

# The King-Devick test: Improving the Capacity to Diagnosis Concussion among High School Football Athletes



Nicole Gregoire, MPH, MMS (c)  
Faculty Advisor: Amanda Murphy MMS, PA-C  
Department of Medical Sciences



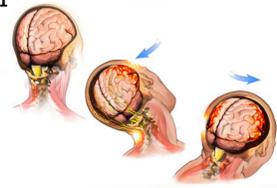
## Abstract

Sport-related concussions, particularly in children, are a major public health concern due to the complexity of the condition and high prevalence of undiagnosed and/or unreported concussions. The lack of a standardized sideline assessment tool has contributed to this issue. Because of this, researchers have further investigated the use of tools such as the Sport Concussion Assessment Tool, 3<sup>rd</sup> edition, (SCAT3), as well as the King-Devick (KD) test of saccades. This was a qualitative systematic review that sought to determine if the SCAT3 more accurately diagnosed concussions when used independently or when used in combination with the KD test in youth athletes. Few studies directly compared these tools; therefore, more research is warranted. However, the studies included here support the composite use of the SCAT3 and KD for improved diagnostic capacity.

## Introduction

**Concussion: brain tissue damage due to rotational and shear forces that occur after a bump or blow to the head or body<sup>1</sup>**

- 20% of the 1.3 million concussions that occur each year are sport-related<sup>1,2</sup>
- Highest incidence in American football at high school and collegiate levels<sup>3-5</sup>



**Short- and long-term sequelae include cognitive, behavioral and physical problems**

- Decreased quality of life due to lasting effects on academic performance, home life, social relationships, and the ability to participate in physical activities
- Can be more severe with undiagnosed or mismanaged concussion<sup>6-9</sup>

**Current methods for sideline diagnosis:**

- No standardized tool
- SCAT3: consensus-driven tool with components that evaluate symptoms, cognition, balance, coordination<sup>10</sup>
- KD test: 2-minute exercise that evaluates saccades<sup>11</sup>
  - Any worsening in performance has demonstrated high sensitivity and specificity for detecting a concussion

## Methods

A literature search was conducted through PubMed, EBSCO, Cochrane Library, OVID, and Google Scholar in November 2018. A total of five articles consisting of one cross-sectional study, one pooled and meta-analysis, one prospective case-control, and two prospective cohort studies were included based on publication date, full-text availability and sample population. The study design and results of these articles was then analyzed and compared.

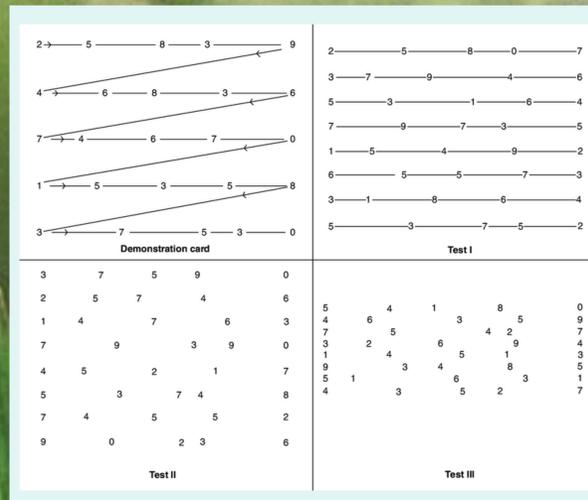
## Results

- **Zero** studies directly compared the ChildSCAT3 – a version used for children under 13 years-old – with KD.
- **2 out of 5** studies directly compared the SCAT3 with and without KD, and demonstrated a statistically significant increase in specificity when SCAT3 and KD tests were used together
- **4 out of 5** studies demonstrated evidence that the KD test has adequate sensitivity and specificity
- Despite varied study design, **5 out of 5** studies concluded that both the SCAT3 and KD should be recommended for use within a composite of tests as this significantly increases the capacity for detection.

### Summary of Study Results

Study	Design	SCAT3	KD	KD Sensitivity	KD Specificity	SCAT3 + KD
Babl et al. (2016)	Prospective case-control	S	--	--	--	--
Galetta et al. (2015a)	Pooled and meta-analysis	--	S	86%	90%	S
Galetta et al. (2015b)	Prospective cohort	S	S	--	--	S
Oberlander et al. (2017)	Cross-sectional	--	S	--	--	--
Seidman et al. (2015)	Prospective cohort	--	S	--	--	--

Key: S = significant; NS = not significant; KD = King-Devick; SCAT3 = Sport Concussion Assessment Tool, 3<sup>rd</sup> Ed.



## Discussion

- The KD test shows promise as an effective tool for the sideline detection of concussion when used as an adjunct to the SCAT3.
- Studies directly comparing the two tests demonstrated a statistically significant improvement in discriminatory ability (ROC curve) from 68% to 87% for SCAT3 components alone to 97% to 100% when combined.
- While there is growing research on the reliability, sensitivity and specificity of such a composite test, they are not yet determined.

**Strengths:**

- This qualitative review study supports a composite test
- Exposes many gaps in the literature

**Limitations:**

- Few studies directly comparing the two tests
  - Few studies were included
  - Study design is highly varied
  - No reported sensitivity or specificity for a composite
- Inherent limitations due to study type – inability to use RCT design and blinding, inherent convenience bias in sample selection

## Conclusions

- There is no standardized assessment for the sideline evaluation of concussions despite research concluding that a composite of tests should be used.
- Despite being consensus-driven, the failure of the SCAT3 to assess saccades may contribute to misdiagnosed and mismanaged concussions.
- Sensitivity and specificity of a composite tool have yet to be determined so it is difficult to make steadfast conclusions.
- Based on the discriminatory ability and test-retest reliability of the KD in combination with the SCAT3, it reasonable to recommend a composite assessment tool.
- Further research is warranted to determine the sensitivity, specificity and discriminatory ability of these tests when used compositely.

## References

- Centers for Disease Control and Prevention (CDC). Traumatic brain injury and concussion. 2016. <https://www.cdc.gov/traumaticbraininjury/basics.html>. Accessed April 9, 2019.
- Kelly KD, Lissel HJ, Rowe BR, et al. Sport and recreation-related head injuries treated in the emergency department. *Can J Sport Med*. 2001;11:77-81. doi:10.1097/00042752-200104000-00003
- Pflieger R, Pflieger K, Hager B, et al. The incidence of concussion in youth sports: a systematic review and meta-analysis. *Br J Sports Med*. 2016;50:292-297. doi:10.1136/bjsports-2015-094978
- Dompier TP, Kerr ZY, Marshall SW, et al. Incidence of concussion during practice and games in youth, high school, and collegiate American football players. *JAMA*. 2015;309(7):659-665. doi:10.1001/jama.2015.0210
- Gezani LM, Fields SK, Collins CL, Dick RW, Comstock RD. Concussions among United States high school and collegiate athletes. *J of Athl Train*. 2007;42(4):495-503.
- Miciano A. Persistent post-concussion symptoms, multi-morbidity burden, quality of life, global physical health, and work performance after mild head injury: Two-year rehabilitative outcome. *Neurology*. 2012;78(1)Supplement P01.183.
- Hallstead ME B, Walter KD. Clinical report: Sport-related concussion in children and adolescents. *Pediatrics*. 2010;126(3):507-615.
- Baugh CM, Krushik E, Kierans PT, Mensel D, Meehan WF (2016). Football players' perceptions of future risk of concussion and concussion-related health outcomes. *J Neurotrauma*. 2016;34:790-797. doi:10.1089/neu.2016.4585.
- Micke AC, Cairns NJ, Dickson DW, et al. The first NINDS/NIMH consensus meeting to define neuropathological criteria for the diagnosis of chronic traumatic encephalopathy. *Acta Neuropathologica*. 2016;131:75-86. doi:10.1007/s00401-015-1515-z
- McCorry P, Meuwisse W, Dvorak J, et al. Consensus statement on concussion in sport – the 5<sup>th</sup> international conference on concussion in sport held in Berlin, October 2016. *Br J Sports Med*. 2017;51(1111):838-847. doi:10.1136/bjsports-2017-097699
- Dhawan PS, Leong D, Tappell L, et al. King-Devick test identifies real-time concussion and asymptomatic concussion in youth. *Neuro Clin Pract*. 2017;7:464-473.
- Babl FE, Donnio D, Davignon L, et al. Accuracy of components of SCAT to identify children with concussion. *Pediatrics*. 2016; 40(2):pii=S20163258. doi:10.1542/peds.2016-3258
- Galetta KM, Liu M, Leonard EP, Ventura JE, Galetta SL, Babler L. The King-Devick test of rapid number naming for concussion detection: meta-analysis and systematic review of the literature. *Concussion*. 2015a;1(1):CNCR. doi:10.2217/cnc.15.8
- Galetta KM, Morganti J, Moehringer N, et al. Adding vision to concussion testing: a prospective study of sideline testing in youth and collegiate athletes. *J Neurophysiol*. 2015b;133(1):235-241. doi:10.1097/WNO.0000000000000206
- Oberlander TJ, Olson BL, Weidauer L. Test-retest reliability of the King-Devick Test in an adolescent population. *J of Athletic Training*. 2017;52(1):439-445. doi:10.4085/1062-6050.52.2.12
- Seidman DH, Burlingame J, Youff LR, et al. Evaluation of the King-Devick test as a concussion screening tool in high school football players. *J Neuro Sci*. 2015;356:97-101. doi:10.1016/j.jns.2015.06.021