

Head Impact Exposure in Youth Football

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Abstract—The head impact exposure for athletes involved in football at the college and high school levels has been well documented; however, the head impact exposure of the youth population involved with football has yet to be investigated, despite its dramatically larger population. The objective of this study was to investigate the head impact exposure in youth football. Impacts were monitored using a custom 12 accelerometer array equipped inside the helmets of seven players aged 7–8 years old during each game and practice for an entire season. A total of 748 impacts were collected from the 7 participating players during the season, with an average of 107 impacts per player. Linear accelerations ranged from 10 to 100 g, and the rotational accelerations ranged from 52 to 7694 rad/s². The majority of the high level impacts occurred during practices, with 29 of the 38 impacts above 40 g occurring in practices. Although less frequent, youth football can produce high head accelerations in the range of concussion causing impacts measured in adults. In order to minimize these most severe head impacts, youth football practices should be modified to eliminate high impact drills that do not replicate the game situations.

Keywords—Concussion, Brain injury, Biomechanics, Helmet, Linear, Rotational, Acceleration, Pediatric, Children.

INTRODUCTION

Sports related concussions have received increased public awareness, with many states considering or implementing laws directing the response to suspected brain injury. This is a result new research suggesting possible links to long-term consequences from repetitive concussions. Emergency department visits for concussions increased 62% between 2001 and 2009, and researchers estimate that between 1.6 and 3.8 million sports related concussion occur each year

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in the United States. Of all sports, football accounts for the highest incidence of concussion, and therefore receives the most attention. One of the leading thoughts to minimize the incidence of concussion in football is to limit players' exposure to head impacts. Strategies to reduce a player's exposure to head impact include teaching proper tackling techniques and modifying the rules of the game.

To make educated decisions toward reducing the incidence of concussion in football, head impacts in football have been extensively studied over the past decade. The National Football League (NFL) was the first to investigate this problem in detail by reconstructing concussive impacts through analysis of game film using instrumented crash test dummies. While this work was of high quality, it was limited by a dataset that did not account for the full exposure to head impacts that players experienced. Since then, new technology, the Head Impact Telemetry (HIT) System (Simbex, Lebanon, NH), has allowed for the direct instrumentation of headgear in sports. The HIT System consists of a series of accelerometers that fit inside football helmets, and records a player's biomechanical head response to every head impact they receive. Since Virginia Tech first instrumented college football players with the HIT System in 2003, over 1.5 million head impacts have been collected and analyzed across participating institutions. This has allowed head impact exposure and injury risk to be investigated at the high school and college level. Based on this research, some colleges have made educated recommendations about contact in practices in an effort to reduce the head impact exposure of players. Furthermore, this research has led to design guidelines for improved adult football helmets.

There are approximately 5 million athletes participating in organized football in the United States; with