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The black hole of sports

Brain damage studies build a strong case for banning youth collision sports

By **Derrick Z. Jackson** | GLOBE STAFF JANUARY 08, 2012

"YOU SEE all those brown little things?" Ann McKee asked me as I looked through a microscope. I was viewing a slide sample of the brain of Dave Duerson, the Notre Dame All-American defensive back who won Super Bowls with the 1985 Chicago Bears and the 1990 New York Giants. Duerson was a Notre Dame trustee, a National Football League Man of the Year for community service, and an economics major who completed a management program at Harvard Business School. Early in his football retirement, he nearly tripled the annual sales of a meat supply company to $63.5 million.

The glory and fortune disappeared in the last decade. An onset of memory loss, hammering headaches, spelling problems, blurred vision, and hot temper led to spousal abuse, divorce, bankruptcy, and, finally, suicide last February at age 50. In the most eerie recognition yet by an ex-football player as to why he was

STAN GROSSFELD/GLOBE STAFF

Dr. Ann McKee studies the effects of concussions on brains.

losing his mind, Duerson shot himself in the chest to preserve his head for research. He left behind the now-famous note, "Please, see that my brain is given to the NFL's brain bank."

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That brain was sliced open by McKee, a co-director of Boston University's Center for the Study of Traumatic Encephalopathy. The "brown things" were nerve cells filled with tau protein, prevalent in degenerating brains like those in Alzheimer's disease. There were so many brown spots, with tails curling off them, that the slide looked like a muddy negative of spinning galaxies.

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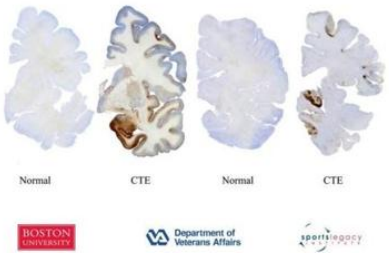

The effect of head injuries on the brain

In that microscopic universe, we were looking into the black hole of contact sports: Chronic Traumatic Encephalopathy. This was the hole likely blown into Duerson's head in a career of at least 10 recognized concussions and countless subconcussive hits. This is the void we still let our kids fall into, cheering them all the way.

"If it were a normal person, you would see absolutely none of that," McKee said in her lab at the Bedford Veterans Administration Medical Center, where she also runs brain banks for research on military injuries, Alzheimer's, and heart disease. She pointed out how the tails of the tau-infested cells made long projections to make contact with other cells, causing short circuits and disordered thoughts.

"Totally chaos," she said. "I deal with neurodegenerative disease all the time, but you don't see it in 50-year-olds even if you had a gene for the disease."

McKee then showed me a slide of another well-known NFL player who died in his late 70s or early 80s. The constellations of tau were overwhelming. "He's got

disease everywhere," McKee said. "There is no place I can go in this brain that's just not incredibly diseased. I've never seen anything like this. This is the worst case I've seen. This guy's brain is 800 grams, half the size of most players' brains."

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A slide from a healthy brain would have had a far more clear background with blue spots. The difference in an injured athlete's brain is so dramatic that the comparisons should be required viewing for parents and youths contemplating high-contact sports and the coaches, athletic directors, and school principals in charge of them. These images should be pinned on the wall with those of blackened lungs we've long used to scare teens from smoking. They just might scare parents and officials into keeping children away from such sports until the sport is changed to minimize head injury.

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McKee says there is urgency to learning more about the effects of head injuries. "I think the data is only going to get stronger," she said. "It's not going to get weaker. There's a huge sense of responsibility that we really need to figure this out so that we can help these guys."

The urgency grows with each new brain analyzed. In an interview with McKee and her BU Center co-directors, Robert Cantu and Robert Stern, all three say they fear that today's hard-earned concussion awareness, won only in the last couple of years against the prior denial of the NFL, is already being outstripped by new scientific findings.

Chief among them is that the biggest culprit for CTE for many athletes may not be the massive blows that cause concussions but the thousands of lesser ones that do not.

"It gets very scary," McKee said. "In fact, it's gotten to the point where I don't even think about the future. I just report what I see. I think it's going to change things, but I really don't know how it's going to change. I think we have some very concerning information."

It is scary enough that Cantu, who has a book coming out this year on concussions and children, believes that children under 14 should not play collision sports like football, ice hockey, soccer, and lacrosse until they are modified to eliminate head blows in routine practice and play. "It doesn't make sense to me," Cantu said, speaking for himself and not for the center, "to be subjecting young individuals to traumatic head injury. There's no head injury that's a good one, and you can't play collision sports without accumulating head injuries."

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The BU Center has now analyzed the brains of more than 75 deceased athletes. It has found CTE, originally diagnosed in 1928 in "punch drunk" boxers, in more than 50 of them, including at least 14 of 15 NFL players, and four of six National Hockey League players. Evidence of early CTE has now been found in former high school and college football players who died when they were 17, 18, and 21.

The 21-year-old with CTE was Owen Thomas, a popular captain of the University of Pennsylvania football team and a junior in the school's Wharton business program. He committed suicide in 2010 after what friends said was a sudden plunge into depression. He had no history of it, nor of a diagnosed concussion on the football field. But he was a lineman who was known as a hard hitter from the moment he started playing at age 9. He likely took thousands of head blows.

Those circumstances, beyond even the findings in professional athletes, made McKee realize on the day she analyzed Thomas's brain that CTE "wasn't a fluke. This wasn't just a series of horrible coincidences, this was real, this was shockingly common - and it was affecting our kids . . . All I could think of was Owen Thomas, what was going through his mind, was it possible that these changes somehow influenced his decision to take his life?"

The evidence to date has forced significant recent changes in contact sports. The NFL, colleges, and state high school athletic associations, including in Massachusetts, have revised or instituted new protocols for taking concussed players off the field and not returning them to play until medically cleared. The NFL recently handed down a precedent-setting one-game suspension for the recent vicious helmet-to-helmet hit by Pittsburgh Steelers linebacker James Harrison on Cleveland Browns quarterback Colt McCoy.

The NHL has also improved its treatment protocol and now penalizes deliberate hits to the head during play. Hockey Canada now penalizes all hits to the head during play, even accidental ones, in the minors (5 to 17 years old) and for females. The Ivy League this season slashed the number of football practices with contact in full pads.

But while reporting of concussions is way up, there is yet no proof that blows to the head are dramatically down. The NFL and the National Collegiate Athletic Association face multiple lawsuits from former players - including those in their 20s, 30s, and 40s who claim to be suffering from all the hits - who say the organizations were negligent in addressing brain trauma. The NFL last year gave the BU Center an unrestricted $1 million to further its research, but the league also continued to rack up concussions, 260 last season compared to 200 in 2008, according to the Associated Press.

After the Browns became the latest team to botch a concussion diagnosis - with team medical staff saying it missed McCoy being flattened by Harrison - the league decided to put an independent trainer in the press box to survey the action. But that change falls short of the critics' call for an independent neurologist on the sidelines. For a $9 billion enterprise, that would seem to be a small price to pay for medical credibility.

Play remains so violent in the NHL that at one point in mid-December, 23 players were out with concussions. Three weeks ago, Rajendra Kale, the interim editor-in-chief of the Canadian Medical Association Journal, called for the banning of fighting in hockey, citing BU's research that repetitive head trauma of any kind may contribute to CTE. Three of the four deceased hockey players

found to have CTE were “enforcers,” known for fighting, including 28-year-old Derek Boogaard.

The Journal’s editorial came two weeks after NHL commissioner Gary Bettman dismissed connections between concussions and CTE, and downplayed head trauma in fighting, saying, “Our fans tell us they like the level of physicality in our game.” But calls to end fighting are growing from within. David Branch, the president of the Canadian Hockey League, which is the prime feeder league for the NHL, which has much tougher penalties against fighting, this month told the National Post that, “The time will come where [fighting] will be deemed to be totally unacceptable.”

And Hall of Fame goaltender Ken Dryden criticized Bettman’s level of denial in a December essay in the Toronto Globe and Mail, saying, “That’s how thousands of asbestos workers and millions of smokers died.”

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Nothing the NFL or NHL does can begin to address where brain trauma actually starts in many cases: youth sports. A Centers for Disease Control and Prevention report in October found that virtually the same number of youths ages 10 to 14 (60,272) annually go to emergency rooms for nonfatal traumatic brain injuries as youths 15 to 19 (61,851).

For boys, the top cause in both age groups was football. For girls, the top cause at 10 to 14 was bicycling. By 15 to 19, it was soccer. Other significant causes for girls 10 to 19 were basketball and gymnastics.

Emergency room visits for youth sports-related traumatic brain injuries overall went up 62 percent from 2001 to 2009. Much of that rise likely represents much better concussion awareness. But researchers also believe it represents athletes continuing to get bigger, faster, and stronger - and sports officials not adjusting their rules fast enough to mitigate the damage. This makes no sense when, according to the CDC, “younger persons are at increased risk for TBIs with increased severity and prolonged recovery.”

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Those ER visits scream for us to hear the silent story. In ongoing research, a Purdue University engineering team, using accelerometers in football helmets and before-and-after brain scans, has found "previously undiscovered" levels of cognitive impairment in high school players who suffered no concussions. Researchers Eric Nauman, Thomas Talavage, and Larry Leverenz recorded up to 1,800 hits in a season, primarily among linemen and linebackers. G forces of the hits generally ranged from four times to more than 20 times that of a roller coaster. There were four recorded hits of nearly 300 G.

The number of hits correlates with the working assumption by BU researchers that high school football linemen likely absorb between 1,000 and 1,500 subconcussive head blows a season.

"We can see what part of the brain shuts down or works twice as hard to complete a task," Nauman said in an interview. "As these hits accumulate, different parts of the brain stop working, and other parts are being recruited to cover up for the damage. Even though they may not show symptoms, the brain has changed. We scratch our heads, both at what the brain can take and the damage the brain can hide."

In November, an Albert Einstein medical school study also found subconcussive trauma among adult men and women amateur soccer players who frequently headed the ball. In an amazing parallel to the estimated number of head hits to football linemen, significant trauma was seen in soccer players who headed the ball 1,000 to 1,500 times a season.

"It only amounts to a few times a day for a regular player," said Einstein researcher Michael Lipton in a press release. "Heading a soccer ball is not an impact of a magnitude that will lacerate nerve fibers in the brain. But repetitive heading may set off a cascade of responses that can lead to degeneration of brain cells."

It is a cascade that, despite the publicity given to the NFL and the NHL, knows

no gender. Purdue's Nauman said heading in girls has a g-force four to eight times that of a roller coaster, and can also cause cognitive impairment without an actual concussion. In a sports medicine journal review article last year, the BU researchers noted that the rate of concussion for collegiate women's soccer players is slightly higher than for male football players, the rate for women's hockey players is more than twice that of male hockey players, and the rate of women's lacrosse players is equal to the men.

With scientific restraint, McKee, Cantu and Stern cautioned against panic. As sports fans, they are not at all interested in banning contact sports. They just want to get the head out of the way.

But that isn't happening. Despite the media spotlight on concussions, brain safety is so lightly regarded in daily life that 85 percent of high school youths told federal researchers in 2009 that they rarely or never wore a helmet while bicycle riding, a percentage unchanged from 10 years ago. That is surely why bicycling is the second-leading cause of emergency brain injury treatment for boys and girls of all ages, after football.

It all adds up to a major course correction for collision sports. Banning collision sports for youths under 14 makes good sense, as Cantu suggests, but there should also be a federal commission to find ways to get head trauma out of normal high school play. Given the up to 1,800 hits per year and the cautionary story of Owen Thomas, high school and youth football linemen should be held to a strict play count. With no new football helmet yet in sight that would prevent both skull fractures and concussions, it would mean re-teaching the techniques of tackling to end any leading with the head, launching off the feet, and helmet-to-helmet hits, even accidental ones.

In soccer, that means eliminating heading from high school on down and setting a maximum number of times a college player can head the ball in practice and in games. In hockey, that means banning all fighting and penalizing even accidental hits to the head. It means ending body checks that crush and rattle players against the boards.

It means the NFL, NHL, and Major League Soccer must lead by example in making it clear that the brain comes before brutality. The NFL must end all launching of players, and penalize all helmet-to-helmet hits. The NHL must ban fighting and slamming against the boards. The MLS must set limits for heading.

Stern is often asked about NFL Hall of Fame quarterbacks Steve Young, 50, and Troy Aikman, 45, each of whom suffered many concussions, but now are both successful television football analysts.

"That's like saying, 'Here's a 60-year-old woman who doesn't have breast cancer, so how can you say that there's a risk of getting breast cancer?' It's really a ridiculous argument," Stern said.

Yet to be done is research that better identifies concussions and subconcussive damage. Cantu said that for every recognized concussion, seven or eight are probably missed. The BU team has begun to interview 100 living former NFL players to explore possible treatments for CTE while athletes are alive. "We don't yet have therapies that get at the root of the underlying problem, because we don't really yet understand the problem," Cantu said. ". . . We don't know how much impact is necessary, what are the genetic factors or the environmental factors such as how many blows close together or far apart does it take. What we do know scares us."

Couple that with McKee's belief that the data are "only going to get stronger." That should make the constellations of tau in her slides the center of the contact-sports universe, before another generation of pee-wee football, soccer, and hockey players enter this black hole.

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