

Understanding Brain Injury in Adolescence

**A guide for parents, coaches, educators and
those that work with youth**

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Presented by Sun Life Financial Chair in Adolescent Mental Health
www.teenmentalhealth.org

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Quick fact: Thousands of brain injuries occur in Canada each year, the majority of them occur in youth under the age of 25.

Our brain is the most sophisticated and complex organ in the human body. It controls the way we feel, think behave, understand, experience, and interact with the world around us. It continues to develop well into the adolescent years (13-25 years of age) with many important changes happening during that time. A brain injury sustained at this critical time may have a significant and long-lasting impact of brain development.

For example, a brain injury may harm not only the current functioning of the damaged part, it can also affect how other parts of the brain grow and develop over time.

The extent of brain damage will depend on:

- ① **The type of injury**
 - Traumatic (open or closed)
 - Non-traumatic
- ② **The severity of the injury**
 - Mild
 - Moderate
 - Severe
- ③ **Where the hit or blow occurred on the brain**
 - Front
 - Back
 - Left
 - Right

This guide will provide a basic overview on important issues pertaining to brain injury in adolescence. The goal of this guide is to give young people, parents, coaches and other individuals who work with youth:

- ④ A better understanding of what brain injury is in adolescence
- ⑤ Help you feel more comfortable about talking with your doctor or other health care professionals
- ⑥ Help adults cope and communicate with youth who suffer from brain injury

Brain Injury

Traumatic

- **Open brain injury**

Happens when something goes in or through the brain, such as a gunshot wound. The impact of open brain injury depends on which part of the brain is affected. A injury to the forefront of the brain will lead to problems confined to that region of the brain.

- **Closed brain injury**

Happens due to a hit or blow to the head. This then forces the head in the opposite direction, causing the brain to bounce around the inner walls of the skull. This can cause damage in more than one area of the brain.

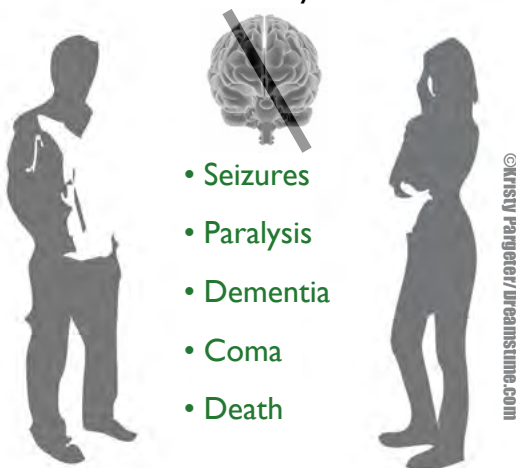
Non-traumatic

- **Brain infections**
- **Strokes**
- **Brain tumors**
- **Metabolic disorders**
- **Ingestion of toxic substances**
- **Anoxic injuries (death of brain cells due to lack of oxygen)**

Quick fact: Only one in 20 people with traumatic brain injury receive the rehabilitation they require.

Open brain injury

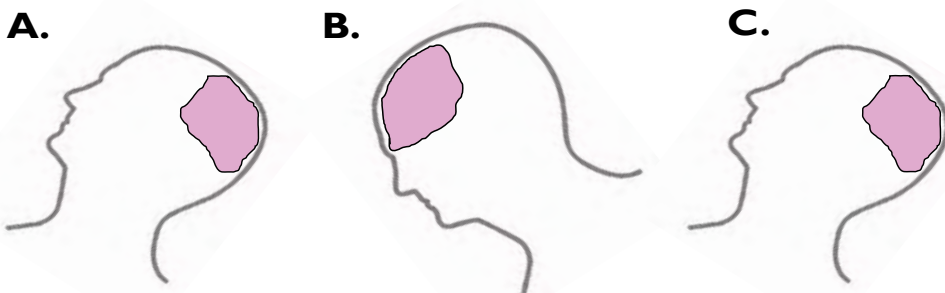
Open brain injury happens when an object penetrates the skull or when the skull is broken. This type of injury is usually quite visible and requires treatment immediately. It can result in:



Closed brain injury

Imagine in a game of hockey, skating up the ice with the puck and your opponent body checks you while you had your head down. This would cause you to fall backward and hit your head on the ice. This action will likely have caused you to bruise your brain in two places, even if there is no obvious damage to your head.

What happens to your brain in this situation is that the initial blow to the head causes a bruise in the back part of the brain where your head first struck the ice (see image A). This type of injury is called a “coup.” Following this, your brain will bounce around your skull, striking the side opposite to where it first struck (see image B). This is called the “countercoup.” Your brain can continue to bounce and strike the skull in different places depending on how severe the initial hit was (see image C).



Quick fact: It is estimated that one-third of youth will obtain a mild traumatic brain injury (concussion) by the time they finish school. In Canada, a concussion occurs every four minutes.



Mild traumatic brain injury

Mild brain injuries, also known as a concussion, can lead to many problems and since there is no obvious damage to the head, the adolescent may not realize how serious it may be. This is why it is so important to seek medical attention even if there is only a short period of confusion after a head injury. If the injury did result in brain damage, it's important that immediate treatment be put into place.

Diagnosing a mild traumatic brain injury is usually based on how the youth felt at the time of the accident or shortly after it. The diagnosis can also be determined by a noticeable change in behaviour, emotions or thinking observed by friends or family.

Moderate traumatic brain injury

Moderate traumatic brain injury occurs when the youth is knocked unconscious for longer than just a few moments, it can last for hours. Concussion symptoms and behaviour, emotion or thinking changes can last for weeks or months, sometimes longer.

Severe traumatic brain injury

Severe brain injury is diagnosed when the adolescent has sustained a severe concussion, bleeding, loss of consciousness, coma or skull fractures. This type of injury is much more serious and the effects can be long lasting.



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The most important things to remember in these situations are:

- 🕒 Seek immediate medical attention
- 🕒 Keep the injured youth (and yourself) calm, explain to them what has happened and that they will be getting medical attention soon
- 🕒 Make sure the young person understands what the recommended treatment is and why
- 🕒 Help the young person follow treatment recommendations
- 🕒 Support the young person's return to usual activities when cleared by the doctor



Quick fact: Brain injury is the leading cause of seizure disorders, death and disability worldwide and the No. 1 killer and disabler of individuals under the age of 44.

Signs and symptoms of a **mild**, **moderate** and **severe** traumatic brain injury

Note: moderate and severe traumatic brain injuries can include any of the signs and symptoms of a mild brain injury.

Loss of consciousness for up to 30-minutes

Confusion

Headaches

Temporary memory loss

Ringing in the ears

Nausea

Slurred speech

Drowsiness

Dilated pupils

Mood swings

Depression

Poor concentration

Poor attention span

Sensitivity to lights and sounds

Trouble with balance

Irritable

Personality changes

Behaviour changes

Trouble sleeping

Loss of consciousness for more than 30-minutes

Slow breathing

Blurred vision or vision loss

Migraine like headaches

Hearing loss

Slow pulse

Amnesia

Coma

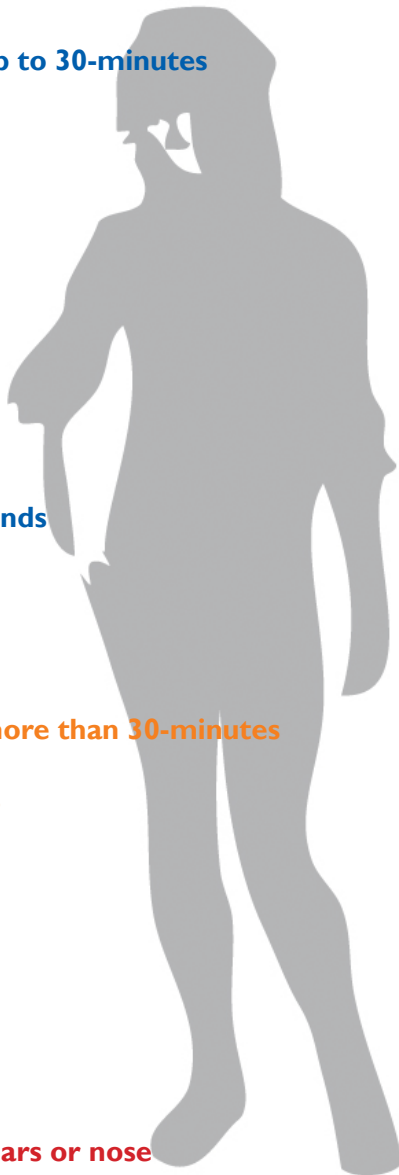
Numbness in limbs

Paralysis

Loss of bowel control

Epilepsy or seizures

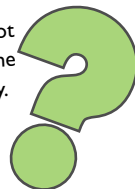
Spinal fluid coming out of ears or nose



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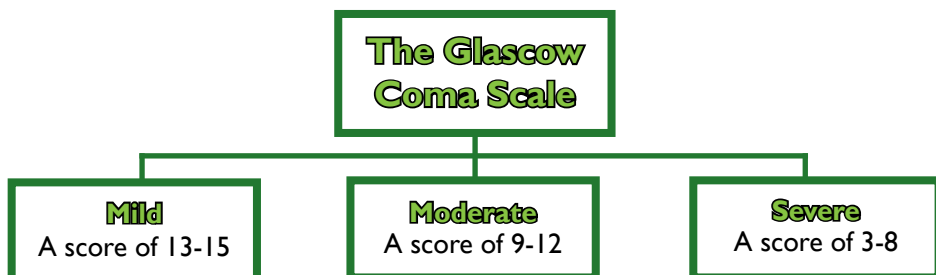
Note: Sometimes it can be difficult to recognize the symptoms of a brain injury. Subtle symptoms can conceal serious brain damage. Whatever the degree of brain injury, it's important to seek immediate medical attention. Brain injuries which are not treated or not treated properly can even be fatal.

Quick fact: The damage from brain injury does not always stop once the injury is over; it can continue over the course of several days and even months after the initial injury.



Glasgow Coma Scale

The Glasgow Coma Scale is a method used to evaluate patients suspected of having a severe brain injury. This method is used in hospitals to help health professionals assess the degree of consciousness of the adolescent suffering from the brain injury.



E

Eye response

- 4 Eyes open spontaneously
- 3 Eye opening to verbal command
- 2 Eye opening to pain
- 1 No eye opening

M

Motor response

- 6 Obeys commands to move arms and legs
- 5 Withdraws from pain locally (when pinched)
- 4 Withdraws from pain generally
- 3 Flexes limb in response to pain
- 2 Straightens limb in response to pain
- 1 No movement in response to pain

V

Verbal response

- 5 Oriented and speaks normally
- 4 Confused but speaks normally
- 3 Inappropriate words
- 2 Incomprehensible sounds
- 1 No verbal response

E+V+M= total score



Quick fact: The assessment after a concussion most commonly done by doctors is called a “neurological exam.” This comprises of a series of questions and tests that will display important information about how the brain and other parts of the nervous system are working.

The brain is divided into four lobes and each lobe deals with many different brain functions. Depending where the head is struck will determine what parts of the brain are affected.

1. Frontal lobe

Reasoning, planning, parts of speech, movement, emotions and problem solving

2. Parietal lobe

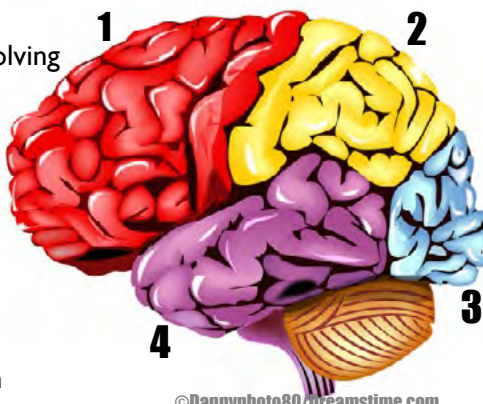
Movement, orientation, recognition, perception of stimuli

3. Occipital lobe

Visual processing

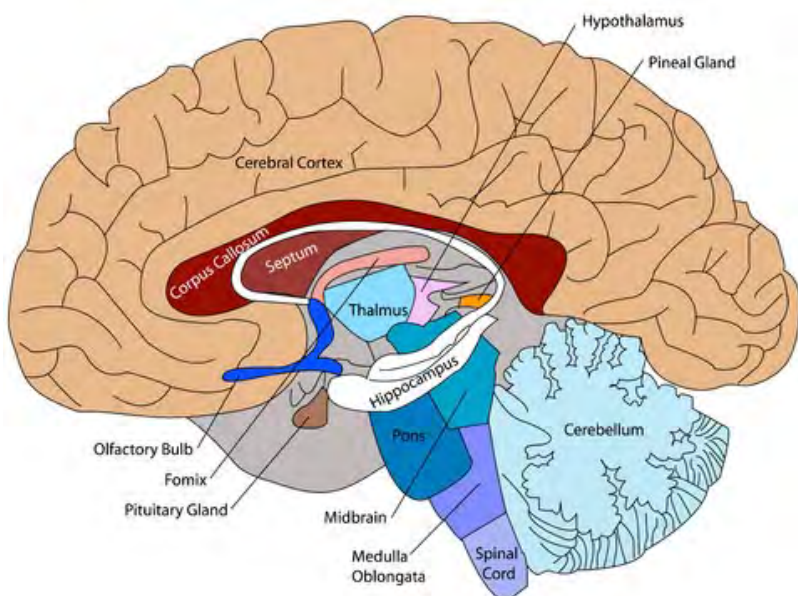
4. Temporal lobe

Perception and recognition of auditory stimuli, memory and speech



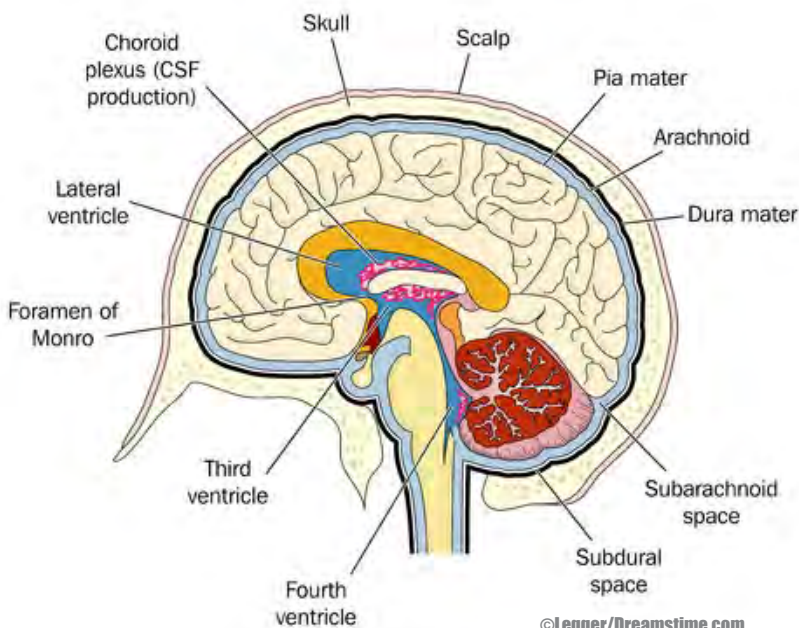
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Imagine if you were to slice the brain in half, this is what it would look like. What areas become damaged depends on the type and severity of the injury.

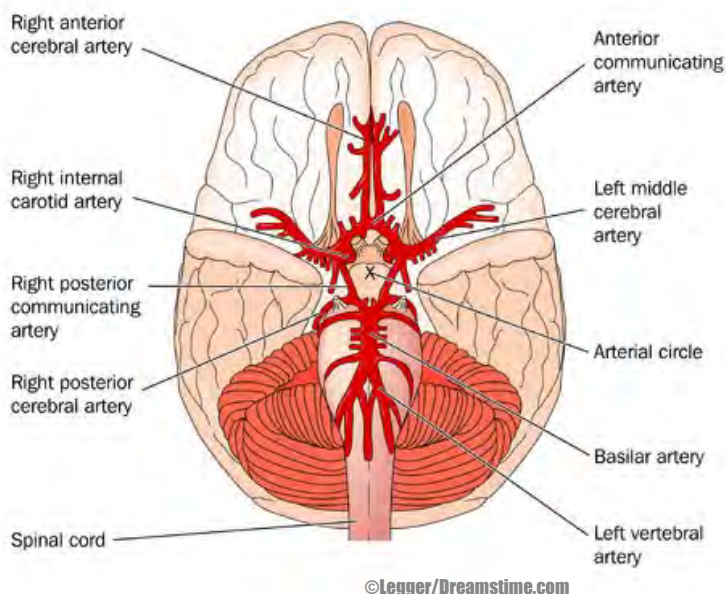


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This diagram shows the various membrane layers under the skull, surrounding the brain. A head injury can affect one or more of these layers. These membranes that cover the brain can be torn or damaged if the brain collides with ridges in the skull.



This diagram demonstrates the arteries at the base of the brain called **The Circle of Willis**. These arteries supply the brain with blood and are connected through a looping pattern, which helps blood flow reach different areas. If blockage or injury occurs to these arteries, there can be serious consequences from not having blood reach parts of the brain or blood spilling into areas where it does not belong.



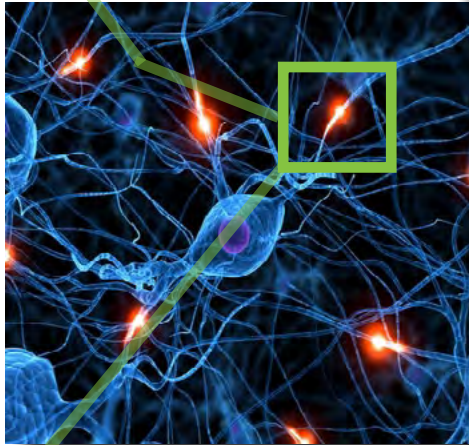
A



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- ⦿ The human brain is composed of about 100 billion neurons, also known as brain cells.
- ⦿ They communicate with each other through complex chemical and electrical signals. When this signaling occurs, it's called a neuron firing.
- ⦿ In diagram A, you see a depicting firing of many neurons, while diagram B gives a magnified view of the firing of a single neuron.
- ⦿ For example, when we speak, selective areas in the brain associated with speech fire. The firing signals that the brain is active in that area.

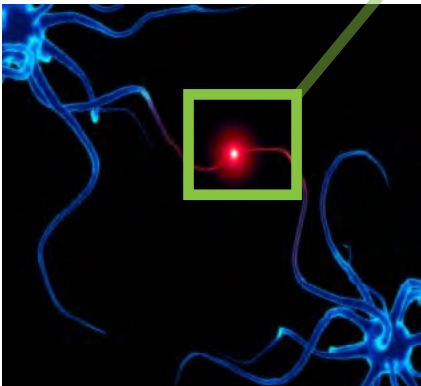
B



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- ⦿ Neurons manufacture chemicals called neurotransmitters which help transmit the chemical/electrical signal at the end of the branches, called the axon.
- ⦿ These signals then make contacts with other brain cells at a location called the synapse, shown in diagram C. This is how information is transmitted from one neuron to another.
- ⦿ If there is damage to these cells or their connections, then information does not get transmitted to that particular part of the brain, which will cause the brain to not operate properly.

C



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- ⦿ When multiple connections establish between neurons, a complex network of neuronal and axonal connections is created, like in diagram B.
- ⦿ Many brain injuries can affect the communication between neurons at the network level.
- ⦿ For example, although injury can happen in a part of the brain that doesn't control balance, because the brain is so interconnected, damage to one part can interfere with the communication network of other parts of the brain and thus have an impact on balance.

Treatment

For a **mild brain injury (concussion)**, the focus is on symptom management such as:

- ⊙ Rest
- ⊙ Gradual transition back to secondary school/university or work
- ⊙ Treatment of headaches
- ⊙ Avoid multitasking and stress
- ⊙ Reduce amount and complexity of cognitive tasks

If symptoms persist, post concussive syndrome may be diagnosed and the adolescent may need to see a neurologist, or another health care professional specializing in diagnosis and management of post concussion syndrome.

As the adult figure, it's important that you ensure the young person doesn't reinjure their brain after a concussion. Therefore, activities such as sports should be avoided at all costs for they can lead to a more serious injury.

For **moderate to severe brain injury**, an accurate assessment of the brain's function is necessary because it allows health professionals to design the most appropriate rehabilitation program.

Since the brain can undergo many changes following a brain injury, it's important to have a detailed evaluation of a person's overall performance after the injury. For example, it may be beneficial to have an appointment with a specialist such as a speech-language pathologist, occupational therapist and a neuropsychologist. These professionals will conduct different types of tests that involve computer based evaluations and some will require real life skills assessment, such as travelling or shopping. This will help the health care team design a specific and uniquely tailored treatment plan, which will also help them to measure improvement over time.

An important part of getting help is through a neuropsychological assessment. This type of assessment examines how the brain works. The adolescent will talk with a neuropsychologist to describe how the brain injury has affected their life. For example, it may have affected their thinking skills, emotional control or social skills. The adolescent will also complete a series of written or computer based tests that measure different brain functions. The results are then interpreted by a neuropsychologist. A neuropsychological assessment can provide information on a variety of different brain functions, such as:

- | | |
|---------------------------|---|
| ⊙ Attention/concentration | ⊙ Problem solving |
| ⊙ Memory | ⊙ Academic abilities |
| ⊙ Thinking speed | ⊙ Social, emotional and behavioural functioning |
| ⊙ Language | ⊙ Planning and organizational skills |



Quick fact: Following a brain injury, a student's academic performance may change because the brain functions differently and some abilities may be reduced. Therefore, the student's learning style may need to be changed. School accommodations or course modifications may be required to help the student reach their potential and minimize frustration.

When a youth with a brain injury decides to return to school, the results of the assessments that had been done should be shared with the school and used to develop appropriate academic accommodations, adaptations, and, if necessary, design an individual program plan. These plans usually rely on using the student's strengths to compensate for deficits, providing support for memory, organization and modifying academic expectations. It's important for not only family members and health professionals to monitor the adolescent's behaviour, but teachers and other educators to monitor them as well.

Potential problems followed by helping suggestions:

Problem	Helping
You may notice the student's concentration and attention span to be very short.	Allow for more time for task completion. A quiet, non-distracting environment can also help with this problem.
The student may have a hard time recalling material and repeating what they have learned.	Using cue cards, rephrasing material in their own words and other mnemonic devices can help with memory and learning.
You may notice the student beginning to have problems speaking and communicating with others.	Refer them to a speech and language therapist to help learn the specific techniques to improve these problems.
You may see the student get more anxious or tired throughout the day.	Allow for more frequent breaks to deal with these uncomfortable behaviours. Excuse them from class when necessary,
You may begin to notice that it takes the student longer to think things through and complete tasks.	Allow for more time to complete tasks and assignments. Outside help (such as a tutor) may be necessary.
The student's personality or behaviour can change, sometimes radically, depending on the injury.	The student may benefit from receiving behavioural support at home and school. Sometimes psychological treatment or medication will be needed.

Return to play process

No one should ever return to play on the same day as an injury - regardless of level of athletic performance. After symptoms are no longer experienced, a gradual (supervised) **return to play process** can begin. If any signs or symptoms return during the **return to play process**, the adolescent must be re-evaluated by a physician before trying any activity again. It is extremely important to note that symptoms may not always occur during an activity, they can occur following the activity or even the next day.

The steps to return to play are:

- 1** No activity, until symptom free
- 2** Light aerobic exercise (this could include walking, yoga or tai chi) - no resistance training
- 3** Sport-specific exercise (for example - running in soccer or skating in hockey)
- 4** No contact drills
- 5** Full contact training after medical clearance
- 6** Return to game play

Concussions can be prevented. While accidents happen, as adults we can do a lot to minimize the damage done by protecting our youth and being good role models.

Some tips to concussion prevention include:

- ⦿ Ensure they wear a seat belt while driving in the car
- ⦿ Act as a role model, wear the proper equipment, don't use alcohol or drugs while driving a vehicle (or bike)
- ⦿ Create awareness and educate youth on the affects of brain injury
- ⦿ Be sure they wear equipment that fits correctly
- ⦿ Promote the coach's rules for safety and rules of sport
- ⦿ Ensure they use the right equipment for game, position or activity
- ⦿ Promote fair play and sportsmanship



Quick fact: If you think someone may have suffered a concussion, it's important they do not return to play the same day of the injury - regardless of the level of athletic performance.

Depression is one of the most common mental disorders in young people, especially those who have suffered a brain injury. In some cases the effects of a concussion can mimic depression and often enough, the side effects of a concussion may cause the youth to develop depression.

Some signs of depression to watch for include:

- ⊙ Lack of interest or pleasure in once enjoyed activities
- ⊙ Minimal motivation
- ⊙ Lack of energy
- ⊙ Difficulty speaking
- ⊙ Frequent headaches
- ⊙ Appetite or weight changes
- ⊙ Irregular sleep patterns (too much or too little)

It's likely the adolescent will feel low after a concussion; it will get better over time once the brain heals. To help speed up the recovery process and keep their mind off the injury, get them to try out these during the recovery process:

Exercise:

20-30 minutes of walking every day

Eating:

Healthy foods like fruits and vegetables and lots of water

Drugs:

Avoid all drugs and alcohol, don't keep anything around the house

Social activities:

Spend time with them every day, help them stay positive

Light:

Get them outside, keep them out of the dark gloomy areas where the side-effects of depression could increase

Sleep:

Be sure they get at least 8 hours of sleep each night

Talk:

If you feel comfortable, talk to them about how they are feeling, see if they will open up to you in ways you can help

Quick fact: Researchers estimate that 90 per cent of all injuries are predictable and preventable. Not wearing a helmet increases the risk of a brain injury dramatically.



Brain injury during adolescence is most common while playing contact sports. These injuries can sometimes have permanent and severe consequences. For example, sports such as hockey, football, soccer, rugby and boxing have a high number of reported brain injuries. It's important that athletic organizations work to improve players' safety by ensuring the proper equipment is being worn and the rules are revised to ensure the safety of the players.

As adults , you are responsible for:

- ⦿ Making sure the proper equipment is being used
- ⦿ Ensuring the equipment is being worn properly
- ⦿ Ensuring the equipment is up to date and safe
- ⦿ Ensuring the equipment meets certification standards

If these recommendations are followed, it can help prevent brain injury, but does not mean it won't occur.



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BE SUPPORTIVE!



Quick fact: For young athletes, it's better to miss one or more games than the whole season. Take the proper precautions and listen to the doctor. Do not go allow them to go back to play until the doctor says it's safe.

If you are a parent/coach and suspect that an adolescent may have suffered a mild brain injury (concussion), it's important that you:

DO	DON'T
<ul style="list-style-type: none">• Check for symptoms• Take the adolescent for a medical check-up	<ul style="list-style-type: none">• Do not allow the adolescent to go back to playing until they have medical clearance

It can be easy for family members to get overwhelmed and so preoccupied with the brain-injured adolescent that they forget to take care of themselves. In particular, parents in an attempt to keep on trying to stay strong for their loved one, may neglect to give themselves a break. Having a family member with a brain injury can be demanding on the family, it's important to:

- Strive to maintain a balanced lifestyle to help cope with the stress
- Seek professional help, such as therapy or counseling, if the stress becomes problematic



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Professional assistance can help you learn more healthy ways to cope with the situation more positively. Your health care providers should be able to give you a list of resources in the community where you can get help.

For more information:

General information about the teen brain and teen mental health:
www.teenmentalhealth.org
www.brainline.org

Brain injury and school: a problem solving system for students with brain injury
www.projectlearnnet.org

Brain injury guides for educators:
www.bced.gov.bc.ca/specialed/docs/moe_abi_resource_rb0116.pdf

Brain Injury Association of Canada
www.biac-aclc.ca

Medical care after brain injury
www.tbirecoverycenter.org/treatment.htm

Sport Concussion Assessment Tool (SCAT)
www.cces.ca/en/files-116

Books:

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CONCUSSION AWARENESS

Definition:

A head-trauma-induced alteration in mental status that may or may not involve a loss of consciousness.

*People who have lost consciousness have a concussion or worse!
A person does not need to lose consciousness to have a concussion!*

A concussion may be caused by a direct blow to the head, face, neck or anywhere else on the body that causes a severe and sudden movement to the head.

COMMON SIGNS AND SYMPTOMS

Symptoms are often subtle

- headache
- pressure in head
- neck pain
- dizziness
- balance problems
- nausea and vomiting
- vision problems
- hearing problems/ringing
- “don’t feel right”
- feeling “dinged” or “dazed”
- confusion
- feeling slowed down
- feeling like in “a fog”
- drowsiness
- fatigue or low energy
- more emotional than usual
- irritability
- difficulty concentrating
- difficulty remembering

PREVENTION - Reduce the risk of brain injury:

1. Appropriate protective equipment should be worn properly and replaced when damaged. Approved helmets should be used in all activities with a risk of head trauma.
2. Adhere to the rules of the sport or activity. Play fair and play smart!
3. Respect all participants.

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www.impacttestcanada.ca



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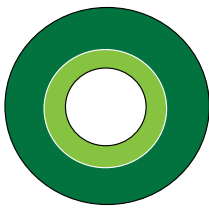
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