

In the sports literature, the effects of traumatic biomechanical forces on the brain have traditionally been referred to as a concussion. In this Guideline, the term concussion/mTBI will be used to maintain consistency within this document.

A sport-related concussion/mTBI is a traumatic brain injury that may be caused by either a direct blow to the head, face, neck or elsewhere on the body as an indirect force being transmitted to the head during sports activity. A sport-related concussion/mTBI can result in a range of clinical signs and symptoms that may or may not involve a loss of consciousness. While the injury may result in neuropathological changes, the acute clinical signs and reported symptoms largely reflect a functional disturbance rather than a structural injury. Sport-related concussion/mTBIs often present without neurological signs, and can cause a variety of symptoms making the injury complex and potentially difficult to assess and manage. Due to rapidly changing clinical signs and symptoms in the acute phase, sport-related concussion/mTBIs are considered to be among the most complex injuries in sports medicine to diagnose, assess and manage.¹ Sport-related concussion/mTBIs can occur in any population playing sport. A concussion/mTBI injury is more likely to occur when the force or impact suffered is not anticipated by the athlete. Concussion/mTBI's are more likely to occur in contact sports, with the highest incidences (excluding combat sports) being in soccer, football, ice hockey, rugby and basketball.^{2,3} However, non-sport-related concussion/mTBI's also occur in athletes, and can impact their return-to-sport as well. The majority of sport concussion/mTBI symptoms in adults resolve within 10-14 days, although the recovery time frame may be longer in children and adolescents.^{1,3-5} For more information on the management of concussion/mTBI in children and adolescents aged 5-18 years please see the [ONF Guidelines for Pediatric Concussion](#).

Accurate diagnosis, management, and return-to-sport decisions are essential at all levels of participation (i.e., amateur to professional) and for all types of sport. Experts unanimously agree that any player suspected of having experienced a concussion/mTBI should be immediately removed from play, must not return to the game or practice and should be referred for Medical Assessment.^{2,6}

Concussion/mTBI can be recognized in the community by all sport stakeholders including athletes, parents, coaches, officials, teachers, trainers, and licensed healthcare providers, however a formal diagnosis should be made by a physician following a thorough medical assessment. Athletes with a sport-related concussion/mTBI may require onsite (on-field) medical assessments by emergency medical professionals for a more severe head injury, cervical or spine injury, or loss of consciousness.

In cases in which a concussion/mTBI is suspected without a more severe head or spine injury, a player should be removed from the field of play and a sideline assessment can be performed. The Concussion in Sport Group has created a revised Sport Concussion Assessment Tool (SCAT5 and the Concussion Recognition Tool 5, presented in [Appendix 3.1](#) and [Appendix 3.2](#) respectively)³ to aid with this; these tools can also be used during sideline evaluation and include information that can be handed to the athlete. If a player shows any of the signs or symptoms of a concussion/mTBI outlined in [Table A](#), concussion/mTBI should be suspected and a referral for a comprehensive evaluation and medical assessment is required.^{1,4,6}

Athletes diagnosed with a concussion/mTBI should be provided with education about the signs and symptoms of concussion/mTBI, strategies about how to manage initial symptoms, guidance on how to gradually return to school, work, and sport, and risks of returning to sport before a concussion/mTBI has resolved and without medical clearance.⁶ Historically, most consensus statements and guidelines have recommended that concussed athletes rest until they are symptom-free, and prescribed physical and cognitive rest had been a mainstay of care in this population. However, there is currently insufficient evidence that that prescribing complete rest is beneficial for recovery. Therefore, after a brief period of rest during the acute phase (24-48 hours) after injury, patients should be encouraged to become gradually and progressively more active while not increasing symptoms. In fact the term relative rest is more appropriate as patients may partake in activity in the initial stages as long as symptoms do not worsen. A reasonable approach involves the gradual return to daily tasks, school, and light physical activity in a way that does not result in a significant exacerbation of symptoms. Vigorous exertion or return to contact sport should be avoided while athletes are recovering.¹

Most athletes who sustain a sport-related concussion/mTBI will make a complete recovery in 1-4 weeks after injury. However, athletes who do not recover within this time frame may benefit from a referral to a physician with experience in concussion/mTBI in a medically-supervised interdisciplinary concussion clinic that has access to professionals with licensed training in mTBI. Individualized medical and rehabilitative care will be provided for the athlete and medical clearance is required before the athlete can return-to-sport.⁶ The *Buffalo Concussion Treadmill Test* ([Appendix 3.3](#)) can be used to investigate exercise tolerance in people with persistent symptoms.

Healthcare professionals should counsel amateur athletes with a history of multiple concussion/mTBIs and subjective persistent neurobehavioural impairments about the risk of further concussion/mTBIs, prolonged symptoms and slower recoveries. Return-to-sport and retirement decision-making in patients with persistent symptoms and multiple concussion/mTBIs requires an individualized approach within an interdisciplinary healthcare team. This may involve a clinical neuropsychologist with certified training in the administration of comprehensive neuropsychological testing, consideration for neuroimaging, and a physician with experience in sport concussion/mTBI management. Considerations for retirement from play: multiple concussion/mTBIs >3, increasing duration of symptoms, subsequent concussion/mTBIs requiring lesser force, inability to return to full-time school or work.^{7,8}

It should be noted that sport-related concussion/mTBI represents one area of study in the mTBI field. Given that the current guideline is not specific to sport-related injuries, the information and guidance included herein for acute and subacute management is limited. Thus, readers interested in further guidance on the assessment and management of concussion/mTBIs in this specific patient population should consult the latest [Consensus Statement on Concussion in Sport: the Fifth International Conference on Concussion in Sport held in Berlin, October 2016](#)¹, [American Academy of Neurology Evidence-based Guideline for Clinicians: Evaluation and Management of Concussion in Sports](#)⁷, the [Concussion Management Guidelines for Certified Athletic Therapists in Quebec](#)⁹, or the [Canadian Guideline on Concussion in Sport](#).⁶ Many sports organizations also formally provide specific guidance and recommendations that are unique to their sport and parallel the principles of existing guidelines; this information can provide further clarity and assistance when making decisions about how to proceed with progressive return to an activity/sport (see resource links in [Appendix F](#)). Further, as discussed above, differences exist between the nature of injuries sustained during sport compared with other types of injuries. Therefore, the application of clinical guidance for sport-related concussion/mTBI may not be appropriate for patients who have sustained other types of injuries.

Table 3.1. Concussion Modifiers

Factors	Modifier
Symptoms	Number Duration (> 10 days) Severity
Signs	Prolonged LOC (> 1 min), amnesia
Sequelae	Concussive convulsions
Temporal	Frequency (i.e., repeated concussions over time) Timing (i.e., injuries close together in time) “Recency” (i.e., recent concussion/TBI)
Threshold	Repeated concussions occurring with progressively less impact force or slower recovery after each successive concussion
Age	Child and adolescent (< 18 years old)
Co- and Pre-morbidities	Migraine, depression or other mental health disorders, attention deficit hyperactivity disorder (ADHD), learning disabilities, sleep disorders
Medication	Psychoactive drugs, anticoagulants
Behaviour	Dangerous style of play
Sport	High-risk activity, contact and collision sport, high sporting level

Adapted from McCrory P, Meeuwisse W, Dvořák J, et al. Consensus statement on concussion in sport. *Br J Sports Med* 2017;51:838-847

Table 3.2. Graduated Return-to-Sport Strategy

Stage	Aim	Activity	Goal of each step
1	Symptom-limited activity	Daily activity that does not provoke symptoms.	Gradual reintroduction of work/school activities
2	Light aerobic exercise	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, co-ordination and increased thinking
5	Full-contact practice	Following medical clearance, participate in normal training activities.	Restore confidence and assess functional skills by coaching staff
6	Return to sport	Normal game play.	

NOTE: An initial period of 24–48 hours of both relative physical rest and cognitive rest is recommended before beginning the RTS progression.

There should be at least 24 hours (or longer) for each step of the progression. If any symptoms worsen during exercise, the athlete should go back to the previous step.

Resistance training should be added only in the later stages (stage 3 or 4 at the earliest). If symptoms are persistent (e.g., more than 10–14 days in adults or more than 1 month in children), the athlete should be referred to a healthcare professional who is experienced in the management of concussion.

Adapted from McCrory P, Meeuwisse W, Dvořák J, et al. Consensus statement on concussion in sport. *Br J Sports Med* 2017;51:838-847

GENERAL RECOMMENDATIONS FOR ASSESSMENT AND MANAGEMENT OF SPORT-RELATED CONCUSSION

		GRADE
3.1*See Note	<p>Patients with sport-related concussion may develop symptoms acutely or sub-acutely. If any one of the following signs/symptoms are observed/reported at any point following a blow to the head, or elsewhere on the body leading to impulsive forces transmitted to the head, concussion should be suspected and appropriate management instituted.</p> <ol style="list-style-type: none"> 1. Any period of loss of or decreased level of consciousness less than 30 min 2. Any lack of memory for events immediately before or after the injury (post-traumatic amnesia) less than 24 hours 3. Any alteration in mental state at the time of the injury (e.g., confusion, disorientation, slowed thinking, alteration of consciousness/mental state) 4. Physical symptoms (e.g., vestibular, headache, weakness, loss of balance, change in vision, auditory sensitivity, dizziness) <p>Note: No evidence of intracranial lesion on standard imaging (if present, it is suggestive of more severe brain injury)</p> <p>Refer to Table A for a comprehensive list of signs for possible concussion.^a</p>	C

*Note that this definition was adapted for the purposes of this guideline. For the definition of Concussion as defined by the 2017 Concussion in Sport please visit [HERE](#).

a. Adapted from McCrory P, Meeuwisse W, Dvořák J, et al. Consensus statement on concussion in sport. *Br J Sports Med* 2017;51:838-847

3.2	<p>When a player shows any symptoms or signs of a Sport-Related Concussion (SRC):</p> <ol style="list-style-type: none"> The player should be medically evaluated by a physician or other licensed healthcare professional onsite using standard emergency management principles and particular attention should be given to excluding a cervical spine injury. The appropriate disposition of the player must be determined by the treating healthcare professional in a timely manner. If no healthcare professional is available, the player should be safely removed from practice or play and urgent referral to a physician arranged. Once the first-aid issues are addressed, an assessment of the concussive injury should be made by a healthcare professional using a sideline assessment tool (e.g., SCAT5 - Appendix 3.2). Non-medical professionals should use the <i>Sport Concussion Recognition Tool</i> (Appendix 3.3). The player should not be left alone following the injury, and serial monitoring for increasing symptoms or signs of deterioration is essential over the initial few hours after injury with the aim of detecting an evolving injury. A player with suspected SRC should not be allowed to return-to-play on the day of injury.^b 	A (a) C (b-e)
3.3	The need for early neuroimaging should be determined according to the Canadian CT Head Rule (Figure 1.1). For patients who fulfill these criteria, CT scanning is the most appropriate investigation for the exclusion of neurosurgically significant lesions, such as hemorrhage. Plain skull x-rays are not recommended.*	A
3.4	<p>There is currently insufficient evidence that prescribing complete rest may ease discomfort during the acute recovery period by mitigating post-concussion symptoms and/or that rest may promote recovery by minimizing brain energy demands following concussion.</p> <ul style="list-style-type: none"> An initial period of rest in the acute symptomatic period following injury (24-48 hours) may be of benefit. After a brief period of rest, a sensible approach involves the gradual return to school and social activities (prior to contact sports) as tolerated (i.e., in a manner that does not result in a significant or prolonged exacerbation of symptoms. See Table 12.2).^a 	A
NEW 3.5	Schools, teachers, family members, coaches and athletes should be educated on concussion risk factors/ risks.	C
3.6	A range of “modifying” factors may influence the investigation and management of concussion and, in some cases, may predict the potential for prolonged or persistent symptoms. These modifiers would be important to consider in a detailed concussion history and should be managed in an interdisciplinary manner by healthcare professionals with experience in sport-related concussion (see Table 3.1). ^b	C
3.7	Primary care providers should perform a clinical neurological assessment (including evaluation of mood, mental status/cognition, oculomotor function, gross sensorimotor, coordination, gait, vestibular function and balance) on all concussed athletes as part of their overall management (see Appendix 3.4). ^a	C
RECOMMENDATIONS FOR RETURN-TO-PLAY		
3.8	Return-to-play (RTP) protocol following a concussion follows a stepwise process as outlined in Table 3.2 . With this stepwise progression, the athlete should continue to proceed to the next level if asymptomatic at the current level. Generally, each step should take 24 hours so that an athlete would take approximately 1 week to proceed through the full rehabilitation protocol once they are asymptomatic at rest and with provocative exercise. If any post-concussion symptoms occur while in the stepwise program, then the patient should drop back to the previous asymptomatic level and try to progress again after a further 24- hour period of rest has passed. ^c	C
3.9	If pharmacotherapy is used, then an important consideration in return-to-sport is that concussed athletes should not only be free from concussion-related symptoms, but also should not be taking any pharmacological agents/medications that may mask or modify the symptoms of SRC. When pharmacological therapy is begun during the management of an SRC, the decision to return-to-play while still on such medication must be considered carefully by the primary care provider. ^a	C

* NOT AN ORIGINAL RECOMMENDATION - REPEAT OF 1.3

a. Adapted from McCrory P, Meeuwisse W, Dvořák J, et al. Consensus statement on concussion in sport. *Br J Sports Med* 2017;51:838-847

b. Taken from McCrory P, Meeuwisse W, Dvořák J, et al. Consensus statement on concussion in sport. *Br J Sports Med* 2017;51:838-847

c. Adapted from McCrory P, Meeuwisse WH, Aubry M, et al. Consensus statement on concussion in sport: the 4th International Conference on Concussion in Sport held in Zurich, November 2012. *British Journal of Sport Medicine*. 2013;47(5):250-8.

RESOURCES

APPENDICES		
1	Sport Concussion Assessment Tool (SCAT5)	Appendix 3.1
2	Concussion Recognition Tool 5	Appendix 3.2
3	Buffalo Concussion Treadmill Testing	Appendix 3.3
4	Important Components of a Neurological Exam	Appendix 3.4
5	Other Links/Resources to Consider	Appendix F
Figures		
1	Canadian CT Head Rule	Figure 1.1
TABLES		
1	Common Symptoms of mTBI	Table A
2	Concussion Modifiers	Table 3.1
3	Graduated Return-to-Sport Strategy	Table 3.2
4	Stepwise Approach to Return-to-Work Planning for Patients with Concussion/mTBI	Table 12.2

References

1. McCrory P, Meeuwisse W, Dvořák J, et al. Consensus statement on concussion in sport. *Br J Sports Med.* 2017; 51:838-847
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4. Makdissi M, Cantu RC, Johnston KM, McCrory P, WH. M. The difficult concussion patient: what is the best approach to investigation and management of persistent (>10 days) postconcussive symptoms? *British Journal of Sport Medicine* 2013;47:308-313.
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