

Zurich to Berlin—“Where” Are We Now with the Concussion in Sport Group?

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Abstract

The Concussion in Sport Group recently published its highly anticipated fifth consensus statement on sports-related concussion. The latest iteration features a new organizational format—the “11 Rs” and has input from a wider range of health care professionals, organizations, and experts in the field from both the sport concussion area and from related areas outside of sport. The stated objective of this current document is to “build on the principles outlined in previous statements and develop further conceptual understanding of sports-related concussion.” Its intended audience is “physicians and health care providers who are involved in athlete care, whether at a recreational, elite, or professional level.” We review significant updates including recommendations for sideline evaluation, return to play, and return to learn in athletes with sports-related concussion.

curred at a time when concussion in sport was not particularly topical (6). The initial Vienna product was especially notable for establishing a single “concussion in sport” definition, at a time when many disparate definitions existed. Additionally, it was groundbreaking with its notion of a stepwise return-to-play approach (7). The stated objective of the current statement is to “build on the principles outlined in previous statements and develop further conceptual understanding of SRC” (1). Its intended audience is “physicians and health care providers who are involved in athlete care, whether at a recreational,

Introduction

The Concussion in Sport Group (CISG) recently published its latest (fifth) consensus statement (1) updating and revising the group’s fourth statement published in 2013 (2). Given the track record of previous iterations (3–5), it is suggested that this current edition can be expected to be the most cited and authoritative publication concerning sports-related concussion (SRC) (6).

Back in 2001, the original aim of the CISG conference (Vienna) was “to provide recommendations for the improvement of safety and health of athletes who suffer concussive injuries in ice hockey, rugby, and football (soccer) as well as other sports”(5). One catalyst for this original meeting was to develop a greater understanding of concussion leading into the 2002 Winter Olympic Games. Paradoxically, this oc-

elite, or professional level.” Furthermore, an accompanying editorial goes on to state that “in the face of misinformation about this injury in the minds of parents, coaches, and athletes, it is critical that all involved stakeholders receive scientifically sound and up-to-date information regarding SRC and its potential consequences” (8).

Over time, the methodology used by the CISG 5 has become increasingly more sophisticated with the incorporation of NIH consensus format (9) for the third edition and utilization of the “Delphi method” for the development of the core 12 questions for the fifth consensus (6). Additionally, the expertise on the panel was expanded to include a wider range of health care professionals, organizations, and experts in the field from both the sport concussion area and from related areas outside of sport, including international brain injury consortia. Impressively, more than 60,000 articles were screened to produce 12 systematic reviews to answer the 12 core questions. The authors repeatedly refer to these supportive systematic reviews throughout, and it is strongly advised that they should be reviewed carefully in conjunction with the consensus statement because they give important background rationale for each of the “11 Rs” as well as the Sport Concussion Assessment Tool 5 (SCAT 5) (10).

So, what is new and “where” are we now?

Medical Legal Considerations

Although similar to the legal disclaimer in previous statements, CISG 5 places a more distinct statement front and

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1537-890X/1701/26–30
Current Sports Medicine Reports

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center just after the preamble as opposed to at the end of the document as had been the case for versions 1 to 4 (1), perhaps reflecting the desire to provide cover for clinicians in an ever more litigious environment.

Format

The CISG 5 statement is organized into “11 Rs of SRC management” to illustrate differences from the past 4 conferences and to “provide a logical flow of clinical SRC management” (1): recognize, remove, reevaluate, rest, rehabilitation, refer, recover, return to sport (RTS), reconsider, residual effects and sequelae, risk reduction.

Recognize

The most important change to the SRC definition is an added paragraph: “The clinical signs and symptoms cannot be explained by drug, alcohol, or medication use, other injuries (such as cervical injuries, peripheral vestibular dysfunction, and so on) or other comorbidities (*e.g.*, psychological factors or coexisting medical conditions)” (1). Almost no studies in the existing concussion literature have made attempts to delineate SRC from other disease processes that may mimic or be comorbid with SRC. As such, participant groups in previously published investigations have likely been composed of a mix of SRC, SRC with comorbid conditions/injuries and other disease processes/injuries. This heterogeneity makes even methodologically strong studies difficult to interpret.

The new recommendation for the sideline/time of injury recognition of suspected SRC is to use “multidimensional testing guided via expert consensus (1) and a heady “self” endorsement is given to SCAT 5. CISG 5 calls it “the most well-established and rigorously developed instrument available for sideline assessment” (1) but no specific citations are referenced to support this assertion.

Very significantly, CISG 5 recognizes that baseline testing is not necessary for interpreting postinjury SCAT scores—hopefully this should result in reducing unnecessary use of health care provider time and patient/institutional expenses. This position also has policy implications for sports organizations, such as the NCAA that recommend baseline testing as part of best practices for its member institutions (<http://www.ncaa.org/sport-science-institute/concussion-diagnosis-and-management-best-practices>).

Other key points:

- The SCAT is useful immediately after injury, but its utility appears to decrease significantly 3 to 5 d after injury. The symptom checklist, however, demonstrates clinical utility in tracking recovery.
- Reaction time, gait/balance assessment, video-observable signs, and oculomotor screening may add to the clinical utility of the SCAT tool.
- Follow-up serial evaluation is essential after a suspected SRC regardless of a negative sideline screening test or normal early evaluation.
- SCAT 5 takes at least 10 min to complete.
- An athlete may have a concussion even if their SCAT 5 is “normal.”

SCAT 5 has added sections on Red Flags, Observable Signs, and Cervical Spine Assessment are part of the immediate/on-field assessment. For the off-field/office assessment, a neurological screen has been added. Another new direction is that

the symptom screen is to be handed to the athlete who is instructed to read the directions out loud. A 10-item word list has been added to the immediate memory section purportedly to minimize any “ceiling effect,” although the authors admit in the supporting systematic review that there is no current research supporting this contention. Finally, a basic outline of “return to learn” is included (1).

CISG 5 gives a thumbs down on the use of impact sensor technology for the clinical recognition of SRC stating that “the use of helmet-based or other sensor systems to clinically diagnose or assess SRC cannot be supported at this time” and “current evidence does not support the use of impact sensor systems for real-time SRC screening” (1).

Finally, CISG 5 suggests that the “addition of sideline video review offers a promising approach to improving identification and evaluation of significant head-impact events,” (1) although it seems such technology would be widely impractical/unavailable for most sports settings. It should be noted that no data correlate measured forces with appearance on video and the use of video is only meant to look for episodes of “suspicious” head impact as well as look for postimpact athlete behavior that may have been overlooked by on-field observers.

Remove

Little has changed in terms of this second “R.” Key points still highlight the following:

- 1) When a player shows any signs of an SRC he/she should be evaluated by a licensed health care professional.
- 2) An assessment should be made using the SCAT5 or other sideline assessment tool.
- 3) The player should not be left alone after the injury as serial monitoring is essential to assess for deterioration in the first few hours after the injury.
- 4) A player diagnosed with SRC should not be allowed to return to play on the day of injury.

CISG 5 places new emphasis that “sporting bodies should allow adequate time to conduct this evaluation. Specifically SCAT alone typically takes 10 min. Adequate facilities should be provided for the appropriate medical assessment both on and off the field for all injured athletes” (1). It is implied that this is a quiet area free from distractions, such as crowd noise and weather issues.

Reevaluate

CISG’s new additions for the follow-up examination of an athlete with SRC/suspected SRC include “an evaluation of sleep/wake disturbance, ocular function, and vestibular function” (1). Additionally, CISG5 specifically points out that although “advanced neuroimaging, fluid biomarkers and genetic testing are important research tools,” these tools “require further validation to determine their ultimate clinical utility in evaluation of SRC” (1). This is significant given the reports of facilities prematurely using these investigational technologies for clinical purposes (11–13).

CISG 5 has no new recommendations concerning neuropsychological testing (NP). It is still asserted that “the application of NP testing in SRC has clinical value and contributes significant information in SRC evaluation,” yet no evidence is provided to demonstrate that SRC clinical outcomes are

improved when NP testing is used. CISG 5 re-states that “postinjury NP assessment is not necessary for all athletes,” but offers little guidance concerning what criteria should be used to determine which athletes should be evaluated with NP other than for “return to school in a pediatric athlete...normally best determined in conjunction with a trained neuropsychologist” (it is not clear what is meant by “trained”). In agreement with CISG 4, the CISG 5 reaffirms that baseline or pre-season NP testing “was not felt to be required as a mandatory aspect of every assessment.” The assertion that baseline testing “may be helpful” is maintained, but no convincing evidence is provided to support this vague endorsement for a practice which has been negatively critiqued (14). Similar to the above discussion concerning the SCAT, organizations, and schools should discontinue the unnecessary practice of baseline testing with computerized NP programs so as not to waste precious/limited health care resources. Consistent with previous editions, CISG 5 does not acknowledge any questions raised about conflicts of interest concerning computerized NP testing programs (15).

Rest

The previous primary focus of SRC management in CISG4 was physical and cognitive rest until the athlete was symptom free with the goal of easing discomfort from post-concussive symptoms and possibly promoting recovery by decreasing energy demands on the brain. However, CISG 5 specifically states, “there is currently insufficient evidence that prescribing complete rest achieves these objectives.” Instead, CISG 5 recommends that “after a brief period of rest during the acute phase (24–48 h) after injury, patients can be encouraged to become gradually and progressively more active while staying below their cognitive and physical symptom-exacerbation thresholds (*i.e.*, activity level should not bring on or worsen their symptoms)” (1). The optimum period of rest post-SRC remains unknown (indeed, no rest at all may be warranted) with some evidence showing that excessive rest can be associated with delayed recovery with amplified and prolonged symptoms (16–18). Clinical judgement coupled with an understanding of potential iatrogenic worsening of symptoms associated with prolonged rest should inform management.

Rehabilitation

The rehabilitation section is a completely new addition for CISG5. Historically, there has not been a focus on early concussion interventions because most patients with SRC seem to clinically recover within a short period. However, especially for individuals with persistent symptoms or ongoing impairments after 10 to 14 d, CISG now opines that “the data support interventions including psychological, cervical, and vestibular rehabilitation. In, addition, closely monitored active rehabilitation programs involving controlled sub-symptom threshold, submaximal exercise has been shown to be safe and be of benefit in facilitating recovery,” but acknowledges that “further research should be performed...using high quality designs” recognizing that this is a nascent area (1).

Refer

This section also is new/distinct and is framed in the context of the athlete with persistent symptoms. A major

change in the CISG 5 is the creation of a standard definition for “persistent postconcussive symptoms.” Based on expert consensus, the “use of the term ‘persistent symptoms’ following SRC should reflect failure of normal clinical recovery—that is, symptoms that persist beyond expected time frames (*i.e.*, >10 to 14 d in adults and >4 wk in children).”

The CISG 5 emphasizes that “persistent symptoms” does not necessarily reflect a single etiology and is more accurately described as a “constellation of nonspecific posttraumatic symptoms that may be linked to coexisting and/or confounding factors, which do not necessarily reflect ongoing physiological injury to the brain.”

Treatment of such individuals should involve a multidisciplinary team of health care providers with experience in treating SRC. The CISG 5 notes that there is preliminary evidence specifically supporting the use of the following:

- (a) A symptom targeted aerobic exercise program in patients with persistent postconcussive symptoms associated with autonomic instability or physical deconditioning.
- (b) Targeted physical therapy in patients with cervical spine or vestibular dysfunction.
- (c) A collaborative approach to deal with any persistent mood or behavioral issues, possibly including cognitive behavioral therapy.

Lastly, CISG 5 is tepid in its support of pharmacotherapy in comparison to CISG 4. They note that there is limited evidence to support pharmacotherapy use and warn that “if pharmacotherapy is used, then an important consideration in RTS 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” (1).

Recover

CISG 5 acknowledges that predicting time of recovery from SRC continues to be a difficult task. Multiple factors have been studied as potential markers of prolonged recovery. The historical factors in an athlete’s past medical history which are traditionally screened for (attention deficit disorder, migraine headaches, depression, anxiety, sleep dysfunction, and post-traumatic stress disorder) are suggested to have more utility in planning ways to recover and cope, and less useful for predicting total time to recovery. The best predictor available at this time was determined to be severity of symptoms during the first day. Overall, it has been concluded that no gold standard exists, and more research is necessary.

Various modalities including imaging (functional MRI, cerebral blood flow study, magnetic resonance spectroscopy, diffusion tensor imaging), electrophysiologic testing, and blood markers have been investigated in an attempt to evaluate so-called physiologic recovery (as opposed to clinical recovery). It has been suggested that physiologic recovery takes longer than clinical recovery, but this window for recovery is ill-defined at this time. Even if these new technologies/modalities/laboratory tests are able to detect differences after SRC, they must then be evaluated to determine whether the findings are truly pathologic or only represent normal post-injury or adaptive change. Until positive findings from these

tests can be determined to be clinically meaningful through well-designed trials, they should be considered investigational and interpreted with the utmost of caution.

Finally, there is a paucity of research in the pediatric population, particularly in those younger than 13 yr. It appears that teenage years could be one of the most vulnerable periods, and more studies should be focused in this area (1).

RTS

“No Activity/symptom limited physical and cognitive rest” has been removed as the first step of the 6 stage RTS protocol from CISG 4 and now is positioned as a prelude to the RTS exercise progression (*i.e.*, “an initial period of 24 to 48 h of both relative physical rest and cognitive rest is recommended before beginning the RTS progression protocol”). Step one of the CISG 5 RTS protocol is now “symptom-limited activity/daily activities that do not provoke symptoms.” Steps 2 to 6 for the CISG 5 RTS progression remain unchanged from CISG4. There is added emphasis for the recommendation “that there should be at least 24 h (or longer) for each step of the progression.” Also, there is now discrete direction about when resistance training should be added in the RTS progression (*i.e.*, “the later stages (stage 3 or 4 at the earliest”). While a step wise progression with 24-hour intervals makes sense from a “hedge our bets” perspective, there is essentially no evidence or published literature that supports this. Notably, there is no mention in the RTS progression about epidemiologic evidence for the most likely period for repeat concussion, that is, 10 d after the most recent concussion (19–21) and how that might influence timing for return to contact activity. These studies inform us that more than 90% of repeat concussions occur during this 10-d postconcussion window. Additionally, McCrea et al. (19) suggests that a symptom-free waiting period does not intrinsically influence clinical recovery or subsequent risk for repeat SRC. In plain language, waiting 10 d for an athlete’s return to contact activity (with or without symptoms) seems to be the most important factor for reducing the risk of a repeat “in-season” SRC.

CISG 5 has included some distinct time points for referral—“If symptoms are persistent (*e.g.*, more than 10 to 14 d in adults or more than 1 month in children), the athlete should be referred to a health care professional who is an expert in the management of concussion” (1).

Reconsider

CISG 5 looked at special populations to reconsider how concussion is managed. It was determined that elite athletes should be treated no differently than other athletes after a SRC. It was suggested that the population of children and adolescents, however, should be managed somewhat differently, but admits there is little research to guide this suggestion. As mentioned above, very few studies look specifically at the pediatric population and concussion. This minimal number of investigations has been extremely heterogeneous and has not adequately separated study groups to evaluate subtle differences between younger children and adolescents. Primary differences between children and adults are duration of symptoms and return to school. Normal recovery for those younger than 18 yr with a SRC can be up to 4 wk (vs the 10 to 14 d for adults), student athletes need to get back to being

students first. Although return to school and exercise/activity can be done at the same time, “return to learn should be prioritized over return to sport” and an athlete should not be allowed to fully RTS until they have fully returned to school. Return to school will vary with different regions and school systems, and it is encouraged that policies and procedures are in place at a school to help standardize the way SRC is managed.

For the first time in CISG history, a return to school protocol example has been outlined. Just as with return to play, it is advised to have a 24- to 48-h period of rest before starting return to school. Unlike return to play, the steps for return to school do not have a recommended minimum of 24 h per step. There is no evidence presented for this proposed progression scheme. Of course, each student should be treated as an individual, and it is reasonable to forgo the rest period and return them to school if symptoms are minimal and/or not significantly aggravated by school attendance. The suggested steps are outlined as follows (1):

- (1) daily activities at home that do not give the child symptoms,
- (2) school activities,
- (3) return to school part-time, and
- (4) return to school full-time.

Residual Effects and Sequelae

Long-term effects of multiple SRC are still not clear. Some studies suggest that multiple concussions can lead to long term sequelae such as depression and cognitive impairment. Chronic traumatic encephalopathy (CTE) continues to be clouded in uncertainty. Incidence and prevalence are unknown, a unique clinical profile that is distinct from other entities has not been defined and a cause and effect relationship between concussions and CTE has not been established. Well-designed case-control and/or cohort studies are needed to begin to answer some of these questions.

Risk Reduction

Ultimately, all the diagnostic and management strategies outlined above are reactive. Primary prevention of SRC is the ultimate goal. Key points for prevention from CISG 5(1):

The evidence for mouthguard use in prevention of SRC is mixed, but meta-analysis suggests a nonsignificant trend toward a protective effect in collision sports.

There is some promise that vision training in American college football athletes may reduce SRC, but initial studies have not been replicated at other centers.

Policy and rule changes appear to be a promising avenue to decrease number of SRC as evidenced by youth ice hockey outlawing body checking in athletes younger than 13 yr.

Stricter rule enforcement of red cards for high elbows in heading rules in professional soccer reduces risk of head contact and concussion.

Notably, no mention is made about epidemiologic evidence for the most likely period for repeat concussion, that is, 10 d after the most recent concussion (19–21). Waiting 10 d for an athlete to return to contact activity after SRC shows promise for reducing repeat in-season concussions.

Conclusion

So, “where” are we now? Overall, this most recent sequel from the CISG franchise represents a broad and impressive effort but we have yet again arrived at a location where still much more is unknown than is known concerning SRC. CISG 5 acknowledges that “the science of concussion is incomplete and therefore management and return to play decisions lie largely in the realm of clinical judgement on an individualized basis” (1) giving wide latitude to health care providers who take care of patients with SRC. As with all previous consensus statements and guidelines related to SRC (not limited to those from the CISG), there has yet to be a systematic approach to determining the impact on clinical outcomes from adherence to any particular approach or protocol. It is unlikely that we will see such research completed before version 6.0 appears. Despite this dismal outlook and that our final SRC “destination” is not yet in sight, we believe that CISG 5 is still essential reading for any clinician involved in the care of athletes, given that, despite the disclaimer, it remains the most likely “gold standard” for care of those who suffer from SRC.

The authors declare no conflict of interest and do not have any financial disclosures.

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