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Podcast on Sports Concussion & Mild TBI: Myths & Facts

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A recent high-profile case in New Jersey about a high school football player who died after a second concussion has brought a lot of media attention and legal attention to sports concussion and what is called "second impact syndrome." What I'd like to do in this podcast is clarify some of the science of concussion, also known as "mild traumatic brain injury," and spell out some myths and facts. A lot of personal injury attorneys are looking closely at schools' and teams' liability in cases of sports-related concussions, and legislatures and school districts are hurrying to put policies in place to try to avoid catastrophic outcomes for athletes. In such a climate, understanding the science is important: policy and law should be grounded in the best science of the time.

Before I get started talking about the science, I do want to say that for anyone who has lost someone to a catastrophic brain injury, I extend my deep sympathies. It is terrible to lose someone you love suddenly in an accident. It's natural and human to ask whether the accident could have been prevented. For attorneys who are dealing with such bereaved families on either side of a lawsuit, I recommend imagining how you would feel if you lost a child, and being compassionate in all your communications.

Now of course, compassion and grounding legal cases in the best science are not mutually exclusive. So let's talk about the science of mild traumatic brain injury and concussion. If you don't know much about traumatic brain injury in general, you might want to go back and listen to the first half of our longer podcast, "Protecting Clients with Brain Injury", for a general overview. It's under "Attorney Resources" at www.assesscompetency.com. I will use the abbreviation TBI for "traumatic brain injury."

First, a couple of definitions. Concussion and mild TBI are the same thing: a change in mental status that occurs after a blow to the head. That's the definition: a change in mental status

that occurs after a blow to the head. The change could be confusion, disorientation, memory loss, or loss of consciousness. Generally, doctors and neuropsychologists define a TBI in terms of score on the Glasgow Coma Scale, extent of any loss of consciousness, and the extent of any memory loss after the injury, called "post-traumatic amnesia." A mild TBI (same as a concussion) has a loss of consciousness of anywhere from 0 seconds to 20 minutes, post-traumatic amnesia of less than 24 hours, and a Glasgow Coma Scale score of 13-15, usually meaning the person is fairly alert and responsive. A short handout about the Glasgow Coma Scale can be downloaded from our website too.

The second definition is "second impact syndrome." This is a very rare outcome following TBI, in which the brain swells so much that it is life-threatening. "Edema" is a jargon term meaning swelling, and brain swelling is bad, so this condition is also called "malignant cerebral edema." Blows to the head are not the only possible cause of brain swelling. The idea behind the term "second impact syndrome" is that some people believe that this catastrophic, fatal swelling is more likely to happen if a person has a second concussion when they have not fully recovered from the first concussion. However, this belief is contradicted by current medical evidence. In fact, many such cases of catastrophic brain swelling occur after a single impact.

This leads us to our first myth:

Myth: Second impact syndrome is a well-established medical fact, and is likely to happen if someone goes back into play too soon. That seems to be false.

Fact: This catastrophic brain swelling is a very rare event, and there is currently no evidence linking it to second impacts, as opposed to first impacts. If second-impact syndrome were a common outcome, you would expect to find examples of it in large surveys of athletes. Especially when you studied athletes who rushed back into the game, you would expect to see several examples of second impact syndrome. There are researchers who have studied athletes during playing seasons to investigate this.

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Let me quote from an article about football players and concussion in the Journal of the International Neuropsychological Society that came out late in 2009: Begin quote- "The National Center for Catastrophic Sport Injury Research at the University of North Carolina... maintains a database of sport-related injuries to the brain and spinal cord that result in permanent disability or death. Over the past 10 American football seasons ... (1997–2006), there have been 50 cases of "permanent disability" (disability at ...2- to 3-months post-injury) and 38 deaths due to cerebral injuries, at all levels of play (from sandlot through professional). ...[T]he overall incidence of death or disability is still quite low. The risk of permanent disability or death as a result of cerebral injury in American football is therefore approximately 1 for every 20,500 player/seasons (there is one season in American football, and therefore, a player/season represents annual risk per athlete). For a squad size of 100 players, this would translate to one such injury on average every 205 seasons." End quote.

These are not the numbers you would see if second impact syndrome were likely to happen. In fact, most of those 38 deaths in football over those 10 years were not from cerebral swelling, but from bleeding in the brain known as "subdural hematoma", resulting from, and I quote again: Quote: "the immediate consequences of a single traumatic brain injury". End quote.

Another study published just last year in the journal *Neurosurgery* looked at the effects of a symptom-free waiting period before return to play, studied from 1999 to 2004. Out of 16,624 player-seasons, 635 athletes sustained concussions, or about 4%. 562 athletes ended up in the study. "Symptom-free" in this study was not just based on the athlete's self-report: their cognitive functioning was assessed by a neuropsychologist, their balance and postural stability were assessed objectively. Of these 562 athletes, 339 observed a symptom-free waiting period ranging from 1 day to more than 7 days. The other 223 athletes did not have a symptom-free waiting period before returning to play, and these athletes returned to play an average of about 1 day before having a full resolution of their symptoms. So, what happened to these athletes who were taking a great risk of a second impact? They experienced no adverse events. When they were examined 45 days and again

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90 days after their first injury, they had no more symptoms than the 339 athletes who had waited to be symptom-free before returning to play. What was true was that their symptoms took a bit longer to get better than in the group that waited to return to play until they were symptom-free.

Any parent or team or school who has lost someone knows how devastating such a catastrophic outcome can be. Anyone would want to prevent such an outcome, of course. The question is whether it is really possible to prevent such deaths altogether, short of banning high-impact sports like football completely.

Myth: Second impact syndrome is the biggest risk that athletes face from blows to the head during sports.

Fact: Instead, research on risk from sports concussion and mild traumatic brain injury shows that it seems to be first impacts that are most likely to lead to death or severe disability.

The problem is that when someone hits his or her head and becomes confused or disoriented, or loses consciousness, it is not always immediately clear how severe the brain injury is. What happens at the scene of the accident is usually a good indication of how severe the brain injury is, but in some rare cases, someone may have a more severe condition, such as a bleed in the brain or swelling that can be very serious, even though they do not lose consciousness for a long time, or go into a coma. I can give an example of a man who participated in one of my research studies. He was in the military in the 1970's. During a training exercise, he dove into a ditch, and hit his head on a rock. He was only knocked out for a couple of minutes, and only disoriented for a short while. The doctor saw him, thought he was fine, told him to take some aspirin and go back to training. Scientists and doctors simply did not know as much about brain injury back then. This man never had another concussion or head injury. But after that injury, he started having trouble getting along in the military – he was having trouble concentrating and remembering orders. He suffered a personality change, going from a model soldier to one who was often socially inappropriate and insubordinate. These are the symptoms of a moderate to severe traumatic brain injury, but he had no idea that this was his problem. It was only several years later, when he went to see a doctor in

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the VA about headaches, that they did a CT scan of his brain. Then they discovered that about a third of his frontal lobes were severely damaged. No one knew, based on what happened on the day he was injured, that his brain injury was that severe. He is very lucky. Although he has had difficulties in life because of his brain injury, he survived. It is possible to have a life-threatening brain injury and not realize it right away. In rare cases, the signs of a more severe brain injury only become evident later, after a concussion. That's why "wait and see" is a good policy.

One excellent reason to wait before returning an athlete to play after a blow to the head is to see whether any signs of a more severe brain injury emerge. This is the reason to wait – not second impact syndrome, but to make sure that the first impact did not cause a moderate or severe brain injury. This is a good reason for many emerging regulations and legislation, such as the Zackery Lystedt law in Washington state, to require a certified health care provider to examine athletes with concussion and approve their return to play. The problem may not be second impact syndrome, but may be first impacts that are more severe than the player, parents, or athletic trainers realize at the time the first concussion occurs.

Tragic and catastrophic brain injuries can occur in sports. The best we know right now, from scientific research, is that catastrophic brain injuries are no more likely to occur as a result of a second impact than they are to occur as a result of a first impact. The only way to completely, 100% prevent such rare events is to avoid head impacts altogether, which means no sports, no skiing, no driving, no bicycling, no running, no going up and down stairs, no getting your head near solid objects... you get the picture.

Now, having said that, there are good medical reasons to be conservative, to wait and make sure that the brain injury is not more severe, and to reduce the possibility of multiple concussions. If parents and schools feel safer doing so, they can keep athletes out of play for anywhere from 2 weeks to 3 months after a concussion, to hedge their bets that recovery is complete and that the person suffered only a mild brain injury rather than a more severe one. I encourage people to look

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at the web site COkidswithbraininjury.org to get some good guidelines on concussion management, developed through the REAP program. In particular, it's very important to rest in the first few days, not to have too much exertion. Athletes seem to recover from concussion more quickly if they take it easy and do not return to play until they are symptom free. Finally, and I hope this is reassuring to parents: The best that we know from scientific research right now is that 90% or more of people who have a single, uncomplicated mild TBI, also known as concussion, will recover fully and completely. (Just a reminder about terminology: concussion and mild TBI are the same thing.)

(I'll talk about the difference between complicated and uncomplicated mild TBI in a separate podcast in May. A complicated mild TBI is more severe.)

Another **myth**: So then it's fine to have multiple concussions, right? It's no problem to have more than one concussion or mild TBI. Sadly, the evidence is mounting that that isn't true either.

Fact: Although second concussions have not been scientifically shown to lead to fatal brain swelling and death, multiple mild TBI's do seem to have negative effects in the long run.

A scientific review of studies that was just published this month in the Journal of the International Neuropsychological Society detailed how multiple mild TBI's can have long-term negative effects on cognition, particularly in memory, attention, and what we call "executive functioning". (You can download our pdf file, "The Jargon Dictionary" for a definition of that if you're not familiar with the term.) In the studies that were reviewed in this article, the average number of mild TBI's ranged from 2 to 3, and the period of time between mild TBI's was generally 4-9 months. To summarize: repeatedly banging your head is probably not good for you in the long run. Even if it's not catastrophic, wouldn't anyone want to have their full cognitive abilities later in life?

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Finally, one more factoid for our listeners: If you're wondering how hard you have to hit your head to get a concussion, there is some research on that, using devices inside helmets to measure force. It looks like it takes about 85-100 g's to produce a mild TBI. That's about the force you would get running into a brick wall at 20-25 mph. It can also happen while running down a football field and falling. It's probably not going to happen if you're fixing something under the sink and stand up and bump your head. Does this mean a concussion or brain injury cannot happen with less force? No, it does not mean that. These are average values, what's true most of the time. It's always possible that if a blow to the head twists the head around in just the wrong way, what we call "rotational forces", that the brain can be affected.

Thanks for listening to this "Brain Science and the Law" podcast. Information in this podcast is up to date as of March 2010. I've talked about several scientific research articles in this podcast. If you would like citations or copies of those articles emailed to you, drop me an email. Under "attorney resources" on our web site, I've also provided a link to a Sports Illustrated article about the tragic case in New Jersey that has ended up in a lawsuit. For more information, and to find out about continuing education workshops we offer, go to our web site: www.assesscompetency.com, which we will shortly be moving to www.abouttheadinjury.com.

April 2010: Dementia and capacity assessments

May 2010: Differences between mild and "complicated mild" TBI

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