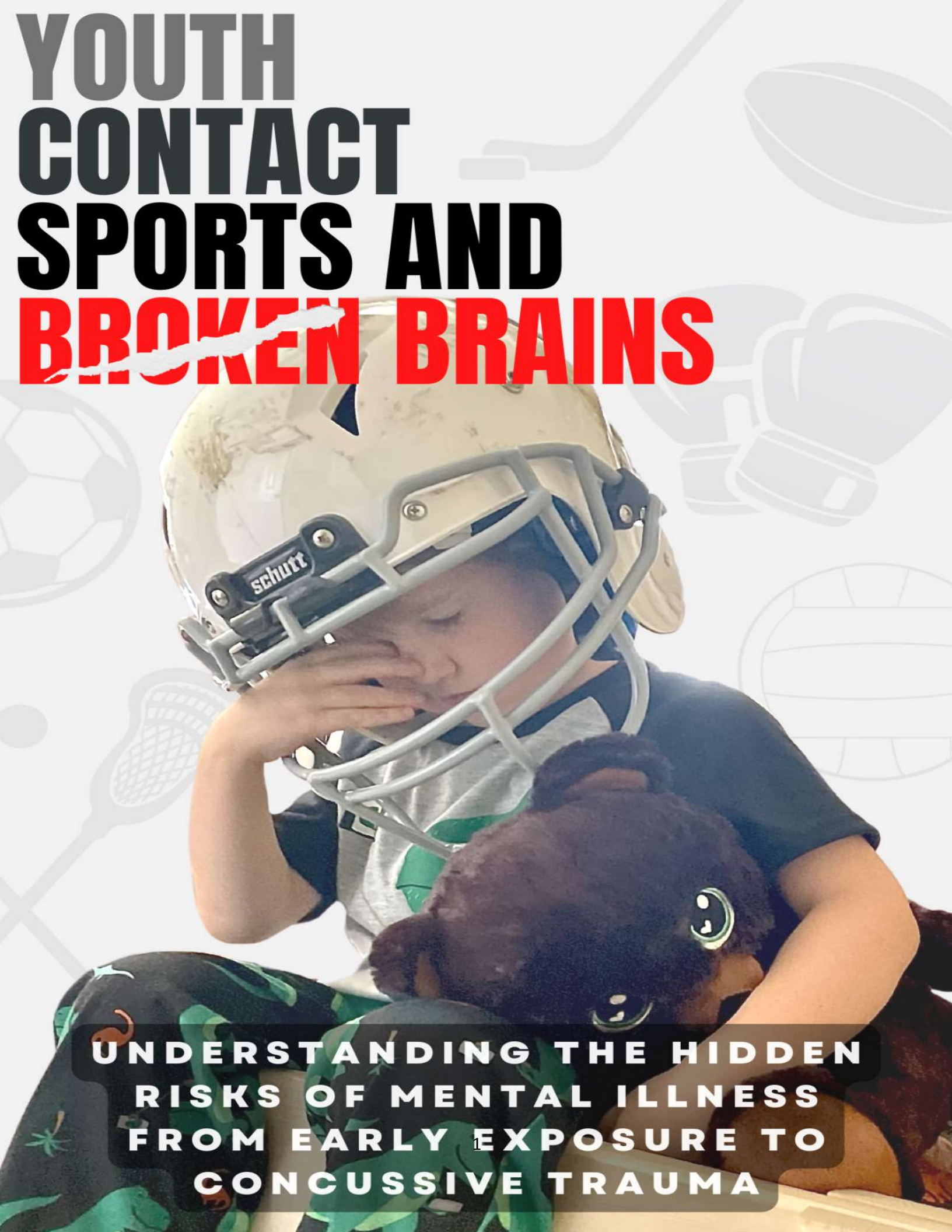
YOUTH CONTACT SPORTS AND BROKEN BRAINS



UNDERSTANDING THE HIDDEN RISKS OF MENTAL ILLNESS FROM EARLY EXPOSURE TO CONCUSSIVE TRAUMA

Youth Contact Sports and Broken Brains

Understanding the Relationship Between Concussive Trauma and Mental Illness and the Logic Behind Delaying Contact Sports Until High School

By
The Mac Parkman Foundation

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Introduction

As parents, you know the risks your kids face every day – drugs, the internet, video games, strangers – and you work diligently and with love to protect them. Why? We do so because we are aware of those risks.

Well, I didn't know about the risks of concussive and subconcussive trauma that we discuss in this book. I couldn't protect my son….and I lost him.

That is why I wrote this book, to try to heal through the sharing of knowledge that I have gained over the last year or so. That there is a demonstrable link between concussive sports, developing brains and mental illness. I want you to know what I now know… You don't want to be in my club.

Especially when it is avoidable.

Unlike other authors who have written about this subject, I am not a scientist, researcher or subject matter expert on the brain. I am a Dad. A parent who has suffered the worst imaginable loss, his child, and who learned in the aftermath of that loss that his son didn't have to die and, like many others, should still be here. A loss that left a gaping hole in a wonderful, loving family that I filled trying to understand why my son Mac was no longer here and discovered through reading and research that there is extensive scientific evidence and information showing that brain trauma and contact sports are linked, that brain trauma and mental illness are linked. I am a Dad who doesn't want any other parent to suffer his loss and thus, wrote the best book he could, to inform and encourage parents to put their child's future, not sports, first.

This book is designed to inform everyone who touches sports, including parents, physicians, psychologists, athletic trainers, and even the athletes themselves, about the direct links between early exposure of developing brains to concussive trauma, brain damage and mental illness. My intent is not to provide a deep medical dissertation or to scare you away from contact sports but to provide a thoughtful guide to protecting children from avoidable brain damage. My premise is simple, youth brain damage and its lifelong or life ending effects can easily be avoided by simply delaying contact sports until the brain is further developed and less vulnerable to it. Organizations like Flag till 14, and the Concussion Legacy Foundation say that the science says that age is 14, or high school. Personally, with the knowledge, grief and loss that I am burdened with, I feel it should be an adult decision, but I can compromise. Something needs to be done, too many of our children are suffering or are dead.

As you read this and quite possibly come to the same conclusions that I have regarding a child's participation in contact sports, you may meet resistance and need to defend your decision to delay your child's engagement. This book will not only help you to defend your decision, but will also help other concerned parents, coaches, and athletes make their own informed choices. In over one thousand conversations with

parents, coaches, athletic trainers, pastors and kids on this subject, not one has pushed back on delaying contact sports if it endangered their child.

The premise of this book is not “anti-contact sports.” In fact, as a semi-pro rugby player, I encourage contact sports for adults whose brains are developed. Delaying participation in contact sports and limiting participating to one sport can nearly eliminate the youth sports brain injury.

Some people will consider the idea of waiting to participate in contact sports “counterculture” or “un-American.” or “feminine.” Nonetheless, no-head soccer and no-check hockey were likewise considered such until the early 2000’s when the benefits of delaying contact became clearer[1] Those precautions are now the norm, protecting many young children. Participation in those sports has accelerated as parents see the movement to non-contact as an intent to better protect their child. To date, no less than six bills in six states have been introduced to prevent participation in middle school tackle football until the age of fourteen. It’s only a matter of time before the love we have for our kids, combined with research and awareness, will drive us to delay participation in tackle football and other contact sports until it is safe to do so.

Why will this happen? Because my position is grounded in logic, science, and research. Research demonstrates that if you interfere with a developing brain by exposing it to concussive trauma during its most critical stage of development, from age four to fourteen, you will damage it and a damaged brain has a significant impact on a child’s future.

Brains are not bulletproof. They are fragile. A child’s brain is the most important organ they have. It will determine who they become, how successful they will be, and what they do in life. If a child’s brain is so important to their future and we know that it will be damaged by contact sports at a young age, it is logical that we should do all we can to protect that brain and the child’s future by simply delaying their participation in contact sports until their brain is developmentally prepared to handle it.

If you are reading this book, you are concerned and likely there is someone you care about or are trying to protect. Youth contact sports are an integral part of our society and its unlikely anyone is untouched by it. The commonality of youth contact sports alone should be enough to compel us to study the risk. Once we understand those risk, we are equally compelled to help others make educated choices in protecting our most precious commodity, the health and lives of our children.

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[1] Rodrigues AC, Lasmar RP, Caramelli P. Effects of Soccer Heading on Brain Structure and Function. Front Neurol. 2016 Mar 21;7:38. doi: 10.3389/fneur.2016.00038. PMID: 27047444; PMCID: PMC4800441.

CHAPTER FOUR

Understanding those risks why you, the loving parent, should read this book.

I organized this book to guide you through the issues we know are important to you.

Section One talks about my son Mac Parkman and the journey that led to the discovery of the links between youth contact sports and concussive/subconcussive trauma that are strongly linked by research to mental illness.

Section Two is the “meat” of this book and covers your child’s amazing brain and its incredible complexity, its structure and fragility and outlines the science and logic underpinning the premise of this book. You will notice that we will continuously discuss three areas of importance that are highly researched and documented. This will include two developmental processes, myelination and synaptic pruning as well as a critical, yet vulnerable part of the brain called the prefrontal cortex. These concepts are very important for the parent to understand, and we will discuss how they function, how they develop, how they are impacted by trauma and how they are linked to mental illness by research and science.

Section Three talks about what parents can do and what we hope the future will be for contact sports and children. The sections are broken down into chapters that contain the basic information that will help you become more informed about the risks that substantiate the Mac Parkman Foundation’s request that parents delay contact sports until their child’s brain is ready.

In the end, this book is about protecting our children. I know you love your child, and you want to set them on the best path possible to a successful and happy adulthood. My son Mac didn’t get that chance. I hope to leverage the knowledge I have gained to help you make better decision than I made for my boy. I hope to help you make the informed choices we never got to make for Mac.

Bruce Parkman - Founder, The Mac Parkman Foundation


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Part One:
Life and Death

Chapter one

MAC

How do I begin to describe our Mac? I tried to use the obituary I had to write for his service…. but those third person words, written in anguish, just doesn't do Mac justice. So, 18 months later, I will try again.

Who was Mac Parkman? Mac Parkman was a vibrant human being who embodied the best attributes humanity and God find endearing in this world. Warm, funny, witty, kind, compassionate, calm, loyal, and caring are just a few of the characteristics that describe our wonderful young man. He brought so much warmth and sunshine to everyone he touched yet was as tough a competitor as one could be . . . a true peaceful warrior until he left this Earth.

Mac was born on March 10, 2003, in Albuquerque, New Mexico into our loving family and spent his first six years there growing up in the foothills to the west of the city in Tijeras, New Mexico. As the "new" kid, he was welcomed warmly by his mom and sisters while I served overseas in the invasion of Iraq. As a newly knit family that had never raised a son or brother, he brought so much love into our lives and brought us closer together with his presence, a gift that our family shares to this day.

Mac was a quiet boy, but he was always moving and active from the get-go. Track, baseball, karate, and skiing with his dad were his early activities. He loved being outside and with his friends, especially eating out at great places like Blake's, Sadie's, and Hooters afterwards. He was quick to learn, a respected student, and enjoyed an early introduction to God at the local Prince of Peace school where he was loved by teachers and students alike, except for a brief period where he was known to tackle the other five-year-old kids. He was hard to keep track of and his favorite trick was freaking his parents out by hiding inside the clothing racks of department stores while we frantically searched for him.

He was a warm and loving child. He loved to be held, have his mom caress his hair or his sisters rock him. His fierce hugs and kisses, the continuous holding of hands, his desire to always be near those closest to him defined his love for those he knew. He was the glue that knitted our mixed family together and was the catalyst for us all to grow closer as the years moved on. His presence was truly a gift from the Lord.

In 2009, our family moved to Woodland Park, and Mac was enrolled in the Colorado Springs Christian School. We lived on a ranch surrounded by forests. Mac joined the wrestling team in first grade along with most of his classmates. Yet, he was one of the few kids to stay with wrestling. He loved the sport, the comradery: and continued participation until his passing. He had several very close friends. Two of them, Nathan and Parker, often stayed at our house and were part of my "cookie church" crew attending the local Methodist church, which had a very elderly congregation that loved to bake. He loved having his friends over to play games, jump on the trampoline, shoot air guns (or real guns on his dad's range), play tag, camp out, and we could hear them wrestling and bumping around upstairs well into the night.

Due to my business activities, Mac fell in love with new places and was always on planes with myself or the family going all over the U.S. and the world. Everywhere he went, he would always want to experience the local culture, food, and sightseeing. He visited Costa Rica, the Hawaiian Islands, Egypt, Finland, Australia, New Zealand, Tahiti, and the UAE. He rode camels and entered the Great Pyramids, hiked mountains and glaciers, went zip lining, kayaking, scuba diving, snorkeling, even went skiing in the UAE in an indoor ski simulator, and practiced skydiving at an indoor skydiving range. He was always interested in what was going on and had a thirst for adventure that never, ever left him.

Mac was also a very active video gamer and loved to game with his friends, both in person and online. Over the years, especially in high school, gaming became very important to him as it allowed him to engage with different groups and continue to interact with his close friends after school. He developed a close-knit group of friends who competed together and some of the best memories we have of Mac are his whooping and yelling with his friends while they participated in Apex, Brawlhalla, and Grand Theft Auto.

It was sports that defined who Mac was in his later years. While we knew he loved wrestling, Mac approached us about joining the football team in seventh grade. Of course, we encouraged him to be and do what he wanted to do, so he joined the CSCS middle school team. With wrestling and football, the family became accustomed to an active traveling routine that stretched over ten months of the year, supporting practices, team dinners, and taking Mac to games. We relished every minute that Mac was engaged in sports, as we always wanted to support him doing the things he loved. Mac continued this schedule all the way to the end of his junior year. He finished wrestling when COVID hit, and all sports were stopped.

Mac was the consummate team player who gave all he had for the team. While he was never the best player (even though I thought he was), he was always one of the hardest working and most consistent athletes who was loved by his coaches and teammates. He had heart and dedication, and he loved being part of the team. Mac relished those wrestling trips where he would be able to stay in a hotel with his teammates and hang out away from his parents. It was not hard to find out where Mac was. There were usually young men laughing their heads off, especially in wrestling, where the team had such tight bonds. In fact, some of my best memories were the wrestling kids on the mat between wrestling periods, all laying on top of each other, telling stories, playing with their phones and being a team.

During his high school years, his football team went to the state quarterfinals and continuously made the playoffs for the first time in years, and he missed qualifying for the State Wrestling finals by only one match. He worked hard, left a lot of sweat, and some blood, on the field and mats, and he and all of us were so proud of what he was working so hard to accomplish. As his wrestling coach said paraphrasing Coach Gabel, “It takes talent to win the first round, conditioning to win the second, but heart to win the third. Mac had heart.” He was a true team player and was loved by all his teammates.

Towards the last months of his life, Mac continued to shine as a family member. He spent time at the beach with his friends and his family in Florida, working hard at school, working out on his own or with friends at the gym, hanging at his buddy's house, and was getting ready to join the Army. While to all of us Mac was, well Mac, we now know inside he was fighting a daily struggle with mental illness to include depression and schizophrenia brought about by physical trauma to his brain. Although, he remained determined not to let anyone know.

In the end, that desire to fight on his own and not impose on those that he loved defined who Mac was; a kind, loving, selfless boy who put everything he had into the fight against depression and psychosis until he had nothing left, just like he did in wrestling. A young man who bravely stood up against one of the most debilitating conditions, determined to not cause his family, friends, or coaches any pain or suffering. He left this world as he wanted, on his own terms, with the desire to relieve himself of the pain he was standing against and determined not to let it get the best of him in the end. He was the bravest of us all.

We love and miss you every day Mac.

Chapter Two

Mac's Last Day

On September 24, 2020, I was working in my office, defying Covid-19's attempt to destroy my business, when my son approached my home office and said he was going to football practice. Never to miss a chance to hug and kiss the boy I loved more than anything else in the world, I left my desk to meet him. I remember him standing there in his sweats (he was always in sweats), handsome as the day is long with his football gear bag in his hand. I approached him, hugged him, and kissed him on the cheek. As always, I said, "Make good decisions." As always, Mac said, "I will dad" and left.

I never saw him alive again.

At 3 PM on September 24, 2020, I received a call from my daughter. She is a nurse practitioner in psychiatric medicine here in Colorado. I answered in my usual lighthearted manner with a joke, then was frozen by the panic in her voice as she delivered the devastating message. Our son Mac had just posted a video from Pulpit Rock, a vertical cliff about two miles from our home, saying he was going to hurt himself.

My gut dropped, adrenaline and fear flooded my system, as she gave me an address where his phone was supposedly located. My daughters and my wife were all on the Apple Find My Phone app as I grabbed a pair of shoes, had no socks, and fled the house in my truck.

Our lives were being shattered.

For the next twenty-one hours, our son was the subject of an intense manhunt and investigation sweeping and re-sweeping a large state park and chasing a moving phone signal. We had over fifty traumatized people, including the Colorado Springs Christian Schools football and wrestling teams, immediate family and friends, and complete strangers joining the police to search for one of the most loved kids they knew. We were all over fields, gullies, and streams, calling for Mac, praying for his health, telling him that he was loved, that he could count on us for help . . . to come home. We found his truck, unlocked and empty at the trailhead below Pulpit Rock, but there was no sign of our boy or where he went. It was our suspicion that he had made those videos he posted from the top of the rock, so the folks that showed up to search started there initially.

The fear a parent feels in these moments is the most terrifying condition one can face. Bordering on paralysis, so many thoughts and emotions are flying through your mind competing for energy and processing. Why is he doing this? What did we do wrong? Is someone making him do this? Is he in trouble? Where can he be? What do I need to do first? Oh, I'm going to kill him! (figuratively) and more. You come unglued, trying to decide what the next steps are, and you act instinctively to do all you can to protect your kid. It's how good parents are wired. Nothing else matters to a parent, especially when their kids are in pain.

Once I got the call, I flew out of our neighborhood driving, cursing, and praying. Breaking about every driving and speed law, I drove up to a house that showed the location of Mac's phone at about forty miles an hour. A man came out angry as hell, but I didn't care. I didn't know if my son was in his house or being held. We got in each other's faces, and I said, "I'm looking for my son, he said he was going to hurt himself, and his phone has him here." He told me he didn't know who Mac was and there was no one there.

I left, knowing that I had to get to my son before he hurt himself. I still thought of his video as a warning. Since everyone was at the trailhead, I drove to the back of the state park and figured I would head in from the other side towards the folks that were searching Pulpit Rock for Mac.

I remember the terror; the fear my son might be hurt, and it drove me deeper into the hills behind the state park. I ran from gully to gully yelling his name, thinking he would be in the most inaccessible parts of the park. From time to time, I would come upon wrestlers or football players looking for Mac and we would update each other. Panicking, I covered eight miles, staying connected with my wife who was at the trailhead. She was meeting with police and directing additional searches based on our communications. I knew what she was doing was supposed to be my job, but I had to find my son. I knew he was alive. The boy I loved would never hurt himself. I texted repeatedly telling him whatever his problem was, it was going to be ok. "We will work it out. You can trust Dad. Dad is here to help you son. Please call or text me."

News came. The wrestling coach found one of Mac's shoes, but no sign of Mac. I rationalized, "He must have dropped one of his shoes off the cliff to test the jump and then he changed his mind. He must be near. He has only one shoe." I started assessing the terrain to the north of Pulpit Rock thinking he must have gone that way and gone deeper into the hillsides. My feet started to bleed as I didn't have any socks on, but I didn't care.

More news, someone found his other shoe. I thought, "Great, now he is in his socks, surely he must be found soon." We kept searching the rock, getting frantic as night was drawing near. It was going to get cold. I needed to find Mac and bring him home. I continued to search alongside the other committed and loving folks who wanted Mac home.

A report came in that someone saw Mac or someone that looked like him in black sweats and a white long-sleeved shirt getting into a car A black Charger. The report uplifted us all with hope that Mac was alive. I decided that since he wasn't on Pulpit Rock, I would go home and get ready to head back out.

As I left for home, my wife told me to make a call to the Center for Missing and Exploited Children as advised by the police. One of our friends, a former police officer, was there and he and I made the call with a sinking heart. I thought, this could be the start of Mac really not being here, but I pushed that thought to the back of my mind. I

called a good friend of mine, a local Sheriff, to ask for help when the El Paso County Search Team turned down our request for dogs to search for Mac. He said he would make a call, but for me to stay on them. I grabbed some water, put on socks, and got ready to head out.

Around 8:30 PM, we got further good news. Mac's phone locator went off, placing him on the creek that bisects Colorado Springs, an area that was mostly industrial in nature. Most of us went over there and one of Mac's wrestling partners' father, a local police officer, sent over some cars to help look for him. We searched everywhere, looking in dumpsters, dark corners, crossing fields, entering culverts, yelling out Mac's name, knowing he had to be somewhere. Since it was dark, I sent my daughter's boyfriend back to my gun safe to get my night vision goggles to help the search. I took the NODs and went all over the place, never thinking my son was gone, only that I had to find him.

Then, another sighting of someone with black sweats and a long sleeve white shirt, over by the hospital, but closer to Pulpit Rock. Mac was on the move I thought! We went there, happy that someone had seen him, and searched all over the hospital, which was still under construction. The local security guard came out and said we couldn't enter. We told him that we were looking for our Mac, that it was cold and maybe he snuck inside. While he went in to search the building, we searched the perimeter and the grove of trees behind the building. No Mac.

We then went into the apartment complex next door. We went into any building that had an open door, looking in the stairwells, calling Mac's name . . . hoping . . . hoping . . . no Mac.

By this time, it was 4:30 in the morning. Even though we had not found Mac, all remained certain he was alive. We found both his shoes, his phone showed movement and we had two sightings. He was alive but didn't want to be found. We went home. Even though I was dead on my feet, I slept an hour and I got up knowing Mac was still alive. Cold, but alive. I told my wife, "I'm leaving. I'll be back with Mac." We were back in the park at 0600 to start the search again.

This time, I thought I would be smart. I got my binoculars, bundled up, and figured I would sit on the rock and monitor his truck. So, I did, scanning the area below Pulpit Rock, North Nevada Boulevard, all the way to the interstate. As the sun rose, people started to ascend the rock as it's a popular hike in the area. As I was sitting there, a woman with two daughters came close, and I asked them if they had seen Mac. I described him with a broken voice and tears streaming down my face and the lady asked if she could say a prayer for him. With a sob, I said, "Please." We formed a prayer circle on top of Pulpit Rock with the sun warming our backs. Her daughter composed one of the most moving prayers I have ever heard for my son and our call for his safety and well-being. I thanked them profusely, wiped my eyes, and went back to the edge to continue scanning the area.

Around 10 AM, the sun had risen and so did the heat. I was in winter clothes, I started to heat up and called for someone to replace me. Just then, I thought I saw a young man in black pants and a white shirt on a road about a mile away next to the interstate. When my replacement arrived, he stated that my wife had gotten the El Paso County Search Team going and that the dogs were on their way. I went down, got into my truck, and drove to look for the person I thought was Mac.

Arriving close to the area, I got out of my truck and began to search. It was an industrial park, bordered by a railway, rock strewn paths, spikey, mangled undergrowth, and homeless camps. I started walking down an older trail that went along the railway. About a quarter mile in, I came across a homeless camp. I recognized the situation could be dangerous, but was armed and wanted to find Mac, so I went in.

I asked someone if they had seen Mac. The camp was filled with people who needed help but had been there for a while. Tents, chairs, even mirrors hung on trees. A half-naked man approached me and said he heard I was looking for my son. I confirmed I had been looking for him since yesterday afternoon. To my surprise, he asked me if he could say a prayer for our son. I said, “Of course,” and as I replied two more people came over. We formed a prayer circle and for the second time that day, a complete stranger said an amazing prayer over our Mac. I looked down at the grime coated hands that I was holding. I couldn’t help but think of the sad honesty of the moment. The fact that I, a father in need, had found compassion and faith in a compound of people in need. Again, I dried my tears, thanked them for their prayers, blessed them and moved on.

Hungry, I went to McDonalds for a quick bite and was getting ready to head back when I got the call that I needed to return. Not knowing that McDonald’s was the last place my son ate lunch with his friends, I got my filet-o-fish and headed back.

When I returned, I noticed that there was a TV camera set up and a reporter on site. Owing to my time as a Green Beret, I have a particular aversion for the press: however, I figured that maybe they could get the word out on Mac missing and get more people looking for him. The father of my son’s best friend approached me and said to come with him. As we walked to the trail head, he told me they had found Mac. Hoping beyond all hope, I asked him if he was ok. He shook his head no. I asked if he was dead, he nodded yes. I started to fall. He caught me and I immediately went to find my wife who had just heard the news.

I was informed that around 11 AM, the search dogs ascended to the base of Pulpit Rock and immediately found our son’s body. He had become wedged in a crevice, making his body almost impossible to see or locate. He had jumped from an 80-foot cliff to his death. According to the investigator Mac’s death was immediate. I could see the medical teams at the base of the cliff, and I was thinking, “How the hell was Mac not found? We had people all over that area.” As I continue to say since that day, “God makes holes-in-one for a reason.”

I went to my family. They were devastated. My wife collapsed to her knees, our daughters around her trying to help her as she screamed “My boy, my baby boy.” I was crying, saying repeatedly, “I didn’t know, I didn’t know.” Everyone wanted to hug us. I just wanted everyone to leave. I didn’t know how I was going to handle this, and I knew it wasn’t going to be well. I did not want to follow my son. Not yet. I had to find out why he left me.

The homicide investigator on the scene wanted to see me. I was angry. Angry for not being able to find my boy. Angry at Mac for not telling me what his problem was and giving me a chance to help. Angry because here I was talking to an investigator with every team parent around me, our pastors, our friends’ families all finding out that our son was dead. Angry because my wife and daughters were receiving the worst news of their lives and were in obvious pain. Turns out the detective was a suicide victim. His father had committed suicide in his youth. He was a good man, trying to help. But I wasn’t listening. I was still in shock and angry as I told him, “I don’t care what it takes. I want my fucking house and my son’s truck ripped apart and I want to know why he died.”

I told him I wanted to see my son. He told me that I couldn’t yet. He was waiting on an assessment of our son’s condition and until he obtained it, we were not allowed to go up. He relayed that if Mac's body was in an unpresentable condition, he thought it would be better if we didn’t see it, not at this time. I returned to my wife and waited, comforting her as best I could while she dealt with the blind, raw pain of losing her only son. We stayed close until the detective approached us and told us that they were going to remove Mac’s body from the mountain and that we were not going to be allowed to see him until later. I knew then that my son, Mac, was gone for sure.

As the news rippled through the crowd that Mac was dead, people started to filter away. The news people were first, which was good since I didn’t want them in my face. People didn’t know how to help, but still offered. I put my wife in a friend’s car and sent her home. I would stay to pick up our son’s car and bring it home.

I had no idea why my son had to die that way, but I decided I was going to do everything I could to find out.

Part Two:

Causes and Effects of Subconcussive Trauma

Chapter Three

Understanding the Iceberg

DID ONE HIT LEAD TO A 13-YEAR OLD'S SUICIDE?

James Ransom Photo courtesy of the Ransom family

James Henry Ransom loved football. He began playing tackle at age nine. He liked blocking and was a natural lineman. By age twelve, he was known as one of the toughest kids on his team. He would go head-to-head, repeatedly.

After a game on September 12, 2015, James told his dad that a player had hit him on the side of his head, intentionally. Being tough was demanded by his coaches, so James didn't mention it during the game. But that night, he told his dad he had his "bell rung." And it wasn't the first time. There had been several times when he had been hit and "seen stars."

Three days later, during practice, James began to feel nauseous and dizzy. He was diagnosed with a concussion and told to not play for a week. In the blink of an eye, this talkative, smart, funny, well-liked kid transformed into a negative loner, acting out, with memory lapses, and obsessive-compulsive behaviors. James was in treatment for a year. Four days after Thanksgiving 2016, thirteen-year-old James took his own life.

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Remember when you learned about icebergs? Maybe you were in school. Or maybe it was when you saw the movie *Titanic*. Remember the most peculiar thing about icebergs? To most, it's that most of an iceberg is submerged. It's not visible. It's not knowable. What I discovered and want to pass on to you about contact sports and mental illness is what has been hiding in plain sight. Unfortunately, what you don't know and can't see, can hurt you. What you can't see is hurting your children.

That's what happened to us. We didn't see Mac's pain. We didn't know what we know now, only after undergoing every parent's worst nightmare.

A quick story about how we got to this point:

After Mac died, I was clueless, rudderless, and floundering in pain and loss. My wife had to go into therapy, our daughters were struggling and to top it all off, I ended up with a new stepson when I took in one of Mac's best friends who was struggling to find his way. I had so many questions, and no one could answer them.

To keep myself moving, I started to write a book on Mac that was based on a habit I had developed based on the lack of fatherhood that I had as a kid. Every six months to a year, I wrote Mac a letter, outlining how he had grown, developed and the things he had done with me and the family. The book was to be called "Letters to Mac" and to ensure that the story wasn't lost, I was focused on covering the entire depressing story of his passing.

When the autopsy came, the coroner was clear that it was a suicide. Mac had no toxins in his body when he died. My son ran off an eighty-foot cliff to his death sober. In my vacuum of thoughts and loss, I talked about the amazing boy he was, the loving family he had, the blessed life he lived, and how over one thousand people attended his service. Then I asked, “Why is my son not here?” The coroner’s response was, “Did your son have concussions?” I answered, “Yes, three, over three different sports seasons and he was cleared each time.” He mentioned “CTE,” and said that he started an investigation, but didn’t have the right “tools” and suggested I learn more.

That coroner’s statement led me to the internet. Through the grace of God, I found the Patrick Risha CTE Foundation, and I left a message. The next day the founder, Karen called me up and asked me my story. When I got done, she said, “Bruce, Mac’s brain never had a rest” and said she would put me in touch with the Concussion Legacy Foundation. The CLF foundation manager and I had a conversation that indicated that Mac may have been suffering from some of the conditions of CTE and they then connected me to the CTE Center run by Dr. Ann McKee at Boston University.

I started digging into CTE and understanding the damage that can happened to a child’s brain from early exposure to concussive and subconcussive trauma. I bought every book on the condition and started tracking research documents, newspaper articles, anything that could help me understand why Mac wasn’t here. Did he have CTE? Was that the cause of the schizophrenia and depression he claimed he suffered from before his death? Finding mounting research showing that such brain damage leads to mental illness, I started to get a clearer picture as to why Mac was not here.

So, gaining hope that some understanding about Mac’s death could be forthcoming for me and my family, I put the book I was writing down and continued to research, share, and converse about the links between contact sports and mental illness. It became clear I had identified a major risk to our kids – an iceberg, one might say – that many parents, including I, did not understand. An iceberg composed of tens of thousands, no, hundreds of thousands of children, adolescents and adults suffering from debilitating mental illness with no clue as to why they were struggling.

That is how we got to this point.

Let’s talk about CTE.

At the tip of the iceberg is Chronic Traumatic Encephalopathy or CTE. You may already know CTE as the killer of professional athletes, collegiate athletes, and retired athletes from boxing, football, hockey, soccer, rugby, and more. While CTE has been more widely acknowledged since 2009, almost everyone sees it as an adult disease. Most findings regarding CTE come from adults who have died prematurely. This is the tip of the iceberg people see and are aware of. In fact, since Mac’s passing, at least half the people we talk to know about CTE. Not bad for a disease that was rarely talked about just five years ago.

For those who don't follow sports or don't read a lot of news, CTE seems like something that doesn't apply to the average everyday person. CTE is all about professional athletes, right? Guys who have been playing for decades, or guys who get paid tons of money to play. They knew the risks, didn't they? Maybe. It's no less heartbreaking for their loved ones.

Junior Seau, the fist pumping, emotional leader of the San Diego Chargers for thirteen years, the Patriots for four years, died of a self-inflicted gunshot wound to the chest. The National Institute of Health concluded he had CTE. He left three children, their mother and his family.

Tom McHale, who spent nine successful years in the NFL, died of an accidental drug overdose. An autopsy revealed CTE. He left a wife and three sons.

Terry Long, who played eight seasons with the Pittsburgh Steelers, drank a full gallon of antifreeze, which caused his death. An autopsy revealed CTE.

Dave Duerson, who won two Super Bowl championship rings, died of a self-inflicted gunshot wound to the chest. He sent a text to his family saying he wanted his brain to be used for research at the Boston University School of Medicine which is conducting research into CTE. He left behind three sons and a daughter with his ex-wife.

In 2021 and 2022 alone, Vincent Jackson, Louis Nix III, Paul Orndorff, Parys Haralson, Mark Pavelich, Shane Olivea, Demarlo Belcher, Junior Siavii, Dan Reeves, Katie Meyer, Ralph Neely, Santonio Beard, Greg Clark, Phillip Adams and others from the National Football League, National Hockey League and wrestling arenas all died young, some from suicide, some from violence, all quite possibly from playing sports.

Despite the tip of the iceberg being visible in the news, CTE is still not considered a risk to anyone other than professional athletes, though some college athletes and even Olympic athletes are creating controversy with their mental illness struggles. To the public, there doesn't seem to be a link between this condition that has destroyed professional athletes, and the millions of kids, teenagers, and young adults who play the same sports.

Part of the problem is how CTE has been publicized. As "the NFL disease," it definitely shouldn't affect your children, or yourself from when you played sports. It is portrayed as some kind of "niche" disease, meaning, if you haven't played professional sports, then you probably are not susceptible to it.

The other part is how CTE is explained. The discussion primarily surrounds the presence of tau proteins in the brain and how they affect other parts of the brain after being damaged. It is also common knowledge that CTE cannot be diagnosed until after death. So, why should people worry about a condition that ***appears*** to affect a very

small percentage of Americans (professional athletes) and cannot be detected until death?

The problem with the portrayal of CTE in this fashion is that it ignores a primary fact that is crucial to understanding the disease. That fact is that ***almost every case*** of CTE that has been studied was accompanied by symptoms of mental illness. But if mental illness is an indicator of brain damage and the long path to being diagnosed with CTE, why do we have to wait until death? Mental illness can be detected long before a potential CTE diagnosis. Why are we, as a society, not looking at mental illness as one indicator that someone is suffering from concussive induced brain damage?

There are three key points I would like you to consider:

The first point is that many of these men and women didn't die from CTE. They died from ***mental illness*** as a result of concussive and subconcussive exposure that damaged their brains and caused them to develop CTE. CTE is the physical evidence of the disease that results from a brain being exposed to repeated head trauma or concussive trauma for years. Mental Illness is the psychological manifestation of that brain damage in the form of depression, drug abuse, aggression, criminality, schizophrenic episodes, and suicide. What is key here is that CTE cannot be diagnosed until after death, but symptoms of mental illness are displayed much earlier even in teenagers. An informed parental, medical, psychological and coaching/athletic training community could identify children and young athletes that show signs of mental illness and decide to stop further exposure in order to protect the child's brain and prevent more permanent and disabling damage.

When you read about CTE related deaths, examine how each person died and what led up to that moment for each athlete. Invariably, you will read horror stories of failed marriages, arrests, drug and alcohol abuse, bankruptcy, aggression, depression, and suicide. There are physical signs as well, including seizures, epilepsy, palsy, and impairments that can indicate CTE is influencing an athlete's body. But until an autopsy is done, it's only an educated guess. However, the mental illness that can accompany every stage of CTE is real, it can be diagnosed, it can be treated.

The second key point that you need to understand is, almost every one of these athletes who has died from CTE, started their journey to that end as a ***child athlete***. Depending on the age of the athlete, most of them probably started playing in middle school, as most high school athletes do. And they may have started even younger, in Pee Wee leagues where kids as young as five are wearing pads and hitting other children.

The third point is that there is an overall focus on concussions currently that overshadows the real risk to our kids: subconcussive trauma. We focus on concussions as they are a recognized form of mild Traumatic Brain Injury (mTBI) that usually can be identified and diagnosed. The most significant ones can be seen (and felt) in the violent collisions we see on TV. Over time, our focus on concussions has driven the entire

conversation, with minimal time being spent on the continuous, relentless damage that is caused, especially at a younger age, by subconcussive trauma. It is our opinion that athletes are not becoming mentally impaired and committing suicide because of concussions, but because of the combination of those concussions and the relentless pounding the brain takes in the form of subconcussive trauma that prevents the brain from healing properly leading overtime to permanent brain damage and to mental illness.

Keeping these points in mind, do you feel that the extreme actions of athletes suffering from CTE are the actions of sports heroes? Why would men like Junior Seau, Tom McHale, Terry Long, and Dave Duerson, who led on the sports field, were known as wonderful sons and fathers, were wealthy benefactors of charities, and who helped those less fortunate, all commit suicide? These are not the actions of heroes. They are the actions of men (and now women) who developed mental illness as a result of overexposure to concussive and subconcussive trauma who were in extreme pain. Their mental illness led to grave emotional stress in these amazing people. These loving, hardworking, professional people, much like my son Mac, were left incapable of feeling like they could continue to exist. They were left feeling like death was preferable to life because of their anguish. An anguish that was brought about by physical injury to the brain.

Think of the millions of American children, teenagers, and adults who have been exposed to years, sometimes decades, of contact sports with little understanding of the physiological damage those years of contact and trauma can do to a brain. Continuous and unrelenting physical damage causes irreparable harm to the brain resulting in mental illness due to an abnormally functioning brain. Eventually, the mental illness will manifest itself in mannerisms, actions, and decisions caused by the psychological distress and physical ailments that come with brain damage. Over time, their mental illness progresses until some athletes become depressed, schizophrenic, suffer anxiety, act impulsivity, and some, like Mac, commit suicide.

This is the underbelly of the iceberg. There are far too many child, teenage, and adult athletes who are suffering from mental illness because of early and/or long-term exposure to concussive and subconcussive trauma. Millions of kids who are encouraged or motivated to play contact sports. Their parents, doctors, athletic trainers, psychologists, and coaches do not have the information they need to make informed decisions to manage the risk of subconcussive trauma. Kids are playing sports in a vacuum of critical medical information and are at greater risk for mental illness with each year they play before the age of fourteen.

For decades we have failed to protect our children. Moreover, we have encouraged them to participate in activities that are harming them. Not because we don’t love them, because we didn’t have the knowledge we needed to make protective and informed decisions.

If mental illness is an indicator of brain damage and the possible start of a long road to a diagnosis of CTE, why are we not identifying and linking the mental illnesses suffered by numerous child, teenage and adult athletes to concussive and subconcussive trauma? We know that many athletes suffer from mental illness. Is it all related to sports? Absolutely not. But in the case of early and prolonged exposure to concussive trauma, is it a possibility? You can bet your helmet it is!

Why even worry about brain damage and mental illness if we know that delaying exposure to concussive and subconcussive trauma until later in life could eliminate this risk to our kids? Right now, numerous studies and research done on brain developmental stages, brain trauma, and psychological disorders indicate that around the age of fourteen, the brain has developed sufficiently to be resilient enough to be initially exposed to contact sports. Organizations like Boston University, the Concussion Legacy Foundation, Practice like the Pros, Flag till fourteen and supported by NFL greats like Brett Favre support the concept. Additionally, other NFL greats like Many NFL greats didn't start playing tackle football until they were 14 years old, including Jim Brown, Tom Brady, Walter Payton, Jerry Rice and Lawrence Taylor, according to the Concussion Legacy Foundation.

Be forewarned, even after the age of fourteen, too much concussive and subconcussive trauma can cause harm. But if exposure to contact sports is managed properly, the potential harm to a child's brain could be mitigated.

The key issue is awareness and education about the risks of early exposure of developing brains to concussive trauma. There is no one, other than non-profits like the Concussion Legacy Foundation, trying to educate interested people on the risk of youth brain trauma in contact sports. Think about that. There is little to no education on subconcussive trauma for doctors, athletic directors, school supervisors, athletic trainers, coaches, or parents. Millions of kids are exposed to subconcussive trauma ***every day*** due to our lack of knowledge concerning the risk.

Add to this the years of exposing a vulnerable brain to trauma and the eventual progression of that brain damage to mental illness. Who is going to treat that? No one. That is where we are as a society. Our children are being exposed to trauma that will affect them for the rest of their lives and our medical, psychological, coaching, and parental communities are ignorant, not only of the damage being caused but also how to identify and treat it.

This book is important because we love our children, and we will do anything for them. We would die for our children. They are God's most precious gift. Why wouldn't we protect them from something as mundane as contact sports until the time is right?

Our desire to protect our children is only as good as our knowledge of the risk they are facing. How does the commitment to our kids apply to risks you ***do not*** know? How do you protect or defend your child from something you don't know is hurting them? Daily, weekly, monthly? We can't. This book is about the knowledge so that you

can make the choice. I will say this repeatedly throughout the book: due to the lack of education and knowledge about this issue, you, the parent, are the front line of defense to protect your child's brain and their future. Right now, no one else is going to help defend your child but you.

Chapter Four

Your Child's Brain

'Is This Worth It?' Football, a Suicide and a Path Forward

Zac Easter's story shows the harsh reality of football.

Zac Easter started playing football when he was eight years old. He was not diagnosed with a concussion until he was in high school, but at the age of ten, he began complaining of headaches. At 5-foot-4, Zac was much smaller than the other players, but he was a hard hitter. He learned early on that he could use his head as a battering ram, which was so effective, it more than made up for his stature.

At a football camp before his senior year, a head on collision on the field made him woozy. During that senior season, Zac suffered a concussion, was sidelined for three weeks, then immediately got another one. His brother described him as "emotionless" and "vacant" on the sidelines that night.

Zac loved football and he didn't want to quit. He didn't want to disappoint his friends, his family, his teammates, or himself. As a senior, Zac started experiencing increased headaches, memory loss, and mood swings and his deterioration continued for six years after his last football game in high school. He suffered silently but kept a journal of his symptoms which included depression, anxiety, and hearing voices. In November of 2015, Zac shot himself in the heart to preserve his brain for research into CTE. For the Parkman family, Zac's story touched us personally and spoke to Mac's tragic outcome.

Why Be Concerned About Your Child's Brain?

After Mac's passing and learning about the impacts of concussions, we teamed up with the Concussion Legacy Foundation, the Patrick Risha Foundation, Boston University, and other experts to learn more about what happened to Mac. The research we found revealed many facts about the adolescent brain that most parents just do not know. This chapter reviews the basics we should all understand.

We love our children. Most parents understand the importance of the brain as an organ but do not associate the organ with their child's future. That fragile, critical organ called the brain drives a child's entire life and is integral to who and what they are. It will determine who they are and how they act. It will control their impulses, desires, and activities. The brain will determine a child's socio-economic status and will play a major role in the success they have in life, the occupations they choose, and even how long they will live. Without a properly developed and functioning brain, a child's future will be dim, and their full potential will be unrealized. It is clear brain health is critical so why would we risk damaging it?

What most people don't understand is exactly how a child's brain is vulnerable to concussive and subconcussive trauma, both as a vital organ and as an organ that passes through critical developmental processes as they grow. The irony is almost ludicrous. We know that a child's brain is vulnerable to trauma. Hell, we follow our children, put helmets on them, put nets on trampolines, and put training wheels on bikes. We know that our kid's brain needs to be protected. Yet, when it comes to contact sports and concussive and subconcussive trauma, we appear clueless and allow those

same brains that we work so hard to protect to be exposed to relentless pounding and trauma.

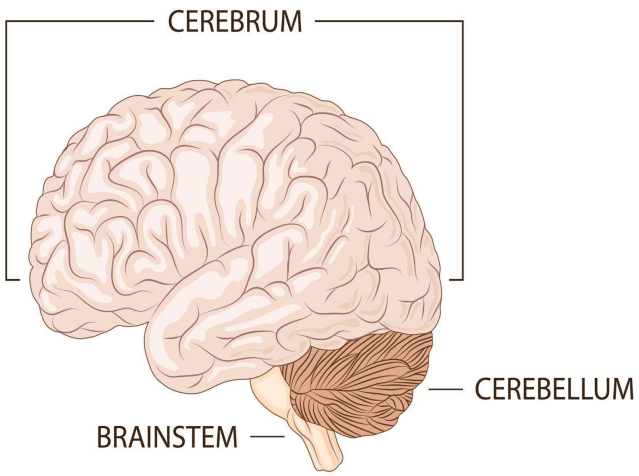
In a nutshell, we must protect our children's brains from concussive and subconcussive trauma for normal development. Why do we protect them from falls, collisions, bike, car, skateboard, snowboard accidents, and more? Because we know that these risks will impact their brain health and mental well-being.

It's time to add concussive and subconcussive trauma to this list of risks and avoid contact sports until later in a child's life.

Physical Description of the Brain

The Central Nervous System (or CNS) is the "processing center" of the body and is composed of the spinal column and the brain. Of course, we all know how critical these components are for an excellent quality of life, and for that reason, when something goes wrong with the CNS, it's usually bad.

The brain is considered the best protected organ in the body. It is encased in a bony structure called the cranium, or skull, which protects the brain from external impacts. Then the brain is protected by the meninges, three layers of membranes that surround the brain and spinal column to protect it. The final layer of protection is the Cerebral Spinal Fluid, which surrounds the brain, and in which, the brain floats.



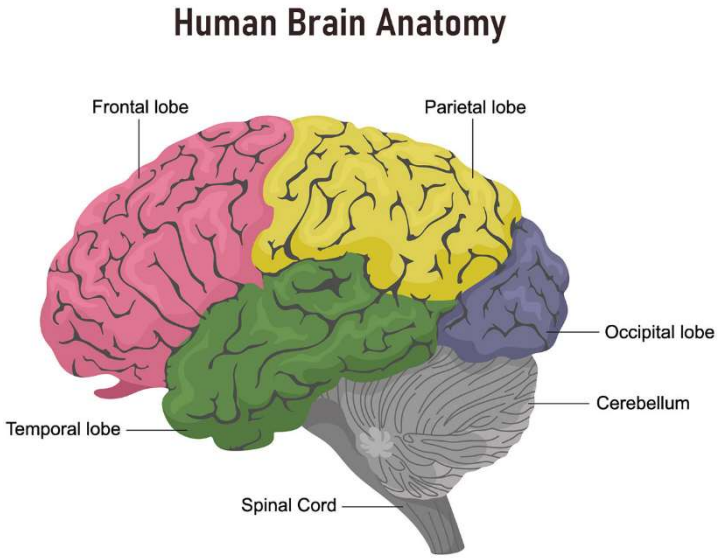
The brain has three major parts: the cerebrum, the cerebellum, and the brain stem.

The cerebrum is the largest part of the brain that fills up most of the skull. This portion of the brain controls most of our advanced functions, such as learning, thinking, coping, reading, as well as our emotions, and is divided into two hemispheres, a right and a left, that control the muscles and senses on the opposite side of the body. The left hemisphere controls your right-side muscles and vice versa.

The cerebellum coordinates complex actions like walking and talking and is located at the back of the brain.. Damage to this area may result in movement becoming jerky or uncoordinated, which is known as cerebellar ataxia. The child's speech may also become slurred and difficult to understand. The cerebellum has rich

connections to the cerebrum. Therefore, damage to the cerebellum can result in disruption to some of the functions controlled by other parts of the brain.

The brainstem connects the brain to the spinal column and controls our basic body functions like breathing and body temperature. As a result, damage to the brainstem can be life-threatening.



Each hemisphere of the cerebrum can be divided into four lobes. Here's a breakdown of each lobe and the functions they control:

Lobe	Function	Consequence of Damage
Frontal	Executive functions - planning, decision-making, regulating behavior, reasoning, goal-directed behavior Attention Motor activity Language production	Difficulty with cognition and executive functioning Difficulty maintaining attention Paralysis on the opposite side of the body Difficulty with language output
Parietal	Visuospatial skills Perception of the sense of touch, pain, and temperature	Visuospatial difficulties Sensory neglect - being less aware of parts of the body Loss of the sense of touch, pain, and temperature on the opposite side of the body
Temporal	Memory and learning Processing emotions Hearing	Memory difficulties Difficulty finding and using the correct words Depression Hearing loss
Occipital	Vision	Vision loss Distortion of what we see

The frontal lobes are the largest lobes in the brain and extensively connected to other parts of the brain. The very front of the frontal lobe is called the prefrontal cortex and controls many complex functions necessary for adulthood. Due to the frontal lobes' size, location at the front of the brain and proximity to the skull and a bone at the base of the skull called a "sphenoid bone" it is considered very vulnerable to trauma, and numerous studies focus on the relationship between the prefrontal cortex and brain damage/mental illness due to this fact.[2]

Given the nature of sports related impacts, it is the prefrontal cortex, which is the most important to us as parents for several reasons.

First, due to its location directly behind the forehead, the prefrontal cortex is the area of the brain which takes the brunt of the concussive and subconcussive impacts from youth contact sports[3] Second, the prefrontal cortex, otherwise known as "the CEO of the Brain" is responsible for the complex and executive functions necessary in adulthood. These executive functions include the organization of several sensory inputs, the maintenance of attention, planning, reasoning, language comprehension, social behavior, and the coordination of goal-directed behaviors – everything a child will require to function as an adult. Third, and remember this, this part of the brain is the ***last part of the brain to develop.*** This process starts around the age of eleven in girls and 12 and boys and is not considered completely developed until an adult's mid-20s.[4][5] Some studies indicate that this part of the brain continues to develop until we reach our mid-30s.[6]

To parents, the essential nature of the prefrontal cortex to our child's success makes it critical to protect, as any damage done by trauma prior or during development will negatively impact the child's ability to reach their potential. The functions of the prefrontal cortex are certainly a crucial aspect of what we think of as "human" cognition

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[2] Lefebvre G, Chamard E, Proulx S, Tremblay S, Halko M, Soman S, de Guise E, Pascual-Leone A, Théoret H. Increased Myo-Inositol in Primary Motor Cortex of Contact Sports Athletes without a History of Concussion. J Neurotrauma. 2018 Apr 1;35(7):953-962. doi: 10.1089/neu.2017.5254. Epub 2018 Feb 9. PMID: 29279021; PMCID: PMC5865614.

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[5] Johnson SB, Blum RW, Giedd JN. Adolescent maturity and the brain: the promise and pitfalls of neuroscience research in adolescent health policy. J Adolesc Health. 2009 Sep;45(3):216-21. doi: 10.1016/j.jadohealth.2009.05.016. PMID: 19699416; PMCID: PMC2892678.

[6] https://www.menshealth.com/health/a26868313/when-does-your-brain-fully-mature/

and are essential to your child's future. They cannot function as an adult without a properly developed prefrontal cortex. If this part of the brain is damaged, your child's brain will not properly mature and the probability of cognitive decline and suffering from mental illness will be high.

Portions of the temporal lobe are also highly connected to the prefrontal cortex, which controls the emotions processed in the temporal lobe. As a result, damage to this area can also result in depression. Due to their location on the sides of the skull and how close they are to the bone; these lobes are also considered very vulnerable to trauma.

While much of our focus is on the prefrontal cortex, it's obvious that the other parts of the brain, which are as fragile, control other critical functions and should be protected from harm as well.

So, while much of our focus is on the prefrontal cortex, it's obvious that the other parts of the brain, which are as fragile, control other critical functions and should be protected from harm as well.

Neurological Components

The CNS, while protected by the skull and vertebrae, is composed of sensitive, fragile tissue. In fact, the brain is so soft that, without some form of hardener or treatment, you couldn't pick a brain up off the ground. The vulnerability of the brain to trauma is significant, not just because it is fragile, but because of the critical functions that it performs.

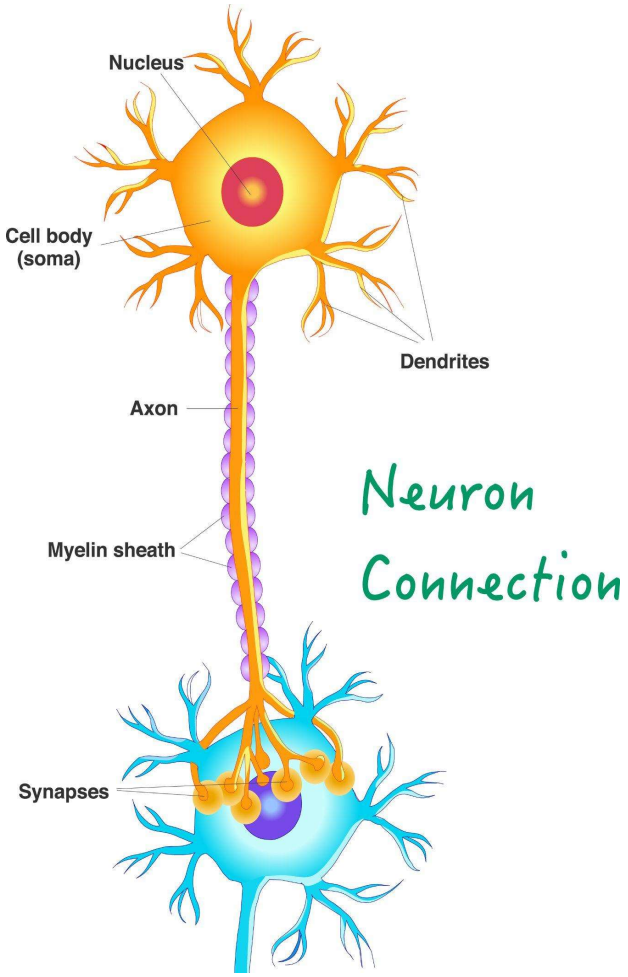
For example, depending on your researcher, there are between 86 and 100 billion neurons in the brain and each neuron can be connected to up to 10,000 other neurons. Multiply that out and you get a number with 14 zeros! How many is that? According to renowned brain expert Dr. Allan Hamilton, "the number is so high that there are more connections in the human brain than there are elemental particles in the entire Universe. It is mind-boggling!" Why do we expose our children's brains to concussive and subconcussive trauma when it will only damage this beautiful, complex organ and negatively impact their future?

Neuron - Neurons (also called nerve cells) are the fundamental units of the brain and nervous system, the cells responsible for receiving sensory input from the external world, for sending motor commands to our muscles, and for transforming and relaying the electrical signals at every step in between.

There are several key components of the neuron that undergo significant growth and development in a child's brain, particularly from the age of three to the age of thirteen. There are more, but the ones listed below form most of the connections in your child's brain.

Axon – A component of a neuron being the long threadlike part of a nerve cell along which impulses are conducted from the cell body (the processing part of the neuron) to other cells. It is estimated that there are between 860 and 1000 trillion synapse connections in the brain.

Myelin - The myelin sheath wraps around the axons. This sheath protects the axons a lot like the insulation around an electrical wire. When the myelin sheath is healthy, nerve signals are sent and received quickly. Myelin is a lipid, making the brain the organ that contains the most fat, which is why it is so squishy. The myelin (or myelin sheath) plays three primary roles. First, it insulates the axon and allows for a more rapid transmission of the nerve signal. How fast? Myelinated nerves transmit signals 100 times faster than non-myelinated ones. Second, since myelin insulates the axon from other nerve components, the myelin prevents the nerve signal from being interrupted by other signals in the brain. Third, the myelin also provides some minimal protection for the axon against damage.



Synapse - Synapses are the part of the circuit that connects sensory organs to the brain, like those that detect pain or touch in the peripheral nervous system. Synapses are the contact points where one neuron communicates with another and connects neurons in the brain to neurons in the rest of the body. There are estimated to be over 1,000 trillion synapses in the brain.

White Matter versus Grey Matter

You have heard the terms white or grey matter regarding the brain. In layman's terms the grey matter is where the brain processes information and the white matter relays the information to the grey matter for processing.

Scientists have discovered that the grey matter is only about four millimeters thick, the same thickness as a piece of heavy cloth and that it is primarily composed of cell bodies called “somas.” It gets its color from the substantial number of these cell bodies and that their axons do not have any myelin around them. The grey matter is where substantial processing occurs in the brain, controlling our muscular and sensory activity, our thoughts, our decisions, and more.

White matter contains less somas, but many, many more axons and synapses than grey matter. The “white” in white matter comes from the waxy myelin that begins to coat the nerves as the child’s brain starts to develop in order to improve their ability to transmit nerve signals. At birth, there is very little myelin, but as the child grows, the myelination process starts at the base of the neck and finally coats the nerves in the frontal lobes in their twenties, and some studies say into their thirties.

The white matter used to be considered nothing more than connective tissue for the grey matter of the brain and historically the focus has been on the grey matter of the outer portion of the brain where most of the brain’s processing takes place. However, more recent research found that white matter, which represents 60% of the brain, is a dynamic organ that regulates most of the advanced and complex functions the brain must master as a child approaches adulthood. As we will see later in this short read, myelin and white matter are what “matters” when we start talking about concussive trauma to a developing brain, and the links from that damage to mental illness.

This is important to remember as the last part of the brain to go through myelination is the frontal lobe containing the prefrontal cortex. So, the nerves in that part of the brain do not have the additional protection of myelin when exposed to trauma. When these underdeveloped nerves are subjected to trauma, that damage will cause significant issues as your child matures.

Interesting Facts About a Child’s Brain

From birth to the age of five, the brain develops more than at any other time in a child’s lifetime.

A newborn baby has all the neurons it will have for the rest of its life.

A two-year-old baby has twice as many synapses as a full-grown adult. If intelligence is defined as the ability to learn, children between the ages of two and seven may be the most intelligent humans on the planet. In the first few years of life, more than one million new neural connections form every second and a healthy toddler creates an astounding two million synapses per second.

By the time children are two years old, their brains have approximately 100 trillion synapses, over 1,000 times the number of stars in our galaxy. This is many more than they will ever need. And by three years of age, a baby’s brain has reached almost ninety percent of its adult size.

Children who experience more positive interactions in their early years go on to be healthier and more successful in school and in life. But exposure to family violence, physical trauma, or a lack of quality early learning experiences can negatively impact a child's early brain development, and subsequently, their long-term success.

Experiencing stress is an important part of healthy development that prepares the body to deal with threats. However, when these responses remain activated at high levels for significant periods of time, toxic stress results which can impair the development of neural connections, especially in the areas of the brain dedicated to higher-order skills.

As mentioned, your child's brain will not be fully developed until the age of twenty-five or so. And some of the most interesting developments happen between the ages of three and thirteen, making this the most important time to protect your child's brain.

Neural signals are transmitted at a speed of 268 miles an hour.

Your brain is 60% fat.

There are over 100,000 miles of myelin in the brain.

There are over 100 trillion neuron connections in the brain, that is over 1000 times the number of stars in our galaxy.

Your brain, at around 3 pounds, averages around 2% of your body weight, but uses up to 20% of its energy and oxygen intake

25% of your cholesterol is in your brain, without cholesterol, your brain will die

Each neuron can transmit up to 1000 signals per second to tens of thousands of other synapses

Your brain is a motor generating between 10 to 23 watts of energy, enough to power a light bulb!

Brain Plasticity:

Starting at birth and lasting through the third stage of brain development (until age eleven), your child's brain is described as an organ that has "high plasticity." The word "plasticity" does not refer to the composition or texture of the brain (like putty or

something malleable, as I thought it did). The term refers to the ability of the brain to "rewire" itself as it develops.

From birth, your child's brain starts with a blank slate of 86 to100 billion neurons. As soon as the brain is formed, it starts to develop and become more "plastic." as it begins to create other structures, including synapses, which allow neurons to connect with other neurons that connect to other parts of the body. By the age of three, your child has developed a massive number of synapses. Some estimates are as high as seventy trillion!

For years, it was thought plasticity was a means for the child's brain to deal with trauma and would assist in repairing the physiological damage. However, the latest research indicates that the impact of trauma on plasticity, including the trauma induced by contact sports, can negatively affect your child's critical brain development processes. Studies indicate while children seem fully recovered due to the amazing capabilities of the brain to "repair" itself, the impact of the trauma may result in other issues, such as other portions of the brain assuming the developmental role of the injured area. Also, new neuron growth may be impaired, leaving your child unable to develop more complex learning and coping strategies as they mature.

Bottom line is that the concept of brain plasticity is not applicable to those who feel that the "dings" that a child's brain receives during contact sports can be repaired. While there is some damage that can be repaired by a child's "plasticity,' the significant damage done to a developing brain by contact sports cannot be repaired. For example, your body can repair a broken arm, but it cannot regrow one. The limitations of plasticity in repairing the brain must be considered by any of a child's stakeholders, parents, coaches, athletic trainers and others, who introduce developing brains to trauma.

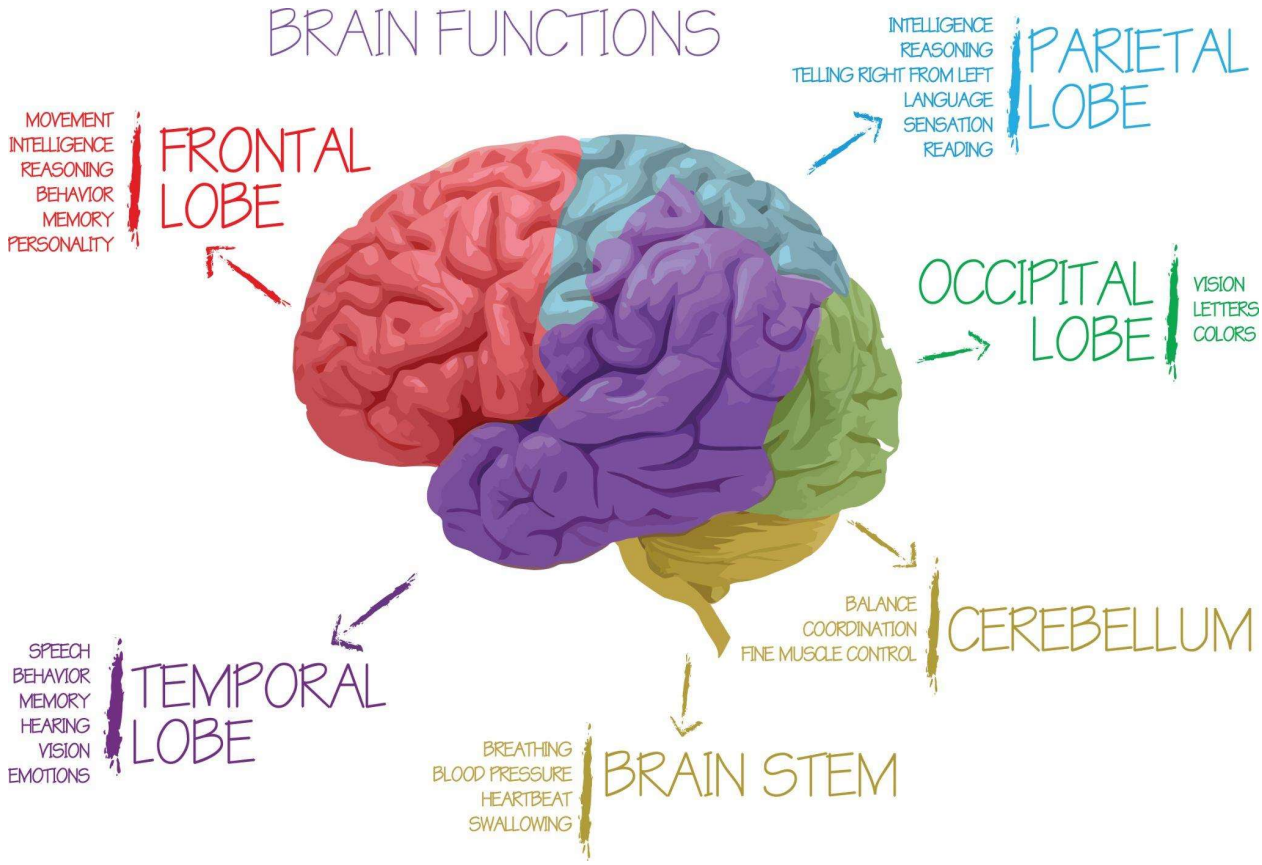
Chapter Five

Brain Development

Kelly Catlin started struggling with her mental health 2019, after a cycling crash where she broke her arm and suffered a concussion.

Kelly Catlin was a three-time world champion cyclist and Olympic silver medalist. She studied computational and mathematical engineering at Stanford and played classical violin. She was fluent in Chinese. She coupled her exceptional intelligence with focus and determination, becoming a success at everything she put her mind to.

In January of 2019, Kelly experienced a bad concussion while cycling. She had severe symptoms and was unable to perform at the same level, losing all sense of purpose. On March 8, 2019, Kelly Catlin died by suicide at age twenty-three.



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The reason it is important to understand the development of a child's brain is to be able to logically connect the damage caused by exposure to concussive and subconcussive trauma with mental illness.

While the process of brain development is primarily the same for all kids, external factors can greatly affect that process in terms of the time it takes a brain to develop and the completion of that development. Extensive research reveals that childhood trauma affects the development of the brain as exposure to physical and emotional

trauma can cause cognitive and emotional declines, even impacting the ability of the brain to be fully functional once your child attains maturity.

I want to reinforce the fact that during a child's life, their brain is developing at a dizzying pace and will continue to develop every day. From birth to the age of five, your child's brain develops the capacity to think and regulate at supersonic speed. In fact, by the ages of six to seven, their brain is already 90% of the size it will be as an adult, with as many neurons as an adult and twice as many synapses. There is a literal explosion of growth, development, and learning being done daily.

While there is minimal research specifically on the impact of contact sports on a young brain, there is substantial research on Traumatic Brain Injuries (TBI) in children. This TBI research offers a relevant reference because the damage done to a child's brain by early and prolonged exposure to trauma results in the exact same types of damage that occurs during contact sports. It is logical to extrapolate the research done on adults and apply that to a developing brain which research indicates is more susceptible to trauma. We believe the damage is magnified in children due to their brain's underdeveloped state. Impacts to a developing brain can increase both the damage and the possibility of mental illness. If exposure to concussive trauma is sufficient to damage an adult brain, we can only imagine the damage that can be done to a developing one.

Brain Development Stages

As your child grows, their brain develops sequentially from the more primitive parts that support basic bodily functions, including the "fight or flight" response, to those that enable higher level functioning, such as thinking and emotions. In the mid to late 1950s and early 1960s, a psychologist named Jean Piaget developed a theory regarding the development of a child's brain that is now widely accepted. The theory breaks a child's brain development into four stages:

Stage 1: Sensorimotor – Ages 0-2: This stage is where the child learns about the world through movement and sensation. They learn that they are separate from people and objects around them. They realize their actions can cause things to happen in the world around them. They also learn that things continue to exist even though they can't be seen (object permanence).

Stage 2: Pre-Operational – Ages 2 to 7: In this stage, children begin to think symbolically and learn to use words and pictures to represent objects. They still struggle to see things from another's perspective and tend to think about things in very concrete terms. While the foundation of language starts in the previous stage, this stage sees increased development of language skills.

Stage 3: Concrete Operational – Ages 7-11: During this stage, children begin thinking logically about concrete events. They begin to understand the concept of conservation – that the amount of liquid in a short wide cup is equal to the liquid in a tall skinny glass. Children become less egocentric and begin to think about how other people might think or feel and they begin to understand that their thoughts, feelings, and opinions are unique to them.

Stage 4: Formal Operational – Ages 12 to 16: This stage is characterized by the development of abstract and hypothetical thought. Skills such as logical thought, deductive reasoning, and systematic planning also emerge during this stage. Teens begin to think more about moral, philosophical, ethical, social, and political issues. While this stage can last past the age of fourteen, there is continued debate as to when this stage ends, and it is recognized that girls will usually complete these stages earlier than boys. Of course, critical growth and development continue to take place until the brain is fully developed around the age of 25.

These stages are progressive. The successful development of any stage is reliant on the successful development of earlier stages, meaning that if the brain is damaged in an earlier stage, the next stage of growth will be affected as well. This is one reason that athletes don't begin showing signs of mental illness until their late teenage years and into their 20's and 30's because that is when the parts of the brain essential to higher thinking start maturing and the progressive damage from earlier years begins to impact more advanced cognitive requirements.

As a child, the brain is only required to complete primarily basic cognitive tasks and is focused on developing as an organ. As a teenager, the brain is required to begin transitioning from a child to an adult and execute more complex tasks to include abstract thought, behavior management, and socialization. Damage done to later developing parts of the brain (like the prefrontal cortex) that are responsible for these more complex tasks are also linked to psychological disorders like aggression, impulsivity, depression, and mania.

Brain Developmental Processes

During the time that your child's brain will take to develop, there are critical processes that the brain goes through to prepare itself for more complex tasks and to become more efficient. Exposure to trauma can easily impair these processes threatening proper development.

Bottom line is, don't expect your child to mature into a functioning adult if these developmental processes are interrupted though the introduction of trauma. The processes build on each other throughout your child's life and provide a progressive path to a functional brain that can adapt to the child's environment as they grow.

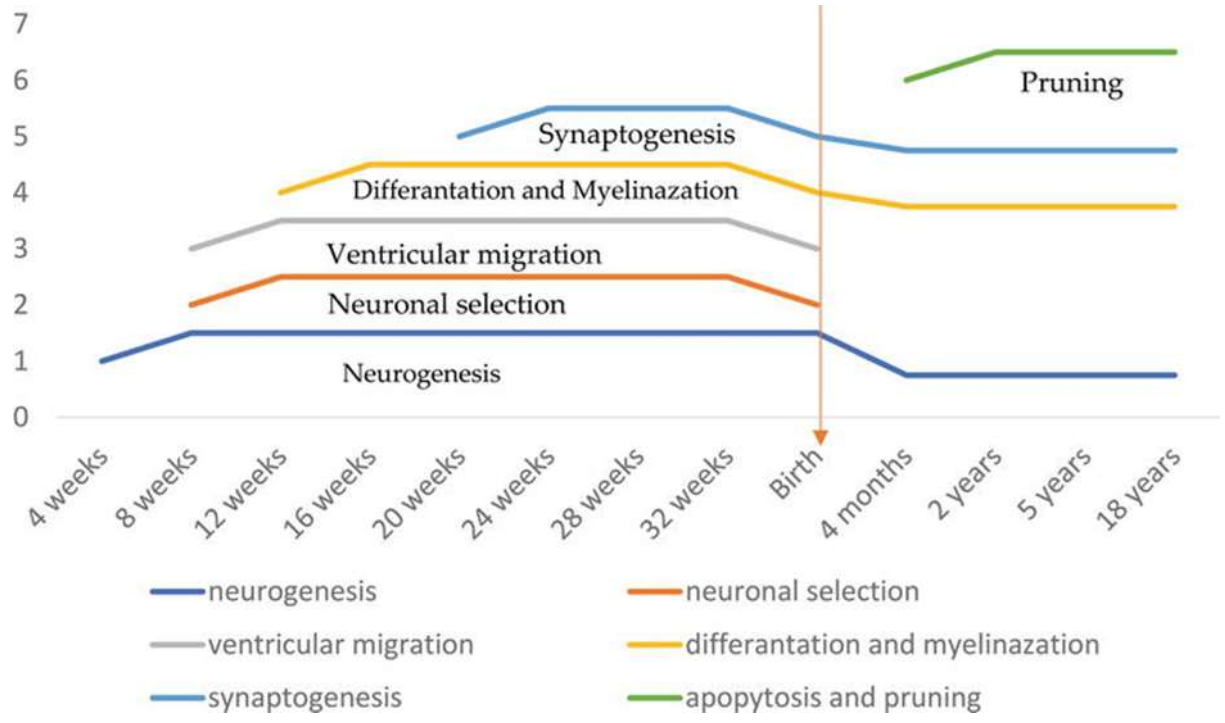

Figure 1. Timeline of Brain Development[7]

As you can see from the chart above, there are numerous processes that a child's brain goes through as it matures. Two of the most important brain developmental processes are synaptogenesis and myelination. Do not let the long terms confuse you. We will break them down so you can see their importance to your child's brain health.

Synaptogenesis is the development of connections between neurons.

Synaptic pruning is the process by which a child's brain "rewires" itself by removing synapses, the creation of new neural connections that form during synaptogenesis.

Myelination is the development of a protective sheathing around the axon connecting the neurons and synapses.

While your child is growing, these processes work in tandem. The brain builds an overabundance of synapses during a period of brain growth. Then, the brain "prunes" the synapses based on its environment to make the brain more efficient. At the same time, the process of myelination coats the axons in the remaining synapses to protect them and make them even more efficient.

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[7] Development of the Pre Frontal Cortex, Merve Uhtun, http://dx.doi.org/10.5772/intechopen.78697

Synaptogenesis– Synaptogenesis (the development of connections between neurons) is ongoing throughout a person's life with most of the synaptic development occurring in the first two years. During this early stage called "exuberant synaptogenesis," the child's brain can develop up to 700 synapses every single second! Areas of the brain with lots of synapses are associated with "grey matter."

The development of synapses spreads throughout the brain according to how the brain will mature later in life. Areas of the brain that mature early, like the visual and auditory cortexes, develop synapses first. These areas mature between the ages of four and six. Areas that mature later, like the prefrontal cortex, develop synapses later.

There is another critical phase of synapse development that takes place before puberty, just as your child begins to be impacted by hormones. This phase takes place in the prefrontal cortex, which, as we stated, is the last part of the brain to mature, developing the complex functions the child will require as an adult. At the end of this burst of synapse development, a teenager has two to three times the synapses that an adult has.

By the time your child passes into their twenties, most of their synaptic development is complete. However, new studies are showing that synapse development can continue on into later life.

Synaptic Pruning – Following each burst of synaptogenesis, the brain turns on another process called synaptic pruning. This is the process by which the developing brain naturally eliminates or "prunes" excess synapses to become more efficient at handling complex brain functions. Remember when we talked about how the brain creates way more synapses than it needs? Well, this overabundance of synapses causes issues as the brain utilizes only a percentage of them. Much like pruning a tree to remove dead limbs, the brain "prunes" or removes synapses that are no longer being utilized.

The pruning process usually follows periods of intense synapse development where the brain builds more synapses than it requires. For example, from birth to the age of three, your child will develop twice as many synapses as they will need as an adult. That's right, twice as many. The goal of synaptic pruning is just that, pruning those synapses that the brain doesn't need to make the brain more efficient. Some scientists call it "rewiring" the brain, others say it "quiets the noise" in a child's brain as it grows.

Myelination - Another key brain development process that can be disrupted by trauma is called myelination. Myelination refers to the accumulation of myelin, the layer of fatty tissue that surrounds the axon, the thin threads that transfer signals from the neuron to the synapse. Neurons whose axons are covered in myelin are also referred to as "white matter" in the brain. White matter corresponds with the brain maturing and the

ability to rapidly develop neural networks. This process occurs as the child grows, enabling their brains to send and process signals much more effectively.

The myelination process is critical to proper brain development as myelin provides the ability to rapidly transmit signals. Without proper development of myelin, signals cannot be transmitted effectively, can be slowed down, or maybe blocked entirely. It's like the insulation on an electrical wire. Without the protection of the insulation, you can get shocked, sockets can catch fire, and signals are slow. In the context of a child's brain, think of them learning how to walk. Their efforts are uncoordinated and slow, unlike an older child or teenager. This is because their neurons lack myelin.

In a normal brain, myelination is conducted in an orderly fashion. It begins in the brain stem, spreads through the cerebellum in the back of the brain, and only then into the cerebrum or front portions as the child grows. As the last part of the brain to develop, myelination of the prefrontal cortex will continue through the "tweens" and young adulthood, until their mid-twenties or even into their 30s.

Unfortunately, as stated earlier, this area of the brain not only takes the brunt of the trauma caused by contact sports but is also the most critical area of the brain for abstract thinking and complex, executive functions that your child will require as they age. When myelin in the prefrontal cortex is torn and disrupted by traumatic forces, the ability to properly develop is significantly impacted and the resulting brain damage is linked to lower intellectual performance and mental illness. We cannot repeat this enough: without a functioning prefrontal cortex, your child will be mentally impaired as an adult.

In a damaged brain, problems with myelination are significant and can lead to severe physical and psychological problems.[8] Again, think of the wire insulation analogy. If you don't have insulation on the wires in your car, your TV, your iPhone, what happens? Major problems, right? Well, tampering with the insulation on your child's brain is the same. Interfere with the brain's ability to transmit signals effectively and you get problems. Big ones!

Obviously, protecting your child's ability to develop and sustain myelination normally is of significant concern to parents, primarily if these associated disorders can be prevented by not exposing your child's brain to concussive and subconcussive trauma.

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[8] Fields RD. White matter in learning, cognition and psychiatric disorders. Trends Neurosci. 2008 Jul;31(7):361-70. doi: 10.1016/j.tins.2008.04.001. Epub 2008 Jun 5. PMID: 18538868; PMCID: PMC2486416.

Executive Function Development

This next section doesn't describe a brain development process but does describe how the brain development processes of synaptogenesis, synaptic pruning and myelination will affect the most critical part of the brain that our children will rely on as an adult – the prefrontal cortex and why it's so important to protect it from damage.

The prefrontal cortex is that area of the brain closest to the skull behind the forehead. It is one of the last regions of the brain to mature, and controls executive functions.[9] As I mentioned in chapter four, executive functions refer to the higher-level thinking skills your child will use to control and coordinate their other mental abilities and behaviors. They allow your child to conduct complex activities such as planning, problem solving, reasoning, abstract thinking, self-control, moral reasoning, emotional reasoning, and decision making.[10]

Check out the list of executive functions in the box below. These are all activities associated with growing up and functioning as an adult in society.

Basic Function	Description
Attentional control	The individual's capacity to choose what they pay attention to and what they ignore.
Cognitive Inhibition	The mind's ability to tune out stimuli that are irrelevant to the task or process at hand.
Inhibitory Control	The ability to inhibit impulses or dominant responses to external stimuli. An example would be self-control.
Working Memory	An individual's limited capacity to temporarily hold information which is critical for reasoning, behavior, and decision making.
Cognitive Flexibility	The ability to adjust activity and content, switch between tasks, rules, and corresponding behaviors.

[9] https://memory.ucsf.edu/symptoms/executive-functions
[10] https://developingchild.harvard.edu/science/key-concepts/executive-function/

It is obvious that the prefrontal cortex is critical to supporting the actions of an adult. If your child's basic executive functions were disrupted, they would be impacted developmentally. An adult would have a difficult time surviving on their own without the ability to leverage executive functions in their lives.[11] Dr. Julie Stamm states that "even small disruptions in executive functions can have an impact. A person with subtle difficulty with attentional control may be labeled as highly distracted or unreliable, and that may impact their ability to get a job or promotion. Someone who has difficulty with inhibition may be seen as having a short fuse, which can have an impact on their relationships."

As a parent, this is highly concerning because the frontal lobe, which houses the prefrontal cortex, is the area most susceptible to damage caused by concussive and subconcussive trauma due to its location behind the forehead and takes the majority of the force of most concussive impacts.[12] This area can also be harmed by blows to the back of the head as the brain will bounce off of the opposite side of the skull. Research has shown that exposure to trauma in contact sports is linked with shrinkage of the frontal lobe, as well as reduced blood flow, which affects recovery and changes in white matter.[13]These effects are now commonly associated with mental illness.

Understanding the critical role of these developmental processes and knowing that damage to the brain will interfere with the development of critical functions necessary to survive, why would we expose our child's brain to the possibility of being damaged during these critical years of development? Why would we risk their future? The research associating trauma with mental illness is astounding. There is simply no doubt that traumatically impacting your child's brain processes through early exposure to youth contact sports can damage their brain, leading to cognitive decline and psychological issues later.

When it comes to a child's brain resiliency, it is better to play it safe and wait until the child's brain is better positioned to endure the trauma induced by contact sports, especially when non-contact versions of those sports are available. Giving your child more time to be a kid is preferable to trying to push your child into contact sports before their brain is ready, as any damage that will result, can seriously impact the rest of their life.

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[11] Cognitive and Brain Development: Executive Function, Piaget, and the Prefrontal Cortex, Hattie J. et al. Archives of Psychology, vol. 1, issue 3, December 2017

[12] Nel, K., & Govender, S. (2018). Cumulative Mild Head Injury (CMHI) in Contact Sports. In (Ed.), Traumatic Brain Injury - Neurobiology, Diagnosis and Treatment. IntechOpen. https://doi.org/10.5772/intechopen.80668

[13] Meier TB, Bellgowan PS, Bergamino M, Ling JM, Mayer AR. Thinner Cortex in Collegiate Football Players With, but not Without, a Self-Reported History of Concussion. J Neurotrauma. 2016 Feb 15;33(4):330-8. doi: 10.1089/neu.2015.3919. Epub 2015 Aug 17. PMID: 26061068; PMCID: PMC4761822.

Chapter Six

Understanding Concussive and Sub-Concussive Trauma

Ohio State wrestler and football player Kosta Karageorge was found dead in a dumpster back in November of 2014. It was a loss that shocked a community, and helped bring attention to the issue of head trauma in football.

Kosta Karageorge was a student athlete at Ohio State University. He wrestled for three years, then joined the football team his senior year. He had a long history of concussions. After suffering another concussion in the fall of 2014, he became disoriented and suffered mood swings. He broke up with his girlfriend and sent texts to his mother saying that concussions were affecting his mind and he hoped he wasn't an embarrassment.

In December of 2014, after being missing for several days, the twenty-two-year-old was found in a dumpster near his campus apartment. He died from a self-inflicted gunshot wound.

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The issue of concussive and subconcussive trauma and its ties to youth sports and mental illness is a relatively new concept for the general public. The medical and research communities have known for some time now that trauma can damage a child's brain. There are also decades of research that prove damage to the brain from trauma can result in mental illness. Just go to Google and look these issues up, like I did. As a matter of fact, when it comes to this issue, I would encourage everyone reading to do their own research. The information has been known and people with an agenda have worked not to share it with parents.

In fact, the very first published evidence of concussive trauma affecting an athlete's brain came in 1929 when Dr. Harrison Martland described a group of boxers having "punch drunk syndrome" Subsequent researchers focused on the subject and as many know, Dr. Bennet Omalu was the first to identify and label the disease now known as CTE in football players in 2005 with Dr. Ann McKee publishing her first paper on CTE in 2009. Since then, hundreds of research papers have been published on the various links between contact sports, concussive trauma as well as subconcussive trauma and brain damage. In addition to these numerous studies linking trauma to brain damage, many more have been published on the links between that brain damage and mental illness.

Mental illness affecting our children that can be identified, that can be treated but most importantly, ***that can be prevented!***

Despite all the research and science outlining these risks and linkages, where is the recognition and concern about these risks from the parent and umbrella organizations that govern sports and oversee our nation's health? For years, the Center for Disease Control (CDC) and the National Institute of Health (NIH) provided excellent material on concussion awareness and recommendations. Yet, they have not identified the risks of early repetitive concussive and subconcussive trauma to a developing brain. Nor have they provided any guidance outlining the risks to a child's health, physiological or mental. In October 2021, the CDC did release a study showing that tackle football players receive twenty-three times more head impacts than flag football players. The study also stated about prolonged concussive exposure: "If sustained repeatedly, head

impacts over time may lead to pathological changes over time that are linked to cognitive and behavioral [issues].” That’s all…after decades of research. Obviously, there is a lot more work to be done as there is still limited guidance for parents and little to no recognition of the risks that we are taking with our kids’ brains.

So why are these facts and risks not known by parents? And why are the impacts of concussive and subconcussive trauma on a developing brain from early participation in youth contact sports not recognized by athletic trainers, doctors, and psychologists? These are the folks we trust to take care of our children. The fact that these people are not educated concerning the current science surrounding these risks is illogical and bordering on reprehensible.

We need to stop treating concussions lightly and take them for the serious brain injury that they are. In fact, most researchers will call a concussion a mild traumatic brain injury or mTBI. That’s right a concussion from “sports related injuries” is considered significant enough to be listed alongside car crashes, violence and explosive effects.”[14] This is a lot more serious that personally, I thought a concussion was. The current protocols of taking two weeks off and getting a simple memory baseline test is insufficient when we cannot see or accurately determine the amount of damage that was done.

Another issue requiring you to be knowledgeable on concussive and subconcussive trauma is that medical professionals are overwhelmed with work and strained medical systems are not allowing adequate time and training to better address the issues of long term concussive and subconcussive exposure. Some of these professionals receive training in concussion management and some don’t, but it is well known that most medical professionals are not regularly updated on concussion management as it is but one of the many conditions that they have to identify and treat. They definitely receive minimal, if any, training to assess a child’s concussive lifestyle, which affects their ability to make appropriate recommendations for care, follow-up and further exposure. There are concussion specialists you can take your child to, but they are few and far between and many times we don’t even know they exist. (I sure didn’t.)

These medical professionals are usually the doctors in the Emergency Room who are following standard protocols when treating our kids. None of this is wrong in any way. This is how they are trained. But given the fact that most of these medical practitioners are not specialists in brain trauma and that most concussions do not require advancing the case to a neurologist, it is important to be informed because we are the front line in protecting our children.

That is why you, as a parent, grandparent, guardian, or caretaker, must be informed about the risks of contact sports at a young age. Understanding the damage caused by Repeated Head Impacts (RHIs) or Repeated Brain Trauma (RBT) is significant. Understanding the concept of subconcussive trauma and its relationship to brain

[14] http://pnl.bwh.harvard.edu/education/what-is/mild-traumatic-brain-injury/

damage and mental illness in young children is crucial. Without that knowledge, we put our children at risk when we act in love (and ignorance) allowing them to play contact sports at a young age.

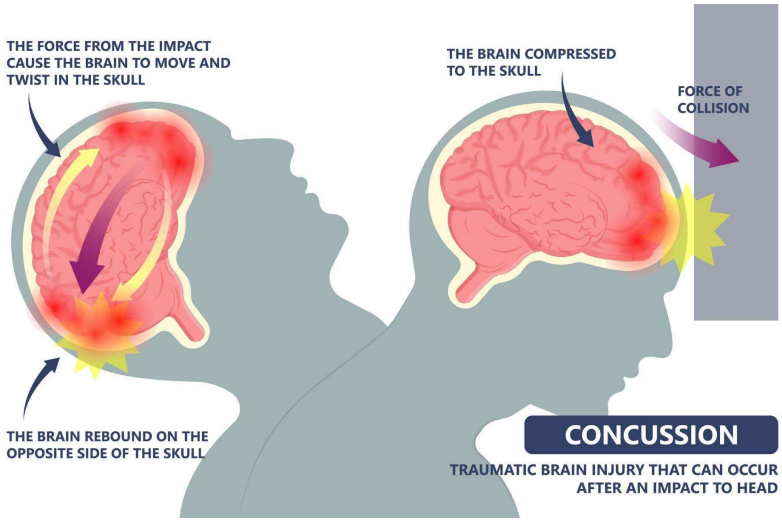
Concussive Trauma

The issue of concussive trauma is easily defined for most adults. We are aware of concussions. We read about them regularly. It seems like every week there is a story about an NFL player with CTE. And with millions of concussions occurring every year, we have all either had one or known someone who has had one. But if you think you know about concussions – like I thought I did – you should read a bit more. Most of the knowledge we have about concussions is based on our personal experiences or light reading.

Let's start with a standard definition: Concussive trauma is acute trauma resulting in a mTBI, (yes, the same TBI that is often associated with bomb blasts and the military) that usually happens after a blow to the head. It can also occur with violent shaking and movement of the head or body. You don't have to lose consciousness to get a concussion or experience persistent post-concussive symptoms.

When a concussion occurs, many people think that it's the impact of the brain against the skull that creates the trauma. In fact, a concussion is composed of two distinct actions, both of which negatively impact the brain and injure it.

Contact Force and Primary Injury



Contact force is the major origin of brain damage in so-called "still" injuries where an immobile victim receives a blow to the head. Also called the "primary injury" because it occurs first, the knock to the head results in movement of the head and neck on impact and causes angular acceleration, a combination of translational (straight on) and rotational (spinning) acceleration. [15] This acceleration can cause shearing and stretching of axons and "bruising" to other parts of the brain when it does

[15] Peter M. Black, Patricio C. Gargollo, and Adam C. Lipson , The Dana Foundation; The Anatomy of Brain Trauma, Concussion, and Coma; https://www.brainline.org/article/anatomy-brain-trauma-concussion-and-coma

hit the skull. This contact force is exacerbated by parts of the brain that have different rigidity causing them to move at different speeds after contact that can tear or shear neurons.[16]

What many parents do not know is that there are two areas that sustain damage during a concussion as a result of what is called a “coup/contrecoup” event where the brain literally bounces around inside the skill. It is from the French “coup,” which is “blow” and “contrecoup,” which is “contra-blow” or “blow to the other side.” The coup is the injury that happens where the child takes a blow to the head. The contrecoup is the injury that the child suffers in the area opposite the initial injury. Think of hitting a bowl of Jell-O. Where you hit the bowl is the “coup” area. The back of the bowl, where the Jell-O impacts after you hit it, is the “contrecoup” area.

Secondary Injury

What many people don’t know is that there is a secondary injury to the brain that takes place hours to days after the primary injury. In fact, research indicates that much of the brain damage that takes place is directly related to the secondary injury. This injury is primarily the reaction of the body and brain to the concussion. These conditions, in the form of hypoxia (a decrease in oxygen), ischemia (insufficient blood supply), swelling (increases in intracranial pressure), or an actual shift in the brain, can cause even more injury to your child. Additionally, there is the release of chemicals, free radicals, acute inflammatory markers and other responses that have been proven to actually attack the brain.

This is a serious issue for parents as these conditions have been proven to last for over thirty days per incident. When you add the fact that most athletes come back to the field two weeks after a concussion, it is likely that these conditions are still present and worsened by the additional trauma the already injured brain endures. Continued exposure to contact sports doesn’t allow the brain to heal, so a continued state of neuroinflammation occurs.

During one concussion, a child’s brain not only suffers from two impact related injuries, but both of those injured areas also suffer secondary injuries that can cause additional problems. ***That is four injuries per concussion***. If the child continues to play contact sports, the secondary injuries persist to the detriment of their brain. This is too much trauma for a child to undergo, especially when their brain is still developing.

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[16] Adnan A. Hirad1,2*, Jeffrey J. Bazarian1, Kian Merchant-Borna1, Frank E. Garcea et.al. A common neural signature of brain injury in concussion and subconcussion, Science Advances, vol 5, no 8, 7 August 2019, https://www.science.org/doi/10.1126/sciadv.aau3460

Subconcussive Trauma

As if concussions are not bad enough, let's talk about subconcussive trauma, the type of trauma that doesn't result in a diagnosed concussion, but significantly impacts a child's brain. The lack of initial symptoms, coupled with the devastating impact that continuous and prolonged subconcussive trauma can have on a developing brain, is the reason why understanding subconcussive trauma is so important. Subconcussive trauma is an inherent part of contact sports and cannot be prevented, except by not participating until the brain is better able to handle it. The longer your child is exposed to it, the higher their risk for damaging their brain, resulting in mental illness.

Many parents are unaware of subconcussive trauma because, until recently, it has not been commonly discussed. It is not mentioned as part of most concussion protocols. A few organizations have only just started mentioning it. I recently brought it up to a panel with several CDC members who stated that subconcussive trauma is an area that "needs more research." On top of minimal information, there is no guidance for parents to look at when considering contact sports for their kids. This risk is hardly known at all.

Subconcussive trauma may be the most poorly understood side effect of contact sports and its impact on children. It is a hidden, insidious injury that is inflicted with every blow a child's head takes on the playing field or practice field. The damage and risks to children are unknown, unmeasured, and parents are on their own as to how they perceive and deal with this. Some may say, "It's nothing, just a small bump." And because there are no symptoms, "There is nothing to worry about." They are wrong.

Dr. Bennet Omalu, the renowned forensic pathologist who discovered CTE in a NFL football player, said this about subconcussive trauma: "The issue is not about concussions. A concussion is a very severe type of injury that would manifest immediately with symptoms. For one documented concussion, there are thousands of subconcussive blows. It is not about concussion; we should make that very clear. It is about exposure to repeated blows of your head, repeated blunt force trauma of your head over time with or without concussions. With or without a helmet, you stand the risk of suffering irreversible brain damage."

The difference between a concussive and subconcussive hit is significant. The concussive hit creates some form of symptoms which can be diagnosed while single subconcussive blows provide no 'apparent' damage. None. Without symptoms, the ability to diagnose and treat any damage to the brain is not an option. Yet, this form of trauma happens every day to kids who play contact sports. Every time a kid comes off the line, makes a tackle, or collides with another player with his or her head, that is a subconcussive impact. Heading the ball in soccer is a subconcussive impact. Getting smacked in the head with a hockey or lacrosse stick can be a subconcussive impact. Going to the ground, the pitch, the mat, or the field with their head is a subconcussive impact. Just think how many times this happens to a child, especially in football. Some

studies put the number of hits a football player takes at 1400 to 1500 a season[17],[18]. Just one season.

So how do these subconcussive events affect your kid's brain? Those bumps and hits can significantly alter their brain. Check out this paragraph from *Effects of Subconcussive Head Trauma on the Default Mode Network of the Brain:*

> "Similar to concussions, subconcussive impacts have the potential to transfer a high degree of linear and rotational acceleration forces to the brain and can cause pathophysiological changes in the brain. Yet unlike concussions, this type of repetitive head trauma in contact sports goes undiagnosed or unmanaged, leading to a large number of these insults accumulated over the course of a season, let alone a career. Post-mortem studies have identified that repeated subconcussive impacts may have an accumulative effect, and it is thought they accelerate the cognitive aging process, leading to altered neuronal biology later in life."[19]

Other studies have shown that there is an increase in neuro-inflammation which significantly reduces the brain's ability to heal.[20] One paper states, "It also has been thought that repetitive head trauma, similar to neuro-inflammation, may have cumulative effects leading to neurodegeneration and may be linked to behavioral impairments after concussion."[21]

The connection between neuro-inflammation and mental illness is one that is widely accepted nowadays, even though the ties between *sports related* neuro-inflammation and mental illness are not well researched or even discussed. An article in the Psychiatric Times states that "inflammatory processes induce changes in brain/body functioning that can contribute to the development of a wide range of

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[17] https://www.technologyreview.com/2010/10/01/200177/analyzing-hard-hits-on-the-football-field/

[18]

[19] Effects of Subconcussive Head Trauma on the Default Mode Network of the Brain; 2014, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4238241/

[20] Shultz SR, MacFabe DF, Foley KA, Taylor R, Cain DP. brain injury in the Long-Evans rat induces acute neuroinflammation in the absence of behavioral impairments. Behav Brain Res. 2012 Apr 1;229(1):145-52. doi: 10.1016/j.bbr.2011.12.015. Epub 2011 Dec 19. PMID: 22245525.

[21] Effects of Subconcussive Head Trauma on the Default Mode Network of the Brain; 2014, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4238241/

psychiatric conditions."[22] Another article states that "neuropsychiatric disorders (i.e., mood disorders and schizophrenia) and inflammation are closely intertwined."[23]

How much subconcussive trauma is sustained by child athletes in general? A new study released in 2021 focused on identifying the difference between tackle and flag youth football (ages 7-13) and the resulting subconcussive impacts. The study found that the average youth tackle football player had almost 390 subconcussive hits per activity (game or practice).[24] Think of that: 477 football players experienced almost 186 THOUSAND impacts during a season of 27 games and practices. If you take the lower average of 1,800,000 children 6-12 who are playing football, that is over 700,735,849 subconcussive hits per year!!! To kids!!! And this is just based on a small percentage of players. For a child under the age of fourteen, this is just too much trauma.

How hard are these hits? This is another area of concern for parents. There is no agreement on how much "G force" is required to sustain a concussion or subconcussive hit and a recent study showed that the average acceleration of concussive injuries for children was lower than that of adults.[25] So it took less force to cause a concussion in a child's brain. [26] For a little perspective, 1 G is the force of gravity. If you sneeze, that is a G force of 2.9. In the study mentioned above the average G-force in these "subconcussive" hits was between 25 and 27Gs depending on the position. A force of 25 Gs, is the equivalent of running your car into a wall at 30 MPH. The amount of force a body may receive in a violent car crash is over 100 Gs. Most professionals, including those in the NFL, feel that a concussive blow is between 95 and 100 Gs!

So, if kids are not being concussed with most of those hits, then obviously, they are subconcussive hits. Your child takes hits during practice and play, but playing hits are even more forceful and can happen twice as often as in practice. Even if those hits are "only" 25 Gs, (less than one third of what is considered a concussive hit and the equivalent of crashing your car at 30 MPH), who doesn't think that hitting a wall over and over again at that magnitude of force doesn't impact a child's brain?

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[22] Introduction: The Inflammation Connection, April 30, 2018, Charles Raison, MD; https://www.psychiatrictimes.com/view/introduction-inflammation-connection

[23] Bauer ME, Teixeira AL. Inflammation in psychiatric disorders: what comes first? Ann N Y Acad Sci. 2019 Feb;1437(1):57-67. doi: 10.1111/nyas.13712. Epub 2018 May 11. PMID: 29752710.

[24] Head Impact Exposures Among Youth Tackle and Flag American Football Athletes, https://journals.sagepub.com/doi/10.1177/1941738121992324

[25] Campolettano ET, Gellner RA, Smith EP, Bellamkonda S, Tierney CT, Crisco JJ, Jones DA, Kelley ME, Urban JE, Stitzel JD, Genemaras A, Beckwith JG, Greenwald RM, Maerlender AC, Brolinson PG, Duma SM, Rowson S. Development of a Concussion Risk Function for a Youth Population Using Head Linear and Rotational Acceleration. Ann Biomed Eng. 2020 Jan;48(1):92-103. doi: 10.1007/s10439-019-02382-2. Epub 2019 Oct 28. PMID: 31659605; PMCID: PMC6928097.

[26]

So how many Gs can this add up to? One study estimated that a person who played four years of high school and four years of college football would, on average, endure over 8000 impacts, equating to over 183,834 Gs of force.[27] So, if running a car into a wall at 30 MPH is the equivalent of 25 Gs, that is 6,127 car crashes worth of damage that your child will face. ***And that is if they don't start until they are in high school!***

Those "bumps" and "dings" along the way, with no rest, and especially combined with concussions (most of which go unreported), add up to a very serious brain injury. In fact, due to its hidden, yet equally destructive effect on the brain, subconcussive trauma is just as, if not more, serious than a concussion. Even though there is no visible "disease" or 'condition" that has recognizable symptoms, prolonged subconcussive trauma definitely alters the brain though the continued presence of trauma induced swelling and preventing a damaged brain from healing. Over time, the continuous exposure of the brain to subconcussive trauma leaves it in a semi-permanent state of inflammation and the damage becomes more pronounced as the brain cannot heal and when it does, it heals improperly.

Trauma of any type, concussive or subconcussive, is trauma and will still impact a child. To most parents, exposing a child's brain to any trauma should be unacceptable. When a child's brain is in its developmental state, between the ages of three and thirteen, it is growing and going through critical brain development processes that should not be interrupted. Because of the repeated hits and trauma, the brain continues to be inflamed and swollen. When the brain is in this condition, the ability for the brain to recover and heal is significantly impaired and even stopped. When healing does take place, it may result in improper healing where healthy parts of the brain assume responsibility for damaged parts. When it comes to brain health, subconcussive trauma is a significant threat.

Why is understanding this so important? Because if your child is playing contact sports, they are suffering subconcussive trauma. There is no doubt. While we may be able to prevent some concussions, particularly in contact sports, you cannot prevent sub-concussions. Bluntly put, every child may not suffer a concussion, but every child will experience subconcussive trauma playing contact sports. I don't care what your football or soccer leagues and coaches say, different forms or tackling or heading the ball a certain way will not prevent subconcussions. Yes, people will say that millions of children have played contact sports and are seemingly fine. What about a year or even years later? Who has been watching these kids and monitoring them for their total subconcussive exposure and its impact on their brain and mental health? No one, because their coaches only get a seasonal look at these kids and do not know what other sports they play, or teams they play on, or recreational sports that they enjoy.

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[27] Steven P. Broglio, James T. Eckner, Douglas Martini, Jacob J. Sosnoff, Jeffrey S. Kutcher, and Christopher Randolph. Cumulative Head Impact Burden in High School FootballJournal of Neurotrauma.Oct 2011.2069-2078.http://doi.org/10.1089/neu.2011.1825

Because of the complete gap of research, knowledge, testing, and education regarding subconcussive trauma in children and the inability to track the total exposure of the child to subconcussive trauma the number of child athletes affected by the resulting brain injuries in the form of depression, anxiety, personality disorders, sleep disorders, seizures, and other maladies is not known and in my opinion, after decades of kids playing contact sports, incalculable.

Yet, despite these identified risks and the importance to the parent, there is no guidance from our national health organizations, sports organizations or even our medical community on how many subconcussive hits a child can take, or how long a child can suffer from being exposed to them. There is not even an agreement on how much force constitutes a subconcussive blow or for that matter, a concussive one. Yet repeatedly, organizations, institutions, medical journals, and research papers say they are aware that subconcussive exposure is definitely a “risk,” and more research is necessary. Meanwhile, our children are enduring these hits. Only by understanding the long-term impact of subconcussive trauma on the developing brain can some of the symptoms that could manifest later be considered in diagnosing a brain injury.

If it wasn’t bad enough that the effects of subconcussive trauma cannot be diagnosed, the impact of the trauma may not show up for years. Once the effects are evident, it could be too late for effective treatment. Mac, our son, is an example. Mac’s last diagnosed concussive incident was three years prior to his death.

All of the damage discussed thus far is preventable by avoiding contact sports until age appropriate. However, even then, it is critical we manage concussive and subconcussive exposure as children who started contact sports earlier logically end up with having more concussions.[28]. It is not a license to play contact sports year-round, as that level of exposure can be detrimental to the continued development of the brain. Remember, your child’s brain isn’t fully developed until the age of twenty-five.

Can Subconcussive Impacts affect Your Child’s Brain?

People will say that there is no “hard data” on sub-concussions and their impact on children. To a degree they are correct on a small part of the issue but miss the point on the bigger picture. Most of the research focuses on the impact of mTBI, TBI, and concussions and is limited on children, especially in the long-term implications of subconcussive exposure. But this is not rocket science. The reasons for the lack of data are many, primarily because it’s extremely difficult to assess subconcussive trauma. How do you assess the impact of something that has no immediate symptoms? This is not a concussion, an acute impact with immediate results that can be assessed.

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[28] Jaclyn B. Caccese, Fernando Vanderlinde Santos, Mariana Gongora, Ian Sotnek, Elizabeth Kaye, Felipe Yamaguchi, John Jeka; History of undiagnosed concussion is associated with concussion-like symptoms following subconcussive head impacts Neurology Dec 2018, 91 (23 Supplement 1) S26-S27; DOI: 10.1212/01.wnl.0000550684.23716.bb

However, there is a tie between the cumulative damage sustained by thousands of minor hits to a developing brain, in the aggregate, or combined with one or more concussive events, causing brain damage and inflammation that lead directly to mental illness.

The connection between trauma and brain damage is well researched and documented. For proof, hit our friend Google. There is not one person in the sports world who says that children do not suffer impacts while playing or practicing a contact sport. That's why it's called a contact sport. If this is true, and it is, isn't it logical that those hits, concussive and subconcussive, add up over time? And that by playing multiple seasons of one sport, or back-to-back sports, or adding concussive recreational activities like skateboarding, snowboarding, parkour, or motorbike racing, could exacerbate that damage?

And what does that damage do to a child's brain? While researchers once believed the plasticity of a child's brain meant it could resist trauma better than an adult brain, research proved this was inaccurate. In fact, current literature indicates the opposite is true.[29] Trauma to a child's brain results in the development of disease in the cortex leading to deterioration of the nerves, overactive brain processes, and decreases in intellectual capability.[30] This is especially critical for the prefrontal cortex as it is not yet fully formed yet responsible for the critical executive functions that the child will rely on as an adult. As a matter of fact, during the third stage of brain development, which takes place from age 5 to 11, the prefrontal cortex attains its maximum and the transition from gray to white matter is just starting to develop. This process of transitioning from gray to critical white matter continues well into childhood and should not be impacted by trauma in order to optimize the child's future potential.[31] Pretty serious stuff. I don't think parents and kids signed up for this outcome, do you?

Issues with Diagnosing Concussive and Subconcussive Trauma

Let me give you another reason to delay sports. That is the inability of a doctor to appropriately diagnose the severity of the damage done by a concussion. Currently, the medical profession will admit their ability to diagnose the damage to a brain from a concussion is severely limited at the cellular level, where the damage takes place. Often, after a severe concussion, a doctor may order a Magnetic Resonance Imaging (MRI) or Computerized Tomography (CT) scan to look at the brain. However, for a "regular" concussion which usually means the child didn't lose consciousness, the child

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[29] Vicki Anderson, Megan Spencer-Smith, Amanda Wood, Do children really recover better? Neurobehavioural plasticity after early brain insult, *Brain*, Volume 134, Issue 8, August 2011, Pages 2197–2221, https://doi.org/10.1093/brain/awr103

[30] Daneshvar DH, Riley DO, Nowinski CJ, McKee AC, Stern RA, Cantu RC. Long-term consequences: effects on normal development profile after concussion. *Phys Med Rehabil Clin N Am*. 2011;22(4):683-ix. doi:10.1016/j.pmr.2011.08.009

[31] Cognitive and Brain Development: Executive Function, Piaget, and the Prefrontal Cortex, Hattie J. et al. Archives of Psychology, vol. 1, issue 3, December 2017

will simply be evaluated and released under care. CT scans are great for identifying major problems associated with trauma such as bleeding, swelling or blockages. MRIs are superior to CT scans but are expensive and are not usually ordered for concussions unless there are severe symptoms.

The issue with these technologies is that while they are excellent at finding significant damage from severe concussions, i.e., internal bleeding and structural changes to the brain, they are not able to identify significant changes in the brain at the cellular level when a concussion is involved. Most emergency room doctors and primary care physicians look for major injuries and, in almost all concussion related cases, they will not detect any and just discharge the child. Even newer forms of MRI which can detect some alterations in brain structure and function cannot identify all alterations of the brain from a concussion or mTBI, and they are still only available for use in the research setting.[32]

Complicating this is the fact that the damage from long term concussive and subconcussive exposure takes years to manifest, while MRI and CT scans are used to assess a concussion in a specific point of time. Most children have concussions very infrequently so there is no historical record of the brain to compare a new image with. While neurological damage is hard to identify and diagnose it's even harder if the patient never has a concussion, or only a few where there is not a continuing record of any symptomatic issues. There are some new technologies such as Diffusion Tensor Imaging (DTI) or functional Neurocognitive Imaging (fNCI) technology that are supposedly better, but they are not widely disseminated and have a cost many parents don't have coverage for and can't afford.

What does this mean? It means that the doctor's treatment of your child's concussion is subjective. There are many factors why, but the primary one is the inability of your Doctor, any Doctor really to ***accurately depict*** what has happened inside your child's head. The inability to accurately diagnose trauma, unlike a broken arm, is the reason why it is so critical for parents to be cautious. Most individuals in healthcare are dedicated professionals doing their best to provide care. However, when it comes to accurately diagnosing the damage from a concussion, they are limited in their diagnosis due to their inability to ***see*** the damage, ***touch*** the damage and to accurately determine when that damage has healed.

Subconcussive trauma is more dangerous for the developing brain. Because subconcussive trauma in and of itself ***cannot be diagnosed*** the damage cannot be acknowledged and then treated. This is different for concussive trauma, where a known impact has manifested damage done by displaying symptoms of a concussion and major damage to the brain can be determined.

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[32] American Society of Neuroradiology; https://www.asnr.org/patientinfo/conditions/tbi.shtml#block3

This point is extremely important for parents to understand because the path of subconcussive trauma is the path to mental illness. The damage from subconcussive trauma is slow and cannot be measured let alone diagnosed. Without an ability to identify the damage from the trauma and no reason, like a broken leg or arm, to assess the child's sports history, the child continues to play and expose their brains to more trauma. A study from 2016 showed that brains are affected after just one season of contact sports and states "Early evidence suggests that there may be a link between subconcussive head impacts and functional changes such as memory and cognitive impairments and depression, as well as brain alterations similar to those in neurodegenerative diseases including dementia and Parkinson's diseases".[33] Do we really want this for our kids?

We know that subconcussive trauma is real, it impacts a child's brain, and we understand that we cannot diagnose its presence or its growing impact on a child's development. We know that, over time, the impact of that trauma, if unchecked, will result in brain damage that is linked to mental illness. We also know that we have a pandemic of mental illness in this country, and we have no idea how many of these kid's deteriorating mental health is the result of contact sports. Yet, we still allow millions of children to take subconcussive hits every day. We are letting our children down if we allow this to continue. It's crazy.

Importance of Awareness

Given the fact that every child suffers subconcussive exposure during play and the fact that the medical, psychiatric, athletic and coaching staff, and most parents are uninformed about this danger puts every child's brain at risk. Given the lack of guidance regarding these phenomena, parental awareness is crucial.

Especially since most kids will end up wanting to play or will play a contact sport. Sports is an inherent part of the U.S. culture, and when you look at football, rugby, soccer, wrestling, lacrosse etc. it can be assumed that the U.S. leads the world in children playing contact sports. Sports are fed to us and our kids daily. However, in the last forty years or so, contact sports slowly moved downstream from high school athletes to kids as young as five. That's right, five. This has dramatically increased the exposure of developing brains to long term subconcussive impacts, in some cases over 1000 impacts per season! The fact that this will, over time, injure a child's brain is indisputable and the time to end contact sports for kids is coming. Until then, it is so important to educate yourself with research, medical journals, and news articles to understand just how many children and families out there are suffering from the impact of this trauma.

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[33] Davenport EM, Urban JE, Mokhtari F, Lowther EL, Van Horn JD, Vaughan CG, Gioia GA, Whitlow CT, Stitzel JD, Maldjian JA. Subconcussive impacts and imaging findings over a season of contact sports. Concussion. 2016 Aug 16;1(4):CNC19. doi: 10.2217/cnc-2016-0003. PMID: 30202561; PMCID:

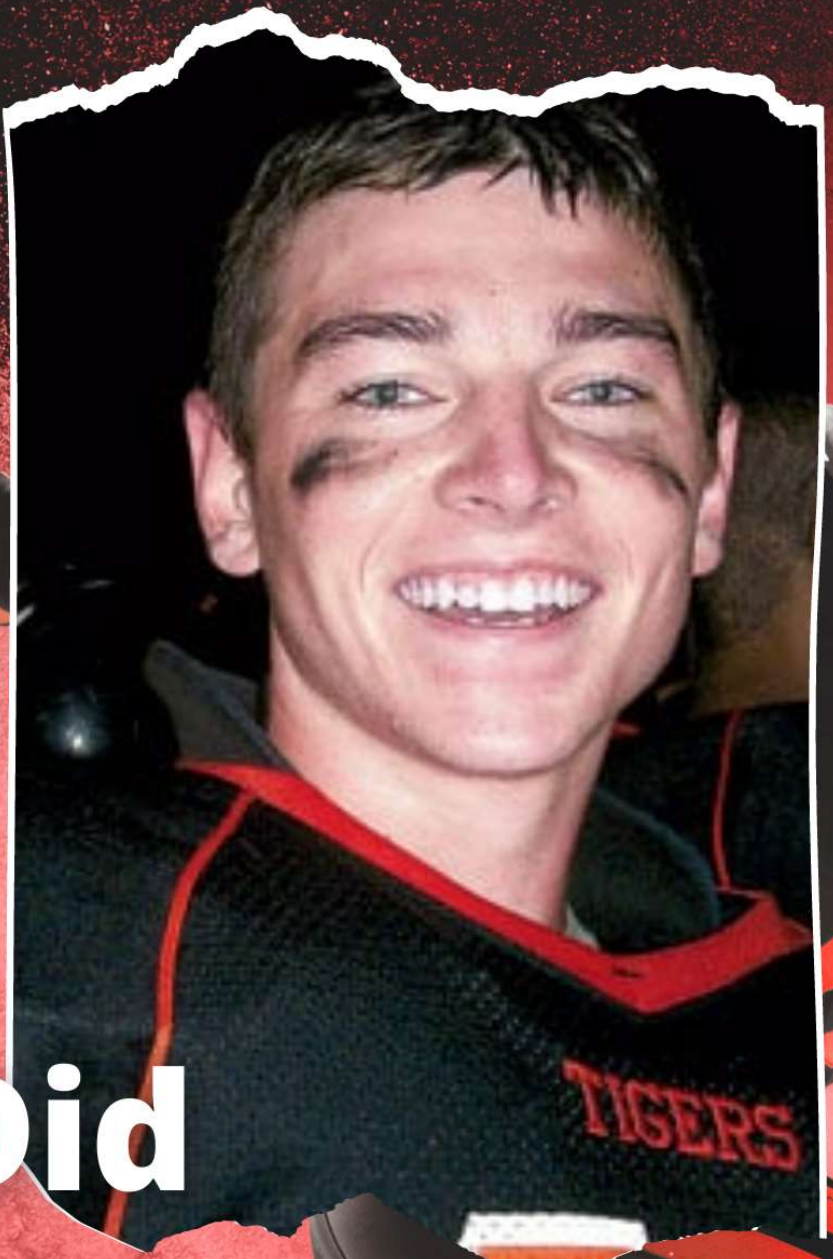
It frustrates me that we have information to help protect our children from trauma; yet there has been no desire or mechanism to distribute it despite the critical nature of the material and the vulnerability of the youth population. I don't know whose responsibility it is to educate us; the national health agencies, the medical community, the sports leagues, (like that will ever happen), or our schools, and honestly, I really don't care. To me, given the research and science that has been conducted and the information that is there regarding these risks to our kids, something in our society has failed and parents, like me, are left to understand this incredibly complex subject on our own.

If continued exposure to concussive and subconcussive trauma is going to degrade our child's brain and their future, why not try to prevent it? What about delaying exposure until a child's brain is more developed? Why not limit exposure to concussive trauma until the age of fourteen? Why not limit the time spent playing contact sports, as well as the amounts and types of concussive sports played? Wouldn't this all make sense if we love our kids?

Most of the trauma referenced in this book is avoidable. We cannot continue to expose our kids to subconcussive trauma and ignore the risks. They are children following their instincts, peer pressure, and parental desires. But they are our treasure, and they MUST be protected. Only your awareness and action on behalf of your child can do that. There is no cavalry coming to protect your child. You are all they have.

Chapter Seven

A Young Brain's Vulnerability to Trauma



Did Football Kill Austin Trenum?

Seventeen-year-old Austin Trenum loved cheesecake, the Beastie Boys, and SpongBob Squarepants. He loved his parents, his little brothers, and his girlfriend, Lauren. And he especially loved football. He was a happy kid ranking in the top six percent of his class academically. One Friday night in 2010, he sustained a concussion on the football field. Dazed and slurring his words on the sidelines, they decided to take him to the hospital where his parents learned had headaches “after every game.”

This was not Austin’s first concussion. There had been warning signs: memory losses, uncharacteristic angry outbursts, breaking down in tears in the locker room, and not turning in assignments at school. On Sunday evening, he went up to his room and hung himself. Austin’s mother heard his father scream when he found him.

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What most people don’t understand (because it’s not advertised), is exactly how vulnerable their child’s brain is to trauma. Parents know and understand that their child’s developing brain needs to be protected from trauma. Which is why they wear helmets, seat belts and other safety items. Yet our society has not yet linked participation in contact sports with trauma, for some reason, that trauma is not understood, or it's ignored. Why has something so logical as protecting your child’s brain (which parents do every day) not made it to the forefront of discussion when we talk about our children and contact sports?

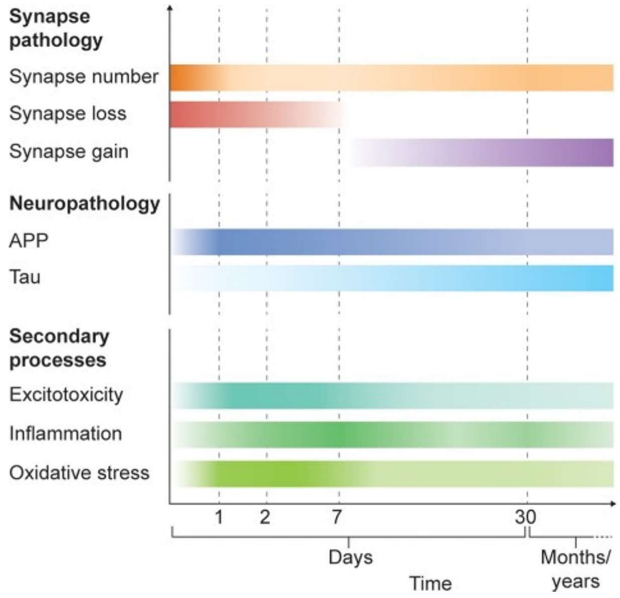
Your child’s brain is an extremely fragile and vulnerable organ despite the protection of the skull. Your child’s brain is the consistency of Jell-O. You cannot easily hold a brain in your hand without significant preservation and chemical hardening to be able to handle it. Yet there is no more complex, nor important organ in our bodies. Your child’s future depends on their brain developing free of trauma.

The protective measures we are proposing are based on solid science and research related to brain trauma that has been developed over many years. Brain trauma is not a new issue. For centuries, humans have been subject to trauma from war, accidents, sports, and other things, like abuse. If you type “brain and trauma” into a search engine, you will get hundreds of research papers discussing various aspects of trauma and its relationship to the brain. While most of these are based on concussive trauma from things like blast injuries, sports concussions, and diseases: the research is still relevant to us as parents. According to Dr. Julie Stamm, the first written knowledge was a surgical papyrus in Egypt around 1600 BC that described a series of brain injury cases and their physical and cognitive consequences!

Trauma is trauma. Regardless of how the trauma is induced, at least from a concussive perspective, all factors being equal (G force, angle of impact etc.) the injuries and resulting complications are the same. If a soldier suffers repeated head injuries or has a major TBI from a blast, the same injuries are present as when a football

player suffers a major concussion in a hit. If that soldier is exposed to repeated blasts or concussive trauma, the effects on the brain are the same as a hit on a football or lacrosse field: primary injuries to the brain, plus secondary injuries of inflammation, and faulty brain repair activities.

Figure 1 Summary of pathological changes following traumatic brain injury. After TBI, synapse density is reduced for ...



Brain, Volume 144, Issue 1, January 2021, Pages 18 –31, https://doi.org/10.1093/brain/awaa321

In the image above, look at the impact that just one TBI can have on the brain. You can see that there is a decrease in synapses followed by an increase due to healing, but you can also see that the brain never reaches its pre-TBI levels. Amyloid Precursor Protein (APP) and Tau are proteins that are both associated with Alzheimer's and CTE. They show an increase after TBI with the tau growth usually expanding over the years with more and more trauma. Then the secondary processes (injuries) like inflammation and oxidative stress increase causing more harm to the brain, in our case, not just any brain, a child's brain.

Who wants to be discussing subjects like synaptic loss, tau proteins, and chronic inflammation when it comes to their child's brain?

A brain's fragility and importance make it highly vulnerable to trauma. Fragility because it is a very delicate organ with an extremely high level of physical complexity which, once damaged, is difficult to repair. Once injured, the brain responds with a host

of protective reactions that in the early stages help the brain to heal. However, when your child is returned to play and receives additional continuous subconcussive trauma, the brain can't heal.

The issue for scientists and researchers is, how a child's brain differs from an adult's brain. Does the difference account for any variables that make the knowledge gained from research inapplicable to children? Most research indicates the trauma to a child's brain is more severe than that of an adult.[34]

The reason a child's brain is far more vulnerable to trauma is because it still has critical growth processes to complete. It is an ***undeveloped*** brain that requires the care and protection that only a parent can bring. Without that care, the brain's development is interfered with, and critical processes are impacted. Those impacts have been shown through research and science to be linked to brain damage, and with prolonged exposure, to mental illness.

When you think about your children and things like driving, having a phone, or being allowed to go on a date, do you allow your kids to do these things before they are ready? No, you don't. They have not demonstrated maturity at the time, and when they do, you will allow them to do those things.

The same rationale must apply to contact sports. And the outcome is far more severe if we do not wait. This is not about teaching your kid to drive, or giving them a phone when they are ready, this is your child's brain. Until it has developed more fully and finished some of these critical processes, you are playing Russian Roulette with their future.

One study sums it up by suggesting, "Once the genetically predetermined sequence of brain maturation has been interrupted, neural recovery may not necessarily translate to functional recovery."[35] Translation: if you impact a brain's development process, it will heal, but not normally. If that doesn't give you pause, I don't know what would.

You may wonder, why the age of fourteen? What does that have to do with trauma? There are significant variables you need to know that will help you understand why the brain is vulnerable to trauma before the age of fourteen.

First, a child's brain has yet to fully myelinate, especially in the prefrontal cortex. So, any damage to that area will not only affect a child's neurons, synapses, and axons, but also the critical phase of myelination that is required for normal advanced brain

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[35] Vicki Anderson, Megan Spencer-Smith, Amanda Wood, Do children really recover better? Neurobehavioural plasticity after early brain insult, *Brain*, Volume 134, Issue 8, August 2011, Pages 2197–2221, https://doi.org/10.1093/brain/awr103

functions. Your child needs that myelination to develop the ability to manage more complex cognitive and behavioral issues so they can become a fully functioning adult.

Second, the child's brain still has to finish the synaptic pruning process which is critical to normal brain development and doesn't start until adolescence. The introduction of trauma to the child's brain effects this process in two ways. It damages and/or kills synapses, leaving less of them to prune, but it also can affect the pruning process which is highly associated with schizophrenia.

Third, a child has a larger head in relation to their body than an adult but lacks the neck musculature to absorb the impacts associated with sports. There have been studies and the results are sobering. One study done at Virginia Tech showed that kids are hitting each other before the age of fourteen with the same impact as college and adult players.[36] We all know the skinny kid that showed up to play football and there are children no longer here because of the impact of just one tackle.

Fourth, and most importantly, this is your CHILD. He is not a man, no matter how much we want to project our vision of manliness and toughness upon them. You can introduce trauma to them by participating in contact sports, but that will not make them mature any faster, nor does it help them in the long run. It is best to let them be a child. I used to say to my son, "Why do you young'uns want to grow up so fast? You will only be a child ONCE!" You can teach them how to be tough when they are an adult.

What this means to us parents is that our child's brain and body needs to grow and develop to a certain point before they can be safely introduced to contact sports. More and more research suggests that age is fourteen. Those with the Mac Parkman Foundation recommend 18 if at all; but recognize 14 is a place to start.

The research is the reason NFL pros like Brett Favre, Nick Buoniconti, Harry Carson, and organizations like Practice Like the Pros have all come out in favor of no contact sports until age fourteen. Even the NFL has a flag football program called NFL Flag, though it needs to do more in recommending it as the alternative to contact sports for kids.

So, what have we said so far? Continuous exposure to concussive and subconcussive trauma will cause changes to your child's brain and affect critical brain development processes which will affect their physical and mental well-being.

I hope I have made my point that your child's brain is vulnerable.

Now, let's get into some of the science that will help you understand why a child's brain needs to be protected from trauma while it is still developing. Some of these concepts we have talked about, but not in the sense of vulnerability to trauma.

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[36]https://vtx.vt.edu/articles/2020/01/ictas-youthfootballrisk.html

Brain Plasticity

Brain plasticity is the brain's ability to adapt and respond to new experiences, including trauma, through regeneration or developing new pathways. This means that the brain can reorganize and create new connections, even new neurons, in response to a child's environment. Brain plasticity comes in two types, functional, which means a brain can move functions from one damaged area to another, and structural, where the brain can change its physical structure because of learning or experience. These are both beneficial as they allow the child's brain to adapt and learn as they grow. They become smarter when exposed to new concepts and ideas and can even recover from some brain injuries. It is now known that while brain plasticity continues throughout a person's life, a child's brain is generally more sensitive and responsive and more vulnerable than an adult brain[37].

From a concussive standpoint, this may seem like the brain can repair itself and in terms of a mild brain injury, it may be able to. However, brain plasticity has limitations. When there is physical damage or continuous exposure to concussive trauma, plus the secondary effects of inflammation, bleeding, and other physiological responses to brain injury, the brain's ability to repair the damage is insufficient. In some cases, the healing process may still induce physical and psychological disorders.

This is of concern to parents because the brain's ability to respond and repair is also highly dependent on its ability to properly develop without being exposed to trauma. Damage to the brain's structure of neurons, axons, and synapses, primarily in the deeper or "white matter" regions of the brain, impacts the structural plasticity of the brain. In other words, it affects the brain's physical ability to reorganize or "rewire" itself.

Affecting the processes of myelination and synaptic pruning will impact the functional plasticity of the brain and its neurological structure which will, in turn, affect behavioral change or recovery. Impacting the functional and structural changes of white matter early in a child's life will significantly damage the ability of the prefrontal cortex to properly develop, leaving the child's brain unable to properly develop both physically and psychologically.

There is also evidence that damage to a child's brain is more harmful than to an adult's brain. The vulnerability of a child's brain may result in less effective healing or effect plasticity, resulting in longer recovery periods and more persistent symptoms.[38]

So, what have we said? That your child's brain plasticity is limited when it comes to repairing a damaged brain and that the continuous exposure to concussive and

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[37] Vicki Anderson, Megan Spencer-Smith, Amanda Wood, Do children really recover better? Neurobehavioural plasticity after early brain insult, *Brain*, Volume 134, Issue 8, August 2011, Pages 2197–2221, https://doi.org/10.1093/brain/awr103

[38] Dennis M, Spiegler BJ, Juranek JJ, Bigler ED, Snead OC, Fletcher JM. Age, plasticity, and homeostasis in childhood brain disorders. *Neurosci Biobehav Rev*. 2013;37(10 Pt 2):2760-2773.

subconcussive trauma will cause changes to their brain's white matter and effect critical brain developmental processes which will affect their physical and mental well-being.

Now, let's address three critical areas of concern and look at the outcomes when children are exposed to concussive trauma:

Myelination: As we discussed, myelination is the critical development stage where the child brain accumulates myelin around the axon which increases its thickness and electrically insulates sections of the nerve cell. Myelin is the layer of fatty tissue, or white matter, which surrounds the axon of the neuron allowing for more rapid transmission of signals along that cell. Impeding this critical brain development process can delay or inhibit the further development of myelin which prohibits the adaptability of the developing brain. In a nutshell, without proper myelination, a child's brain will not develop or function properly.

In children, the myelin sheath can undergo significant changes under concussive stress that are associated with neurological disorders. Trauma can hinder the myelination process so that the myelin sheath is thinner[39]. (A healthy axon can have up to 150 layers of myelin). If the sheath is thinner, the possibility of interference by other signals increases. Myelin can also be stripped off the axon, leaving the axon unprotected and interfering with proper nerve signal transmission. Damage to the sheath can allow nerve signals to pass outside the axon itself. It is also known that when myelin is damaged, the brain's attempt to repair it usually is insufficient, leading to more issues with nerve transmission or creating new neurons.

Physically, one of the most recognized diseases associated with myelin is Multiple Sclerosis, a condition where the body attacks the myelin sheaths causing neurological disorders. Problems with myelin are associated with other less known disorders such as optic neuritis, transverse myelitis, and Guillain-Barré syndrome.

Psychologically, problems with myelination are associated with a wide range of psychiatric disorders, including schizophrenia, chronic depression, bipolar disorder, obsessive-compulsive disorder, and posttraumatic stress disorder. Problems with myelination have also recently been associated with white matter defects, as well as cognitive and emotional disorders including autism, dyslexia, and attention-deficit hyperactivity disorder.

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[39] Stamm JM, Koerte IK, Muehlmann M, Pasternak O, Bourlas AP, Baugh CM, Giwerc MY, Zhu A, Coleman MJ, Bouix S, Fritts NG, Martin BM, Chaisson C, McClean MD, Lin AP, Cantu RC, Tripodis Y, Stern RA, Shenton ME. Age at First Exposure to Football Is Associated with Altered Corpus Callosum White Matter Microstructure in Former Professional Football Players. J Neurotrauma. 2015 Nov 15;32(22):1768-76. doi: 10.1089/neu.2014.3822. Epub 2015 Sep 23. PMID: 26200068; PMCID: PMC4651044.

2) **Synaptic pruning and synapses.** As I mentioned in earlier chapters, synapses allow information to travel throughout the nervous system in a coordinated way so the person can adjust their behavior to environmental stimuli and control body functions, memories, and emotions. Children are born with twice as many synapses as they will need as an adult and during the ages of three to thirteen, a child's brain will begin to cut off, or "prune" those synapses that are no longer needed. In short, the brain rewires itself to be more efficient as the requirements for more complex functions grow.

Introducing trauma to the synaptic development process can greatly impact your child's ability to develop normally and can severely impact both synaptogenesis and synaptic pruning. The continuous exposure to trauma leaves the brain in a permanent state of inflammation. In response to the trauma, the brain releases proteins and chemicals, creates swelling and pressure that negatively impact the brain, and interferes with proper healing eventually causing the brain to lose synapses. Children who suffer from a trauma impacted brain will eventually have fewer synapses than a normal child. When the pruning process begins, a child with fewer synapses will end up with even fewer synapses after the pruning process is completed, leaving them vulnerable to mental illness. We now know that over pruning can be caused by trauma and can devastate a brain by eliminating synapses that are essential for proper functioning. This will inhibit your child's ability to handle more complex brain tasks, or what are known as executive functions.

Research shows that the cause of most of the damage to synapses comes, not from the primary hit that takes place during a concussion, but the secondary effects that occur well after the primary hit. Those effects include:

- Inflammation – the brain's response characterized by swelling, release of fluids, cells, and chemicals to help healing.
- Oxidative stress – an imbalance of unstable molecules called free radicals and antioxidants that harms cells.

Excitotoxicity – a condition where the brain's reaction to trauma releases chemicals that can attack key portions of the brain and cause cell death.

Synapses themselves are also susceptible to trauma and can undergo "cellular death" after significant trauma has occurred. One study showed a significant decrease in synapses for seven days after just one TBI incident.[40] Other studies on blast related mTBIs, like the impact of a major concussion, show that the pressure placed on the brain can stretch or shear the axons and synapses causing synapse losses.[41] While synaptic counts recover almost fully after thirty days, if there is repetitive trauma (as

[40] Aimun A B Jamjoom, Jonathan Rhodes, Peter J D Andrews, Seth G N Grant, The synapse in traumatic brain injury, *Brain*, Volume 144, Issue 1, January 2021, Pages 18–31,

[41] Przekwas A, Somayaji MR, Gupta RK. Synaptic Mechanisms of Blast-Induced Brain Injury. *Front Neurol*. 2016;7:2. Published 2016 Jan 21. doi:10.3389/fneur.2016.00002

occurs in contact sports), that ability to recover is impacted and over time, those damaged synapses will not be replaced.

When a child's brain has been damaged from exposure to trauma, synapses may be damaged or eliminated. That means the child begins the synaptic pruning process with fewer synapses than it should have. Pruning a less than desirable number of synapses will leave the child with even fewer synapses as an adult, contributing to cognitive and mental health issues.[42][43] A decrease in synapses has been highly correlated with mental disorders such as schizophrenia.

The research associating synapses impacted by trauma with mental illness is astounding. There is simply no doubt that traumatically impacting your child's brain processes through early exposure to youth contact sports can damage their brain, leading to cognitive decline and psychological issues later on.

3) **Prefrontal Cortex.** Again, it is well documented that the prefrontal cortex is responsible for most of the executive functioning of the brain (the actions necessary to function as an adult). The prefrontal cortex is composed of both gray and white matter where the gray matter processes the information passed to it from the white matter. Until around the age of 14 (this differs slightly from child to child) the white matter is underdeveloped and under-myelinated. To complicate matters, the processes of myelination, synaptogenesis and synaptic pruning are ongoing at the same time. Remember, it is also one of the last portions of the brain to mature, meaning any damage to this area of the brain prior to maturation will cause significant decreases in a child's brain's ability to develop and mature, leading to cognitive and psychological issues. If we are concerned with the future of our children, this is ***the*** one area of a child's brain that we need to protect. Without a functioning, developed prefrontal cortex, our children will not reach their full potential.

The relationship between mild trauma or mTBI and mental illness is made clear in this paragraph from a research paper on the long-term consequences of trauma on normal brain development:

> "One cohort study of 490 children who experienced an mTBI before age fourteen and who had no prior history of psychiatric illness found that these children were significantly more likely to have psychiatric issues in the three years following injury than were uninjured controls. The children

[42] Lepeta K, Lourenco MV, Schweitzer BC, et al. Synaptopathies: synaptic dysfunction in neurological disorders - A review from students to students. *J Neurochem*. 2016;138(6):785-805. doi:10.1111/jnc.13713

[43] Park K, Biederer T. Neuronal adhesion and synapse organization in recovery after brain injury. *Future Neurol*. 2013;8(5):555-567. doi:10.2217/fnl.13.35

most commonly presented with attentional problems in the first year following injury."[44]

Studies have also shown that an underdeveloped or abnormal prefrontal cortex leads to impulsivity and an inability to control decisions.[4546]

A child's brain is a vulnerable organ that we need to protect due to its essential function and contribution to a child's success in life. We have shown that, until the brain is developed, there are significant development processes that the brain is required to undergo to properly function as an adult. Impacting those processes has serious consequences regarding cognitive and psychological outcomes.

If we can agree that your child's brain is of significant concern and deserves to be protected, then isn't it also logical that we should be waiting until our child's brain is mature enough to handle the impact of contact sports before we allow them to participate?

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[44] Daneshvar DH, Riley DO, Nowinski CJ, McKee AC, Stern RA, Cantu RC. Long-term consequences: effects on normal development profile after concussion. Phys Med Rehabil Clin N Am. 2011 Nov;22(4):683-700, ix. doi: 10.1016/j.pmr.2011.08.009. Epub 2011 Sep 23. PMID: 22050943; PMCID: PMC3208826.

[45] Blair RJ. The Neurobiology of Impulsive Aggression. J Child Adolescent Psychopharmacology. 2016 Feb;26(1):4-9. doi: 10.1089/cap.2015.0088. Epub 2015 Oct 14. PMID: 26465707; PMCID: PMC4779272.

[46] Rodger LI. Wood and Andrew Worthington, Neurobehavioral Abnormalities Associated with Executive Dysfunction after Traumatic Brain Injury, Front. Behav. Neurosci., 26 October 2017 https://doi.org/10.3389/fnbeh.2017.00195

Chapter Eight

Contact Sports, Brain Damage, and Mental Illness

During a lacrosse game in March 2019, Jared suffered a concussion that led to headaches and sensitivity to light. The following month, on April 23, Jared Crippen took his own life.

Jared Crippen was a popular sixteen-year-old, a star wrestler, and a high school lacrosse player. He seemed to have it all, until he suffered a concussion during a lacrosse game in March of 2020. That led to headaches and sensitivity to light. After two weeks, he returned to the lacrosse field, but his behavior had changed. He started talking back to his mother. He skipped classes. He seemed depressed. His mother later heard that he left a party because he had started crying for no apparent reason.

A month later, on April 23, 2020, Jared took his own life.

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When it comes to mental illness, many people think that they are mostly genetic in nature or are caused from past trauma such as child molestation or abuse. When you mention brain damage and mental illnesses, then the focus shifts towards traumatic events like a car crash or another violent accident. What many don't yet know is that the brain damage suffered from continuous concussive or subconcussive exposure has the same negative impacts on the brain and thus creates the same mental health issues.

While it's important for parents to understand the links between trauma and brain damage, it is equally important for them to understand the relationship between brain damage and mental illnesses so that they understand exactly what is happening to their child's brain when exposed to concussive trauma.

This is critical since most of the research done on sports related trauma has been focused on CTE not traumatic brain damage and mental illness. Since Dr. Bennet Omalu's landmark paper announcing the existence of CTE in 2005, followed by Dr. Ann McKee's paper in 2009, attention to CTE has grown, but the focus continues to be on the physical symptoms of the disease, and the search for tests that can diagnose the disease while an athlete is still alive.

This research, while important, doesn't help the parent understand the importance of keeping their child away from contact sports while their brain is developing. But the discussion about CTE does give us one critical insight into the disease and that is that mental illness was present in 100% of athletes who ended up taking their lives and were later diagnosed as having CTE. Some of them suffered for many years.

Question: what did Junior Seau, Vincent Jackson, Mike Webster, Phillip Adams, Dave Duerson, Aaron Hernandez, and many more professional, collegiate, and adolescent athletes have in common?

Answer: Mental Illness

While the conversations and research around CTE have slowly illuminated the tragic circumstances of the disease and the accompanying symptoms of mental illness, it is important for the parent to understand that concussive and subconcussive trauma

alone can cause mental illness. You do not have to wait or rely on a diagnosis of CTE to understand that our child's brain is being damaged. In fact, according to Dr. Ann McKee, there has been only one case of CTE diagnosed in a teenager. That was a 17-year-old athlete and the area that was impacted was the size of a quarter. Mental illness is the only symptom that we can assess to determine if our child is impacted by concussive and subconcussive trauma.

By understanding that mental illness is a logical and proven outcome of prolonged exposure to concussive trauma, then we can focus on identifying it early and hopefully prevent an athlete's brain from further damage and defend their quality of life. This understanding also creates a critical and urgent need to address this emergency through education, awareness, legislation, regulations, anything necessary to protect our children's developing brains from exposure to concussive trauma. To us, this is a national emergency that needs immediate attention.

What the Research Tells Us.

Remember, explosions, falls, car accidents ***and*** concussions are all considered forms of traumatic brain injuries or TBIs. This is important to us because most of the research done has been focused on TBIs not sports related trauma. However, since we know that both TBIs and sports related trauma produce the same negative effects on the brain, it's logical to apply the research done on TBIs to athletes of all ages who have suffered brain damage from contact sports.

To prove that there is research demonstrating these links, simply google brain trauma, TBI or brain damage and mental illness and you will get many studies, papers and articles on the subject. Unfortunately for me, this google search is not one that I had a reason to make until I lost my son.

While most of the research is focused on TBIs, like car crashes or falls, others focus on sports related trauma and regardless of the study they tell a sobering tale about the relationships between brain damage and mental illness. A book on sports related TBIs mentions that "while relatively few studies have examined the long-term effects of recurrent, sport-related concussion, several concerning trends have emerged, including increased risk of depression, cognitive impairment, earlier onset Alzheimer's disease, dementia, and neurodegenerative cause of death".[47] One study in Finland found a rate as high as 48% of people who suffered from TBIs had a psychiatric

[47] Clark M, Guskiewicz K. Sport-Related Traumatic Brain Injury. In: Laskowitz D, Grant G, editors. Translational Research in Traumatic Brain Injury. Boca Raton (FL): CRC Press/Taylor and Francis Group; 2016. Chapter 2. Available from: https://www.ncbi.nlm.nih.gov/books/NBK326721/

disorder.[48] Another found that 1 in 5 people who had a TBI or Post Traumatic Stress Disorder or PTSD suffered from major depression and states that "Traumatic brain injury (including mTBI) appears to be a forerunner to a host of neuropsychiatric disorders ranging from Major Depressive Disorder (or MDD) to bipolar disorder to neurodegenerative disorders such as dementia and Parkinson disease.[49] Finally, a study from Sweden states, "Given our findings, which indicate potentially causal effects between TBI exposure in childhood and later impairments across a range of health and social outcomes, age-sensitive clinical guidelines should be considered and preventive strategies should be targeted at children and adolescents."[50]

It's important to note that much of the research concerns subjects who received just ***one TBI!*** It doesn't represent the actual sports reality where children's brains are exposed to prolonged, continuous concussive and subconcussive trauma. But if one TBI can result in such significant psychological outcomes, then wouldn't it be logical that continuous exposure of a developing brain to multiple Mild TBIs can result in significant brain damage leading to the same or worse outcome of mental illness?

Every year, more and more research is publicized outlining the links between concussive sports and mental illness. This year, the Concussion Legacy Foundation, Boston University, and neuroscientists from the University of California have announced research into the changes that occur in the brain's white matter and have published white papers showing the correlation between new mental illness and concussed athletes.[51] Sooner or later, the American public will be a lot more aware of the epidemic of broken brains that has occurred over the last forty to fifty years.

This goes to the core of why this issue has not been recognized and dealt with years ago. The damage from repetitive concussive and concussive trauma takes ***years*** to manifest and, other than a concussive event, is not identifiable. Thus, coaches, athletic trainers and parents have no reason to think that their children, or the athletes that play for them are suffering. But they are, and the effects, initially in the form of mental illness, do not show up for years. Once those initial issues manifest themselves, a downward spiral is almost unavoidable as much of the damage cannot be repaired.

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[48] Schwarzbold M, Diaz A, Martins ET, et al. Psychiatric disorders and traumatic brain injury. *Neuropsychiatr Dis Treat*. 2008;4(4):797-816. doi:10.2147/ndt.s2653

[49] Stein MB, Jain S, Giacino JT, et al. Risk of Posttraumatic Stress Disorder and Major Depression in Civilian Patients After Mild Traumatic Brain Injury: A TRACK-TBI Study. *JAMA Psychiatry.* 2019;76(3):249–258. doi:10.1001/jamapsychiatry.2018.4288

[50] Sariaslan A, Sharp DJ, D'Onofrio BM, Larsson H, Fazel S (2016) Long-Term Outcomes Associated with Traumatic Brain Injury in Childhood and Adolescence: A Nationwide Swedish Cohort Study of a Wide Range of Medical and Social Outcomes. PLoS Med 13(8): e1002103. doi:10.1371/journal.pmed.1002103

[51] Shahrestani, S., Ballatori, A.M., Ton, A., Chen, X.T., Zargarian, A., Chan, A.K., Strickland, B.A., Brunswick, A., Micko, A. and Zada, G., 2021. Demographic-Dependent Risk of Developing Severe Novel Psychiatric Disorders after Concussio. *Journal of neurotrauma*.

The link between trauma and mental illness has been validated and proven. But the relationship is still unrecognized in the sports world, partly because of ignorance, partly because of hidden agendas, and partly because of a lack of awareness, education, and training. Until the facts are accepted and disseminated throughout the parental and sports communities, the momentum necessary to achieve large-scale change will not be there. But in the meantime, I have made it my mission to educate one parent at a time about this subject because every child saved from a life hampered by mental illness will be worth it.

Demonstrating the link between brain trauma and mental illness is critical for the public and medical communities to accept this reality. By proving causality between brain trauma and mental illness, the entire ecosystem that we use to treat mental illness could be different, and rightfully so. It is our hope that, in the future when a patient exhibits mental illness after brain trauma, that mental illness should be treated as a condition related to TBI, instead of being seen as a random psychiatric disorder. This awareness has the capacity to change treatment protocols, speed up identification, and improve overall prevention.

The bottom line? Brain damage as a result of trauma is definitively linked to psychological disorders. That includes Major Depressive Syndrome and schizophrenia (which many CTE victims suffer from), as well as suicide. This is not a guess. This is science and research conducted over decades. In fact, the first report linking dysfunctional synaptic pruning and schizophrenia happened back in the early 1980s! Of course, this linkage is of considerable concern to parents, and is documented in the resource section of this book and on our website: www.mpfact.com.

It's not my intent to write a medical paper, but to get the point across regarding the linkage between trauma and mental illness, I want to add a few extra points about the three areas of concern I have already mentioned: myelination, synaptic pruning, and protecting the prefrontal cortex.

Why? As we have traveled together through these chapters, we are aware that these three areas alone are the best studied and have demonstrated the direct relation between concussive trauma, brain damage and mental illness. Additionally, we now know from research that these areas are negatively affected by trauma and that the outcome is significant cognitive and mental disorders.

Myelination: We have established that myelin (the white fatty sheath that coats the neurons) is essential for the clear and fast transmission of nerve impulses. In fact, young children process information more slowly because they lack myelin when very young. Loss, disorganization, or damage to myelin slows down or blocks the transmission of nerve impulses.

When the myelin is damaged by trauma as in a concussion, the brain may respond by increasing myelin, or conduct a process called remyelination, however, this may not be a good thing as animal studies have shown that remyelination following mild TBI may result in disorganized and therefore less functional myelin.[52] Studies show that abnormalities in myelin are associated with psychological disorders like Major Depressive Disorder, anxiety, and autism and it can even contribute to major diseases such as Multiple Sclerosis..[53] Another study shows that damage to myelination has been reported in association with toxicities, inflammation, and cranial irritation, which all effect proper brain function. The study goes on to state that when a child has a frontal lesion, myelination is not only interrupted, but may also be prevented from further formation.[54] The absence of myelin is associated with a number of neurodegenerative diseases and cognitive impairment.[55] As a consequence, the failure of myelin to develop properly, may impact the child's brain function and development.

There are numerous other studies showing the impact of improper formation of myelin, or damaged myelin, on brain function and development. It should now be obvious to all of us that impacting this developmental process will significantly alter your child's future.

In reviewing the research, the links between damaged myelin and mental illness becomes very clear. Many of the neurological disorders you may know of, like Multiple Sclerosis, are the result of impacted myelination. More recently, changes in myelin have been linked to a number of psychiatric conditions, such as schizophrenia, major depression, autism, post-traumatic stress disorder, Alzheimer's disease, dyslexia, attention-deficit hyperactivity disorder, obsessive-compulsive disorder, and Tourette's. White matter has even been implicated in stuttering and tone deafness[56].

This research demonstrates that we need to take extreme care of our children's brains and help, not hinder, their ability to properly undergo the process of myelination without exposing them to concussive trauma. Many of the disorders associated with sports related trauma and CTE are the same ones that are associated with impacted myelination, validating the link between concussive trauma and the myelination process.

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[52] Acute and chronic changes in myelin following mild traumatic brain injury, https://www.sciencedaily.com/releases/2018/05/180501085536.htm

[53] Sacchet, M.D., Gotlib, I.H. Myelination of the brain in Major Depressive Disorder: An *in vivo* quantitative magnetic resonance imaging study. *Sci Rep* **7,** 2200 (2017). https://doi.org/10.1038/s41598-017-02062-y

[54] Chapman SB, McKinnon L. Discussion of developmental plasticity: factors affecting cognitive outcome after pediatric traumatic brain injury. J Commun Disord. 2000 Jul-Aug;33(4):333-44. doi: 10.1016/s0021-9924(00)00029-0. PMID: 11001160.

[55] Cognitive and Brain Development: Executive Function, Piaget, and the Prefrontal Cortex; Hattie J. et al. *Archives of Psychology,* vol. 1, issue 3, December 2017

[56] https://www.medicalnewstoday.com/articles/318966#White-matter-in-psychiatric-disease

With absolutely no training available to the medical, psychiatric, or athletic training professionals around the impact of concussive sports on myelination, athletes who demonstrate symptoms of mental illness will not get the help they need.

Synaptic Pruning: Remember when I explained how, if a child's brain structure is damaged and there are fewer synapses, then once synaptic pruning begins it ends up consuming more synapses than it should consume, leaving the child with less cognitive ability or even mental illness? This process is significantly affected by physical trauma in two ways. First, the number of synapses available for pruning is decreased by the damage from both the primary and secondary injuries of a concussion. Second, excessive synaptic pruning can take place from mechanisms that are activated because of trauma and inflammation.

When this process is altered or impacted, there are direct consequences of mental illness. As far back as 1982, it was proposed that excessive synaptic pruning can lead to mental illness, especially schizophrenia, and particularly during adolescence, which is when this disease is primarily diagnosed[57]. Research shows that excessive synaptic pruning is done by microglia, which are cells of the brain that regulate brain development, maintain its neural networks, and repair injury. When over activated by stress, trauma, or neuroinflammation (all products of concussive and subconcussive trauma), the brain releases proteins that direct the microglia to attack the synapses instead of maintaining them, resulting in a lower number of synapses that can severely impact the brain.[58]

There are two extremes of mental disorders that can occur when synaptic pruning gets disturbed. The first one is autism, where an abnormal synaptic pruning process leaves children with too many synapses. The second one is schizophrenia where children have too few synapses due to an overstimulated pruning process. The second is strongly associated with trauma and has been recognized as a common issue with athletes that have suffered from CTE. Other studies show that the secondary effects of trauma can lower the number of overall synapses and reduce the quality of recovery further endangering the child's future.

Synaptic pruning is one of the most critical developmental processes that a child's brain undertakes and impacting that process in any way will affect your child's future. In fact, there are over 130 brain disorders associated with mutations arising from

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[57] Feinberg I. Schizophrenia: caused by a fault in programmed synaptic elimination during adolescence? J Psychiatr Res. 1982-1983;17(4):319-34. doi: 10.1016/0022-3956(82)90038-3. PMID: 7187776.

[58] Germann M, Brederoo SG, Sommer IEC. Abnormal synaptic pruning during adolescence underlying the development of psychotic disorders. *Curr Opin Psychiatry*. 2021;34(3):222-227.

disrupting synapse proteins.[59] One study showed that synaptic pruning, after just one season of sports, was significantly affected.[60] Why would we allow a disruption of this critical process?

Prefrontal Cortex : You already know how critical the prefrontal cortex is and how it is also one of the most susceptible regions to injury. On the flipside, the high adaptability of the adolescent prefrontal cortex might make it particularly vulnerable to abnormal healing. Damage leading to dysfunction of this region is associated with many of the cognitive and behavioral issues associated with psychiatric disorders. So, it is no surprise that one study states that "appropriate prefrontal development is crucial for high-order cognitive abilities."[61] Interfering with the development of the prefrontal cortex has been linked to several psychiatric diseases.

Both myelination and synaptic pruning are critical to understand when discussing the prefrontal cortex because it is comprised mostly of white matter, which is of course myelinated and connected to numerous synapses. In fact, the prefrontal cortex has so much white matter it has the highest degree of connectivity of any brain lobe. Given the importance of the prefrontal cortex and the vulnerability of its location directly behind the forehead, I think we can all agree that it would be unwise to interfere with its proper development.

There are numerous studies showing that an impaired prefrontal cortex is associated with mental health disorders. Earlier, we talked about how impacting the processes of myelination and synaptic pruning can lead to improper healing or "miswiring" of the brain. It is now commonly recognized that both cognitive impairment and psychiatric disorders can result from that miswiring, including anxiety disorder, depression, schizophrenia, bipolar disorder, and Alzheimer's disease.[62] One study starts with "Dysfunction of the prefrontal cortex (PFC) is a central feature of many psychiatric disorders, such as attention deficit hyperactivity disorder (ADHD), post-traumatic stress disorder (PTSD), schizophrenia and bipolar disorder.[63]

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[59] Aimun A B Jamjoom, Jonathan Rhodes, Peter J D Andrews, Seth G N Grant, The synapse in traumatic brain injury, *Brain*, Volume 144, Issue 1, January 2021, Pages 18–31,

[60] Playing Youth Football Could Affect Brain; Development; Gowtham Krishnan Murugesan, M.S, https://press.rsna.org/timssnet/media/pressreleases/14_pr_target.cfm?ID=2051

[61] Prefrontal Cortex Development in Health and Disease: Lessons from Rodents and Humans; Mattia Chini; Ileana L. Hanganu-Opatz November 24, 2020, DOI:https://doi.org/10.1016/j.tins.2020.10.017

[62] Gao, Wen-Jun & Wang, Huai-Xing & Snyder, Melissa & Li, Yan-Chun. (2012). The Unique Properties of the Prefrontal Cortex and Mental Illness. 10.5772/35868.

[63] Gamo, N. J., & Arnsten, A. F. T. (2011). Molecular modulation of prefrontal cortex: Rational development of treatments for psychiatric disorders. *Behavioral Neuroscience, 125*(3), 282–296. https://doi.org/10.1037/a0023165

Remember those microglial cells and how, when they are activated, they can damage the brain? Microglial damage to stress-sensitive regions like the prefrontal cortex and hippocampus may lead directly to negative cognitive symptoms, and account for several of the structural brain changes associated with schizophrenia.[64]

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[64] Howes, O., McCutcheon, R. Inflammation and the neural diathesis-stress hypothesis of schizophrenia: a reconceptualization. *Transl Psychiatry* **7,** e1024 (2017). https://doi.org/10.1038/tp.2016.278

Articles

https://www.sun-sentinel.com/health/fl-xpm-2012-05-26-fl-concussions-youth-suicide-brett-0527-20120526-story.html

Did One Hit Lead to a 13-Year-Old's Suicide? (bleacherreport.com)

Star NJ athlete gets concussion — 5 weeks later, commits suicide (nj1015.com)
https://amp.desmoinesregister.com/amp/97288230

https://www.braininjuryaustralia.org.au/stories/mum-i-am-not-the-same-person-concussion/

https://www.wbur.org/onlyagame/2018/02/02/zac-easter-cte-concussion-football

https://www.washingtonian.com/2012/07/23/did-football-kill-austin-trenum/

https://www.washingtonpost.com/sports/2021/01/06/georgia-tech-recruit-bryce-gowdy-suicide/

https://www.latimes.com/sports/story/2020-12-08/stanford-volleyball-hayley-hodson-concussions-cte-lawsuit

https://www.nytimes.com/2016/06/27/sports/kosta-karageorge-cte-concussions-suicide.html

https://www.invw.org/2018/12/18/unanswered-questions-grieving-parents-wonder-about-the-impact-of-their-sons-concussion/

https://www.nytimes.com/2021/04/08/sports/olympics/bobsled-cte-concussions-sledhead.html

https://concussionfoundation.org/personal-stories/legacy-stories/patrick-anderson

It should now be apparent to most people that there is a significant correlation between the impacts of concussive trauma and the resulting cascade of reactions that can result in mental illness.

In addition to everything I have mentioned so far, there is so much more research out there to support the links between a damaged brain and mental illness. It is our role as parents to understand these relationships, the negative impact they can have on a developing brain, and the potential for mental illness in our children. I hate to keep harping on this, but you are their first line of defense, you are all they have.

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https://concussionfoundation.org/personal-stories/legacy-stories/evan-hansen

Resources:

Concussion Legacy Foundation's HelpLine
Flag Football Under 14
and Team Up Speak Up programs.

Part Three:
What You Can Do

Chapter Nine

What Can Parents Do?

It is clear that the long-term exposure of a developing brain to concussive and subconcussive trauma will injure a child's brain and negatively impact their future. The facts can no longer be disputed. It is vitally important to read not only this book, but other research, medical journals, and news articles, to understand the scope of this problem. There are too many children and families out there suffering from the impact of this trauma on developing brains.

Fortunately, the risks of a child damaging their brain and dealing with mental illness can be low if the child waits until the age of fourteen (we recommend 18) to play contact sports and the parents mitigate the number of concussive exposures by limiting the number of sports played, giving the brain a chance to rest. No longer can we continuously expose our kids to subconcussive trauma and ignore the risks. They are children, following their instincts, peer pressure, parental desires, and perceived social norms.

Our children are our treasure, and they ***must*** be protected. Only awareness and action on behalf of parents can do that. Currently, there is no government agency or human rights group coming to save your kid. It's up to us. In the words of Margaret Mead, "Never doubt that a small group of thoughtful, committed, citizens can change the world. Indeed, it is the only thing that ever has."

Following is a play-by-play list of what you as a parent can do to protect your child:

#1 - Just Wait

First and foremost, ***wait until your child turns fourteen*** to participate in full contact sports. Prevention is the best medicine because some trauma may be irreversible. Again, we recommend eighteen as your child's brain is still developing, but waiting until fourteen and minimizing other forms of concussive exposure the risks for you are lower.

#2 - Know Concussion Warning Signs and Symptoms

Generally, a doctor will assess the child and ask them questions related to the incident, how they feel and if they lost consciousness and if so, for how long. There used to be a grading system for concussions based on loss of consciousness and symptoms, but it is barely used any more. There is a general consensus that most concussions are graded as a mild TBI but that a prolonged loss of consciousness and amnesia, accompanied by vomiting, bleeding and symptoms lasting more than 24 hours may move that concussion to a moderate or severe level based on tests and evaluations.

Symptoms: There are numerous symptoms of concussions. They can be physical, emotional, or mental symptoms. Here's what you need to look for:

- Confusion or feeling dazed
- Clumsiness
- Slurred speech
- Nausea or vomiting
- Headache
- Balance problems or dizziness
- Blurred vision
- Sensitivity to light
- Sensitivity to noise
- Sluggishness
- Ringing in ears
- Irritability or other behavior or personality changes
- Difficulty concentrating
- Loss of memory
- Fatigue or sleepiness
- Loss of consciousness
- Forgetfulness, such as repeating yourself
- Slowed response to questions
- Problems with sleep
- Depression
- Problems with taste or smell
- Emotional changes or apathy

Most people associate concussions with violent hits that leave athletes shaken or obviously affected. However, many symptoms such as dizziness, headaches, and nausea are indicators of milder concussions. These often get ignored by the athletes or go unreported because, in most cases, they, their parents, and coaches may not recognize that the child had a concussion. Furthermore, most children under fourteen can't verbalize about most of the symptoms they may be having.

For moderate or severe concussions, a doctor should require a further evaluation by a CT scan or MRI to determine if there was any substantial damage or bleeding. If your child has had a moderate or severe concussion, you should insist on this procedure, at a minimum.

Treatment: With obvious concussions, most children are sent to a medical practitioner to be evaluated. Mild concussions are unfortunately not considered as serious because no loss of consciousness has occurred. Most children will undergo an evaluation and be released with a list of instructions to follow. Usually those instructions include resting, no participation in sports, minimal exposure to light, and no video games. It is critical that parents strictly enforce these instructions and pay close attention to their child.

Usually, a doctor will recommend the following activities to be restricted or actions to be taken:

- Avoid returning to work or school too quickly. Refrain from doing most of your normal activities until your symptoms subside.
- Avoid activities (such as contact sports) that put you at higher risk for another head injury.
- Do not ignore symptoms or lie about them to an athletic trainer or doctor.
- Do not spend much time in front of a computer screen or television. Playing video games or even watching television that features bright lights, noise, and rapidly changing images may cause headaches and other symptoms.
- Avoid airplane travel, if possible. Some people have complained of worsened concussion symptoms after a plane flight.

However, new research shows that instead of resting completely, moderate exercise for about 20 to 30 minutes, starting after a rest period of 24-48 hours, can be beneficial for recovery if:

- It is maintained at a heart rate level that does not make symptoms worse.
- It is not an activity that increases the risk of concussion (stationary bike is the best option, but walking can be ok, too).
- It is done under the guidance of a trained medical professional. This does not mean the exercise needs to be performed in a clinic, but athletes should be in contact with a medical provider regularly to update their exercise prescription.

Academics should be treated similarly. A small amount of work to start with maybe helpful if symptoms aren't made worse. It isn't a "no," it is more about what can be reasonably handled to help the healing process and not hurt it.

This new research makes a lot of sense as some exercise and thinking will be good for the brain. If you recall, after a concussion the body responds in a manner that causes inflammation in the brain that causes a decrease in oxygen and blood flow, both

which are necessary to heal. Through very moderate exercise and thinking, blood flow will increase to the brain which will offset the negative impacts of inflammation.

For moderate and severe concussions, the instructions given to you by a doctor will be more pronounced, restrictions will be tighter, and the return to play protocols will be more extended.

My recommendations for parents are to extend any resting periods until you are certain that your child is symptom free. There is nothing wrong with more rest for a child's brain. Given the fact that we still cannot exactly determine the type and amount of damage a child may have suffered, it is much better to err on the side of caution especially before returning to contact sports.

#3 – Do a Concussion Follow Up

Here is where most parents, including myself, do not do their child justice after they have had a concussion. We are trained to respect the professionals – the doctors, nurses, trainers, and coaches – who know sports and concussions much better than we do. Personally, a lot of us have had concussions. As a former Special Forces Sergeant Major and semi-professional rugby player, I have had my share.

But we are talking about kid's brains . . . and we need to be more proactive.

#4 – Do a Post Concussive Symptom Follow Up

Following up with a child post-concussion is the best thing a parent can do. Be familiar with the symptoms of a concussion and diligently monitor your child for ***any*** of those symptoms during, and most importantly, after the concussion recovery period. Be a pain. Challenge them. Ask them about their symptoms repeatedly until even you get sick of hearing "Stop, Mom/Dad!" If there are any lingering symptoms of a concussion, get your child right back to the doctor.

During this time, also look for symptoms that you, or your child, may be incorrectly attributing to another cause. Although it may be weeks after a concussion, if your child has a headache, dizziness, sensitivity to light or noise, it may not be just a headache, but a continued manifestation of concussive issues. If your child is having difficulty with sleep or seems overly emotional, apathetic, or just doesn't quite seem like themselves, it may be due to lingering concussion symptoms

Regardless of what a doctor says, thirty days after a concussion, take your child back to the doctor for a follow-up assessment. Please talk to your child about being very honest with the doctor. This is a brain injury, and they need to be upfront about their symptoms. Even if they want to "sandbag" it and rest more and not play sports, which is a much better alternative than a child lying to the doctor and heading back out to the field to suffer further trauma. Also be aware of any talk about death or the afterlife as this may signify impulsivity and possible suicidality.

#5 - Baseline Testing

Another area to consider is baseline testing, especially if your school doesn't offer it. Baseline testing is a computer or paper-based test that is given to the athlete at the beginning of the season to determine a "baseline" that can be used to assess the athlete's cognitive condition after a concussive event. These are important to determine when they can return to play. While simple, and despite claims of being susceptible to manipulation, these tests can be an effective barometer of where a student athlete might be lying about their symptoms.

The use of baseline testing can be even more effective if used as a surveillance tool for your child's brain health. We recommend the use of baseline testing before and at the end of each sports season to determine if there is any significant decrease in cognitive capability. If you only use this tool after a concussion, you miss the chance to identify declines in cognitive performance due to subconcussive trauma, which may have no outwardly visible symptoms.

These tests are very inexpensive. My conversations with one of the largest suppliers of these tests, ImPACT, revealed that these tests can be conducted for under $5 per child, which is easily within the range of most parents.

However a point of caution should be noted, some research has demonstrated that over time, a child can "memorize' the test and can ensure that they can actually compensate for a concussion by getting a high score. Other research shows that some children will purposely score low on the baseline test, so they have a better chance of getting a high score upon being concussed and getting back on the field earlier. While baseline testing is important and definitely better than having none at all, a baseline cognitive test should not be used as the sole determination for a child returning to play. You know your child better than anyone, and if you don't feel they are ready to return to sport, no test, no doctor, and no coach should determine otherwise.

#6 - Return to Play and Concussion Management

For the athletes, parents, and coaches, return to play is a subject that must be managed as a team effort to ensure that no bias or pressure is placed on the athlete to return too early. It is critical that the athlete be monitored for any symptoms of trauma during this process, which could be weeks or months depending on the concussion grade and any continued symptoms.

There is a six stage process recommended by the CDC that should be followed by the coaches, trainers, parents, and athletes to ensure a full recovery prior to being reintroduced to full contact sports. Monitoring is key, primarily for the parent who has much more interaction with the athlete. Continuous badgering is encouraged! Athletes cannot progress to the next step if any concussion related symptom returns, or a new one emerges. If that happens, stop all athletic activities and get your child back to the

medical provider. Once the symptom is gone, the athlete can return to the previous step.

During this time, it is also critical for the parents to monitor their child for any pressures from the coaches or the team to come back too early. Peer pressure is huge in school, as we all know, and student athletes take great pride in their contributions to the team. Coaches should be agnostic to when the student returns and any coach that pushes for a child to return before you, the parent, is ready, should be told to remove himself from participation in the child's return to play process. This is your child. And with the knowledge you are gaining here, you are the one who can best protect them from serious harm.

You will also want to take into consideration the point in the sports season where the injury took place. If it is early in the season, or pre-season, do you want to put your child back out on the field only to be exposed to concussive and subconcussive contact again? I recommend extending time for recovery if it's early in the season to ensure the fullest recovery possible. With continuous monitoring of your child for concussion related symptoms and a thirty day post concussion syndrome assessment, a longer rest period will ensure that your child has a full recovery.

Most of us think of concussions as some well documented and easy to heal condition when, in fact, it is far more serious. Concussions are brain injuries, and it is very, very difficult to assess the severity of the damage due to our inability to see, touch, and test what damage has occurred. The tests and evaluations that medical practitioners do administer give them a very good picture of what MAY have happened, but they cannot conclusively tell you, the parent, what just happened to your child's brain. That's why it is critical for you to operate with extreme caution regarding your child's recovery. Error on the side of caution continuously. You may get some flak for it, but in the end, you did your job, and your child will be safe.

Chapter Ten

Understanding Total Trauma: It's More Than Playing One Sport!

In this book, you were introduced to the importance of assessing your child's overall exposure to concussive and subconcussive trauma. This short chapter emphasizes this issue, further pointing out that there is currently no education in the medical, psychological, or athletic training and coaching fields to assess or identify how much trauma our children are exposed to or even how many traumas they can endure. You, the parent, must be self-informed so that you can monitor your child's exposure and make intelligent decisions to protect them.

Subconcussive and concussive trauma can find their way into any child's life in a variety of ways. Contact sports are one way, but recreational activities and a child's lifestyle can also significantly impact the amount of trauma their brains are being exposed to. Subconcussive trauma is insidious, and parents need to understand its presence in all its forms.

As previously mentioned, subconcussive trauma is a significant cause of brain damage from contact sports. It is continuous, cannot be diagnosed, and the impacts can seriously affect a child's brain development and healing processes. It is critical that parents understand that it's not just one sport or one season, but the extension of sports through additional forms (travel league, municipality, school, private club, tournaments) that add additional exposures to your child. Your child can wrestle or play football or hockey for most of a year, weather dependent. Throw in participation in multiple sports, plus recreational activities, and a child will suffer significantly more exposure to subconcussive trauma than what is good for their brain.

Parents often do not see subconcussive events, even while they are happening. Take contact sports. Many parents, like me, are completely unaware of the subconcussive nature of sports like wrestling. (You can pick your sport here, but I want to explain what I was seeing as a parent.) The kids in wrestling have headgear. They are playing on mats. Injuries are uncommon and severe injuries very rare. That makes it safe, right? No. Every time your kid's head hits the mat, it's a subconcussive hit. Every time the other kid goes in to engage and smacks your kid behind his head or drives his head into the mat with his forearm on a takedown, that is a subconcussive hit.

Overall, wrestling doesn't seem to be bad. But when you combine that with a concussion, or if the child plays more than one concussive sport, or the child participates in wrestling year-round in private clubs or leagues, those hits add up over time and can affect their brain. It's so important for a parent to look at their child's concussive exposure in its totality. It all adds up.

Now, let's look at more concussive sports like football, hockey, rugby, and lacrosse where the athletes are moving faster and hitting a lot harder. Here, the concussive and subconcussive impacts are clearer when the athletes check, tackle, or hit each other. Every time your kid takes a hit, his or her brain is being jostled, twisted, or impacted by subconcussive force. Over time, those hits add up, and over extended periods of time, they can lead to brain damage and mental illness.

On top of all that, kids don't just play sports. They are kids. They are always playing and participating in recreational activities, like equestrian sports. More than thirty million people participate in equestrian sports competitively every year! Then, there's skiing, snowboarding, bicycling, and skateboarding. In fact, Stanford's Children's Health website states that, "almost fifty percent of head injuries sustained in sports or recreational activities occurs during bicycling, skateboarding, or skating." This demonstrates that parents have a lot more to be aware of regarding subconcussive and concussive injuries than just football.

The glaring issue I want to point out is that, although subconcussive trauma is recognized in numerous journals, studies, and reports as a significant cause of concern for children's health, no one is receiving training in assessing a child's total concussive exposure. It is appalling in that, everywhere that I have gone to conduct the research for this book, subconcussive trauma is mentioned as a critical gap in knowledge that "needs more attention." How can the leading medical, neurological and even athletic training organizations in this country make such a statement and not do anything about it? These are our ***kids!*** This failure to address this critical and recognized risk with research to inform our nation's parents makes it even more difficult for them to protect their kids from damaging their brains. Maybe this is because subconcussive trauma is a new area of research. Or maybe it's because researchers are just becoming aware of the impact of this trauma on a child's brain development process. We don't know. What we do know is that subconcussive trauma is a significant area of risk for our children and, as parents, we need to protect them from it.

I am certain that the nurse practitioner, doctor, athletic trainer, coach, or even a concussion specialist, will not be able to evaluate subconcussive trauma. They are looking for concussions, or chasing whatever specific reason you brought them in. They are event driven and not trained to ask these kids the right kinds of questions. The parent, as in so many issues in a child's life, must be preemptive in protecting their children.

Underlying the frustration for parents like me is the lack of guidance on evaluating a child's total concussive exposure, or really any area of concussion education. To parents who have lost their children, this is a cruel oversight by the medical community and particularly government agencies like the Center for Disease Control whose responsibility includes creating guidelines for society to protect its children. As Chris Nowinski from the Concussion Legacy Foundation has mentioned, we have a pitch count that parents and coaches follow to protect a child's elbow, but we don't have a number of subconcussive hits, or concussive hits for that matter, for them to follow to protect a child's brain.

How much sports are too much? Ask many parents, doctors, and psychologists, and no one knows. Most will say that there is no limit, that sports are a healthy means for kids to stay active. This may be the case in non-contact or limited contact sports, but with the continuous impacts on the developing brain, this is patently untrue for contact sports. When Mac had his third concussion, I threatened to pull him out of sports until

someone could tell me how many concussions were acceptable. I didn't receive anything other than a promise from the athletic trainer that they will do their best to protect our kids. He sent me a 256-page book, the "National Athletic Trainers' Association Position Statement: Management of Sport Concussion" that listed the concussion protocols that he said were used as their guidelines. Mac never had another concussion we were aware of, yet the damage continued to progress because of the continued aggregate subconcussive trauma, which the booklet never mentioned. Guess what was on page 256, the last page, "as such, the relationship among concussion, subconcussive impacts, and long-term brain health is not clear. These studies are viewed as preliminary; additional research is needed to adequately address this association." I sincerely hope this has changed since 2017. The reason that this is highlighted is to show that many professionals are not aware of subconcussive trauma, and they will not have the ability to assess it as they do not know your child's history. Only you do.

The only way to protect your child from excessive concussive exposure and to provide them the best possible outcome for their life is to monitor and manage that exposure by avoiding it until the brain is better able to handle it and limiting it thereafter.

If you decide to allow your kids to play sports at 14, be aware that turning fourteen doesn't automatically mean a child is an adult and can handle the exposure of the brain to concussive trauma. In fact, at a recent huddle for families whose husband, brother, sister, or son was part of the Boston University Brain Bank, we ran into another gentleman whose son took his life. When we told him about Mac's Foundation and our proposal to wait until fourteen to play contact sports, he commented that fourteen was the age his son ***began*** to play football.

A child's brain is still growing and developing until the age of twenty-five and still needs protection. In my opinion, back-to-back concussive sports, or more than one concussive sport is a no go. Extensive exposure through participating in multiple forms of a contact sport, (public school, travel league, and private club) is also a non-starter. Treating some recreational activities with caution, like snowboarding, wheeled activities, and equestrian activities is also recommended.

Sports are fun, great for learning life skills, and staying active. Nonetheless, we need to limit our children's overall exposure to concussive and subconcussive trauma. You know the statistics on kids becoming super sports stars, right? Less than one percent will go on to be a professional athlete. No matter what your dreams are or how good your child is in sports, those statistics will not change. Given those chances, they will likely not be relying on sports for their livelihood. But they will be relying on their brain for the rest of their lives. Why take the risk when it can be mitigated by managing their exposure to concussive trauma? Trust me, it is not worth it.

Chapter Eleven

The Future of Contact Sports (If we were Santa…)

I would like to share the vision of the Mac Parkman Foundation for an America where the understanding of early exposure to concussive and subconcussive trauma is widely known and has been used to promote changes to child athletics to better protect our children and their future.

In a podcast the other day, we were talking about concussive trauma and rugby and how we wanted to see men be more vulnerable and change our society to a point where men and women athletes would talk about their suffering before they hurt themselves, or someone else. As we talked, I started thinking about all the kids, parents and adult athletes that I have met since Mac left that are gone, or suffering. How many leaders, scientists, researchers, presidents, entrepreneurs have we lost? How many great fathers and mothers will never be around to watch their kids grow? How many are no longer here? And it hit me like a train. How can we compute the immeasurable, incalculable loss of human potential that this country has sustained over the last 50 years or so? Not to mention the sadness and grief that hundreds of thousands if not millions of Americans are experiencing through the loss of a loved one, or by watching a loved one struggle.

This is all avoidable. Unlike cancer, natural disasters Covid-19, there is an answer, there is a cure, but we as a society must take our medicine and make the choices that are necessary to protect our children.

Stop exposing young, developing brains to concussive and subconcussive trauma.

That's it.

In anticipation of the day when that is a reality, that our children are the priority that they should be, I would like to describe a world that would reflect that new reality.

First, while we feel that contact sports should be an adult decision and played by Americans over the age of eighteen, we understand the need to compromise to build some momentum that is acceptable to our sports centered culture. In that light, we would like to see some legislation that drives change by making contact sports unavailable until the age of fourteen and promotes non-contact forms of sports until that age. While we know that seems extreme, it's not. USA Hockey and USA Soccer are moving in that direction with their promotion of no-check and no-head sports, and we hope that they continue to increase the age based on the science and research that is available.

We think moving in this direction can also save football in America. For years, attendance at youth tackle football has been on a significant decline as parents become more aware of the risks associated with concussions. Many are just saying no to their child getting hurt. Something needs to change or that decline in attendance will simply continue.

It is an interesting fact that in Julie Stamm's book, *The Brain on Youth Sports: The Science, the Myths, and the Future,* she points out that both USA Hockey and U.S. Soccer saw participation rise when they invoked non-contact forms of their sports. We believe that the NFL could be a significant player in driving change by recognizing the dangers of subconcussive and concussive trauma and demanding better protection of our children by recommending flag football until the age of fourteen. By proving that they are focused on taking care of kids through refusing to support organizations that continue to harm kids by allowing them to play contact football, the NFL can gain back a lot of the parental trust they lost and maybe resuscitate the sport.

In terms of awareness, we think that the CDC should issue a warning or public statement on the dangers of exposing developing brains to concussive and subconcussive trauma. Our government is supposed to lead the way on protecting its citizens. While they have provided some excellent guidance on concussions, they have not done anything to educate the public on the dangers of brain damage and potential mental illness from early exposure to contact sports. They should also update their concussion training programs to include these risks as there is no mention of subconcussive trauma and the links to mental illness from over exposure. We also feel that the CDC should assist Congress in developing legislation outlawing contact sports for kids under the age of fourteen.

In the future, we would like to see a world where all potential stakeholders in a child's athletic upbringing are educated on the risks of concussive and subconcussive trauma and that educational material be made available to the public. Right now, athletic trainers, coaches, doctors, nurses, psychologists, school supervisors, and yes coroners, are all NOT trained in the subjects covered in this book. Curricula for these professions should be updated and certification courses or continuing education credits mandated so that they can help families make informed decisions and better protect the youth of America.

We would like to see a world where parents fully understand the risks to their kids from early exposure to concussive and subconcussive trauma and are not driven to promote contact sports with their kids until the age of fourteen. A world where moms and dads are happy with sports that promote athleticism and are aerobic, keeping our children healthy and understanding that they are providing the best path possible for their child. Let's remove just one more risk of the many that parents are aware of that threaten their children. Personally, I would like all these "travel teams" and other clubs that extend concussive sports seasons banned. That would go a long way toward protecting our children's brains.

I would also like to see a world where kids are restricted from playing back-to-back concussive sports. School associations need to look at their schedules and determine what concussive sports are being played and shift seasons to accommodate that. For example, Mac played back-to-back football and wrestling, which

should not have been permitted. Of course, changes cannot be made in a vacuum of information.

In this world, we would take responsibility for those brain injured kids, many who are now adults and offer them the care, support and compassion they need to manage their challenges. We have no idea how many kids are in mental health care facilities, halfway homes, or even prisons, because they are suffering from mental illness. A mental illness that is not their fault, it is ours. We need to identify all these people and help them while we build a world free of unnecessary concussive and subconcussive exposure and the associated pain.

In this world I imagine, our kids grow up happy and are free to be kids. Their bodies are protected from unnecessary punishment, their brains are allowed to develop normally, and they participate in all the sports they would like until the age of fourteen, just not concussive ones. In a world like this, our children will have a better chance than they have ever had to live a life free from brain injuries that cause mental illness while science can continue to do research and make changes that improve sports safety for both children and adults.

I wish this world had been around earlier than 2020. I wish that I had the knowledge then that I have now. I wish someone had informed me of the risks – or even scared me about them. I wish I had known how to recognize the symptoms of depression. I wish so much because I wish my son was still here with me. I wish I could grow old and pass on all the wisdom that I have learned over the years to my beloved son, Mac.

I didn't know. But now, you do. Please, please, use this knowledge well.

If only I knew then what I know now.

P.S. I love you so much Mac and I hope you are proud; I am trying to make things right and will continue to try and do better.

Love, Dad.

Resources

CITATIONS

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