



On-Field Diagnosis and Management of Sports-Related Concussion in Pediatric Athletes

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Background: In pediatric sports medicine, the accurate diagnosis of sports-related concussions (SRCs) relies on keen observation and precise evaluation during athletic endeavors. Unlike many medical conditions, SRC is not readily diagnosed through traditional imaging studies or laboratory tests.

Indications: The absence of objective diagnostic tools for the diagnosis of concussion emphasizes the critical need for a set of evidence-based examination skills to empower health care professionals, including physicians, physical therapists, and athletic trainers, in making reliable diagnoses.

Technique Description: At the forefront of the essential examination skills is the Vestibulo-Ocular Motor Screen (VOMS), a recognized and valuable tool for both diagnosing and monitoring the recovery of individuals affected by SRC. This video presentation aims to offer a comprehensive exploration of the neurologic domains most frequently impacted in pediatric patients experiencing SRCs. Furthermore, it provides a detailed and insightful guide on the proper execution of the VOMS examination.

Discussion/Conclusion: Upon watching the video, viewers will acquire the skills to discern SRCs in young athletes. This information is most important for health care professionals who are tasked with recognizing and promptly removing pediatric athletes suspected to have a SRC, as well as monitor their recovery and assess their readiness to return to competition.

Patient Consent Disclosure Statement: The author(s) attests that consent has been obtained from any patient(s) appearing in this publication. If the individual may be identifiable, the author(s) has included a statement of release or other written form of approval from the patient(s) with this submission for publication.

Keywords: concussion; pediatric; vestibular; athlete; trauma

VIDEO TRANSCRIPT

Hello all and thank you very much for your attention to this presentation. Today, we will be reviewing a comprehensive approach to diagnosing and managing concussion

during sport in pediatric athletes. Specifically, this approach will provide athletic trainers a format for recognizing concussion on the field. There are no financial disclosures related to this work. All athletic trainers and doctors involved in this project are employed by Stanford Medicine Children's Health.

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BACKGROUND

The main goals of this presentation are to help athletic trainers define concussion, help athletic trainers describe the domains commonly affected in concussion, provide an overview of the general rehabilitation process with particular attention to the vestibular-ocular motor screen in the context of concussion diagnosis, and help clearly define the athletic trainer's role in performing the sideline concussion evaluation.

The most challenging aspect of diagnosing concussions is the fact that it is a clinical diagnosis.⁶ At this time, there



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is no reliable imaging study or laboratory value that can independently diagnose concussions.⁶ Concussion is defined as a rapid onset of transient neurologic dysfunction following a biomechanical force applied to the brain.⁶ Symptoms from a concussion can vary from person to person but most commonly are reported to be headaches, dizziness, nausea, and lightheadedness.⁶ A diagnosis of a concussion should be considered in all athletes who have suffered a direct or indirect blow to the head and report any signs or symptoms of abnormal neurologic function afterward. As a better understanding of the pathophysiologic mechanisms underlying concussion is evolving, it is now understood that specific neurologic domains are characteristically affected during the symptomatic phase of concussions.^{2,6} These domains can be broadly characterized as somatic or autonomic, visio-vestibular, mood, and cognition.^{2,6} These domains underscore the types of symptoms that concussed patients tend to report.

As an example, it is thought that headaches, light and sound sensitivity, fatigue, and exercise intolerance can be mapped to somatic dysfunction.^{2,6} This is based on work that demonstrated that early exposure to a graduated exercise program allowed concussed athletes to have relief from these symptoms as well as recover at a faster pace compared to controls.^{2,4} Therefore, to systematically alleviate these symptoms in the short and long term and to improve rates of recovery, it has been found that graduated exercise intensity that provokes symptoms very mildly is more beneficial early on rather than strict rest and full avoidance of symptoms.⁴

Concussed athletes commonly describe cognitive dysfunction related to their concussion.^{1,2,6} These cognitive symptoms can include issues with memory recall and inattentiveness.⁶ It has been found that patients who return to various degrees of academic workloads that are below maximum can recover at relatively equal rates.¹ This indicates that patients can resume some cognitive activity early in the recovery process.¹ This can greatly help alleviate the degree that student-athletes fall behind in school as a result of their concussion.

Mood symptoms following a concussion can affect patients to varying degrees.^{2,7} The mood symptoms themselves may arise from chemical changes in the brain as a response to the injury but can also be facilitated by changes in the patient's environment and activity level as a consequence of the concussion.^{2,7}

For the acutely concussed athlete on the field, visio-vestibular dysfunction provides an opportunity for additional confirmatory physical examination and can assist the athletic trainer in making sports participation decisions and advising athletes and their families.^{2,6} Visual abnormalities are a relatively common finding in concussed adolescents.⁵ A carefully performed vestibulo-ocular motor screening examination, or VOMS, is extremely beneficial in helping diagnose concussions acutely and can also assist in tracking recovery in the long term.^{2,6} Immediate evaluation of a suspected concussed athlete should include close monitoring of patient behavior following the suspected injury.² Particular attention should be paid to the patient's

gait, disposition and attitude, and speech.² Acute alterations in balance, the expression of confusion, or unexplained high emotion, including anger or sadness, can be evidence that the brain has been injured and concussion symptoms are being exhibited.⁶ Additionally, it is important to elicit from the patient if they are feeling any symptoms. Changes in vision, nausea, headache, and amnesia are common symptoms that patients may complain about if they are concussed.^{5,6} To provide additional assistance in discerning if a patient is concussed, we will now review a sideline VOMS examination.

TECHNIQUE DESCRIPTION

First, it may be necessary to bring the athlete to the training room or locker room to perform the examination. Position yourself about 1.5 feet away from the athlete. To begin, start simply by asking the athlete to track your finger movements with their eyes. You are observing to see if they can smoothly track rapid movements. After about 10 seconds, you should ask the athlete if they feel any symptoms.

Next, perform the horizontal saccadic movement. Position your fingers at approximately shoulder length and ask the athlete to quickly look from one finger to the other. You should follow this with vertical saccadic testing. Again, follow the same instructions, and after each test, ask the athlete if they have any symptoms.

For near point of convergence testing, ask the athlete to fix their gaze on the letters of a small pen or pencil. Slowly advance the object toward their face and note down the distance in centimeters when it becomes blurry and splits. Anything less than 6 is considered normal.² For horizontal gaze stabilization, position your finger in front of the athlete and ask them to maintain fixation while shaking their head as if saying no. Perform this for 20 repetitions. At the end of the task, ask if they feel any symptoms. Again, follow this with vertical gaze stabilization, following the same instructions and inquiring about symptoms at the end. For visual motor sensitivity, ask the athlete to extend their own arm forward in the thumbs-up position. While maintaining focus on their own thumb, rotate their upper body from left to right, and after several repetitions, stop the athlete and ask them if they have any symptoms.

Last, test the athlete's tandem gait and balance. Have them walk in a heel-to-toe manner along a line for several steps. The athlete should attempt to do this walking forward and backward with their eyes open and again with their eyes closed. Observe for any significant issues with balance or significant sway.

DISCUSSION

The diagnosis of a concussion can be clinically challenging, and the athletic trainer's role in rapid identification and removal from play of concussed athletes can be a herculean but quintessential task. We encourage athletic trainers to rely on close observation of athlete behavior following


suspicious injuries, as well as inquire about any symptoms indicating affected brain function. Additionally, mastery of the VOMS examination is an important skill set to assist athletic trainers in making return-to-play decisions for athletes undergoing concussion evaluation.


A few pearls, pitfalls, and controversies are worth discussing. In a concussed athlete, any symptom that they report that specifically worsens with physical or cognitive exertion should be very carefully evaluated. This is because this likely indicates that it is a concussion symptom that they are reporting that has not yet fully resolved. The literature seems to denote that female athletes generally tend to take a longer time to recover from concussion than male athletes.³ At this time, it is not exactly clear what factors play a role in this prolonged recovery rate. Additionally, the science has not settled on exactly how many concussions or how severe of a concussion is considered too many or too severe to suggest that an athlete should consider retiring from a high-risk sport. Additionally, studies are currently being performed on the utilization of protective gear in soccer, water polo, and other related sports. At this time, it is unclear if protective gear will make a significant difference in decreasing rates of concussion.

Here are our references.

We thank you all very much for your attention.

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