSC at time of injury, 2-3 hours, 24 hours, 48 hours, and 72 hours post injury.

IMPORTANT

Provide copies of both SCAT3 and GSC to the responsible adult doing home monitoring and for physician visit.

If EMS is called, transfer of care should involve giving the paramedics the original copy of completed SCAT3 and intervention notes. The AT can take a picture of the form with their camera phone for later reference and documentation.

In all cases, it is highly recommended that athletes with suspected head injury seek medical attention.

An athlete with a suspected concussion can never RTP same day and must follow currently accepted age-specific RTP guidelines.

Table 1*

1.2.3 Signs and Symptoms of a Concussion

Physical	Cognitive	Emotional	Sleep
Headache	Feeling like "in a fog"	Irritability	Drowsiness
Nausea or vomiting	Difficulty concentrating	"Don't feel right"	Sleep more than usual
Dizziness	Difficulty remembering	Sadness	Sleep less than usual
Loss of consciousness	Feels slowed down	Nervous or anxious	Hard to fall asleep
Seizures or convulsion	Forgets recent events	More emotional	
Neck pain	Confusion	"Pressure in head"	
Sensitivity to light	Repeats questions		
Sensitivity to noise	Answers slowly		
Balance problems	Amnesia		
Blurred vision			
Fatigue or low energy			
Stunned or dazed			

Note: Concussion should be suspected in the presence of any or more of the above symptoms following some form of head injury. [18]

* Table 1 was taken directly from page 184 from Muriel Lezak's book, Neuropsychological Assessment, which she adapted from SCAT2 and Halstead and Walter (2010) [18]

1.3 Clinical Assessment

Regardless of the nature and complexity of the signs and symptoms associated with the head injury, ATs should always approach this condition in the same clinical manner that they would address any other musculoskeletal injury.

The clinical concussion assessment would include secondary complimentary subjective and objective history taking questions. Physical examination would include specific concussion related special tests to recognize certain concussion injury consequences and provide proper decision making processes for the treatment and/or the healthcare referral of the concussed athlete.

1.3.1 Components of a complete Clinical Assessment:

1.3.1.1 Balance Error Scoring System (BESS Balance Test)

- NOTE: Clinical assessment of balance and postural control is considered a reliable and valid assessment tool for concussed athletes/individuals [7, 19, 20]

Procedure: Use modified BESS Balance Test

a. Double leg stance (for 20 seconds)
b. Single leg stance (for 20 seconds)
c. Tandem Stance (for 20 seconds)

1.3.1.2 Vestibular/Vision Assessment

a. Smooth Pursuits Test:
    - Tests ability to follow object smoothly without effort/strain or nystagmus
b. Convergence Test:
    - Tests ability to follow converging object without effort/strain or double vision [21, 22]

1.3.1.3 Rivermead Post-Concussive Symptom Questionnaire (RPQ):

a. A modified version of the original [23] RPQ that separates the scoring into two parts – RPQ-3 and RPQ-13. – **Appendix 6**

    NOTE: This modification demonstrates that the RPQ can be used clinically as a subjective test-retest assessment tool for concussion symptoms. [23]

1.3.1.4 Physical Evaluation of the Cervical Spine:

Assessment of the cervical spine should be performed as per the CATA scope of practice guidelines for cervical spine evaluation. [14]

1.3.1.5 SCAT3 / Child SCAT3

SCAT3 – For individuals aged 13 and older [11] – Appendix 1
or
Child SCAT3 – For children from 5-12 years old. [10] – Appendix 2

NOTE: With individuals aged 5-12 years old, it is outlined that cognitive rest is an important factor of the concussion recovery. [10]

1.3.2 Adjunct Testing

1.3.2.1 Physician directed tests

The following tests are physician directed, but are still important for the AT to acknowledge within, or in addition to, their assessment:

NOTE: Computed Axial Tomography (CAT) and conventional Magnetic Resonance Imaging (MRI) usually fail to detect evidence of structural brain abnormalities in concussions. However, reviews of research in the biomechanical modeling of mTBI conclude that mTBI leads to functional neuronal disruption, and at times, structural damage. [24, 25, 26]

1.3.2.2 Assessment performed by a neuropsychologist

Neuropsychological Assessment (NP) by a neuropsychologist allows the AT to assist clinical decisions relevant to the overall management of the concussed athlete, in addition to other management tools. Some NP testing tools can be used for both child and adult age populations.

NOTE: Due to the continual cognitive development of the child during the maturation period, NP testing has been shown not to be as effective as a baseline test or a comparison model.

2. Concussion Treatment Guidelines

2.1 On field and Sideline Treatment

Concussions are one of the most difficult injuries to treat on field or sideline. Each athlete may respond differently to head trauma and it is difficult to find one protocol that will be applicable in every case. ATs must make an informed decision on concussion management with the tools available to them and treat concussions with the utmost care.

Sometimes the presence of concussion signs makes it difficult to determine whether a more serious injury exists or will develop. The range of potential differentials may include, however is not limited to, an epidural bleed, subdural hematoma, intra-cranial contusion, and Second Impact Syndrome (SIS).

Recent studies are giving more credence to a more conservative approach to concussion. [27, 28] There is some emerging research evidence that vascular injuries can occur even in mild traumatic brain injuries. [29, 30]

2.1.1 Evaluation Tools

a. SCAT3: 13 years old and over [11] – Appendix 1
b. Child SCAT3: 5-12 years old [10] – Appendix 2
c. Post-Concussion Symptom Inventory
   - Post-Concussion Symptom Inventory Child (PCSI-C) [31]
     Ages 5-12 – Appendix 7
     or
   - Post-Concussion Symptom Inventory (PCSI) [31]
     Ages 13-18 – Appendix 7
     or
   - Post-Concussion Symptom Inventory (PCSI-P) [31]
     Parent of child aged 5-18 – Appendix 7
     or
   - Graded Symptom Checklist (GSC) [11]
     Aged over 18 – Appendix 3

2.1.2 On-Field Management

- If a concussion is suspected, the athlete should be removed from play.
- Determine if there are indications for emergency management protocols (c-spine, seizure, etc.). If there are any doubts about urgency of symptoms, ERP should be initiated, the athlete should be provided necessary care, closely monitored, and urgently referred to an ER physician by ambulance.[16, 32]

- Use age appropriate SCAT3 [11] or Child-SCAT3 (5-12 years old) [10] tool to determine possible presence of a concussion. [33]
- If the athlete is not deemed to have a medical emergency or contraindications to transport off the field, the athlete may be moved to the sideline for further assessment. [33]

2.2 Sideline Management

A more detailed assessment may be carried out on the sideline to determine the extent of concussion.

- Appropriate care is provided as per presentation of symptoms.
- The athlete is continuously monitored, especially during the first 30 minutes, until a plan of action is made.
- A physician referral plan is made (see Referrals Following a Concussion - section 2.4 [34])

IMPORTANT

The athlete should not be left alone during the initial 4 hours post injury.

NOTE: Documentation of acute concussion signs will help with the RTP, especially if there is no baseline available. Comparison to a baseline may be used when available to detect subtle signs, which may be missed.

2.3 Global Management

Every athlete who has received a direct or indirect head trauma should be monitored from the time of injury to the point where signs and symptoms have completely disappeared.

All athletes with any signs or symptoms of an acute concussion are removed from play for a minimum of 1 week for an adult [7] or 2 weeks for a child, [35] and must follow acceptable age-appropriate RTP guidelines. [35]

IMPORTANT

Generally, a graduated RTP should only proceed once an adult athlete has been asymptomatic for at least 24 hours. A child will need a longer period of rest, which ranges between 1-7 days before the graduated RTP protocol commences. [36] Every case is different and is affected by co-morbidities and history.

NOTE 1: The determination of the safest initial rest period duration for athletes ≤ 25 years of age remains one of the biggest challenges due to the lack of consensus. Thus, the recommendation from the CTSQ is to air on the side of caution and encourage a longer rest period for this age group.

NOTE 2: The availability of baseline values is an important tool in the assessment and treatment of concussions. Every AT should strive whenever possible to have a database of baselines available for athletes under their care. Some symptoms can be present pre-morbidly or at baseline, so it would be valuable to note changes from their usual presentation.

IMPORTANT

The parent or legal guardian should fill out the Post-Concussion Symptom Inventory (PCSI) form for parents and help the athlete fill out the age appropriate PCSI form for children to allow for proper monitoring of the signs and symptoms of the concussion. This will also allow for adequate documentation of the athlete's progress throughout the rehabilitation and RTP. See Appendix 5 for instructions on how to fill out and use the PCSI. [31]

2.4 Referrals following a concussion

All concussions should be referred to a physician, ideally one who has experience dealing with head injuries, for follow-up investigation. In some concussion cases, symptoms may take up to 72 hours to develop. Therefore, ATs should remain in contact with their injured athlete and/or the person monitoring them for the first 48-72 hours to ensure appropriate follow-up is made.

A physician referral is also required if further diagnostic testing is indicated, medications prescribed, or if there are medical forms/letters that must be completed for school or work.

There are generally three categories of physician referrals:

- Urgent referral
- Same-day referral
- Post-concussion referral

2.4.1 Urgent referral

Urgent cases require immediate referral to an ER physician by ambulance. The athlete would be immobilized and then transported urgently to the nearest trauma hospital.

It is practical to be over-cautious, but there are realities of the pre-hospital care system that should be considered. The current 2013 protocols for the Services Préhospitaliers d'Urgences du Québec (Quebec Emergency Medical Services) [34] indicate the use of a cervical collar and full spinal immobilization (including vacuum mattress) for ANY head injury. The use of urgent referral should be validated before use. However, if there is any doubt, initiate ERP including 9-1-1 ambulance dispatch sooner than later.

The following are typical red flags indicating need for an urgent referral:

- Unconsciousness/prolonged loss of consciousness
- Altered or decreasing level of consciousness
- Decreased neurological function
- Decreased or irregularity in pulse
- Unequal/dilated/unreactive pupils
- Mental status changes such as lethargy, non-arousal, confusion, agitation
- Seizure activity, lucid interval
- Convulsions
- Vomiting
- Severe or increasing headache
- Visual changes
- Slurred speech
- Any sign/symptoms of associated injuries such as to the spine, possible skull fracture or cranial bleeding.

IMPORTANT

When Emergency Medical Services (EMS) is called, transfer of care should involve giving the paramedics a copy of the completed SCAT3 and intervention notes. Having a means to make a quick copy for later reference or documentation is useful, such as taking a picture with a camera phone.

2.4.2 Same Day Referral

A physician's office visit is recommended on the same day for concussion follow-up when there are no red flags present. The AT would not leave the athlete for at least 30 minutes. The athlete would be monitored by either an AT or delegated to a responsible adult/guardian for any deterioration until seen that day. If a same day office/clinic visit is not possible for any reason, it is recommended that the athlete be taken to the ER, however an ambulance would not usually be required.

Same day referral criteria includes:

- No loss of consciousness
- Alert, oriented, normal neurological exam
- Minimal symptoms that persist more than 15 minutes
  - Mild nausea
  - Mild light/noise sensitivity
  - Mild memory issues
  - Any alteration from baseline (if available)
- Headache still present after 15 minutes
  - The pain is constant
  - Does not increase in intensity

- Is not severe
- No other urgent indicators

IMPORTANT

The athlete should be monitored for the next 4 hours before a decision is made to refer as a same-day or post-concussion follow-up.

It is important to provide the person monitoring the athlete a completed copy of the SCAT3 that also includes concussion injury advice. Also provide a copy of GSC form (within initial findings) for home monitoring.

- RECOMMENDATION: A physician note should also be obtained stipulating whether a follow-up physician visit is required before RTP, or if the RTP can be done under guidance of an AT.

2.4.3 Post-Concussion Referral

A physician's office visit is recommended within the next few days for concussion follow-up in the absence of urgent or same day referral criteria. The consultation with the physician should be within 3 to 7 days post-injury.

This visit will ensure medical follow-up, documentation of condition, completion of forms for insurance and medical notes for absences and/or academic accommodations.

Post-Concussion referral criteria includes:

- Mild headache (as listed under same day criteria) with absence of red flags
- All other symptoms completely gone within 15 minutes

IMPORTANT

The athlete would not leave the presence of the AT for at least 30 minutes and the athlete would be monitored for any deterioration until seen by physician.

It is important to provide the person monitoring the athlete a completed copy of the SCAT3 which also includes concussion injury advice, along with a copy of the GSC form (within initial findings) for home monitoring.

RECOMMENDATION: A physician note should also be obtained stipulating whether a follow-up physician visit is required before RTP, or if the RTP can be done under guidance of an AT.

NOTE 1: In some cases, athletes with minimal initial symptoms are removed from play for precautionary reasons. When these symptoms resolve quickly, without issue and complication, follow a graded RTP (See below for RTP).

NOTE 2: It often happens that the athlete may never see a physician. This reality was voiced at a 2013 sport concussion seminar [37] and may prove to be more the rule than the exception. The CTSQ will further address this issue and provide direction in future updates to this document.

2.5 Additional information

2.5.1 Return to Hospital / Worsening Symptoms

It should be understood that during an initial hospital ER visit, a CT scan may not always be done. If symptoms worsen or if any red flags appear (usually within first 24-48 hours), the athlete should return to the same hospital. [17] Physician discretion would dictate whether imaging would be of benefit in this situation. CT scans are used sparingly and only in urgent situations, especially in the pediatric population.

Although initially the injury seems mild and there was no need for transportation to the hospital, the symptoms should be monitored closely as they may worsen with time

Specific neurological indicators that show need for referral to emergency room include: [38]

- Loss of consciousness
- New, worsening or changing headache [17, 38]
- Severe headache
- Persistent or increasing neck pain
- Repeated vomiting (adult >1 time, less than 13 years old >3 times) [38, 39]
- Dizziness
- Double vision
- Difficulty recognizing people/places
- Weakness/numbness in limbs
- Increasing confusion or irritability
- Slurred speech
- Seizure
- Difficulty walking, difficulty with balance
- Excessive drowsiness
- Personality changes
- Any symptom that concerns athlete or person caring for athlete

2.5.2 Home Care and Monitoring

Careful monitoring during the first 24-72 hours is critical to identify any evolving issue.

If the athlete does not need to see a physician same-day, the AT should provide a structured plan for home care and monitoring. This includes giving a copy of initial

GSC and instructions. To ensure adequate home monitoring, GSC should be completed at time of injury, 2-3 hours, 24 hours, 48 hours, and 72 hours post injury. The age-appropriate PCSI forms, provided by the AT should be completed by the parent and child during the homecare and monitoring time frames.

Any change or deterioration in cognitive or physical state or an increase in symptom severity requires an immediate physician evaluation.

The following is a list of criteria for immediate physician evaluation. [41]

- Loss of consciousness
- New, worsening or changing headache [17, 38]
- Severe headache
- Persistent or increasing neck pain
- Repeated vomiting (adult >1 time, less than 13 years old >3 times) [38, 39]
- Dizziness
- Double vision
- Difficulty recognizing people/places
- Weakness/numbness in limbs
- Increasing confusion or irritability
- Slurred speech
- Seizure
- Difficulty walking, difficulty with balance
- Excessive drowsiness
- Personality changes
- Any symptom that concerns athlete or person caring for athlete

IMPORTANT

As cognitive rest is important, the practice of keeping awake or waking up the athlete the first night is not advised. [42, 43, 44, 45] This practice may in fact disrupt sleep patterns and increase symptoms the next day due to combined effects of injury and sleep deprivation. Sleep is restorative and the athlete should be allowed to sleep. [46]

However, the parent or designated guardian should check in on the athlete after they are asleep. Suggested monitoring the first night may involve quickly observing the athlete while they are sleeping to take note of abnormal breathing patterns, excessive snoring, posturing, or distress. This can be done 2 and 4 hours after the athlete has gone to bed. At this point the parent/guardian can also note if the athlete is not sleeping. If there is any doubt in athlete's condition, the athlete should be woken up to be sure that they can be awakened, that there is no amnesia or any increase in symptoms requiring an urgent intervention.

General rules in management usually involve waking the athlete up only if the athlete had experienced a LOC, prolonged period of amnesia, or if they are still experiencing significant symptoms. [47]

2.5.3 Athletic Therapist follow up

The completed GSC and PCSI forms should be brought to subsequent physician/AT visits. Ideally, the AT should see the athlete on a daily basis to monitor symptoms until they resolve and should be directing the RTP. In the first day or two post-injury, contact by phone may suffice to check on progress.

3. Clinical Treatment

3.1 Protocols

Clinical assessment should reveal treatment goals. Treatment should include the following components of a rehabilitation program and should ideally be interdisciplinary [48]:

- Soft Tissue Mobilization/Manual Therapy:
  - To reduce tension in the musculoskeletal system that may be contributing to prolonged concussive symptoms (cervicogenic headache, dizziness, tinnitus, nausea, poor balance, auditory complaints, ear/eye pain) [7, 21, 49, 50]
- Cervical spine stability exercises:
- Deep cervical flexor activation exercises [7, 49, 50]
- Muscle flexibility exercises [7, 49, 50]
- Postural balance exercises [21, 49, 50]
- Core stability exercises [7, 49, 50]
- Vestibular/Vision exercises [21, 49]

Furthermore, when providing concussion rehab guidelines, the following should be included:

- Return to Play guidelines [7, 10, 11, 23, 49, 50]
- Sleep hygiene education [49, 50]
- Pharmacological management (physician directed) [7, 49, 50]
- Psychological management (physician or neuropsychologist directed) [7, 21, 49, 50]

IMPORTANT

As stated earlier, any athlete who is still symptomatic and considered slow to recover (refer to glossary), should be re-referred and re-evaluated by a physician. The athlete should also consult a health care professional who is an expert in the management of concussions. An interdisciplinary approach is recommended. [48]

3.1.1 Importance of awareness and education

NOTE: Awareness of concussions and its effects are a very important component of clinical concussion rehab.

Adult Population:

- Occupational concussion management education [21, 50]

Child Population:

- Parent/family concussion management education [10, 50]
- School/teacher concussion management education [10, 50]
- Sport/coach concussion management education [10, 50]

3.2 Special Considerations

3.2.1 Post-Traumatic Headache

Post-traumatic headache is the most common symptom of sport-related concussion. This is one of the symptoms that make it difficult to determine urgency of referral. The International Headache Society has a classification category for secondary headaches associated with head and neck trauma.

The four most common classifications of post-traumatic headaches are: [51]

I. Tension type (including cervicogenic component)
II. Migraine
III. Combined migraine and tension-type
IV. Cognitive fatigue

3.2.2 Medications

It is recommended that only physicians with experience in the management of concussions prescribe medication to the athlete/individual. As long as the athlete is on medication, any RTP should be considered with caution since medication may hide signs of an evolving issue.

3.2.3 Second Impact Syndrome (SIS)

Second Impact Syndrome is a rare occurrence, but can lead to catastrophic results or a further delay in recovery. Second Impact Syndrome can occur when an athlete is subjected to a second direct or indirect head injury while still experiencing symptoms from a prior injury. This seems to occur until the late teens to early twenties. Care should be taken not to receive another insult to the brain while still experiencing signs of a concussion. [52, 53, 54]

3.2.4 Vomiting

Vomiting after a head injury may have different implications depending on the situation. For children (<13 years old), persistent vomiting (>3 times) is a more reliable indicator. [40] For adults, more than once would be suspect in the absence of migraine/motion sickness history. Some people with family or personal history of migraines or motion sickness may be more prone to vomiting after a head injury. In these cases, vomiting may not be indicative of head injury severity. Persistent vomiting may be more of an indicator than a single occurrence post trauma. Approximately 10-15% of children vomit after a mild traumatic brain injury. [39, 40]

3.2.5 Summary Statement Regarding Physician Referrals

An athlete with a suspected concussion can never RTP the same day and must follow currently accepted age-specific RTP guidelines.

Any athlete who is still symptomatic and considered slow to recover (refer to glossary), should be referred and re-evaluated by a physician. The athlete should also consult a health care professional who is an expert in the management of concussions. An interdisciplinary approach is recommended [48] (refer to clinical treatment guideline – clinical).

4. Comments regarding Pre Season Screening and Post Injury Evaluation

To date there is no agreement on the best screening tool due to the many factors that are involved such as means of administration, cost, type of sport and population. The following is a list of widely used, accepted, and scientifically validated assessment tools to be used as reference.

Computerized Neuropsychological Assessment (NP) testing:

- Currently demonstrates variable test-retest reliability
- Greater reliability when testing the visual motor speed and reaction times
- Online version had fewer invalid baseline results compared to the desktop version [55]

SCAT3:

- Currently there is no scientific validation research on the SCAT. Despite that fact, it is still recommended within the Zurich 2012 Consensus statement. [7]

SCAT2:

- There is not enough evidence to support the use of the total/composite score
- There is good evidence supporting the use of scoring of each component separately – revised SCAT2
- Baseline balance testing shows good evidence in both adults and child populations [56, 57]
- Baseline concentration testing in child athletes is unreliable producing numerous false positives and false negatives [56, 57, 58, 59]

Revised Rivermead Post-Concussive Symptom Scale:

- Only scale that is empirically driven
- Developed prior to clinical use
- A modified version of the original RPQ[6] that separates the scoring into two parts – RPQ-3 and RPQ-13. This modification demonstrates that the RPQ can be used clinically as a subjective test-retest assessment tool for concussion symptoms. [23]

McGill ACE Post-Concussion Symptoms Scale

- Used clinically to provide an evidence-based clinical protocol at the initial evaluation. [60]

5. Return to Play Guidelines

RTP procedures after suffering a concussion follow a progressive stepwise manner based on symptoms experienced by athletes. RTP should be individualized, progressive, sport and age-specific and based on critical clinical judgment.

IMPORTANT

An athlete should never return to play or activities on the day of the injury, even if signs and symptoms have cleared.

In order to diminish, and eventually eliminate symptoms related to the concussion, physical and cognitive rest for a period varying between 24 hours for adults and up to 7 days for children is necessary. [36, 61] In the case of persistent symptoms, complete rest longer than 7 days should be approached cautiously. [39] Instead, gradual exposure to physical and cognitive activities (if and only if tolerated) for short periods of time can be of help in order to reduce symptoms before undergoing the stepwise approach to RTP. [7, 62]

IMPORTANT

It is crucial, however, that the stepwise approach to return to activities only be attempted when symptoms have fully resolved. [7, 46]

RTP should be monitored on a daily basis by the AT to note the presence/absence of symptoms and suggest proper sport-specific exercises as well as the appropriate exercise intensity.

5.1 Age considerations

Studies in the field of brain development and maturation suggest that a child's brain continues evolving until early adulthood. [8, 9] Even though the total brain size reaches 95% of its maximum size by age six, its cortical and subcortical components change dramatically during childhood and adolescence. [63]The full brain maturation is said to be achieved between the ages of 20 and 30 years, with the prefrontal cortex to be one of the last brain regions to mature. [9, 64] For these reasons, RTP procedures have been separated between two age groups; children and young adults less than 25 years of age, and adults over 25 years of age.

NOTE: The Quebec health system recognizes any individual under 18 years old to be a child. Hence, RTP procedures for children include a rest period of several days. [61] For example, The Montreal Children's Hospital recommends a 7-day rest period before entering RTP procedures. [35]Due to age considerations for brain maturation between the ages of 18 and 25, we highly encourage proper clinical judgment in the number of rest days to be prescribed and strongly recommend a longer rest period as opposed to a shorter one.

5.2 Return to Play for Children & Young Adults (≤25 years old)

To help with the RTP process and to allow proper cognitive rest, it is highly encouraged that children modify their school attendance and activities in order to decrease symptoms. [7, 65] Hence, full return to school (meaning the child can tolerate a full day at school with a normal course load) is greatly advised before children can begin the stepwise approach to return to sports/activities. [45]

5.2.1 Return to Learn†

Best practice suggests that:

- The concussed individual communicate with the school (school nurse, teacher, and/or school mental health professional) and sign a release of information for the school personnel to coordinate with the AT.
- The interdisciplinary team consisting of the AT and the school administrators work together to decide on the level of academic adjustment needed at school depending on the type and severity of the symptoms present and the times of the day when the student feels better or worse.

IMPORTANT

The return to learn approach consists of 6 stages that should be separated by a minimum of 24 hours without symptoms before proceeding to the next step. Furthermore, throughout this process, there should be no physical activity.

Step 1
- Cognitive rest
  - No reading, homework, computer, video games or smartphone

Step 2
- Gradual reintroduction of cognitive activity
  - Gradually integrate cognitive activities for short periods of time

Step 3
- Homework before school attendance
  - Able to perform homework
  - When the student is beginning to react well to 30 minutes of light mental activity, consider returning to school.

Step 4
- School re-entry
  - Partial day of school attendance, homework

Step 5
- Reintegration into school
  - Increase to full day of school

† Adapted from Importance of 'return-to-learn' in pediatric and adolescent concussion by Master, Gioia, Leddy & Grady. [65]

Step 6

- Return to learn, full cognitive workload
  - Return to school, including tests and exams, catch-up work, etc

5.2.2 Return to Play‡

Step 1

- No Activity
  - Requires that children and young adults be symptom free for several days (preferably 7) before they can move on to Step 2 [7, 61]

Step 2.

- Light aerobic exercise, keeping intensity between 50-70% of maximum heart rate for 20 minutes. [66]
  - Walking, swimming, stationary cycling

NOTE: It has been suggested in the literature that a rest period of 7 days could help decrease the severity of symptoms related to the concussion and increase cognitive performance upon recovery. [67] From Step 2 to 7, a minimum of 24 hours between steps is necessary.

Step 3

- Light aerobic exercise (50-70% max heart rate for 20 minutes) and the addition of individual sport-specific drills
  - Specific drills should be incorporated to the workout and should not include any plyometrics and rotation/change of direction exercises such as spins and jumps.

Step 4

- Sport-specific exercise
  - Drills that are sport-specific, done individually or with a teammate. Increase duration of exercise, resistance training can be incorporated. Should not include head impact activities. Possible to incorporate plyometrics and rotation/change of direction exercises such as light jumps and spins.

Step 5

- Non-contact training drills
  - Practice more complex drills, increase resistance training, increase level of skills (jumps, spins)

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‡ Adapted from the Montreal Children's Hospital Concussion Kit [35] & Zurich Consensus statement on concussion in sport. [7]

Step 6

- Full practice with body contact

Step 7

- Return to play
  - Normal game-play with body contact.

If a particular step during the graded RTP protocol was to cause symptoms, athletes should rest (cognitive and physical) until symptom-free for a minimum of 24 hours before starting over at the previous step.

5.3 Return to Play for Adults (>25 years old)[§]

Although there is no current consensus on a stepwise approach to return to work following a mTBI, similar procedures to those of return to learn in children should be applied. In fact, before going back to physical activities, an adult should have succeeded in going back to work without experiencing symptoms. Hence, it is highly recommended that adults follow a similar return to work approach as the return to learn protocol for children, adolescents and young adults.

Step 1

- No Activity
  - Physical and cognitive rest to decrease symptoms

NOTE: Adults should be symptom free for at least 24 hours before they can move on to Step 2

Step 2

- Light aerobic exercise, keeping intensity between 50-70% of maximum heart rate for 20 minutes. [66, 68]
  - Walking, swimming, stationary cycling

NOTE: From Step 2 to 6, a minimum of 24 hours between steps is necessary

Step 3

- Light aerobic exercise (50-70% maximum heart rate for 20 minutes) and addition of individual sport-specific drills
  - Specific drills should be incorporated to the workout and should not include any plyometrics and rotation/change of direction exercises such as spins and jumps.

Step 4

- Sport-specific exercise
  - Drills that are sport-specific, done individually or with a team-mate. Increase duration of exercise, resistance training can be incorporated. Should not include head impact activities. Possible to incorporate plyometrics and rotation/change of direction exercises such as light jumps and spins.

Step 5

- Non-contact training drills
  - Practice more complex drills, increase resistance training, increase level of skills (jumps, spins)

Step 6

---

§ Adapted from the Zurich Consensus statement on concussion in sport. [7]

- Full practice with body contact

Step 7

- Return to play
  - Normal game-play with body contact.

NOTE: If a particular step during the graded RTP protocol was to cause symptoms, athletes should rest (cognitive and physical) until symptom-free for a minimum of 24 hours before starting over at the previous step.

APPENDIX

Appendix 1 – SCAT3 [11]

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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'. 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 day of Injury.

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 excercise.

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)[4]

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[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

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 50 cm x 40 cm x 6 cm).

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.

4. McCrea M. Standardized mental status testing of acute concussion. Clinical Journal of Sport Medicine. 2001; 11: 176–181.

5. Guskiewicz KM. Assessment of postural stability following sport-related concussion. Current Sports Medicine Reports. 2003; 2: 24–30.

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

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

SCAT3

Br J Sports Med 2013 47: 259

Appendix 2 – SCAT3 Child [10]

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Child-SCAT3™

Sport Concussion Assessment Tool for children ages 5 to12 years

For use by medical professionals only

What is childSCAT3?[1]

The ChildSCAT3 is a standardized tool for evaluating injured children for concussion and can be used in children aged from 5 to 12 years. It supersedes the original SCAT and the SCAT2 published in 2005 and 2009, respectively[2]. For older persons, ages 13 years and over, please use the SCAT3. The ChildSCAT3 is designed for use by medical professionals. If you are not qualified, please use the Sport Concussion Recognition Tool'.Preseason baseline testing with the ChildSCAT3 can be helpful for interpreting post-injury test scores.

Specific instructions for use of the ChildSCAT3 are provided on page 3. If you are not familiar with the ChildSCAT3, 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 and any reproduction in a digital form require approval by the Concussion in Sport Group.
NOTE: The diagnosis of a concussion is a clinical judgment, ideally made by a medical professional. The ChildSCAT3 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 ChildSCAT3 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 (like those 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 severe brain injury. If the concussed child displays any of the following, then do not proceed with the ChildSCAT3; instead activate 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
- Persistent vomiting
- Evidence of skull fracture
- Post traumatic seizures
- Coagulopathy
- History of Neurosurgery (eg Shunt)
- Multiple injuries

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.

Potential signs of concussion?

If any of the following signs are observed after a direct or indirect blow to the head, the child 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

2 Sideline Assessment – child-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)

Where are we at now?	0	1
Is it before or after lunch?	0	1
What did you have last lesson/class?	0	1
What is your teacher's name?	0	1
child-Maddocks score		of 4

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

Any child with a suspected concussion should be REMOVED FROM PLAY, medically assessed and monitored for deterioration (i.e., should not be left alone). No child diagnosed with concussion should be returned to sports participation on the day of Injury.

BACKGROUND

Name: _____ Date/Time of Injury: _____

Examiner: _____ Date of Assessment: _____

Sport/team/school: _____

Age: _____ Gender: M F

Current school year/grade: _____

Dominant hand: right left neither

Mechanism of Injury ("tell me what happened"?): _____

For Parent/carer to complete:

How many concussions has the child had in the past? _____

When was the most recent concussion? _____

How long was the recovery from the most recent concussion? _____

Has the child ever been hospitalized or had medical imaging done (CT or MRI) for a head injury?	Y N
Has the child ever been diagnosed with headaches or migraines?	Y N
Does the child have a learning disability, dyslexia, ADD/ADHD, seizure disorder?	Y N
Has the child ever been diagnosed with depression, anxiety or other psychiatric disorder?	Y N
Has anyone in the family ever been diagnosed with any of these problems?	Y N
Is the child on any medications? If yes, please list:	Y N

SYMPTOM EVALUATION

3 Child report

Name: _____

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

Total number of symptoms (Maximum possible 20) _____

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

☐ self rated ☐ clinician interview ☐ self rated and clinician monitored

4 Parent report

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

Total number of symptoms (Maximum possible 20) _____

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

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

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

☐ parent self rated ☐ clinician interview ☐ parent self rated and clinician monitored

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

Please circle one response:

no different | very different | unsure | N/A

Name of person completing Parent-report: _____

Relationship to child of person completing Parent-report: _____

Scoring on the ChildSCAT3 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.

COGNITIVE & PHYSICAL EVALUATION

5 Cognitive assessment

Standardized Assessment of Concussion – Child Version (SAC-C)[4]

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

Orientation score _____ of 4

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		
6-2	0 1	5-2	4-1	4-9
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 5				

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

Sunday-Saturday-Friday-Thursday-Wednesday-Tuesday-Monday	0	1

Concentration score _____ of 6

6 Neck Examination:

Range of motion Tenderness Upper and lower limb sensation & strength

Findings: _____

7 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
Tandem stance (non-dominant foot at back):	Errors

Tandem gait[6,7]

Time taken to complete (best of 4 trials): _____ seconds

If child attempted, but unable to complete tandem gait, mark here ☐

8 Coordination examination

Upper limb coordination

Which arm was tested: ☐ Left ☐ Right

Coordination score _____ of 1

9 SAC Delayed Recall[4]

Delayed recall score _____ of 5

Since signs and symptoms may evolve over time, it is important to consider repeat evaluation in the acute assessment of concussion.

INSTRUCTIONS

Words in *Italics* throughout the ChildSCAT3 are the instructions given to the child by the tester.

Sideline Assessment – child-Maddocks Score

To be completed on the sideline/in the playground, immediately following concussion. There is no requirement to repeat these questions at follow-up.

Symptom Scale[8]

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.

On the day of injury

- the child is to complete the Child Report, according to how he/she feels now.

On all subsequent days

- the child is to complete the Child Report, according to how he/she feels today, **and**
- the parent/carer is to complete the Parent Report according to how the child has been over the previous 24 hours.

Standardized Assessment of Concussion – Child Version (SAC-C)[4]

Orientation

Ask each question on the score sheet. A correct answer for **each question scores 1 point.** If the child does not understand the question, gives an incorrect answer, or no answer, then the score for that question is 0 points.

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 child 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, you would say 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.

Days in Reverse Order:

"Now tell me the days of the week in reverse order. Start with Sunday and go backward. So you'll say Sunday, Saturday … 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."

Circle each word correctly recalled. **Total score equals number of words recalled.**

Balance examination

These instructions are to be read by the person administering the childSCAT3, and each balance task **should be demonstrated to the child.** The child should then be asked to copy what the examiner demonstrated.

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 two different parts."

(a) Double leg stance:

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

(b) Tandem stance:

Instruct the child to stand heel-to-toe with the non-dominant foot in the back. Weight should be evenly distributed across both feet. Again, the child should try to maintain stability for 20 seconds with hands on hips and eyes closed. You should inform the child that you will be counting the number of times the child moves out of this position. If the child stumbles out of this position, instruct him/her to open the eyes and return to the start position and continue balancing. You should start timing when the child is set and the eyes are closed.

Balance testing – types of errors - Parts (a) and (b)

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 child. The examiner will begin counting errors only after the child has assumed the proper start position. **The modified BESS is calculated by adding one error point for each error during the two 20-second tests. The maximum total number of errors for any single condition is 10.** If a child commits multiple errors simultaneously, only one error is recorded but the child should quickly return to the testing position, and counting should resume once subject is set. Children who 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 2 stances can be performed on a surface of medium density foam (e.g., approximately 50cm x 40cm x 6cm).

Tandem Gait[6,7]

Use a clock (with a second hand) or stopwatch to measure the time taken to complete this task. Instruction for the examiner – **Demonstrate the following to the child**:

The child is 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****. Children 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.*

Explain to the child that you will time how long it takes them to walk to the end of the line and back.

Coordination examination

Upper limb coordination

Finger-to-nose (FTN) task:

The tester should **demonstrate it to the child.**

"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). 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 as quickly and as accurately as possible."

Scoring: 5 correct repetitions in < 4 seconds = 1
Note for testers: Children 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.

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5. Guskiewicz KM. Assessment of postural stability following sport-related concussion. Current Sports Medicine Reports. 2003; 2: 24–30.

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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

8. Ayr, L.K., Yeates, K.O., Taylor, H.G., &Brown, M. Dimensions of post-concussive symptoms in children with mild traumatic brain injuries. Journal of the International Neuropsychological Society. 2009; 15:19–30.

CHILD ATHLETE INFORMATION

Any child suspected of having a concussion should be removed from play, and then seek medical evaluation. The child must NOT return to play or sport on the same day as the suspected concussion.

Signs to watch for

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

- New Headache, or Headache gets worse
- Persistent or increasing neck pain
- Becomes drowsy or can't be woken up
- Can not recognise people or places
- Has Nausea or Vomiting
- Behaves unusually, seems confused, or is irritable
- Has any seizures (arms and/or legs jerk uncontrollably)
- Has weakness, numbness or tingling (arms, legs or face)
- Is unsteady walking or standing
- Has slurred speech
- Has difficulty understanding speech or directions

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

Return to school

Concussion may impact on the child's cognitive ability to learn at school. This must be considered, and medical clearance is required before the child may return to school. **It is reasonable for a child to miss a day or two of school after concussion, but extended absence is uncommon.** In some children, a graduated return to school program will need to be developed for the child. The child will progress through the return to school program provided that there is no worsening of symptoms. If any particular activity worsens symptoms, the child will abstain from that activity until it no longer causes symptom worsening. Use of computers and internet should follow a similar graduated program, provided that it does not worsen symptoms. This program should include communication between the parents, teachers, and health professionals and will vary from child to child. The return to school program should consider:

- Extra time to complete assignments/tests
- Quiet room to complete assignments/tests
- Avoidance of noisy areas such as cafeterias, assembly halls, sporting events, music class, shop class, etc
- Frequent breaks during class, homework, tests
- No more than one exam/day
- Shorter assignments
- Repetition/memory cues
- Use of peer helper/tutor
- Reassurance from teachers that student will be supported through recovery through accommodations, workload reduction, alternate forms of testing
- Later start times, half days, only certain classes

The child is not to return to play or sport until he/she has successfully returned to school/learning, without worsening of symptoms. Medical clearance should be given before return to play.

If there are any doubts, management should be referred to a qualified health practitioner, expert in the management of concussion in children.

Return to sport

There should be no return to play until the child has successfully returned to school/learning, without worsening of symptoms.
Children must not be returned to play the same day of injury.
When returning children to play, they should **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 approximately 24 hours (or longer) for each stage and the child should drop back to the previous asymptomatic level if any post-concussive symptoms recur. Resistance training should only be added in the later stages.
If the child is symptomatic for more than 10 days, then review by a health practitioner, expert in the management of concussion, is recommended.
Medical clearance should be given before return to play.

Notes:

CONCUSSION INJURY ADVICE FOR THE CHILD AND PARENTS / CARERS

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

This child 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. It is expected that recovery will be rapid, but the child will need monitoring for the next 24 hours by a responsible adult.

If you notice any change in behavior, vomiting, dizziness, worsening headache, double vision or excessive drowsiness, please call an ambulance to transport the child to hospital immediately.

Other important points:

- Following concussion, the child should rest for at least 24 hours.
- The child should avoid any computer, internet or electronic gaming activity if these activities make symptoms worse.
- The child should not be given any medications, including pain killers, unless prescribed by a medical practitioner.
- The child must not return to school until medically cleared.
- The child must not return to sport or play until medically cleared.

Clinic phone number

Patient's name

Date/time of injury

Date/time of medical review

Treating physician

Contact details or stamp

Child SCAT3

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Appendix 3 – Graded Symptom Checklist (GSC) [5]

SYMPTOM	TIME OF INJURY	2-3 HOURS POST-INJURY	24 HOURS POST-INJURY	48 HOURS POST-INJURY	72 HOURS POST-INJURY
Blurred vision					
Dizziness					
Drowsiness					
Excess sleep					
Easily distracted					
Fatigue					
Feel "in a fog"					
Feel "slowed down"					
Headache					
Inappropriate emotions					
Irritability					
Loss of consciousness					
Loss of orientation					
Memory problems					
Nausea					
Nervousness					
Personality change					
Poor balance/coordination					
Poor concentration					
Ringing in ears					
Sadness					
Seeing stars					
Sensitivity to light					
Sensitivity to noise					
Sleep disturbance					
Vacant stare-glassy eyes					
Vomiting					

NOTE: The GSC should be used not only for the initial evaluation, but also for each subsequent follow-up assessment until signs and symptoms have cleared at rest and during physical exertion. In lieu of simply checking each symptom present, the CAT(C) /Certification Candidate can ask the athlete to grade or score the severity of the symptom on a scale of 0-6 where 0 = not present. 1 = mild. 2 = moderate and 6 = most severe.

Appendix 4 – Cranial nerve tests [14, 15]

	Cranial Nerve	Function	Special Test
I	Olfactory	Smell	Ask athlete to identify familiar odor (eg: fruit, purel, alcohol prep pad)
II	Optic	Visual acuity	Ask athlete to read score board, eye chart
III	Occulomotor	Pupillary reaction	Using penlight, determine if pupils are equal and reactive to light
IV	Trochlear	Eye movements	Using penlight, ask athlete to track light medial, laterally, inferiorly, superiorly
V	Trigeminal	Facial sensation	Perceive light facial touch, ask athlete to bite down on tongue depressor
VI	Abducens	Lateral eye movements	Using penlight, ask athlete to track lateral and medial
VII	Facial	Facial expression	Ask athlete to smile, frown, etc
VII	Acoustic	Hearing, Balance	Hearing: Snap finger beside each ear Balance: Tandem stance
IX	Glossopharyngeal	Swallow, Voice	Ask athlete to swallow, speak
X	Vagus	Swallow, Gag	Ask athlete to swallow, check gag with tongue depressor
XI	Spinal	Neck strength	Check isometric neck strength, shoulder shrug
XII	Hypoglossal	Tongue movement/strength	Ask athlete to stick out tongue, move medial and lateral

Adapted from Magee, Orthopedic Assessment, 4th edition [15]

Appendix 5 – Glasgow Coma Scale [34]

A) Eye opening (E) :		
Spontaneously:		4
To verbal command:		3
To pain:		2
No response:		1
B) Best motor response (M) :		
Obeys commands:		6
Localizes to pain:		5
Withdraws to pain:		4
Abnormal flexion:		3
Abnormal extension:	2	
No response:		1
C) Best verbal response (V) :		
Oriented converses:		5
Disoriented:		4
Inappropriate words:		3
Incomprehensible sounds:		2
No response:		1

The coma score = E + M + V **Minimum: 3** **Maximum: 15**

Appendix 6 – Rivermead Post Concussion Symptoms Questionnaire

Reproduced with permission

Rivermead Post Concussion Symptoms Questionnaire

Modified (Rpq-3 And Rpq-13)[42] Printed With Permission: Modified Scoring System From Eyres 2005 [28]

Name:			Date:	
After a head injury or accident some people experience symptoms that can cause worry or nuisance. We would like to know if you now suffer any of the symptoms given below. Because many of these symptoms occur normally, we would like you to compare yourself now with before the accident. For each symptom listed below please circle the number that most closely represents your answer.				
0 = not experienced at all 1 = no more of a problem 2 = a mild problem 3 = a moderate problem 4 = a severe problem				
Compared with **before** the accident, do you **now** (i.e., over the last 24 hours) suffer from:				
	not experienced	no more of a problem	mild problem	moderate problem	severe problem
Headaches	0	1	2	3	4
Feelings of dizziness	0	1	2	3	4
Nausea and/or vomiting	0	1	2	3	4
Noise sensitivity (easily upset by loud noise)	0	1	2	3	4
Sleep disturbance	0	1	2	3	4
Fatigue, tiring more easily	0	1	2	3	4
Being irritable, easily angered	0	1	2	3	4
Feeling depressed or tearful	0	1	2	3	4
Feeling frustrated or impatient	0	1	2	3	4
Forgetfulness, poor memory	0	1	2	3	4
Poor concentration	0	1	2	3	4
Taking longer to think	0	1	2	3	4
Blurred vision	0	1	2	3	4
Light sensitivity (easily upset by bright light)	0	1	2	3	4
Double vision	0	1	2	3	4
Restlessness	0	1	2	3	4
Are you experiencing any other difficulties? Please specify, and rate as above.					
1.	0	1	2	3	4
2.	0	1	2	3	4

Administration only:

RPQ-3 *(total for first three items)*	
RPQ-13 *(total for next 13 items)*	

http://www.maa.nsw.gov.au/default.aspx?MenuID=148

Appendix 6 – Rivermead Post Concussion Symptoms Questionnaire (cont.)

Rivermead Post Concussion Symptoms Questionnaire (cont.)

Modified (Rpq-3 And Rpq-13)[42] Printed With Permission: Modified Scoring System From Eyres 2005 [28]

Administration only

Individual item scores reflect the presence and severity of post concussive symptoms. Post concussive symptoms, as measured by the RPQ, may arise for different reasons subsequent to (although not necessarily directly because of) a traumatic brain injury. The symptoms overlap with broader conditions, such as pain, fatigue and mental health conditions such as depression[72].

The questionnaire can be repeated to monitor a patient's progress over time. There may be changes in the severity of symptoms, or the range of symptoms. Typical recovery is reflected in a reduction of symptoms and their severity within three months.

Scoring

The scoring system has been modified from Eyres, 2005[24].

The items are scored in two groups. The first group (RPQ-3) consists of the first three items (headaches, feelings of dizziness and nausea) and the second group (RPQ-13) comprises the next 13 items. The total score for RPQ-3 items is potentially 0–12 and is associated with early symptom clusters of post concussive symptoms. If there is a higher score on the RPQ-3, earlier reassessment and closer monitoring is recommended.

The RPQ-13 score is potentially 0–52, where higher scores reflect greater severity of post concussive symptoms. The RPQ-13 items are associated with a later cluster of symptoms, although the RPQ-3 symptoms of headaches, dizziness and nausea may also be present. The later cluster of symptoms is associated with having a greater impact on participation, psychosocial functioning and lifestyle. Symptoms are likely to resolve within three months. A gradual resumption of usual activities is recommended during this period, appropriate to symptoms. If the symptoms do not resolve within three months, consideration of referral for specialist assessment or treatment services is recommended.

References:

Eyres, S., Carey, A., Gilworth, G., Neumann, V., Tennant, A. (2005). Construct validity and reliability of the Rivermead Post Concussion Symptoms Questionnaire. *Clinical Rehabilitation*, 19, 878-887.

King, N. S., Crawford, S., Wenden, F.J., Moss, N.E.G. Wade, D.T. (1995). The Rivermead Post Concussion Symptoms Questionnaire: a measure of symptoms commonly experienced after head injury and its reliability *Journal of Neurology*, 242, 587-592.

Potter, S., Leigh, E., Wade, D., Fleminger, S. (2006). The Rivermead Post Concussion Symptoms Questionnaire *Journal of Neurology*, October 1-12.

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Appendix 7 – Post-Concussion Symptom Inventory (PCSI)

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PCSI Administration Manual

The Post-Concussion Symptom Inventory (PCSI) was developed to assess common post-concussion physical, cognitive, and behavioral/emotional symptoms directly via the child's self-report. Age-specific PCSI forms were created appropriate to the age/developmental level of the child (i.e., age 5-7 years, 8-12 years and 13-18 years). A companion parent symptom report form was also developed which serves to augment symptom assessment in children by gathering parent-observed symptoms (Gioia et al., 2009).

Forms. The PCSI for the 5 to 7 year age group is comprised of 5 symptom rating items, removing items with complex vocabulary (e.g., fogginess, nausea, irritability), subtle internal states (e.g., fogginess), and other items not likely monitored by younger children (e.g., sleep). The PCSI for 5- to 7-year-olds includes five items that tap physical (three items), cognitive (one item), and emotional (one item) symptoms.

The PCSI form for 8- to 12-year-olds includes 17 items that assess physical (eight items), cognitive (four items), emotional (three items), and fatigue (two items) symptoms.

The PCSI for the 13- to 18- year olds includes 21 items that assess physical (eight items), cognitive (six items), emotional (four items) and fatigue (three items) symptoms.

The Parent PCSI is composed of 20 items that assesses physical (eight items), cognitive (five items), emotional (four items) and fatigue (three items) symptoms.

Each of the post-injury forms includes an additional item asking the child/adolescent/ parent to indicate if they are "acting differently than before the injury." This item is presented as a general summary judgment of their overall state.

Administration. One may use the PCSI to collect symptom report data as a *pre-injury baseline, retrospective baseline and a post-injury* measurement. It is important to understand the different time frames of the symptom reporting and the corresponding differences in administration. When administering the PCSI as a Pre-Injury Baseline or Post-Injury assessment; each symptom is preceded by the phrase "Yesterday or Today" to give the child the time frame within which they should be making their decision about the symptom's presence and degree. The PCSI is intended to assess the child's *current* symptom state and not whether the child has ever experienced the symptom. This is a very important point that examiners must emphasize to the child and parent – we want to know how the child is *currently* feeling. The same intent and emphasis applies whether the child is taking a baseline or post-injury exam.

When administering the PCSI post-injury, it is often useful to find out how the child normally feels, this is known as a Retrospective Baseline. In this case, the child is asked to report if they experienced any of the symptoms prior to the injury (and if so, to what degree).

Scores. The PCSI scales produce a *Total Symptom* score for the 5-7 year, 8-12 year, 13-18 year and Parent PCSI versions, as well as scores reflecting the specific *Physical, Cognitive, Emotional,* and *Fatigue* symptom domains for 8-12, 13-18 and Parent Versions. Scores for the PCSI are simple sums of the number and degree of symptoms.

Parent Report Form (PCSI – P) [31]

Post-Concussion Symptom Inventory (PCSI-P)
Parent Report Form
Pre and Post-Injury

Student's Name:_____ **Today's date:** _____
Birthdate:_____ **Age/ Grade:**_____
Person Completing Form:_____ **Relation: Mother ___ Father___ Other___**

Instructions: We would like to know if your child had problems with these symptoms before their injury. Next, we would like to know if these symptoms have changed after the injury. Please rate the problem at two points in time- **Before the Injury/ Pre-Injury** and **Current Symptoms/ Yesterday and Today**.

Please answer all the items the best that you can. Do not skip any items. Circle the number to tell us how much of a problem this symptom has been for your child.

0 = Not a problem 3 = Moderate problem 6 = Severe problem

		Before the Injury/ Pre-Injury		Current Symptoms/ Yesterday and Today
1	Complains of headaches	0 1 2 3 4 5 6		0 1 2 3 4 5 6
2	Complains of nausea	0 1 2 3 4 5 6		0 1 2 3 4 5 6
3	Has balance problems	0 1 2 3 4 5 6		0 1 2 3 4 5 6
4	Appears or complains of dizziness	0 1 2 3 4 5 6		0 1 2 3 4 5 6
5	Appears drowsy	0 1 2 3 4 5 6		0 1 2 3 4 5 6
6	Sleeping more than usual	0 1 2 3 4 5 6		0 1 2 3 4 5 6
7	Sensitivity to light	0 1 2 3 4 5 6		0 1 2 3 4 5 6
8	Sensitivity to noise	0 1 2 3 4 5 6		0 1 2 3 4 5 6
9	Acts irritable	0 1 2 3 4 5 6		0 1 2 3 4 5 6
10	Appears sad	0 1 2 3 4 5 6		0 1 2 3 4 5 6
11	Acts nervous	0 1 2 3 4 5 6		0 1 2 3 4 5 6
12	Acts more emotional	0 1 2 3 4 5 6		0 1 2 3 4 5 6
13	Acts or appears mentally "foggy"	0 1 2 3 4 5 6		0 1 2 3 4 5 6
14	Has difficulty concentrating	0 1 2 3 4 5 6		0 1 2 3 4 5 6
15	Has difficulty remembering	0 1 2 3 4 5 6		0 1 2 3 4 5 6
16	Has or complains of visual problems (blurry, double vision)	0 1 2 3 4 5 6		0 1 2 3 4 5 6
17	Appears more tired or fatigued	0 1 2 3 4 5 6		0 1 2 3 4 5 6
18	Becomes confused with directions or tasks	0 1 2 3 4 5 6		0 1 2 3 4 5 6
19	Appears to move in a clumsy manner	0 1 2 3 4 5 6		0 1 2 3 4 5 6
20	Answers questions more slowly than usual	0 1 2 3 4 5 6		0 1 2 3 4 5 6
	PCSI Total Symptom Score	**Pre-Injury** _____		**Post-Injury** _____
In general, to what degree is your child acting "differently" than before the injury (not acting like himself or herself)?		**No Difference 0 1 2 3 4 Major Difference** *Circle your rating with "0" indicating "Normal" (No Difference) and "4" indicating "Very Different" (Major Difference)*		

Authored / Developed by: Gioia, Janusz, Sady, Vaughan, & Isquith. 2012.

Children Report Form Age 5-12 (PCSI – C) [31]

Post-Concussion Symptom Inventory for Children (PCSI-C)

Pre/Post Version 5 to 12

Name:_____ **Today's date:**_____ **Birthdate:**_____ **Age**_____ **Grade:**_____

Instructions: We would like to know if you have had any of these symptoms before your injury. Next, we would like to know if these symptoms have changed after your injury.

I am going to ask you to tell me about your symptom at two points in time - Before the Injury and Yesterday / Today. Interviewer: Please circle only one answer.

	0 = No 1 = A little 2 = A lot	Before the Injury /Pre-Injury				Current Symptoms/ Yesterday and Today		
1	Have you had headaches? Has your head hurt?	0	1	2		0	1	2
2	Have you felt sick to your stomach or nauseous?	0	1	2		0	1	2
3	Have you felt dizzy? (like things around you were spinning or moving)	0	1	2		0	1	2
4	Have you felt grumpy or irritable? (like you were in a bad mood)	0	1	2		0	1	2
5	Has it been hard for you to pay attention to what you are doing? (like homework or chores, listening to someone, or playing a game)	0	1	2		0	1	2
	Continue if age 8 or older							
6	Have you felt more drowsy or sleepy than usual?	0	1	2		0	1	2
7	Have bright lights bothered you more than usual? (like when you were in the sunlight, when you looked at lights, or watched TV)	0	1	2		0	1	2
8	Have loud noises bothered you more than usual? (like when people were talking, when you heard sounds, watched TV, or listened to loud music)	0	1	2		0	1	2
9	Have you had any balance problems or have you felt like you might fall when you walk, run or stand?	0	1	2		0	1	2
10	Have you felt sad?	0	1	2		0	1	2
11	Have you felt nervous or worried?	0	1	2		0	1	2
12	Have you felt like you are moving more slowly?	0	1	2		0	1	2
13	Have you felt like you are thinking more slowly?	0	1	2		0	1	2
14	Has it been hard to think clearly?	0	1	2		0	1	2
15	Have you felt more tired than usual?	0	1	2		0	1	2
16	Has it been hard for you to remember things? (like things you heard or saw, or places you have gone)	0	1	2		0	1	2
17	Have things looked blurry?	0	1	2		0	1	2

All Ages- Do you feel "different" than usual? (Circle one) 0=No 1=A little 2=A lot

PCSI Total Symptom Score	**Pre=**	**Post=**

Subscale scores (Age 8-12) Pre/Post	**Physical**	**Cognitive**	**Emotional**	**Fatigue**
	/	/	/	/

Authored / Developed by: Gioia, Janusz, Sady, Vaughan, Schneider & Natale. 2012.

Child Report Form Age 13-18 (PCSI) [31]

Post-Concussion Symptom Inventory (PCSI)
Self-Report Assessment Form
Pre and Post-Injury Report
Ages 13-18

Patient Name:_____ **Today's date:**_____
Birthdate:_____ **Age:**_____

Instructions: We would like to know if you have had any of these symptoms before your injury. Next, we would like to know if these symptoms have changed after your injury. Please rate the symptom at two points in time- Before the Injury/Pre-Injury and Currently.

Please answer all the items the best that you can. Do not skip any items. Circle the number to tell us how much of a problem this symptom has been for you.

0 = Not a problem 3 = Moderate problem 6 = Severe problem

		Before the Injury/ Pre-Injury		Current Symptoms/ Yesterday and Today
1	Headache	0 1 2 3 4 5 6		0 1 2 3 4 5 6
2	Nausea	0 1 2 3 4 5 6		0 1 2 3 4 5 6
3	Balance problems	0 1 2 3 4 5 6		0 1 2 3 4 5 6
4	Dizziness	0 1 2 3 4 5 6		0 1 2 3 4 5 6
5	Fatigue	0 1 2 3 4 5 6		0 1 2 3 4 5 6
6	Sleep more than usual	0 1 2 3 4 5 6		0 1 2 3 4 5 6
7	Drowsiness	0 1 2 3 4 5 6		0 1 2 3 4 5 6
8	Sensitivity to light	0 1 2 3 4 5 6		0 1 2 3 4 5 6
9	Sensitivity to noise	0 1 2 3 4 5 6		0 1 2 3 4 5 6
10	Irritability	0 1 2 3 4 5 6		0 1 2 3 4 5 6
11	Sadness	0 1 2 3 4 5 6		0 1 2 3 4 5 6
12	Nervousness	0 1 2 3 4 5 6		0 1 2 3 4 5 6
13	Feeling more emotional	0 1 2 3 4 5 6		0 1 2 3 4 5 6
14	Feeling slowed down	0 1 2 3 4 5 6		0 1 2 3 4 5 6
15	Feeling mentally "foggy"	0 1 2 3 4 5 6		0 1 2 3 4 5 6
16	Difficulty concentrating	0 1 2 3 4 5 6		0 1 2 3 4 5 6
17	Difficulty remembering	0 1 2 3 4 5 6		0 1 2 3 4 5 6
18	Visual problems (double vision, blurring)	0 1 2 3 4 5 6		0 1 2 3 4 5 6
19	Get confused with directions or tasks	0 1 2 3 4 5 6		0 1 2 3 4 5 6
20	Move in a clumsy manner	0 1 2 3 4 5 6		0 1 2 3 4 5 6
21	Answer questions more slowly than usual	0 1 2 3 4 5 6		0 1 2 3 4 5 6
22	In general, to what degree do you feel "differently" than before the injury (not feeling like yourself)?	**No Difference 0 1 2 3 4 Major Difference** *Circle your rating with "0" indicating "Normal" (No Difference) and "4" indicating "Very Different" (Major Difference)*		

Appendix 8 – Return to play guidelines for child [35]

Reproduced with permission Montreal Children's Hospital, Trauma Center [35]

L'Hôpital de Montréal pour enfants
The Montreal Children's Hospital
Centre universitaire de santé McGill
McGill University Health Centre

TRAUMA

RETURN TO SPORTS FOLLOWING A CONCUSSION

If you have sustained a concussion, this action plan is recommended before you put your team jersey back on for the game.

You must complete your recommended period of rest and follow the activity restrictions. You should be symptom-free at rest for a full week before returning to any physical activity. When you are ready to return to play follow these gradual progressive steps.

There should be approximately 24 hours in between each step. If any symptoms return at any time during this action plan, stop working out. Rest until you are symptom-free for 24 hours. Then return to the previous step. If symptoms do not resolve or get worse, you are urged to seek medical attention.

★ **STEP 1: Light general conditioning exercises**
- NO CONTACT.
- Begin with a warm up (stretching/flexibility) for 5-10 minutes.
- Start a cardio workout of 15-20 minutes which can include: stationary bicycle, treadmill, fast paced walking, light jog, rowing or swimming.

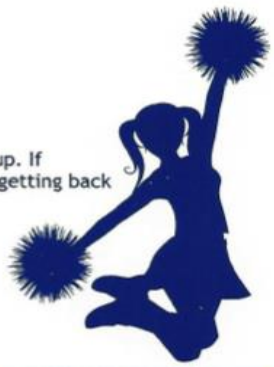
★ **STEP 2: General conditioning and sport specific skill work done individually**
- NO CONTACT.
- Begin with a warm up (stretching/flexibility) for 5-10 minutes.
- Increase intensity and duration of cardio workout to 20-30 minutes.
- Begin sport specific skill work within the workout, but no spins, dives or jumps.

★ **STEP 3: General conditioning, skill work done individually and with a team-mate**
- NO CONTACT.
- Increase duration of session to 60 minutes. Begin resistance training.
- Continue practicing sport specific individual skills.
- May begin general shooting, kicking or passing drills with a partner.
- May start beginner level spins, dives and jumps.

★ **STEP 4: General conditioning, skill work and team drills**
- NO CONTACT. NO SCRIMMAGES.
- Resume pre-injury duration of practice and team drills.
- Increase resistance training and skill work as required.
- Gradually increase skill level of spins, dives and jumps.

★ **STEP 5: Full practice with body contact**
- CONTACT. SCRIMMAGES.
- Participate in a full practice to get yourself back in the lineup. If completed with no symptoms, discuss with the coach about getting back in the game.
- Coaches must make sure that the athlete has regained his/her pre-injury skill-level and is confident in his/her ability to return to activity.

★ **STEP 6: Return to competition**



TRAUMA
The Montreal Children's Hospital
2300 Tupper Avenue
Montreal, Quebec H3H 1P3
www.thechildren.com/trauma
(514) 412-4400 extension 23310

References

1. Code des professions, Gazette Officielle du Quebec, 27 octobre 2010, 142 année, no. 43.
2. Ontario Neurotrauma Foundation, Guidelines for Mild Traumatic Brain Injury and Persistent Symptoms. 2012.
3. McDonald BC, Flashman LA, Saykin AJ. Executive dysfunction following traumatic brain injury: neural substrates and treatment strategies. *NeuroRehabilitation*. 2002; 17(4): 333-44.
4. Gennarelli T. Mechanisms of brain injury. *Journal of Emergency Medicine*. 1993; 11(suppl 1): 5–11.
5. Guskiewicz KM, Bruce SL, Cantu RC, Ferrara MS, Kelly JP, McCrea M, Putukian M, Valovich McLeod TC. National Athletic Trainers' Association Position Statement: Management of Sport-Related Concussion. *Journal of Athletic Training*. 2004 Sep; 39(3): 280-297.
6. Schneider RC. Head and Neck Injuries in Football: Mechanisms, Treatment and Prevention. Baltimore, MD: Williams & Wilkins; 1973.
7. McCrory P, Meeuwisse WH, Aubry M, et al., Consensus statement on concussions in sports: the 4th International Conference on Concussion in Sport held in Zurich, November 2012. *British Journal of Sports Medicine* 2013; 47: 250-258.
8. Tamnes CK, Ostby Y, Fjell AM, Westlye LT, Due-Tonnessen P, Walhovd KB, Brain maturation in adolescence and young adulthood: regional age-related changes in cortical thickness and white matter volume and microstructure. *Cerebral cortex* 2010 Mar; 20(3): 534-48.

   doi:10.1093/cercor/bhp118. Epub 2009 Jun
9. Lebel C, Walker L, Leemans A, Philipps L, Beaulieu C, Microstructural maturation of the human brain from childhood to adulthood. *NeuroImage.* 2008 Apr 15; 40(3): 1044-55. doi 10.1016/j.neuroimage.2007.12.053.
10. Epub 2008 Jan 11. McCrory P, Meeuwisse WH, Aubry M, et al., Child SCAT3. *British Journal of Sports Medicine* 2013; 47: 263.
11. McCrory P, Meeuwisse WH, Aubry M, et al., SCAT3. *British Journal of Sports Medicine* 2013; 47: 259.
12. Carroll LJ, Cassidy JD, Holm L, Kraus J, Coronado VG. Methodological issues and research recommendations for mild traumatic brain injury: the WHO Collaborating Centre Task Force on Mild Traumatic Brain Injury. *Journal Rehabilitation Medicine*. 2004 Feb;(43 Suppl): 113-25.
13. International classification of diseases and related health problem, 10th revision. World health organization, Geneva.

14. Magee DJ, Orthopedic Assessment 4th ed. Philadelphia PA, WB Saunders 2002.

15. James R. Scifers, Special Tests for Neurologic Exam. Thorofare NJ, Slack Inc., 2008.

16. NAEMT, PHTLS. Trauma First Response. St. Louis MO., Elsevier, 2011.

17. G. Gioia, M. Collins, (ACE) Acute Concussion Evaluation Care Plan University of Pittsburg Medical Center, 2006.

18. Lezak M, Howieson DB., Bigler ED., Trabel D. Neuropsychological Assessment. 5th Edition. New York, New York: Oxford University Press, Inc., 2012: 184.

19. Guskiewicz KM, Assessment of postural stability following sports-related concussion. *Current Sports Medicine Reports*. 2003; 2: 24-30.

20. Guskiewicz KM, Balance assessment in the management of sport related concussion Clinical Sports Medicine 2011 Jan: 30(1): 89-102.

21. Alsalaheen BA, Mucha A, Morris LO, Whitney SL, Furman JM et al., Vestibular rehabilitation for dizziness and balance disorders after concussion. *Journal of Neurologic Physical Therapy* 2010; Jun 34(2): 87-93.

22. Maruta J, Suh M, Niogi SN, Mikherjee P, Ghajar J, Visual tracking synchronization as a metric for concussion screening. *Journal of Head Trauma Rehabilitation* 2010; Jul-Aug (4): 293-305.

23. Eyres S, Carey A, Gilworth G, Neumann V, Tennant A, Construct validity and reliability of the Rivermead Post Concussion Symptoms Questionnaire. *Clinical Rehabilitation* 2005; 19(8): 878-887.

24. Bigler ED. Neuropsychology and clinical neuroscience of persistent post-concussive syndrome. *Journal of the International Neuropsychological Society*. 2008; 14:1-22.

25. Giza C, Hovda D. The Neurometabolic Cascade of Concussion. *Journal of Athletic Training*. 2001; 36(3): 228-235.

26. Son BC, Park CK, Choi BG. Metabolic changes in pericontusional oedematous areas in mild head injury evaluated by 1H MRS. *Acta Neurochirurgica*. 2000 (suppl); 76:13-16

27. Giza C, Kutcher J, Ashwal S, et. al. Summary of evidence-based guideline update: Evaluation and management of concussion in sports: Report of the Guideline Development Subcommittee of the American Academy of Neurology. Neurology2013 (published online ahead of print March 18, 2013): DOI: 10.1212/WNL.ob013e31828d57dd

28. Halstead, M, Walter, K. Clinical Report - Sport-Related Concussion in Children and Adolescents. *Pediatrics* 2010; 126(3): 597-615.

29. Benson RR, Gattu R, Sewick B, Kou Z, Zakariah N, Cavanaugh JM, Haacke EM. Detection of hemorrhagic and axonal pathology in mild traumatic brain injury using advanced MRI: implications for neurorehabilitation. *NeuroRehabilitation*. 2012; 31(3):261-79.

doi: 10.3233/NRE-2012-0795.

30. Parikh G., MRI Finds Possible Vascular Injury After Mild Head Injury, American Academy of Neurology (AAN) 65th Annual Meeting. Abstract P04.273, March 16-23, 2013.

31. Gioia, G., Janusz, J., Isquith, P., et al. (2008). Psychometric properties of the parent and teacher Post-Concussion symptom Inventory (PCSI) for children and adolescents. Journal of the International Neuropsychological Society, 14 (Suppl. 1), 204.

32. Robb S. Rehberg, Sports Emergency Care - A team approach, 2nd ed. Slack Inc., Thorofare, NJ, 2013.

33. Guskiewicz KM, Broglio SP Sport-related concussion: on-field and sideline assessment. *Physical Medicine and Rehabilitation Clinics of North America* 2011, Nov; 22(4): 603-17.

34. Protocoles d'Intervention Clinique à l'usage des Techniciens Ambulanciers-Paramedics (PIC TAP-2013) 5 ieme édition, 2013 Direction Medicale Nationale des services prehopitaliers , Bibliotheque et Archives nationales du Québec

35. Montreal Children's Hospital Concussion Kit, Returning to sports following a concussion. Montreal Children's Hospital, Trauma Program, 2012.

36. Davis GA & Purcell LK, The evaluation and management of acute concussion differs in young children. *British Journal of Sports Medicine* 2013;0

37. Journée de formation "Les commotions cérébrales dans le sport" INS-Institut National du Sport, 18 octobre, 2013, Montreal.

38. Centers for Disease Control and Prevention Heads Up: Facts for physicians about mTBI. Atlanta GA, Center for Disease Control and Prevention, 2011.

39. Brown FD, Brown J , Beattie TF. Why do Children vomit after a minor head injury. *Journal of accident & emergency medicine*. 2000; 17:268-271

40. Bainbridge J. et al, Vomiting-is this a good indication for CT head scans in patients with minor head injury? *British Journal of Radiology*, 85 (2012): 183-186.

41. Home Care Sheet (CDC). http://www.cdc.gov/concussion/pdf/TBI_Patient_Instructions-a.pdf

42. Halstead ME, Walter KD. American Academy of Pediatrics. Clinical report--sport-related concussion in children and adolescents. *Pediatrics*. 2010 Sep;126(3):597-615. doi: 10.1542/peds.2010-2005. Epub 2010 Aug 30.

43. Gibson S, Nigrovic L, O'Brien M, et al., The effect of recommending cognitive rest on recovery from sport-related concussion. *Brain Injury* 2013; 27 (7-8)

44. Moser RS, Glatts C, Schatz P, Efficacy of immediate and delayed cognitive and physical rest for treatment of sports-related concussion. *The Journal of Pediatrics* 2012; 161(5).

45. Grady MF, Master CL, Gioia CA, Concussion pathophysiology: Rationale for physical and cognitive rest. *Pediatrics annals*; 41.

46. Harmon K, Drezner J, Gammons M, et. al. American Medical Society for Sports Medicine position statement: concussion in sport. *British Journal of Sports Medicine* 2013; 47:15-26.

47. Guskiewicz KM, Bruce SL, Cantu RC, Ferrara MS, Kelly JP, McCrea M, Putukian M, Valovich McLeod TC. National Athletic Trainers' Association Position Statement: Management of Sport-Related Concussion. *Journal Athletic Training*. 2004 Sep; 39(3): 280-297.

48. Stewart GW, McQueen-Borden E, Bell RA, Barr T, Juengling J. Comprehensive assessment and management of athletes with sport concussion. *International Journal of Sports Physical Therapy*. 2012 Aug; 7 (4): 433-47.

49. Leddy JJ, Sandhu H, Sodhi V, Baker JG, Willer B. Rehabilitation of Concussion and Post-concussion Syndrome. *Sports Health*. 2012; 4(2): 147-154.

50. Marshall S, Bayley M, McCullagh S, Velikonja D, Berrigan L, Clinical practice guidelines for mild traumatic brain injury and persistent symptoms. *Canadian Family Physician* 2012; 58: 257-67.

51. The International Classification of Headache Disorders 2nd edition, International Headache Society, London United Kingdom.

52. Cantu RC. Second-impact syndrome. *Clinical Sports Medicine*. Jan 1998; 17(1): 37-44.

53. Guskiewicz KM, McGrea M. *Head Injuries In: Starkey C, Johnson G, eds.* Athletic Training and Sports Medicine, Sudbury, MA: Jones and Bartlett Publishers*; 2006: 557-578.*

54. Shrey DW, Griesbach GS, Physical Medicine and Rehabilitation Clinics of North America 2011 – The Pathophysiology of Concussions in Youth. Phys Med Rehabil Clin N Am. 2011 November:22(4):577-602.

55. Resch J, Driscoll A, McCaffrey N, Brown C., et al., ImPact Test-Retest Reliability: Reliably Unreliable? *Journal of Athletic Training* 2013; Jul-Aug; 48(4): 506-11.

56. Guskiewicz KM, Register-Mihalik J, McCrory P, McCrea M, Johnston K, et al., Evidence-based approach to revising the SCAT2: introducing the SCAT3. *British Journal of Sports Medicine* 2013; Apr; 47(5): 289-93.

57. Jinguji TM, Bompadre V, Harmon KG, Satchell EK, et al., Sport Concussion Assessment Tool-2: baseline values for high school athletes. *British Journal of Sports Medicine* 2012; Apr; 46(5): 365-70.

58. Galetta MS, Galetta KM, McCrossini J, Wilson JA, et al., Saccades and memory: Baseline associations of the King-Devick and SCAT2 SAC tests in professional ice hockey players. *Journal of Neurological Sciences* 2013; 328(1): 28-31.

59. Schatz P, Moser RS, Solomon GS, Ott SD, Karpf R, Prevalence of invalid computerized baseline neurocognitive test results in high school and collegiate athletes. *Journal of Athletic Training* 2012; May-Jun; 47(3): 289-96.

60. McLeod TC, Leach C, Psychometric properties of self-report concussion scales and checklists. *Journal of Athletic Training* 2012; Mar-Apr; 47(2): 221-3.

61. Purcell L, What are the most appropriate return-to-play guidelines for concussed child athletes? *British Journal of Sports Medicine* 2009; 43(Suppl.1).

62. Silverberg ND, Iverson GL, Is rest after concussion "The best medicine?" Recommendations for activity resumption following concussion in athletes, civilians and military service members. *Journal of Head Trauma Rehabilitation* 2013; 28 (4).

63. Lenroot RK, Giedd JN. Brain development in children and adolescents: insights from anatomical magnetic resonance imaging. *Neuroscience & Biobehavioral Reviews*. 2006; 30(6): 718-29. Epub 2006 Aug 2.

64. Casey BJ, Giedd JN, Thomas KM. Structural and functional brain development and its relation to cognitive development. *Biological Psychology*. 2000 Oct; 54(1-3):241-57.

65. Master CL, Gioia CA, Leddy JJ, Grady MF, Importance of 'Return-to-learn' in pediatric and adolescent concussion. *Pediatrics annals* 2012; 41.

66. Guskiewicz KM, McLeod V, Pediatric sports-related concussion, The Journal of Injury, Function and Rehabilitation 2011; Vol 3; Issue 4, 353-364.

67. Schneider KJ, Iverson GL, Emery CA, et al., The effects of rest and treatment following a sport-related concussion: a systematic review of the literature. *British Journal of Sports Medicine 2013;* 47.

68. Gagnon I, Galli C, Friedman D, Grilli L, Iverson G, Active rehabilitation for children who are slow to recover following sport-related concussion. Brain Injury, November 2009; 23(12): 956-964.