



Use of a rapid visual screening tool for the assessment of concussion in amateur rugby league: A pilot study

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ABSTRACT

Aim: This study undertook to use the K-D sideline test with the SCAT2 to see if concussions could be identified in amateur rugby league players over a representative competition period.

Method: A prospective cohort study was conducted on two teams participating in an amateur rugby league. All players were tested for signs of concussion utilising the K-D test and players with longer times than their baseline scores undertook a further concussion assessment with the SCAT2.

Results: Five athletes with suspected concussion were evaluated by K-D testing. Three concussions were associated with witnessed events during the matches and two athletes were identified by the team medic as having longer K-D time scores incidentally post-match compared to baseline. Post-match K-D scores for all concussed athletes were worse than baseline for those with reported or witnessed concussion events (7 s; 5.0–7.1; $p=0.025$) and for those identified incidentally (> 5 s; 8.9–9.1 s). Both groups also reported more symptoms on the PCSS (a part of the SCAT2) post-match.

Discussion: In this rugby cohort, the K-D test was not only useful in identifying changes in players with witnessed head trauma, but in identifying changes in players with an un-witnessed suspected concussion.

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1. Introduction

The identification and management of sports-related concussion is now an issue that is being faced by all sports. The risk of an acute catastrophic head injury [1] and long-term neurological sequelae as a result of repeated sports-related concussions [2] has been reported. The identification of concussion is a diagnostic challenge even for the sports medicine professional [3]. This is, in part, due to the fact that every sports-related concussion is unique and no two concussions present identically [3]. To complicate things further, the signs and symptoms of a sports-related concussion may not present immediately but may evolve over several hours to days after the event has occurred [3]. This challenge is even greater for the amateur sports volunteer who acts as the sideline medic or first aider.

Following the 2004 Second International Concussion In Sport (CIS) conference, the Sports Concussion Assessment Tool (SCAT) was published as part of the summary and agreement statement of those attending [4]. The third international conference on CIS in Zurich [5] resulted in the SCAT being amended and the SCAT2 was produced representing the only new sideline assessment tool published since 2009. The SCAT2 is a longer sideline concussion tool and, although

is an improvement over the original SCAT, will require additional time of approximately 20 min to complete on the sideline making this more of a training room assessment tool as opposed to a readily available sideline assessment tool [3].

Originally developed as a reading tool to assess for the relationship between poor oculomotor functions and learning disabilities, the King–Devick (K-D) test uses a series of charts of numbers that progressively become more difficult to read in a flowing manner [6]. Poor oculomotor function has also been reported as one of the most robust discriminators for the identification of a mild Traumatic Brain Injury [7]. The K-D test has been reported to be a useful rapid screening test to assess sports participants with a suspected concussion on the sideline [8]. Requiring less than 2 min to administer, the K-D test is a practical sideline screening tool that is reportedly quicker than other concussion screening tools such as the Immediate Post-Concussion and Cognitive Testing (ImPACT), Cognitive Status Sport (Cog Sport) [9], the Standardized Assessment of Concussion (SAC) [10] and the Sports Concussion Assessment Tool 2 (SCAT2) [5]. Although these screening tools are useful in assessing for suspected concussion they do not assess eye movements or brain stem function well [11]. The K-D test does however test for impairment of eye movement, attention, language and other areas that correlate with sub-optimal brain function that may occur following a concussive episode [11]. The King–Devick [6,8] is reportedly able to be completed on the sideline in less than a minute and has been moderately

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correlated ($r_s = -0.54$; $p = 0.07$) with the Military Acute Concussion Evaluation (MACE) [12]. With this in mind this study undertook to use the K-D sideline test with the SCAT2 to see if concussions could be identified in amateur rugby league players over a representative competition.

2. Methods

A prospective cohort study was conducted on two teams participating in the amateur representative rugby league regional competition season (seven teams from around New Zealand playing in a home and away competition format over eight weeks from August to October 2011). Over the duration of the study 50 players (mean (\pm SD) age; 22.4 ± 4.1 yr.; stature: 1.81 ± 0.06 m; mass: 96.0 ± 13.7 kg) were enrolled in the study. All players were considered amateur as they received no remuneration for participating in rugby league activities and derived their main source of income from other employment activities. The matches were played under the rules and regulations of the New Zealand Rugby League which includes the mandatory requirement for the wearing of mouthguards during match play. All participants were invited to participate in the study and received a clear explanation of the study, including the risks and benefits of participation. All procedures were approved by the Central Region Ethics Committee of the Health and Disability Ethics Committee (CEN/11/EXP/039).

2.1. Previous concussion history

All players were asked about their concussion history. This included history of concussions in the current and previous playing seasons, number of concussions, residual symptoms from any concussions reported and medical clearance to return-to-play.

2.2. King–Devick (K-D) Test

The King–Devick (K-D) test is a saccadic test measuring the speed of rapid-number naming [6]. The K-D utilises three test cards with a series of single-digit numbers that are read aloud from left to right. The test includes one practice (demonstration) card and three test cards that vary in appearance. Players were asked to read the numbers on each card aloud from left to right as quickly as possible without making any mistakes. The time taken for each card was recorded as was the number of reading errors made and this was combined to provide a summary score for the entire test, the K-D score. The entire test required less than 2 min to administer per player. The K-D test has been reported to have an inter-class correlation for test–retest reliability of 0.97 (95% CI: 0.90 to 1.0) [8]. The K-D tests utilised varied between v1.1.0 (<http://www.kingdevicktest.com>) on an iPad2 and hard copy (v2.0.0).

2.3. Post-Concussion Symptom Scale (PCSS)

The PCSS is a 22-item neuropsychological assessment scale that is a part of the larger Sport Concussion Assessment Tool (SCAT). Developed in the late 1980s [13], the PCSS was designed to measure the severity of symptoms in the acute phase of recovery from a concussion. Using a 7-point Likert-type scale anchored at 0 (complete absence) to 6 (most severe) players rank each symptom according to the severity that they have experienced. The symptoms are not specific to concussion and even non-injured participants have recorded symptoms on the PCSS [13]. A threshold symptom score of 7 was set for the duration of the study [14]. Any player reporting more than 7 symptoms on any assessment were referred for further medical evaluation. This threshold was adopted as an indicator of a head injury having occurred based on prior studies [14]. The internal consistency reliability (Cronbach's α) for the PCSS has been reported to range from 0.88 to 0.94 [13].

2.4. Sport Concussion Assessment Tool (SCAT)

The SCAT2 [5] is a tool developed by combining existing concussion assessment tools [4]. Established as having face validity, the SCAT2 reliability and change scores have not been reported to date [15]. The SCAT2 consists of both subjective and evaluative components consisting of the PCSS, modified Maddock's questions, cognitive assessment and neurological screening. The cognitive assessment consists of a five word immediate (upon hearing the words) and delayed (following concentration tasks) recall assessment, reciting the months of the year in reverse order and repeating single digits in reverse order. The SCAT2 (v1.1; <http://www.scat2.org/>) assessments were completed on an iPad2 or iPod-Touch.

2.5. Match exposure and concussion definition

Injury rates expressed as the number of injuries sustained per 1000 playing hours were determined using previously described methods [16]. Over the duration of the competition, all match and training injuries were recorded by the team sports medic who was a registered comprehensive nurse with tertiary sports medicine qualifications and accredited in injury prevention, assessment, and management. All injuries were recorded on a standardized injury reporting form regardless of severity [17]. The definition of a concussion utilised for this study was “any disturbance in brain function caused by a direct or indirect force to the head. It results in a variety of non-specific symptoms and often does not involve loss of consciousness. Concussion should be suspected in the presence of any one or more of the following: (a) Symptoms (such as headache), or (b) Physical signs (such as unsteadiness), or (c) Impaired brain function (e.g. confusion) or (d) Abnormal behaviour” [5].

2.6. Testing procedure

Every player named in the representative squad's completed a pre-competition questionnaire on concussion history, a baseline PCSS and 2 trials of the K-D test a week before they participated in any match activities. The fastest time of the K-D test with no errors was recorded as the baseline score. During matches, any player observed to have received a direct blow to the head, was slow to rise from a tackle or collision or appeared unsteady on their feet following a collision were assessed on-field. Any signs of delayed answering, incorrect answers to questions or if the player appeared to be impaired in any way they were removed from the match activity and rested on the sideline. Player's with a loss of consciousness were treated for a cervical spine injury.

Players who reported any sign(s) of a concussion or who were suspected to have incurred a concussion as a result of match participation were removed from the match and assessed with the K-D test and the SCAT2 within 30 min of the injury occurring. The judgement of whether a player had incurred a suspected concussion was left to the team medic. No player with a suspected concussion was allowed to return to training or match activities without:

- a. Having an initial medical assessment;
- b. Having undertaken a graduated return-to-play protocol;
- c. Had remained symptom free; and
- d. Have received a full medical clearance to return to full match participation.

The management team established guidelines for the use of the K-D test in assessing players for suspected concussion based on previous studies [8,18]. These were:

- (1) Any player who had a difference of up to 3 s from the baseline combined with a symptom score lower than seven on the PCSS was to undergo a further K-D test and PCSS assessment at the

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