Learning outcome, instructions for completing the evaluation, and statements of disclosure can be found on page 221.

Current Recommendations On Management of Pediatric Concussions

Diane Gillooly

Concussions are a form of traumatic brain injury (TBI). Concussion is defined by the American Academy of Neurology as a "trauma-induced alteration in mental status that may or may not involve loss of consciousness" (Kirkwood, Yeates, & Wilson, 2012, p. 1360). At least 1.7 million TBIs occur annually, with 75% being in the form of concussion. Almost half a million patients ages 14 years and younger visit emergency rooms annually for TBI (Centers for Disease Control and Prevention [CDC], 2011). Diagnosing a concussion can be difficult because symptoms vary among individuals and may be subtle and vague, and neuro-radiologic imaging studies typically reveal no abnormalities. Due to the varying degree of symptomatology and recovery, there are no specific recommendations on when it is safe for patients to resume normal activity. Complications can arise if a second injury occurs prior to complete healing from the initial concussion. This literature review identifies current recommendations on the screening and management of concussion in the pediatric population. A clear, concise definition of concussion is presented, as well as recommendations for concussion management. Return to play and return to learn guidelines are explored. The nursing role in concussion management is discussed, and future implications are explored.

Concussion is a form of traumatic brain injury (TBI), which impacts the pediatric population. Almost half a million patients ages 14 years and younger visit emergency rooms annually for this type of injury (Centers for Disease Control and Prevention [CDC], 2011). Children are thought to be at a higher risk for concussion injuries when compared to adults due to anatomical and structural differences, such as head shape and size, brain water content, vascularization, myelination, and weaker neck muscles (McGuire & McCambridge, 2011). Children ages 0 to 4 and 15 to 19 years had the highest incidence of annual TBI-related emergency department (ED) visits, hospitalizations, and death in the years 2002-2006, and males had higher rates of TBI-related ED visits than females (see Tables 1 and 2) (Faul, Xu, Wald, & Coronado, 2010).

Although falls account for the largest number of TBIs (Faul et al., 2010), sports-related concussions are a great concern, with an estimated 3.8 million sports or recreation-related concussions occurring annually, accounting for 8.9% of high school injuries (Halstead, Walter, & The Council on Sports Medicine and Fitness, 2010). Football is the leading cause of concussion in high school athletes, followed by girls' soccer, boys' lacrosse, and boys' soccer, and although data are limited, rugby and ice hockey are also thought to account for high rates of concussion (Halstead et al., 2010). Although the

Diane Gillooly, DNP, RN-BC, APN, *is a Clinical Assistant Professor and Director of Generic Undergraduate PTL Faculty Development, Rutgers, the State University of New Jersey, School of Nursing, Newark, NJ.*

Table 1.
Annual Traumatic Brain Injury (TBI)-Related Emergency Department Visits, Hospitalizations, and Deaths 2002-2006

Age (in Years)	ED Visits	Hospitalizations	Deaths
0-4	251,546	15,239	998
5-9	105,015	8,799	450
10-14	117,387	11,098	726
15-19	157,198	24,896	3,995

Source: Faul, Xu, Wald, & Coronado, 2010.

Table 2.
Annual Traumatic Brain Injury (TBI)-Related Emergency Department Visits by Age Group and Gender 2002-2006

Age (in Years)	Males	Females
0-4	139,001	112,545
5-9	68,671	36,343
10-14	90,221	27,166
15-19	98,761	58,437

Source: Faul, Xu, Wald, & Coronado, 2010.

Table 3.
Symptoms of Concussion

Thinking/Remembering	Physical	Emotional/Mood	Sleep
Difficulty thinking	Headaches Fuzzy or blurry vision	Irritability	Sleeping more than usual
Feeling slowed down	Nausea/vomiting Dizziness	Sadness	Sleeping less than usual
Difficulty concentrating	Sensitivity to Light Balance problems	More emotional	Trouble falling asleep
Difficulty remembering new information	Feeling tired, lack energy	Nervousness or anxiety	

Source: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, 2010.

incidence of concussion is higher among males, females playing similar sports to males have higher rates of concussion, which is hypothesized to be due to weaker neck muscles and smaller head mass (Halstead et al., 2010). Sports-related concussions are on the rise. In an 11-year period, concussion incidence increased from 0.12 per 1,000 athlete exposures in academic year 1997-1998 to 4.9 per 1,000 in academic year 2007-2008, which is a 4.2-fold increase or an average annual increase of 15.5% (Lincoln et al., 2011).

The diagnosis of concussion can be difficult to make because symptoms vary among individuals and may be subtle and vague, and neuroradiologic imaging studies typically reveal no abnormalities. Without proper evaluation and treatment, concussions can go undiagnosed and have potentially catastrophic results. Early diagnosis is imperative for proper concussion management. Healthcare professionals need to understand the definition of concussion, mechanism of injury, and complications that can result. Current recommendations for screening and managing concussion injuries are required to prevent complications. Because recovery from concussion varies widely among patients, it is essential to screen patients for symptoms, and restrict both physical and cognitive activities while symptomatic. Gradual return to normal activities is recommended.

Definition

Concussion is caused by shaking of the brain following injury. The American Academy of Neurology defines concussion as a biomechanical alteration in brain function, usually involving the areas of memory and orientation, and may or may not include loss of consciousness (Giza et al., 2013). Concussion is characterized by several common features:

- *Concussion may be caused either by a direct blow to the head, face, neck, or elsewhere on the body, with an "impulsive" force transmitted to the head.*
- *Concussion typically results in the rapid onset of short-lived impairment of neurologic function that resolves spontaneously.*
- *Concussion may result in neuropathological changes, but the acute clinical symptoms largely reflect a functional disturbance rather than a structural injury.*
- *Concussion results in a graded set of clinical symptoms that may or may not involve loss of consciousness. Resolution of clinical and cognitive symptoms typically follows a sequential course; however, it is important to note that in a small percentage of cases, post-concussive symptoms may be prolonged.*
- *No abnormality on standard structural neuroimaging studies is seen in concussion* (McCrory et al., 2013, p. 186).

Mechanism of Injury

When a blow to the head or body occurs, significant movement of the brain results in shearing forces that disrupt the brain's neurometabolic function (Grady, Master, & Gioia, 2012). Neuronal depolarization causes rapid influx of calcium and efflux of potassium. The shift in ions causes the sodium-potassium pump to work overtime, requiring increased amounts of adenosine triphosphate (ATP). This results in a drastic increase in glucose metabolism and disrupted cerebral blood flow (Giza & Hovda, 2001). The depolarization of brain cells and resultant alteration in neurotransmission deadens receptors that are associated with memory and learning (McBride, 2012).

Screening and Diagnosis

In the absence of visible blood and other physical signs of trauma, and the fact that neurological, behavioral, physical, and cognitive symptoms may manifest at different stages, diagnosing concussion can be difficult (Martinez, 2011). Athletes may underreport symptoms to avoid being sidelined. Children and parents may also underreport symptoms to avoid exclusion from school and extracurricular activities. The Third International Conference on Concussion in Sport panel agreed that diagnosis of concussion encompasses the assessment of a variety of areas, including clinical symptoms, physical signs, behavior, balance, sleep, and cognition (McCrory et al., 2009). Symptoms of concussion vary among individuals and typically fall into four categories (see Table 3) (CDC, National Center for Injury Prevention and Control, 2010).

Utilization of established screening tools in conjunction with physical examination can greatly improve the chances of making a correct diagnosis (McGuire & McCambridge, 2011). Common concussion assessment tools include the CDC's Acute Concussion Evaluation (ACE), Standard Assessment of Concussion (SAC), the Sport Concussion Assessment Tool 3 (SCAT 3), and child SCAT3 for children under 12 years of age. The ACE

tool was designed for pediatricians as part of the CDC Heads Up Toolkit for physicians (CDC, 2013). The tool assesses the type of injury sustained in addition to symptoms that affect physical, cognitive, and sleep functions, as well as risk factors for a prolonged recovery, such as history of previous concussion, headache, and developmental and psychological history (Gioia, 2012). The SAC is a brief neurocognitive screening that evaluates orientation, immediate memory, concentration, and delayed recall, and was designed to be used in conjunction with other screening measures (McCrea, 2001). The SCAT 3, modified from the SCAT 2 as a result of the 4th International Conference on Concussion in Sports in November 2012, is a type of neuropsychological test that assesses attention and memory function (McCrory et al., 2013). The SCAT 3 incorporates the Glascow Coma Score, which assesses eye, verbal, and motor responses, and a Maddocks Score that asks questions, such as the venue, the score, and what team the athlete played the previous week (McCrory et al., 2013). The SCAT 3 includes a symptom evaluation and SAC, as well as examination of neck, balance, and coordination (McCrory et al., 2013). The ACE, SAC, and SCAT 3 concussion evaluation tools are ideal for initial concussion assessment.

Other evaluation tools include symptom checklists, such as the Post-Concussion Symptom Scale, Graded Symptom Checklist, Head Injury Scale, McGill Abbreviated Concussion Evaluation, HeadMinder, and Concussion Symptom Inventory, which allow for self-reporting of symptoms (Scorza, Raleigh, & O'Connor, 2012). Neuropsychological testing can aid in the identification of cognitive deficits and includes written tools, such as the Trail Making Test, Digit Symbol Substitution Test, Controlled Oral Word Association Test, Hopkins Verbal Learning Test, and the Stroop Color and Word Test, as well as computer-based evaluations, such as HeadMinder, Cogsport, ImPACT, and the Automated Neurophsychological Assessment Metrics (Scorza et al., 2012). Neuropsychological tests provide the best information when a pre-injury baseline is available for comparison; computer-based tools are less labor-intensive than the written format and can be administered rapidly and to several patients concurrently (Scorza et al., 2012). Many schools and athletic programs use neuropsychological testing, including baseline testing, prior to the start of the sport season.

Concussion results in functional, rather than structural, injury to the brain; therefore, neuroimaging studies, such as computed tomography (CT) scans and magnetic resonance imaging (MRI), will not detect concussion (Hunt & Asplund, 2010). Conditions that may indicate more severe brain or structural injury and warrant imaging include loss of consciousness for greater than 30 seconds, seizures, severe headache, repeated vomiting, disorientation to time and place or person, irritability, difficulty in arousing, or worsening symptoms (Halstead et al., 2010). CT is preferable to MRI due to its superior ability to detect skull fracture and intracranial hemorrhage, as well as being expedient, cost-effective, and easier to perform (Halstead et al., 2010).

Sideline evaluation should include physical and neurologic examination in combination with a cognitive evaluation using an established concussion tool as described above (Halstead et al., 2010). In-hospital evaluation is the same as sideline evaluation, with the addition of a detailed history and more thorough neurological examination (Scorza et al., 2012). Evaluation in the emergency department or pediatrician's office should also include a detailed history of previous head injury, head and neck examination, as well as gait and balance testing (Halstead et al., 2010).

Management

Proper management of concussion is essential in ensuring adequate recovery and prevention of complications, such as re-injury or second impact syndrome (SIS). It is imperative that patients who sustain concussions heal properly, with complete resolution of symptoms before returning to normal activities. Because patients recover at different rates, there is no gold standard in managing concussion and no universal recommendation on the amount of time a patient should rest. A systematic literature review conducted by Putakian, Aubry, and McCrory (2009) revealed that the critical elements of concussion management are physical and cognitive rest until symptoms resolve, followed by gradual return to pre-injury activity. These recommendations are supported by the Zurich Concussion Consensus document (Putakian et al., 2009). Though clinical trials are lacking, the consensus among experts is that patients with concussion should undergo physical and cognitive rest until asymptomatic (Zafonte, 2011).

Physical activity of all kinds should be restricted until symptoms resolve because the resultant increase in energy demands on the brain may prolong recovery (Halstead et al., 2010). Return to play should be initiated in a step-wise fashion, beginning with no activity, during which time both physical and cognitive rest is implemented. The next step includes light aerobic activity, such as swimming or cycling, in which no resistance training is allowed. Progression to sport-specific training, such as hockey or soccer drills; then non-contact drills, such as passing drills and beginning of resistance training; followed by full-contact practice; and finally return to play, in which normal game play occurs (McCrory et al., 2009). It is imperative that upon return of symptoms in any phase of the gradual return to play guidelines, the child returns to the previous stage until symptoms once again resolve (Duff, 2009).

Additionally, it is recommended that adequate cognitive rest also be provided. Known as "subsymptom threshold cognitive activity" (Master, Gioia, Leddy, & Grady, 2012, p. 2), cognitive activity needs to be kept below the level that causes symptoms, such as headache and fatigue. Any activity that requires attention and concentration, such as school work and videogames, can hinder recovery (McCrory et al., 2009). Additionally, concussion has been shown to produce cognitive deficits that can hinder a student's academic performance (Halstead et al., 2013). Therefore, cognitive rest should include decreased workload, increased time allotted for completion of assignments and tests, and restriction of activities, such as playing video games, watching television, and using a computer, all of which can worsen symptoms and delay recovery (Halstead et al., 2010). Upon reintegration into school, the student's overall workload should be reduced, and adequate time should be allotted for the completion of make-up work (Halsted et al., 2010).

At its most extreme, cognitive rest can entail refraining from school completely, with no homework, reading, or texting (Master et al., 2012). Returning to cognitive activities should be a gradual process, and patients should be monitored for symptoms. Cognitive activity should be maintained below the level at which symptoms are experienced (Master et al, 2012). Returning to school with reduced length of the school day and slowly transitioning to full days can lessen the resurgence of symptoms (Lear & Hoang, 2012). Academic accommodations should also be made for students following concussion injury, including excused absences, rest periods during the school day, extended time on assignments, postponement/staggering of tests and extended testing times, accommodation for light and noise sensitivity, use of readers and notetakers, smaller and quieter testing rooms, preferential classroom seating, and provision of tutors (McGrath, 2010).

Little evidence exists to support pharmacologic management of concussion. Many existing studies pertain to severe brain injury and cannot be generalized to concussion (Hunt & Asplund, 2010). There is conflicting evidence on whether or not amitriptyline is beneficial for treating post-concussion headaches and whether or not corticosteroids have either positive or negative effects (Hunt & Asplund, 2010). Additionally, the traditional use of ibuprophen for reducing inflammation is not grounded in evidence. A 2006 study by Brown, Iwata, Putt, and Smith revealed worsened cognitive outcomes in rats. However, Wallenquist and colleagues (2012) found that ibuprophen weakened the inflammatory response in rats. Medications are used for symptom management, but caution should be taken with drugs that could increase risk of intracranial bleeding, such as non-steroidal anti-inflammatory drugs (NSAIDs), and those that could mask worsening symptoms or deterioration in mental status should be avoided (Scorza et al., 2012).

Concussion clinics can be a valuable service to pediatric patients following concussion injury. Although most concussions heal within seven to 10 days (Scorza et al. 2012), patients whose symptoms persist benefit from an active rehabilitation program (Makdissi, Cantu, Johnston, McCrory, & Meeuwisse, 2013). Multidisciplinary-approach concussion clinics offer valuable services to individuals with prolonged symptoms. Clinics provide services from various personnel, including sports medicine physicians, neurologists, exercise physiologists, physical therapists, psychologists, social workers, and education specialists, as well as equipment, such as treadmills and balance testing equipment (Makdissi et al., 2013). Having multiple healthcare personnel in one building can enhance concussion rehabilitation and provide a convenient means for patients to obtain needed services.

Complications

Without proper evaluation and treatment, concussions can go undiagnosed, leading to potentially catastrophic results. SIS, though rare, is a devastating complication of undiagnosed concussion. SIS is defined as the rapid swelling of the brain after a person suffers a second concussion prior to the resolution of symptoms from a previous concussion (Tracy, 2012). SIS is characterized by "the absence of space-occupying hematoma and subsequent rapid and profound brain swelling" (Wetjen, Pichelmann, & Atkinson, 2010, p. 553).

Upon initial concussion, the brain's autoregulatory mechanisms compensate for the stress of the injury and protect against massive brain swelling. On the second impact, the brain loses the ability to autoregulate intracranial and cerebral perfusion pressure. This can result in massive swelling, brain herniation, and death within two to five minutes (Bey & Ostick, 2009). After multiple concussions, the brain becomes more susceptible to injury with less impact, and recovery is prolonged (McBride, 2012). Improper diagnosis and management of concussion can lead to premature return to normal activities, predisposing patients to the occurrence of SIS.

Post-concussive syndrome is a complication in which symptoms may persist for several weeks or even months (Tracy, 2012). Although concussion symptoms usually resolve within days or weeks of the injury, they can continue after three months in post-concussive syndrome (King & Kirkwilliam, 2011). Post-concussive syndrome can alter quality of life and school and job performance. Without proper diagnosis of concussion, identification of post-concussive syndrome will not be made, leading to confusion and frustration for patients.

Legislation

Between 2009 and 2014, all 50 states and the District of Columbia have enacted laws regarding TBI (National Conference of State Legislatures, 2014). Additionally, each state included policy regarding youth concussion and sports. The laws vary from state to state, with some giving specific guidelines as to removal of a student from play when concussion is suspected, and others providing instructions on training requirements for coaches and athletic trainers (National Conference of State Legislatures, 2014). Many laws pertain to interscholastic organized sports, but do not speak to recreational league sports. As a result of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990, children with longer-term deficits can receive accommodations in school using a 504 Plan (Halstead et al., 2013). When the concussion results in partial or total impairment necessitating modifications of the curriculum or specialized instruction situations, an Individualized Education Plan (IEP) can be developed (Halstead et al., 2013).

Implications for Nursing

To properly manage concussion symptoms, a correct diagnosis must be established. When performing an assessment of a child with suspected concussion, it is crucial that the nurse obtain a thorough history, including any prior concussions or head injury. It is important to obtain information about pre-injury conditions that should be taken into account when evaluating presenting symptoms (Halstead et al., 2013). Additional stressors, such as family conflicts or pressure from coaches, may affect symptom reporting and should be evaluated (Halstead et al, 2013).

Symptom checklists can be useful in assessing symptoms the patient is experiencing, as well as evaluating their severity (Halstead et al, 2013). Because symptoms are self-reported, nurses should obtain as much detail as possible to ascertain the effects of the concussion on the patient's physical and cognitive well-being. Detail-

Instructions For Continuing Nursing Education Contact Hours

Current Recommendations on Management of Pediatric Concussions

Deadline for Submission: **October 31, 2018** **PED 1605**

To Obtain CNE Contact Hours

1. To obtain CNE contact hours, you must read the article and complete the evaluation through the ***Pediatric Nursing*** **website** at **www.pediatricnursing.net/ce**
2. Evaluations must be completed **online** by October 31, 2018. Upon completion of the evaluation, your CNE certificate for **1.4** contact hour(s) will be mailed to you.

Learning Outcome

After completing this learning activity, the learner will be able to identify current recommendations for the screening and management of concussion in the pediatric population and describe nursing's role in concussion management.

Fees — *Subscriber:* FREE ***Regular:*** $20

The author(s), editor, editorial board, content reviewers, and education director reported no actual or potential conflict of interest in relation to this continuing nursing education article.

This educational activity is provided by Anthony J. Jannetti, Inc.

Anthony J. Jannetti, Inc. is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

Anthony J. Jannetti, Inc. is a provider approved by the California Board of Registered Nursing, provider number CEP 5387. Licensees in the state of California must retain this certificate for four years after the CNE activity is completed.

This article was reviewed and formatted for contact hour credit by Rosemarie Marmion, MSN, RN-BC, NE-BC, Anthony J. Jannetti, Inc. Education Director.

ed information about the nature of the symptoms, frequency, and precipitating factors should be obtained to determine which areas of a patient's environment need to be modified.

The nurse plays a crucial role in educating the patient, family, school, and coaches regarding the patient's condition, and the need for modifications. In the early stages, rest and modified physical environment are essential, and educating the patient and family on the necessity of these modifications will aid in recovery and increase compliance. Education of patients, families, school personnel, and coaches on the need for physical rest and return to school is essential in assisting a child during recovery (Halstead et al., 2013). A team approach is crucial to reducing the risks of mistakes that could lead to re-injury or prolonged recovery (Halstead et al., 2013). Nurses are key personnel in keeping the patient, family, and other members of the interdisciplinary team abreast of the child's progress.

School nurses play an integral role in concussion management in the school setting. The position statement of the National Association of School Nurses states that the school nurse possesses the necessary skills to identify possible concussions; provides education to students, parents and staff; and works together with healthcare providers, school staff, athletic trainers, and parents to guide students' graduated academic and physical recovery process (Diaz, Wyckoff, & National Association of School Nurses, 2012). The school nurse should provide education regarding identification, management, and prevention of concussion to school administrators, coaches, and parents as well as taking part in teams who develop emergency action and concussion management plans in the school (McLeod, 2014). The school nurse can be instrumental in working with healthcare providers and faculty/school administrators in developing 504 and IPE plans, as well as ensuring that the appropriate accommodations are provided. The school nurse is in an ideal position to monitor ongoing symptoms and communicate findings with healthcare providers and families (Diaz et al., 2012). Additionally, school nurses can provide emotional support to students as they work through various emotional and psychological issues during a gradual healing process (Diaz et al., 2012).

Future Implications

Due to the varying presentation and recovery of concussion, it is difficult to prescribe a "one-size-fits-all" approach to concussion management. Although the benefits of physical rest have been documented, more research is needed on its value in concussion recovery and how best to return the child to normal physical activity levels. Even less research exists on cognitive rest and the benefits of a gradual return to learn process. Further studies are needed to demonstrate the best methods for returning a child to the learning environment and how best to accommodate a child post-concussion, while promoting academic progression and mental well-being.

References

Bey, T., & Ostick, B. (2009). Second impact syndrome. *Western Journal of Emergency Medicine, 10*(1), 6-10.

Brown, K.D., Iwata, A., Putt, M.E., & Smith, D.H. (2006). Chronic ibuprophen administration worsens cognitive outcome following traumatic brain injury in rats. *Experimental Neurology, 201*(2), 301-307. doi:10.1016/j.expneurol.2006.04.008

Centers for Disease Control and Prevention (CDC). (2011). Nonfatal traumatic brain injuries related to sports and recreation activities among persons aged < 19 years – United States, 2001-2009. *Morbidity and Mortality Weekly Report, 60*(39), 1337-1142.

Centers for Disease Control and Prevention (CDC). (2013). *Heads up: Facts for physicians about mild traumatic brain injury (MTBI).* Retrieved from http://www.concussiontreatment.com/images/CDC_Facts_for_Physicians_booklet.pdf

Centers for Disease Control and Prevention (CDC), National Center for Injury Prevention and Control. (2010). *Traumatic brain injury & concussion.* Retrieved from http://www.cdc.gov/traumaticbraininjury/symptoms.html

Diaz, A.L., Wyckoff, L.J., & National Association of School Nurses. (2012). Concussions-The role of the school nurse. Position statement. *National Association of School Nurses, 28*(2), 110-111. doi:10.1177/1942602x12473949

Duff, M.C. (2009). Management of sports-related concussion in children and adolescent. *The ASHA Leader, 14*(9), 10-13.

Faul, M., Xu, L., Wald, M.M., & Coronado, V.G. (2010). Traumatic brain injury in the United States: Emergency department visits, hospitalizations and deaths 2002–2006. Atlanta, GA: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control.

Gioia, G. (2012). Pediatric assessment and management of concussions. *Pediatric Annals, 41*(5), 198-203.

Giza, C.C., & Hovda, D.A. (2001). The neurometabolic cascade of concussion. *Journal of Athletic Training, 36*(3), 228-235.

Giza, C.C., Kutcher, J.S., Barth, J., Getchius, T.S.D., Gioia, G.A., Gronseth, G.S., ... Zafonte, R. (2013). Summary of evidence-based guideline update: Evaluation and management of concussion in sport. *American Academy of Neurology, 80*(24), 2250-2257.

Grady, M.F., Master, C.L., & Gioia, G.A. (2012). Concussion pathophysiology: Rationale for physical and cognitive rest. *Pediatrics, 41*(9), 377-382.

Halstead, M.E., McAvoy, K., DeVore, C.D., Carl, R., Lee, M., Logan, K., … the Council on School Health. (2013). Returning to learning following a concussion. *Pediatrics, 132*(5), 948-957. doi:10.1542/peds.2013-2867

Halstead, M.E., Walter, K.D., & The Council on Sports Medicine and Fitness. (2010). Sport-related concussion in children and adolescents. *Pediatrics, 126*(3), 597-615. doi:10.1542/peds.2010-2005

Hunt, T., & Asplund, C. (2010). Concussion assessment and management. *Clinics in Sports Medicine, 29*(1), 5-17. doi:10.1016/j.csm.2009.09.002

King, N.S., & Kirkwilliam, S. (2011). Permanent post-concussion symptoms after mild head injury. *Brain Injury, 2*(5), 462-470.

Kirkwood, M.W., Yeates, K.O., & Wilson, P.E. (2006). Pediatric sport-related concussion: A review of the clinical management of an oft-neglected population. *Pediatrics, 117*(4), 1359-1371.

Lear, A., & Hoang, M. (2012). Sports concussion: A return-to-play guide. *Journal of Family Practice*, *61*(6), 323-328.

Lincoln, A.E., Caswell, S.V., Alquist, J.L., Dunn, R.E., Norris, J.B., & Hinton, R.Y. (2011). Trends in concussion incidence in high school sports: A prospective 11-year study. *The American Journal of Sports Medicine, 39*(5), 958-963. doi:10.1177/03635546510392326

Makdissi, M., Cantu, R.C., Johnston, K.M., McCrory, P., & Meeuwisse, W.H. (2013). The difficult concussion patient: What is the best approach to investigation and management of persistent (>10 days) postconcussive symptoms? *British Journal of Sports Medicine, 47,* 308-313. doi:10.1136/bjsports-2013-092255

Martinez, D.E. (2011). Research & science. Bloodless concussion: The misunderstood injury. *Journal of The American Chiropractic Association*, *48*(7), 16-36.

Master, C.L., Gioia, G.A., Leddy, J.J., & Grady, M.F. (2012). Importance of 'return-to-learn' in pediatric and adolescent concussion. *Pediatric Annals, 41*(9), 1-6.

McBride, D.L. (2012). Concussion: The hidden injury. *Journal of Pediatric Nursing, 27,* 763-764.

McCrea, M. (2001). Standardized mental status testing on the sideline after sport-related concussion. *Journal of Athletic Training, 36*(3), 274-279.

McCrory, P., Meeuwisse, W., Aubry, M., Cantu, B., Dvorak, J., Echemendia, R.J., **...** Tator, C.H. (2013). Consensus statement on concussion in sport – The 4th International Conference on Concussion in Sport held in Zurich, November 2012. *Clinical Journal of Sports Medicine, 23*(2), 89-117.

McCrory, P., Meeuwisse, W., Johnston, K., Dvorak, J., Aubry, M., Molloy, M., & Cantu, R. (2009). Consensus statement on concussion in sport – The 3rd International Conference on Concussion in Sport Held in Zurich, November 2008. *Clinical Journal of Sports Medicine, 19*(3), 185-200.

McGrath, N. (2010). Supporting the student-athlete's return to the classroom after a sport-related concussion. *Journal of Athletic Training, 45*(5), 492-498.

McGuire, C.S., & McCambridge, T. I. (2011). Concussion in the young athlete: Diagnosis, management and prevention. *Contemporary Pediatrics, 28*(5), 30-46.

McLeod, T.C.V. (2014). Managing concussion in the school setting. *NASN School Nurse, 29*(5), 232-235.

National Conference of State Legislatures. (2014). *Traumatic brain injury legislation.* Retrieved from http://www.ncsl.org/research/health/traumatic-brain-injury-legislation.aspx

Putakian, M., Aubry, M., & McCrory, P. (2009). Return to play after sports concussion in elite and non-elite athletes? *British Journal of Sports Medicine, 43*(Suppl. 1)*,* i28-i31.

Scorza, K.A., Raleigh, M.F., & O'Connor, F.G. (2012). Current concepts in concussion: Evaluation and management. *American Family Physician, 85*(2), 123-132.

Tracy, M. (2012). Shake, rattle, and roll: The impact of undiagnosed concussions in pediatrics. *Journal of Emergency Nursing, 38*(6), 580-581.

Wallenquist, U., Holmqvist, K., Hanell, A., Marklund, N., Hillered, L., & Forsberg-Nilsson, K. (2012). Ibuprophen attenuates the inflammatory response and allows formation of migratory neuroblasts from grafted stem cells after traumatic brain injuries. *Restorative Neurology and Neuroscience, 30,* 9-19. doi:10.3233/RNN-2011-0606

Wetjen, N.M., Pichelmann, M.A., & Atkinson, J.L.D. (2010). Second impact syndrome: Concussion and second injury brain complications. *Journal of the American College of Surgeons, 211*(4), 553-557.

Zafonte, R. (2011). Diagnosis and management of sports-related concussion: A 15-year-old athlete with a concussion. *Journal of the American Medical Association, 306*(1), 79-86.