Identification and management of children with sport-related concussion

Canadian Paediatric Society

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Concussion is a common injury sustained by children participating in many different sports. In children 15 years of age and younger, the estimated incidence of traumatic brain injury, including concussions, is 180 per 100,000 children per year, accounting for more than 10% of all visits to emergency departments (1). A recent Canadian emergency department study (2) demonstrated that 3% of all sport-related injuries were head injuries. The majority of sport-related head injuries occurred in individuals younger than 20 years of age (66%) (2). Sport-related head injuries accounted for 18.2% of all serious head injuries in children younger than 10 years, 53.4% in 10- to 14-year-old children and 42.9% in 15- to 19-year olds (2) (level of evidence: III [Appendix 1]). However, concussion can be difficult to diagnose because the signs and symptoms may be subtle and easily overlooked (level of evidence: III) (3-5). Athletes may minimize or not recognize the signs and symptoms of concussion and, therefore, may not seek medical attention (6,7).

Despite significant concussion-based research, there are no specific guidelines for the management of sport-related concussion in children. Both the Canadian Paediatric Society (8) and the American Academy of Pediatrics (9) have published position statements on managing head trauma; however, these statements do not address sport-related concussion and, in particular, return-to-play guidelines. Although adult guidelines are often used, there are age-related differences in recovery following head injury, with younger children taking longer to recover from concussions (level of evidence: II-2). Concussions in children may be more difficult to diagnose than in adults because they are often unrecognized by the child or adult witnesses. Therefore, paediatric sport-related concussion guidelines are necessary (10).

The present statement has been written to assist physicians in the management of children aged five to 18 years with sport-related concussion. The recommendations are guidelines only, and are based on currently available data as well as expert opinion. They are intended to review the definition, signs and symptoms of concussion; the need for investigations; management principles, emphasizing return-to-play guidelines; and prevention strategies. Because of the paucity of quality research available, physicians are urged to use a conservative approach in the management of children with sport-related concussion.

DEFINITION OF CONCUSSION

Concussion is defined as "a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces" resulting "in the rapid onset of short-lived impairment of neurological function that resolves spontaneously" (11). Concussion may be sustained by a direct blow to the head, face or neck, or by a blow to somewhere else on the body that transmits an impulsive force to the head (11-15). Most concussions do not cause a loss of consciousness or cause only a transient (ie, lasting seconds) loss of consciousness (11).

SIGNS AND SYMPTOMS OF CONCUSSION

Athletes may exhibit many signs or symptoms following a head injury (Table 1). If any of these are present, a head injury should be suspected and appropriate management instituted (11-14,16). Younger children may complain of abdominal pain or discomfort more than headache or cognitive symptoms in the setting of concussion; therefore, a concussion may be easily overlooked. Concussive symptoms may be prolonged, sometimes lasting weeks to months (level of evidence: II-2) (5,17-20).

Significant cognitive sequelae may result from concussion, including poor attention and concentration, reduced speed of information processing, and impaired memory and learning (level of evidence: II-2) (19,21,22). There may also be a significant negative secondary impact on educational and social attainment because these cognitive functions are critical for performing normal daily activities during childhood and adolescence, such as learning new skills and attending to schoolwork (level of evidence: II-2) (1,19,20,22).

A rare complication following head injury in children is diffuse cerebral swelling, also known as the malignant brain edema syndrome (level of evidence: III) (1,18,23-27). This phenomenon occurs almost exclusively in children and adolescents. The proposed mechanism for this entity is a loss of autoregulation of the brain's blood supply, resulting in rapid cerebrovascular congestion and increased intracranial pressure, which may progress to brainstem herniation, coma and death (1,5,18,23-26). This loss of cerebral vascular autoregulation is believed to be responsible for the second impact syndrome, a rare event that occurs in young athletes. Second impact syndrome is believed to occur when an

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TABLE 1
Features of concussion

Cognitive features	Symptoms	Signs
General confusion	Headache	Poor coordination or balance
Difficulty determining time, date and place	Dizziness	Vacant or glassy-eyed stare
Unaware of time of game, opposing team and score of game	Feeling dazed	Vomiting
	Feeling stunned; "having my bell rung"	Slurred speech
Amnesia – retrograde; post-traumatic/ anterograde	Seeing stars or flashing lights	Slow to answer questions or follow directions
	Ringing in the ears	Easily distracted, poor concentration
Loss of consciousness	Sleepiness	Unusual or inappropriate emotions
	Loss of vision	Personality changes
	Double vision or blurry vision	Inappropriate playing behaviour (eg, moving in the wrong direction)
	Nausea	
		Decreased playing ability

Data from reference 10

TABLE 2
Classification of concussion

Simple	Complex
• Most common	• Persistent symptoms lasting longer than 10 days, including recurrence with exertion; may last weeks to months
• Usually resolves in seven to 10 days	• Concussive convulsions
	• Prolonged loss of consciousness (longer than 1 min)
• No sequelae	• Permanent deficits or cognitive impairment
	• Multiple concussions occurring with less impact force

athlete sustains a second concussive injury while still symptomatic from a previous concussive injury (5,18,23). The 'second' injury may be seemingly very minor, but within seconds to minutes of impact, the athlete collapses and rapidly becomes comatose. This is almost universally fatal. Although this entity is widely feared, the evidence that these catastrophic events are the result of a second impact is lacking (level of evidence: III) (24,27). It is more likely that these are incidences of diffuse cerebral swelling occurring after mild injury to the immature brain (24,27).

CLASSIFICATION OF CONCUSSION SEVERITY

Most concussion grading systems are based on anecdotal experience and lack validation (level of evidence: III) (11,12,15,17,27,28). Loss of consciousness or amnesia has traditionally been used as an indication of injury severity. However, brief losses of consciousness (less than 1 min) do not correlate with severity of sporting concussive injury (11,12,14). In addition, the type and duration of symptoms may be more important than the presence or duration of amnesia alone (11,12). It is now recognized that the severity of concussions can best be determined retrospectively, after all concussive symptoms and signs have cleared and cognitive function has normalized (level of evidence: III) (12).

A simplified system of classification was recently proposed, classifying concussion into 'simple' and 'complex' (Table 2) (12). Athletes who have complex concussions should be managed by physicians with specific concussion expertise (strength of recommendation: B [Appendix 1]) (12).

INVESTIGATIONS

Diagnostic imaging

Concussion results in an aberration in brain physiology and function rather than a structural injury. Structural lesions can usually be ruled out based on a complete history and thorough physical examination. Skull x-rays and computed tomography scans usually do not demonstrate any visible injury and, therefore, are not routinely recommended (level of evidence: III) (5,11,12,15). If there is suspicion of a structural lesion (focal neurological deficit, seizure activity or prolonged unconsciousness), appropriate imaging should be performed (strength of recommendation: A) (8,9,11,12,15).

In complex concussions (eg, prolonged symptoms), imaging studies may be appropriate (level of evidence: III; strength of recommendation: B) (11,12,17). Magnetic resonance imaging is a more sensitive modality to detect subtle structural injuries such as contusions and diffuse axonal injury (29). More specialized imaging techniques, such as single photon emission computed tomography, positron emission tomography and functional magnetic resonance imaging, may be able to demonstrate pathophysiological and functional abnormalities following concussion (29).

Neuropsychological testing

Cognitive deficits associated with minor head injury include impaired attention and concentration, mild disorientation and memory difficulties. Numerous studies have evaluated brief (30 min) neuropsychological testing in the athletic population, including traditional pen and paper tests (10,19,21,22,30-32) and, more recently, computer-based programs (1,33-35). In the acute assessment of a concussed athlete, brief neuropsychological test batteries that assess attention and memory function have been shown to be practical and effective (level of evidence: II-2) (21,31,36). The Standardized Assessment of Concussion has been studied in healthy children aged nine to 14 years and is reliable in this age group (level of evidence: II-2) (37). The Sport Concussion Assessment Tool, which incorporates aspects of the Standardized Assessment of Concussion, has been developed for use on the field (Appendix 2) (12). This tool has not yet been validated in children.

Neuropsychological tests can be used to aid the return-to-play decision but not in isolation; repeated clinical assessments are key. If neuropsychological tests are used, preinjury baselines should be established in all athletes at the beginning of each sport season to maximize the clinical utility (level of evidence: II-2) (11,12,14,30,36). Following a concussive injury, athletes can then be compared to their own baseline value to determine whether there are any deficits. Because neuropsychological tests can be affected by many factors (including previous head injury, test anxiety, attention deficit disorder, psychiatric conditions and learning disabilities), without baseline data, an athlete's test result would have to be compared with population normal values, which may lead to test misinterpretation (30). For instance, test results for an athlete with high cognitive ability may be falsely interpreted as normal and lead to a premature return to sport; conversely, an athlete with low baseline functioning may be kept out of play unnecessarily long (30).

Another limitation of neuropsychological tests is practice or learning effect (11,12,30). The more an athlete performs a test, the better he or she performs because of prior exposure, particularly in tests of memory (30). This can be minimized by limiting retesting, using different versions of pen and paper tests, or by using computer-based tests that have infinitely variable paradigms (level of evidence: II-2) (11,12,30). In addition, no study has demonstrated that cognitive deficits persist after concussive symptoms have resolved. In fact, athletes may return to their baseline levels on neuropsychological tests while still experiencing concussive symptoms (30).

A unique concern regarding neuropsychological testing in the paediatric population is that children are undergoing rapid cognitive development. Computerized neurocognitive studies (1,35) have demonstrated that a substantial improvement in performance occurs between ages nine and 18 years on tests of simple and choice reaction time, working memory and new learning, with the largest changes seen between nine and 15 years (level of evidence: II-2). These developmental changes can potentially confound postinjury assessments because maturational improvements may offset any injury-related cognitive impairment; therefore, children and youth may require baseline testing as often as every six months (strength of recommendation: A) (1). However, the clinical implementation of baseline testing, particularly in the paediatric age group, is premature until sound scientific evidence is available to justify the financial costs, time and energy required to implement them.

Because of these concerns, neuropsychological testing is not indicated in the management of simple concussions. However, in those athletes who have sustained multiple concussions or who demonstrate prolonged postconcussive symptoms (ie, complex concussions), age-appropriate, detailed neuropsychological testing may be useful to help identify specific cognitive deficits, which may aid in educational planning (level of evidence: III; strength of recommendation: B) (12,30).

MANAGEMENT

If a young athlete is suspected to have sustained a concussion, he or she should immediately be removed from the game or practice. If the athlete is unconscious, a cervical spine injury must be assumed and appropriate cervical spine precautions undertaken (collar and board, and ambulance transfer to emergency department). Airway, breathing and circulation must be assessed in any unconscious athlete (strength of recommendation: A) (5,8,9,15,17,18,38).

The conscious athlete should be observed closely for any signs of deterioration (15). Symptoms may get worse later that day or the next day. Every concussed athlete should be medically evaluated by a physician, including a full neurological and mental functioning assessment, as soon as possible (15). A player should never return to sport if symptomatic (strength of recommendation: A) (5,11-13,17,18,28,38). Concussed athletes frequently have reduced attention, impaired response times and memory deficits, which may result in a decreased ability to avoid dangerous situations, thus putting them at risk for another concussion or other injury (level of evidence: II-2) (19,21,30). If in doubt, it is important to sit them out.

Following medical evaluation for a concussion, an athlete should not be left alone. A responsible adult, ideally a parent, should monitor the child for worsening symptoms, such as severe headache, persistent vomiting or seizure activity. The child should be checked through the night, but should not be awakened unless there is evidence of deterioration (abnormal breathing, seizures or vomiting). If there is any deterioration, the child should be immediately re-evaluated by a physician (strength of recommendation: A).

The most important aspect of concussion management is physical and cognitive rest (strength of recommendation: A) (11-14). The child should not play sports, exercise or participate in recreational activities, such as riding a bike, or wrestling with friends or siblings. Cognitive rest includes avoiding activities that require mental concentration, such as reading, watching television, working on a computer and playing electronic games. They may even need to miss school

while symptomatic because the mental effort required to perform schoolwork may make symptoms worse and prolong recovery (level of evidence: II-2) (20). If school absence is necessary to allow symptoms to resolve, children should subsequently return gradually (including half days) once symptoms have resolved. If they do not have worsening or recurring symptoms, they may return full time (level of evidence: III; strength of recommendation: B). If prolonged absence from school (more than two weeks) is necessary due to persistent symptoms, a neurological consultation may be of value (strength of recommendation: I).

RETURN-TO-PLAY GUIDELINES

An athlete with a concussive injury should not be allowed to return to activity until all signs and symptoms have resolved, and the athlete has been cleared to do so by a physician (level of evidence: II-2; strength of recommendation: A) (5,11-15,17,18,28,38). The ideal length of the symptom-free period has not been established; however, athletes should be symptom free for several days before beginning a medically supervised, stepwise return-to-play protocol (Table 3) (strength of recommendation: B) (11-14,28). Each step should take a minimum of 24 h. As long as symptoms do not return, athletes may progress to the next step. If symptoms recur, athletes should rest for 24 h to 48 h and try to progress again, starting at the level where they were asymptomatic.

TABLE 3
Stepwise return-to-play protocol

Step 1	Complete rest, no activity
Step 2	Light exercise, such as freeplay, walking or stationary cycling, for 10 min to 15 min
Step 3	Sport-specific activity for 20 min to 30 min (eg, skating in hockey, running in soccer)
Step 4	'On field' practice with no contact
Step 5	'On field' practice with body contact, once cleared by a physician
Step 6	Game play

MULTIPLE CONCUSSIONS

Management of an athlete who has sustained multiple concussions is controversial. A concussed athlete may be at increased risk for subsequent head injuries, which may be cumulative (level of evidence: III) (27,28). Many published guidelines recommend termination of the sport season and lifetime avoidance of contact sports with repeated concussions (strength of recommendation: B) (5,14,17,28). Each athlete should be evaluated individually. Athletes should be advised to avoid contact sports if subsequent concussions result in more severe symptoms, if symptoms occur with less force, if their playing style or sport puts them at increased risk of future injuries, or if they have a learning disability or persistent cognitive symptoms (level of evidence: III; strength of recommendation: B) (28).

PREVENTION

Head injuries can be prevented or minimized by wearing the appropriate protective equipment for the specific sport (level of evidence: II-2) (11,12,15,28,39-42). Approved helmets should be worn in all contact sports and in all activities with a risk of head injury (eg, cycling, skateboarding, in-line skating, skiing, snowboarding and equestrian activities) (strength of recommendation: A) (11-15,28,43). Appendix 3 contains a list of approved helmets for wheeled sports. It is important that the equipment be worn properly and be well maintained (44,45). Any damaged equipment should be replaced promptly.

It is critical to recognize that there is no such entity as a 'concussion-proof' helmet. Players may feel they are not at risk for head injury if wearing their helmet and may adopt a more aggressive playing style, thereby putting themselves at greater risk of injury (11,12,45). To minimize risk of concussion, athletes should respect the rules of their sport and practice fair play.

Coaches and trainers play an important role in reducing the number of concussions. They must ensure that their athletes are taught the proper sport techniques, such as correct body checking in hockey, tackling in football and heading the ball in soccer. Neck muscle strengthening programs may help reduce the risk of concussion by reducing the impact forces transmitted to the brain, although evidence for this is currently lacking (11). Coaches and trainers should be familiar with the signs and symptoms of concussion and immediately remove players from play if a head injury has occurred. They should ensure that athletes are medically evaluated and are not allowed to return to play until medical clearance has been obtained.

Rule changes and enforcement can also decrease the risk and incidence of concussive injuries (11,12,45). Rules mandating padded goal posts in soccer and football, and the banning of spearing in football have been shown to reduce the number of concussive injuries (level of evidence: III) (28,45). In hockey, eliminating hits to the head, not allowing checking from behind and eliminating fighting may help to reduce head injuries (11,12). Discouraging enrolment in sports where intentional head injury is promoted, such as boxing, may also decrease the risk of concussion in children (46).

CONCUSSION EDUCATION

It is vital that athletes, coaches and trainers, parents and health care providers be aware of the symptoms and signs of concussion and the appropriate management of concussive injuries (6). More information can be found on the following Web sites: <www.casm-acms.org>, <www.thinkfirst.ca> and <www.cdc.gov/ncipc/tbi/Coaches_Tool_Kit.htm>.

ADVOCACY ISSUES IN SPORT CONCUSSION

Paediatricians can advocate for their patients in the following ways:

- Discouraging patients from participating in sports, such as boxing, in which intentional injury to the head is promoted;

- Educating coaches and trainers, schools and policy-makers in sport regarding the signs and symptoms of concussion, and the need for medical evaluation or clearance before an athlete returns to play;
- Encouraging patients, particularly those who have sustained repeated concussions, to participate in noncontact versions of their chosen sport; and
- Supporting legislation requiring mandatory wearing of helmets for all sports in which there is a significant risk of head injury, including all wheeled sports, skiing, snowboarding and equestrian sports.

RECOMMENDATIONS

The Canadian Paediatric Society makes the following recommendations regarding sport-related concussion in children:

- Anyone working with children involved in sports should educate themselves on the signs and symptoms of sport-related concussion (Table 1). Loss of consciousness is not required to sustain a concussion.
- An athlete who has sustained a head injury during sport should be immediately removed from play and not allowed to return to play that game. The athlete should be closely monitored for any signs of deterioration and should not be left alone. Importantly, a symptomatic athlete should never return to play.
- An unconsciousness athlete should be assumed to have a cervical spine injury and should be appropriately immobilized before ambulance transportation to hospital.
- All athletes sustaining a head injury should be evaluated by a physician as soon as possible. Following medical evaluation, they should be monitored by a parent for the next 24 h to 48 h for signs of deterioration. If any signs of deterioration occur, the athlete should immediately be re-evaluated by a physician.
- Diagnostic imaging and neuropsychological testing are not routinely recommended.
- The athlete should rest until all symptoms have resolved. This includes both physical and cognitive rest.
- Once the athlete has been symptom free for several days, he or she can begin a medically supervised, stepwise return-to-play protocol (Table 3).
- Return to sport following a sport-related concussion should only occur after medical clearance by a trained physician.

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APPENDIX 1
Levels of evidence and strength of recommendations*

Level of evidence	Description
I	Evidence obtained from at least one properly randomized controlled trial.
II-1	Evidence obtained from well-designed controlled trial without randomization.
II-2	Evidence obtained from well-designed cohort or case-controlled analytical studies, preferably from more than one centre or research group.
II-3	Evidence obtained from comparisons between times and places, with or without the intervention. Dramatic results in uncontrolled experiments could also be included in this category.
III	Opinions of respected authorities, based on clinical experience, descriptive studies or reports of expert committees.
Grade	**Description**
A	There is good evidence to recommend the clinical preventive action.
B	There is fair evidence to recommend the clinical preventive action.
C	The existing evidence is conflicting and does not allow a recommendation to be made for or against use of the clinical preventive action; however, other factors may influence decision-making.
D	There is fair evidence to recommend against the clinical preventive action.
E	There is good evidence to recommend against the clinical preventive action.
I	There is insufficient evidence to make a recommendation; however, other factors may influence decision-making.

**The levels of evidence and strength of recommendations were based on the methods of the Canadian Task Force on Preventive Health Care (47)*

APPENDIX 2
Sport Concussion Assessment Tool (SCAT)

The SCAT Card
(Sport Concussion Assessment Tool)
Medical Evaluation

Name: _____ Date _____

Sport/Team: _____ Mouth guard? Y N

1) SIGNS

Was there loss of consciousness or unresponsiveness?	Y	N
Was there seizure or convulsive activity?	Y	N
Was there a balance problem / unsteadiness?	Y	N

2) MEMORY

Modified Maddocks questions (check correct)

At what venue are we? __; Which half is it? __; Who scored last?__

What team did we play last? __; Did we win last game? __?

3) SYMPTOM SCORE

Total number of positive symptoms (from reverse side of the card) = _____

4) COGNITIVE ASSESSMENT

5 word recall	(Examples)	Immediate	Delayed (after concentration tasks)
Word 1 _____	cat	___	___
Word 2_____	pen	___	___
Word 3 _____	shoe	___	___
Word 4 _____	book	___	___
Word 5 _____	car	___	___

Months in reverse order:
Jun-May-Apr-Mar-Feb-Jan-Dec-Nov-Oct-Sep-Aug-Jul (circle incorrect)

or

Digits backwards (check correct)

5-2-8	3-9-1	_____
6-2-9-4	4-3-7-1	_____
8-3-2-7-9	1-4-9-3-6	_____
7-3-9-1-4-2	5-1-8-4-6-8	_____

Ask delayed 5-word recall now

5) NEUROLOGIC SCREENING

	Pass	Fail
Speech	___	___
Eye Motion and Pupils	___	___
Pronator Drift	___	___
Gait Assessment	___	___

Any neurologic screening abnormality necessitates formal neurologic or hospital assessment

6) RETURN TO PLAY

Athletes should not be returned to play the same day of injury.
When returning athletes to play, they should follow a stepwise symptom-limited program, with stages of progression. For example:

1. rest until asymptomatic (physical and mental rest)
2. light aerobic exercise (e.g. stationary cycle)
3. sport-specific exercise
4. non-contact training drills (start light resistance training)
5. full contact training after medical clearance
6. return to competition (game play)

There should be approximately 24 hours (or longer) for each stage and the athlete should return to stage 1 if symptoms recur. Resistance training should only be added in the later stages.
Medical clearance should be given before return to play.

Instructions:
This side of the card is for the use of medical doctors, physiotherapists or athletic therapists. In order to maximize the information gathered from the card, it is strongly suggested that all athletes participating in contact sports complete a baseline evaluation prior to the beginning of their competitive season. This card is a suggested guide only for sports concussion and is not meant to assess more severe forms of brain injury. **Please give a COPY of this card to the athlete for their information and to guide follow-up assessment.**

Signs:
Assess for each of these items and circle Y (yes) or N (no).

Memory: If needed, questions can be modified to make them specific to the sport (e.g. "period" versus "half")

Cognitive Assessment:
Select any 5 words (an example is given). Avoid choosing related words such as "dark" and "moon" which can be recalled by means of word association. Read each word at a rate of one word per second. The athlete should not be informed of the delayed testing of memory (to be done after the reverse months and/or digits). Choose a different set of words each time you perform a follow-up exam with the same candidate.

Ask the athlete to recite the months of the year in reverse order, starting with a random month. Do not start with December or January. Circle any months not recited in the correct sequence.

For digits backwards, if correct, go to the next string length. If incorrect, read trial 2. Stop after incorrect on both trials.

Neurologic Screening:
Trained medical personnel must administer this examination. These individuals might include medical doctors, physiotherapists or athletic therapists. Speech should be assessed for fluency and lack of slurring. Eye motion should reveal no diplopia in any of the 4 planes of movement (vertical, horizontal and both diagonal planes). The pronator drift is performed by asking the patient to hold both arms in front of them, palms up, with eyes closed. A positive test is pronating the forearm, dropping the arm, or drift away from midline. For gait assessment, ask the patient to walk away from you, turn and walk back.

Return to Play:
A structured, graded exertion protocol should be developed; individualized on the basis of sport, age and the concussion history of the athlete. Exercise or training should be commenced only after the athlete is clearly asymptomatic with physical and cognitive rest. Final decision for clearance to return to competition should ideally be made by a medical doctor.

For more information see the "Summary and Agreement Statement of the Second International Symposium on Concussion in Sport" in the April, 2005 Clinical Journal of Sport Medicine (vol 15), British Journal of Sports Medicine (vol 39), Neurosurgery (vol 59) and the Physician and Sportsmedicine (vol 33).

APPENDIX 2
Sport Concussion Assessment Tool (SCAT) (continued)

This tool represents a standardized method of evaluating people after concussion in sport. This Tool has been produced as part of the Summary and Agreement Statement of the Second International Symposium on Concussion in Sport, Prague 2004

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

1. Concussion may be caused either by a direct blow to the head, face, neck or elsewhere on the body with an 'impulsive' force transmitted to the head.
2. Concussion typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously.
3. Concussion may result in neuropathological changes but the acute clinical symptoms largely reflect a functional disturbance rather than structural injury.
4. Concussion results in a graded set of clinical syndromes that may or may not involve loss of consciousness. Resolution of the clinical and cognitive symptoms typically follows a sequential course.
5. Concussion is typically associated with grossly normal structural neuroimaging studies.

Post Concussion Symptoms

Ask the athlete to score themselves based on how they feel now. It is recognized that a low score may be normal for some athletes, but clinical judgment should be exercised to determine if a change in symptoms has occurred following the suspected concussion event.

It should be recognized that the reporting of symptoms may not be entirely reliable. This may be due to the effects of a concussion or because the athlete's passionate desire to return to competition outweighs their natural inclination to give an honest response.

If possible, ask someone who knows the athlete well about changes in affect, personality, behavior, etc.

Remember, concussion should be suspected in the presence of ANY ONE or more of the following:

- Symptoms (such as headache), or
- Signs (such as loss of consciousness), or
- Memory problems

Any athlete with a suspected concussion should be monitored for deterioration (i.e., should not be left alone) and should not drive a motor vehicle.

For more information see the "Summary and Agreement Statement of the Second International Symposium on Concussion in Sport" in the April, 2005 edition of the Clinical Journal of Sport Medicine (vol 15), British Journal of Sports Medicine (vol 39), Neurosurgery (vol 59) and the Physician and Sportsmedicine (vol 33). This tool may be copied for distribution to teams, groups and organizations.

The SCAT Card
(Sport Concussion Assessment Tool)

Athlete Information

What is a concussion? A concussion is a disturbance in the function of the brain caused by a direct or indirect force to the head. It results in a variety of symptoms (like those listed below) and may, or may not, involve memory problems or loss of consciousness.

How do you feel? You should score yourself on the following symptoms, based on how you feel now.

Post Concussion Symptom Scale

	None		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
Balance problems or dizzy	0	1	2	3	4	5	6
Nausea or vomiting	0	1	2	3	4	5	6
Vision problems	0	1	2	3	4	5	6
Hearing problems / ringing	0	1	2	3	4	5	6
"Don't feel right"	0	1	2	3	4	5	6
Feeling "dinged" or "dazed"	0	1	2	3	4	5	6
Confusion	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
Drowsiness	0	1	2	3	4	5	6
Fatigue or low energy	0	1	2	3	4	5	6
More emotional than usual	0	1	2	3	4	5	6
Irritability	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

(follow up symptoms only)

Sadness	0	1	2	3	4	5	6
Nervous or Anxious	0	1	2	3	4	5	6
Trouble falling asleep	0	1	2	3	4	5	6
Sleeping more than usual	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Other: _____	0	1	2	3	4	5	6

What should I do?

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. You should not be left alone and must go to a hospital at once if you:

- Have a headache that gets worse
- Are very drowsy or can't be awakened (woken up)
- 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 your feet; have slurred speech

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

What can I expect?

Concussion typically results in the rapid onset of short-lived impairment that resolves spontaneously over time. You can expect that you will be told to rest until you are fully recovered (that means resting your body and your mind). Then, your doctor will likely advise that you go through a gradual increase in exercise over several days (or longer) before returning to sport.

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APPENDIX 3
Certified helmets recommended for different activities

Activity	Recommended helmet	Certification	Type of protection
Bicycling	Bicycle helmet	CSA, CSPC, Snell B-95, N-94 certified	Single impact
In-line skating	Bicycle helmet or in-line skating helmet	CSA, ASTM F-1446/F-1447 or Snell N-94 certified	Single or multiple impact
Skateboarding	Skateboarding helmet	ASTM F-1492, Snell N-94, CEN certified	Single or multiple impact
Scootering	Bicycle helmet	CSA, CSPC, Snell B-95, N-94 certified	Single impact
Rollerskating	Bicycle helmet	BS EN 1078 certified	Single impact

ASTM American Society for Testing and Materials; BS British Standards Institute; CEN Comité Européen de Normalisation; CSA Canadian Safety Association; CSPC Consumer Products Safety Commission; EN European Normalisation. Reproduced with permission from reference 43

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