



HARROGATE
CONSENSUS AGREEMENT
**CYCLING-SPECIFIC SPORT RELATED
CONCUSSION**

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INTRODUCTION

Concussions are defined as traumatic transient disturbances of neurological function caused by external forces to the head, face or neck [1], and are common and increasingly- recognised sports related injuries [2]. Sport-related concussions (SRC) account for between 1.3 and 9.1% of all cycling-specific injuries, but concussion diagnosis can be difficult, and potentially unreported incidents may affect a reliable estimate of SRC incidence [3-6]. Most studies of the effects of multiple concussions have shown neurocognitive impairments in the areas of memory and processing speed, chronic traumatic encephalopathy, with a loss of quality of life [7-8]. Moreover, the number of concussions and the time interval between concussions increase the severity of subsequent concussions and lead to higher risk of neurological sequelae. It is therefore fundamental to make a confident diagnosis of concussions in cycling as soon as possible and memorise the personal history of concussion.

SRC is considered to be among the most complex sport-related injuries to diagnose, assess and manage [1]. Increased awareness has been made globally in the diagnosis and management of SRC in contact and team sports with the 2017 Berlin Consensus statement [1]. Concussion diagnosis is challenging because of non-specific self-reported and confounding symptoms and the lack of validated objective tests, but the last Concussion in Sport Group consensus statement provided a guiding reference, including a standardised tool for evaluating concussions, the Sport Concussion Assessment Tool (SCAT5).

Attention has been drawn to the difficulty in managing suspected SRC in a fast-paced sport such as road cycling and a recent review evidenced the lack of published consensus for the management of SRC in cycling [9]. This has highlighted the lack of an effective and time-efficient assessment protocol for the discipline of road cycling, and a first cycling-specific protocol for the assessment of SRC in the field has recently been suggested [10]. However, other cycling disciplines such as mountain bike (cross-country Olympic and marathon) and the Omnium in track cycling, pose similar difficulties in managing suspected SRC cases.

There is a pressing need for a specific cycling SRC protocol, especially for fast-paced disciplines of cycling, such as road cycling. A consensus meeting on cycling SRC was convened to attempt to fill this gap and establish a SRC protocol for cycling. Our aim was to agree on standard terminology, definitions, diagnostic protocols and return-to-race (RTR) protocols for the various cycling disciplines. The intent of this work is to increase the recognition of and sensitivity of diagnosis of SRC within elite road cycling and other disciplines, and as a consequence, improve rider welfare.

METHODS

Background to the meeting

The consensus meeting on cycling-specific SRC was held in Harrogate, Great Britain, in September 2019. In the lead-up to this conference, 8 experts in the field of cycling medicine were invited to participate in the conference and agreement meeting. They are the authors of this report.

Prior to the meeting, the experts were invited to perform a review of the existing evidence and prepare presentations of their practical experience and views relating to SRC in cycling. These were presented at the conference and were followed by a discussion of the relevant points which are addressed in this proposal. This article presents the results of the consensus meeting and provides suggestions for the diagnosis and management of SRC in cycling.

Medical legal considerations

The consensus statement is not intended as a clinical practice guideline or legal standard of care and should not be interpreted as such. This document is only a proposal, and is of a general nature, consistent with the reasonable practice of a healthcare professional. The proposed protocol will evolve as epidemiological evidence on SRC in road cycling develops and feedback is received from interested parties.

ROAD-SIDE / TRACK-SIDE SRC ASSESSMENT

The panel recognised that cycling consists of different and varied disciplines. Some of these provide a setting in which an on-the-spot assessment is possible (most race events in track cycling, BMX) and provide opportunities for management of suspected cases of SRC in line with the Berlin Consensus statement [1]. However, other disciplines (road cycling, mountain bike - marathon and cross-country Olympic -, and Omnium in track cycling) provide challenging circumstances where health care providers have limited access to participants and in which participants are unable to discontinue participation in the race and undergo a full on-the-spot assessment. These therefore require discipline-specific protocols and guidelines which recognise the limitations imposed by these circumstances, but nevertheless improve on the current situation in which SRC may go undiagnosed and lead to continued participation by athletes who may pose a risk to other participants and themselves.

SRC recognition

The recognition of suspected SRC in cycling disciplines for which there is no significant time pressure to diagnose concussion is based on the use of the SCAT5 [1,13]. This multidimensional testing tool is the most rigorously developed instrument, useful immediately after injury to differentiate concussed from non-concussed riders.

For fast-paced cycling discipline such as road cycling, a standardised initial screening assessment, to determine whether an athlete needs to be definitively removed from competition or can return to race following a head injury event is needed. The present concussion protocol is based on the principles which have been adopted by the International Rugby Board and which have transformed the management of concussion in elite rugby [11].

The three-stage diagnostic process involves:

1. Initial assessment immediately following potential concussive event
2. Re-assessment immediately following completion of the race or the stage, on the same day of the injury
3. Re-assessment the day following the initial injury

In order to account for the often transient, evolving or delayed onset of SRC symptoms, serial clinical evaluations should be used to optimise the diagnosis of SRC [12]. Riders can be evaluated more regularly if they display any suspected concussion symptoms which would warrant further evaluation. This protocol stipulates that any presentation of signs or symptoms of potential concussion helps to confirm the diagnosis of SRC. This can occur at any stage in the protocol, including at either of the two SRC re-evaluation time points.

1) Initial assessment immediately following head impact event

The panel recognised that in the road cycling and mountain biking disciplines, participants may sustain injuries and SRC in the field when medical personnel are not immediately present or cannot rapidly access the participants.

Riders who sustain traumatic events that could potentially result in SRC need not be solely identified by medical personnel. In situations where the race doctor, the team medical doctor, other team medical doctors or allied health professionals are not in the immediate proximity of such an event it is considered acceptable that key team staff may recognise the potential for SRC and take appropriate actions.

a- Immediate withdrawal:

Medical staff, allied medical staff, key team staff members, riders and other participants may alert the participant, the race medical staff and / or race officials of the presence of one or more of the immediate and permanent removal features (Table 1) that warrant immediate and permanent withdrawal from competition. If the recognition of these symptoms can be shared between health care professionals and non-health professionals, the confirmation of immediate and permanent withdrawal remains under the medical responsibility. Education policies are implemented by the International Federation (i.e. UCI) and National Federations to ensure that all race officials, participants and team staff are aware of these features. A specific recognition and removal tool, which can be used by non-healthcare professionals, helps in making the decision of immediate withdrawal from the race.

Red Flags
Loss of consciousness, confirmed or suspected
Seizure or convulsion
Behaviour change, increasingly restlessness, agitation, combativeness
Vomiting
Severe or increasing headache
Double vision
Weakness or tingling / burning in arms or legs
Neck pain or tenderness
Observable signs
Lying motionless on the road or the track
Disorientation, confusion, inability to respond to questions
Balance impairment
Blank or vacant look
Facial injury after head trauma
Blurred vision, diplopia, difficulty with tracking a moving target
Inability to speak or swallow

Table 1. Red Flag and observable signs of a concussion.

b- Road-side / track-side assessment:

In the absence of any of the Immediate and Permanent Removal features and where the nature of the incident indicates potential for SRC (broken helmet, significant impact, rider not responding to radio etc.), race officials, commissaires, team staff members or other appropriate persons involved in the race may alert the race officials of the potential for SRC. Inspection of the videotape of the injury or video-based observation, if available, is also helpful to identify potentially concussed riders.

Depending on the context of the race, the participant and the team doctor or race doctor should be alerted to the potential for SRC and the participant should undergo a standardised assessment at the side of the road or the side of the course (Figure). In road cycling, where either the official race doctor or the participant’s own team doctor is not available within a reasonable time frame, the doctor of another team may be requested to perform the on-the-spot assessment.

The panel recognised that in road cycling (and mountain bike cross-country Olympic and mountain bike marathon) there is no opportunity for “time-out” or substitution as is the case in field sports such as rugby, football or others. As such, any on-the-spot assessment needs to observe a balance between accurate and appropriate assessment, and the need for the participant who is no longer suspected of SRC to return to race in a timeout fashion which does not impact on their right to compete.

As such, the panel recognised that the road-side / track-side assessment needs to incorporate a modified version of the SCAT5 considered to be the current standardised tool for evaluating concussions in field sports [13]. This assessment should include the features listed in Table 2 and detailed in appendix.

Modified Maddocks questions
Rapid symptom screen (headache, nausea, dizziness)
Immediate 10 words recall
Reverse digits
Balance assessment (feet together, head back)
Assessment of spine and neck
Delayed 10 words recall

Table 2. Summary of road-side / track-side assessment features
(See appendix A for full assessment)

The principles of SRC assessment in the field, including immediate recognition and road-side / track-side assessment are illustrated in Figure. Any participant with a suspected SRC should immediately be withdrawn from the competition and, as soon as possible, undergo further evaluation in a medical facility (where appropriately indicated) or within the team’s medical support structure by a suitably trained and qualified medical doctor. It should be remembered that the neurocognitive assessment should be carried out in a strictly distraction-free environment, with the rider in a resting state.

2) Re-assessments and further evaluations

SRC is an evolving injury in the acute phase and the onset of symptoms may be delayed or initially unrecognised. Therefore this assessment should be repeated immediately after the race is completed on the same day of the injury, and the day after the suspected SRC, to evaluate the progression of the injury. Riders can be evaluated more regularly if they display any suspected concussion symptom, and subsequently at appropriate intervals during the RTR process. The panel recognised that the Berlin Consensus statement on concussion [1] provides appropriate guidelines regarding the post-race assessment of confirmed or suspected SRC. In brief this should include:

- A medical assessment which includes a comprehensive history and detailed neurological examination including evaluation of mental status / cognition, sleep / wake disturbance, oculomotor function, gross sensorimotor, coordination, gait, vestibular function, gait and balance,
- Determination of the clinical status, including whether there has been improvement or deterioration since the time of injury,
- Determination on whether there is a need for emergent neuro-imaging to exclude a more severe brain injury.

The post-race assessments should be conducted in a standardised-fashion, for example using the SCAT5. This tool should be used by trained physicians or licensed healthcare professionals with experience in SRC, in a distraction-free environment and with adequate time for examination and administration of evaluation tests.

Assessment of cognitive function is an important component of the post-race management of SRC. The panel recognised that computerised neurocognitive assessments, although not essential, are commonly used and may aid in the diagnosis and evaluation of SRC. These tools are readily available and take little time, but their routine use and validity remains questionable [14]. They must be used with caution and as screening tools together with multifaceted assessments. In addition, post-injury computerised cognitive assessment may assist RTR decisions, especially when an athlete is clinically asymptomatic at an early stage in the RTR evaluation process.

It was the panel's opinion that baseline or pre-season assessment may be helpful or add useful information to the overall interpretation of clinical assessment in SRC and assist the RTR decisions [15]. Common pre-season testing includes assessment of standard examinations found in the SCAT5 tool [13] and/or computerised cognitive or neuropsychological tests [15]. Given its potential usefulness for interpreting post-injury tests, pre-season SCAT5 baseline testing should therefore be recommended or be made mandatory at elite / professional level.

The panel recognised that newer modalities such as ocular testing using mobile devices are promising and may provide rapid, accurate diagnostic tools for SRC. Impairments of vestibular / ocular motor function are commonly associated with concussions. Specific vestibulo-ocular motor screening tests (VOMS) could be useful in detecting vestibulo-ocular dysfunction on road lines, although these tests rely on self-reported symptoms and are susceptible to unreliable results in some subjects [16]. Head impact sensors provide linear and rotational acceleration data that can be automatically available for real-time view. However, a large range of linear and rotational forces was recorded at the origin of concussions, suggesting significant variations in thresholds of forces at the origin of concussive injuries [17]. The use of these devices in SRC are still being evaluated and their use should be guided by more global SRV guidelines such as any pending update of the Berlin Consensus statement [7,16].

The panel also recommended that all SRC events should be notified to the UCI Medical Director (medical@uci.ch) to ensure adequate surveillance of the management of these injuries as well as long-term follow-up of the impact of SRC on riders. Such a provision implies a specific procedure which will be put in place by the International Federation (i.e. UCI).

RETURN TO RACE (RTR)

In line with the Berlin Consensus statement [1], the panel agreed that after a brief period of rest during the acute phase (24–48 hours) of SRC, patients can be encouraged to become gradually and progressively more active while staying below their cognitive and physical symptom-exacerbation thresholds (the exercise or cognitive load which exacerbates or triggers symptoms). The duration of this period of recovery is dependent on the severity of the initial injury and the characteristics of the individual athlete.

Interventions such as psychological, cervical and vestibular rehabilitation may be performed during this recovery process and may benefit recovery of brain functions.

The panel considered that following the resolution of symptoms, the athlete should only return to competition following a graduated step-by-step rehabilitation process. In the sport of cycling these necessitate some sport-specific modalities. The progressive RTR protocol is outlined in Table 3, as previously documented by Heron et al. [10]. The gradual increase in physical demand during exercise should not cause the return of any of the concussion-related symptoms. After the initial period of rest, the step-by-step exercise programme begins, with each step being taken only if no concussion-related symptoms appear. The minimum duration before returning to competition should be 1 week once riders are free of post-concussive symptoms. The panel agreed that junior athletes should undergo a minimum 2-week recovery period prior to RTR.

Conclusions

The diagnosis of concussion is challenging as it relies on non-specific symptoms and because of the lack of objective diagnostic testing. The challenge is even higher in fast-paced sports such as road cycling. The aim of this document is to allow the formulation and introduction of a cycling-specific SRC assessment and management protocol within the different disciplines of cycling. This protocol should be reviewed regularly to ensure it offers an evidence-based approach in line with the evolving knowledge on SRC assessment and management, and to optimise its application in the field.

Stage	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Activity	Complete rest	Symptom limited light activity (indoor trainer or non cycling activities) with added rehabilitation	Up to 70% of MHR or 50% of FTP power for up to 30min. Performed on indoor trainer.	Up to 90% of MHR or FTP power for up to 30min. Performed on indoor trainer. Can follow with 30min ride in the field with one rider as supervision or 30min roller session with no errors.	No restriction of intensity or intensity	Return to normal training
Duration	24-48 hrs	Min 1. day	Min. 1 day	Min. 1 day	Min. 1 day	Min. 1 day
Progression to next stage	24-48hrs	When symptom free and preferably only after repeat medical assessment	If no symptoms provoked by exercise (headache, dizziness, nausea)	If no symptoms provoked by exercise (headache, dizziness, nausea) and no roller error or technical error in the field	If no symptoms provoked by exercise (headache, dizziness, nausea) and no technical error in the field	If no symptoms provoked by exercise (headache, dizziness, nausea) and no technical error in the field

MHR = maximal heart rate; **FTP** = functional threshold power.

Table 3: Progressive return-to-race activities and progression criteria.

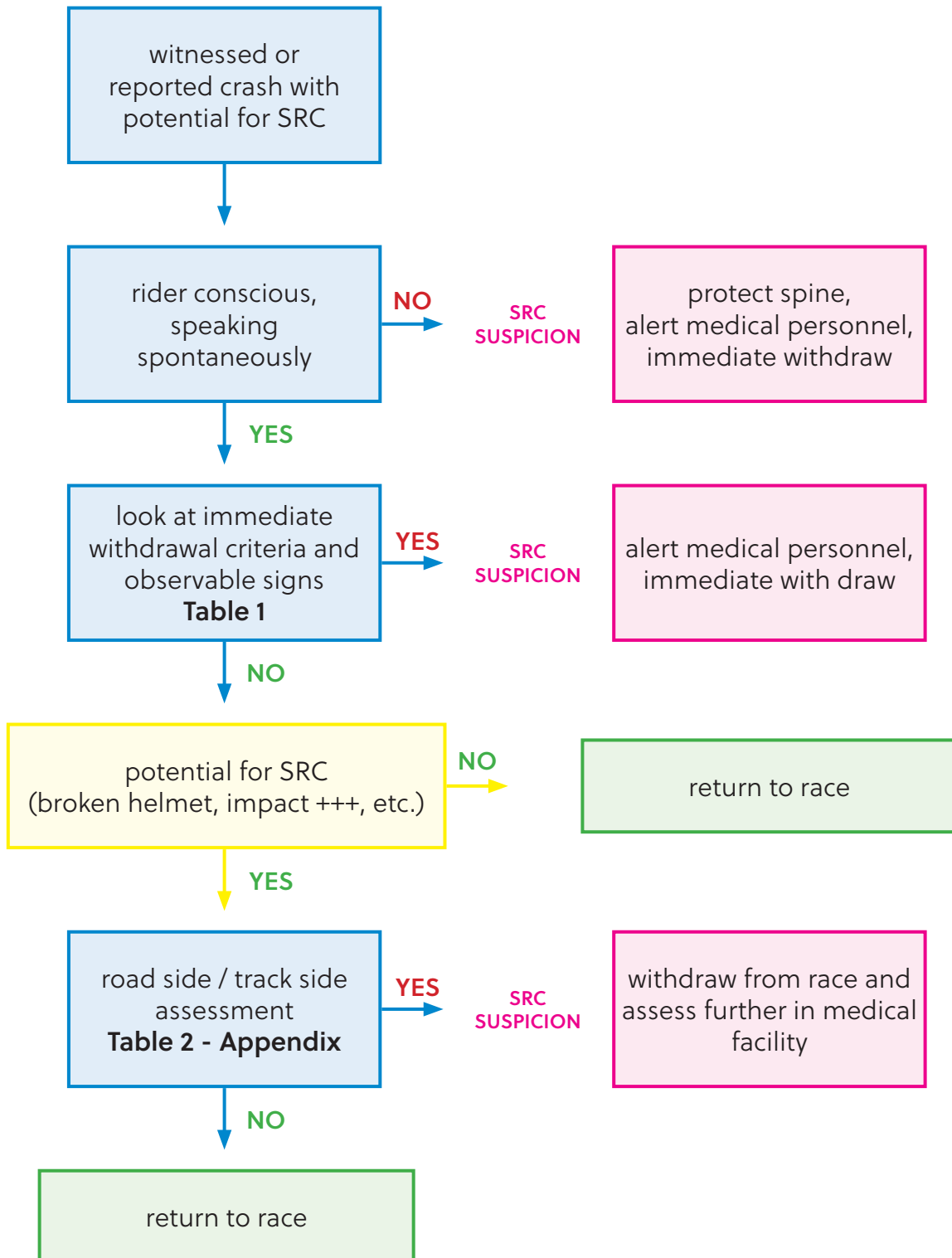


Figure 1: Immediate recognition and road-side / track-side assessment algorithm.

APPENDIX A

ROAD-SIDE / TRACK-SIDE ASSESSMENT

1) Rapid symptom screen:

The athlete should be requested to confirm if they are experiencing any of the following symptoms and if affirmative, whether they are mild, moderate or severe.

- Headache
- Nausea
- Dizziness
- Double vision

Two or more symptoms of mild severity or at least 1 symptom of moderate or greater severity should be interpreted as an indication of a high probability of SRC.

2) Maddocks questions:

State: "I am going to ask you a few questions, please listen carefully and make your best effort. First, tell me what happened?"

Follow this with the Modified Maddocks questions:

- What day is it?
- What race are we in?
- How many km to go?
- What was your last race?
- Who is the DS in this race?
- Who won yesterday (stage races)

If an athlete answers all the Maddocks questions correctly then the likelihood that he/she is suffering from concussion is low (0-11%) [18].

However, the false positive rate for the test is relatively high, ie an athlete not being able to answer one or more questions and not having concussion (29-68%).

Interpretation of the Maddocks questions should therefore be performed bearing in mind the history and results of the remainder of the assessment.

3) Assessment of spine and neck:

Does the athlete report that their neck is pain free at rest?

If there is NO neck pain at rest, does the athlete have a full range of ACTIVE pain-free movement?

Is the limb strength and sensation normal?

Any abnormal assessment should prompt withdrawal and further medical assessment.

4) Immediate Memory:

The Immediate Memory component can be completed using the traditional 10-word per trial list. Three trials must be administered irrespective of the number correct on the first trial.

State: *"I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order."*

The words must be read at a rate of one word per second.

Then perform 3 trials of immediate memory using this list. Complete all 3 trials regardless of the score on previous trials.

For trials 2 and 3 state: *"I am going to repeat the same list again. Repeat back as many words as you can remember in any order, even if you said the word before."*

Score 1 pt. for each correct response. Total score equals sum across all 3 trials. **Do NOT inform the athlete that delayed recall will be tested.**

Baseline reference values have been provided and in non-concussed athletes on overall score of 20 out of 30. Athletes correctly identified approximately 5, 7 and 8 words for trial 1, 2 and 3, respectively.

Suggested 10-word lists

- Wheel
- Brake
- Road
- Food
- Car
- Hotel
- Bottle
- Rider
- Podium
- Jersey

5) Balance assessment:

This balance testing is based on a modified version of the Balance Error Scoring System (BESS). Due to the presence of modified footwear in the sport of cycling, only the double legs stance has been included.

The examiner will begin counting errors only after the athlete has assumed the proper start position. The modified BESS is calculated by adding one error point for each error during the test. The maximum number of errors is 10. If the athlete commits multiple errors simultaneously, only one error is recorded but the athlete should quickly return to the testing position, and counting should resume once the athlete is set. Athletes who are unable to maintain the testing procedure for a minimum of five seconds at the start are assigned the highest possible score, ten, for that testing condition.

State: "I am now going to test your balance. This test will consist of three 20-second tests. Place your feet together with your hands on your hips and with your eyes closed. You should try to maintain stability in that position for 20 seconds. I will be counting the number of times you move out of this position. I will start timing when you are set and have closed your eyes "

1. Hands lifted off iliac crest
2. Opening eyes
3. Step, stumble, or fall
4. Moving hip into > 30 degrees abduction
5. Lifting forefoot or heel
6. Remaining out of test position > 5 sec

Any errors should raise the suspicion for SRC but should be interpreted in the context of the results of the remainder of the assessment. [19]

6) Reverse digits:

State: "I am going to read a string of numbers and when I am done, you repeat them back to me in reverse order of how I read them to you. For example, if I say 7-1-9, you would say 9-1-7."

Use a 5-digit string and read at the rate of one per second.

If incorrect repeat with a second string.

Errors in both tests should raise suspicion for SRC but should be interpreted in the context of the number of errors and the results of the remainder of the assessment.

7) Delayed Recall:

The delayed recall should be performed after 5 minutes have elapsed since the end of the Immediate Recall section.

State: "Do you remember that list of words I read a few times earlier? Tell me as many words from the list as you can remember in any order."

In the global population the average delayed memory score is 6.6 out of 10 words. Inability to recall 4 or more of the words should raise the suspicion for SRC but should be interpreted in the context of the results of the remainder of the assessment.

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