

Concussion

Concussion is a traumatic brain injury¹ resulting from acceleration/deceleration forces from 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 to make the diagnosis. Tools in this document are found in the Living Guideline for Pediatric Concussion Care available at pedskoncussion.com.

Symptoms

- » Physical/somatic symptoms include headache, nausea, loss of balance, and/or dizziness.
- » Cognitive symptoms include feeling in a 'fog', difficulty concentrating/remembering, and/or confusion.
- » There can also be emotional (anxiety, depression) changes, behavioural issues, and/or sleep disturbance.

Initial Assessment²

HISTORY & PHYSICAL EXAMINATION³

- » Record the acute event, symptoms (initial and ongoing), past medical history (concussions, migraine, ADHD/learning disorders), medications, social history.
- » Assess Glasgow Coma Scale (GCS), balance (Balance Error Scoring System), HEENT, neck, neurological exam including gait, Romberg's testing, vestibular-ocular exam. [[Training video for the vestibular-ocular exam.](#)]
- » Use [Living Guideline PedsConcussion Physical Examination](#) and printable [Medical Assessment Letter](#).

DETERMINE NEED FOR NEUROIMAGING

- » Order Head CT if a clinically important intracranial injury is suspected using [PECARN](#) and/or [CATCH 2](#) rule.^{4,5}
- » Head CTs and MRIs are not used routinely as they are NORMAL in concussion.

DETERMINE RISK OF PERSISTENT POSTCONCUSSION SYMPTOMS (PPCS)⁶

- » Assess risk of symptoms lasting one month or longer using 5P criteria (see Table 1 below) to aid in counselling.
- » Refer children at higher risk for persistent symptoms ([5P risk score](#) ≥ 6) to a medically supervised interdisciplinary concussion team for early intervention, if available. Otherwise, primary care provider should coordinate referrals (e.g., physiotherapy, occupational therapy, and/or mental health) for ongoing rehabilitation, as required.

Table 1: PPCS Risk Factors: 5-P risk score: Low (0-3), Moderate (4-8), High (9-12).

PPCS Risk Factor	Age (years)			Sex		Duration of Prior Concussion		Personal History of Migraine		Answers Questions Slowly		Tandem Stance Errors		Headache		Sensitivity to Noise		Fatigue	
<i>Categories</i>	5-7	8-12	13-18	Male	Female	No Prior or <1 week	1+ week	No	Yes	No	Yes	0-3	4+, or unable to do test	No	Yes	No	Yes	No	Yes
Points	0	1	2	0	2	0	1	0	1	0	1	0	1	0	1	0	1	0	2

Patient Disposition

- » Strongly consider admission or prolonged ED observation in patients with increasing or persistent confusion/irritability, worsening headache, persistent vomiting, ongoing seizures, focal neurologic symptoms/signs, prolonged altered level of consciousness, history of bleeding disorder, and/or multisystem injuries.
- » Discharge patients with normal mental status and improving symptoms, no risk factors indicating need for CT scan (or normal CT scan, if performed), no indications for prolonged hospital observation.
- » Discharge patients with written instructions on when to return to ED/primary care provider.

Treatment

- » Counsel physical and cognitive rest for 24-48 hours then gradual individualized return to physical/cognitive activities. Complete rest for more than 24-48 hours may contribute to prolonged recovery.²
- » Avoid contact sports/activities that risk repeat concussion until full return to school without concussion-related academic accommodations, AND medical clearance for full-contact sport and high-risk activities.
- » Most children recover within 2-4 weeks, although 30% may have persistent post-concussive symptoms after 1 month.⁸
- » Recommend medical follow-up 1-2 weeks following the acute injury or earlier if symptoms worsen. Initiating clinical care early (within 8 days) is associated with improved recovery times.⁷

COGNITIVE REST AND RETURN TO SCHOOL²

Children with concussion require a 24-48 hour break from school followed by gradual return to full academic activities. Children should return to school when they feel able to resume academic activities that do not exacerbate symptoms (with adequate accommodations in place). Medical clearance is not required to return to school, and gradual return should be encouraged as soon as possible, even if they are still experiencing symptoms. Prolonging the return to school may be detrimental to recovery. Complete absence from the school environment for more than one week is not recommended.

Table 2: Return-to-School Strategy¹

Stage	Aim	Activity	Goal of each step
1	Complete rest (24-48 hours maximum)	Encourage mental rest for the first 24-28 hours after concussion. Avoid schoolwork, screen-time, work, and driving. Activities such as crafts, board games, and talking on the phone are suggested.	Limit activities that may increase the heart rate or make symptoms worse.
2	Daily activities at home that do not worsen symptoms or bring on new symptoms	Typical activities 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.
3	School activities	Homework, reading, or other cognitive activities outside of the classroom.	Increase tolerance to cognitive work.
4	Return to school part-time	Medical clearance is not required to return to school. Gradual introduction of schoolwork with academic accommodations. May need to start with a partial school day or with increased breaks during the day. Any school activity that may lead to hitting their head or body contact should be avoided.	Increase academic activities.
5	Return to school full-time	Gradually progress. Reduce concussion-recovery related academic accommodations as symptoms improve.	Return to full academic activities and catch up on missed school work.

PHYSICAL REST AND RETURN TO ACTIVITY^{1,2}

Initiate 24-48 hours of rest before starting a step-wise return to physical activity. Light physical activity should be started even if symptoms are present as long as the symptoms are tolerated and do not worsen. Activities that increase risk of injury are not permitted until Stage 5 (see Table 3 below). If new symptoms or worsening symptoms develop at any stage, return to the previous stage. Resume step-wise return as tolerated, with the goal of avoiding prolonged rest. Children must have returned to full-time school without concussion-related accommodations before progressing to Stages 5 and 6. All patients require medical clearance before progressing to Stage 5.

Table 3: Return-to-Activity Strategy¹

Stage	Aim	Activity	Goal of each step
1	Complete physical rest (24-48 hours maximum)	Light daily activities around the house.	Limit activities that may increase the heart rate or make symptoms worse.
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 and/or acetaminophen).
- » Physiotherapy for cervicogenic headache and/or vestibular therapy.
- » Counsel families/primary care teams that early Cognitive Behavioural Therapy referral for emotional/behavioural symptoms are important for optimal recovery.
- » Counsel regarding the importance of hydration and sleep hygiene. Melatonin can be considered for sleep problems.
- » The use of sunglasses, ear plugs, and/or noise-cancelling headphones may also be helpful.

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, Drs. Roger Zemek and Jennifer Dawson of CHEO, 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. (2017). [Consensus statement on concussion in sport - 5th international conference in sport held in Berlin, October 2016](#). *Br J Sports Med*. 51(11), 838-847.
- 2) Reed, N.*, Zemek, R.*, Dawson, J., Ledoux, AA., et al. (2021). [Living Guideline for Pediatric Concussion Care](#). *these two authors contributed equally.
- 3) Osmond M, Klassen TP, Wells G.A., et al. (2018). [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.
- 4) Kuppermann N, Holmes JF, Dayan PS et al. [Identification of children at very low risk of important brain injuries after head trauma: a prospective cohort study](#). *Lancet*. 374 (9696): 1160-1170.
- 5) Zemek R, Barrowman N, Freedman SB, et al. (2016). [Clinical risk score for persistent postconcussive symptoms among children with acute concussion in the ED](#). *JAMA*. 315(10):1014-1025.
- 6) Lumba-Brown A, Yeates KO, Sarmiento K, et al. (2018). [Centers for disease control and prevention guideline on the diagnosis and management of mild traumatic brain injury among children](#). *JAMA Pediatr*. 172(11):e182853.
- 7) Kontos AP, Jorgensen-Wagers K, Trbovich AM, et al. (2020). [Association of time since injury to the first clinic visit with recovery following concussion](#). *JAMA Neurol*. 77(4):435-440.

