



## Concussion in the young



SPORTS MEDICINE

Recognition of concussion can be difficult in young people as the symptoms and signs are non-specific.

PROFESSOR GARY BROWNE

**T**ONY is a previously well 14-year-old elite male rugby player.

He presents with his parents, following a head-to-head clash with another player four days prior. He was allowed to continue to play, despite complaining of progressively worsening ringing in ears, headache and dizziness.

After the game, Tony had no memory of the accident. As he did not lose consciousness during the tackle, it was felt he could not have had a concussion and he was taken home to 'sleep it off'.

However, Tony's parents are concerned as "he is still not quite right". He keeps asking them to repeat themselves as if he does not comprehend what they are saying.

He went to school two days after the game, but during the day, he appeared to 'collapse' at his desk.

Afterwards, Tony appeared stable, fully alert and oriented, and moving around normally.

He was taken to the local ED, where he was evaluated and told he had a concussion and had no need of further investigation. He was discharged home to rest and told to go to his GP in 48 hours for review.

On presentation, Tony has an awkward clumsy gait, is complaining of headache, poor balance, inability to concentrate and seems extremely anxious. He says he has never had concussion before.

### Introduction

Most children with concussion first go to their primary care provider for treatment.

### Definitions

Concussion is a type of brain injury that occurs as a result of a direct impact to the head or an impact to the body that causes transmission of forces to the head and brain. It results in short-lived neurological impairment, with symptoms that may evolve over hours to days following the injury.

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**A loss of consciousness is not necessary for the diagnosis of concussion and is in fact reported in fewer than 8% of all concussions.**

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### Recognition

Recognition of concussion can be difficult in young people as the symptoms and signs are non-specific, and may be subtle.

Suspect a concussion following a knock to the head or body, even if trivial, if the young person complains of symptoms such as headache, dizziness, vertigo or imbalance, lack of awareness of surroundings, as well as nausea and vomiting.

This may be associated with other signs of concussion, such as confusion, amnesia of the traumatic event, a brief seizure, or difficulty with balance or walking.

A loss of consciousness is

brain tissue displacement and shear injury.

These properties can amplify the complex neuro-metabolic cascade that follows a concussion injury.

The immature brain is, therefore, more vulnerable to secondary insults such as second impact syndrome and potential for prolonged recovery.

Further, the prefrontal cortex, the region responsible for executive function, is particularly vulnerable to injury in adolescence.

### Initial assessment

Any young person suspected of a concussion — no matter how trivial the episode — should be immediately removed from the field of play.

If no medical personnel are available for evaluation, the family should attend the local ED or family GP in a timely manner.

Important in the acute stage is the exclusion of rare but life-threatening entities, such as intracranial haemorrhage, extradural haema-

toma, cervical spine injury and skull fracture.

When more severe or life threatening injury is suspected, stabilise using ABC trauma principles and call an ambulance.

If the young person appears stable, they can then be assessed for concussion on the sideline.

The sideline examination, for assessing both symptoms and signs, can be conducted using the SCAT3 tool for adolescents or Child-SCAT3 for children. The presence of any one symptom or sign of concussion should raise suspicion for concussion and warrants automatic banning from further participation in the game.

If concussion is diagnosed, the young person should be systematically re-evaluated at 15-minute intervals to ensure their condition stabilises.

Educating the young person being sent home and the caregiver to report and monitor for any features of deterioration is critical. At home,

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parents should monitor for the development of any of the features of HEAD BUMPS (Headache, Eye trouble, Abnormal behaviour, Dizziness, Balance dysfunction, Unsteady on feet, Memory impaired, Poor concentration, Something's not quite right).

Should any of these symptoms occur, or if the patient's condition is progressively worsening, urgent medical assistance should be sought.

### Re-evaluation in primary care

The GP is commonly called upon to assess concussion in their surgery. Initially, the diagnosis of concussion needs to be verified by carefully documenting the history of recent head impact together with symptoms and signs of concussion that have followed. Differential diagnoses of concussion, such as heat illness, migraine headache or even benign positional vertigo, should be considered.

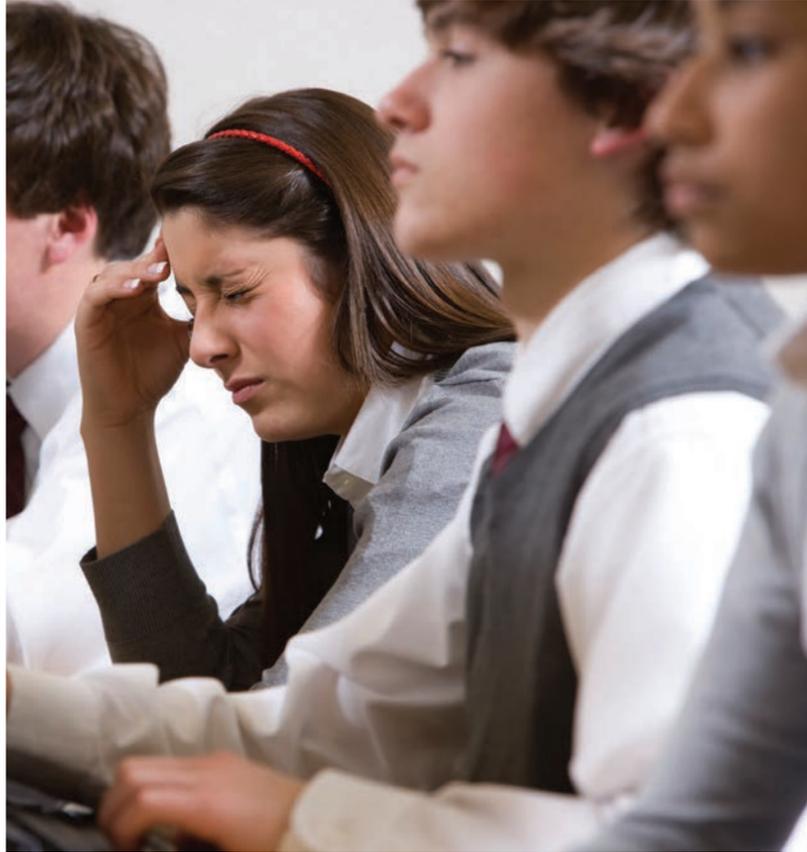
Concussion is a clinical diagnosis based on the four pillars of concussion evaluation: history, physical examination with neurological exam, balance and cognitive testing.

The assessment begins with a careful history of the mechanism of injury, the patient's symptoms, and asking about potential factors or comorbidities that may impact on recovery.

It is typical for a young person's symptoms to fade or stabilise during the acute post-injury period. Increasing symptom severity should raise concern for underlying serious brain injury.

## BOX 1. CONCUSSION CLINICAL DOMAINS

<b>Somatic</b>	<ul style="list-style-type: none"> <li>• Headache</li> <li>• Nausea/Vomiting</li> <li>• Sensitivity to light/noise</li> <li>• Visual problems</li> <li>• Fatigue</li> <li>• Dazed, Stunned</li> <li>• Dizzy, Balance problems</li> </ul>
<b>Cognitive</b>	<ul style="list-style-type: none"> <li>• Feeling mentally "foggy"</li> <li>• Feeling slowed down</li> <li>• Answer questions slowly</li> <li>• Difficulty concentrating</li> <li>• Forgetful of event</li> <li>• Repeats questions</li> <li>• Drop academic performance</li> </ul>
<b>Emotional</b>	<ul style="list-style-type: none"> <li>• Irritability</li> <li>• Sadness/Depression</li> <li>• Personality change</li> <li>• Anxiety/panic</li> <li>• More emotional</li> <li>• Less emotional (apathy)</li> </ul>
<b>Sleep</b>	<ul style="list-style-type: none"> <li>• Drowsy</li> <li>• Sleeping more</li> <li>• Sleeping less</li> <li>• Difficulty falling/staying asleep</li> </ul>



By the time the young person has presented to their primary care physician, the Glasgow Coma Scale should be normal. Post-traumatic amnesia should have resolved by this stage, but if prolonged, more serious injury should be considered.

The patient can be asked the so-called Maddocks questions, which assess attention and memory. The Abbreviated Westmead Post-Traumatic Amnesia Scale is now widely used to assess for amnesia.

General physical exam is important, including orthostatic vital signs, as autonomic instability may manifest with symptoms such as postural dizziness.

The standard neurological assessment includes examination of the cranial nerves and cervical spine, looking for focal changes. Focal neurological findings, such as abnormal pupillary responses, abnormal extraocular movements, and abnormal motor or sensory functions, raise suspicion of serious brain injury and warrant immediate referral.

Abnormalities in the gaze and vestibular systems are common following a concussion.

Testing of gaze and vestibular functions are collectively known as the vestibular ocular motor screening (VOMS) test.

One of the most consist-

ent findings in concussion is postural instability, and it is tested by observing the patient's ability to maintain balance when standing. Gait examination is also assessed, although deficits or changes are often subtle. The Romberg and Tandem Romberg tests should be performed, as these are more sensitive for subtle postural changes in young people.

Neurocognitive testing (NCT) can reveal impaired cognitive function, and can also demonstrate sequential recovery.

While comprehensive NCT in primary care is impractical, an abbreviated form using the SCAT framework is less time-consuming and

can provide valuable clinical information about memory and executive function.

### Management in primary care

Anticipatory guidance is the mainstay of management in primary care.

Reassurance, education about the injury and brief psychological counselling in the early phase can reduce the risk for later development of post-concussion syndrome.

Rest is the initial intervention and is best used as needed and as tolerated, but not overdone. Severe and prolonged restriction of activity, referred to as "cocoon therapy" can prolong symptoms.

Controlled activity (cognitive and physical) in patients with rapidly resolving symptoms should be considered. Provided the patient's activity remain below the symptom threshold in which a patient is still injured but not producing a detectable clinical syndrome, then progressive challenges with controlled activity can improve symptom tolerance.

In the young person with a typical concussion, imaging is unnecessary. Evidence suggests that CT scanning has little advantage over simple observation, even in the primary care context. Concussion management can be best framed into three distinct phases. Each phase is defined by the current clinical experience of the individual patient. These time frames are only estimates, and often are longer in younger persons and in those with complicating comorbid diagnosis.

### Acute rest phase; 2-5 days

Acute symptoms because of their severity, significantly limit both cognitive and physical activities. A brief period of physical and cognitive rest is initially recommended. During this phase, the young person is typically unable to tolerate routine activities of daily living. This is also the best time to set expectations for recovery.

Total resolution of symptoms at this stage is not necessary prior to resuming school. It is, however, important to balance cognitive exertion and cognitive rest. If done well, most young people will be absent from school for only 2-3 days.

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Supportive care is critical, including a healthy diet and good nutrition, adequate hydration, avoiding skipping meals and good sleep hygiene. Symptoms such as headache, nausea and sleep disturbance can be addressed with medications just as they would in non-concussed patients

**Relative rest phase; 5-7 days**

The young person is symptomatic, but not to a degree that consistently limits routine activity. This phase heralds the beginnings of physiological recovery, with cognitive and exercise tolerance, although not to pre-injury levels.

Returning to school is the focus, although at this stage cognitive stamina is limited. The introduction of reading, computer work and schoolwork within symptom threshold is now appropriate. As a general rule, most young people are ready to return to school once they are asymptomatic or can comfortably tolerate more than 30 minutes of cognitive activity.

Medications used to control concussion symptoms should begin to be tapered

**BOX 2. RISK FACTORS FOR A PROLONGED RECOVERY**

- History of prior concussion
- Younger age
- Headache
- Fogginess
- On-field loss of consciousness, post-traumatic amnesia, > 5minutes of alteration in mental state
- History of prior headaches
- History of prior learning disability or cognitive/attentional problems
- Dizziness



and be limited at this stage. Facilitated low-impact exercise may be reintroduced.

**Graduated exertion phase; 7-14 days**

The young person should no longer be using medications for concussion-related symptoms. They should have completed a full return-to-learning program, and be ready to undergo an active process of return to play. The activity plan should proceed with a minimum of 24 hours spent at each level.

There should be at least 14

days from when symptoms resolve before returning to full contact sport (after medical clearance).

Most patients with concussion will have symptoms resolve in response to cognitive and physical rest, and they will be able to gradually increase cognitive and physical activity over the course of no more than 3-4 weeks.

**Secondary assessment**

A proportion of patients (15-20%) have symptoms that do not resolve with appropriate intervention. Patients

with this atypical recovery should be referred to a specialist clinic, if possible.

**Tony's outcome**

Although Tony's standard neurological examination excluded serious injury, focused concussion evaluation revealed significant abnormalities. His symptom score was 46 (out of a possible 132) including headache and photophobia.

He performed poorly on the VOMS, complaining of double vision with significant accommodative deficit,

with each manoeuvre precipitating headache, dizziness and nausea.

He had significant balance dysfunction and deficits in short-term memory.

A diagnosis of concussion is confirmed and a further 48 hours of rest is recommended. Paracetamol is also advised, along with a healthy diet, fluids and sleep. Tony is also to avoid all screens including mobile phones until the next visit. Tony and his parents are reassured recovery is likely, but gradual.

After 48 hours, Tony returns for a follow-up visit. He has improved significantly. He has tolerated light cognitive activity. He continues to be active with routine physical activity and has no symptoms related to this. He now accelerates his return to school and is encouraged to resume regular aerobic activity below symptom threshold.

He returns in another week and has re-engaged with school fully without difficulty, his symptom score is 6 and his focused concussion assessment has returned to his normal pre-injury baseline.

You recommend he start a return-to-play program, which he should complete over the next week.

At two weeks post-injury, Tony has returned fully to all activities both cognitive and physical.

You advise that now he is asymptomatic, he can return to full contact rugby in two weeks.

There is strong evidence that in young people, a concussion that is managed well and results in full recovery over the expected time frame is unlikely to result in any long-term problems. ●

**Professor Gary Browne is medical director of concussion service at the Children's Hospital Institute of Sports Medicine, Children's Hospital at Westmead and Sydney Children's Hospital Network.**

References on request.

This article is one in a series on brain injury, in association with Brain Injury Australia [www.braininjuryaustralia.org.au](http://www.braininjuryaustralia.org.au)

More information for parents and doctors can be found at: [www.sitoutconclusion.org.au](http://www.sitoutconclusion.org.au)



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