The Sport Concussion Assessment Tool 5th Edition (SCAT5)

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ABSTRACT

This paper presents the Sport Concussion Assessment Tool 5th Edition (SCAT5), which is the most recent revision of a sport concussion evaluation tool for use by healthcare professionals in the acute evaluation of suspected concussion. The revision of the SCAT3 (first published in 2013) culminated in the SCAT5. The revision was based on a systematic review and synthesis of current research, public input and expert panel review as part of the 5th International Consensus Conference on Concussion in Sport held in Berlin in 2016. The SCAT5 is intended for use in those who are 13 years of age or older. The Child SCAT5 is a tool for those aged 5–12 years, which is discussed elsewhere.

INTRODUCTION

The Concussion In Sport Group (CISG) developed the Sport Concussion Assessment Tool (SCAT)[1] during the 2004 meeting in Prague to serve as an educational tool for the public and to assist medical providers in evaluating sports-related concussion (SRC). The SCAT combined previously separate approaches to the assessment of symptoms (graded symptom checklist), cognitive status (five-word immediate recall, delayed recall, Maddocks questions)[2] and gross neurological functioning (speech, eye motion and pupil reaction, pronator drift and gait assessment; all assessed as 'pass' vs 'fail').

The SCAT was revised in 2008 and the new version, the SCAT2,[3] was based on a review of the empirical literature at the time. The SCAT2 comprised eight subscales that assessed symptoms (Graded Symptom Checklist—Total Symptoms, Symptom Severity),[4] physical signs score, cognitive functioning (Standardized Assessment of Concussion (SAC),[5] Maddocks questions,[2] balance (modified Balance Error Scoring System (mBESS),[6 7] the Glasgow Coma Scale (GCS),[8] delayed word recall and a brief coordination examination. The subscales could each be scored independently and summed for a maximum total score of 100. The SCAT2 was designed for use by medical practitioners. The Pocket SCAT2, a separate tool, was developed for use by non-medically trained individuals.

The SCAT2 was revised in 2012 as part of the 4th International Consensus Conference on Concussion in Sport in Zurich,[9] following a systematic review of the scientific literature by Guskiewicz et al,[10] culminating in a new version, the SCAT3. In addition, a new tool for children (under the age of 13) called the Child-SCAT3 was developed. The components of the SCAT3 include: indications for emergency management, potential signs of concussion, GCS, Maddocks questions, medical background questions, symptom evaluation, cognitive assessment, neck examination, balance examination, coordination examination,[11] considerations for management and concussion advice. The SCAT3 removed the total/composite score of the SCAT2 since there was no evidence for its validity, but retained scoring of the individual subscales. Other improvements included the addition of several 'visible' or 'observable' signs of concussion and the option of using a more sensitive 'foam' component of the full BESS.[6 7] A timed tandem gait test was also added as an alternative to the mBESS.[11 12] Additional information was added to the 'Concussion injury advice' section.[10] A separate Concussion Recognition Tool (CRT) was also developed in place of the pocket SCAT to provide information to non-medical personnel regarding the importance of recognition and removal from play of athletes suspected of SRC.

METHODS

The CISG met in Berlin in 2016 at the Fifth International Consensus Conference on Concussion in Sport. The meeting methods are detailed elsewhere[13]. The consensus process followed the approach previously employed by the CISG, which included the development of 12 questions that were to be addressed by systematic reviews in advance of the meeting, an open forum for presentation and discussion, followed by an expert panel meeting. A subset of the expert panel met on a separate day to make recommendations for improving the SCAT following examination of the results of the SCAT systematic review and reports/observations of professionals who use the tool clinically.

The SCAT5 systematic review[14] consisted of five different but inter-related searches covering: (1) adult SCAT; (2) child SCAT; (3) sideline assessment; (4) video surveillance/observable signs of concussion and (5) oculomotor assessment. The present paper will only focus on the SCAT5 (for athletes aged over 12 years). The Child-SCAT5 (for younger athletes) is published separately in this issue.[14]

RESULTS

The SCAT5 systematic review[14] concluded that studies employing the SCAT (all forms) or its components generally had a low to moderate levels of bias and were generalisable to the larger population, although variability was noted in methodologies, risk of bias, quality of evidence and presentation of data. Overall, the graded symptom checklist, SAC and BESS/mBESS were found to be most useful immediately postinjury in differentiating concussed from non-concussed athletes when using either intraindividual or normative baseline/postinjury comparisons. The diagnostic utility of the SCAT and its components appears to decrease significantly after 3–5 days postinjury, which suggests that the tool may have differential utility in helping to diagnose concussion and tracking recovery versus assisting return to play decision making.[15] As such, the tool appears to be clinically useful in screening evaluations and making the diagnosis of SRC but has a more limited role in tracking recovery and assisting the return to play/sport decision. The symptom checklist does demonstrate clinical utility in tracking recovery.

A notable limiting factor for the SCAT was evidence of a ceiling effect on the SAC portion for adolescents and adults. Specifically, ceiling effects were apparent on the Immediate Recall subcomponent of the SAC.

Although possibly a result of the search strategy, there were limited data that examined the utility of the SCAT across different cultural and linguistic groups.

THE SCAT5

The SCAT5 is a tool for use by healthcare professionals in the evaluation of individuals 13 years old or older, who are suspected of having sustained an SRC. The Child SCAT5 is used to evaluate SRC in children 5–12 years old.[14] A separate tool, the Concussion Recognition Tool 5 (CRT5),[16] was developed for use by non-medically trained individuals to assist in the identification and initial management of *suspected* SRC. The designation of the SCAT5 (rather than SCAT4) was chosen to align the version number with the fifth meeting of the CISG. There is no SCAT4.

In revising the SCAT, the expert panel was cognisant of the fact that the SCAT3 has been used widely across many different countries and a significant amount of normative data has been gathered. Similarly, healthcare professionals have generally found the SCAT3 to be useful and have become proficient in its administration. For these reasons, the modification of the SCAT3 into the SCAT5 was not only guided by information gathered in the systematic review, expert panel discussions and input from conference attendees but also with the understanding that the tool should maintain as much continuity as possible with the SCAT3 and should only be changed where necessary.

The modifications included in the SCAT5 are presented in box 1.

DISCUSSION

The SCAT5 continues the tradition of its predecessors by creating a standardised approach to acute evaluation of suspected concussion that includes measures and methods shown to be useful in detecting SRC. The SCAT5 maintains consistency with the SCAT3 wherever possible, although it does address some of the limitations identified in the systematic review and provides additional evaluative tools. For example, to increase the utility of the tool, a Rapid Neurological Screen has been included that consists of an evaluation

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Box 1   SCAT5 modifications

► Declaration that the complete SCAT5 cannot be appropriately completed in less than 10 min.
► Inclusion of an Immediate/Acute Assessment section, including indications for emergency management and observable signs of possible concussion.
► Clarified instructions that the Symptom Checklist should be completed by the *athlete* in a *resting* state.
► Different instructions for completing the symptom checklist at baseline and postinjury have been added.
► Addition of questions that compare the athlete's postinjury presentation with preinjury behaviour.
► The SAC immediate and delayed word recall lists include an option to use 10 words instead of 5 to minimise ceiling effects.
► All six versions of the SAC word lists are now presented with alternate stimulus sets for the word list and digits backwards. Their administration should be randomised at baseline and serially postinjury.
► A notation of when the last trial of the word list was administered is required (the delayed recall should not be administered sooner than 5 min after the immediate memory subtest).
► Digits Backwards now contains six versions of the digit strings, which should be randomised at baseline and serially postinjury.
► A Rapid Neurological Screen has been included.
► A section has been added that includes affirmation that the SCAT5 was used or supervised by a healthcare professional and whether a concussion was diagnosed.
► The Instruction section has been enhanced to include all of the modifications described above.
► The Return to Sport progression emphasises that the initial period of physical and cognitive rest should typically only last 24-48 hours.
► A Return to School progression has been added, including possible academic accommodations.
► The SCAT5 specifically indicates that written clearance by a healthcare professional is necessary prior to returning to play/sport.

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of the cervical exam, athlete's speech, ability to read, balance, gait, visual tracking and finger to nose coordination. The Rapid Neurological Screen is a brief screening tool that does not replace a more complete examination.

The diagnosis of concussion relies on a clinical synthesis of complex, non-specific and at times contradictory information. Accordingly, only healthcare professionals trained in assessing and managing SRC should use the SCAT5, which is not designed to be used in isolation to make or exclude the diagnosis of concussion. The SCAT5 includes comprehensive instructions for the appropriate administration of the subscales that should be carefully studied and practised prior to clinical use.

The expert panel discussed the time necessary to administer the complete SCAT5 and consensus was reached that no less than 10 min were required. Those sports that allow only a limited amount of time of less than 10 min for an acute evaluation screening of suspected concussion are encouraged to review their existing rules if indicated. Since there did not appear to be any empirical evidence to support a specific time

frame (eg, 10 min), the SCAT5 does not specify any time frame between exercise and administration of the SCAT. However, there is expert consensus that the SCAT5 should be administered in a resting state, which means that the athlete should be at or near his or her resting heart rate. Anecdotal reports of athletes memorising and rehearsing words lists and digits are addressed with the provision of six distinct groups of five words and six sets of digit strings, which should be randomly presented at baseline and sequentially postinjury. The added option of using a 10-word list per trial could diminish ceiling effects, while preserving continuity with the 5-word list in those settings where ceiling effects are less apparent. As this is a novel methodology, normative data will need to be collected on the 10-word lists and research will be required to examine its utility.

The systematic review noted that there was scant information on the use of the SCAT in athletes with disabilities, as well as across different cultures and language groups. Indeed, much of the normative data that exist are limited to a few sports in North America. It is recommended that a systematic approach be undertaken to translate and culturally adapt the SCAT5 into a broad range of languages. Research is encouraged to establish a comprehensive set of norms across language groups, sports, gender, disabilities and age.

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