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Original paper

Video analysis of craniofacial soccer incidents: A prospective study

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Abstract

Objective: The aim of this study was to assess the occurrence of incidents involving the craniofacial region during Brazilian Professional Soccer League matches. The mechanisms of these incidents and the association between their characteristics and severity were also analyzed. *Design:* Prospective Epidemiology Study. *Methods:* A total of 113 first division matches of the Brazilian Soccer League were analyzed in 2009. Data collected included incident type, site affected, causing agent, severity, player position, field zone, referee decision and time of the match when the incident took place. Descriptive analysis considered absolute and relative frequencies and 95% confidence intervals. Fisher Exact Tests were used to test associations ($p \leq 0.05$). *Results:* Out of all matches, in 84.1% at least one craniofacial region related incident happened, totaling 227 incidents (mean of 2.0 per match). With reference to incident mechanisms and characteristics, 91.2% were hits and the most affected site was the face (70.0%). The most frequent causing agent was the upper extremity (59.5%) and the most frequently affected player was the striker (31.7%). The incident severity was associated with player position ($p < 0.01$), the causing agent ($p < 0.01$), field zone ($p < 0.01$), site affected ($p = 0.03$) and incident type ($p < 0.01$). *Conclusions:* Soccer presented a high number of incidents against head and face during professional practice in Brazil, representing a real risk to athletes. Preventive strategies should be focused on game rule observance and "fair play".

Keywords: Soccer; Facial injuries; Head injuries; Videotape recording

1. Introduction

Currently, one hundred and twenty million people are estimated to take part in soccer matches worldwide,[1] making soccer one of the most popular sports ever. In Brazil, especially, soccer is a national passion, and millions of people play or support their teams in the local leagues.

Sports participation has been shown to increase traumatic injury risk.[2] In activities where body contact between athletes usually occurs, they are more likely to suffer dangerous falls or blows and, consequently, injuries to the craniofacial complex.[3–5]

Despite the popular belief that soccer is not a violent sport, it presents a high risk of injuries to athletes, including oral and craniofacial injuries.[6] Considering purposeful heading as an essential part of the game of soccer, it is reasonable to predict that many incidents against the head and face will occur during the competitive practice of the sport. In fact, head injuries have been reported to account for 4–20% of all injuries in soccer,[6] occurring as a consequence of the impact between heads or head and elbow in most cases.[7] In Europe, soccer is responsible for 50% of sports-related orofacial trauma.[4] In this context, the analysis of the occurrence and the mechanisms that lead to craniofacial incidents is essential to understand how to prevent the incidence of this type of injury.

The aim of this study was to assess the occurrence of incidents involving the craniofacial region during Brazilian

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Professional Soccer League matches by the analysis of video recordings. In addition, the mechanisms of these incidents and the association between their characteristics and severity were analyzed.

2. Methods

To access incidents with potential injury risk and injury occurrence, three matches from each of the 38 rounds of the Brazilian Professional Soccer League were randomly selected for analysis (totaling 114 games). The matches were analyzed by video tapes made available on the internet by Globo Television Network one day after the end of each round. Each match was recorded by at least five cameras. The incidents/injuries were classified according to type, head/face affected area, causing agent, action type, player position, field zone, time of game and severity. Incident types were classified as hit, laceration and fracture. In cases with multiple types of incidents the most severe was considered. Fracture diagnosis was defined by consulting the club medical department or their internet sites whenever direct contact was not possible. These contacts were established when a player left the game due to an incident/injury and a suspicion of fracture was identified by video analysis. The site affected was divided into head and face, and the face was categorized in thirds: the upper third, from the frontal bone to the upper limit of eye orbit; the middle third, from the zygomatic arch to the upper lips; and the lower third, from the lower lips to the bottom of the mandible. The causing agent was defined as the part of the opponent's body or game element (grass or ball) that caused the craniofacial incident. The type of action was dichotomized as intentional or occasional while player positions considered were the goalkeeper, side back, centre back, middle fielder and striker. The game field was divided into three zones: defense, middle field and attack. Time was continuously assessed, and later categorized in sextiles (each half of the game was divided into three parts). The severity of the incident was classified as: low, when the player lay on the grass for at least 15 s after being hit, or appeared to be in pain but did not receive any medical assistance; moderate, when the player received "first aid" out of the field but continued in the game; and severe when, after receiving medical treatment, the player was substituted of the game due to the incident/injury. Referee decision was categorized in "no foul", "foul pro injured player", "foul against injured player", "yellow card", and "red card".

Two different trained analyzers watched the full matches. Obtained data were compared between analyzers after each game analysis and, in case of disagreement on some of evaluated criteria, the study coordinator was consulted to discuss the specific incident. A total of seven incidents (3.1%) presented some disagreement. In these cases a consensus was reached after a new observation of the incident by the research team.

The number of incidents involving the craniofacial region was quantified per game and per 1000 playing hours. The total hours of match play were computed as follows: 22 players × 90 minutes = 33 hours per match. To obtain a more realistic analysis of incident occurrence by player position, a correction coefficient based on a 1:4:4:2 team formation, the most usual in Brazil, was used. Descriptive analysis of each variable collected was assessed in absolute and relative frequencies and 95% confidence intervals were calculated. Fisher Exact Test was used in the analysis of associations ($p \leq 0.05$).

The research protocol of this study was approved by the Research Ethics Committee of the Dentistry School from the Federal University of Pelotas – no. 43/2008. The identities of players and clubs involved on incidents were preserved.

3. Results

Of the 114 matches selected to be analyzed, one was excluded because the complete video tape of the match was not available, totaling 113 watched matches which represented almost 170 hours or 10,170 minutes of game. Out of all matches, in 95 (84.1%) at least one craniofacial region related incident happened. Of these, 41.9% presented one incident, 28.2% two, 17.2% three, 7.9% four and 4.8% more than five incidents. The number of craniofacial incidents observed was 227 (2.0 incidents per match), a rate of 60.9 per 1000 playing hours.

Table 1 shows a descriptive analysis of the data collected. From the total of incidents involving the craniofacial region, hits were the most common [91.2 (86.7–94.5)], followed by lacerations [8.4 (5.1–12.8)]. The head [30.0 (24.1–36.4)] and the middle third of the face [28.6 (22.8–35.0)] were the most affected sites, while contact by upper extremities (arms, elbows and shoulders) were the most usual causing agents [59.4 (52.8–65.9)]. Most incidents were classified as occasional [89.9 (85.2–93.5)] and the middle field was the field zone where most of these incidents occurred [47.1 (40.5–53.8)]. Strikers were the players most often involved in craniofacial incidents [15.8 (11.4–21.3)], which happened more frequently in the final third of each half of the match. More than 50% of the decisions taken by the referee were "no foul" [52.9 (46.1–59.5)].

The analysis of the factors that influence incident severity (Table 2) shows that goalkeepers were more exposed to moderate/severe incidents. Similarly, incidents caused by contacts with lower extremities in the defense zone of the field tend to be more severe. Also, incidents in the upper third of the face were more severe when compared with other parts of the face and head, while players that suffered laceration had a greater need of medical assistance during the match.

Upon observation of the site affected by the incident and the causing object, it was possible to verify that incidents caused by the ball and upper extremities tend to affect the

Table 1
Distribution of incidents by interest variables during professional soccer games in Brazil ($n = 227$).

Variable/categories	Number of incidents	% of incidents (95% CI)
Incident type		
Hit	207	91.2 (86.7–94.5)
Laceration	19	8.4 (5.1–12.8)
Fracture	1	0.4 (0.1–2.4)
Site		
Head	68	30.0 (24.1–36.4)
Upper third of face	44	19.4 (14.4–25.1)
Middle third of face	65	28.6 (22.8–35.0)
Lower third of face	50	22.0 (16.8–28.0)
Causing agent		
Head	35	15.4 (11.0–20.8)
Upper extremities	135	59.4 (52.8–65.9)
Lower extremities	41	18.1 (13.3–23.7)
Ball	13	5.7 (3.1–9.6)
Ground	3	1.3 (0.3–3.8)
Incident severity		
Low	163	71.8 (65.5–77.5)
Mild	58	25.5 (20.0–31.7)
High	6	2.6 (1.0–5.7)
Action type		
Accidental	204	89.9 (85.2–93.5)
Intentional	23	10.1 (6.5–14.8)
Player position		
Goalkeeper	15	6.6 (3.7–10.7)[a]
Right/left back	37	8.1 (4.7–12.2)[a]
Centre back	37	8.1 (4.7–12.2)[a]
Middle fielder	66	7.2 (4.1–11.2)[a]
Striker	72	15.8 (11.4–21.3)[a]
Referee decision		
No foul	120	52.9 (46.1–59.5)
Foul pro injured player	76	33.5 (27.4–40.0)
Foul against injured player	16	7.0 (4.1–11.2)
Yellow card	12	5.3 (2.8–9.1)
Red card	3	1.3 (0.3–3.8)
Field zone		
Defense	64	28.2 (22.4–34.5)
Middle field	107	47.1 (40.5–53.8)
Attack	56	24.7 (19.2–30.8)
Time of game (sextiles)		
First	35	15.4 (11.0–20.8)
Second	38	16.7 (12.1–22.2)
Third	44	19.4 (14.4–25.1)
Fourth	31	13.7 (9.5–18.8)
Fifth	28	12.3 (8.3–17.3)
Sixth	51	22.5 (17.2–28.4)

[a] % values consider the correction coefficient based on a 1:4:4:2 formation.

head more than the face, as compared with other causing agents, such as lower extremities and the head (Table 3).

4. Discussion

The main aim of the present study was to assess the occurrence of incidents involving the craniofacial region during professional soccer matches. It was observed that these types of incident occur with a considerable frequency during the matches, affecting players differently according to their

Table 2
Association between interest variables and incident severity during professional soccer games of the Brazilian league ($n = 227$).

Variable	Severity of incident			p-Value
	Low	Mild	High	
Player position				0.008[a]
Goalkeeper	6 (40.0)	8 (53.3)	1 (6.7)	
Right/left back	23 (62.2)	13 (35.1)	1 (2.7)	
Centre back	28 (75.7)	9 (24.3)	0 (0.0)	
Middle fielder	55 (83.3)	8 (12.1)	3 (4.5)	
Striker	51 (70.8)	20 (27.8)	1 (1.4)	
Causing agent				0.003[a]
Head	21 (60.0)	14 (40.0)	0 (0.0)	
Upper extremities	109 (80.7)	24 (17.8)	2 (1.5)	
Lower extremities	22 (53.7)	15 (36.6)	4 (9.8)	
Ball	8 (61.5)	5 (38.5)	0 (0.0)	
Ground	3 (100.0)	0 (0.0)	0 (0.0)	
Action type				0.38[a]
Accidental	145 (71.1)	54 (26.5)	5 (2.4)	
Intentional	18 (78.3)	4 (17.4)	1 (4.3)	
Field zone				0.003[a]
Defense	36 (56.2)	26 (40.6)	2 (3.1)	
Middle field	86 (80.4)	17 (15.9)	4 (3.7)	
Attack	41 (73.2)	15 (26.8)	0 (0.0)	
Incident site				0.27[a]
Head	49 (72.1)	16 (23.5)	3 (4.4)	
Upper third of face	24 (54.5)	20 (45.4)	0 (0.0)	
Middle third of face	49 (75.4)	14 (21.5)	2 (3.1)	
Lower third of face	41 (82.0)	8 (16.0)	1 (2.0)	
Incident type				≤0.001[a]
Hits	156 (75.4)	46 (22.2)	5 (2.4)	
Laceration	7 (36.8)	12 (63.2)	0 (0.0)	
Fracture	0 (0.0)	0 (0.0)	1 (100.0)	

[a] Fisher exact test.

position, the causing agent and field zone. Also, it can be observed that the mechanism of the incident affected the site reached. Incidents caused by upper extremities tend to affect the head more frequently than the face. The assessment of incidents by video analysis was a subjective and qualitative method that has been recently used to elucidate in detail the mechanisms of incidents during soccer practice.[8–10] The videos analyzed were high-quality and well-defined with a sufficient number of cameras in each match, which allowed the analysis of incidents from at least two points of view (one in close-up). Also, each action could be observed in the slow-motion mode, reducing disagreements. Due to the

Table 3
Association between site of incident and causing agent in professional soccer matches from Brazilian league ($n = 227$).

Variable	Site of incident		p-Value
	Face	Head	
Causing agent			0.014[a]
Head	15 (42.9)	20 (57.1)	
Upper extremities	33 (24.4)	102 (75.6)	
Lower extremities	18 (43.9)	23 (56.1)	
Ball	1 (7.9)	12 (92.1)	
Ground	1 (33.3)	2 (66.7)	

[a] Fisher exact test.

fact that the incidents were assessed by video analysis, it was impossible for the authors to have a precise diagnosis of incident consequences, and thus define these consequences as real injuries, including concussions. On the other hand, this method is the unique feasible possibility to analyze a representative sample of matches from a national league in a country with continental dimensions like Brazil. While hits and lacerations were assessed by visual analysis, fractures were defined by consulting either medical club departments or official website information. Despite the fact that incidents are not considered injuries by definition, they represent a potential risk of injury occurrence,[11] and the analysis of the mechanisms involving these incidents is extremely important to understand and prevent injuries occurrence during soccer practice. Also, the validity of using incident – by definition, game stopped because a player appeared to be injured or needed medical attention – as the unit of analysis can be questioned. In some cases, players would simulate an injury to gain some tactical advantage. We believe, though, that this kind of behavior is not representative of the whole analysis once the real contact could be observed in the video and simulations without contact to the head or face were not included in the analysis.

Despite the fact that several studies have described the occurrence of injuries and their characteristics during professional soccer practice,[10,12,13] very few studies have focused on head and face injuries,[3,7,8] and none in Brazil. Incidents affecting the face were more commonly observed than incidents affecting the head, in agreement with findings from Icelandic and Norwegian leagues.[8] Our findings also show that incidents caused by an upper extremity to head impact affect the face to a much greater extent than other contact types.

Elbow to head impacts have been described in the literature as the action with greatest potential to lead to head or face injury.[8] Although our findings are partially in agreement with this information, once the upper extremities were the agent that caused more incidents, the severity of the incident was greater when caused by the lower extremities. Even though relatively few in number, lower extremities to head incidents have the potential of causing severe injuries to the face and head. This study demonstrates that almost half of these incidents were classified as moderate or severe. In addition to this, goalkeepers tended to suffer more serious incidents when compared with other player positions, which can be attributed to the fact that these players are more exposed to head to leg impacts due to the need to go down on the ground as a part of their role in the game.

Considering only player position, there is not a consensus on injury risk. In the present study, strikers were significantly more affected by incidents than other players, which is in accordance with other findings.[14] Other studies showed no differences in injury risk for different player positions,[15] whereas one study found a major risk for defenders.[16] It is important to highlight that these studies evaluated the occurrence of incidents involving all parts of the body, not only the head and face, which can account for the differences found in our research.

Although strikers were more affected by head incidents, the field zone where most incidents occurred was the midfield, probably as a result, as described by Andersen et al.[8] of the "war in the midfield area", where the aim is either to win the ball when the opponent is on the attack and thus defensively unbalanced, or to stop the opponent that has won the ball from exploiting his tactical advantage. Strikers, defenders and middle fielders play an important role in this "war". Considering incidents severity, the defense zone was the most affected, probably because strikers are more aggressive when near the goal.

Findings on the time of the match are in agreement with a previous study by Hawkins et al. (2001),[17] who found that more injuries occur in the final 15 minutes of each half of the match. It was observed probably because the teams are more focused in getting a favorable score to finish either the first half or the final half of the match, thus obtaining an advantage over the opponent team.

A recent study showed that most of the physicians of Brazilian professional soccer teams do not have sufficient knowledge about emergency procedures and prevention of dental trauma, a common injury to the craniofacial region.[18] Our findings add information on injury type and mechanisms and can help professionals involved in soccer practice to prevent injury occurrence as a consequence. Referees also play a role in the prevention of injuries. However, in more than 50% of the incidents observed in our study, the decision taken by the referee was "no foul", as seen in other European countries.[8,9] On the other hand, protective appliances like mouthguards and headgear should be provided to athletes so as to prevent craniofacial injuries. Several authors have mentioned that the use of mouthguards could prevent orofacial injuries in different kinds of sports, including soccer.[19,20] In spite of this, mouthguard use in soccer is not common worldwide.[18,21] Headgear attenuate the impact caused by head to head contact, but is not effective in decreasing the ball impact when heading,[22] which cannot be considered as an important problem as our findings suggest that incidents caused by a ball to head impact are very rare during professional soccer games.

Despite the improvement in protective equipment, it is rare to see a football player using any type of gear for this purpose. Thus, it seems more reasonable to obtain a decrease in incidents involving head and face by promoting the observance of game rules and "fair play" spirit by both athletes and referees.

5. Conclusion

It was possible to observe a high number of incidents against head and face during professional soccer practice in Brazil, representing a real risk of injuries occurrence to athletes. Preventive strategies should be focused on the

observance of game rules and "fair play" spirit by both athletes and referees and on the improvement of the knowledge of players, coaches and clubs' health staff about the use of protective appliances.

Practical implications

- This study confirms that soccer practice presents a high number of incidents against head and face, which can lead to injuries to athletes.
- The observance of game rules and "fair play" spirit by both athletes and referees seems to be the better strategy to reduce the number of incidents.
- The use of protective appliances could be taken in account for players in risk position, as goalkeepers and other players that are involved in the defense zone.

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