



BOTTOM LINE RECOMMENDATIONS:

Concussion

Concussion is “a traumatic brain injury, induced by biomechanical forces”.¹ Concussion results from acceleration and deceleration forces which 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. Loss of consciousness and amnesia are **not required** for a diagnosis of concussion.

Note: Tools in this document are found in the *Guidelines for Diagnosing & Managing Pediatric Concussion: Recommendations for Health Care Professionals (GDMPC-HCP)* available on the *Ontario Neurotrauma Foundation* website.

SYMPTOMS

- » Somatic symptoms include headache, nausea, loss of balance & dizziness.
- » Cognitive symptoms include feeling in a 'fog', difficulty concentrating/remembering & confusion.
- » There can also be emotional and/or behavioural changes and sleep disturbances.

ASSESSMENT OF CHILDREN PRESENTING WITH CONCUSSION²

HISTORY

- » The acute event » Symptoms » Interval history » Social history » Medications
- » Medical history (concussions, migraine, ADHD/learning disorders)

Symptom inventories: [SCAT5](#) most widely used tool but may be too comprehensive for ED setting.

PHYSICAL EXAMINATION³

- » Gait & Romberg's testing » Social history » Fundoscopy
- » Neurological examination » HEENT and neck examination » [Glasgow Coma Scale \(GCS\)](#)
- » Balance examination using modified [Balance Error Scoring System \(page 5, step 4\)](#)

DETERMINE THE NEED FOR CT IMAGING

- » Head CT is appropriate if a clinically important intracranial injury (epidural or subdural) is suspected. See [CATCH2](#) rule for more information⁴.
- » Need for CT can routinely be eliminated based on the PECARN rule⁵ (page 53 of the [GDMPC-HCP](#)).
- » Head CTs are not used routinely as they are NORMAL in concussion (same as in adults).

DETERMINE RISK OF PERSISTENT POSTCONCUSSION SYMPTOMS (PPCS)⁶

- » Assess risk of symptoms lasting one month or longer using 5P criteria (see Table 1) to aid in counselling.
- » Risk score: Low (0-3), Moderate (4-8), High (9-12)

CRITERIA FOR SAFE DISCHARGE HOME

- » Patients and caregivers should monitor symptoms daily.
- » Combined with clinical judgment, home observation is safe if::
 - » Normal mental status with improving symptoms.
 - » No risk factors indicating need for CT scan or normal CT scan if already done.
 - » No indications for prolonged hospital observation including worsening symptoms, bleeding disorders, multisystem injuries or comorbid symptoms.

CRITERIA FOR HOSPITAL ADMISSION OR PROLONGED OBSERVATION

- » Consider admission or prolonged observation if '**red flag**' symptoms:
 - » Increasing confusion or irritability
 - » Convulsions
 - » Neck pain
 - » Repeated vomiting
 - » Unusual behavioural change
 - » Change in state of consciousness
 - » Focal neurologic symptoms
 - » Worsening headaches
 - » Slurred speech

Table 1: 5P Criteria for PPCS Risk⁶

PPCS Risk Factor	Categories	PTS
Age Group	5 to 7	0
	8 to 12	1
	13 to 18	2
Sex	Male	0
	Female	2
Longest Symptom Duration	No Prior or <1 week	0
	1+ week	1
Personal History of Migraine	No	0
	Yes	1
Answers Questions Slowly	No	0
	Yes	1
Tandem Stance	0-3	0
	4+, or unable to do test	1
Headache	No	0
	Yes	1
Sensitivity to Noise	No	0
	Yes	1
Fatigue	No	0
	Yes	2

TREATMENT OF PEDIATRIC CONCUSSION

- » Along with rest recommendations below, it is important to manage sleep hygiene and hydration.
- » The mainstay of concussion treatment is **physical and cognitive rest**.
- » Most children recover within 2 weeks although post-concussive symptoms persist after 1 month in up to 30%.⁷

COGNITIVE REST²

- » Most children require a 24-48 hour break from school followed by gradual return to full academic/cognitive activities.

Table 2: Return-to-School Strategy¹

Stage	Aim	Activity	Goal of each step
1	Daily activities at home that do not cause or increase symptoms	Typical activities of the child during the day as long as they do not increase symptoms (e.g. reading, texting, screen time). Start at 5-15 minutes at a time and gradually build up.	Gradual return to typical activities.
2	School activities	Homework, reading, or other cognitive activities outside of the classroom.	Increase tolerance to cognitive work.
3	Return to school part-time	Gradual introduction of schoolwork. May need to start with a partial school day or with increased breaks during the day.	Increase academic activities.
4	Return to school full-time	Gradually progress.	Return to full academic activities and catch up on missed school work.

PHYSICAL REST^{1,2}

- » An initial period of 24-48 hours of rest is recommended before starting a stepwise, graduated return to physical activity.
- » Patients may begin light physical activity even if symptoms are present as long as the symptoms are tolerated; activities that increase risk of falls or collision are **not** permitted until stage 5 (see below).
- » If the patient experiences new symptoms or worsening symptoms at any stage, they should go back to the previous stage.
- » It is important that children have fully returned to full-time school activities before progressing to stage 5 and 6 (full contact practice and full competition).
- » All athletes require medical clearance prior to returning to full sports contact activities.

Table 3: Graduated Approach to Return to Physical Activity¹

Stage	Aim	Activity	Goal of each step
1	Symptom-limiting activity	Daily activities that do not provoke symptoms.	Gradual re-introduction of work/school activities.
2	Light aerobic activity	Walking or stationary cycling at slow to medium pace. No resistance training.	Increase heart rate.
3	Sport-specific exercise	Running or skating drills. No head impact activities.	Add movement.
4	Non-contact training drills	Harder training drills (e.g. passing drills). May start progressive resistance training.	Exercise, coordination, and increased thinking.
5	Full contact practice	Following medical clearance.	Restore confidence and assess functional skills by coaching staff.
6	Return to sport	Normal game play.	

SYMPTOMATIC TREATMENT

- » Analgesia for headache (NSAIDS or acetaminophen) and use of sunglasses, ear plugs or noise-cancelling headphones.

The purpose of this document is to provide healthcare professionals with key facts and recommendations for the diagnosis and treatment of concussion in children. This summary was produced by the concussion content advisor for the TREKK Network, Dr. Roger Zemek of the Children's Hospital of Eastern Ontario, and uses the best available knowledge at the time of publication. However, healthcare professionals should continue to use their own judgment and take into consideration context, resources and other relevant factors. The TREKK Network is not liable for any damages, claims, liabilities, costs or obligations arising from the use of this document including loss or damages arising from any claims made by a third party. The TREKK Network also assumes no responsibility or liability for changes made to this document without its consent. This summary is based on:

- 1) McCrory P et al. [Consensus statement on concussion in sport – the 5th international conference on concussion in sport held in Berlin, October 2016](#). *Br J Sports Med*. 51(11), 838-847 (2017).
- 2) Zemek R, Duval S, DeMatteo C et al. [Guidelines for Diagnosing and Managing Pediatric Concussion \[Internet\]](#). Toronto, ON: Ontario neurotrauma Foundation; 2014 June [accessed 2014 Nov 28].
- 3) Guskiewicz KM. [Assessment of postural stability following sport-related concussion](#). *Current Sports Medicine Reports*. 2003; 2: 24 – 30
- 4) Osmond M, Klassen TP, Wells G.A., et al. [Validation and refinement of a clinical decision rule for the use of computed tomography in children with minor head injury in the emergency department](#). *CMAJ*. 190(27), 816-822 (2018).
- 5) Kuppermann N, Holmes JF, Dayan PS et al. [Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study](#). *Lancet*. 374 (9696): 1160-1170 (2009).
- 6) Zemek R, Barrowman N, Freedman SB, et al. [Clinical Risk Score for Persistent Postconcussive Symptoms Among Children with Acute Concussion in the ED](#). *JAMA*. 2016;315(10):1014-1025.
- 7) Davis GA, Anderson V, Babl FE, et al. [What is the difference in concussion management in children as compared to adults? A systematic review](#). *Br J Sports Med*. 2017;51(12):949-957.