Paediatric Progress: How should it change your practice?

Primary care management of concussion in Canada

Michael J. Ellis MD FRCSC^{1,2,3}, Shannon Bauman MD CCFP(SEM) Dip. Sport Med^{4,5,6},
Stephanie Cowle BA⁷, Pamela Fuselli MSc⁷, Charles H. Tator MD PhD FRCSC^{8,9}

¹Department of Surgery and Pediatrics and Child Health, Section of Neurosurgery, University of Manitoba, Winnipeg, Manitoba; ²Children's Hospital Research Institute of Manitoba, Winnipeg, Manitoba; ³Pan Am Concussion Program, Winnipeg, Manitoba, Canada; ⁴Department of Surgery and Department of Family Medicine, Royal Victoria Regional Health Care Centre, Barrie, Ontario; ⁵Department of Community and Family Medicine, University of Toronto, Toronto, Ontario; ⁶Concussion North, Barrie, Ontario; ⁷Parachute Canada, Toronto, Ontario; ⁸Department of Surgery, Division of Neurosurgery, University of Toronto, Toronto, Ontario; ⁹Canadian Concussion Centre, Toronto Western Hospital, Toronto, Ontario

Correspondence: Michael J. Ellis, Pan Am Clinic, Pan Am Concussion Program, 75 Poseidon Bay, Winnipeg, Manitoba R3M 3E4. Telephone 204-925-1527, fax 204-927-2770, e-mail mellis3@panamclinic.com

Abstract

Concussion has emerged as an important public health issue affecting thousands of Canadians annually. Health care providers including paediatricians, family and emergency medicine physicians, nurses, and nurse practitioners are commonly tasked with the responsibility of providing primary care to patients with acute concussion and those with persistent post-concussion symptoms. In July 2017, Parachute, in collaboration with the Public Health Agency of Canada and Sport Canada released the *Canadian Guideline on Concussion in Sport* that outlines a standardized and evidence-based approach to the recognition, diagnosis, and management of youth and adults with suspected concussion. In this report, we provide a brief overview of the important roles of primary care providers in the medical assessment, management, and prevention of concussion as outlined in this national best practice guideline.

Keywords: *Canada; Canadian Guideline on Concussion in Sport; Concussion; Primary care; Public health.*

Concussion is a form of traumatic brain injury (TBI) that can result from a variety of mechanisms including sports, motor vehicle collisions, work, and school-related activities. Concussion is caused by the transmission of biomechanical forces to the brain that results in alterations in brain functioning that are usually temporary (1). Failure to properly identify, diagnose, and manage concussions can lead to premature return to activities with a risk of recurrent head injury leading to prolonged symptoms and, in rare circumstances, fatal or disabling brain injuries resulting from second impact syndrome (2).

Over the past decade, there has been a significant increase in the number of Canadians seeking medical attention in primary care and emergency department settings for concussion (3). As a consequence, it is important for primary care providers, including paediatricians, family and emergency medicine physicians, nurses, and nurse practitioners to be up to date with

respect to current best practices and Canadian evidence-based guidelines. In July 2017, Parachute, in collaboration with the Public Health Agency of Canada, Sport Canada and national sport, health, and education stakeholders released the *Canadian Guideline on Concussion in Sport*, which provides a clinical framework and resources to assist in the standardized evaluation and evidence-based management of Canadian youth and adults with a suspected concussion (Figure 1) (4). Although the Guideline was developed based on a review of the current scientific evidence and international expert opinion related to sport concussion (1), this standardized approach should be applied to all Canadians who sustain a concussion during any setting and are returning to school, work, and sport activities. Here, we provide a brief overview of the important roles of the primary care provider in the initial medical assessment, management, and prevention of concussion in the context of this

Figure 1. The Canadian Sport Concussion Pathway (Source: Canadian Guideline on Concussion in Sport. 2017. www.parachutecanada.org).

new national best practice guideline. This review also provides an update to the previous position statement published by the Canadian Paediatric Society (5).

MEDICAL ASSESSMENT

The *Canadian Guideline on Concussion in Sport* recommends that all youth and adult athletes with a suspected concussion should be immediately removed from play and undergo urgent referral for medical assessment by a medical doctor or nurse practitioner (4). A concussion should be suspected in any individual who sustains a blow or impact to the head, face, neck, or body and demonstrates any visual signs of concussion

or reports any of the symptoms of concussion (Table 1). Whether the patient undergoes initial consultation in an emergency department or an office setting, the purpose of the medical assessment is to determine whether a concussion or other injury has occurred and provide clear discharge instructions to patients and their families including information about return to school, work, or play.

The diagnosis of concussion is a clinical diagnosis based on symptoms and signs because at present there is no biological marker that is sufficiently accurate to diagnose a concussion in an individual patient (6). Patients who sustain a concussion can present with a wide spectrum of physical, cognitive, sleep, and emotional symptoms that are nonspecific in nature.

Table 1. Concussion symptoms, visual signs of concussion, and red flags

Symptoms	Headaches or head pressure** Dizziness Nausea and vomiting Blurred vision Sensitivity to light Sensitivity to sound Balance problems Neck Pain Fatigue or low energy Feeling slowed down	Feeling like 'in a fog' 'Don't feel right' Difficulty concentrating Difficulty remembering Confusion or drowsiness Sadness Nervousness or anxiety Irritability Feeling more emotional
Visual signs	Loss of consciousness or responsiveness* Lying motionless on ground/slow to get up Unsteady on feet, balance problems or falling over, incoordination Seizure*** Facial injury after trauma	Grabbing/clutching head Dazed, blank or vacant look Confused, not aware of plays or events Clutching head
Red flags	Neck pain Increased confusion or irritability Seizure or convulsion*** Weakness or tingling/burning in arms or legs	Deteriorating conscious state Severe or increasing headache Unusual behaviour Double vision

Sources: Concussion Recognition Tool 5. 2017. <https://bjsm.bmj.com/content/bjsports/47/5/267.full.pdf>; Canadian Guideline on Concussion in Sport Pre-season Concussion Education Sheet. 2017. www.parachutecanada.org.

*A patient does not need to be knocked out (lose consciousness) to have had a concussion.

**Although headaches associated with concussion can be heterogeneous, the typical headache that accompanies acute concussion is often described as a mild to moderate, global, pounding, throbbing, or dull headache. This description is different than the severe, thunderclap-like or progressively worsening headache that is characteristic of patients with intracranial hemorrhage, such as sub-arachnoid or intracerebral hemorrhage.

***Patients that present with convulsions or seizures should be initially evaluated at the nearest emergency department and considered for referral to a neurologist or neurosurgeon for comprehensive management.

Therefore, to diagnose a concussion, a primary care provider must independently and reliably rule out more severe forms of TBI, cervical spine injury, and other neurological or medical conditions. To accomplish these essential tasks requires the primary care provider to complete a thorough clinical history, perform a focused physical examination, and consider diagnostic imaging studies on an individual patient basis. Clinical history details collected from the patient, parents, or witnesses should include the mechanism of injury, the presence of any 'red flags', experienced at the time of injury and details regarding any subsequent sideline or medical assessments (see Table 1). Pre-existing conditions that can impact concussion recovery and should be assessed include a history of previous concussions, migraine, or nonspecific headaches, attention-deficit hyperactivity disorder, learning disorders, mood disorders, and previous cervical spine injuries. It is important to assess the nature and severity of the patient's current symptoms, which can be accomplished through a clinical interview and the administration of a validated age-appropriate symptom inventory such

as the post-Concussion Symptom Scale included in the Sport Concussion Assessment Tool-5 (SCAT5) or Child SCAT5 (1).

The physical examination should include assessment of level of consciousness and mental status (Glasgow Coma Scale) as well as cranial nerve, motor, sensory, reflex, cerebellar, balance, and gait testing. In addition, an assessment of cervical spine range of motion and central and paraspinal tenderness should be performed. In some cases, features of the clinical history may prompt additional physical examination testing. For instance, patients who present with vertigo or dizziness may be screened for benign paroxysmal positional vertigo using the Dix-Hallpike test or undergo vestibulo-ocular reflex testing using the head thrust test (7).

Concussion can also result in disturbances in cognitive functioning including memory, processing speed, reaction time, and attention (8). Screening of concentration and memory by the primary care provider can be accomplished using brief tests included in the SCAT5 and Child SCAT5 (1). If postinjury neurocognitive or neuropsychological testing is deemed necessary,

it is recommended that these tests be interpreted by a neuropsychologist (8–10).

The majority of patients presenting with concussion will not require any diagnostic imaging, however imaging should be considered in cases where a structural brain or spine injury is suspected. Computerized tomography imaging of the head should be limited to the emergency department setting and be guided by evidence-based clinical decision-making rules (11–13). Cervical spine imaging should be considered in patients presenting with severe neck pain or focal neurological deficits localized to the cervical spine (e.g., bilateral hand paresthesias), a dangerous mechanism of injury, or decreased range of motion and central neck tenderness on physical examination (13,14). Magnetic resonance imaging of the brain should be considered in patients who present in the sub-acute phase of injury in the office setting with focal neurological deficits, post-traumatic seizures, and worsening headaches that have not responded to treatment to rule out any structural causes for these clinical presentations (i.e., intracranial hemorrhage, mass lesions).

CONCUSSION MANAGEMENT

Once the primary care provider has completed the medical assessment, the *Canadian Guideline on Concussion in Sport* recommends that all patients with a suspected concussion be provided with a standardized *Medical Assessment Letter* that clearly communicates the assessment findings and recommendations to the patient and their parents (http://www.parachutecanada.org/downloads/injurytopics/Medical-Assessment-Letter_Parachute.pdf). Patients who are deemed not to have had a concussion or other injury should be provided with this *letter* indicating they are cleared to return to school, sport, and work activities without restriction. In contrast, patients diagnosed with a concussion should be provided the *letter* stating this diagnosis and indicating that the patient should avoid any activities with a risk of head injury but be allowed to begin participating in school, work, and low-risk activities at a level that does not bring on or worsen the patient's symptoms.

All patients diagnosed with a concussion should be provided general information about the symptoms of concussion, strategies about how to manage symptoms, the correct pathway for returning to sports with proper medical clearance, and recommendations about steps that can be taken to ensure a gradual return to school, work and sport activities. The *Canadian Guideline on Concussion in Sport* recommends that all student-athletes diagnosed with a concussion be managed according to standardized Return-to-School and the Return-to-Sport Strategies. The Return-to-School Strategy is a new addition to the 5th International Consensus Statement on Concussion in Sport and provides a four-step outline that allows students to partner with parents and school stakeholders to promote a gradual return to school activities (Table 2). Following a brief,

initial 24–48 hours of rest, patients should also be advised to make a gradual return to physical exercise and sport-specific activities by following the six-step Return-to-Sport Strategy that is specific to the sport they are returning to (Table 2). It is no longer recommended that concussed patients maintain physical and cognitive rest until all symptoms have subsided prior to re-engaging in school and physical exercise. However, if a patient experiences new or worsening symptoms at any stage of these strategies they should be encouraged to go back to the previous stage. Concussed students must return to full-time school activities prior to progressing to Stage 5 and 6 of the Return-to-Sport Strategy. The recovery process for each patient should be supervised by the primary care provider through frequent follow-up visits and can be facilitated by providing patients with the *Canadian Guideline on Concussion in Sport Medical Clearance Letter* which outlines activities they are medically cleared to participate in and can be given by the patients or parents to coaches and teachers. (http://www.parachute-canada.org/downloads/injurytopics/Medical-Clearance-Letter_Parachute.pdf). Adult patients with concussion should be encouraged to work with their employer to make a safe and gradual return to work activities.

At present, there is no objective test to confirm physiological recovery following concussion. Patients should be considered to be clinically recovered when they are asymptomatic at rest (or back to their preinjury state in patients with pre-existing condition such as migraines or mood disorders), are tolerating full-time school and work without symptoms, have a normal neurological examination and have tolerated noncontact sport practices without any symptoms, where applicable. Athletes who meet these criteria can be considered for medical clearance to return to full-contact practices (Stage 5) and game play (Stage 6). Prior to returning to full-contact sport practices and game play, athletes should be provided with the *Medical Clearance Letter* specifying that the primary care provider has personally evaluated and medically cleared the athlete to return to these activities.

In remote or northern communities with limited access to medical doctors, a trained nurse with prearranged access to a medical doctor or nurse practitioner can perform the medical assessment, manage concussion patients, and complete the *Medical Assessment Letter* and *Medical Clearance Letter*.

MULTIDISCIPLINARY CONCUSSION CARE

Although the majority of youth and adults who sustain a concussion will make a complete recovery within weeks of injury with proper guidance through the Return-to-School and Return-to-Sport Strategies, approximately 15 to 30% will experience persistent post-concussion symptoms (PPCS). PPCS are defined as those that persist for greater than 2 weeks in adults or greater than 4 weeks in youth (1). Patients with PPCS

Table 2. Return-to-school and sport strategy

Stage	Aim	Activity	Goal of each step
Return-to-School Strategy			
1	Daily activities at home that do not give the student-athlete 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 min 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
Return-to-Sport Strategy			
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	Noncontact 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 and complete return to school	Restore confidence and assess functional skills by coaching staff
6	Return to sport	Normal game play	

Source: McCrory et al. (1).

should be considered for referral to a physician-supervised multidisciplinary concussion clinic that may be a single facility or a network of health care providers who provide consolidated and coordinated evaluation and treatment. High-quality multidisciplinary concussion clinics can be recognized by the presence of a medical doctor with expertise and training in concussion and TBI such as a sports medicine physician, rehabilitation medicine physician, neurologist or neurosurgeon who is ideally on-site and works with other licensed health care professionals with expertise in disciplines such as neuropsychology, physiotherapy, and occupational therapy (15). At these clinics, multidisciplinary therapeutic interventions can be initiated to target the underlying causes of PPCS including vestibulo-ocular dysfunction, cervical spine dysfunction, exercise intolerance, migraine and post-traumatic headaches, mood disorders as well as sleep and cognitive dysfunction (16–19). Multidisciplinary concussion clinics are also ideal for making retirement from sport recommendations in select cases (20,21).

In regions of Canada without access to a multidisciplinary concussion clinic, a referral to a medical doctor with clinical training and experience in concussion (e.g., a sport medicine physician, neurologist, or rehabilitation medicine physician)

should be considered for the purposes of developing an individualized treatment plan.

Prevention

Primary care providers can also play an important role in optimizing concussion prevention such as by encouraging all patients and community sport and school stakeholders to undertake annual concussion education using the *Canadian Guideline of Concussion in Sport Pre-season Concussion Education Sheet* (Free to download here: http://www.parachutecanada.org/downloads/injurytopics/PreSeason-Education-Sheet_Parachute.pdf). Primary care providers can also encourage athletes to practice good sportsmanship, wear appropriate protective equipment including helmets, as well as support ongoing initiatives to enact youth sport concussion legislation in their provinces (22,23). Primary care providers play an important role in secondary prevention by providing timely access to standardized concussion care to prevent adverse outcomes such as second impact syndrome and the development of PPCS. Despite being marketed by various health care providers in Canada, there is insufficient evidence to recommend preseason baseline testing for youth

and adult athletes using any concussion assessment tools (10). Although widespread baseline neurocognitive testing is not recommended in youth athletes (8,10,24,25), this may be considered in athletes with pre-existing conditions (learning disorders, attention-deficit hyperactivity disorder, previous concussions). Given the myriad of factors that impact the results of neurocognitive and neuropsychological testing in patients with concussion, it is recommended that whenever these tests are preformed they should be interpreted by a clinical neuropsychologist (8). Lastly, primary care providers working with multidisciplinary experts in concussion and TBI are ideally positioned to recommend sport retirement in patients with a high volume of concussions, structural brain injuries, or persistent deficits.

CONCLUSION

Primary care providers including paediatricians, family and emergency medicine physicians, nurses, and nurse practitioners play an important role in the recognition, assessment, management, and prevention of concussion among Canadian youth and adults. The Canadian Guideline on Concussion in Sport provides primary care providers with important recommendations and resources to help guide the standardized assessment and medical management of patients with acute concussion and PPCS.

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