Predicting the Impact of Increased Football Field Width on High-Speed Collision Rate Using a Novel Computational Model

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Introduction

High-acceleration head impact is a known risk factor for mild traumatic brain injury (mTBI) based on previous studies using helmet accelerometry. In football, offensive and defensive skill players are known to be at higher risk of mTBI, likely due to their increased speed of play. Previous studies in other collision sports have suggested that increased playing surface may contribute to a decreased rate of high-speed collision. Here, we developed a novel computer simulation to test the hypothesis that an increased football field width leads to a decreased rate of high-speed collisions.

Methods

A novel computer simulation was developed using MATLAB (MathWorks, Natick, MA). 4 wide receivers were matched against 7 defensive players. Each offensive player was randomized to 1 of 5 typical routes on each play. The ball was thrown 3 seconds into play, and ball flight time was 2 seconds. Defensive players were delayed 0.5 second before reacting to ball release. High-speed collision was defined as the receiver converging with a defensive player within 0.5 second of catching the ball. The simulation counted the number of high-speed collisions for 1 team per season (65 plays per game for 16 games per season = 1040 plays per season) averaged over 10 seasons. The simulation was validated against existing data using the standard field width 53.3 yards. Field width was increased in 1-yard intervals until 58.3 yards.

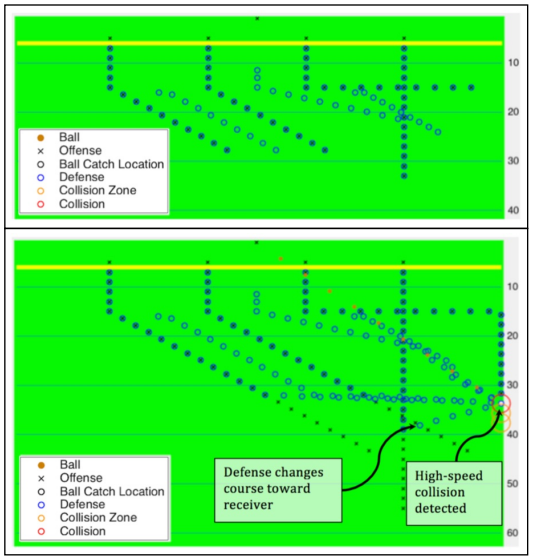

Figure 1 – Top: Field prior to ball release. Each offensive player is randomized to one of 5 trajectories. Each defensive player either follows the nearest offensive player, or bisects the trajectories of the two nearest offensive players. Bottom: After the ball is released and reaction time passed, defensive players target the receiver. A high-speed collision is ultimately detected.

Results

Using standard field width (53.3 yards), 188 +/- 4 high-speed collisions were seen per team per season (18% of plays). When the field width was increased by 3 yards, high-speed collision rate decreased to 135 +/- 3 per team per season, a 28% decrease ($P<0.0001$).

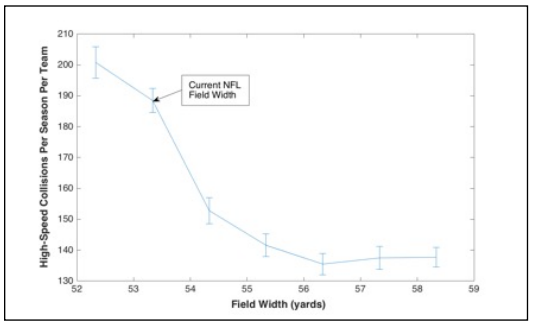

Figure 2: Results of the simulation illustrated in a graph of High-Speed Collisions Per Season Per Team versus Field Width. Each data point represents the mean over 10 seasons. Error bars represent standard error of the mean. A small increase in field width results in a significant decrease in rate of high-speed collisions.

Conclusions

Based on a novel computer simulation, even small increases in football field width can lead to substantial decline in rates of high-speed collisions. These findings could have implications for mTBI.

Learning Objectives

By the conclusion of this session, participants should be able to: 1) Describe the importance of field size of collision rate. 2) Identify that changing field size has potential to reduce rates of mTBI in football

References:

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