Abstract:
There has been increased public awareness, research, and legislation regarding to concussion or mild traumatic brain injury (mTBI) in young athletes. Along with this, there has been an increase in the number of annual emergency department (ED) visits for the evaluation of sports- and non-sports-related head injuries. Several medical organizations have published recommendations regarding the management of concussion and subsequent return to activities. The purpose of this article is to: (1) summarize these guidelines and provide up-to-date recommendations regarding concussion treatment, and (2) provide this author's approach to the concussion management in both the ED and sports medicine clinic settings.

Keywords:
concussion; mild traumatic brain injury; return to learn; return to play protocol; chronic traumatic encephalopathy; second impact syndrome

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Updates in Concussion Care: New Data, New Guidelines

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In the past decade, there has been increased awareness and research dedicated to concussion or mild traumatic brain injury (mTBI) in young athletes. State legislatures throughout the US have weighed in on the prevention and/or management of concussion in youth sports. Currently, all 50 states have some type of concussion law in place. With this increased lay awareness comes vigilance for our young athletes, but may produce incorrect information and heightened anxiety regarding concussion care and return-to-play guidelines. With mTBI awareness on the rise, the number of annual emergency department (ED) visits for the evaluation of sports- and non-sports-related head injuries has increased as well. In fact, the ED is often the first clinical setting for patients and families to seek care for mTBI.

Concussions can affect many aspects of a young patient's daily life. After first addressing acute injury symptomatology and treatment, family concerns and questions arise regarding the timing for return to school, sports, and other activities, as well as the long-term effects of mTBI. In response, several medical organizations have published recommendations regarding the concussion management and subsequent return to activities, including the American Academy of Pediatrics (AAP)[1] and American Medical Society for Sports Medicine (AMSSM).[2] In addition, the Centers for Disease Control and Prevention (CDC) recently published a comprehensive guide regarding this topic.[3]

The purpose of this article is to: (1) summarize these guidelines and provide up-to-date recommendations regarding concussion treatment, and (2) provide this author's approach to the management of concussions in both the ED and sports medicine clinic setting (Appendix A and B). The AMSSM position statement on concussions states the following: "Greater efforts are needed to educate involved

parties including athletes, parents, coaches, officials, school administrators, and healthcare providers to improve concussion recognition, management, and prevention. Physicians should be prepared to provide counseling regarding potential long-term consequences of concussion and recurrent concussion."[2]

DEFINITIONS AND RISK FACTORS

Defining concussion is the first and perhaps most important step when communicating with a young athlete's family. What constitutes mTBI? The AMSSM position statement defines concussion as "...a traumatically induced transient disturbance of brain function and involves a complex pathophysiologic process. Concussion is a subset of mild traumatic brain injury that is generally self-limited and at the less severe end of the brain injury spectrum."[2]

Attempts have been made to identify risk factors for concussion with prolonged symptoms. Some identified risk factors are previous history of concussions (total number, as well as severity and duration of symptoms), female gender (in a sport with comparable activity to males), and younger age.[2] Comorbidities, such as mood disorders, learning disorders, migraine headaches, and attention deficit disorders may complicate symptoms, diagnosis, and management of concussions.[2,3]

Figure 1 serves to illustrate a hypothetical injury/recovery curve after a concussion. The vertical axis represents one's brain health and function and the horizontal axis represents time from injury. The horizontal lines represent an individual's symptom/pain and critical injury thresholds. With brain injury resulting in significant symptoms, above the symptom/pain threshold, point A is reached. Over time, the brain recovers enough for symptoms to abate (point B), at last achieving full recovery (point C). However, the challenge with this recovery phase is the distinction between points B and C. Although a patient can be asymptomatic by report, it is difficult to determine full brain function recovery. Currently, there is no clinically available diagnostic test to objectively measure recovery in brain function.

Second impact syndrome is commonly used to describe a second head injury that occurs before an

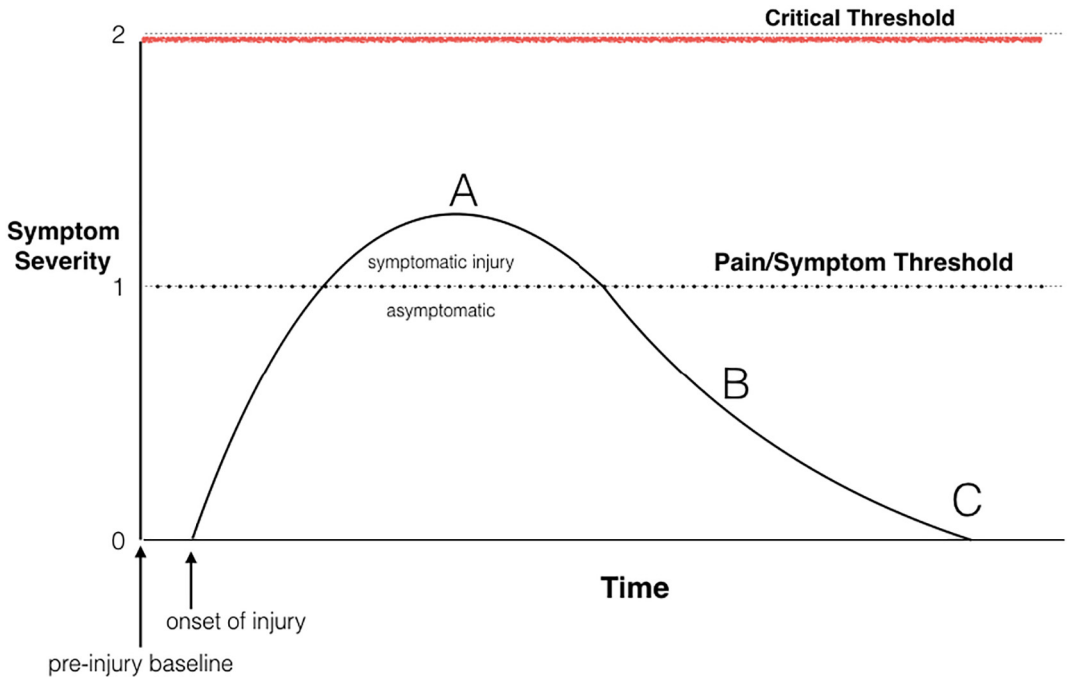

Figure 1. Hypothetical injury/recovery curve after a concussion. The vertical axis represents symptom severity from baseline, progressing to symptomatic injury, short of a critical threshold, or catastrophic injury. The horizontal axis represents from left, time zero or preinjury, then onset of injury, then recovery with time. The horizontal dotted line represents an individual's pain/symptom threshold. With acute brain injury, the athlete experiences maximal symptoms (point A). As brain health improves and symptoms abate, the recovery curve falls below the pain/symptom threshold (point B), until reaching full recovery (point C). With no clinically available diagnostic test to objectively measure full recovery of brain function, the challenge is distinguishing the athlete at point B versus point C. Other confounding factors include variable pain thresholds among individual athletes, comorbidities, and presence of adrenaline during exertion, which serves to raises the pain threshold.

individual has fully recovered from a previous injury. Second impact syndrome speaks to the risk of reaching a critical threshold for resultant catastrophic injury (Figure 1). Using this figure, if a hypothetical patient at points A or B resumed play and sustained a second injury, which does *not* require as much force as the original injury, further decline in brain function can occur, with catastrophic injury possible, including intracranial bleed, brain swelling, and death.

MAKING THE DIAGNOSIS

The diagnosis of a concussion remains a clinical one. According to the definition used above, in order to clinically diagnose mTBI, an individual should have experienced: (1) a traumatic force to the brain (even if the patient does not recall the mechanism of injury), and (2) a transient disturbance in brain function. Such disturbances manifest as symptoms, including headache, nausea, vomiting, dizziness, visual disturbances, sleep disturbances, and emotional changes. Some patients may not experience symptoms immediately, with delay occurring till after cessation of play, or 2 to 3 days later. All too commonly, some young athletes withhold their reporting of symptoms, afraid of being removed from the game.

Currently there is no laboratory biomarker or test that provides a definitive diagnosis of concussion.[2,3] By definition, a concussion or mTBI does not involve macroscopic structural changes to the brain, therefore cannot be imaged by traditional neuroimaging such as a CT scan or MRI.[2,3] However, there are several tools available to provide more objective data. Assessment of the patient prior to the start of a sports season is ideal, with repeat assessment for comparison after injury. Unfortunately, most patients who sustain concussions, unless mandated for sports participation, do not have a pre-injury assessment. One assessment tool is a graded symptom checklist (Figure 2). This checklist helps healthcare providers track the progression of recovery, and helps in the decision making of which symptoms to target with treatment. Finally, standardized, computerized neuropsychological testing is another method often employed for functional brain assessment. The validity of each tool is beyond the scope of this article.[2,3]

NEUROIMAGING

A very common reason for a teen to seek emergency care after mTBI is parental concern and questions about the need for neuroimaging. A collaborative research group within the Pediatric Emergency Care Applied Research Network (PECARN) published a brain injury algorithm to identify patients at low risk for clinically important intracranial injuries.[5] "Clinically important" was defined as requiring intubation, surgery, inpatient admission for greater than 48 hours, or death. The study serves as a useful tool for all healthcare providers to identify the group of patients who need immediate ED referral for evaluation and neuroimaging (Figure 3).

Patients in the high-risk group for clinically important injury included those with a Glasgow Coma Scale (GCS) of 14 or less, altered mental status, or clinical signs of a basilar skull fracture. Altered mental status was defined as slow responses, agitation, or repetitive questioning. Altered mental status can be a changing variable, as an injured patient may have symptoms immediately after injury, with resolution at time of arrival to the ED. Signs of basilar skull fracture include raccoon eyes, Battle's sign (bruising over the mastoid bone), hemotympanum, or new rhinorrhea suggestive of cerebrospinal fluid leak. For patients with just one of these high-risk factors, there was a 4.3% chance of having a clinically important traumatic brain injury.

The next level identified in the PECARN study was intermediate risk of clinically important intracranial injury. Intermediate risk factors included vomiting, history of loss of consciousness, severe headache, and severe mechanism of injury. Severe mechanism was defined as motor vehicle collision that resulted in ejection of the patient from the vehicle, death of a passenger, rollover of the vehicle, or an estimated car speed of greater than 35 miles per hour. Alpine skiing or snowboarding can subject an athlete to similar speeds. Also included in this severe mechanism category was pedestrian or unhelmeted cyclist struck by a motorized vehicle, fall from a height greater than 2 m (for patients >2 years of age), or the head struck by a high-velocity projectile object (eg, a baseball). Sports that may subject an athlete to a fall from a height would include gymnastics, pole vaulting, high jump, diving, and horseback riding, among others. Individuals with these intermediate factors had a 0.9% risk of having a clinically important traumatic brain injury. Recommendations for care of intermediate risk individuals included observation in the ED or neuroimaging. This decision may be based on clinician judgment and experience, severity or number of symptoms, the progression or worsening of symptoms, and/or the preference of the adult caretaker. Patients with neither high nor intermediate risk factors were found to have <0.05% risk of clinically important traumatic brain injury. Therefore, neuroimaging was not recommended.

Please rate your symptoms based on how much you have felt in the last 24 hours.

	None			Moderate			Severe
Headache	0	1	2	3	4	5	6
Nausea	0	1	2	3	4	5	6
Vomiting	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
Numbness or tingling	0	1	2	3	4	5	6
Dizziness	0	1	2	3	4	5	6
Balance problems	0	1	2	3	4	5	6
Sleeping more than usual	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Feeling as if "in a fog"	0	1	2	3	4	5	6
Difficulty concentrating	0	1	2	3	4	5	6
Difficulty remembering	0	1	2	3	4	5	6
Trouble falling asleep	0	1	2	3	4	5	6
More emotional than usual	0	1	2	3	4	5	6
Irritability	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Nervousness	0	1	2	3	4	5	6
Fatigue	0	1	2	3	4	5	6
Sleeping less than usual	0	1	2	3	4	5	6
Visual problems	0	1	2	3	4	5	6

Form Completed by: _____ Signature: _____

Parent/Guardian Signature: _____ Relationship to patient: _____

Date/Time: _____ Interpreter (as applicable): _____

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Figure 2. Concussion assessment tool that is a graded symptom checklist.

While not addressed in the study, time of day of the injury may factor in to the decision to proceed with brain imaging. Late in the day, at a patient's usual bedtime, sleepiness from fatigue may be difficult to discern from an alteration in mental status due to injury. Another important consideration is the availability of resources within your clinical site, particularly presence of on-site neurosurgery, critical care unit, operating rooms, and/or the full complement of trauma center resources. If these are not available at your clinical site, then the transport time to a center with neurosurgery capabilities may factor into clinical decision making.

DISCHARGE RECOMMENDATIONS

Day-to-Day Activity Modifications

The most important modification in day-to-day activity for the concussed teen is avoidance of

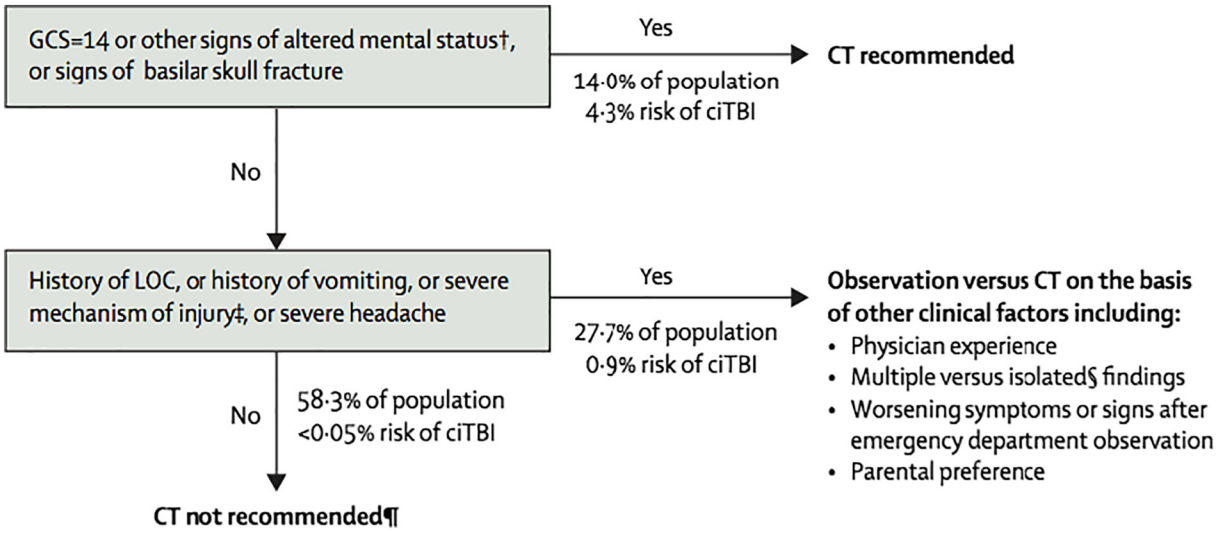


Figure 3. Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study. From Kuppermann N, Holmes JF, Dayan PS, et al.[5]

contact sports or activities. Besides this "no contact" instruction, there are no universally accepted recommendations for a child's return to normal daily activities. The practice of 'cocooning,' or confinement to home with very limited activity, has been found ineffective in achieving earlier recovery for concussed patients.[6,7] In fact, some patients have experienced clinical worsening with this practice.[7] This author has had concussed patients characterize home confinement, with limited TV, texting, and/or play time, to punishment, or being "grounded."

One suggested strategy for the acutely injured teen at home, is to start 15-minute blocks of alternating activities, including: (1) quiet rest with no screen usage, (2) school work, and (3) enjoyable, non-contact activity or "free time" (eg., TV viewing, phone calls, texting). As patients require less frequent periods of rest, school work and free time can be advanced in 15- or 30-minute blocks.[6] It is reasonable to have the patient avoid all vigorous activities while he or she is recovering.

Return to Learn and School Modifications

The recent CDC guidelines specify a limit of 2 to 3 days for remaining at home, out of school, on restricted activity.[3,6] Once back at school, the AAP's Return to Learn guidelines suggest that individuals may need academic accommodations in the classroom to minimize worsening symptoms.[1] Such accommodations include: (1) extra allotment of time for assignments and tests, (2) noise accommodation, with the student allowed to leave class early to navigate hallways and/or cafeteria at a quieter time, and (3) visual accommodations, with limitations on required screen time, printed material in place of computer assignments, and sunglasses use indoors for light-sensitive teens. Each child and each classroom discipline may require different accommodations.

Another school strategy for the recovering concussed teen is the temporary elimination of non-core classes to allow the student rest time in a school nurse's office, or use of "study hall" for missed and ongoing classroom assignments. In addition, alteration of grades to a "pass/fail" system may relieve the stress of maintaining peak academic performance during concussion recovery. Such a grading system allows a student to complete a test or assignment, with any incorrect answers returned to the student for correction. This allows the student to remain "caught up" with assignments and learning objectives. Otherwise, the student may fall behind and remain behind with future assignments and learning objectives.

In discussing this with patient and family, one can use the analogy of a knee injury. During recovery and therapy, there is no expectation for the athlete to run faster and jump higher with a torn cruciate ligament. So, too, no concussed athlete should be expected to perform at preinjury academic levels on return to school. Most student athletes recover from concussion within 3 weeks, at which time accommodations can be lifted. Those students requiring more time may benefit from an individual education plan and referral to a concussion specialist.[1,3] Return to learn should take priority over the return

TABLE 1. Return to play protocol. Each step should take 24 to 48 hours before progressing to the next stage. The athlete should NOT advance to the next stage if he/she experiences recurrence or worsening of concussion symptoms. The athlete should stop for at least 24 hours and resume at the same stage. He/she should not advance unless asymptomatic for 24 hours.

STAGE	AIM	ACTIVITY	GOAL
0	Symptom-limited activity	Daily activities that do not provoke symptoms	Gradual return to school activities
1 - B	Bicycling (light aerobic exercise)	Stationary bicycle or walking or light jogging	Increase heart rate but NO head movement
2 - R	Running (sport-specific exercise)	Running/sprinting/skating drills	Add movement
3 - A	Agility (non-contact drills)	More progressive training drills and resistance training	Add coordination and increase thinking
4 - I	'In-Red' (full-contact practice)	After medical clearance, participate in normal practice	Coaching staff observes, assesses functional skills, helps restore confidence
5 - N	No restrictions return to sport	Normal game play	

to play protocol. See Appendix A for recommended talking points with athletes and their parents.

Return to Play Protocol

Since concussions became a public health concern in 2001, one consistent recommendation was the graduated return to play protocol (Table 1).[6,8] Like the "soda bottle" analogy, with a shaken bottle slowly opened, athletes should return to contact activities in a gradual fashion. If a patient experiences recurrence or worsening in symptoms (or starts to "bubble"), rehab activities should be halted until patients become asymptomatic ("bubble-free") at that level. A common mnemonic for this return-to-play protocol, with stages of increasing exercise levels, is BRAIN.

B - Bicycling (stationary) = light aerobic exercise with minimal head movement. This stage distributes blood flow to muscles and away from the brain. If the recovering brain is not ready, the student athlete may experience recurrence or worsening of symptoms.

R - Running = more sport-specific training. Again, blood flow distribution is away from the brain to muscle. In addition, the brain is subjected to more forces, with the head "bouncing" during activity.

A - Agility = non-contact, sport-specific drills. In addition to blood distribution to muscles and head movements, as above, the brain is now involved in the cognitive activity of maintaining coordination. This is physical activity with a "thinking" brain.

I - "In Red" = full-contact practice. The athlete is under observation, wearing a "red jersey" with coaching staff watching for performance difficulties or return of symptoms. This also allows for the athlete to build confidence in returning to sports. This should require some form of medical clearance.

N - No restrictions = cleared for game play.

Traditionally, if a patient is symptomatic at rest, he/she is not eligible for this protocol. However, some studies have demonstrated a benefit for submaximal aerobic exercise to begin prior to the athlete becoming completely asymptomatic at rest.[6,7] If the athlete experiences symptoms during or for the next 24 hours after completing a stage in the protocol, he or she should: (1) take a day off, and (2) resume activity at that same stage until asymptomatic for 24 hours. Some experts suggest a longer time period between stages for younger athletes.[4]

TREATMENT

At this time, the most effective treatment plan for sports related concussions and mTBI is time and education. Parents and athletes should be counseled that approximately 70–80% of mTBI do not show lasting deficits for more than 1 to 3 months after injury and that recovery times are variable.[3] Healthcare providers should also recognize risk factors and comorbidities that may lead to prolonged symptoms. Such risk factors and comorbidities include previous history of mTBI, lower cognitive ability, neurological or psychiatric

disorder, learning difficulties, increased preinjury symptoms, family or social stressors, Hispanic race/ethnicity, lower socioeconomic status, more severe symptoms at presentation, and female gender.[2,3] The above-mentioned return to learn and return to play protocols should be discussed with families. Also, discuss warning signs of more serious injury and clear follow up instructions with a primary care provider and/or sports medicine specialist.

Medications

At present, there is no universal medication that treats concussions. After injury, non-opioid analgesics (ibuprofen or acetaminophen) can be offered for headache and pain relief. However, parents should also be advised that analgesic overuse can potentially lead to rebound symptoms and headaches.[3] Treatment should be tailored towards prolonged symptoms (eg., headache, sleep disturbance, emotional changes), but this can be managed by the outpatient specialist. Chronic headaches are likely to be multifactorial and should be referred to a facility with the capabilities for a multidisciplinary evaluation.[3] Physical therapy, in the form of vestibular therapy, has been found to be helpful in the return to play of athletes experiencing signs/symptoms of vestibulo-oculomotor dysfunction.[3]

FUTURE RESEARCH

Chronic Traumatic Encephalopathy

There is increasing recognition and body of literature that supports chronic traumatic encephalopathy (CTE) as a long-term neurologic sequela of recurrent concussive or traumatic head injuries accrued over a lifetime. It is currently believed that the accumulation of repetitive microscopic structural brain injuries from years of concussive (and even sub-concussive injuries) result in a build-up of an abnormal brain protein called tau. These abnormal brain deposits affect the brain in a permanent manner, producing more severe symptoms than expected from a typical concussion. Symptoms associated with CTE include memory loss, confusion, impaired judgment, depression, aggression, suicidality, and dementia. Currently, CTE can only be definitively diagnosed post mortem via brain histopathology.

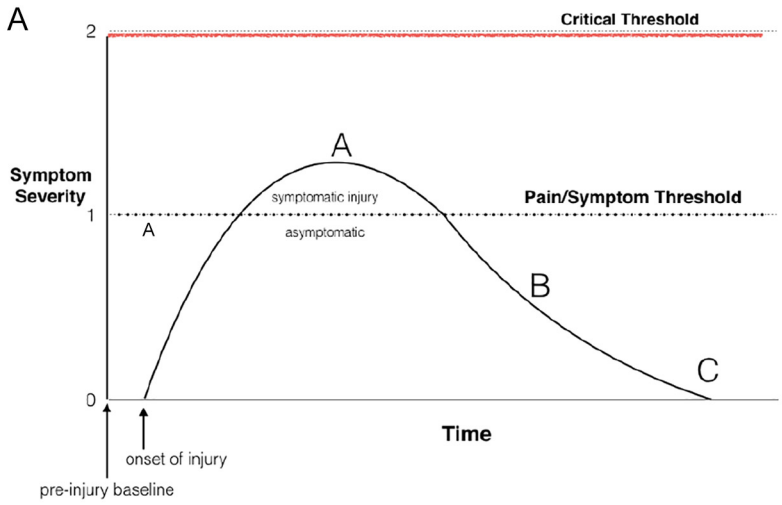
Although CTE is beyond the scope of this article, many parents and athletes express questions and concerns about the long-term neurologic consequences of sustaining repeated concussions. To explain this condition by modifying our previous recovery chart, a simple model representation is provided (Figure 4A-C). While more research in this area is needed, CTE is believed to change our baseline brain function via deposits of tau proteins in specific areas of the brain, that in turn affects brain function permanently. This change, due to chronic repetitive head injuries, results in the individual's gap from baseline to symptom threshold narrowing or becoming nonexistent (Figure 4C). It is important to counsel parents and athletes that CTE is hypothesized to occur through cumulative episodes of mTBI over a lifetime. With the estimated likelihood of a young athlete to reach a professional football league at less than 0.1%, it may not be appropriate to apply data from studies of a small group of elite athletes to the general population.[9] Large-scale epidemiological studies of children within grade school or high school contact sports are needed to better identify risk factors for CTE or other long-term neurologic impairments.

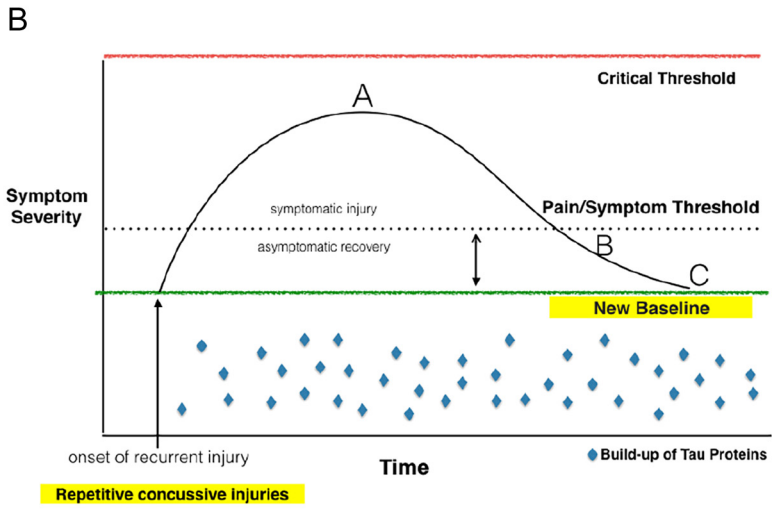
Disqualification From Sports

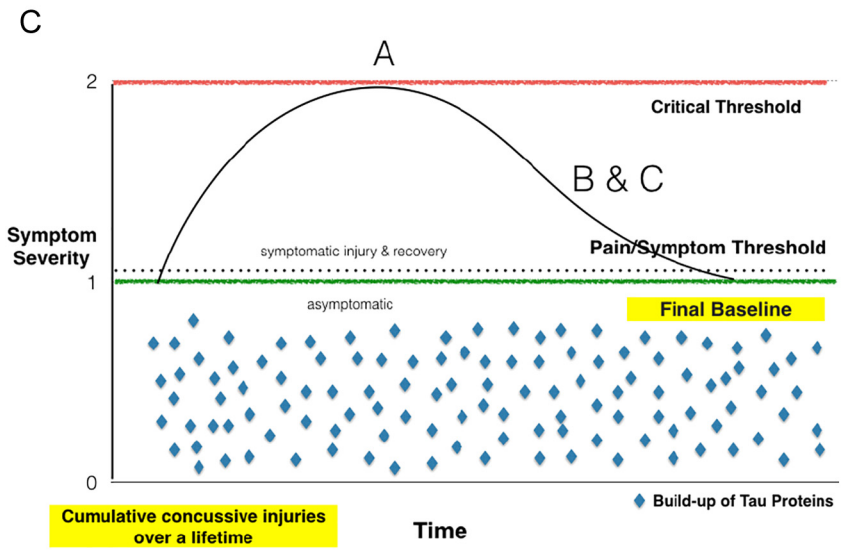
The recommendations concerning the timing for cessation of all play for an athlete who competes in contact sports and has sustained concussive injury is challenging, as there are currently no evidence-based guidelines for this specific decision (Appendix B).

SPORTS AND CONCUSSION: THE BIG PICTURE

Overestimation of risk and overly protective precautions may serve to increase family anxiety to the point of cessation of all sports. Legislative policies may also paint an inaccurate picture. Consider the incidence of catastrophic head injury in contact sports compared to bicycle collisions in the United States: approximately 10 to 20 deaths occur annually due to sports versus over 700 due to bicycles. While all 50 states have concussion laws, only 20 promote safety through bicycle helmet legislation (despite a reported 70% reduction in fatality rates with helmet use).[10,11] Despite good coaching and appropriate protective gear, injuries do occur. However, with prompt identification of injury and cessation of play, judicious rest with adherence to return to play protocols, provision of clear medical explanation and instructions to the athlete and family, timely return to normal activity is possible, limiting the risk of re-injury during, and after, recovery. Youth participation in sports for the vast majority can continue, with athletes reaping the benefits of sports participation, including physical exercise, team building and socialization, goal setting and accomplishment, stress relief, time management skills, work/play balance, emotional boost, improved


A
Critical Threshold
2
Symptom Severity
1
0
A
symptomatic injury
asymptomatic
Pain/Symptom Threshold
A
B
C
Time
onset of injury
pre-injury baseline


B
Critical Threshold
A
Symptom Severity
symptomatic injury
asymptomatic recovery
Pain/Symptom Threshold
B
C
New Baseline
onset of recurrent injury
Time
Build-up of Tau Proteins
Repetitive concussive injuries


C
A
2
Critical Threshold
B & C
Symptom Severity
symptomatic injury & recovery
Pain/Symptom Threshold
1
asymptomatic
Final Baseline
0
Build-up of Tau Proteins
Cumulative concussive injuries over a lifetime
Time

mental acuity and problem-solving skills, and the promotion of agile minds and bodies.

APPENDIX A. TALKING POINTS WITH PARENTS AND ATHLETES ABOUT CONCUSSION

1. Explain that you do not have to "hit your head" to sustain a concussion. The brain can experience a traumatic force just by violent rotation or shaking of the head or body without a direct blow to the head. For example a belted passenger in a car collision sustains whiplash from rapid deceleration that results in concussive symptoms.
2. Refrain from using terminology that indicates the brain is "bruised" or "swollen." Concussions are brain injuries at the microscopic level resulting in symptoms and a *functional* injury or change in the normal operations of the brain. In contrast bruising and swelling imply *structural* injuries found on neuroimaging such as a CT scan.
3. Refrain from classifying concussions as mild or severe. Since the Consensus Statement from the 3rd International Conference on Concussion in Sport in 2008 it was determined that categorizing concussions did not truly identify injury severity nor help determine return to play guidelines.[4]
4. Try the analogous comparison of the *roller coaster ride*. If a person exits the ride with a headache, nausea and vomiting he/she is concussed. Each person on the ride experiences the same forces but not everyone develops symptoms. Individual brains may have different responses or symptom thresholds. Concussion discussion includes: (1) the force delivered to the brain, and (2) individual brain response and sensitivity to these forces.
5. Another useful visual aid is *soda in a bottle*. The bottle is analogous to the skull and the soda is brain. When you drop the bottle or shake it violently you may experience an explosion or spray of soda. This equates to a more severe (structural) brain injury. Most of the time however dropping a bottle results in bubbles within the bottle but no explosion. The visible bubbles are analogous to concussive symptoms. You can "see inside" to this abnormal process of the injured brain. Now comes the challenge: When the bubbles have subsided can you open the bottle? There's still a risk of soda spray even if the bottle looks safe to open and so you unscrew the cap slowly. The concussed brain without symptoms may still require a slow monitored return to all play and school activities. As you are slowly opening the bottle if see you bubbles forming (or recurrent concussive symptoms) it would be advisable to stop unscrewing the cap – and stop progression of the return-to-play protocol slowing down activity for further recovery.

APPENDIX B. TALKING POINTS WITH PARENTS AND ATHLETES ABOUT STOPPING PLAY

1. It is important to know that there are no specific "number of concussions" in the medical literature that force an athlete to stop play in all contact sports.
2. Using the roller coaster analogy, if you are sensitive and repeatedly become symptomatic after riding the roller coaster, continuing this activity will predictably result in symptoms and more injury. If you are symptomatic on a smaller roller coaster, there should be no attempt to ride a larger one, with higher speeds and bigger drops, flips, or turns, which translates to more traumatic forces on the brain.

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Figure 4. (A) Hypothetical injury/recovery curve for the first concussive injury, with maximal symptomatic severity reached at point A, then asymptomatic with time at point B, then return to baseline brain function and complete recovery at point C. (B) Hypothetical injury/recovery curve for repetitive concussive injuries, with the point of maximal symptom severity (point A) now closer to the critical threshold of catastrophic brain injury. Note the presence of tau protein brain deposits, theorized to accumulate with repetitive brain injury, leading to a new baseline of brain function, with a narrower "jump" from baseline to symptom threshold (double headed arrow), and recovery to a new, post-injury baseline at point C. (C) Hypothetical injury/recovery curve for cumulative concussions over a lifetime, with maximal symptoms (point A) close to or exceeding the critical threshold, an elevation in the baseline brain function such that an asymptomatic state is no longer possible (points B and C indistinguishable), and an excess of tau protein deposits accumulating in the brain. Chronic encephalopathy after a lifetime of injuries can lead to a variety of impairments in brain function, including memory loss, confusion, impaired judgment, depression, aggression, suicidality, and dementia.

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