



Head impact location analysis in collegiate women's soccer indicates a lack of heading in practice may increase sub-concussive exposure

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INTRODUCTION

Heading is an important part of soccer, yet research has indicated that the cumulative effects of repetitive heading may cause sub-concussive injury (Koerte et al., 2015).

In soccer, players purposely and voluntarily use their heads to manipulate the ball and are exposed to a high number of head impacts over the course of a season.

Optimal headers near the top of the forehead result in lower linear and angular acceleration than headers on the top or sides of the head (Hanlon & Bir, 2012).

Linear and angular acceleration of the brain experienced during head impact have both been linked to cerebral concussion and other brain injuries, as a result of shear stress and intracranial pressure buildup (Ivancevic, V. G., 2009).

In practice, headers are routinely practiced with an emphasis on hitting the ball squarely with the top of the forehead.

In games, players are more focused on the outcome rather than on skill development, resulting in less focus on heading technique.

METHODS

Participants

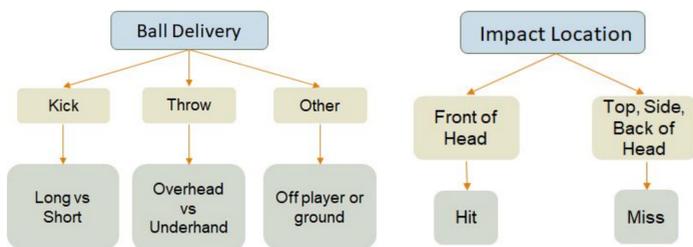
- 20 women Varsity soccer players (aged 18-23)

Protocol

- Video was collected for each game and practice over the course of a single competitive season, including playoff and cup games

Analysis

- All video recordings were analysed to determine two key factors:
 - Ball delivery
 - Ball impact location



OBJECTIVES

- To evaluate heading exposure in a collegiate soccer season
- To evaluate and determine the effectiveness heading technique by analyzing head impact location
- To compare heading exposure across practice and games based on ball delivery method

RESULTS

Table 1: Demographic Information

Number of Players	20
Average Age (Years)	19.90 ± 1.55
Average Height (cm)	168.66 ± 5.24
Average Number of Games	15.95 ± 5.61
Average Number of Practices	29.6 ± 2.99

Table 2: Player Positioning

Position	Number of Players
Midfielders	6
Defenders	6
Forwards	8

Table 3: Average Number of Headers

	Range	Mean
Games	2-143	54.24 ± 40.84
Practices	6-34	15.14 ± 9.10

RESULTS

Video analysis revealed a total of 1154 head impacts were recorded during 21 games played. In contrast, only 316 head impacts were recorded during 31 practices (Figure 1).

The analysis of the ball delivery method revealed that 48.0% ± 3.0% of all headers in games resulted from a long kick, as compared to other types of ball delivery. The largest discrepancy between game and practice head contacts was from an overhead throw; during games, 13.1% ± 4.3% of head contacts resulted from an overhead throw, whereas in practices, overhead throws made up only 1.4% ± 1.3% of head contacts (Figure 2).

The analysis of head impact location in games revealed 46% of head impact resulted in a HIT while 53% resulted in a MISS (1% unknown) (Figure 3). In comparison, in practice 55% of head impacts resulted in a HIT while 45% resulted in a MISS (Figure 4).

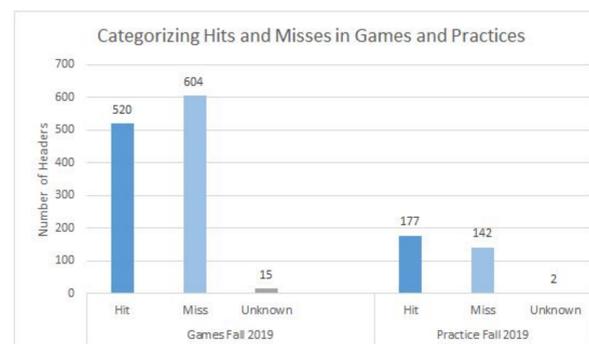


Figure 1. A comparison of the number of hits and misses for both games and practices.

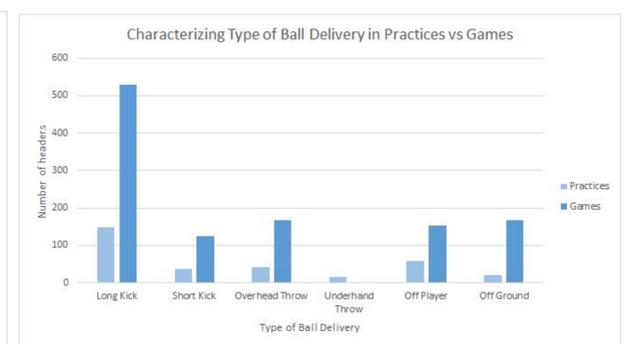


Figure 2. Categorizing ball delivery comparing practices and games.

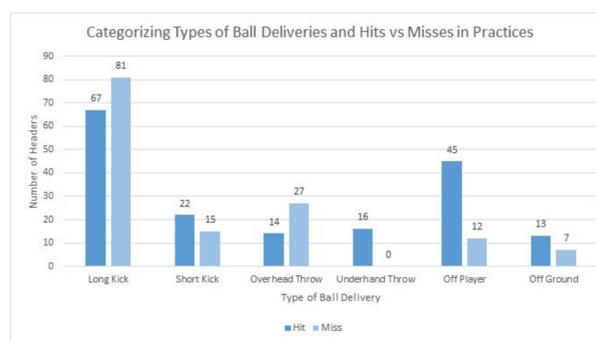


Figure 3. A comparison of the number of hits and misses for different ball deliveries in practices.

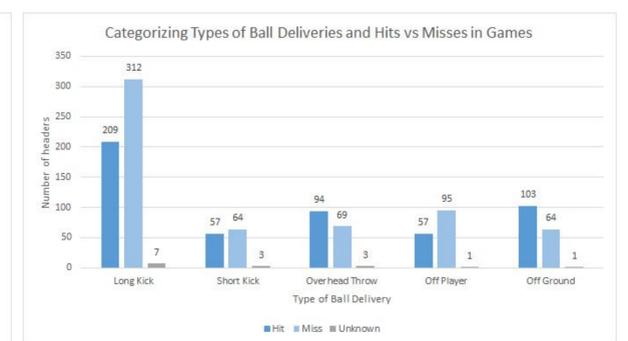


Figure 4. A comparison of the number of hits and misses for different ball deliveries in games.

CONCLUSIONS

Heading is an integral part of the game of soccer. Players are exposed to a large number of headers throughout a season and their career, potentially leading to sub-concussive effects on the brain.

Our results show that headers impacting the top, sides and back of the head are common during games. If optimal headers contacting the forehead can reduce linear and angular acceleration of the brain during head impact, increasing the percentage of optimal headers in-game may reduce the risk of brain injury in players.

During practice, players are in a controlled setting and can mentally prepare themselves to head the ball, focusing on proper technique. In comparison, during games players are not focused on technique and may be unprepared for headers.

Additionally, the most common type of ball delivery in games was found to be long kicks, which is also an example of a ball delivery with a low percentage of optimal headers in games.

Optimizing simulation of common in-game ball deliveries with low percentages of optimal headers such as long kicks in practice could have a positive effect on the percentage of optimal headers in games.

This study provides the foundation for coaches to structure their practice to promote the optimal header in games.

FUTURE RESEARCH

Future research to compare the difference in linear and angular acceleration of the brain for various ball deliveries will shed light on the effect of improper heading technique to decrease potential for sub-concussive effects.

Additionally, future research could investigate whether a player's level of confidence when anticipating a header has an effect on the likelihood of the header being optimal.

Limited representation of players and player-position of this team is not indicative of tactical structures used by other teams, which may result in different header probabilities. Further research into other styles of positioning structure may provide insights regarding specific player-positions and their respective probabilities of heading the ball.

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