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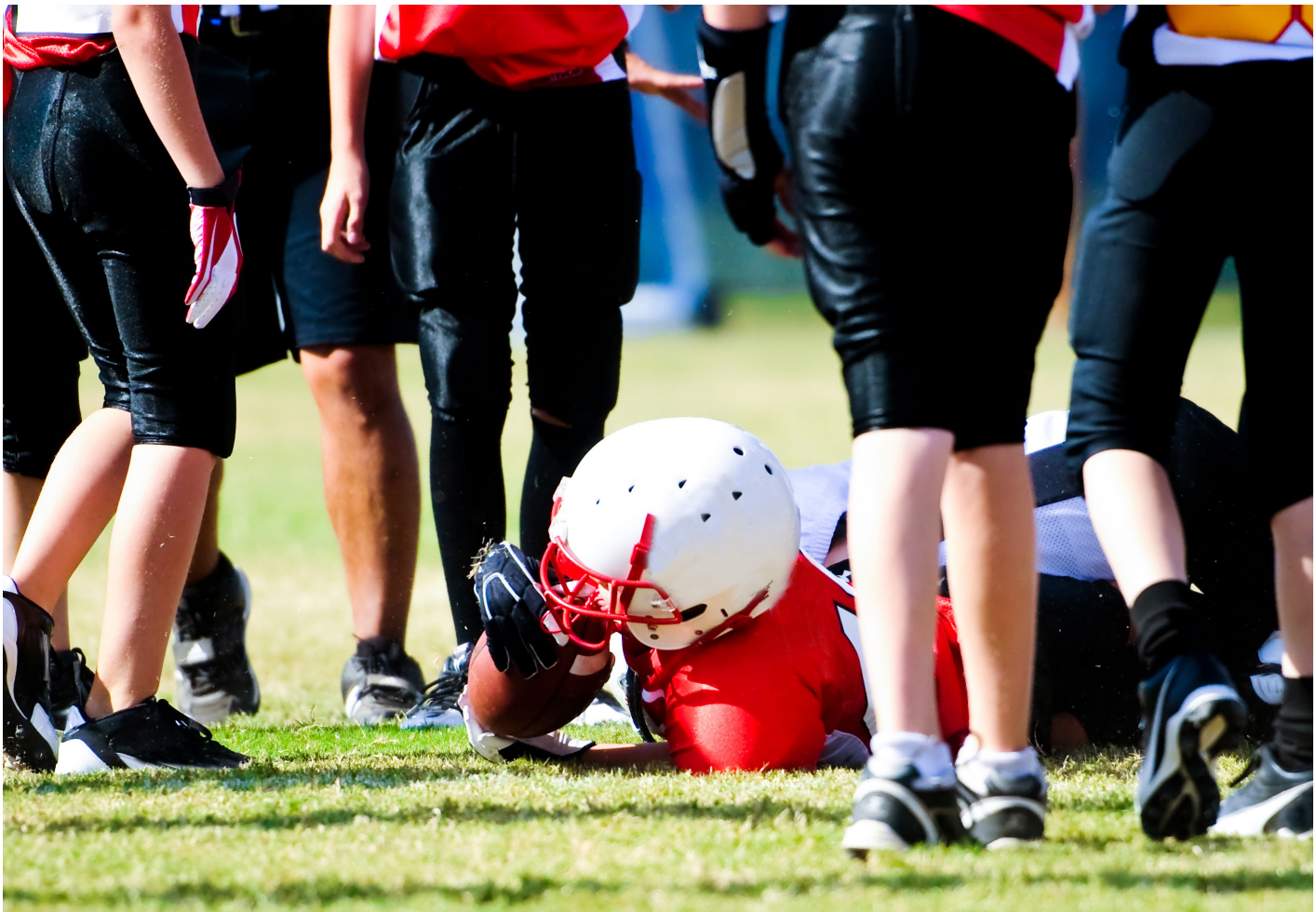

Sport-Related Concussion

By Alecia Gende, DO, Fellow Physician, University of Iowa Health Care Sports Medicine and Andy Peterson, MD, MSPH, FAAP, Director, University of Iowa Health Care Sport Concussion Program

Sport-related concussion (SRC) receives a fair amount of attention in the media and has become a stopping point for some Iowa contact sport athletes and their parents. Since 2011, Iowa law has been in place regarding concussion identification and recovery. In an attempt to answer questions and provide reassurance, this review is written for health care providers caring for concussed athletes and their parents. For a complete review of sport-related concussion and the current guidelines, please refer to the Consensus Statement from the 5th International Conference on Concussion in Sport.[1]

(continues on page 2)

Sport-Related Concussion *(continued from page 1)*

Iowa's youth sports and concussion law, covering private and public school students grades 7-12, was updated in July 2018. The law focuses on education and prevention. It dictates that all coaches and officials attend training every two years, all parents of students are provided an information sheet on brain injury, and that the sheet is signed by both parent and student prior to participation. Updates also included the requirement for school districts to provide protective equipment and adopt the return-to-play protocol developed by Iowa governing bodies before July 1, 2019. Concerning concussed athletes returning to school, the updated law mandates school districts develop and support a return-to-learn protocol developed in collaboration with the student, parent or guardian, and a licensed health care provider based on guidance from the Brain Injury Association of America.

Concussion, a form of traumatic brain injury, occurs after blunt trauma to the brain. Impact between head and ground or head/neck and various body parts of an opposing player are common examples. The sudden change in forces causes a diffuse injury to the brain, altering its ability to conduct impulses and negatively impacting brain function. Concussed athletes may lose consciousness or even have a seizure at the time of injury. Others may appear stunned and confused or have poor athletic performance. Athletes frequently complain of headache, "feeling in a fog," emotional lability, and difficulty concentrating. Recognition of a SRC is the first step in management. McCrory, et al describe sport-related concussion as an evolving injury with dynamic signs and symptoms. Athletic impact with potential to cause SRC and any athlete signs or symptoms, even transient, should prompt further sideline evaluation. The Sideline Concussion Assessment Tool (SCAT5) is a quick, standardized tool to assess the neurologic and cognitive function of the injured athlete.[2] It is easily accessible online and free of charge, a link is included at the end of this article. Although no concussion tool is perfect, a well done SCAT5 can assist in safe management and screening of the suspected concussed athlete and can guide the provider in removal-from-play or return-to-play decisions. Any Iowa athlete with suspected sport-related concussion, whether recognized by coaches, officials, or a licensed health care provider, should be removed from play. Most concussed athletes will not require neuroimaging, but if the athlete's neurologic function declines or if focal neurologic deficits are assessed, neuroimaging, such as CT or MRI, should be performed.

After a concussion is diagnosed and an athlete is removed from play, symptoms become the primary driver through the recovery phase. Using the SCAT5 symptom score daily to assess symptom severity is a common practice. Although the specific amount of rest is not well defined in the literature, rest, both physical and cognitive, is recommended during the acute phase of recovery, typically 24-48 hours. After that, concussed athletes are encouraged to gradually increase their activity so long as they stay below symptom-exacerbation threshold and avoid vigorous exertion. The recovery period is different for each individual and may vary for each concussion in a single athlete. Once symptom free, a progressive and gradual return-to-play protocol is initiated. An athlete is progressed through each phase after 24 hours and when the activity is tolerated without symptoms. If an athlete develops symptoms, they are rested and progression to the next level is halted. After an athlete is symptom free, they are restarted at the prior asymptomatic level and again progressed as tolerated every 24 hours until the protocol is completed. A concussed athlete is managed by a variety of professionals trained in concussion evaluation and management, such as a physician, physician assistant, nurse practitioner, chiropractor, nurse, physical therapist, and/or licensed athletic trainer. Per Iowa law, each concussed athlete must receive written clearance by one of these professionals prior to beginning the return-to-play protocol. The Iowa guidelines are below, and at: https://idph.iowa.gov/brain-injuries/concussion

1. Athlete is asymptomatic for 24 hours and has received written medical clearance to begin return-to-play process
2. Low impact, light aerobic exercise—stationary cycling, no resistance/weight training
3. Harder aerobic exercise—running, sprinting, line drills
4. Non-contact, sport-specific training—passing drills, ball handling, batting, running drills, progressive resistance training
5. Full contact practice—following medical clearance
6. Full return-to-sport

In some settings, computerized neurocognitive testing also is used to assess recovery and assist providers with return-to-play decisions. Computerized neurocognitive testing is not used independently, but as an adjunct to

clinical judgement. When possible, a baseline test is administered prior to injury and the test is repeated after an athlete is asymptomatic and compared to the baseline. An asymptomatic athlete who has returned to baseline on testing may be safely progressed to return-to-play protocol.

In few athletes, symptoms will persist beyond expected time frames, >10-14 days in adults and >4 weeks in children. Each athlete should receive a comprehensive history and physical exam to identify the areas on which to focus during rehabilitation. Consider sub-symptom aerobic exercise for deconditioning or autonomic instability, specific physical therapy for cervical spine or vestibular dysfunction, or cognitive behavioral therapy for mood and behavior issues. Referral to a sports or neurology specialist is occasionally necessary and will depend on local resources and practice patterns. A concussion specialist should be considered any time the licensed health care provider is less than comfortable managing the athlete, or if recovery is not progressing in a typical fashion.

Appropriate reimbursement and management of the electronic medical record is another aspect of concussion management. It is recommended and more specific to utilize ICD-10 codes, "concussion without loss of consciousness," and "concussion with loss of consciousness," rather than "mild traumatic brain injury." ICD-10 encounter codes provide initial visit, subsequent encounter, and sequela for follow-up visits with an athlete.

Prompt recognition of sport-related concussion, removal-from-play, and gradual, protocoled return-to-play can mitigate risks and help keep Iowa student athletes safely in the game.

References and resources

1. McCrory P, Meeuwisse W, Dvoraks J, Aubry M, Bailes J, et al. Consensus statement on concussion in sport-The 5th International Conference on Concussion in Sport, Berlin, October 2016. *British Journal of Sports Medicine*. 2018;51:838-847.

2. Davis GA, et al. *Br J Sports Med*. 2017;0:1–8. doi:10.1136/bjsports-2017-097506SCAT5.

Link to SCAT5: https://bjsm.bmj.com/content/bjsports/early/2017/04/26/bjsports-2017-097506SCAT5.full.pdf

Vision Screening in the Office Setting

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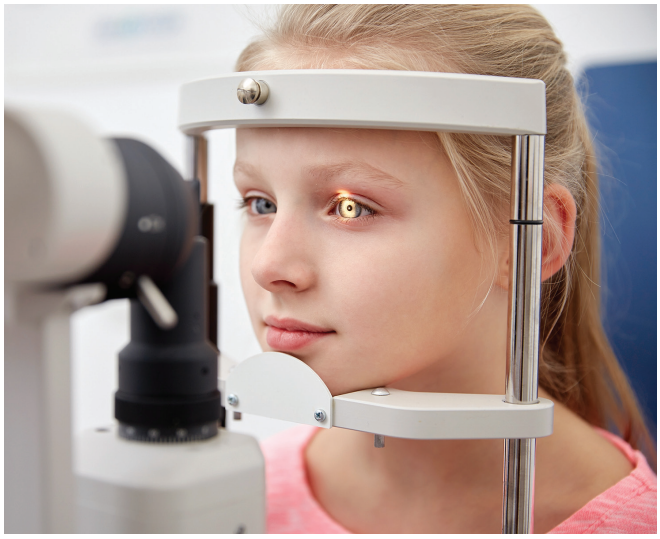

Examination of the eyes and vision in children is an important part of office-based screening, as it can identify many eye disorders, including amblyopia. Amblyopia, defined as decreased vision in one or both eyes, despite appropriate glasses correction and no structural problems, affects 2% of children.[1] Screening for vision problems begins in infancy and continues throughout childhood and adolescence,[2,3] and is most effective when performed periodically throughout childhood.

Vision screening is an efficient and cost-effective way to recognize eye problems that can be prevented by referral to an eye care professional. The earlier a child with amblyopia or high refractive error is identified, the more effective the treatment. Amblyopia treatment prior to age five is more likely to be effective, however vision screening may be difficult in this age group secondary to cooperation and understanding, so particular attention is paid to using techniques for success in young children.

The method of vision screening is dependent on the child's age and development, as well as the clinical resources available. In the office setting, vision screening can be performed by pediatricians, family practitioners, nurses, medical assistants, and technicians, generally at well care visits.

In Iowa, community vision screening is performed by Iowa KidSight. This is a vision-screening program, in which Lions Club volunteers throughout Iowa organize and conduct vision-screening sessions in local communities using instrument-based photoscreeners. The results are interpreted by trained staff at the University of Iowa Department of Ophthalmology. This voluntary program is open to any child six months of age through kindergarten at no cost.

In the office setting, vision screening is not just checking the visual acuity, but rather includes history taking, inspection of the eyes, red reflex testing, pupil exam, ocular alignment and motility testing, and ophthalmoscopy.[2,3]

In all children, ocular history as well as family history of use of glasses during childhood, eye surgery or patching, or other eye problems should be obtained. Caregivers' observations regarding the appearance, alignment, and function of the eyes are valuable. Either family history or caregivers' observations alone may prompt referral.

Inspection of the eyes can be performed with a penlight, carefully evaluating the structures of the eyelids, conjunctiva, cornea, sclera, and iris. Ptosis, a cloudy or abnormally large cornea, significant light sensitivity, or ongoing conjunctivitis should be referred to a pediatric eye care specialist. Tearing from nasolacrimal duct obstructions should generally be referred, if not resolved after 12 months of age.

Red reflex testing is performed in a darkened room with a direct ophthalmoscope set on "0." From an arm's length distance, the light is shined at both eyes simultaneously, and the red reflex of the retina compared between the eyes. Both red reflexes should be identical in color, brightness, and size. An abnormal red reflex, which is dull, or conversely bright white or yellow, can be a sign of significant abnormality needing prompt referral. There is significant variation in normal red reflexes between patients, and checking red reflexes frequently and thoughtfully will help establish a foundation of normal against which to compare. Red reflex testing can detect opacities in the cornea, cataracts, vitreous hemorrhage, retinal detachment, or retinoblastoma. More subtle differences can be caused by strabismus or refractive error.

Pupils should be round, equal, and equally reactive to light. Asymmetry of pupil shape or reactivity, or a size difference of more than 1 mm may be due to injury, disease, or neurological disorder. If pupils are less than 1 mm different in size, this is generally physiologic, unless associated with ptosis or a limitation in eye motility.

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CDC PEDIATRIC mTBI GUIDELINE
Checklist

CDC HEADS UP
SAFE BRAIN. STRONGER FUTURE.

For healthcare providers treating children 18 years of age and younger

HEALTHCARE PROVIDERS SHOULD:

ASSESS.

Conduct a physical examination to identify findings that:

- Suggest more severe TBI (e.g., hemotympanum, pupillary asymmetry).
- May impact management of mTBI (e.g., concurrent injuries or baseline deficits, oculomotor dysfunction).
- Suggest other contributions to symptoms (e.g., dehydration, cervical tenderness, scalp hematoma).

Do not image routinely (including CT & MRI).

- Use validated clinical decision rules predicting risk for more severe injury to determine need.

Assess symptoms using validated scales. Consider cognitive and balance testing.

Conduct a history to identify risk factors for poor prognosis using validated prediction rules.

COUNSEL.

Provide information about:

- Warning signs that injury may be more serious.
- Typical recovery course.
- How to prevent further injury.
- Gradual re-introduction of activity that does not worsen symptoms.
- The need for social and emotional support.

Offer clear instructions (preferably verbal and written) on return to activity, including school and sports, customized to the patient's symptoms.

- After a few days of rest (2-3 days), begin light activity & then gradually re-introduce regular activities (not inclusive of sports) that do not significantly worsen symptoms.
- Assess school-related needs & monitor progress in collaboration with parents and school professionals.
- Once back to regular non-sports activities (including school), patient can begin return to sports using a standard progression with gradually increasing levels of physical exertion.
- No return to contact sports activity until symptom-free with exertion (including without the use of pain medication).

REFER.

Identify and tailor treatment plans/referrals to address:

- Acutely worsening symptoms → consider neuroimaging.
- Chronic headache → non-opioid analgesia (monitor for overuse), multi-disciplinary evaluation.
- Vestibulo-ocular dysfunction → vestibular rehabilitation.
- Worsening sleep problem → sleep hygiene, sleep specialist.
- Cognitive impairment → treatment directed at etiology, neuropsychological evaluation.
- Emotional dysfunction → psychotherapeutic evaluation and treatment.

A combination of risk factors that may indicate need for neuroimaging include:

- Age < 2 years old
- Recurrent vomiting
- Loss of consciousness
- Severe mechanism of injury
- Severe or worsening headache
- Amnesia
- Non-frontal scalp hematoma
- Glasgow Coma Score < 15
- Clinical suspicion for skull fracture

Examples of validated scales include, but aren't limited to:

- Post-Concussion Symptom Scale
- Health and Behavior Inventory
- Post-Concussion Symptom Inventory
- Acute Concussion Evaluation

Factors associated with poor prognosis:

- Older age (older children/adolescents) or Hispanic ethnicity
- Lower socio-economic status
- History of intracranial injury
- Premorbid histories of mTBI or increased pre-injury symptoms
- Neurological or psychiatric disorder
- Learning difficulties or lower cognitive ability
- Family and social stressors

Parents should watch for warning signs:

- A headache that gets worse & does not go away
- Significant nausea or repeated vomiting
- Increased confusion, restlessness, or agitation
- Slurred speech, drowsiness, or inability to wake up
- Weakness, numbness, or decreased coordination
- Loss of consciousness, convulsions, or seizures

Steps in a return to play progression generally include:

Step 1: Return to regular non-sports activities
Step 2: Light aerobic exercise
Step 3: Sport-specific exercise
Step 4: Non-contact training drills
Step 5: Full contact practice
Step 6: Return to sport

Refer patients whose symptoms do not resolve as expected with standard care after 4-6 weeks.

To view the full set of recommendations from the CDC Pediatric mTBI Guideline, visit www.cdc.gov/HEADSUP.

American Association for Pediatric Ophthalmology and Strabismus

Vision Screening
Recommendations

AGE	TESTS	REFERRAL CRITERIA COMMENTS
Newborn to 12 months	• Ocular history • Vision assessment • External inspection of the eyes and lids • Ocular motility assessment • Pupil examination • Red reflex examination	• Refer infants who do not track well after 3 months of age. • Refer infants with an abnormal red reflex or history of retinoblastoma in a parent or sibling.
12 to 36 months	• Ocular history • Vision assessment • External inspection of the eyes and lids • Ocular motility assessment • Pupil examination • Red reflex examination • Visual acuity testing • Objective screening device "photoscreening" • Ophthalmoscopy	• Refer infants with strabismus. • Refer infants with chronic tearing or discharge. • Refer children who fail photoscreening.
36 months to 5 years	• Ocular History • Vision assessment • External inspection of the eyes and lids • Ocular motility assessment • Pupil examination • Red reflex examination • Visual acuity testing (preferred) or photoscreening • Ophthalmoscopy	Visual Acuity Thresholds: • Ages 36-47 months: Must correctly identify the majority of the optotypes on the 20/50 line to pass. • Ages 48-59 months: Must correctly identify the majority of the optotypes on the 20/40 line to pass. • Refer children who fail photoscreening.
5 years and older*	• Ocular history • Vision assessment • External inspection of the eyes and lids • Ocular motility assessment • Pupil examination • Red reflex examination • Visual acuity testing • Ophthalmoscopy	• Refer children who cannot read at least 20/32 with either eye. Must be able to identify the majority of the optotypes on the 20/32 line. • Refer children not reading at grade level.

**Repeat screening every 1-2 years after age 5.*

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Vision Screening in the Office Setting *(continued from page 4)*

Ocular alignment testing can be achieved with the corneal light reflex test or cover test. In a corneal light reflex test, a penlight is directed toward the face from an arm's length distance, and the pinpoint light reflection on the corneas is compared. The light reflection should be symmetrical and in the center of the pupils, whereas asymmetry suggests strabismus. In cover testing, a visually interesting target such as a sticker, toy, or video on a smartphone is shown to the child, and each eye is alternately covered. Any shift of the eye despite reliable fixation on the target typically indicates strabismus. A similar visually interesting target can be moved to assess the movement of the eyes.

Intermittent misalignment of the eyes is common and normal up to four months of age. Any constant eye misalignment should be referred, no matter the age of the child, as should intermittent misalignment after four months of age.

Checking vision in preverbal children can be accomplished by checking the ability of the child to fixate and follow a toy or other interesting object with both eyes, followed by each eye separately, and then comparing the behavior between the two eyes. Referral is indicated for an asymmetrical response.

Checking vision in older children is better facilitated when the child is able to cooperate with identifying shapes or letters on an eye chart. While some three-year-old children can cooperate with this, typically four-year-old children and older have a much higher rate of success. Testing should be done with one eye covered, preferably with an adhesive patch to prevent peeking around an occluder or hand. A distraction free environment, such as a room or quiet hallway is ideal. Most charts are calibrated for a 10-foot distance. Traditionally, threshold screening has been used to identify the smallest line of letters each eye can see. As this can often result in loss of cooperation, critical line screening has been used successfully.

In critical line screening, the child is asked to name a majority of letters or shapes on the critical line appropriate for his or her age:

- Age 36-47 months: critical line to pass is 20/50 in each eye
- Age 48-59 months: critical line to pass is 20/40 in each eye
- Age 60 months and above: critical line to pass is 20/30 in each eye

Instrument-based photoscreening is most helpful in children 12 months-5 years of age,[4] or older for children with developmental delay. These devices are effective and commonly used. Preprogrammed or user-entered criteria unique to the instrument determine need for referral based on risk factors for amblyopia, rather than a diagnosis of amblyopia. These devices have been validated, with referral criteria optimized for high specificity in young children and high sensitivity in older children. Evidence-based recommendations for referral criteria have been published.[5]

CPT codes are available for vision screening.

- 99173: Screening test of visual acuity, quantitative, bilateral. This includes quantitative estimate of visual acuity (i.e., 20/30).
- 99174: Instrument-based ocular screening (e.g., photoscreening, automated refraction), bilateral; with remote analysis and report. This includes iScreen.
- 99177: Instrument-based ocular screening (e.g., photoscreening, automated refraction), bilateral; with on-site analysis. This includes WelchAllyn Spot, SureSight, Plusoptix, RetinoMax, and 2WIN.

Frequent and age-appropriate screening is key in detecting amblyopia and its risk factors. Both traditional and instrument-based methods are effective, and as primary care providers are at the front lines of this important battle, they should be armed with effective tools to succeed.

References and resources

1. Friedman DS, Repka MX, Katz J, et al. Prevalence of amblyopia and strabismus in white and African American children aged 6 through 71 months: the Baltimore Pediatric Eye Disease Study. *Ophthalmology.*2009;116(11):2128-2134 e2121-2122.

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4. AAPOS. Vision Screening Recommendations. https://aapos.org/syndicated/vision-screening. Accessed June 19, 2019.

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What's in this issue

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