

# Sport Related Concussion (SRC)

November 2007

## Special points of interest:

- A Mild concussion in athletes is easy to miss.
- Return to play too early can result in catastrophic results.
- An athlete who sustains a concussion should not go back to activity the same day and should remain out of play until all symptoms and neuro-cognitive functioning have returned to normal.
- If unsure about the status of an athlete's ability to return keep them out of the game.

## Inside this issue:

Evaluation of Concussion	1
Grading of Concussion	2
Neuropsychological Testing	2
Neuroimaging	2
Rehabilitation and Return to Sport	3
Second Impact Syndrome	3
Post Concussion Syndrome	3
Prevention	4
Computerized testing	4
Resources/References	4

## Missing a Concussion Can Have Disastrous Consequences

There is no consensus on the definition of a concussion, or sport related concussion (SRC). At the 1st international conference on head injury in Vienna concussion was defined as "A complex pathophysiological processor affecting the brain, induced by traumatic biomechanical forces."

A concussion is a violent jarring or shaking that results in a disturbance of brain function



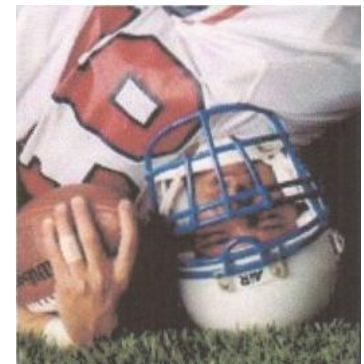
Loss of consciousness is not a prerequisite for concussion to have occurred.

Football and hockey account for the majority of head injuries in sports in North America. It is estimated that 300,000 concussions occur in the U.S. annually due to football. An estimated 10-13% of all soccer injuries are head injuries.

The presentation of concussion in athletes can vary from an obvious concussion with LOC to one which produces minimal signs and symptoms and can easily be missed. The occurrence of a second concussion before full recovery from a preceding one may lead to a rapidly fatal condition known as "second impact syndrome". Ongoing minor symptoms may affect future functioning both cognitively and in sports. It has also been observed that there seems to be a cumulative effect regarding cognitive impairment with each successive concussion. Younger athletes are thought to be more prone to brain damage from injury or metabolic insults. Previous injury is believed to make one more susceptible to injury. There may even be a genetic susceptibility to concussion. The term minimal traumatic brain injury (MTBI) has recently been used to describe brain injuries resulting from non catastrophic events. This term does not in any way imply that

the brain has not sustained a transient or permanent injury.

It is important to question athletes carefully about symptoms



The majority of concussions in athletes do not have an obvious history or presentation.

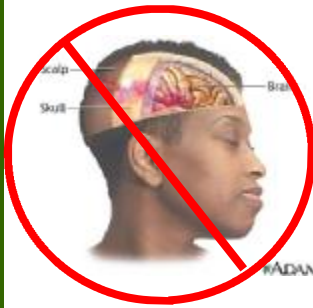
indicative of concussion after any injury in which a direct or indirect (acceleration/deceleration) force could have been applied to the head. The examining physician must ask about a history of any previous injury to the head and face as athletes will often not admit or realize that a concussion may have occurred in the past.

## Evaluation of Concussion

Any signs or symptoms such as being glassy eyed, personality changes unsteadiness, improper behavior, fatigue, slowness or problems with judgment should alert the physician to the possibility of the occurrence of a concussion. Classical signs of head injury such as a scalp wound, discharge from the nose or ears and a stiff neck are typi-

cally absent. The on field assessment includes taking spinal precautions as necessary and assessment of neurological and mental status with a focus on testing memory and concentration. Standardized assessments such as The Standardized Assessment of Concussion (SAC) have been developed and are effective on site and follow up

tools for concussion assessment. Visit [www.cjsportmed.com](http://www.cjsportmed.com) to view the tool. If any signs of serious head injury are present, including LOC, the athlete should be sent immediately to hospital for assessment using spinal precautions. Office follow up involves repeat assessments for subtle signs of concussion and recovery.



*As most SRC's do not result in observable physical pathology, concussion severity is best determined by the presence and duration of symptoms and return of clinical and functional exam to normal.*

## Classification and Grading of Concussion

A first attempt at organizing treatment and return to play after SRC involved developing scales to grade the severity of a concussive episode. These often involved taking into account the occurrence of loss of consciousness or amnesia. None of these guidelines had any scientific basis. One of the recommendations from the Prague conference on SRC in April 2004 was to abandon the use of grading scales in favor of combined measures of recovery

to determine the severity of injury and prognosis. The combined measures of recovery include signs and symptoms of SRC, cognitive impairment including those determined through neuropsychological testing as well as the duration of symptoms. It has also become clear that a concussion severity can only be determined in after all concussion symptoms have cleared, the neurologic examination is normal and cognitive function has

returned to baseline. An attempt to classify concussions into simple or complex concussions has also been proposed. Simple concussions are those without significant LOC or other neurologic symptoms and resolve over 7-10 days spontaneously. This of course can only be determined after the concussion has resolved. There is also no clear consensus as to what constitutes full return of functioning after SRC.

**“Neuropsychological testing is of extreme value in the assessment of concussion and for deciding on when to return an athlete to activity.”**

## Neuropsychological Testing

There has been increasing interest lately in the neuropsychological testing for the initial assessment and recovery from concussion. In a “typical” uncomplicated concussion sustained in football, neuropsychological testing usually returns to baseline by day 10-14. There are numerous tests available, some being administered manually with paper and pencil (McGill, SAC, ACE) and some computerized. A com-

mon problem with these tests is that a baseline score is often not available. Computerized testing systems (IMPACT, CogSport, ANAM, Head-Minder) use large normative data bases to compare tests results in order to compensate for lack of baseline data. The ability of athletes to be tested in the privacy of their own home (over the internet) improves their test taking compliance. Randomization of testing

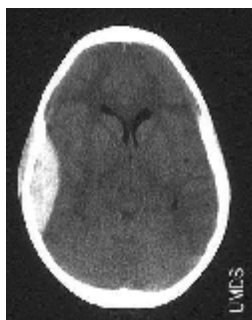
order minimizes a possible learning effect from repeat testing. Most of these tests are expensive for single use and are generally geared for use by teams and sport organizations. CogSport does provide testing for individuals at affordable rates. (See back page for example of computerized neuropsychological testing post concussion.)

## Neuroimaging

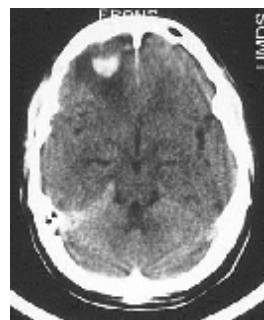
Conventional neuroimaging is usually normal in concussion unless there is a profound injury often indicated by localizing signs or persistent clinical or cognitive symptoms. When these are present an MRI or at least a CT of the head should be obtained. Newer modalities such as PET scans SPECT and functional MRI's (fMRI's) are being investigated as tools to help assess the degree of physical pathology in concussion but are not available for routine clinical use. In general it is recommended that in uncomplicated minor concussions in

which the resolution of signs and symptoms is not prolonged

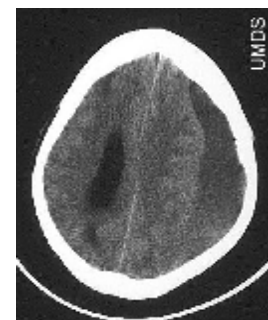
(10-15 days) no neuroimaging investigations are needed.



*CT scan of an epidural hematoma*



*CT of an intracerebral hemorrhage*



*CT of a chronic subdural hematoma*

## Management and Rehabilitation

Immediately after a concussion the athlete should be removed from the game not be allowed to return to the same game or practice session. ***The older method of trying to grade the concussion to see if the athlete can return to play in the same game is no longer acceptable practice.*** They must be reassessed regularly to ensure there is no deterioration of their condition. It is essential that they not be left alone as their condition may change rapidly. They should have a proper medical evaluation as outlined previously.

Return to play should be considered after the resolution of symptoms and the return of neuropsychological testing to normal. At that point a rehabilitation program should be instituted in a stepwise progression. Any recurrence of symptoms during rehabilitation necessitates dropping back to the previous level of the program for at least 24 hours before attempting to progress again. A player should never be sent back to play or practice with ongoing symptoms or cognitive abnormalities. ***“When in doubt, sit them out”***

Return to sport progression:

1. No activity until asymptomatic.
2. Light exercise e.g. walking or light stationary cycling.
3. Sport specific activity such as running for soccer.
4. On field practice without contact.
5. Full activity.

Take at least 24 hours to progress from stage to stage. If symptoms recur, rest until symptoms subside (at least one day) and then resume activity one stage below the stage which produced symptoms.



*Low intensity stationary cycling or walking are safe activities to return to once an athlete is asymptomatic at rest.*

## Second Impact Syndrome

Second impact syndrome occurs when a previously concussed athlete (often unknown to the athlete themselves and/or unreported to the coach or physician) sustains a second concussion, however mild, while still recovering from the first concussion. After a brief period of mild symptoms or even normal findings, the athlete rapidly deteriorates (minutes) neurologically often

starting with loss of consciousness and ending in rapid death due to herniation of the brain contents through the foramen magnum. It is thought to occur due to loss of autoregulation of intracranial pressure. Adolescents seem more susceptible to this condition. It is truly a catastrophe which is preventable through education. Athletes and coaches should be taught to recognize and report the subtle

signs and symptoms of concussion. Physicians must maintain a high index of suspicion for concussion in any injury and ensure to not send any athlete back to sport or practice until they achieve normal functioning and are asymptomatic both at rest and with exertion. Remember ***“when in doubt sit them out”***.

The best way to avoid “second impact syndrome” is prevention:

***“When in doubt sit them out”***

## Post Concussion Syndrome

Eighty percent of concussions in sports clear in 5-10 days and in 10-15 days in football. Signs and symptoms may persist up to 6 months or longer. At times symptoms such as depression may occur an athlete who has to be kept from activity for a prolonged period. The symptoms of depression may be situational and not indicative of persistent brain dysfunction. This can make it difficult to decide when to return the athlete to activity. Always remember, ***“when in doubt, sit them out”***.

The following are symptoms indicative of a post concussion syndrome.

- Dizziness
- Headache
- Nausea
- Vomiting
- Balance problems
- Difficulty falling asleep
- Sleeping excessively
- Drowsiness
- Sensitivity to light
- Sensitivity to noise
- Emotional lability
- Irritability

- Sadness
- Nervousness
- Numbness or tingling
- Feeling slowed down
- Feeling like in a fog
- Difficulty concentrating
- Difficulty remembering
- Other complaints

The persistence of any of these symptoms warrants restriction from activity, continual follow up, possible investigations and referral for further assessment.



*Persistent headache is a common post concussion symptom which would preclude return to activity.*

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## Prevention of Concussion

Prevention is the best way to reduce morbidity and mortality from head injuries and concussions. There has been controversy in the literature with respect to protective head gear and mouth guards in various sports as well as the effect of heading in soccer.

Among our most numerous athletes, one piece of equipment stands out as having proven to reduce and prevent head injuries and that is the bicycle helmet. Studies have shown that in areas where enough public education is given, the use of bicycle helmets has increased and has resulted a significant decrease in head injuries in children. The impact of such an intervention is tremendous. It is important to stress the proper wearing of such helmets to achieve adequate protection.

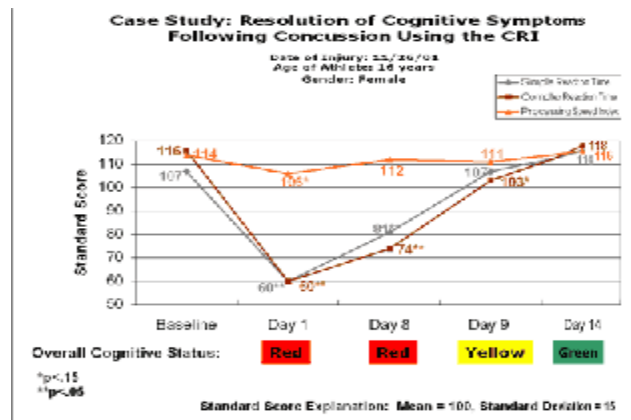


The proper way to wear a bicycle helmet

ADAM.

## Computerized Neuropsychological Testing of an Athlete Post Concussion

Use of computerized testing can provide an objective measure of neuropsychological recovery from a concussion. The test result presented here is from the Head-minder™ testing protocol (CRI = "concussion resolution index"). The graph demonstrates the deficit incurred and recovery of the athlete to baseline over a period of 14 days with repeat testing. This testing represents one parameter in deciding when to return an athlete to activity.



## Useful Resources for Managing Athletes With Concussion

Severe injuries are initially dealt with by immediate referral to the appropriate hospital. Most concussions are dealt with in the office over the course of a few weeks. Proper follow up means frequent reassessments and taking the athlete through a proper rehabilitation program (daily reassessment). Most concussions in athletes resolve in 10 to 15 days. For those with more severe signs and symptoms at the outset or prolonged recovery, referral for

assessment should be made. In Toronto, patients with prolonged signs and symptoms can be referred to the Toronto Acquired Brain Injury Network at (416) 753-6072 or [www.abinetwork.ca](http://www.abinetwork.ca). Children up to the age of 18 can be referred directly to Bloorview MacMillan Children's Centre at (416) 753-6072 or [www.bloorviewmacmillan.on.ca](http://www.bloorviewmacmillan.on.ca). Referral forms available online. Further information on concussion

in sports and computerized neuropsychological testing may be obtained online at: [www.casm-acms.org](http://www.casm-acms.org).

The Prague Conference Summary Statement is available online at [www.athletictherapy.org/docs/PragueConcussionArticle.pdf](http://www.athletictherapy.org/docs/PragueConcussionArticle.pdf)

