The American Football Helmet and Concussions

Next to Baseball, Football can be said to serve as America’s second pastime. Unfortunately football accounts for the most sports-related concussions in the United States. From this startling fact sports equipment manufacturers have been constantly updating the design and functionality of their helmets. The National Operating Committee on Standards for Athletic Equipment (NOCSAE) is one governing body that institutes safety requirements for manufacturers.1 Their testing standard involves dropping the helmet being tested from a height of 1.50m onto a dense rubber surface resulting in an impact of 5.47m/s.1 This test is then repeated and the helmet is angled to have the impact affect different parts. The data can be modeled by the equation SI=(integral), a(t)^2.5dt. The resulting SI score has to be below 1200 in order for a helmet to pass the safety test.1

One of the dangers associated with concussions is that after receiving one, a player is more susceptible to further trauma for up to 14 days.2 Along with this time period is the tendency of concussions to, “show no pathological changes on standard MRI and CT scans.”2 The human brain goes through multiple symptoms as it begins to recover from brain trauma. One study done by Michael Levy, M.D. outlined the overall process. After the initial trauma, there is a marked decrease in blood to the affected area of the brain. Compounding the problem is that with this decrease in blood in is an increased metabolic demand from the injured tissue.2 While these symptoms are short-term, multiple traumatic brain injuries can lead to severe long term health effects and can become fatal. Two areas of the brain that show susceptibility to trauma are the frontal and temporal lobes. After experiencing multiple injuries, they show signs of degeneration leading to pathological disorders that can be identified by CT/MRI scans.2

One limitation of modern helmets is that they are designed solely to combat linear collisions.

Modern helmets just as earlier ones cannot protect players from any injuries resulting from “rotational acceleration of the brain.”3 While multiple technologies have developed since the early 1970’s there are still substantial road blocks. Players’ tendencies to lead with their heads actually caused an increase in concussions as helmets were made stronger until a ruling change in 1975.3 Two equations modeling the forces sustained by players are:

\[ F = m_{\text{Striking}}a_{\text{Striking}} + FN \]
\[ F = m_{\text{Struck}}a_{\text{Struck}} \]

Safety in the game of football will require more than the newest collision-reduction technology or more advanced helmets. It is going to require both the players themselves and the efforts of doctors and researches. However, as treatment and awareness of brain trauma advances today’s athletes are benefiting from resources that athletes of the past sorely lacked.


4- Concussion In Professional Football: Biomechanics of Struck Player, David Viano, M.D. Ph.D. Ira Cassson, M.D., Elliot Pellman, M.D. VOLUME 61 | NUMBER 2 | AUGUST 2007 www.neurosurgery-online.com