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Promoting Sport Safety: An Educational Resource for Concussion Awareness among High School Athletes

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Abstract

In recent times, awareness of the risks associated with mild traumatic brain injury (mTBI), commonly referred to as concussion has come to the forefront. In a time where the topic of concussion is at an all-time high with professional athletes in the National Football League (NFL), it is critical to discuss concussions at the high school level when adolescents are still growing. Organized sports in high school are beneficial for a variety of reasons, but high school sports do not come without risk. Physical education should place an increased importance on educating the participants of the risks and misconceptions associated with concussion. One common misconception about concussion is that one must lose consciousness in order to have sustained a concussion. However, continuing to play sports while experiencing concussion symptoms carries significant risks, including death. While there are many reasons why athletes do not report their concussion symptoms including: fear of the coach, losing playing time, losing the game, and not appearing tough; the reason should not be due to a lack of education.

Speech-Language Pathologists (SLPs) are particularly well suited to inform athletes on concussion due to their depth of education on long-term cognitive and communication risks associated with traumatic brain injury. High Schools serving students in this age range would benefit from a structured curriculum developed to educate athletes about sport safety, including concussion. Six key components have been developed as the learning curriculum in order to educate athletes about mild traumatic brain injury (mTBI) as well as the cognitive and communication factors affected by mTBI. This education expands the current concussion information sheet given in a sports packet to fulfill Education code 49475 desiring athletes to be educated on concussion each year through consent forms signed by both the parent and student athlete.

Chapter 1: Introduction and Literature Review

Purpose

The purpose of this project is to increase awareness of how school-based Speech-Language Pathologists (SLPs) are involved in working with athletes who sustain a mild traumatic brain injury (mTBI), also known as a concussion, as well as to educate and develop a structured curriculum for high school athletes about mTBI and the cognitive and communication effects that may be affected. Prior to a student sustaining a concussion, athletic trainers, coaches, athletes, and parents can learn about the cognitive-linguistic factors that are affected by concussions. SLPs are prepared to instruct others in cognitive linguistic factors resulting from concussion including: verbal reasoning, memory, problem solving, and comprehension” (Sirmon-Fjordbak, 2010). Nearly every state in the U.S. requires both parents and players to receive basic concussion safety information in order to participate in sports. However, “more education than can fit onto an 8 ½ x 11 in. sheet of paper is urgently needed” (De Lench, 2015). Relevant literature suggests: “One in five high school athletes will sustain a concussion during the sport season and thirty-three percent of sports concussions happen during practice” (Headcase, 2013). Fifty percent of concussions may not be reported in the United States during competitive sports (Harmon, Drezner, Gammons, Guskiwicz, Halstead, Herring, Kutcher, Pana, Putukian, Robers, 2013). For children and adolescents, sports and recreational activities are the third leading cause of traumatic brain injury in the United States (Duff, 2015). Every year, approximately sixty percent of high school students participate in organized sports (Duff, 2015). It is estimated that over 300,000 concussions take place each year in the U.S. on sports fields and in sports arenas (AAN, 2015; Gessel, Fields, Collins, Dick, Comstock, 2007). One in ten student

athletes sustains a concussion during practice or play each sport season (Sirmon-Fjordbak, 2010). According to the ASHA, under the principles of ethics III, speech-language pathologists (SLP) have a responsibility to promote public understanding of the profession (ASHA, 2015). Due to residual cognitive and communication impairments, athletes who sustain a concussion can require the services of an SLP (Manasse-Cohick & Bornstein, 2008). The curriculum provided in this resource is focused on education encompassing mild traumatic brain injury in order for athletes to recognize and report when mTBI occurs. Most specifically, athletes will also learn about cognitive and communication impairments that may be affected as a result from a concussion. The California Interscholastic Federation (CIF) (2015), governing interscholastic high school athletics in California, educates athletes through an informational sheet that is sent home for the athlete and parent to sign and return. However, student athletes may benefit from education in a formal setting to learn about concussion recognition, prevention information, management and treatment options. Student athletes may discuss how different life would be due to a mild, moderate or severe traumatic brain injury. Additionally, they may visualize how their life would be different in relation to school, dating, home life, and many other situations. This formalized educational opportunity would review and further expand the information given in the CIF handout, while also learning about how an SLP may help them with a concussion injury. Athletes should be taught in multiple modalities, including presentation of verbal information in order to maximize different learning styles. Information should be presented in written and spoken; visual and verbal, and participatory ways in order to recall the information. The athletes should learn and be able to recall the information, not just sign a piece of paper stating that they read about concussion. Dale (1969), found that those who read written information were able to recall 10% of it after 3 days, while 65% of presented visual and verbal information could be

recalled. However, when put into a hands-on model such as role-playing or given case studies practice, 70% of the information could be recalled. The lesson in this curriculum ensures that visual, verbal, and interactive activities are used. Paul Echlin, M.D., a leading concussion expert and researcher in Canada stated: “Education is vital to decrease the incidence of concussion and improve treatment” (De Lench, 2015).

Introduction

Mild Traumatic Brain Injury

Mild traumatic brain injury, as aforementioned, is more commonly referred to as *concussion*. A definition of concussion in sport by the third International Conference on Concussion in Sport describes it as “...an injury caused by a direct blow to the head, face, neck, or elsewhere in the body with impulsive force transmitted to the head resulting in impaired neurologic function and acute clinical symptoms” (McCroory, Meeuwisse, Johnston, Dvorak, Aubry, Molloy, Cantu, 2009). The American Association of Neurological Surgeons (2015) specify that a concussion is a brain injury causing a temporary loss of normal brain function with no outward signs of head trauma in many incidents. In most instances someone with a concussion does not ever lose consciousness (AANS, 2015). In essence, mTBI is generally a functional problem. Concussions are not frequently recognized as problematic or a brain injury, yet an estimated 5.3 million Americans are living with disabilities from a brain injury (Huff, 2009). Ted Stachulski, Brain Injury Association of Vermont’s “Survivor of the Year,” called it a silent epidemic after being misdiagnosed for four years. Huff (2009) reported: “Eighty-five percent of mTBI’s are not undetected by MRIs.” The American Society of Neuroradiology states that MRIs may not be able to detect irregularities right after the incident due to microscopic brain injury, yet injured brain tissue may be detectable years later, revealing brain atrophy (ASNR,

2013). Harmon et al. (2013) cited that 50% or more of concussions might go unreported. The highest incidence of sports-related concussion treated in hospitals in 2009 were cycling, football, basketball, baseball and softball (AANS, 2014). Concussions occur in all sports yet some sports, positions, and playing styles have an increased risk of concussion. When rules of play in sports are similar, more concussions are seen in female athletes than males. The American Academy of Neurology (2013) suggests the greatest threat of a sports-related concussion for females is in soccer and basketball. A recent study aimed to find out if age differences existed with respect to both neuropsychological and electrophysiological functions following a sport concussion. They found that neurophysiological deficits are existent for at least 6 months post-injury and adolescents, rather than children or adults, were more sensitive to the effects of a sport concussion (Baillargeon, Lassonde, Leclerc, & Elleberg, 2012). Common signs and symptoms of concussion that athletes should be aware of are described below. Athletes should also learn how to recognize if other teammates may have sustained a concussion.

Signs observed by teammates, coaches, and parents

Signs of a concussion typically observed by teammates, parents, and coaches may include: appearing dazed or stunned, clumsy movement, answering questions slowly, personality changes, or inability to recall events prior to or after a hit or fall (CDC, 2015). Players may also be confused about plays or forget plays, may be unsure of the game score or the opponent team, and shows behavior or personality changes (CDC, 2015).

Symptoms of mTBI/Concussion

In a recent study to see if high school football players knew concussion symptoms, it was concluded that the athletes neither had the appropriate knowledge of symptoms or consequences of a concussion (Cournoyer & Tripp, 2014). Parental consent forms were sent

home prior to the survey where parents were instructed to discuss concussion awareness with their child. Almost half of the athletes (46%) said this had not occurred. The study concluded that after the surveys were assessed, there was no correlation between the method of education and their knowledge. Their findings revealed athletes poorly recognize the following concussion symptoms: nausea or vomiting, neck pain, grogginess, difficulty concentrating, and personality or behavioral changes. Only a small portion of the athletes recognized brain hemorrhage, coma, or death to be possible consequences if a concussion is inappropriately cared for (Cournoyer & Tripp, 2014). Overall, the education (parent consent form to teach their child) did not give knowledge about signs and symptoms of concussion. Rather, when student-athletes were presented with a test-retest model the athletes were able to name major symptoms of concussion. Symptoms of a concussion may include: headaches or a feeling of pressure in the head, nausea or vomiting, balance problems, trouble walking or standing, feeling foggy, drowsiness, blurred or double vision, bothered by light or noise, confusion, concentration or memory problems, or “not feeling right” (CDC, 2015). Symptoms of a concussion may appear all at once or are seen gradually as the athlete has more demands placed on him. Student athletes affected from mTBI start to realize the differences when returning to everyday activities (CDC, 2015). Both signs and symptoms can be missed because athletes may look as if nothing is wrong externally. An athlete needs to ensure that they seek medical attention, rest properly and adhere to their physician’s recommendations before returning to school and sports. All concussions damage the brain somewhat, so resting to allow healing time for the injury is crucial (Mayo Clinic, 2015). Extended recovery times and the possibility of a concussion combined with catastrophic injury are risks for youth athletes at a higher rate than the general population (Harmon et al., 2013). Kelly, Nichols, Filley, Lillehei, Rubinstein, Kleinschmidt-DeMasters, (1991) published a case of

a high school football player who passed away due to diffuse brain swelling from repeated concussions. None of the concussions sustained by the player included a loss of consciousness. These types of catastrophic outcomes may result from mild concussions that repeatedly occur. Students that participate in sports have an increased risk in sustaining multiple concussions due to a repetition of the same activities that cause concussion. John Jaso, a catcher for the Tampa Bay Rays was unsure if he would continue playing due to the fact that he ended the past two baseball seasons early because of concussions he suffered. His concussions were not from collisions with a base runner but transpired over time from a collection of smaller hits to his facemask by foul tips. Catchers may always run the risk of suffering a concussion due to the position they play in baseball. Currently, pitchers now throw harder than they ever have with increases in speed, so the catcher position may be at an even increased risk of sustaining a concussion than it has been previously. Major League Baseball (MLB) is continuing to study the catcher's helmets and made an official rule change in 2014, limiting collisions between the base runner and catcher at home plate. This change was implemented to prevent injuries, including concussion (Gaines, 2015). Recently, a concern in football has been that buildups of small hits are just as unsafe as big hits. Purdue University released a study in 2012, stating that their research looking at high school football players using helmet-sensor impact data suggested a concussion is not just the result of one big impact but is likely the cause of multiple hits during the sport season (Venere, 2012).

Second Impact Syndrome

Once the brain is affected by concussion, the subsequent ten days pose the greatest risk to secondary injury (AAN, 2013). "In the acute phase after concussion, the most dangerous potential sequelae of repeated head injury is second impact syndrome" (Saigla, Berger, &

Mitchel, 2014). Second Impact Syndrome (SIS) occurs when a second concussion transpires before the first concussion has fully healed and most often has catastrophic results (BrainandSpinalCord, 2015). Dr. Michael Turner, who led a case looking at SIS in the Journal of Neurosurgery, stated that SIS has a 90% mortality rate and of the 30 cases he has reviewed, all those who suffered from SIS were people in high school or college. He also believes the high rate of SIS in high school is due to the immature brain, as it is continuing to grow until people are 18 or 19 years old. Student athletes participating in boxing, baseball, football, hockey and skiing, have had predominant incidents of SIS (Lupkin, 2013). Further injury before the brain returns to normal can have serious, and many times fatal, repercussions. It is important to know that people become more susceptible to concussion after their first head injury, therefore the secondary impact does not have to be as strong as the initial injury (Mayo Clinic, 2014). If an athlete continues to play having concussion symptoms, the potential risk for second impact syndrome may be heightened.

Post-Concussion Syndrome

When concussion symptoms continue beyond initial injury, which symptoms can last weeks to months, it is a medical problem known as post-concussion syndrome (WebMD, 2015). Post-Concussion syndrome is comprised of numerous clinical symptoms including headache, dizziness, anxiety, cognitive dysfunction (memory, concentration, thinking), mood irregularities, and fatigue or sleep disturbance (WebMD, 2015). Causes of why some people maintain post-concussion symptoms while others recover have not yet been understood (Mayo clinic, 2014). Some researchers think post-concussion syndrome is due to neurotransmitters being disrupted as a result of the impact while others believe it is associated with psychological factors (Mayo clinic, 2014). Regardless of symptoms being structural or psychological, effects of

concussion may last longer than previously thought. Reported case studies suggest that ten percent of concussion symptoms appeared to resolve within one-week and only 50% resolve within one-year, suggesting a longer time-period where an athlete is susceptible to a secondary injury (Saigal, Berger, & Mitchel, 2014). When symptoms continue more than three weeks after injury, the timeframe most professionals classify post-concussion syndrome, academic modifications may need to be formally addressed (Straus, 2015).

Literature Review

The Growing Adolescent

In 2010, a committee presented to the U.S. House of Representatives on: The Impact of Concussions on High School Athletes. They stated that athletes are at a higher health risk sustaining sports-related concussions in high school than those of college or professional level due to the immature brain being increasingly vulnerable to injury. The adolescent brain from ages 14-16 years old, has not yet reached full maturation (Howell et al., 2013). Wolfe (2016) suggests that the frontal lobe goes under a second wave or growth and reorganization just prior to puberty where millions of new synapses are formed and the pruning process of these connections is not complete until early adulthood. Myelination gradually moves to higher function areas only after primitive areas of the brain have been myelinated first therefore; the frontal lobes are the last to be myelinated (Wolfe, 2016). Because of this continual maturation of the brain's frontal regions that is responsible for both executive function and working memory, a head injury in this area might result in harmful consequences to cognition (Howell et al., 2013).

Cognition and mTBI

Due to residual cognitive and communication impairments, athletes who sustain a concussion can require the services of an SLP (Manasse-Cohick & Bornstein, 2008). SLPs may initially screen for cognitive and communication concerns, which include concentration, memory, social communication, word-retrieval, self-regulation, planning, problem solving, and abstract verbal reasoning in order to determine if further evaluation is necessary (Cherney, Gardner, Logemann, Newman, O'Neil-Pirozzi, Roth, Pearl Solomon, 2010). Research suggests that SLPs may be the most capable professionals to diagnose and treat concussion among student athletes due to their widespread training (Duff, 2009). Areas of cognition that may be affected by a concussion include: attention, memory, and executive functions (Mashima et al., 2012).

Attention and mTBI

The anterior brain structures are understood to assist in the role of centering attention on pertinent stimuli while sifting out information that is unnecessary (Stuss, Shallice, Alexander, & Picton, 2006). Attention is essential for any person but also important for adolescents, as they are still in their academic years. A deficit in attention from a mTBI would cause academic problems such as: difficulty being seated for a whole class period, difficulty attending to the teacher in class due to being highly distracted, trouble finishing homework or a project, trouble multitasking, or maintaining discourse with a peer or teacher (Neumann & Lequerica, 2002). Other difficulties of attention due to mTBI include: Lapses in sustained attention, are extremely distracted, and show reduced concentration ability (Mashima et al., 2012). Completions of tasks are difficult for adolescents with mTBI and might be abandoned before achievement due to a reduced

concentration span. Shared complaints among mTBI injuries in combat reported attention problems that are similar, including: “distractibility and poor concentration during competing activities in the environment, difficulty in completing tasks, reading lengthy material, following the plotline of a movie, as well as a decreased ability to shift from one task to another and difficulty in multitasking” (Mashima et al., 2012). Brain injury often harms cognitive abilities including: memory, learning, attention, and concentration, word finding, as well as visual perception. If attention span is compromised, an athlete with mTBI problems will also likely have memory difficulties (Headway, 2016; Mashima et al., 2012).

Memory and mTBI

Memory problems due to mTBI include an impaired working memory and problems learning new information (Mashima et al., 2012). Students with head injuries may suffer either retrograde or anterograde amnesia. Retrograde amnesia is a loss of memories for events prior to the accident (Johnson, 2010). An example of this may be that the athlete remembers the defensive lineman coming to tackle them, but they do not remember the tackle or collision. Anterograde amnesia is the loss of ability to create new memories following the injury where complex systems have been injured and the chemical balance in the brain is upset (Johnson, 2010). An example of this is when an athlete has been in the hospital for hours or weeks longer than they think and only remember the last day or last hour spent there. Athletes suffering three or more concussions have an increased risk of loss of consciousness (8-fold greater risk), anterograde amnesia (5.5-fold risk), as well as confusion (5.1-fold greater risk) following a subsequent concussion (Straus, 2015). Memory deficits are often a result of mTBI with

patients reporting difficulty remembering appointments, directions, instructions, names of people, and misplacing items (Mashima et al., 2012). Memory deficits from mTBI would also affect academic performance. Classroom and test accommodations may be realistic for a student with a brain injury (Kreutzer & Hsu, 2015). Classroom accommodations might include: Additional time to complete assignments that were supposed to be completed in-class, extra or extended break time, the student is provided instructor's notes or quality notes from other individuals in the class, and the student is allowed to audio-record the class (Kreutzer & Hsu, 2015). For assignments, grading should have less emphasis on spelling and grammar errors, preferential seating at/near front of class, quality over quantity of work, avoidance in placing the student in high pressure environments (e.g. short time frames, high workload) and lastly, the student may be exempt from oral reading in front of classmates due to impaired reading skills are all types of class accommodations (Kreutzer & Hsu, 2015). Sleep helps consolidate information that is learned and is crucial to memory (Rasch & Born, 2013). Extra sleep for a student might be needed while the brain heals from injury (BrainLine, 2015). However, sleep disturbance may be a problem for those with head injuries, including mTBI. An athlete with mTBI might have sleep problems, and it is possible that the brain may have difficulty making or using natural chemicals that allow us to fall and stay asleep (BrainLine, 2015).

Executive Function and mTBI

During the adolescent years, the extensive development of the brain occurs at the level of behavior and cognition as well as executive functions (Blakemore & Choudhury, 2006). Elliott (2016) defines executive function as a “complex cognitive processing

which requires coordination of several sub-processes to accomplish a certain goal, and intimately connected to the frontal cortices.” Examples under the executive function umbrella are: initiating, organizing, planning, social skills, topic maintenance, time management and self-monitoring. Head trauma in adolescence has been linked to deficits in both attention and executive function that may jeopardize everyday task performance (Howell, Osternig, Van Donkelaar, Mayr, Chou, 2013). Howell et al. (2013) note that little research on attention and executive function exists in adolescents following concussions by using laboratory-based measures. Their longitudinal study, using the Attentional Network Test (ANT) and the Task-Switching Test (TST) within 72 hours, revealed that concussed adolescents appear to have trouble recovering executive function post-injury and could require longer recuperation time until full recovery. Howell et al. (2013) suggest using evaluations such as the ANT and TST, which focus on attention and executive functions that can be useful in both assessment and follow-up post head injury for the adolescent population. Recent research also suggests that using executive function tests for individuals with a mild to moderate traumatic brain injury may be useful for predicting injury outcome (Hartikainen, Walija, Isoviita, Dastidar, Liimatainen, Solbakk, Ogawa, Soimakallio, Ylinen, Ohman, 2010). Damage to the frontal lobes (e.g. head on head collision) while being a youth may leave a person knowing what they are supposed to do, but are incapable of executing the tasks. They may also be impulsive, uninhibited, have problems with self-control, setting goals or priorities, planning ahead, as well as many others executive functions taking on the role of CEO or “conductor” in the brain (Wolfe, 2016). Other important executive function skills include initiation, inhibition, emotional regulation, social skills, topic maintenance, planning and organizing, along

with self-monitoring (Cooper-Kahn & Dietzel, 2015). Executive functions assist youth in overseeing their life responsibilities such as managing themselves and their resources, like organizing their day, or completing school assignments in order to achieve a goal (Cooper-Kahn & Dietzel). A deficit in executive function for an athlete may result in: Disorganized thoughts and actions, unproductive planning, decreased initiation, reduced insight, unsuccessful reasoning, decision making and problem solving, decreased mental flexibility, and difficulties self-monitoring (Mashima et al., 2012). A deficit in executive function may result in academic struggles such as: time management, making plans, assessing ideas, reflecting on class assignments, asking for assistance, and waiting to speak unless called on (National Center for Learning Disabilities, 2008).

Academics and mTBI

The Sports Concussion Institute (2012) states concussion symptoms arise when student athletes are physically active but also mentally active. Therefore, “Even though a concussion may occur outside the classroom, its effects may become visible as a student exerts themselves cognitively in the classroom” (Sports Concussion Institute, 2012). Activities in the classroom may augment the symptoms of a concussion slowing down recovery time therefore class modifications or accommodations to reduce mental strain are suggested (Sports Concussion Institute, 2012). Cognitive concussion symptoms may include trouble concentrating, memory difficulties, and feeling “slowed down” (Sports Concussion Institute, 2012). These aforementioned cognitive concussion symptoms may have academic performance deficits that include: difficulties with time management, problems recalling information, and trouble with due dates of assignments (Sports Concussion Institute, 2012). Accommodations for the student that are suggested include a

reduction in the homework amount, class notes printed prior for the student, and unlimited testing time (Sports Concussion Institute, 2012). Moser et al. (2005) found that costs of collective concussions could affect overall academic performance. Academic abilities are catastrophic for students who sustain a concussion including: reading, math, vocabulary, writing, and spelling (Kreutzer, & Hsu, 2015). A student's grade point average (GPA) happened to be substantially lower for those who sustained many concussions as well as those who recently sustained a concussion (Moser et al., 2005). This study also suggested a correlation between a lower GPA and increased concussion susceptibility (Moser et al., 2005). If an athlete does sustain a concussion, their GPA may continue to drop, as there will be increased difficulty with cognition. Due to attention being the basis for other cognitive tasks, troubles in attention can "likely compound impairment in both memory and executive functions" (Mashima et al., 2012).

Return To Learn (RTL)

Straus (2105) reports that, regardless of the grade, educational problems experienced by student-athletes are directly associated to the severity of their post-concussion symptoms. Due to heightened academic pressure especially at the high school level, student-athletes report having more difficulty in subjects that are more demanding, such as math and reading (Straus, 2015). Following a concussion, students all have different roads to recovery. Therefore, following a RTL plan that is customized by doctors and other allied health professionals so the student can go at their own pace is essential (The Children's Hospital of Philadelphia, 2015). There is a need to provide support, predominantly at the high school level where demands are higher (Ransom, Vaughan, Pratson, Sady, McGill, Gioia, 2015). Ransom et al. (2015) stated after a

concussion, increased time is spent on homework, and symptomatic headaches are interfering with learning at school. The American Academy of Pediatrics (AAP) in their 2013 clinical report has revealed common signs and symptoms along with the potential academic impact as well as adjustments that can be made to help the student-athlete (see Table 1) (Halstead, McAvoy, Devore, Carl, Lee, Logan, 2013). After sustaining a concussion, an athlete will need ample rest to help their recovery. Dr. Rosemarie Scolaro Moser, a sports concussion neuropsychologist states: “Both cognitive (i.e. mental) and physical rest following a concussion are needed to reduce the work the injured brain has to do to allow it to heal.” Physicians may recommend that staying home from school for a few days could be best. During this time, it will be important for the athlete to not engage in activities that could be strenuous on the brain (i.e. loud movies, texting, reading, video games). The student-athlete will also want to avoid studying and, if symptoms persist beyond one-week, go back to their primary physician (CIF, 2015). When returning back to school, a student might go to a couple classes at a time and ease back into academics. A formal evaluation may be given by the special education team, which includes the SLP, if symptoms persist to see if school changes are necessary. These academic modifications may be written into a legally binding document called an Individualized Education Plan (IEP) or written into a 504-plan. The Individuals with Disabilities Education Act (IDEA) offers a Free Appropriate Public Education (FAPE) for students that need support through special education services. A 504 plan is available through the Rehabilitation Act of 1973 and Americans with Disabilities Act of 1990 for a student who needs accommodations on a long-term basis but does not qualify for special education because they do not meet one of the 13 classifications on an IEP (Halstead et al., 2013).

Modifications on either of these plans may consist of a reduced homework load, extra testing time, having questions read to them, or limited attendance. All student-athletes diagnosed with a concussion, regardless of being put on an IEP or 504 plans, should go through the CIF Concussion Return To Learn (RTL) Protocol adapted from Cincinnati Children's Return to Learn Protocol (see Table 2). This RTL Protocol describes in detail what is required at each step for the student to safely Return To Learn. The focus should be on the student-athlete returning to the school curriculum and completing the return to learn protocol before physical activity or returning to play (Halstead et al., 2013).

Athletics and mTBI

According to Headcase (2013) “thirty-three percent of all concussions happen at practice.” However, many sport-related concussions are not reported. They also stated: “Ninety percent of most diagnosed concussions happen without a loss of consciousness” so many athletes do not report or think they have had a concussion (Headcase, 2013; AAN, 2015). For fear of losing the game, not looking tough enough, or disappointing the coach many players feel they must continue playing (The Impact of Concussions on High School Athletes, 2010). By not reporting concussion symptoms, there are many risks to both the athletes' health and academics. In a recent study, it was determined that youth athletes participating in contact sports for two years or more could be putting themselves at a higher risk for TBI that is more severe (Moser, Schatz, Jordan, 2005). As a result of many athletes who continue to play in both games and practices while suffering concussion symptoms, they are risking successive and more problematic brain injuries (Register-Mihalik, Guskiewicz, Valovich, McLeod, Linnan, Mueller, Marshall, 2013). Moser (2005) surveyed 223 high school athletes finding that twenty percent of the youth

reported sustaining at least one concussion. Therefore, athletes may sustain one or more concussions throughout their high school athletic years. McCrory et al. (2013) stated that the brain is at an increased risk when recuperating from a concussion, so “When in doubt, sit them out.” Once an athlete sustains a concussion, school-based SLPs may collaborate with teachers to track the student’s symptoms including: sleepiness, agitation, inattention, lack of responsiveness, and reduced comprehension of spoken messages, thereby assisting in a safe return to play (Sirmon-Fjordback, 2010).

Return To Play (RTP)

Return To Play is another step-by-step protocol (see Table 3) that gradually eases the athlete back into physical fitness or sports (CIF, 2015). California State Law AB 2121 (Effective 1/1/15) requires that an athlete not Return To Play in a game (i.e. competition) before a 7-day period is over and after being evaluated by a physician who made the concussion diagnosis. The return to play protocol describes in detail what must happen at each stage I-VI in order for the athlete to return to play (CIF, 2015). Of utmost importance, students need to be back at their educational baseline before returning to any type of physical activity, sports, or other extracurricular activities after sustaining a concussion (Halstead et al., 2013). ImPACT testing is one way where results are matched to ensure students are back at their academic baseline (ImPACT, 2016).

Speech-Language Pathologists and mTBI

In order for athletes to agree to “Sit out” they need to know why they should sit out. Sirmon-Fjordbak (2010) stated that Speech-Language Pathologists (SLPs) are prepared to inform others (such as athletic trainers, coaches, athletes, and parents) on the potential cognitive-linguistic factors that may be affected by a concussion. The American

Speech-Language-Hearing Association (2000) has stated that although we cannot prevent some communication disorders, school-based SLPs can help the public become aware of risk factors, and warning signs. They also state the school-based SLP have an important part in educating as part of a team addressing the prevention of communication disorders. SLPs may make an impact at the high school level on the topic of concussion in sports (ASHA, 2000). Lastly, Manasse-Cohick & Bornstien (2008) sum it up perfectly talking about sports-related concussion: “What you don’t know can hurt you.”

Communication and TBI

Residual post-injury effects of a concussion may also include concerns with the ability to communicate effectively or efficiently. Communication profiles in TBI can include: preservation (repeating and talking about something unrelated over and over), verbosity (talk a lot), confabulation (making up something because they don’t have the memory to remember what actually happened), and inattentive (attention problems make it difficult to communicate because they aren’t able to stay on topic). Other deficits may include pragmatic challenges, which include: disinhibition (where they are frank and have no filter in their communication), are egocentric (just talk about themselves), may have a denial of their deficit, are sexually or socially inappropriate and personal mood changes (irritable or emotionally unstable). Neumann & Lequerica (2002) describe many other language and communication problems including: trouble reading emotions of other people & not responding correctly to others feelings in social scenarios, confusion with jokes or sarcasm, and difficulty initiating and following conversations, trouble thinking of the right word and organizing thoughts. All of these would be detrimental to an

adolescent. Lastly, not being able to understand others tone of voice or body language would prove difficult in high school social situations (Neumann, & Lequerica, 2002).

The relationship between head injuries and a loss of speech dates back to 3500 B.C. (Thomsen, 1975 & Wahrborg, 1991). Since that time, much more research has been done including Paul Broca (1861) who found a lesion in the posterior portion of the inferior frontal gyrus, classified as Broca's Aphasia. Carl Wernicke in 1874 confirmed another lesion in the posterior portion of the superior temporal gyrus, named Wernicke's Aphasia. In 1975, Thomsen's study to evaluate the types of aphasia after severe concussion and the outcome of language disruptions reveals that amnesic (anomic) aphasia, and verbal paraphasias were the most frequent symptoms agreeing with the Heilman, Safran, and Geschwind, (1971) study. Anomic aphasia is described by the National Aphasia Association (2016) as: "Persons whose speech is fluent and grammatically correct but it is full of vague words and circumlocutions as if having the feeling that the word is on the tip of one's tongue, particularly for nouns and verbs." Understanding language along with the ability to repeat and read is typically unharmed, yet those with anomic aphasia have word finding problems evidenced in both written and spoken expression (National Aphasia Association, 2016). Those who sustain head trauma, where parts of the brain which control language are affected, can cause aphasia may have difficulty with the formulation of sentences as well as difficulty with spelling, understanding number concepts like time or counting money as well as difficulty reading any type of written material (ASHA, 2016). Verbal paraphasias are actual words that are used incorrectly, however the word is usually associated (e.g. cat for dog). Noticeably,

students who suffer from a brain injury and have residual post-injury affects could have trouble with spoken and written expression in the academic setting.

Motor speech disorders and sport concussion although not common, sometimes occur with severe concussions, repeated concussions, the occurrence of intracranial bleeding, as well as brainstem and peripheral nerve damage (Cannito, 2014). Acquired motor speech disorders are comprised of various dysarthrias and apraxia of speech (AOS). ASHA (2016) states that apraxia of speech is where messages are interrupted from the brain to the mouth, and the person cannot move their lips or tongue in the correct placement to say the sounds accurately, even though muscles are not weak. Open head injuries (e.g., missile wound) are more associated with AOS than closed head injuries (CHI), and AOS is most often found following a stroke. Duffy (2005) found AOS in 15% of 115 cases following a traumatic brain injury that were reviewed at the Mayo Clinic, but most cases were open-head injuries (Cannito, 2014). Dysarthria is found to have impaired movement of the muscles used for speech, which may include the lips, tongue, vocal folds, and/or diaphragm. Dysarthria may result from a brain injury, but the type and severity will be determined from the area of the nervous system affected (ASHA, 2016). The different types of dysarthria consist of spastic, flaccid, ataxic, hypokinetic, hyperkinetic and mixed (McCaffrey, 2013). Theodoros, Murdoch, & Goozee (2001) revealed in their 43-patient sample that all dysarthrias except hyperkinetic were found secondary to TBI, ranging from mild to severe. Following a closed-head injury (CHI), dysarthria is more common than AOS (Cannito, 2014). Generalized motor disturbances are common of all dysarthrias where paralysis or incoordination affects both speech and nonspeech movements (Cannito, 2014). All four subsystems of speech may

be affected or any one or combination of subsystems may be affecting including, articulation, resonance, phonation, and respiration (Cannito, 2014). Screening within a clinic should be administered by an SLP to functionally assess all cranial nerves (CNs) important to speech production as well as listen to the patient in both conversation and reading to determine any impairment of intelligibility, rate, or naturalness. If there are any difficulties of the patient with speech intelligibility, rate, or naturalness, the SLP should complete a comprehensive motor speech evaluation (CMSE). When a case history is taken of the patient, an SLP may inquire of the person's concussion history: repeated concussion, SIS, and multiple subclinical concussions that may lead to more severe deficits associated with chronic traumatic encephalopathy (CTE). The Rancho Los Amigos Scale is used by clinicians when assessing a patient during the first weeks to months after brain injury. The scale assesses both cognition and behavior and is used frequently, as it does not require the person's cooperation (Johnson, 2013). The severity of the CHI as determined by something such as the Rancho Los Amigos Scale, and the time post-injury, where more severe deficits have been linked to motor speech disorders will also most likely be part of the case history (Cannito, 2014). Furthermore, conditions related to communication that preexisted such as stuttering, articulation disorder, cleft palate, respiratory illness, hearing loss, visual impairment, or learning disabilities should be noted since any of these may contribute to a postconcussive speaking problem, even if managed effectively preceding the injury (Cannito, 2014). Quality of life is significantly influenced due to a motor speech disorder including speech comprehensibility, social interaction, employability, and self-esteem (Cannito, 2014). The ten most common deviant speech characteristics occurring in TBI from the Theodoros et al. (2001) study,

showed hypernasality being most frequent, reduced rate, imprecise consonants, reduced pitch variation, decreased breath support for speech, abnormal stress patterning, reduced phrase length, impaired overall intelligibility, prolonged intervals, and reduced loudness variation being the least frequent. While sport-related concussion is not common to result in motor speech disorders, there is evidence to suggest that they do occur, most often due to a severe injury (Cannito, 2014). When motor speech disorders do occur, SLPs are able to do a full CMSE to determine suitable recommendations for management and treatment (Cannito, 2014).

Prevention

One prevention area where SLPs can have an influence, relates to sports-related concussion at the high-school level (Manasse-Cohick & Bornstein, 2008). SLPs can educate athletes on prevention by giving them knowledge about ImPACT testing. The ImPACT acronym stands for Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT, 2016). Athletes may participate locally, such as a community hospital, in ImPACT testing before a sport season begins to establish a baseline of neurocognitive functions. Maine has been leading research on concussion study and treatment and was one of the first states to embrace ImPACT testing, where a neurocognitive test establishes a baseline and has to be matched for a diagnosed student with concussion before they can return to play (Lowe, 2015). Evaluating the differences of pre and post assessment demonstrates where deficits in cognition have occurred (Scripps, 2015). ImPACT testing consists of a computer-based, 20-minute test that provides a baseline of an athlete's attention, memory, problem solving, reaction time, and processing speed. If an athlete sustains a concussion, they would retake the ImPACT test and compare results. Members

of the San Diego community can go to places like Scripps Hospitals, which offer the ImPACT testing for ten dollars. When athletes, parents, and coaches are educated on concussion, ImPACT testing should be addressed so that athletes are aware of baseline testing that can be completed before starting the sport season. Lowe (2015) stated that the Maine Concussion Management Initiative is currently tracking concussions. This program will keep track of those who suffered a concussion and when and how it happened through a Head Injury Tracker (HIT) program. Like ImPACT testing, HIT is another way to study concussions in anticipation of learning more about prevention methods (Lowe, 2015). Due to concussions occurring most often in contact sports like football, Maine has also established practice guidelines for football, which limits the number of days a team can have full-contact practices during the season, and the time of full-contact during practice to 30-minutes (Lowe, 2015). An athletic trainer, David Enos, stated that he has seen concussions in every sport and everyone involved should be made aware (Lowe, 2015). Dr. Dawn Comstock, an expert in sports injuries has been tracking high school injuries since the 2005 through the High School Sports-Related Injury Surveillance (RIO) Study. The first year of the study, girls' soccer had the highest concussion rate of 17.2% of players. In the most recent study in the 2014-15 school year, girls' soccer had a concussion rate of 34.5% higher than football at 25.2%. So are more students sustaining concussions? The more likely answer is that the increase is due to increased identification and diagnosis now (Lowe, 2015).

Summary

In conclusion, SLPs are well-suited to take a role in working with student athletes who sustain a concussion thanks to their training in assessment and understanding of the

skills and abilities necessary to be successful in both academic and social settings and their specific training in both cognition and traumatic brain injury (Duff, 2015). SLPs can help with the gathering of baseline cognitive and communication data as a reference for injury severity and also a recovery benchmark to suggest improvement not seen on imaging like a CT scan or MRI (Sirmon-Fjordbak, 2010). School SLPs are in a good position to service students that sustain a concussion causing deficits in memory, attention, naming and listening comprehension, balance, and visual-perceptual skills (Sirmon-Fjordbak, 2010). The first step is for SLPs to educate other school personnel such as administrators and school psychologists that this is in their scope of practice. When cognitive impairments or brain injuries affecting communication, social functioning or learning arise, they should look to SLPs as a vital member of their team working to keep student athletes safe and healthy in both academics and sports (Duff, 2015). School-based SLPs may also exert an effort to educate athletic trainers, coaches, athletes, and parents about concussion and the cognitive & communication factors that may persist including: memory, problem solving, and comprehension (Sirmon-Fjordback, 2010; Register et al., 2013).

Chapter 2: Process and Product

Background

In patients that suffer mTBI (concussion), cognitive rehabilitation is needed in order to make them aware of the processes that contribute to learning difficulties in school and social life, as well as their performance in sport. Every year, nearly sixty percent of high school students participate in organized sports and that number is growing annually (Duff, 2015). It is estimated that 300,000 concussions take place each year in the U.S. on sports fields and in sports arenas (AAN, 2015; Gessel, Fields, Collins, Dick, Comstock, 2007). SLPs can assist athletes with prevention and treatment strategies to help improve academic performance and optimize their quality of life. Treatment strategies for cognitive & communication domains include: “identifying barriers and supports, and developing compensatory strategies to improve performance of processing speed, memory, comprehension, social communication, problem solving, judgment, initiation, planning, and self-monitoring” (Mashima, Roth, MacLennan, Picon, Hammond, Goo-Yoshino, Isaki, Singson, Frank, 2012).

Purpose

This curriculum was developed to help Speech-Language Pathologists play a greater role in working with student athletes who may sustain a traumatic brain injury. As of now, SLPs do not have a specified responsibility, neither are SLPs recognized in working with this population (Duff, 2015). This curriculum was also created to make more professions aware of the role SLPs play in helping those with brain injuries where communication, social functioning, cognition, and learning can be affected. SLPs need to educate school personnel, administrators, and psychologists that education in prevention and management of concussion is within SLPs scope of practice (Duff, 2015). Sirmon-Fjordbak (2010) also stated: “SLPs are poised to educate athletic trainers, coaches, athletes, and parents about the cognitive-linguistic factors that are affected by concussions, such as verbal reasoning, memory, problem-solving, and comprehension.” When an SLP is not available to implement this curriculum, athletic trainers and coaches may wish to teach these lessons. The athletic trainers and coaches would use this as an extension to the aforementioned CIF handout, required to give to athletes informing them about concussion.

Overview

This curriculum developed includes:

Part 1: Introduction of mild Traumatic Brain Injury (35 min.)

To be given by the coach or athletic trainer prior to SLP presenting parts 2-6.

Part 2: Review of mTBI (25 min.)

Part 3: Introduction of Traumatic Brain Injury (TBI) and TBI scale (20 min.)

Part 4: Cognitive rehabilitation-Attention (15 min.)

Part 5: Cognitive rehabilitation-Memory, Concepts, Problem-Solving (15 min.)

Part 6: Cognitive rehabilitation- Executive Function (15 min.)

The curriculum was influenced by Kristy Weissling’s: The House Where Language Lives: Model of components of cognition described below:

As each level is described of the “House” in its part (4-6), it will be added it to the hierarchy that is being built. This will show the students the components works bottom-up (as learned) then, top down (once learned).

The House Where Language Lives:

Model of components of cognition

Dr. Kristy Weissling

<p><u>Executive Functions:</u> Effects all the levels from the top down and the bottom up. It is the part of cognition that directs which cognitive functions will be engaged and when. It encompasses the coordination of all the process that will result in the successful completion of goal directed behavior. It is the roof and makes the house a home.</p>
<p><u>Problem Solving/Reasoning:</u> Once you have formed concepts you can begin to manipulate them through the use of problem solving both tangible problems and abstract (reasoning) ones.</p>
<p><u>Concepts:</u> Once you have the ability to remember you can begin to form concepts around your memory. These concepts are integral to the formation of language. Language building requires concept formation and the attachment of symbols to those concepts.</p>
<p><u>Memory:</u> Once you attend to stimuli, you can begin to remember it. There are many types of memory systems including: sensory memory, working memory (immediate or short-term memory), and long-term memory.</p>
<p><u>Attention:</u> The fuel of cognition. Split into many different types: selective, sustained, divided, alternating. Attention is available in a limited supply. It is manipulated through processes of selection, engaging, and disengaging. Without attentional skills other cognitive skills cannot develop completely.</p>

Part 1: Introduction of Mild Traumatic Brain Injury

Note: To be given by coach or athletic trainer prior to an SLP coming for parts 2-6

Duration-35 minutes

Background:

Speech-Language Pathologists (SLPs) in collaboration with athletic educators can inform athletes on important safety procedures that come with playing sports, including concussion. Research suggests that SLPs may be the most capable professionals to diagnose and treat concussion among student athletes due to their extensive training (Duff, 2009). The American Association of Neurological Surgeons (2015) specify that a concussion is a brain injury resulting in temporary loss of normal brain function with no external signs of head trauma in many incidents. In many cases someone with a concussion never loses consciousness. The American Academy of Pediatrics reported: “Concussions among teens age 14 to 19 have risen 200% in the last decade” (Headcase, 2013). Every year, nearly sixty percent of high school students participate in organized sports and that number is growing annually (Duff, 2015). It is estimated that 300,000 concussions take place each year in the U.S. on sports fields and in sports arenas (AAN, 2015; Gessel, Fields, Collins, Dick, Comstock, 2007). A conservative estimate is that one in ten student athletes sustains a concussion during practice or play each sport season (Sirmon-Fjordbak, 2010).

Methods:

1) Introduction: Define mild Traumatic Brain Injury (mTBI)

- Ask the athletes what they think the definition is and then continue with the appropriate response below:

Mild traumatic brain injury is more commonly referred to as *concussion*. A definition of concussion in sport by the third International Conference on Concussion in Sport describes it as “...an injury caused by a direct blow to the head, face, neck, or elsewhere in the body with impulsive force transmitted to the head resulting in impaired neurologic function and acute clinical symptoms” (McCroly, Meeuwisse, Johnston, Dvorak, Aubry, Molloy, Cantu, 2009). In essence, a mild traumatic brain injury is generally a functional problem and does not require that the athlete lose consciousness. Concussions are not frequently recognized as problematic or a brain injury, yet an estimated 5.3 million Americans are living with disabilities from a brain injury (Huff, 2009). Ted Stachulski, Brain Injury Association of Vermont’s “Survivor of the Year,” called it a silent epidemic after being misdiagnosed for four years.

- Ask the athletes what sports they think have the highest incidence of concussion: The highest incidence of sports-related concussion is in football, rugby, hockey, soccer, and basketball. Concussions occur in all sports yet some sports, positions, and playing styles have an increased risk of concussion. When rules of play in sports are similar, more concussions are seen in female athletes than males. The American Academy of Neurology (2013) suggests the greatest threat of a concussion in sport for females is in soccer and basketball.

Most concussion symptoms subside within days of the impact, but other times symptoms continue beyond this time period (Society for Neuroscience, 2012). Common signs and symptoms of concussion that athletes should be aware of are described below. Athletes should also learn how to recognize if other teammates may have sustained a concussion.

- Ask the athletes what signs they know of when someone has had a concussion:

Signs of a Concussion:

Signs of a concussion typically observed by teammates, parents, and coaches may include:

- Appearing dazed or stunned
- Clumsy movement
- Answering questions slowly
- Personality changes
- Inability to recall events prior to or after a hit or fall
- Confused about plays or forget plays
- Be unsure of score
- Be unsure of the opponent team
- Have slurred speech
- Pass out

(CDC, 2015)

- Ask the athletes what symptoms they know of when someone has sustained a concussion:

Symptoms of a Concussion:

Symptoms of a concussion may include:

- Headaches or a feeling of pressure in the head,
- Nausea or vomiting,
- Balance problems,
- Trouble walking or standing,
- Feeling foggy,
- Drowsiness,
- Blurred or double vision,
- Bothered by light or noise,
- Confusion,
- Concentration
- Memory problems,
- “Not feeling right”

(CDC, 2015).

- Ask the athletes when they think these symptoms appear. Then describe the statement below:

Symptoms of a concussion may appear all at once or are seen gradually as the athlete has more demands placed on him, such as in the classroom. Those affected by mTBI start to realize the differences when returning to everyday life (CDC, 2015). Both signs and symptoms can be missed because the athlete looks as if nothing is wrong externally, also known as “the walking wounded.” An athlete needs to ensure that they seek medical attention, rest properly and adhere to their physician’s recommendations before returning to the learn (school) and game (sports). All concussions damage the brain somewhat, so resting and allowing healing time for the injury is crucial (Mayo Clinic, 2015).

- Ask the athletes what Post-Concussion Syndrome is. Then describe the statements listed below.

Post-Concussion Syndrome:

When concussion symptoms endure beyond the initial injury, which symptoms can last for weeks to months, it is a medical problem known as post-concussion syndrome (WebMD, 2015). Causes of why some people maintain post-concussion symptoms while others recover from the symptoms have not yet been understood (Mayo clinic, 2014).

Post-Concussion syndrome is comprised of numerous clinical symptoms including headache, nausea, vomiting, cognitive dysfunction, impaired attention/concentration, impaired memory, mood irregularities, fatigue or sleep disturbance.

Reported case studies suggest that ten percent of concussion symptoms appeared to resolve within one-week and only 50% resolve within one-year, suggesting a longer time-period where an athlete is susceptible to a secondary injury (Saigal, Berger, & Mitchel, 2014).

- Ask the athletes what they can guess Second Impact Syndrome is. Then describe the statements listed below.

Second Impact Syndrome (SIS):

Once the brain is affected by concussion, the subsequent ten days pose the greatest risk to secondary injury (AAN, 2013). “In the acute phase after concussion, the most dangerous potential sequelae of repeated head injury is second impact syndrome” (Saigal, Berger, & Mitchel, 2014).

Second Impact Syndrome (SIS) occurs when a second concussion happens before the first concussion has fully healed and most often has catastrophic results (BrainandSpinalCord, 2015).

Dr. Michael Turner, who led a case looking at SIS in the Journal of Neurosurgery, stated that SIS has a 90% mortality rate and of the 30 cases he has reviewed, all those who suffered from SIS were people in high school or college. The high mortality rate of SIS is probably a result of quick swelling of the brain following the second injury.

Student athletes participating in boxing, baseball, football, hockey and skiing, have had predominant incidents of SIS. (Lupkin, 2013). Further injury before the brain returns to normal can have serious, and many times fatal, repercussions. It is important to know that people become more susceptible to concussion after their first head injury, therefore the secondary impact does not have to be as strong as the initial injury. (Mayo Clinic, 2014). If an athlete continues to play having concussion symptoms, the potential risk for second impact syndrome is heightened.

- Ask the athletes what they are expected to do after sustaining a concussion. (Note: answers should focus on seeing a medical professional, getting rest (cognitively and physically), and gradually returning to school and sports.

Treatment: Due to the fact that symptoms may last longer than originally thought, athletes need a transition plan to return to sports. A physician, athletic trainer, speech-language pathologist, and parents, may determine a pace that is deemed appropriate for an appropriate return. When symptoms are prolonged more than three weeks, the timeframe most professionals classify post-concussion syndrome, academic modifications may need to be formally addressed (Straus, 2015).

What is Return To Learn (RTL)?

See: http://cifstate.org/sports-medicine/concussions/CIF_Concussion_RTL_Protocol.pdf

In essence, RTL is ensuring athletes gradually return to learning (i.e. academics). Straus (2105) reports that, regardless of the grade, educational problems experienced by student-athletes are directly related to the severity of their post-concussion symptoms. Due to heightened academic pressure especially at the high school level, student-athletes report more difficulty in demanding subjects, such as math and reading (Straus, 2015). Following a concussion, students all have different roads to recovery. Therefore, following a RTL plan where doctors and other allied health professionals can customize a plan for the student to go at an individualized pace is essential (The Children's Hospital of Philadelphia, 2015). During this time, it will be important for the athlete to not engage in activities that could be taxing (i.e. loud movies, texting, reading, video games).

The student-athlete will also want to avoid studying and, if symptoms persist beyond one-week, go back to their primary physician (CIFS, 2015). When returning back to school, a student might go to a couple classes at a time and ease back into academics.

There is a formal CIF Concussion Return To Learn (RTL) Protocol adapted from Cincinnati Children's Return to Learn Protocol. This RTL Protocol describes in detail what is required at each step for the student to safely Return To Learn.

- Emphasize the order of RTL and RTP: The focus should be on the student-athlete returning to the school curriculum and completing the return to learn protocol before physical activity or returning to play.

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What is Return To Play (RTP)?

See: http://cifstate.org/sports-medicine/concussions/CIF_Concussion_Return_to_Play_Protocol.pdf

Return To Play is another step-by-step protocol that gradually eases the athlete back into physical fitness or sports. California State Law AB 2121 (Effective 1/1/15) requires that an athlete not Return To Play in a game (i.e. competition) before a 7-day period is over after being evaluated by a physician who made the concussion diagnosis. The return to play protocol describes in detail what must happen at each stage in order for the athlete to return to play.

- Reiterate order of RTP and RTL: Of utmost importance, students need to be performing back at their academic baseline before returning to any type of physical activity, sports, or other extracurricular activities after sustaining a concussion (Halstead et al., 2013).

Prevention & Evolving Technology

- Gear, primary, and secondary prevention:
 - Helmets help to stop impact injuries including: fracture, laceration, bleeding, etc. however have not proven to decrease the occurrence or severity of a concussion. The best primary prevention can be modification to rules of the game. Secondary prevention can be helped with both RTL and RTP enforcement (Harmon et al., 2013).
- Describe ImPACT Testing and its importance with prevention:

ImPACT stands for Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT, 2016). Athletes may participate locally, such as a community hospital, in ImPACT testing before a sport season begins to establish a baseline of neurocognitive functions. An athlete diagnosed with concussion must match their neurocognitive baseline before they can return to play (Lowe, 2015). ImPACT testing consists of a computer-based, 20-minute test that provides a baseline of an athlete's attention, memory, problem solving, reaction time, and processing speed. If an athlete sustains a concussion, they would retake the ImPACT test and compare results.

Pass out the “Graded Concussion Symptom Checklist” (see link below): This is a form that is recommended to be filled out after a good night's rest prior to the beginning of the sport season as a baseline. If an athlete sustains a concussion, they will fill this out again and give it to their doctor as well as fill one out each day to see how symptoms are progressing or worsening.

See: http://cifstate.org/sports-medicine/concussions/CIF_Graded_Concussion_Symptom_Checklist.pdf

- Collect all checklists (i.e. each athletes baseline) and give to coach/athletic trainer.

Next, SLP to continue on with parts 2-6.

Part 2: Review of Mild Traumatic Brain Injury

Duration: 25 minutes

Methods

SLP Introduction: Introduce yourself. Explain that further on in the lessons, more will be described as to how an SLP helps with brain injuries. You may discuss that many types of cognitive therapy will be further discussed in the lessons on how an SLP might help them academically within the school setting.

Review definition of mTBI:

- Ask the athletes what a mTBI is and then continue to review with the appropriate response below:

Mild traumatic brain injury is more commonly referred to as *concussion*. A definition of concussion in sport by the third International Conference on Concussion in Sport describes it as "...an injury caused by a direct blow to the head, face, neck, or elsewhere in the body with impulsive force transmitted to the head resulting in impaired neurologic function and acute clinical symptoms" (McCrary, Meeuwisse, Johnston, Dvorak, Aubry, Molloy, Cantu, 2009). In essence, a mild traumatic brain injury is generally a functional problem and does not require that the athlete lose consciousness. Concussions are not frequently recognized as problematic or a brain injury, yet an estimated 5.3 million Americans are living with disabilities from a brain injury (Huff, 2009). Ted Stachulski, Brain Injury Association of Vermont's "Survivor of the Year," called it a silent epidemic after being misdiagnosed for four years.

Concussion was typically thought of as having a loss of consciousness and confusion. However, its current definition describes concussion as having a possible loss of consciousness, often with no loss of consciousness, confusion, and loss of self-awareness (Manasco, 2014).

Review Signs and Symptoms of mTBI:

- Give the names of the four common categories (listed below) that describe concussion symptoms. Next, have the students decide what types of things go into each category. (Note: you may want to break the athletes up into pairs or small groups. Ensure the symptoms listed above are written on the board or are printed out so that they can decipher which symptom will go in each category. It is also suggested to put the 4 categories into something that looks like a pie chart in order for them to visually remember all 4 categories.)

Symptoms of concussions are frequently described by four categories:

- 1) Thinking/remembering: The thinking and remembering category includes difficulty concentrating or thinking clearly, along with difficulty remembering new information.
- 2) Physical: Physical symptoms include headaches and dizziness, blurry vision, balance problems, feeling like they have no energy, and sensitivity to noise or light.

- 3) Emotional/mood: The emotional and mood category encompasses feeling sad, irritable, nervous, anxious, or emotional.
- 4) Sleep: The last category of sleep consists of sleeping more or less than usual or difficulty falling asleep.

Concussion Goggles Activities:

- Introduce the concussion goggles (fatalvision.com). Explain that we need 2 volunteers. One volunteer will represent an athlete without a concussion and the other will represent an athlete with a concussion (with the goggles on). Choose two new volunteers for the second activity.
 - Two Activities:
 - 1) Walk the Line: Put down two strips of masking tape on the gym floor. Have both participants turn around five times with their head on a bat, then walk down the line and back again. The athlete that is “concussed” will experience blurred or double vision as well as trouble walking and confusion to stay exactly on the line.
 - 2) Shoot a hoop: Have two participants. One at a time, run from one side of the court to the free throw line and back again. Then throw the basketball after which they must go back to the free throw line again and shoot a hoop (i.e. free throw). See how differently the “concussed” athlete shoots the ball than the other participant who has not experienced a concussion. The participant wearing the concussion goggles will experience the same types of things: (double vision, trouble concentrating on target, confusion, etc.).

Conclusion:

- Conclude with asking the students to name one of the four categories that describe concussion symptoms. Continue until all four categories have been reviewed.
- Ask someone to give you a definition of mTBI.

Continue with Part 3: Introduction to Traumatic Brain Injury

Part 3: Introduction to Traumatic Brain Injury

Duration: 25 minutes

Methods

Introduction:

- Ask: Now that we know what mild Traumatic Brain Injury (mTBI) is, what is a Traumatic Brain Injury (TBI)?

A traumatic brain injury is damage to the brain resulting from external and typically forceful event, and does not include damage from disease, stroke, or surgery. However, the severity of a TBI ranges from a concussion, with changes in LOC and transient amnesia to a severe TBI resulting in coma or death (Manasco, 2014).

TBIs can result from an open or closed-head injury. An open-head TBI is where the skull is opened and an object penetrates the skull (usually thought of as a bullet wound in combat, assault, or fall in which an object penetrates the skull) (Manasco, 2014). Effects of an open-head injury usually result in focal damage.

A closed-head injury is where the skull remains intact in closed-head injuries and consists of two types: acceleration-deceleration and impact-based injuries, which may occur in combination (Manasco, 2014) Effects of a closed-head injury usually result in disuse/broad damage.

- How do we determine if a brain injury is mild, moderate, or severe?

Explain the two things that most often determine the level of severity are: 1) level of consciousness (LOC) and 2) post-traumatic amnesia (PTA), or memory loss. Post-traumatic amnesia is the time that has gone by since the initial injury to the minute the patient displays constant memory of what is going on around them (Pangillinan, 2015).

Severity Level	LOC Duration
Mild	LOC less than 30 minutes
Moderate	LOC 30 minutes to 6 hours
Severe	LOC Greater than 6 hours
(Pangillinan, 2015)	

Severity level	PTA/Memory loss
Mild	PTA less than 24 hours
Moderate	PTA extending beyond 24 hours
(Friedland & Hutchinson, 2013)	

- Explain that there are two TBI Scales (i.e. Glasgow Coma Scale (GCS) and Rancho Los Amigos (RLA) levels) that are typically used to measure consciousness

Introduction to RLA: Clinicians use the RLA scale when assessing a patient during the first weeks to months after injury, as it doesn't require the person's cooperation (Johnson, 2013).

RLA

Distribute a handout (<https://s-media-cache-ak0.pinimg.com/originals/06/f9/74/06f974f2b419a5f12394b3fdb1d27c53.jpg>) of the RLA scale so that they have a visual to follow along as the levels are described.

RLA Levels: The RLA has ten levels that describe what a person will demonstrate as they improve through recovery of a TBI. A lower level describes an observed lower cognitive function, whereas a higher level is observed to be a higher cognitive function.

Levels one through three (I-III) describe no response, generalized response, and localized response.

- Ask: What would you look/present like if you were in one of these stages?
You could be in a comatose, vegetative, or minimally conscious state. You would not make any purposeful movements, and if you did they would be inconsistent. You may turn to something such as sound, a light, blinking lights.
Show: <http://www.youtube.com/watch?v=aAvyVJ7SJZ8> (3:30-6:15)
- Ask: What are some examples of how your life would be different if you were in one of these stages? (Note: answers might include not being able to live at home, not able to play sports, not able to communicate with others (note in the video the left hemisphere damage where the language centers are) such as family and friends, etc.)

Levels four through six (IV-VI) describe confused agitated, confused inappropriate, and confused appropriate.

Describe: Tell the athletes that these stages are the “confused” stages. Stage 4 is where a person is confused and agitated. They need total assistance with getting dressed and eating. They also have problems with attention.

Stage 5 is where a person is still confused but is no longer agitated but acts or says things that are inappropriate. They are not oriented to person (i.e. themselves), the time (i.e. day, month, year), or place (i.e. where they are currently at). At this stage they still need help with daily activities (i.e. driving, bills, planning an activity, going to run errands, etc.)

This means that they still need a caregiver full time for all daily activities as they will get agitated easily and need someone to help reduce daily distractions (i.e. loud music, lights, too many people talking, television, etc.) They will also need someone full time as they get distracted easily and may require a lot of visual prompts to be re-directed to a task (i.e. brushing teeth).

Stage 6 is where the person is still confused yet is now appropriate. They can sometimes remember orientation of time and place. They have an awareness of themselves and those they are close to and can now perform daily living activities with a moderate amount of assistance instead of maximal assistance. Memory is impaired where recent happenings such as visitors are not remembered, but have some long-term memories of the past, such as a birthday or holiday. Memory aids/tangible items (i.e. notepads, calendars, cellular phone or tablet applications) are used in order to remember appointments, things to do, along with any others.

Show: Possible stage 6: <http://www.youtube.com/watch?v=eXqkBmjPeBs> (minutes 00:35-4:45)

- Ask: What things come to your mind after seeing this story of Andrea? What things did you notice in the video that she needed help with? (i.e. physical) and what other things did you notice that she now is able to use (i.e. computer). Can you imagine putting yourself into her shoes? (i.e. If you were a senior in high school like her, how would you feel? What would happen to scholarships, sport recruitments, college life, etc.?) Remember, this all happened from one car accident.

Levels seven through ten (VII-X) describe automatic appropriate and four purposeful appropriate levels.

Review: Do a quick summary of levels 7-10 by use of the handout. Explain that these levels describe a purposeful and appropriate individual however still have difficulties such as in executive functioning (i.e. decreased judgment, problem solving). These levels may be thought of as more a minor traumatic brain injury where problems may be more functional rather than structural.

Explain: The next few parts of the lesson will review more of the functional aspects that may result from mTBI including attention, memory, and executive function.

*Optional materials if time is allotted: (Treatment focus SLPs may use in the RLA levels)

RLA I-III: Focus for therapy in the severe stages includes: awareness, arousal and attention. The main treatment focus is to “do no harm.”

RLA IV-VI: Focus of therapy is geared towards using compensatory strategies with consistency, as the patient is unable to recall independently. Memory focus: using a memory book to recall important family or others in their life, a calendar to remember upcoming appointments or to recall events when asked about them. Using tangible items like a memory book or calendar is important. Environmental modifications are usually low lights, low noise, and low stimulation. Other treatment may focus on the client being oriented to person, place, time, and date. Lastly, another focus might be to have the client attend to a task for a specific amount of time (sustained attention).

RLA VII-VIII: Focus for therapy in these stages includes goals that are geared toward language-related functional activities. These might include things such as reading instructions (i.e. cookbook or paragraph level and answer questions), telling time, addressing an envelope, solving daily math problems, counting money, understanding labels on a medication bottle, using the telephone, writing a check/balancing a checkbook, and looking something up on the internet (i.e. restaurant for a reservation).

RLA IX-X: The treatment focus might include consistently using appropriate social behavior, and recognizing needs or feelings of others. For executive functioning: The client might complete a one-page written report on a desired topic or complete a PowerPoint consisting of 10 slides with minimal assistance for planning, organizing, initiating, and the time management for the project or report. A treatment focus might also include: reading a 3-paragraph level passage and recall details after a 5-minute delay using no assistance. Lastly, naming tasks, such as describing 15-17 items in a simple category (i.e. animals) in 60 seconds (normal=25-35 items) to assess thought organization, task vigilance, and expressive language might also be a treatment focus.

(Coca, 2015).

Move onto Part 4: Attention

Part 4: Cognitive Rehabilitation-Attention

Duration-15 minutes

Background

Attention skills are often a deficit in someone that has suffered a brain injury. Attention is a “building block” of other skills such as memory and problem solving. Attention is essential for any person but also important for adolescents, as they are still in their academic years. A deficit in attention would cause difficulty sitting for an entire class period, difficulty paying attention in class due to being easily distracted, difficulty finishing homework or a project, difficulty multitasking, or carrying on a conversation with a peer or teacher (Neumann & Lequerica, 2002). Shared complaints among mTBI injuries in combat reported attention problems that are similar, including: distractibility and poor concentration during competing activities in the environment, difficulty in completing tasks, reading lengthy material, following the plotline of a film, as well as a decreased ability to shift from one task to another and difficulty in multitasking (Mashima et al., 2012). These complaints describe deficits in selective, sustained, alternating and divided attention after mTBI.

Methods:

1) *Introduction of The House Where Language Lives-Attention*

(Ensure this is drawn or shown as the bottom level of the “house.” (See page 30).

Attention: The fuel of cognition. Split into many different types: selective, sustained, divided, alternating. Attention is available in a limited supply. It is manipulated through processes of selection, engaging, and disengaging. Without attentional skills other cognitive skills cannot develop completely.

2) **Describe Attention:** Attention has both overt and covert forms. An overt form can be described as shifting our gaze to bring an object into view. A covert form may be when we decide to listen to something during competing stimuli, or any other type of allocation of attention (Kinchla, 1992). Our parietal and frontal lobes help to initiate, direct, and shift our attention. Attention is the foundation to other cognitive processes. If there are problems with attention, there will most likely be impairments to both memory and executive functions (Mashima, et al., 2012).

3) **Describe the changes in attention due to mTBI:**

(Write these down on a whiteboard so that they can use this information to answer number 4 below).

- Lapses in sustained attention
- Highly distractible
- Decreased concentration
- Poor performance on competing tasks or stimuli

Mashima et al., 2012

4) **Ask the athletes how a deficit in attention would affect them in their lives during school/home/dating/etc. (Ideas are listed below)**

- Difficulty responding appropriately to incoming information
- Difficulty learning new information

- Difficulty filtering out irrelevant stimuli
- Difficulty conversing in situations with distractions, background noise and multiple participants
- Difficulty managing the demands of high-level activity
- Difficulty sustaining attention when reading complex and/or lengthy material
- Difficulty shifting attention as needed
- Difficulty maintaining or changing topics in conversation
- Tangential discourse
- Social avoidance to compensate for overstimulation

Mashima et al., 2012

5) SLP therapy for attention deficits:

Choose one task for each type of attention listed below. Suggested items are in bold. Have a volunteer come up to the front to help you demonstrate the attention type for the others watching. More ideas can be found at:

<http://pathologicallyspeaking.blogspot.com/2013/10/speech-therapy-task-ideas-for-treating.html>

Sustained attention- also thought of as “attention span,” where attention is maintained over time. The first measure of attentional sophistication is one’s ability to sustain attention for increasing intervals (Cristian, 2012). Examples for sustained attention include focusing on one specific task such as playing a video game, or reading a book.

- Time a task (e.g. hopefully they will be able to increase in the amount of time they can sustain the task).
- ***Using a game such as Connect Four, make a pattern on one side that the student must mimic on the other side. To make it easy, use only the black chips, and slowly add in red chips to increase difficulty in the pattern.***

Selective attention- selective attention is the ability to attend to meaningful stimuli and ignore competing or distracting stimuli. An example would be listening to someone’s voice at a loud party. Selective attention is choosing to focus on what you want or “selecting” what you will pay attention to (Cristian, 2012). An important part of selective attention is ignoring distractions both internal (e.g. your thoughts), as well as external (e.g. noise) to be able to attend (Cristian, 2012).

- Therapy is given to the student in a busy/noisy area
- Open a window or door
- Turn on music while telling the student what to do for a task
- ***Listen for key words during a reading task (Tell the students 5 words that they need to listen for when you read a paragraph from a text. Have them raise their hands when they hear those 5 words you told them to listen for).***

The SLP may assess which distractions have more impact on performance by using a timer or checking the student’s accuracy. An SLP may make the tasks the same or comparable with different distractions happening each time.

Alternating attention- One can alternate or shift between activities or tasks that necessitate using different areas of the brain, such as helping a child with homework and fixing dinner.

Alternating attention is where one disengages, switches, and re-engages attention (Cristian, 2012).

- Card sorting tasks
- Blink card naming or sorting tasks (e.g. Flip a card and say the color of the object, on the next flip, say the number of objects, on the next flip say the shape of the objects. The order would continue: color, number, and shape).
- Typing what is on a board or paper, typing the answers to questions on a page (the student practices alternating between the paper or board, their thoughts, the keyboard, screen and mouse).
- ***Stroop tasks (e.g. say the color that is shown, not the color that is written). Print out a Stroop task such as this one. Have two athletes come to the front and demonstrate the task.***



Divided attention- Divided attention is also thought of as “multi-tasking,” where one can split attention between tasks of two or more activities (Cristian, 2012). Unlike alternating attention where you shift tasks entirely, divided attention requires implementation of both tasks at the same time (Cristian, 2012). Examples of divided attention include: talking on the phone while also using the computer, talking to a friend and while getting dressed.

- Attending to multiple stimuli: given a page-length story, instruct them to circle all capital letters, cross out commas, and put a check over prepositional phrases
- ***Sort a deck of cards and listen to someone spelling words, they then have to tell what the word is. (Have one athlete spell out words while the other tries to sort a card deck and tell what the word was the other spelled).***

- 6) Conclusion/Introduction into Memory Part 5:** In summary, attention is fundamental and the foundation for any further cognitive processing. If you don't have attention, how can you create a memory? Once you start attending, you can begin to remember things.

Move onto Part 5: Memory, Concepts, and Problem-Solving

Part 5: Cognitive Rehabilitation: Memory, Concepts, and Problem Solving

Duration-15 minutes

Background

Brain injury often harms cognitive abilities including: memory, learning, attention, and concentration, word finding, as well as visual perception. Memory deficits are often a result of mTBI with patients reporting difficulty remembering names of people, and misplacing items (Mashima et al., 2012). Academic abilities are also catastrophic for students including: reading, math, vocabulary, writing, and spelling (Kreutzer, & Hsu 2015). Often, accommodations are available by the school for students with brain injury to help them overcome limitations and to help them succeed. An SLP in conjunction with a team of others such as psychologists and teachers may be a part of assessing the student to decide appropriate accommodations. Classroom and test accommodations may be realistic for a student with a brain injury (Kreutzer & Hsu, 2015).

Methods:

1) *Introduction of The House Where Language Lives-Memory*

Memory: Once you attend to stimuli, you can begin to remember it. There are many types of memory systems including: sensory memory, working memory (immediate or short-term memory), and long-term memory.

Start with showing memory as the next level in the “house.” (See page 30). Then describe the frequent complaints that students with brain injuries have mentioned:

- “I cannot remember anything I read no matter how many times I re-read the same thing.”
- “I study hard and I feel like I know the material. Then I go into the test and I can’t come up with the answers.”
- “Essay exams are murder. I need 20 minutes to think of what I want to say and then the time has run out.”
- “I am so distracted I can pay attention for five minutes and then my mind wanders.”
- “I got to every class, but nothing sinks in.”

Kreutzer & Hsu, 2015

2) **Introduction Discussion questions:**

- 1) What is memory? (See describing memory below)
- 2) What are two ways we can remember something? (See Iconic and Echoic memory below)
- 3) Why is memory important to your life currently? (Suggestions: Remembering friend’s name, boyfriend/girlfriend’s name, teacher’s name, class assignments, how to get to a class, sport game schedule, errands your mom told you to do on your way home from school, etc.) Tell them that you will go further into memory and how it affects their life later on in the lesson.
- 4) What are two types of memory? (Short-term and Long-term memory)

- 5) If you hit your head in a head on head collision with another player, what deficits regarding memory would you have? (See: Your prefrontal cortex below)
- 6) Why is short-term memory important? (see working memory below)

Describe memory: The Latin term *memoria* and *memor* mean “mindful” or “remembering.” Memories are not kept in our brains as one file to be pulled from, but in fact are stored in many areas of the brain that must be reconstructed almost instantaneously. Some of these areas of the brain include our prefrontal cortex, medial temporal lobes, hippocampus, sensory and association cortices. Our ability to encode, store, and retain information to recall later encompasses memory (Mastin, 2010).

Iconic and Echoic Memory:

Things briefly come through Iconic (we see it) or Echoic (we hear it) memory. Then you put memories into short-term (working) memory and long-term memory.

Your pre-frontal cortex:

After someone has a brain injury, post-traumatic amnesia is common. Post-traumatic amnesia may include retrograde (loss of memories before injury), or anterograde amnesia (a deficit in making new memories). Sustained damage to the prefrontal cortex (e.g. head to head collision) has major implications to deficits in working memory to help create new memories. During encoding, the prefrontal cortex helps to retain information at that moment in order for us to attend to it and actively process it. Our left prefrontal cortex helps with our phonological working memory (encoding linguistic information) and our right prefrontal cortex helps with our visuo-spatial working memory (encoding visuo-spatial and emotional information). Lastly, the prefrontal cortex helps plan what to search for when we retrieve information.

Working Memory:

The working memory, also known as Short-Term Memory (STM) is like a notepad. It stores and processes information at the same time but only for a short period of time that is typically 10 seconds to 1-minute). It can usually hold up to 7 units of information (e.g. a telephone number while looking for pen and paper). Other activities used for short-term memory include: math tasks (e.g. carrying over a number), remembering your argument until the conversation partner stops talking, or reading the beginning of this sentence while you read the rest. Unless we make an effort to elaborate on the STM, the information will decay forever. We must have short-term memories to transfer the information into our Long-Term Memory (LTM) for permanent storing. The prefrontal cortex plays an important role in STM/working memory. It helps as a short-term storage and also requests information from other areas in the brain. The central executive part of the prefrontal cortex houses two neural loops: the visuo-spatial sketchpad and the phonological loop. The visuo-spatial sketchpad activates near the visual cortex, whereas the phonological sketchpad activates near Broca’s area (in the left frontal lobe). The phonological loop helps be an “inner voice” to help repeat word sounds

and keep them in mind. Both of these sketchpads are erased when new information to hold temporarily comes.

3) Describe the changes in memory due to mTBI:

- Impaired memory (specifically working memory)
- Problems with new learning

Mashima et al., 2012

4) Ask the athletes how a deficit in memory would affect them in their lives during school/home/dating/etc. (Ideas are listed below)

- Difficulty recalling instructions or messages
- Difficulty learning new information
- Difficulty remembering names of individuals, appointments, directions, and/or location of personal information (e.g. cell phone numbers, keys, wallet, etc.)
- Difficulty recalling details when reading complex and/or lengthy material
- Difficulty maintaining topic or remembering purpose of conversation

Mashima et al., 2012

Ask the athletes what types of classroom accommodations might be needed for impaired memory (Examples are described below):

- Extra time to complete assignments that were supposed to be completed in-class
- Student is provided instructor's notes or quality notes from peers in the class
- Permit audio-recording of the class
- Student is given instructions in multiple modalities (oral and written)
- For assignments, grading has less weight on spelling and grammar errors
- Allow use of dictionary or thesaurus
- Preferential seating at/near front of class
- Quality over quantity of work
- Avoidance in placing the student in high pressure environments (e.g. short time frames, high workload)
- Student exempt from oral reading in front of classmates due to impaired reading skills

Kreutzer & Hsu, 2015

Ask the athletes what types of test accommodations might be needed for impaired memory (Examples are described below):

- Allow additional time to complete tests
- A quiet, individual environment to minimize distractions when completing tests
- Longer exams to be given in a series of short segments and breaks allowed
- Allow oral exams, an assistant as a scribe, when needed
- Multiple choice instead of open-ended questions
- Given the chance to clarify or explain their answer on assignments/exams
- One examination per day

Kreutzer & Hsu, 2015

5) **Optional: SLP therapy for memory deficits:**

The SLP will look for individual needs of the client in order to determine appropriate compensatory strategies to improve memory. The goal is to decrease demands of impaired memory processes but improve function in everyday activities, such as school (Mashima et al., 2012).

- Drill therapy such as memorizing lists has not been as effective as using intrinsic memory therapy such as external memory aids (e.g. planners, calendars, notebooks, electronic devices). Environmental anchors (e.g. designated areas where homework/lists are kept) are also helpful to improve a patient's quality of life for everyday functioning. If repetitive memory drills are utilized, compensatory strategies should also be used (Mashima et al., 2012).
- In order to help those with working memory deficits (STM), such as those after mTBI, SLPs may use strategies such as helping a student learn to chunk information, associate something with previous knowledge, use repetition, rehearsal (reading aloud), mental simulation, using mnemonics or a motivation to remember it.

6) **Conclusion: Memory/Concepts/Problem Solving:**

Only after you remember something, you can begin to form concepts. These concepts are essential for language preparation. An example of a concept would be: knowing that something that has four legs and barks is a dog. This is essential for language so that when you see something with four legs and barking, you call it a dog. After concepts are formed, you can begin to determine and problem solve through exclusion. If the animal has four legs and does not bark you know it is not a dog but could be a cat or any other animal with four legs.

(Ensure these levels are drawn above the attention level: see page 30).

Problem Solving/Reasoning: Once you have formed concepts you can begin to manipulate them through the use of problem solving both tangible problems and abstract (reasoning) ones.

Concepts: Once you have the ability to remember you can begin to form concepts around your memory. These concepts are integral to the formation of language. Language building requires concept formation and the attachment of symbols to those concepts.

Move onto part 6: Executive Function

Part 6: Cognitive Rehabilitation-Executive Function

Duration-15 minutes

Background: The adolescent brain is still maturing into adulthood, particularly the frontal lobe making the greatest changes. The frontal lobe goes under a second wave of growth and reorganization just prior to puberty where millions of new synapses are formed. The pruning process of these connections is not complete until early adulthood. Myelination gradually moves to higher function areas only after primitive areas of the brain have been myelinated first. The frontal lobes are the last to be myelinated. Therefore, the amount of synapses that must be pruned as well as the amount that needs to be myelinated increases drastically in the brain during the adolescent years. Myelination is likely not complete until age 30 or later. Damage to the frontal lobes during this span of life may leave a person knowing what they are supposed to do, but are unable to execute the tasks. They may also be impulsive, uninhibited, have problems with self-control, setting goals or priorities, planning ahead, as well as many others that take on the role of CEO or “conductor” in the brain (Wolfe, 2016).

Methods:

Executive Functions: Effects all the levels from the top down and the bottom up. It is the part of cognition that directs which cognitive functions will be engaged and when. It encompasses the coordination of all the processes that will result in the successful completion of goal directed behavior. It is the roof and makes the house a home.

1)

Introduction of The House Where Language Lives-Executive Functions

(Draw/show this at the top level of the “house.” See page 30).

2) **Describe Executive Function**

Executive Function:

Executive Functioning incorporates the cognitive-based skills of mental control and self-regulation to manage oneself and one’s resources to accomplish a goal. All of these skills are controlled in the frontal lobe of the brain. When we perceive that someone is disorganized, we are actually observing just one problem skill with executive functioning. Other important executive function skills include initiation, inhibition, emotional regulation, social skills, topic maintenance, planning and organizing, along with self-monitoring (Cooper-Kahn & Dietzel, 2015).

Describe the changes in executive function due to mTBI:

- Disorganized thoughts and actions
- Ineffective planning
- Reduced initiation
- Decreased insight
- Ineffective reasoning, judgment and problem solving
- Decreased mental flexibility
- Difficulty self-monitoring

3) Next, ask the athletes how a deficit in executive function would affect them in their lives during home/dating/social interactions (Ideas are listed below)

- Lack of coherence in discourse (social interactions with family/friends)
- Lack of organization in planning daily activities (planning a date!)
- Difficulty implementing plans and actions (homework, dating)
- Difficulty initiating conversations (meeting others school/dating)
- Problems recognizing and repairing conversational breakdowns
- Inability to determine the needs of communication partners
- Difficulty making inferences or drawing conclusions
- Difficulty assuming another person's perspective
- Difficulty interpreting the behavior of others
- Difficulty evaluating validity of information
- Verbose; lack of conciseness in verbal expression
- Decreased comprehension of abstract language, humor, and/or indirect requests
- Difficulty meeting timelines (e.g. to complete a task-homework)
- Difficulty formulating realistic goals (getting homework done-unrealistic timeframe)
- Difficulty recognizing complexity of tasks and need for simplification (break down projects into smaller components)
- Inappropriate comments (school, home and dating life!)

Mashima et al., 2012

Ask the athletes how a deficit in executive function would affect their learning in the classroom:

- Keeping track of time
- Remembering prior knowledge for discourse
- Assessing ideas
- Reflect on classwork
- Finish work on time
- Ask for assistance
- Wait to speak unless called on

National Center for Learning Disabilities
(NCLD), 2008

4) Optional: SLP therapy for executive function deficits

An SLP may help a student with executive functioning if deficits are shown in difficulty planning a project, comprehending how much time a project will take to complete, trouble initiating activities or tasks, difficulty generating ideas, and many more (NCLD, 2008).

SLPs may use general strategies such as: visual aids or organizational aids, visual schedules, time organizers, electronics with alarms, and written directions accompanied by oral directions. For time management, strategies may include: to do lists and having the student estimate how long tasks will take to finish, and chunking larger assignments into smaller assignments for completion (NCLD, 2008).

- 5) **Story: Present/Summarize the story below describing deficits of executive function. Then ask how this story could relate to someone calling them asking him or her to be a sub player for a basketball team (whatever team they are on) over spring break that is in another state. What might be some of the same struggles if they had a deficit in executive function?** (Note: Look at the description below. Inhibition-accepting to play before confirming with your parents, Emotional control-angry at parent because they don't understand why you committed to playing, working memory-not remembering the dates when you are supposed to play and forgetting to ask even though you have good intentions of doing so (initiation), and planning/organizing sports gear that you would need).

<http://www.ldonline.org/article/29122/>

The Road Trip without a Map:

We'd like to tell you a story about our friend, Robin, who lives life without the benefit of strong executive functioning. Robin is a composite of many individuals we have known, and she struggles with weaknesses in executive skills, despite her well-intentioned efforts to reform herself.

One day in May, Robin gets a phone call from her Aunt Sue in Merryville, Missouri. Aunt Sue is planning a family reunion in July, and she wants to know if Robin and her family can come. All of the extended family will be there. The little town will be overrun with relatives and it is going to be a great corralling of the family from all across the United States. Robin is excited at the prospect and eagerly says, "Of course we'll be there! We wouldn't miss it!"

Aunt Sue gives Robin all the particulars, including the dates of the reunion and places to stay. Robin rummages around in the kitchen junk drawer for a pencil while her aunt talks, but she never does find one with a point on it. She promises to herself to find a pencil and write down all the details just as soon as she gets off the phone. But by the time she hangs up, she can't remember the specifics. She makes a mental note to call back soon to get the dates.

That evening, Robin excitedly tells her husband and two children about the reunion. Her husband asks when it will take place. "Some time in July. I don't remember exactly." He says, "Well, please find out this week because I have to request vacation time at work." Their fifteen-year-old son exclaims, "Hey, I thought July was when I was supposed to go to Band Camp!" "Didn't you remember?" Robin's daughter practically shouts, "I'm going to Ocean City with Julie and her family sometime in July." Robin blows up at them all, yelling, "Why are you all being so negative? This is supposed to be fun!"

About once a week, Robin's husband reminds her to get the information about the reunion. She promises to do so. (And she really means to get around to it!) Finally, in June, Robin's husband gets very annoyed and says, "Do it now! I'm going to stay right here in the kitchen until you call!" Robin makes the call and gets the dates as well as the other particulars. Her husband harrumphs around the house the rest of the evening because now he has only three weeks left before the requested time-off. Luck is on their side, though, because he manages to arrange the vacation around work, and the reunion dates do not conflict with the kids' activities.

Over the next three weeks, thoughts about the trip float through Robin's head from time to time. She thinks about how the kids will need to have things to do in the car since it's a long trip. She thinks about taking food and snacks for the ride. She thinks about getting her work at the office

cleared up in advance so she can be free of commitments for the vacation. She thinks, "I really should take care of that stuff."

A few days before it is time to leave for the two-day drive to Missouri, she starts piling stuff into the van, including clothes and other supplies. (You can only imagine what the inside of this van looks like!)

Finally, it's time to pile the people into the van, too. On the way out of the house, one of the kids asks, "Who will be taking care of the cats while we're gone?" Robin moans, "Oh no! I forgot about that. We can't just leave them here to die and there's no one to take care of them! Now we can't go. What will we tell Aunt Sue?" Her husband takes over, and starts calling around the neighborhood until he finds a teenager who can do the pet sitting. The crisis passes. The cats will be fine.

So, they're off. Robin's husband drives the first shift. He pulls out of the neighborhood, gets onto the main highway, and then asks, "So, what's the game plan? What's the route?" Robin answers, "Missouri is west, so I know we have to go west." He looks at Robin incredulously and says, "You don't know any more details than *that*? Well, get out the map. We can't just head west with no more information than that!" And, of course, Robin says, "What map? I don't have a map." Robin's husband sighs and shakes his head. "Oh no! Another road trip without a map! Why didn't you tell me you were having trouble getting it all organized? I could have helped." Robin replied, "I didn't have any trouble. Everything is fine. We're in the car, aren't we? We'll get there. What are you so upset about?"

Do you think Robin had made reservations for where to stay along the way? Do you think she had planned out how much cash they would need for the trip or made it to the bank ahead of time? These and many other details, of course, had escaped planning.

List of Executive Functions:

- **Inhibition** - The ability to stop one's own behavior at the appropriate time, including stopping actions and thoughts. The flip side of inhibition is impulsivity; if you have weak ability to stop yourself from acting on your impulses, then you are "impulsive." (When Aunt Sue called, it would have made sense to tell her, "Let me check the calendar first. It sounds great, but I just need to look at everybody's schedules before I commit the whole family.")
- **Shift** - The ability to move freely from one situation to another and to think flexibly in order to respond appropriately to the situation. (When the question emerged regarding who would watch the cats, Robin was stymied. Her husband, on the other hand, began generating possible solutions and was able to solve the problem relatively easily.)
- **Emotional Control** - The ability to modulate emotional responses by bringing rational thought to bear on feelings. (The example here is Robin's anger when confronted with her own impulsive behavior in committing the family before checking out the dates: "Why are you all being so negative?")
- **Initiation** - The ability to begin a task or activity and to independently generate ideas, responses, or problem-solving strategies. (Robin thought about calling to check on the date of the reunion, but she just didn't get around to it until her husband initiated the process.)

- **Working memory** - The capacity to hold information in mind for the purpose of completing a task. (Robin could not keep the dates of the reunion in her head long enough to put them on the calendar after her initial phone call from Aunt Sue.)
- **Planning/Organization** - The ability to manage current and future- oriented task demands. (In this case, Robin lacked the ability to systematically think about what the family would need to be ready for the trip and to get to the intended place at the intended time with their needs cared for along the way.)
- **Organization of Materials** - The ability to impose order on work, play, and storage spaces. (It was Robin's job to organize the things needed for the trip. However, she just piled things into the car rather than systematically making checklists and organizing things so important items would be easily accessible, so the space would be used efficiently, and so that people and "stuff" would be orderly and comfortable in the car.)
- **Self-Monitoring** - The ability to monitor one's own performance and to measure it against some standard of what is needed or expected. (Despite the fact that they're off to Missouri without knowing how to get there, with almost no planning for what will happen along the way, and without a map, Robin does not understand why her husband is so upset.)

6) Conclusion:

- Ask if any of the students currently use schedules or organizers.
- Ask the students why (for what purpose) they use their phones, notebooks, or calendars. Explain those items are all to help them with their executive functions.
- Conclude with the importance of the many executive functions we use come through our frontal lobe. If the frontal lobe was injured due to a head on head collision, they might have deficits in executive function, which would affect their home, school, dating, sports life, and many others.

Chapter 3: Implementation and Results

Implementation

The curriculum was implemented at a high school in the San Dieguito Union High School District in Carlsbad, California. The activities and curriculum to educate the student athletes on mTBI took place both in the gym and in a classroom setting. Implementation was during an athletics class that mostly consisted of the freshman, junior varsity and varsity basketball team members. When the class was asked to raise their hand if any of them had previously sustained a concussion, six out of thirty students responded affirmatively, that they believed they had a concussion but were not able to concisely define a concussion.

Part one, "Introduction of mild Traumatic Brain Injury," was given by the high school's athletic trainer, as per the curriculum collaboration method. The student athletes were given an overview of the topic as well as important additional information that was not covered in the state-mandated CIF handout. One example of additional information that was given included education on second impact syndrome (SIS) and post-concussion syndrome. The participants admitted they had never heard of either SIS or post-concussion syndrome, both of which may have lasting consequences to their quality of life.

Part two gave the student athletes a review of what they learned from the athletic trainer. Additionally, this part included an opportunity for student athletes to explain and define important definitions learned such as a mild Traumatic Brain Injury. Visuals were implemented such as drawing a pie chart of how to remember signs and symptoms of mTBI. Although the student athletes were reserved at first, once the concussion goggles simulation activity was implemented they were eager to participate and very attentive to the information presented. This activity proved effective in demonstrating to the student athletes the debilitating effects of mTBI

including: visual disconnect (e.g. blurred vision, seeing double), confusion, trouble standing or walking, dizziness, lack of confidence, hesitation, apprehension, disorientation, as well as many others. The curriculum addressed the various excuses for not reporting concussion symptoms and how this decision could affect them both in sports and school. By giving each student a simulation of what a concussion could feel like, the students will have an increased awareness and ability to recognize the symptoms of a concussion and therefore be more likely to report an injury.

Part three was implemented in the curriculum to educate athletes on what it might be like if they sustain not only a mild traumatic brain injury but also a moderate or severe traumatic injury. It was explained to the students that SLPs work in environments such as hospitals or outpatient clinics, which allows them to give services to patients with varying severities of traumatic brain injury. In part two, the student athletes defined mTBI and in part three they learned the differences from mTBI including ways SLPs measure cognition through scales such as the Rancho Los Amigos Levels (RLA). None of the students stated they knew what the RLA scale was or what it measured. Videos were shared with intermittent class discussions to teach about symptoms a patient might present with at each level of the RLA scale. Descriptions of what a SLPs therapy may look like at the different stages were also included to give the athletes knowledge of how an SLP uses their clinical expertise. This segment gave students an opportunity to extend their learning beyond mTBI and learn about speech-language pathology as a profession.

In part four, the student athletes learned that attention skills could be deficient in someone that has suffered a brain injury, as it is a building block of other cognitive skills. They learned that attention span is essential for any person but especially important for adolescents

like themselves, as they are still in their academic years. They were educated that a deficit in attention could cause difficulty sitting for an entire class period, difficulty paying attention in class due to being easily distracted, difficulty finishing homework or a project, difficulty multitasking, or carrying on a conversation with a peer or teacher (Neumann & Lequerica, 2002). The students were asked how they thought a deficit in attention from mTBI would affect them in their lives. The student's answers included: problems answering questions, and trouble learning if they are not paying attention in class. At the end of part four, SLP therapy was described as helping with sustained, selective, alternating, and divided attention along with interactive activities to help portray what each type of attention looked like.

Part five presented the student athletes with a memory lesson, which was introduced after the attention section in part four because one must have attention in order to be able to remember. The second block of "The House Where Language Lives" was drawn on the whiteboard (see page 30). The lesson then started off with student athletes reading the frequent memory complaints that students with brain injuries have mentioned that were written out on paper slips and passed out. These slips included: "I study twice as long as I used to, but I am doing much worse" and "I cannot remember anything I read no matter how many times I re-read the same thing" (Mashima et al., 2012). By giving the athletes an opportunity to read what others experienced from mTBI have said, they were able to realize that a deficit in memory is likely if they sustain a concussion. The student athletes were asked why memory would be important in school and other aspects of their social lives. Answers to these types of questions included: Difficulty remembering others names (such as family, friends, girlfriends) and difficulty remembering information presented in classes. It was explained to the student athletes that in order to help those with memory deficits, specifically short-term memory, such as those after

mTBI, SLPs may use strategies such as helping a student learn to chunk information, use repetition, rehearsal (reading aloud) and using mnemonic devices. Lastly, in part five, a short discussion was given on how after one remembers something, concepts around that memory can be formed, resulting in language formulation. After a concept has formed, an individual can also problem solve and manipulate the concept through reasoning. This led to part six being written on the whiteboard and added to the top of the hierarchy: Executive Function (see page 30).

In part six, the student athletes were asked if they had ever heard of the term executive function but none of the athletes raised their hand. The story in part six was read aloud by the student athletes which portrayed a mother who had lost many skills in executive functioning including: initiation, inhibition, emotional regulation, social skills, topic maintenance, planning and organizing, along with self-monitoring (Cooper-Kahn & Dietzel, 2015). The student athletes learned that all of these types of executive functions are skills needed for completing goal-directed behaviors. This real-world scenario helped them understand the important purpose of executive functions and how they contribute to their daily activities. It placed the executive functions into a relatable, functional context. Next, the student athletes were asked how a deficit in executive function would affect them in their lives during home, school, dating, or other social interactions. They demonstrated increased understanding with their answers after the lesson. By the time we neared the end of all six parts the athletes needed an obvious example of how executive functions would relate to them. It was described that if they wanted to go out on a date with a girl and they had a deficit in executive functions, they would not have the impulse to go ask her out. Even if they could initiate the conversation, they would have trouble planning the date. If they somehow got to the date, they would not remember the order in which they wanted to organize the activities. At the end, this example continued to show the students how all of the

cognitive and communication processes work together as both a bottom up and top down system in the “House.” Finally, it was mentioned that SLPs might use general strategies to help someone with a deficit in executive functions such as: visual aids or visual schedules, time organizers, electronics/smart phones with alarms. An SLP might also include ways for students to effectively manage their time such as: to-do lists, having the student estimate how long tasks will take to finish, and segmenting larger assignments into smaller assignments for completion (NCLD, 2008).

Results

In summary, implementation led to an increased knowledge among these student athletes regarding cognitive and communication effects due to mTBI, thereby reducing the likelihood of non-reported injuries due simply to a lack of education. The class curriculum aimed to further their education of mTBI and the associated academic and health risks, and empowered student athletes to more actively report a concussion. They learned that permanent brain damage and death are rare but potential results of not identifying and correctly managing a concussion. Additionally, they learned more about the field of speech-language pathology and the role SLPs play in servicing those with brain injuries varying from mild to severe. The class ended with the high school athletic trainer and basketball coach encouraging the athletes to recognize and not be afraid to immediately report any possible concussion symptoms.

Improvements suggested by other licensed speech-language pathologists who reviewed the lessons included: making the lessons brief in consideration of timing for implementation, more explicitly relevant to the life of a high school student, and simplifying lessons to be less technical. The feedback was helpful and encouraging for future refinement.

Chapter 4: Conclusions and Future Development

Conclusions

Despite concussion being a controversial topic at the professional sports level, laws have been passed in many states for schools to implement Return to Play and Return to Learn procedures, showing that concussion awareness is becoming a growing political priority (Salvatore, & Sirmon-Fjordbak, 2011). Concussion management is the quickest growing sub-discipline in neuropsychology, giving possibilities of recognition for school-based SLPs (Duff, 2009). SLPs are most fit to help detect and manage concussion with school-aged individuals due to knowledge of cognitive and communication disorders, experience in assessment administration, and clinical decision-making (Duff, 2009). Additionally, programs implemented by school-based clinicians to educate coaches, parents, and athletes to increase awareness and promote reporting on concussion are supported (Register et al., 2013). Due to residual cognitive and communication impairments, athletes who sustain a concussion can require the services of an SLP (Manasse-Cohick & Bornstein, 2008). School-based SLPs are on site to deliver prompt services to student athletes sustaining concussions due to their locale to monitor neurocommunication and academic growth (Salvatore & Fjordback, 2011). Even though SLPs are rarely involved on a concussion management team in the schools to assist athletes in the RTL and RTP process, SLPs knowledge and abilities makes them fit to be involved with cognitive, academic, social, and communicative achievements (Duff, 2009).

The curriculum for the class provided in this resource was focused on education encompassing mild traumatic brain injury in order for athletes to recognize and report when mTBI occurs. Specifically, athletes also learned about communication and cognitive impairments that may be affected as a result from mTBI. The curriculum was designed to bring awareness of

how mTBI could personally impact an athlete's life, physically, cognitively, and academically.

There are many reasons why athletes do not report their concussion symptoms including: fear of the coach, losing playing time, losing the game, and not appearing tough; these reasons can be effectively reduced through increased education on the consequences of concussions.

During implementation, student athletes were involved through discussion questions and active participation, which helped the student athletes engage more fully in learning about each topic. At the conclusion, the student athletes agreed that they would feel more confident in reporting concussive symptoms now that they were aware of signs and symptoms, how a concussion could affect them personally in their lives, and the further consequences of mTBI.

Future Development

Research is ongoing about concussion and its effect on adolescents in sports. Continued research is needed among school-based speech-language pathologists who work with athletes that have sustained mTBI and its effects on adolescents' full scholastic career. Further research is needed to look at recovery rates of concussion broken down by both age and gender.

Additionally, more research is needed on pre and post baseline testing to decipher the collective deficits of concussion among adolescents so that baseline testing takes a heightened importance in school sports. Supplementary studies will prove helpful in improving the current education provided in this resource as well as implementation of additional parts to the lesson. Feedback from school-based SLPs, coaches, and athletic trainers would be helpful regarding the focus of the curriculum topics.

Enhancement of this project will comprise of the recommendations from licensed SLPs who reviewed the lessons. The implementation will include a clear portrayal of how a teenager's life would be affected due to mTBI. The lessons will also be more succinct and less technical to

ensure students retain the most important knowledge to keep themselves healthy. Speech-Language pathologists, coaches, and athletic trainers that wish to incorporate this curriculum into their school-based athletic programs may use or modify the lesson parts as needed. It is also encouraged to create original activities based on the provided discussion questions and curriculum topics.

School-based SLPs can utilize this resource as one more way to help educate student athletes regarding both prevention and rehabilitation of mTBI. School-based SLPs may also provide this as a platform to educate athletic trainers, coaches, athletes, and parents about concussion and the cognitive & communication factors that may persist. With enhanced awareness of cognitive and communicative impairments following mTBI, there are increased occasions for school-based SLPs to be involved in the wellness of student athletes (Sirmon-Fjordback, 2010; Duff, 2009).

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Appendix A

Table 1. Signs and Symptoms of Concussion and the Strategies to Help in the School Setting

Signs and Symptoms of a Concussion and the Strategies to Help in the School Setting	
Sign/Symptom	Potential Adjustments in School Setting
Headache	Frequent breaks
	Identifying aggravators and reducing exposure to them
	Rests, planned or as needed, in nurses office or quiet area
Dizziness	Allow student to put head down if symptoms worsen
	Give student early dismissal from class and extra time to get from class to class to avoid crowded hallways
Visual symptoms: light sensitivity, double vision, blurry vision	Reduce exposure to computers, smart boards, videos
	Reduce brightness on the screens
	Allow the student to wear a hat or sunglasses in school

	Consider use of audiotapes of books
	Turn off fluorescent lights as needed
	Seat student closer to the center of classroom activities (blurry vision)
	Cover 1 eye with patch/tape 1 lens if glasses are worn (double vision)
Noise sensitivity	Allow the student to have lunch in quiet area with a classmate
	Limit or avoid band, choir, or shop classes
	Avoid noisy gyms and organized sports practices/games
	Consideration of the use of earplugs
	Give student early dismissal from class and extra time to get from class to class to avoid crowded hallways during pass time
Difficulty concentrating or remembering	Avoid testing or completion of major projects during recovery when possible
	Provide extra time to complete nonstandardized tests
	Postpone standardized testing (may require that 504 plan is in place)
	Consider 1 test per day during exam periods
	Consider the use of preprinted notes, notetaker, scribe, or reader for oral test taking
Sleep disturbances	Allow for late start or shortened school day to catch up on sleep
	Allow rest breaks

(Halstead et al., 2015)

Table 2. CIF Concussion Return to Learn (RTL) Protocol

<u>CIF Concussion Return to Learn (RTL) Protocol</u>			
<u>Instructions:</u>			
<ul style="list-style-type: none"> • Keep brain activity below the level that causes worsening of symptoms (e.g., headache, tiredness, irritability). • If symptoms worsen at any stage, stop activity and rest. • Seek further medical attention if your child continues with symptoms beyond 7 days. • If appropriate time is allowed to ensure complete brain recovery before returning to mental activity, your child may have a better outcome than if he or she tries to rush through these guidelines. • Please give this form to teachers/school administrators to help them understand your child's recovery. 			
Stage	Home Activity	School Activity	Physical Activity
Brain Rest	Rest quietly, nap and sleep as much as needed. Avoid bright light if bothersome. Drink plenty of fluids and eat healthy foods every 3-4 hours. Avoid "screen time" (text, computer, cell phone, TV, video games).	No school. No homework or take-home tests. Avoid reading and studying.	Walking short distances to get around is okay. No exercise of any kind. No driving.
	This step usually ends 3-5 days after injury. Progress to the next stage when your child starts to improve, but s/he may still have some symptoms.		
Restful Home Activity	Set a regular bedtime/wake up schedule. Allow at least 8-10 hours of sleep and naps if needed. Drink lots of fluids and eat healthy foods every 3-4 hours. Limit "screen time" to less than 30 minutes a day.	No school. May begin easy tasks at home (drawing, baking, cooking). Soft music and 'books on tape' ok. Once your child can complete 60-90 minutes of light mental activity without a worsening of symptoms he/she may go to the next step.	Light physical activity, like walking. No strenuous physical activity or contact sports. No driving.
	Progress to the next stage when your child starts to improve and s/he has fewer symptoms.		
Return to School - PARTIAL DAY	Allow 8-10 hours of sleep per night. Avoid napping. Drink lots of fluids and eat healthy foods every 3-4 hours. "Screen time" less than 1 hour a day. Spend limited social time with friends outside of school.	Gradually return to school. Start with a few hours/half-day. Take breaks in the nurse's office or a quiet room every 2 hours or as needed. Avoid loud areas (music, band, choir, shop class, locker room, cafeteria, loud hallway and gym). Use sunglasses/ earplugs as needed. Sit in front of class. Use preprinted large font (18) class notes. Complete necessary assignments only. No tests or quizzes. Limit homework time. Multiple choice or verbal assignments better than lots of long writing. Tutoring or help as needed. Stop work if symptoms increase.	Light physical activity, like walking. No strenuous physical activity or contact sports. No driving.
	Progress to the next stage when your child can complete the above activities without symptoms.		
Return to School - FULL DAY	Allow 8-10 hours of sleep per night. Avoid napping. Drink lots of fluids and eat healthy foods every 3-4 hours. "Screen time" less than 1 hour a day. Spend limited social time with friends outside of school.	Progress to attending core classes for full days of school. Add in electives when tolerated. No more than 1 test or quiz per day. Give extra time or untimed homework/tests. Tutoring or help as needed. Stop work if symptoms increase.	Light physical activity, like walking. No strenuous physical activity or contact sports. No driving.
	Progress to the next stage when your child has returned to full school and is able to complete all assignments/tests without symptoms.		
Full Recovery	Return to normal home and social activities.	Return to normal school schedule and course load.	May begin and must complete the CIF Return to Play (RTP) Protocol before returning to strenuous physical activity or contact sports.

** Guidelines adapted from Cincinnati Children's Hospital Return to Learn Protocol

Table 3. CIF Concussion Return to Play (RTP) Protocol

CIF Concussion Return to Play (RTP) Protocol				
CA STATE LAW AB 2127 (Effective 1/1/15) STATES THAT RETURN TO PLAY (I.E., COMPETITION) <u>CANNOT BE SOONER</u> THAN 7 DAYS <u>AFTER EVALUATION BY A PHYSICIAN</u> (MD/DO) WHO HAS MADE THE DIAGNOSIS OF CONCUSSION.				
Instructions:				
<ul style="list-style-type: none"> This graduated return to play protocol MUST be completed before you can return to FULL COMPETITION. <ul style="list-style-type: none"> A certified athletic trainer (AT), physician, and/or identified concussion monitor (e.g., coach, athletic director), must monitor your progression and initial each stage after you successfully pass it. Stages I to II-D take a minimum of 6 days to complete. You must be back to normal academic activities before beginning Stage II, unless otherwise instructed by your physician. You must complete one full practice without restrictions (Stage III) before competing in first game. After Stage I, you cannot progress more than one stage per day (or longer if instructed by your physician). If symptoms return at any stage in the progression, IMMEDIATELY STOP any physical activity and follow up with your school's AT, other identified concussion monitor, or your physician. In general, if you are symptom-free the next day, return to the previous stage where symptoms had not occurred. Seek further medical attention if you cannot pass a stage after 3 attempts due to concussion symptoms, or if you feel uncomfortable at anytime during the progression. 				
You must have written physician (MD/DO) clearance to begin and progress through the following Stages as outlined below (or as otherwise directed by physician)				
Date & Initials	Stage	Activity	Exercise Example	Objective of the Stage
	I	No physical activity for at least 2 full symptom-free days <u>AFTER</u> you have seen a physician	<ul style="list-style-type: none"> No activities requiring exertion (weight lifting, jogging, P.E. classes) 	<ul style="list-style-type: none"> Recovery and elimination of symptoms
	II-A	Light aerobic activity	<ul style="list-style-type: none"> 10-15 minutes (min) of walking or stationary biking. Must be performed under direct supervision by designated individual 	<ul style="list-style-type: none"> Increase heart rate to no more than 50% of perceived maximum (max) exertion (e.g., < 100 beats per min) Monitor for symptom return
	II-B	Moderate aerobic activity (Light resistance training)	<ul style="list-style-type: none"> 20-30 min jogging or stationary biking Body weight exercises (squats, planks, push-ups), max 1 set of 10, no more than 10 min total 	<ul style="list-style-type: none"> Increase heart rate to 50-75% max exertion (e.g., 100-150 bpm) Monitor for symptom return
	II-C	Strenuous aerobic activity (Moderate resistance training)	<ul style="list-style-type: none"> 30-45 min running or stationary biking Weight lifting ≤ 50% of max weight 	<ul style="list-style-type: none"> Increase heart rate to > 75% max exertion Monitor for symptom return
	II-D	Non-contact training with sport-specific drills (No restrictions for weightlifting)	<ul style="list-style-type: none"> Non-contact drills, sport-specific activities (cutting, jumping, sprinting) No contact with people, padding or the floor/mat 	<ul style="list-style-type: none"> Add total body movement Monitor for symptom return
<u>Minimum</u> of 6 days to pass Stages I and II. Prior to beginning Stage III, please make sure that written physician (MD/DO) clearance for return to play, after successful completion of Stages I and II, has been given to your school's concussion monitor				
	III	Limited contact practice	<ul style="list-style-type: none"> Controlled contact drills allowed (no scrimmaging) 	<ul style="list-style-type: none"> Increase acceleration, deceleration and rotational forces Restore confidence, assess readiness for return to play Monitor for symptom return
		Full contact practice Full unrestricted practice	<ul style="list-style-type: none"> Return to normal training, with contact Return to normal unrestricted training 	
<u>MANDATORY:</u> You must complete at least ONE contact practice before return to competition, or if non-contact sport, ONE unrestricted practice (If contact sport, highly recommend that Stage III be divided into 2 contact practice days as outlined above)				
	IV	Return to play (competition)	<ul style="list-style-type: none"> Normal game play (competitive event) 	<ul style="list-style-type: none"> Return to full sports activity without restrictions
Athlete's Name: _____ Date of Concussion Diagnosis: _____				
CIFstate.org 5/2015				

(California Interscholastic Federation, 2015).