

# Brain bytes and ear bites revisited

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## Commentary

In January 1998, neurologist Robert Tyson, MD, penned an excellent opinion article titled Brain Bytes and Ear Bites in response to the infamous Mike Tyson ear-biting incident against Evander Holyfield [1]. The media and public were rightly outraged by this “savage, atavistic deed” [1]. The point of the article, however, was that public concern was misplaced. The real tragedy of boxing, and other sports involving repetitive contact to the head, was mild traumatic brain injury or TBI, a term used synonymously with concussion. Dr. Tyson called for more action on behalf of the medical community and recommended several practical guidelines such as repeated neurologic examinations and neuropsychological assessments throughout an athlete’s active participation in sport along with limitations to the total number of concussions sustained during a career. He also advocated that members of the medical community, without financial entanglements in the sport or its governing bodies, be armed with the authority to end an athlete’s career to avoid further brain damage. Perhaps litigation brought by brain-damaged athletes, he speculated, would get the attention of sport commissions. The following commentary will review the regulatory changes that have occurred since Dr. Tyson’s 1998 article and propose further recommendations based upon the past twenty years of sports-related concussion research.

Over the past twenty years, sports-related concussion has become a well-recognized risk factor for neurologic dysfunction and cognitive impairment across the age span. Public awareness of concussion has grown exponentially with chronic traumatic encephalopathy or CTE, a neurodegenerative disorder associated with early onset dementia, increasingly identified in the brains of former athletes from football, hockey, baseball, rugby, soccer, and professional wrestling. As a result, parents are understandably concerned about their children’s participation in contact sports. However, there remain common misconceptions regarding the effects of concussion in the lay public. For instance, there are the frequently held beliefs that concussion causes permanent cognitive disability or that a couple of concussions ensures the development of dementia in later life. However, the bulk of the neuropsychological research in sports-related concussion demonstrates that a single concussion is associated with temporary, rather than permanent dysfunction. This also seems to be true for multiple concussions spaced out over time. The vast majority of concussed athletes, around 90%, recover within one to two weeks. The fifth iteration of the Diagnostic And Statistical Manual Of Mental Disorders reflects this position noting, “Neurocognitive symptoms associated with mild TBI tend to resolve within days to weeks after the injury with complete resolution typical by three months” [2]. Research has identified preexisting medical or psychiatric conditions and age over 40 as the most consistent risk factors for cognitive symptoms persisting beyond this three-month window of expected recovery [3]. In addition,

research suggests that the risk of persisting cognitive deficits increases when a second concussion is experienced before recovery from a previous concussion, multiple concussive and subconcussive blows are experienced over a short period of time, and/or numerous concussive and subconcussive blows are accumulated over a lifetime [3].

Most of Dr. Tyson’s 1998 recommendations have since been implemented. For example, baseline and repeated neuropsychological testing has become a very common method of assessing the cognitive sequelae of sports-related concussion in contact sports at the high school, college, and professional levels. Boxing commissions have also tightened their regulations with respect to pre-fight physical examinations, implementing standard medical suspension rules for boxers with recent knockouts, and denying boxing licenses to athletes with a history of frequent knockouts. Despite an initial reluctance to publically acknowledge the link between repeated concussion and CTE, the National Football League has instituted several game changes to limit the impact of head trauma, initiating standardized concussion protocols, and offering disability benefits to former athletes with neurocognitive impairment. These changes were indeed driven by lawsuits filed by former athletes and their family members dealing with the devastating effects of neurocognitive impairment and dementia due to repetitive TBI.

It has proved more difficult to implement Dr. Tyson’s recommendations to limit the total number of concussions sustained during athletic participation and allow medical professionals the authority to end an athlete’s career. Trouble applying these guidelines partially stems from gaps in current scientific knowledge. For instance, the point at which the total number or severity of concussive or subconcussive injuries reaches some threshold that ensures cognitive impairment and later neurodegenerative changes remains uncertain. It is also unclear what genotypic and phenotypic factors mediate this threshold and what biomarkers might be available to assess this risk [4]. Further, the prevalence and incidence of CTE in amateur and professional athletes is still unknown, adding to difficulties in discussing its epidemiology and risks for athletes.

Physicians and researchers from Columbia University Medical Center recently proposed one of the first algorithms to guide clinician

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decision-making regarding medical retirement and disqualification from sport [5]. As the authors acknowledge, challenges persist in determining individualized risk profiles for repetitive sports-related concussion and long-term neuropsychological outcomes in contact sport athletes. A comprehensive evaluation should include a medical and psychiatric history, a detailed sports-related concussion history and concussion symptom inventory, a neurologic examination, neuropsychological testing, neuroimaging when indicated, and a discussion of the social motivational factors related to the athlete's continuing participation in sport. Voluntary retirement should be sought initially, as this is consistently associated with more favorable psychosocial outcomes, and providers should make strong recommendations rather than mandates whenever possible [5].

Evidence-based findings that should hasten medical retirement or disqualification from sport include clinical or radiographic evidence of structural abnormalities related to TBI and/or vulnerabilities that would increase the likelihood of subsequent brain damage should future head contact occur. Return to play decisions need to be based upon a complete or near complete return to cognitive baseline on neuropsychological testing. Evidence of significant or progressive cognitive decline should prompt the retirement discussion. Additional areas of concern include postconcussive signs or symptoms lasting more than three months or increasing in severity and duration with each successive concussion, decreased concussion threshold, decreased interval between concussions, and acute neurologic signs such as loss of consciousness and posttraumatic seizure activity [5]. Given research supporting delayed concussion recovery in people over the age of 40, athletes in sports with frequent contact to the head should be advised

to retire at or before the age of 40. Individual factors also need to be considered including baseline cognitive functioning, personal and family medical and psychiatric history, type and level of athletic involvement, anticipated amount of future contact to the head, personal identity through sport, and financial motivations [5].

Despite tremendous progress in the study of mild TBI since 1998, there remains much to be learned. The answers gleaned over the past 20 years of concussion research have slowly translated into evidence-based guidelines and treatments. As Dr. Tyson previously noted, "All these athletes are, or will ever be, is the product of their brain function. If they are damaged, they will be lesser for it, and our society will be lesser for it" [1]. These wonderful athletes continue to need and deserve the protection of the medical community.

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## References

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