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## **DIAGNOSIS CLINICAL CRITERIA OF SPORT RELATED CONCUSSION: TOWARD AN OPERATIONAL CRITERIA DEFINITION IN FRANCE**

### **CRITERES DIAGNOSTIQUES CLINIQUES DE LA COMMOTION CEREBRALE EN PRATIQUE SPORTIVE : VERS UNE DEFINITION OPERATIONNELLE EN FRANCE**

Titre résumé : **DIAGNOSIS CRITERIA OF SPORT RELATED CONCUSSION**

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Abstract :

Objective:

An expert working group was set up at the initiative of the Ministry of Sports with the objective of harmonizing the management of sport related concussion (SRC) in France, starting with its definition and diagnosis criteria

Results:

**Definition:** A clinical definition in 4 points have been establish as follow: Concussion is a brain injury:  
1) caused by a direct or indirect transmission of kinetic energy to the head  
2) resulting for an immediate and transient dysfunction of the brain characterized by at least one of the following disorders: a) Loss of consciousness , b) loss of memory , c) altered mental status, d) neurological signs; 3) Possibly followed by one or more functional complaints (concussion syndrome);  
4) The signs and symptoms are not explained by another cause

**Diagnosis criteria:** In the context of the direct or indirect transmission of kinetic energy to the head, the diagnosis of concussion may be asserted if at least one of the following signs or symptoms, observed or reported, is present within the first 24 hours and not explained by another cause: 1) loss of consciousness; 2) convulsions, tonic posturing; 3) Ataxia; 4) visual trouble; 5) neurological deficit; 6) confusion; 7) disorientation; 8) unusual behaviour; 9) amnesia; 10) headaches; 11) dizziness; 12) fatigue, low energy; 13) feeling slow down, drowsiness; 14) nausea; 15) sensitivity to light/noise; 16) don't feel right, in a fog; 17) difficulty concentrating.

Conclusion:

Sharing the same definition and the same clinical diagnostic criteria for concussion is the prerequisite for common rules of management for all sports and should allow the pooling of results to improve our knowledge of this pathology.

Key words: Sport related concussion – diagnosis criteria – concussion syndrome - mTBI

## Résumé

### Objectif:

Un groupe de travail a été mis en place à l'initiative du ministère des Sports dans le but d'harmoniser les conditions de prise en charge des commotions cérébrales liées au sport (SRC) en France. La première partie du travail a porté sur la définition et les critères diagnostiques

### Résultats:

Définition: Une définition clinique en 4 points a été établie comme suit: La commotion cérébrale est une blessure du cerveau: 1) secondaire à la transmission directe ou indirecte d'une énergie cinétique à la tête ; 2) entraînant une dysfonction cérébrale immédiate et transitoire caractérisée par au moins l'un des troubles suivants: a) perte de connaissance, b) amnésie, c) altération de l'état mental, d) signes neurologiques; 3) possiblement suivie d'une ou plusieurs plaintes fonctionnelles (syndrome commotionnel); 4) Les signes et symptômes ne sont pas expliqués par une autre cause

Critères diagnostiques: Dans le cadre de la transmission directe ou indirecte d'une énergie cinétique à la tête, le diagnostic de commotion cérébrale peut être retenu si au moins l'un des signes ou symptômes suivants, observés ou rapportés, est présent dans les 24 premières heures et non expliqué par une autre cause: 1) perte de connaissance; 2) convulsions, crise tonique; 3) ataxie; 4) trouble visuel; 5) déficit neurologique; 6) confusion; 7) désorientation; 8) comportement inhabituel; 9) amnésie; 10) maux de tête; 11) vertiges, étourdissements; 12) fatigue, faible énergie; 13) sensation de ralentissement, somnolence; 14) nausée; 15) sensibilité à la lumière et/ou au bruit; 16) ne se sent pas bien, dans le brouillard; 17) difficulté à se concentrer.

### Conclusion:

Le partage d'une même définition et des mêmes critères diagnostiques clinique pour la commotion cérébrale est la condition préalable à la mise en place de recommandations communes de prise en charge pour tous les sports et devrait permettre la mutualisation des résultats pour améliorer notre connaissance de cette pathologie.

## 1. Introduction

An expert working group was set up at the initiative of the Ministry of Sports with the objective of harmonizing the management of sport related concussion (SRC) in France. The first step was to establish common diagnostic criteria for this pathology whatever the sport performed, preamble to the establishment of shared management recommendations.

Diagnosis of SRC requires to review the problem of its definition. The term concussion is generally used for mild traumatic brain injury (mTBI) occurring during sports, while in another context, mTBI is preferred. There is still a debate about whether these terms are synonymous or not (1). The conditions of the diagnosis are in fact different between sports and other situations. In sports, brain injury is observed during practice **and its diagnosis performed usually immediately or the following hours after** practice by healthcare professionals in Elite sports or non-healthcare professionals in community level which represents the majority of the cases. At this stage arises the problem of the immediate return to play for the least severe forms which are the most frequent and do not justify emergency procedures and transport to the nearest hospital. Conversely, in other situations of traumatic brain injury, the diagnosis is performed in emergency departments. History relies on what the subject reports, or its relative or first aid. At this stage, the diagnosis is usually of little doubt. The medical attention is rather focused on the screening of potential haemorrhage complications who will require a brain CT scanner to diagnose. The other fundamental difference is that in sports, the event that generates a concussion is observed **and the athlete immediately assessed** while on arrival at the hospital, it is only reported **and the subject is examined several hours after the event**. The direct observation of the event and its immediate consequences allows us to describe a precise semiology, the recognition of which leads to an immediate diagnosis, **especially if the people present on and around the field are aware of the phenomenon. This may explain why the definition and diagnostic criteria for concussion in sports bring functional complaints to the fore, whereas in hospital, the criteria are rather established on signs of more severe intensity (amnesia, disorientation of several hours...)**. In both cases however, it is a brain injury that differs perhaps in its severity but requires the same diagnostic clinical criteria to be identified. It seems therefore reasonable to consider the terms concussion and mild brain injury as synonymous with the same diagnostic clinical criteria without considering imaging arguments. It is important to put an end to approximations and to establish reliable and reproducible criteria for diagnosing this first level of severity of brain traumatic injury. Based on this principle, a definition summarizing the definitions of each of these entities (mild brain injury and concussion) is proposed followed by a definition of the clinical criteria for an operational diagnosis of this pathology whatever its context and therefore applicable whatever the sports considered. In the remainder of this document, only the term concussion will be used.

## 2. Definition

The commonly used definition of SRC is that established at successive international consensus conferences on this topic, the latest one being held in Berlin in October 2016 (2). The most commonly accepted definition of mTBI is that of the American Congress of Rehabilitation Medicine (ACMR) in 1993 (3) as well as that of the WHO Collaborating Center Task Force on Mild Traumatic Brain Injury in 2004 (4). Both definitions of mTBI were usefully discussed and weighted, including the interpretation of the diagnostic criteria (5-9).

These three definitions (figure 1) present very similar characteristics **which have been included and thus grouped together in the same definition** in 4 points for SRC:

**Concussion is a brain injury:**

**1) caused by a direct or indirect transmission of kinetic energy to the head**

**2) resulting for an immediate and transient dysfunction of the brain characterized by at least one of the following disorders:**

- Brief loss of consciousness (this is a mild brain injury characterized by a Glasgow Coma Scale score greater than 12 to 30 minutes of the event).
- Loss of memory for events immediately before or after the injury, lasting less than 24 hours from the trauma
- Altered mental status (confusion, disorientation, unusual or inappropriate behavior)
- Neurological signs (convulsions, postural tonic crisis, ataxia, visual disturbance ...)

**3) Possibly followed by one or more functional complaints (concussion syndrome) of variable intensity that are of immediate onset but sometimes delayed in the minutes or hours following the injury, with a spontaneous resolution in less than 2 weeks in adults, and in less than a month in the child.**

**4) The signs and symptoms are not explained by another cause**

This definition brings together the criteria usually used in daily hospital practice, based essentially on clinical signs such as amnesia, loss of consciousness or signs of cognitive impairment, with those used in sports where symptoms (the concussion syndrome) are highlighted. As it is the same type of trauma occurring in different situations, the objective of this work was to group these criteria equally in a single definition in order to take advantage of the clinical and scientific data acquired in these different contexts. Hospital practice is essentially focused on screening for complications by performing or not performing a brain CT-scan, while sports allows observation of immediate signs or symptoms never seen in hospital. For instance, the criteria retained for the realization of a scanner help to define the criteria for requesting medical advice without delay during sports practice and conversely, the observation in sports of the immediate clinical semiology improve the clinical criteria retained for the diagnosis of mild brain trauma in hospital practice.

This definition emphasizes that concussion is related to the transmission of kinetic energy. Indeed, the head connected by the cervical spine to the thorax, never remains motionless. In direct impacts, the head may initially be in motion and decelerate upon impact, or immobile and accelerate. In the absence of a direct impact (indirect transmission in the case of whiplash), the inertial effects secondary to the rapid displacement of the head are at the origin of the brain injury. Kinetic energy is more accurate than "biomechanical" or "external" force sometimes used (3, 4, 7) and thus allow us to exclude injury by penetrating agents which constitute another traumatic entity even if in these cases there is also a transmission of kinetic energy to the head that should not be neglected.

This definition also adds the concussion syndrome as a potential diagnostic criterion with the difficulty that it may be delayed and could be explained by another cause, in particular a psychological reaction to physical or emotional stress (which may be nevertheless associated with concussion).

At least and for practical reasons, imaging is not part of this definition which remains clinical. Imaging (CT scanner) is needed to screen for potential hemorrhagic complications that transform concussions into complicated concussions (10). Imaging is not performed systematically (only for clinical signs of gravity), and therefore can't constitute as such a diagnostic criterion of concussion.

Signs and symptoms of concussion are transient and resolve in less than 15 days in adults and less than one month in children (5). Beyond these delays, it is a persistent concussion syndrome or post-traumatic syndrome (11). Numerous studies have shown that predictive factors for the persistence of signs and symptoms more than a month after mild traumatic brain injury were primarily preexisting neuropsychiatric disorders and that this syndrome do not consistently differ from signs and symptoms sometimes observed in patients with acute injury to a body area other than the head (12).



### 3. Clinical diagnostic criteria

The concussion clinical diagnostic criteria proposed are based on the 4 points of the definition (figures 2a and 2b):

#### 3.1. Concussion is an injury caused by the direct or indirect transmission of kinetic energy to the head

The transmission of a kinetic energy to the head can be confirmed by the followings:

- The direct transmission of mechanical energy to the head can be observed in a collision with the location and the nature of the impact to the head precisely described. The use of video in sport, especially slow motion, helps to accurately identify the impact. The trace of impact to the head or face (wound, hematoma) could secondarily be observed by physical examination
- The indirect transmission to the head can be observed with a rapid and significant head and neck movements or acceleration-deceleration displacements (commonly known as whiplash)
- The transmission of energy to the head can sometimes be strongly suspected with a subject immediately carrying one or both hands to the head after a collision
- The subject itself and/or its surrounding could also spontaneously report a direct or indirect impact to the head

The observation of the transmission of a kinetic energy to the head is not per se a clinical diagnosis criterion of concussion but it is essential for the interpretation of the signs and symptoms leading to its diagnosis. It is important to emphasize at this point that such a finding leads not only to look for a concussion but also for an associated cervical trauma.

#### 3.2. Concussion results in immediate and transient dysfunction of the brain

The dysfunction is immediate with no delay between the event and the disorders occurrence, underlying the importance of being present to be able to observe them. Otherwise, they will be reported with more uncertainty. This point is important as these disorders are transient with a duration ranging from a few seconds to minutes in mild forms. The immediate and transient dysfunction of the brain is characterized by at least one of the following disorders:

- 3.2.1. Loss of consciousness: The loss of consciousness (LOC) is defined as the loss of awareness of the self and the environment. The subject has his eyes closed, does not execute any simple command and is motionless apart from reflex movements. Its observation confirms the diagnosis of concussion. Contrary to popular belief, LOC is not mandatory for the diagnosis of concussion and is only found in the most severe forms, 15 to 20% of SRC (2). In addition, LOC is brief (a few seconds, very often less than a minute) so that the subject is often conscious and able again to communicate with the first aid. When LOC is secondarily reported by the subject or witnesses, it is often misinterpreted with stupor or even anterograde amnesia and therefore its duration cannot be truly evaluated. Their brevity and difficult recognition by a non-healthcare professional explains why he is important to try to detect observable signs of brief LOC at impact during practice. The clinical diagnostic criterion of LOC can be retained if:

- LOC was noted during a physical examination with a subject who keeps his eyes closed, makes no voluntary movement apart from possible reflex movements and do not execute movement at order (such as shaking hands or opening eyes).
- A complete loss of muscle tone at impact has been observed. This loss of muscle tone can take many forms
  - Body fall without reflex protection movements: Most often the body falls forward, the face abruptly striking the ground. The subject may also fall backwards. In the latter case, there is no movement of the upper limbs to protect against the fall and the head hits the ground violently.
  - Cervical hypotonia characterized by one or more uncontrolled movements of the neck before contact of the head with the ground. Slow motion video analysis is valuable for its detection.
  - Sudden fall in sitting position (usually associated with cervical hypotonia) without any delay between impact and fall. The body collapses from the impact in a sitting position and the head does not hit the ground. Better appreciated during video analysis in real speed than in slow motion.
  - Projection of the upper limbs from the impact, above the head with hands violently hitting the ground. It is a shoulders hypotonia with no longer control of the upper limbs movement.
- A prolonged immobility on the ground of the subject from the fall was observed. Immediately from the impact the subject remains totally immobile on the ground for a long time without any voluntary movement (except reflex movements). There is no formal indication of the duration of this immobility but in sport practice, an expert consensus retains a delay of more than 5 seconds, more precisely stated if the video is available. In the context of kinetic energy transmission to the head, complete and prolonged immobility is a good criterion for LOC if no other reason explains it (see point 4 below).

Finally, it is important to stress that concussion is a mild brain injury characterized by a Glasgow-Coma-Scale (GCS) score greater than 12 at 30 minutes from the event from the event

- 3.2.2. Loss of the memory of the facts preceding or following the trauma, remaining less than 24 hours: This criterion is retained if it is observed that the subject does not remember the facts just after the event (anterograde amnesia) and / or facts that immediately preceded it (retrograde amnesia). It will be necessary to review the subject after 24 hours to ensure the disappearance of memory disorders as they must not exceed 24 hours by definition. In sports, the observed memory troubles last usually only few minutes. It is important to specify that the diagnosis of this criterion depends on the delay from the injury and the way it is investigated: the subject can indeed reconstruct the event according to witnesses or video if available. Questions about the description of the event should be avoided in favor of more factual questions: what is the first memory since or before the event? Behavioral or emotional changes must also not be neglected that can generate authentic amnesic states (9).
- 3.2.3. Mental status impairment: The subject does not seem to be in his normal state and has unusual disorders suggestive of brain dysfunction that can take on many aspects. The diagnostic criterion of mental status disorder is retained if the subject:

- Is confused, obsessed: his remarks are unsuited to the situation, he repeatedly repeats the same question (s)
- is dazed, stunned: his gaze is haggard and / or wandering, seemingly not paying attention to the examiner and looking around him for familiar anchor points to reconnect with the present reality
- is disoriented, not fully recognizing his environment and / or the time course of his actions. In practice, this disorder can be assessed by a general orientation score in five simple items, a wrong answer confirming this disorder (figure 3). In team sports practice, the Maddock score is recommended (13)
- Has unusual behavior: the subject is aggressive, irritable, uninhibited or emotional (crying). In sport practice his behavior is abnormal with inappropriate actions in response to a given situation (incorrect or faulty positioning or aptitude to sport practice ...). the subject may spontaneously report being more irritable or nervous

#### 3.2.4. Neurological signs

The neurological signs constituting diagnostic criteria for concussion are as follows (these are the usual signs, the most frequently observed, without pretending to be exhaustive):

- Seizures: brief and repeated involuntary rhythmic muscle contractions, involving one or more limbs, or even the trunk, sometimes associated with abnormal eye movements, are also called convulsive seizures. Exceptional but impressive, they have not related to prognosis or severity. (11, 14)
- Postural tonic crisis: Extension of a limb remaining suspended in the air for a few moments before falling back to the ground, which can be accompanied by a tonic neck rotation. It mainly concerns the upper limb or limbs but sometimes also the lower limb or limbs. (15)
- Balance Disorders (Ataxia): Inability to coordinate voluntary muscular movements. Typically, include difficulty standing or standing up from the floor, standing instability that may require support, abnormal walking that may require assistance. The diagnosis of ataxia criterion is retained if the subject:
  - Starts to get up and fall back to the ground often without protection
  - Gets up in several stages by looking at each step his equilibrium. The movement to get up seems "jerky" but is "continuous». Sometimes the subject crawls on the ground before he can get up. it is not a subject that is slow to get up and observes stops between each step from the lying to the upright position.
  - Has difficulty standing steadily the first second and is forced to step forward or backward to stabilize. This sign is often very transient, but sometimes obvious: the subject seems unable to stand without being supported by one or, most often, two people. In sport practice, this disorder is not to be confused with the habit of the healthcare team accompanying the athlete's exit by surrounding him with an arm.
  - Has an abnormal initial walk: he begins to walk, appearing to be drawn forward, running after his center of gravity, or, seeming to be drawn backwards, walking on his heels. The instability of walking can also cause a leg crossing or a walk swerving on the side
  - The subject may complain of balance difficulties
- Visual troubles: The subject complains of a dazzling sensation on impact, a blurred vision, an abnormally colored vision, an amputated field of view, or even a tunnel vision.

He can also complain about double vision. Examination may reveal pupillary abnormalities (anisocoria) or nystagmus in the lateral gaze.

3.3. The cerebral dysfunction is **possibly followed by one or more functional complaints (concussion syndrome) of variable intensity that are of immediate onset but sometimes delayed in the minutes or hours following the injury, with a spontaneous resolution in less than 2 weeks in adults, and in less than a month in the child.**

Concussion syndrome includes non-specific symptoms classically divided into 4 areas:

- somatic: headache, dizziness, nausea, vomiting, disturbances of balance and asthenia (fatigue)
- cognitive: difficulty of concentration, memory disorders, feeling of being slow down, in a fog, confusion, disorientation ...
- emotional: irritability, emotional lability, anxiety, depressed mood
- relating to sleep: difficulty falling asleep, drowsiness.

The most common symptoms are headache, dizziness, visual and balance troubles, cognitive slowdown, and drowsiness and fatigue (16). Although these symptoms are not specific, their unusual presence following the transmission of a kinetic energy to the head, unexplained by another cause, constitutes a diagnostic criterion for concussion. If the subject presents only one symptom without any other criterion, the diagnostic value of the presence of this symptom must be carefully questioned with regard to the antecedents of the subject and the nature of the event.

The collection of symptoms can be usefully achieved by questionnaires most often used to collect symptoms in the day(s) following the traumatic event. The most used are the SCAT (**Sport Concussion Assessment Tool**) symptom check-list (2) (Figure 4). The Rivermead Post-Concussion Symptoms Questionnaire have been developed more specifically to detect unfavourable evolution (persistent syndrome) (17) (figure 5).

These symptoms not explained by another cause (see below), grouped in a simplified scale into 8 categories for pragmatic reasons, constitute, by the presence of at least one of them immediately after the traumatic event, a diagnostic criterion for concussion. Appearing a few hours apart from the event, or even after a night of rest, they can still constitute a diagnostic criterion for so-called evolutive or delayed clinical expression forms. Nevertheless, if they are isolated (no other signs of brain dysfunction), the clinical interpretation of their presence for diagnostic purposes must be very carefully questioned, looking for all the other reasons that may explain their presence. The simplified symptom checklist is the following:

1. Pressure in head and / or diffuse headache (excluding localized pain at the point of impact)
2. Vertigo and / or dizziness
3. Fatigue and / or unusual low energy
4. Feeling slow down and / or drowsiness
5. Nausea and / or vomiting
6. Sensitivity to light and / or to noise
7. Does not feel well and / or in the fog
8. Difficulty concentrating

3.4. The signs and symptoms are not explained by another cause

The signs and symptoms are not explained by anything other than the transmission of kinetic energy to the head. There are indeed confounding factors such as alcohol, drugs or psychoactive substances. It is also very important to take into account the psychological trauma and the psychological state prior to the event: it may be useful to ask the subject if he was afraid or if he feels stressed or anxious.

#### 4. Diagnostic difficulties and differential diagnosis

The diagnosis of concussion is sometimes difficult to establish, especially when the subject is seen only in the following day(s) after injury.

If the subject is asymptomatic, the diagnosis is based on the subject declaration, rarely accompanied by a witness of the event. The subject may also not have been aware of his disorders and / or minimize or deny them in order to return to play as soon as possible. It is therefore important to carry out a systematic review of the four points of the proposed definition: mechanism, immediate signs, concussion syndrome, confounding factors, in a retrospective search of the diagnostic criteria.

If the subject is symptomatic, the difficulty lies in establishing the causal link between the symptom(s) and the concussion. The interrogation then focuses on studying the temporal course of complaints (presence since the event, decreasing intensity), their unusual nature and the absence of confounding factors such as a personal or family history of migraines, Attention Deficit Disorder, Hyperactivity Disorder, anxiety (2) ...

It is possible at this stage to use different neuropsychological tests such as paper-and-pencil tests (SCAT5) or computerized tests (18). The use of these tests for diagnostic purposes must, however, be very cautious, especially in the absence of baseline data from the subject himself. In general, there is only statistical population data with variations to normal without validation with respect to the pathology.

It has also been proposed to use a definite, probable or possible diagnostic classification that can be confusing (17). The precautionary principle justifies considering as concussed any subject presenting important doubts about one of the proposed criteria.

If there is no trauma certainty, the presence of symptoms should lead to the search for other neurological diseases, such as spontaneous subarachnoid haemorrhage and ischemic stroke, at the very least.

#### 5. Concussion and emergency

The head and the neck are subject to the same biomechanical constraints. A concussion must therefore be always considered as a cervical trauma and vice versa. In concussions with consciousness troubles, the neck must be immobilized in extension in order to avoid any secondary cervical spine injury (19,20)

Cerebral concussion is usually a "benign" brain injury which can sometimes be complicated and require further investigations (CT Scanner) or very rarely neurosurgical intervention. Warning signs (Red flags) have been identified justifying the athlete to be immediately and safely removed from

participation and evaluated by a physician or licensed healthcare professional who will decide the transportation to a medical facility (figure 6) (2). These signs can also be compared to the criteria used to perform a CT scan for any traumatic brain injury (figure 7) (17,21). The importance of headaches (especially if they are of increasing intensity) associated with vomiting is very supportive of intracranial bleeding. The following emergency criteria require immediate medical advice (figure 2):

1. Severe neck pain or tenderness
2. Double vision
3. Weakness or tingling/burning in arms or legs
4. Vomiting (more than one episode)
5. Severe or increasing headache
6. Seizure or convulsion
7. Deteriorating conscious state
8. Increasingly restless, agitated or combative
9. Amnesia of more than 30 minutes
10. Any sign of basal skull fracture (clear fluid from the nose or ear, hematoma around the eyes or behind the ear)
11. Coagulation disorder, Anticoagulant or antiplatelet therapies ...
12. Age over 65

## 6. Conclusion

Accurate definition of reproducible diagnostic criteria for SRC is the prerequisite for the implementation of common rules of its management and should eliminate approximations and uncertainties around his diagnosis. The immediate observation of injured athletes from the impact during sports practice, allows to describe a rich and varied semiology that enriches the clinical diagnostic criteria usually used in hospital practice for mild brain trauma or concussion.

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## CRITERIA

**In the context of the direct or indirect transmission of kinetic energy to the head, the diagnosis of concussion may be asserted if at least one of the following signs or symptoms, observed or reported, is present within the first 24 hours and not explained by another cause:**

YES	NO					
<input type="checkbox"/>	<input type="checkbox"/>	Loss of consciousness				
<input type="checkbox"/>	<input type="checkbox"/>	Convulsions, Tonic posturing				
<input type="checkbox"/>	<input type="checkbox"/>	Balance troubles (ataxia)				
<input type="checkbox"/>	<input type="checkbox"/>	Visual trouble (diplopia, blurred, colored, narrowed vision, nystagmus)				
<input type="checkbox"/>	<input type="checkbox"/>	Other neurologic sign (deficit...)				
<input type="checkbox"/>	<input type="checkbox"/>	Confusion (Confusion (repeats the same question, inappropriate remarks))				
<input type="checkbox"/>	<input type="checkbox"/>	<b>Desorientation</b> One incorrect answer to one of these questionnaires			<b>General Questionnaire</b>	<b>Maddock's score</b>
			<input type="checkbox"/>	<input type="checkbox"/>	In which place did the event occur?	What venue are we at today?
			<input type="checkbox"/>	<input type="checkbox"/>	What year are we?	Which half is it now?
			<input type="checkbox"/>	<input type="checkbox"/>	What month are we?	Who scored last in this match?
			<input type="checkbox"/>	<input type="checkbox"/>	What is the day of the week?	What team did you play last week/game?
			<input type="checkbox"/>	<input type="checkbox"/>	What time is it (within 1 hour) ?	Dis your team win the last game?
<input type="checkbox"/>	<input type="checkbox"/>	Unusual behavior (inappropriate behavior, aggressiveness, disinhibition, emotional lability)				
<input type="checkbox"/>	<input type="checkbox"/>	Amnesia (anterograde and/or retrograde, difficulties remembering)				
<input type="checkbox"/>	<input type="checkbox"/>	Diffuse headaches and/or Pressure in head				
<input type="checkbox"/>	<input type="checkbox"/>	Dizziness and/or vertigo				
<input type="checkbox"/>	<input type="checkbox"/>	Fatigue, unusual low energy				
<input type="checkbox"/>	<input type="checkbox"/>	Feeling slow down and/or drowsiness				
<input type="checkbox"/>	<input type="checkbox"/>	Nausea and/or vomiting				
<input type="checkbox"/>	<input type="checkbox"/>	Sensitivity to light and/or to noise				
<input type="checkbox"/>	<input type="checkbox"/>	Dont feel right and/or in a fog				
<input type="checkbox"/>	<input type="checkbox"/>	Difficulty concentrating				

### CRITERIA REQUIRING MEDICALADVICE WITHOUT DELAY

- Severe neck pain or tenderness
  - Double vision
- Weakness or tingling/burning in arms or legs
  - Vomiting (more than one episode)
  - Severe or increasing headache
    - Seizure or convulsion
  - Deteriorating conscious state
- Increasingly restless, agitated or combative
  - Amnesia of more than 30 minutes
- Any sign of basal skull fracture (clear fluid from the nose or ear, hematoma around the eyes or behind the ear)
  - Coagulation disorder, Anticoagulant or *antiplatelet therapies* ...
  - Age over 65

**A CONCUSSION MUST BE ALWAYS CONSIDERED ASSOCIATED WITH A CERVICAL TRAUMA UNTIL PROVEN OTHERWISE**

**THE DIAGNOSIS CAN NOT BE EXCLUDED ON THE DAY OF INJURY**

## Critères diagnostiques cliniques de la commotion cérébrale (Traumatisme cérébral léger)

CRITERES			INSTRUCTIONS				
<b>Dans le contexte de la transmission directe ou indirecte d'une énergie cinétique à la tête, le diagnostic de commotion cérébrale peut être affirmé si au moins l'un des signes ou symptômes suivants, observé ou rapporté, est présent dans les 24 premières heures et non expliqué par une autre cause</b>			Il a été observé (ou rapporté par le sujet ou son entourage) un impact direct à la tête (dont il est possible de décrire la nature et le siège) et/ou un déplacement rapide et de grande amplitude de la tête (Whiplash) et/ou un sujet portant immédiatement ses mains à la tête après une collision et/ou une trace d'impact à la tête (plaie, hématome)				
			Les signes et symptômes surviennent <u>immédiatement</u> après l'impact, sans délai, à l'exception de certains symptômes qui peuvent apparaître secondairement, dans les minutes ou heures suivantes, en se préoccupant pour les symptômes d'éventuels facteurs confondants : alcool, médicaments, substances psychoactives récréatives, traumatisme psychologique, troubles psychologiques préexistants: il peut être utile de demander au sujet s'il a eu peur ou s'il se sent stressé ou anxieux.				
OUI	NON		<b>Signe [☑] : observable à la vidéo</b>				
<input type="checkbox"/>	<input type="checkbox"/>	Perte de connaissance	La perte de connaissance est le résultat d'un examen clinique où il est constaté que le sujet : 1) a les yeux fermés ; 2) n'obéit à aucun ordre simple ; 3) ne bouge pas en dehors de mouvements réflexes. Indirectement, la perte de connaissance est diagnostiquée dans l'action, lorsqu'est observé une perte du tonus [☑] : chute abrupte du corps sans aucun mouvement pour se protéger vers l'avant, l'arrière ou en position assise ; hypotonie cervicale ou des épaules. Enfin, la suspicion est forte si le sujet est immobile au sol dès la chute sans aucun mouvement volontaire et pendant au moins 5 sec [☑].				
<input type="checkbox"/>	<input type="checkbox"/>	Convulsions, crise tonique	<b>Convulsions</b> : contractions musculaires rythmiques involontaires brèves et répétées, impliquant un ou plusieurs membres [☑]. <b>Crise tonique posturale</b> : Extension d'un membre restant suspendu en l'air quelques instants avant de retomber progressivement au sol, pouvant s'accompagner d'une rotation tonique du cou [☑]				
<input type="checkbox"/>	<input type="checkbox"/>	Trouble de l'équilibre (ataxie)	Le diagnostic de critère d'ataxie [☑] est retenu si le sujet : 1) Amorçe le mouvement de se relever et retombe au sol ; 2) Se relève de façon saccadée en plusieurs étapes en cherchant à chaque étape son équilibre (parfois le sujet rampe à « quatre pattes » avant de pouvoir se relever) ; 3) a du mal à se tenir debout immédiatement de façon stable sans être soutenu ; 4) marche de façon instable				
<input type="checkbox"/>	<input type="checkbox"/>	Trouble visuel	Vision floue, colorée, champ visuel amputé, vision double, anomalies pupillaires, nystagmus				
<input type="checkbox"/>	<input type="checkbox"/>	Autre signe neurologique (déficit), détail :	Tout autre signe neurologique témoignant d'un dysfonctionnement cérébral				
<input type="checkbox"/>	<input type="checkbox"/>	Confusion	Répète la même question, propos non adaptés				
<input type="checkbox"/>	<input type="checkbox"/>	<b>Désorientation</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Se trompe et ne reconnaît pas un lieu, une personne, ou une séquence temporelle d'événements. Une réponse incorrecte (☹) à l'un de ces questionnaires signale une désorientation.
<b>Questionnaire général</b>			<b>Questionnaire de Maddock (sports collectifs)</b>				
<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	Dans quel lieu est survenu l'évènement ?	Dans quel stade sommes-nous aujourd'hui ?	
<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	Quelle année sommes-nous ?	À quelle mi-temps sommes-nous ?	
<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	Quel mois sommes-nous ?	Qui a marqué en dernier au cours de ce match ?	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Quel est le jour de la semaine ?	Contre quelle équipe avez-vous joué la semaine dernière / le dernier match ?		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Quelle heure est-il (+/- 1 heure) ?	Votre équipe a-t-elle gagné le dernier match ?		
<input type="checkbox"/>	<input type="checkbox"/>	Trouble du comportement	Positionnement ou aptitude à l'action défaillante dans sa pratique sportive [☑], agressivité inhabituelle [☑], désinhibition (propos ou action exagérée et inhabituelle), labilité émotionnelle (pleurs inhabituels), se sent anormalement nerveux(se) ou anxieux(se)				
<input type="checkbox"/>	<input type="checkbox"/>	Amnésie, troubles de la mémoire	Ne se rappelle pas des faits juste après l'évènement (quel est le premier souvenir depuis l'évènement ?) et/ou des faits avant l'évènement (quel est le dernier souvenir avant l'accident ?). Durée de l'amnésie inférieure à 24h. A des troubles de la mémoire (tests de mémoire défaillants ou difficultés à se rappeler des détails de la vie quotidienne)				
<input type="checkbox"/>	<input type="checkbox"/>	Mal à la tête diffus et/ou tête lourde	Ces symptômes non expliqués par une autre cause constituent, par la présence d'au moins l'un d'entre eux, un critère diagnostique de commotion cérébrale dans les suites immédiates du traumatisme. En apparaissant de façon décalée par rapport à l'évènement de quelques heures, voire après une nuit de repos, ils peuvent encore constituer un critère diagnostique (formes évolutives). Néanmoins, s'ils sont isolés (aucun autre signe de dysfonctionnement cérébral), l'interprétation clinique de leur présence à des fins diagnostique doit être très attentivement questionnée en recherchant toutes les autres raisons pouvant expliquer leur présence.				
<input type="checkbox"/>	<input type="checkbox"/>	Vertiges et/ou étourdissements					
<input type="checkbox"/>	<input type="checkbox"/>	Fatigue, manque d'énergie inhabituelle					
<input type="checkbox"/>	<input type="checkbox"/>	Sensation d'être ralenti et/ou somnolence					
<input type="checkbox"/>	<input type="checkbox"/>	Nausées et/ou vomissements					
<input type="checkbox"/>	<input type="checkbox"/>	Gêné(e) par la lumière et/ou le bruit					
<input type="checkbox"/>	<input type="checkbox"/>	Ne se sent pas bien et/ou dans le brouillard					
<input type="checkbox"/>	<input type="checkbox"/>	Du mal à se concentrer					
			<b>MOTIFS DE RECOURS MEDICAL SANS DELAI</b> Mal au cou important - Vision double (diplopie) - Faiblesse ou sensation de picotement/brûlure dans les bras ou les jambes - Mal à la tête important ou croissant – Vomissements (plus d'un épisode) – Convulsions - Détérioration de l'état de conscience - Nervosité, agitation ou agressivité croissantes - Amnésie >30 min – signes de fracture de la base du crâne (écoulement clair par le nez ou l'oreille, hématome derrière l'oreille ou en lunettes) – troubles de la coagulation, traitement anticoagulants ou anti-agrégants – Age > 65 ans				

UNE COMMOTION CEREBRALE EST ASSOCIEE A UN TRAUMATISME CERVICAL JUSQU'A PREUVE DU CONTRAIRE

LE DIAGNOSTIC DE COMMOTION CEREBRALE NE PEUT ETRE EXCLU LE JOUR DU TRAUMATISME

After a head injury or accident some people experience symptoms which can cause worry or nuisance. We would like to know if you now suffer from any of the symptoms given below. As many of these symptoms occur normally, we would like you to compare yourself now with before the accident. For each one, please circle the number closest to your answer.

- 0 = Not experienced at all
- 1 = No more of a problem
- 2 = A mild problem
- 3 = A moderate problem
- 4 = A severe problem

Compared with before the accident, do you now (i.e., over the last 24 hours) suffer from:

- |   |           |
|---|-----------|
| Headaches.....  | 0 1 2 3 4 |
| Feelings of Dizziness .....                           | 0 1 2 3 4 |
| Nausea and/or Vomiting .....                          | 0 1 2 3 4 |
| Noise Sensitivity, easily upset by loud noise .....   | 0 1 2 3 4 |
| Sleep Disturbance .....                               | 0 1 2 3 4 |
| Fatigue, tiring more easily .....                     | 0 1 2 3 4 |
| Being Irritable, easily angered.....                  | 0 1 2 3 4 |
| Feeling Depressed or Tearful .....                    | 0 1 2 3 4 |
| Feeling Frustrated or Impatient .....                 | 0 1 2 3 4 |
| Forgetfulness, poor memory .....                      | 0 1 2 3 4 |
| Poor Concentration.....                               | 0 1 2 3 4 |
| Taking Longer to Think .....                          | 0 1 2 3 4 |
| Blurred Vision .....                                  | 0 1 2 3 4 |
| Light Sensitivity, easily upset by bright light ..... | 0 1 2 3 4 |
| Double Vision .....                                   | 0 1 2 3 4 |
| Restlessness .....                                    | 0 1 2 3 4 |
| Are you experiencing any other difficulties?          |           |
| 1. _____  | 0 1 2 3 4 |
| 2. _____  | 0 1 2 3 4 |

Figure 1: Definitions of sport related concussion and Mild Traumatic Brain injury

Sport Related Concussion	Mild Traumatic Brain Injury
5 <sup>th</sup> International consensus conference on Concussion in Sports (2)	The American Congress of Rehabilitation Medicine (3)
<p><i>Sport related concussion is a traumatic brain injury induced by biomechanical forces. Several common features that may be utilised in clinically defining the nature of a concussive head injury include:</i></p> <ul style="list-style-type: none"> <li>• SRC 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.</li> <li>• SRC typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously. However, in some cases, signs and symptoms evolve over a number of minutes to hours.</li> <li>• SRC may result in neuropathological changes, but the acute clinical signs and symptoms largely reflect a functional disturbance rather than a structural injury and, as such, no abnormality is seen on standard structural neuroimaging studies.</li> <li>• SRC results in a range of clinical signs and symptoms that may or may not involve loss of consciousness. Resolution of the clinical and cognitive features typically follows a sequential course. However, in some cases symptoms may be prolonged.</li> </ul> <p><i>The clinical signs and symptoms cannot be explained by drug, alcohol, or medication use, other injuries (such as cervical injuries, peripheral vestibular dysfunction, etc) or other comorbidities (eg, psychological factors or coexisting medical conditions)</i></p> <p><i>The diagnosis of acute SRC involves the assessment of a range of domains including clinical symptoms, physical signs, cognitive impairment, neurobehavioral features and sleep/wake disturbance. Furthermore, a detailed concussion history is an important part of the evaluation both in the injured athlete and when conducting a pre-participation examination.</i></p> <p><i>The suspected diagnosis of SRC can include one or more of the following clinical domains:</i></p> <ol style="list-style-type: none"> <li>a. Symptoms: somatic (eg, headache), cognitive (eg, feeling like in a fog) and/or emotional symptoms (eg, lability)</li> <li>b. Physical signs (eg, loss of consciousness, amnesia, neurological deficit)</li> <li>c. Balance impairment (eg, gait unsteadiness)</li> <li>d. Behavioural changes (eg, irritability)</li> <li>e. Cognitive impairment (eg, slowed reaction times)</li> <li>f. Sleep/wake disturbance (eg, somnolence, drowsiness)</li> </ol> <p><i>If symptoms or signs in any one or more of the clinical domains are present, an SRC should be suspected and the appropriate management strategy instituted. It is important to note, however, that these symptoms and signs also happen to be non-specific to concussion, so their presence simply prompts the inclusion of concussion in a differential diagnosis for further evaluation, but the symptom is not itself diagnostic of concussion.</i></p>	<p><i>MTBI is a traumatically induced physiological disruption of brain function, as manifested by at least one of the following: 1) any loss of consciousness; 2) any loss of memory for events immediately before or after the accident; 3) any alteration in mental state at the time of the accident (e.g., feeling dazed, disoriented, or confused); 4) focal neurological deficit(s) that may or may not be transient. But where the severity of the injury does not exceed the following: 1) loss of consciousness of approximately 30 min or less; after 30 min, an initial Glasgow Coma Scale score of 13-15; 3) post-traumatic amnesia not greater than 24 hours.</i></p> <p>The WHO Collaborating Center Task Force on Mild Traumatic Brain Injury (4)</p> <p><i>MTBI is an acute brain injury resulting from mechanical energy to the head from external physical forces. Operational criteria for clinical identification include: (i) 1 or more of the following: confusion or disorientation, loss of consciousness for 30 minutes or less, post-traumatic amnesia for less than 24 hours, and/or other transient neurological abnormalities such as focal signs, seizure, and intracranial lesion not requiring surgery; (ii) Glasgow Coma Scale score of 13–15 after 30 minutes post-injury or later upon presentation for healthcare. These manifestations of MTBI must not be due to drugs, alcohol, medications, caused by other injuries or treatment for other injuries (e.g. systemic injuries, facial injuries or intubation), caused by other problems (e.g. psychological trauma, language barrier or coexisting medical conditions) or caused by penetrating craniocerebral injury</i></p>

Table 2

<b>Orientation Score</b>	<b>Maddock's Score (13)</b>
<ul style="list-style-type: none"> <li>• In which place did the event occur?</li> <li>• What year are we?</li> <li>• What month are we?</li> <li>• What is the day of the week?</li> <li>• o What time is it (within 1 hour)?</li> </ul>	<ul style="list-style-type: none"> <li>• In which stadium do we play?</li> <li>• What half-time are we?</li> <li>• Who scored the last points in this match?</li> <li>• Which team did you play last week / previous match?</li> <li>• Did your team win the previous meeting?</li> </ul>

Table 3: Symptoms check-list (2)

SCAT 5 SYMPTOMS CHECK-LIST	minime		modéré		sévère	
	1	2	3	4	5	6
Headaches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pressure in head	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Neck pain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nausea or vomiting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fatigue, low energy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dizziness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Blurred vision	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Balance problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sensitivity to light	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sensitivity to noise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feeling slowed down	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feeling like in a fog	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Don't feel right	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Difficulty concentrating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Difficulty remembering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Confusion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Drowsiness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Difficulty falling asleep	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
More emotional	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Irritability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sadness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nervous or anxious	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Total number of symptoms:

sur 22

Symptom severity score:

sur 132

Do your symptoms get worse with physical activity?

OUI NON

Do your symptoms get worse with mental activity?

OUI NON

Table 4 : SCAT 5 Red Flags (2)

<b>SCAT 5 Red flags</b>
1. Neck pain or tenderness
2. Double vision
3. Weakness or tingling/burning in arms or legs
4. Vomiting
5. Severe or increasing headache
6. Seizure or convulsion
7. Loss of consciousness
8. Deteriorating conscious state
9. Increasingly restless, agitated or combative

Table 5: CT scan rules for Mtbi (2, 21, 22)

<b>SFMU</b>	<b>Canadian CT Head Rule</b>	<b>New Orleans Criteria</b>
<p><i>Risk factors requiring a CT head scan (*in emergency, within an hour):</i></p> <ol style="list-style-type: none"> <li>1. Focal neurologic deficit*</li> <li>2. Retrograde amnesia (before the injury) &gt; 30 minutes</li> <li>3. GCS score &lt;15 at 2 hours after injury*</li> <li>4. Loss of consciousness or amnesia associated with - one of the following traumatic mechanisms: pedestrian against a motorized vehicle, patient ejected from a vehicle or fall from a height of more than one meter - or an age of over 65 years</li> <li>5. Suspected open or depressed skull fracture*</li> <li>6. Any sign of basal skull fracture (hemotympanum, "raccoon" eyes, CSF otorrhea or rhinorrhea, Battle's sign) *</li> <li>7. Vomiting <math>\geq 2</math> in adults*</li> <li>8. Post-traumatic Seizure*</li> <li>9. Coagulation disorder, Anticoagulant or <i>antiplatelet therapies ...</i> *</li> </ol>	<p><i>CT head scan is only required for patients with minor head injury with any one of these findings:</i></p> <p><b>High-risk (for neurologic intervention)</b></p> <ol style="list-style-type: none"> <li>1. GCS score &lt;15 at 2 hours after injury</li> <li>2. Suspected open or depressed skull fracture</li> <li>3. Any sign of basal skull fracture (hemotympanum, "raccoon" eyes, CSF otorrhea or rhinorrhea, Battle's sign)</li> <li>4. Vomiting <math>\geq 2</math></li> <li>5. Age <math>\geq 65</math></li> </ol> <p><b>Medium-risk (for brain injury on CT scan)</b></p> <ol style="list-style-type: none"> <li>1. Amnesia before impact &gt; 30 minutes</li> <li>2. Dangerous mechanism (pedestrian struck by motor vehicle, occupant ejected from motor vehicle, fall from elevation <math>\geq 5</math> ft or 5 stairs)</li> </ol>	<p><i>Computed tomography is required for patients with minor head injury with any one of the following findings. The criteria apply only to patients who also have a Glasgow Coma Scale score of 15</i></p> <ol style="list-style-type: none"> <li>1. Headaches</li> <li>2. Vomiting</li> <li>3. Older than 60 years old</li> <li>4. Drug or alcohol intoxication</li> <li>5. Persistent anterograde amnesia (deficits in short-term memory)</li> <li>6. Visible trauma above the clavicle</li> <li>7. Seizure</li> </ol>