Mechanisms and consequences of head injuries in soccer: a study of 451 patients

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Object. The goal of this study was to evaluate the incidence and mechanisms of head injury during soccer games and to describe the results after spontaneous resolution of symptoms or after treatment.

Methods. In a retrospective study from 2005, records on 451 players from the German Soccer Association who had suffered various injuries were collected. The study used a questionnaire in which the player described the accident and the playing situation as well as the clinical course after trauma. This questionnaire also included information about the physical symptoms of the players and the length of their rehabilitation. Two groups were formed: one with head injuries (case group), and the other with injuries of other body parts (control group).

Results. Of the injuries reported, 108 (23.9%) were related to the head, 114 (25.3%) to the knee, 58 (13%) to the ankle, 56 (12%) to the calf, and 30 (7%) to the shoulder. The areas of the head most frequently involved were the facial and occipital regions. In the head injury group, the head duel was the most common playing action to lead to trauma. In those cases, the body part that hit the injured player was the elbow, arm, or head of the opponent. The most common playing situation was combat in the penalty area. The median hospitalization time after the trauma was 2 days for the case group and 5 days for the control group. The rehabilitation time for the case group was also shorter (median 6.5 days) than for the control group (median 30 days).

Conclusions. Trivial head injuries in soccer can have a long and complicated course. Nevertheless, the temporary disability is shorter in most cases than for players with injuries to other parts of the body. Modifying the rules of play would be necessary to reduce the incidence of head trauma. (DOI: 10.3171/2011.10.FOCUS11184)

Key Words • head injury • trauma • soccer • mechanism of injury • outcome • disability

Soccer is the most popular sport in the world, with approximately 200,000 professional and 240 million amateur players.23 In the last 16 years, a variety of studies have reported on injuries to the head and other parts of the body. Head injuries can be the result of the contact of one head with another head, with the upper extremity of the opponent (usually the elbow), with the ground, with the ball, with the foot or knee, and (rarely) with goalposts.13 Head injuries were reported to amount to 4%–22% of all injuries in soccer, although the severity of all the injuries and the mechanisms involved have not been well documented.24,27,39

In 1991, Tysvaer and Løchen38 postulated that “heading” the ball could lead to chronic brain injuries such as those noticed in boxers.19 Since the publication of these results, several cross-sectional studies4,21,27–30,38 have indicated that soccer can cause measurable sustained brain impairment, and this has raised significant concerns about the effects of repetitive heading in soccer.

The frequency of soccer injuries overall is estimated to be approximately 10–35 injuries per 1000 playing hours.14 The majority of injuries occurred at the lower extremities, mainly in the knees and ankles, although, as Dvorak and Junge14 mentioned, the number of head injuries was probably underestimated. This is due to the fact that the player is afraid to mention his or her symptoms to a trainer for fear of being prevented from returning to play.18 In an anonymous study done by Delaney et al.,11 more than 46% of university soccer players experienced a concussion in just one fall season, and almost two-thirds of the same group experienced a concussion over the 12-month period while playing soccer.12 Serious head injuries are well documented, whereas mild head injuries are often not examined. Usually only players who had concussions with severe symptoms presented for evaluation and diagnosis in the emergency department.

Most of the head injuries are skull fractures or an internal head injury like intracranial hemorrhage, epidural or subdural hematoma, or cerebral contusion.11 Delaney et al.13 reported that the side of the head seems to be the most vulnerable area for concussions, because most concussive blows occur to the side or temporal part of the head. These results differed from our study.
The acute injuries occur in a split second, and it is difficult for medical staff to provide exact information about the injury mechanisms to avoid their consequences. Therefore, based on a series of cross-sectional studies in active and older retired soccer players of the Hessian soccer association (Hessischer Fußball Verband), and using a standardized questionnaire, we tried to describe the most common mechanisms and consequences of head injuries in soccer in a study of 451 amateur players.

Methods

Patient Population

As a source for our retrospective study, we used the claim register of the ARAG, the sport insurance provider for all athletes of the Hessian sports association (Landessportbund Hessen). The claim register of the ARAG includes all registered injuries that have been treated by medical staff. We included all injuries from the previous year, and enrolled 841 people in the study. After the data interpretation and statistical evaluation, we ended up including 451 players in the study.

Our study was retrospective and assisted by a standardized questionnaire. We used coded numbers and anonymous data. We excluded 390 players who, although they matched the case and control groups, did not provide complete information; we included only players who returned completely filled and well-documented questionnaires. We then designated 2 groups. The case group included all athletes who got a head injury during a match or while training (108 players). The control group included all athletes who got injured on other parts of the body during a match or while training (343 players). We did not document overlaps between injury groups.

Questionnaire Used

The questionnaire included 2 parts. In the first part, we collected all the pieces of information on the mechanisms and consequences of the injuries as well as the matching of data and the participant’s capacity to remember the injuries. This part of the questionnaire was based on a validated questionnaire that had been established by Bochum University for the study of injuries in soccer, and we modified it with information on training characteristics.16

The second part of the questionnaire was for information on the symptoms and type of head injury. Importantly, this part also included the specification of time of injury, the type of symptoms as well as their intensity, and the location of the head injury. Almost all of the questions in the first part of the validated questionnaire were closed ended, and the questions in the matching part, in which we interviewed the participants of the study about biological information as well as about their playing level, were open ended. We excluded all enrolled participants of the study who got injured outside the playing area, or who submitted incomplete data on their questionnaires.

Statistical Methods

For analyses dealing with the case series of injured players, t-tests of association were used to compare proportions in the tables. The Fisher exact test was used when 80% of the expected counts were < 5. Statistical analyses were conducted using SPSS version 12.0 software. The level of significance was set a priori at p < 0.05 for t-tests of association.

Results

The case group included 108 athletes aged 6–60 years (median 23 years); the largest part of this group included players between 11 and 25 years of age. This group included 104 male and 4 female patients. The control group included 343 players (323 male and 20 female patients) who had suffered an injury to an extremity or the torso. The age of the players in this group was higher than in the case group; the median age in the control group was 24 years. Consequently, the players in the case group were significantly younger than those in the control group at the time of injury (p = 0.0204). The sex of the injured athletes was not significant (p = 0.280).

Allocation of Head Injuries

In the case group, 57.4% of all injuries (62 of 108) occurred in the facial area. The zygomatic and the orbital regions were the main focus of facial injuries (33 [53.2%] of 62). The nasal region was the second most frequently injured area of the face (21 [33.9%] of 62). In the neurocranium, the occipital region was the most frequently injured head area (27 [58.7%] of 46; 25% of all head injuries), followed by the parietal, frontal, and temporal regions (Fig. 1).

Symptoms of Head Injuries

The typical symptoms of head injuries were headache (91.7%), vertigo (72.1%), amnesia (51.3%), sleep disorders (49.5%), loss of consciousness (45.9%), nausea (40.5%), and poor concentration (29.1%). The highest intensity occurred in the cases of head and neck pain. The longest duration of symptoms occurred in the cases of sleep disorder (7.1 days) and vertigo (6.3 days).

![Fig. 1. Bar graph showing head injuries, categorized by the injured part of the head.](Image)
Mechanisms and consequences of head injuries in soccer

Injuries in the Case Group

In the case group, 46 (42.6%) of 108 athletes suffered from collateral injuries. The most common collateral injuries were fractures (35 [76.1%] of 46), mainly of facial bones like the os nasale (17 [37%] of 46) and the os zygomaticum (7 [15.2%] of 46). A Le Fort fracture also occurred occasionally (3 cases). Other injuries were lacerations (8) and contusions (6), which were mostly localized in the facial region (64.3%). A cerebral infarction (relating to the cerebellum and middle cerebral artery) occurred twice as a consequence of a head injury.

Allocation of Injuries in the Control Group

In the control group, the most injured parts of the body were at the lower extremities (241 [70.3%] of 343), with the upper extremities being injured in 88 (25.7%) of 343 cases. A torso injury only occurred in 14 (4%) of 343 cases.

Injuries in the Control Group

The injuries of the lower extremities were mainly at the knee (114 [47.3%] of 241) or localized ruptures of ligaments (88 [36.5%] of 241). The most common ankle joint injuries were bone fractures (31 [12.9%] of 241) or ruptures of ligaments (25 [10.4%] of 241). The most common injuries at the shin were fractures (39 [16.2%] of 241) and ruptures of the Achilles tendon (12 [5%] of 241). The injuries of the upper extremities included distal fractures (42 [47.7%] of 88) and shoulder fractures (19 [21.6%] of 88). Other players suffered lacerations or contusions on their upper extremities.

Injuries Overall

On the whole, the right side of the body was more frequently injured than the left side. An investigation of the results of all injuries showed that the medium-heavy injuries occurred more often in the case group, whereas the heavy injuries occurred more often in the control group (Table 1).

As shown in Table 2, according to the system of Tönnis and Loew, the largest portion of the players of the case group suffered from Level I severity head injuries (48.1%). Loss of consciousness and amnesia occurred in 56 (51.9%) of 108 players in the case group.

Seventy-four (68.5%) of the athletes in the case group and 274 (79.9%) of those in the control group received in-patient care. In the case group, the therapy was performed conservatively (nonsurgically) for 67 (62%) of 108 injuries, but only for 67 (19.5%), a much smaller percentage, of 343 in the control group. In the control group, 276 (80.5%) of the 343 players were treated surgically. Conservative (p < 0.001) and outpatient (p = 0.0279) treatments were done significantly more often in players in the case group than in those in the control group.

A follow-up treatment was done for 73 (67.59%) of the 108 players in the case group, and for 321 (93.6%) of the 343 players in the control group. Furthermore, subsequent rehabilitation was necessary for 275 (80.2%) of the control group but for only 4 (3.7%) of the case group. In the case group, the occurrence of follow-up treatment (p = 0.000002) and rehabilitation (p < 0.001) was significantly lower than for the control group.

The comparison of these 2 groups showed no significant differences between the players in height or weight, but the Body Mass Index of the players in the case group was significantly lower than that of the players in the control group (p = 0.0199).

The amount of experience playing or time training were not significantly different between groups (p = 0.413). However, the number of competitions was significantly different and was decidedly higher in the case group (p = 0.0377; see Table 3). The investigation of both groups showed no significant differences in the amount of time devoted to recovery due to a rest from training or from competition (Table 4).

As shown in Table 5, we observed that injuries for the case group occurred more often during a competition, at 91 (84.3%) of 108, than did injuries for the control group, at 239 (69.7%) of 343. The differences are significant (p = 0.0008). Our retrospective investigation showed that midfielders suffered an injury more commonly than other players. The results were not significant (p = 0.4779).

The investigation of the place of injury showed that head injuries occurred significantly more often in the central part of the field than on the periphery (p = 0.0093). Furthermore, head injuries took place significantly more often in the central part of the field than on the periphery (p = 0.0214). Defensive or offensive halves of the field showed no significant differences (p = 0.6977). Almost all inju-

### Table 1: Outcome of soccer-related injuries in 108 patients in the case (head injury) and 343 in the control (other injuries) groups*

<table>
<thead>
<tr>
<th>Injury Grade</th>
<th>Case Group (%)</th>
<th>Control Group (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>marginal: disabled 1–3 days</td>
<td>NA</td>
<td>20 of 343 (5.8)</td>
</tr>
<tr>
<td>low: disabled 4–7 days</td>
<td>9 of 108 (8.4)</td>
<td>33 of 343 (9.6)</td>
</tr>
<tr>
<td>medium-heavy: disabled 7–31 days</td>
<td>52 of 108 (48.1)</td>
<td>92 of 343 (26.8)</td>
</tr>
<tr>
<td>heavy: disabled &gt;31 days</td>
<td>47 of 108 (43.5)</td>
<td>198 of 343 (57.7)</td>
</tr>
</tbody>
</table>

* NA = not applicable.

### Table 2: Severity of head injuries in the case group*

<table>
<thead>
<tr>
<th>Level of Severity</th>
<th>Loss of Consciousness</th>
<th>Amnesia</th>
<th>Portion of Players (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0 min</td>
<td>&lt;30 min</td>
<td>52 of 108 (48.1)</td>
</tr>
<tr>
<td>II</td>
<td>&lt;5 min</td>
<td>&gt;30 min</td>
<td>47 of 108 (43.5)</td>
</tr>
<tr>
<td>III</td>
<td>&gt;5 min</td>
<td>&gt;24 hrs</td>
<td>9 of 108 (8.4)</td>
</tr>
</tbody>
</table>

* According to the system of Tönnis and Loew.
ties of players in the control group occurred in their own half of the playing area.

Significantly, the occurrence of head injuries almost always involved contact with another player, at 93.5% (p = 0.0001; see Table 6). Head injuries occurred more often in striker positions than in defensive positions in the case group, but not in the control group. In the majority of cases, head injuries occurred during ball duels (80.6%). This result was highly significant (p = 0.0179). The second mechanism of head injuries was ball shots on the head without an external actor (see Table 7).

In the control group, most of the noncontact injuries were caused by disturbances in the running process. Twisting (36.8%), stumbling (23.8%), and rotation while running (22.8%) were the most common mechanisms of injury in this group.

The development of the injuries is different between the groups. In the case group, they were mostly due to an external actor, but in the control group they were almost equally caused by the players themselves and by other players (30.0% and 31.5%, respectively) (see Table 8).

Additionally, excessive exertion of the players led to injuries for 66.7% of the case group and for 68.5% of the control group. Another reason for the injuries was breaking the rules, for 33.3% of the case group and for 31.5% of the control group. Our investigation of the kind of playing field showed that most injuries occurred on artificial turf, for 65 (60.2%) of 108 patients in the case group and for 256 (74.6%) of 343 patients in the control group.

**Discussion**

Soccer has not always been perceived to be a high-risk sport for craniofacial injuries. However, in recent years studies have shown that this sports discipline is also a high-risk sport in this regard. Current investigations in Europe have shown that soccer is responsible for approximately 50% of all sport-related injuries.9 The incidence of head and body injuries is influenced by the popularity of soccer in each country.

**TABLE 5: Setting of injury and position of injured player in case and control groups**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Case Group (%)</th>
<th>Control Group (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>setting of injury</td>
<td></td>
<td></td>
</tr>
<tr>
<td>competition</td>
<td>91 of 108 (84.3)</td>
<td>239 of 343 (69.7)</td>
</tr>
<tr>
<td>training</td>
<td>17 of 108 (15.8)</td>
<td>104 of 343 (30.3)</td>
</tr>
<tr>
<td>player position</td>
<td></td>
<td></td>
</tr>
<tr>
<td>midfielder</td>
<td>40 of 108 (37.0)</td>
<td>151 of 343 (44.0)</td>
</tr>
<tr>
<td>striker</td>
<td>31 of 108 (28.7)</td>
<td>67 of 343 (19.5)</td>
</tr>
<tr>
<td>defensive position</td>
<td>20 of 108 (18.5)</td>
<td>93 of 343 (27.1)</td>
</tr>
<tr>
<td>goalkeeper</td>
<td>17 of 108 (15.8)</td>
<td>32 of 343 (9.4)</td>
</tr>
</tbody>
</table>

**TABLE 6: Occurrence of contact injury and position of other players involved in contact**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Case Group (%)</th>
<th>Control Group (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>contact injury</td>
<td></td>
<td></td>
</tr>
<tr>
<td>yes</td>
<td>101 of 108 (93.5)</td>
<td>211 of 343 (61.5)</td>
</tr>
<tr>
<td>no</td>
<td>7 of 108 (6.5)</td>
<td>132 of 343 (38.5)</td>
</tr>
<tr>
<td>player position</td>
<td></td>
<td></td>
</tr>
<tr>
<td>midfielder</td>
<td>40 of 101 (39.6)</td>
<td>90 of 211 (42.6)</td>
</tr>
<tr>
<td>striker</td>
<td>28 of 101 (27.7)</td>
<td>36 of 211 (17.1)</td>
</tr>
<tr>
<td>defensive position</td>
<td>25 of 101 (24.8)</td>
<td>65 of 211 (30.8)</td>
</tr>
<tr>
<td>goalkeeper</td>
<td>8 of 101 (7.9)</td>
<td>20 of 211 (9.5)</td>
</tr>
</tbody>
</table>

Similarly to the results of Andersen et al.,2 in our investigation the craniofacial region is, at 57%, the most injured part of the head. Furthermore, these authors investigated the mechanisms of head injuries and found, as did our investigation, that 73% of facial injuries were caused by contact with upper extremities. Head-on-head injury in the Andersen et al. investigation, on the other hand, accounted for only 35% of all head injuries, whereas in our investigation it accounted for 41.4%, primarily at the side of the head. Facial injury occurred in the investigation of Andersen et al. in head duels in 31% of cases and in 33.3% of cases in our investigation. Chomiak et al.9 found that 74.2% of the players suffered a lower-extremity injury during play, whereas it was 70.3% in our investigation. We found that upper-extremity injuries occurred during play in 25.7% of our control group, whereas Chomiak et al. found the same to be true for only 14.4%.

Boden et al.8 investigated head injuries in 29 players, whereas our group involved 108 players. Boden and colleagues described mild head injuries in 72% of all investigated players, whereas in our investigation 48.1% of players suffered mild, 43.5% had moderate, and 8.4% had severe head injuries. Because the investigation of Boden et al. only involved 29 players and we investigated 108 players, we postulated that the frequency of occurrence of the moderate and severe head injuries in a bigger group is clearly higher. In our investigation, we found that headaches were the main symptom of head injuries in 91.7% of cases, similar to Boden’s findings at 97%. Other symptoms were amnesia, poor concentration, vertigo, nausea, and personality change, which were comparable to the study results of Boden et al. (see Table 9).

**TABLE 7: Mechanism of head injury**

<table>
<thead>
<tr>
<th>Type of Play</th>
<th>Case Group (%)</th>
<th>Control Group (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ball duel</td>
<td>87 of 108 (80.6)</td>
<td>164 of 343 (47.8)</td>
</tr>
<tr>
<td>head on head</td>
<td>36 of 87 (41.4)</td>
<td>NA</td>
</tr>
<tr>
<td>arm on head</td>
<td>23 of 87 (26.4)</td>
<td>NA</td>
</tr>
<tr>
<td>leg on head</td>
<td>14 of 87 (16.1)</td>
<td>NA</td>
</tr>
<tr>
<td>head on torso</td>
<td>14 of 87 (16.1)</td>
<td>NA</td>
</tr>
<tr>
<td>ball contact w/o ball duel</td>
<td>15 of 108 (13.9)</td>
<td>96 of 343 (27.9)</td>
</tr>
<tr>
<td>no ball duel or ball contact</td>
<td>2 of 108 (1.8)</td>
<td>83 of 343 (24.2)</td>
</tr>
<tr>
<td>assault</td>
<td>4 of 108 (3.7)</td>
<td>NA</td>
</tr>
</tbody>
</table>
Mechanisms and consequences of head injuries in soccer

### TABLE 8: Cause of injury in the case and control groups

<table>
<thead>
<tr>
<th>Cause</th>
<th>Case Group (%)</th>
<th>Control Group (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>another player</td>
<td>57 of 108 (52.8)</td>
<td>108 of 343 (31.5)</td>
</tr>
<tr>
<td>own blame</td>
<td>16 of 108 (14.8)</td>
<td>103 of 343 (30.0)</td>
</tr>
<tr>
<td>shared blame</td>
<td>16 of 108 (14.8)</td>
<td>26 of 343 (7.6)</td>
</tr>
<tr>
<td>accident</td>
<td>14 of 108 (13.0)</td>
<td>54 of 343 (15.7)</td>
</tr>
<tr>
<td>location on playing field</td>
<td>5 of 108 (4.6)</td>
<td>52 of 343 (15.2)</td>
</tr>
</tbody>
</table>

We found that most head injuries occurred among younger players, who suffered a head injury through contact with the ball. Furthermore, older players suffered these injuries through ball duels; similar results were published by Pickett et al. The reason for the number of head injuries at the ages of 6–10 years is probably the fast development of condition, power, and speed at this age, while the coordination of muscles is not able to keep pace. All these factors induce aggressive ways of playing and lead to head injuries among members of this young group. Also, research of the literature shows results that confirm our finding that male players more commonly suffer head injuries.

Age, sex, and play experience were internal factors of the mechanisms of head injuries of the soccer players, adding to the external factors of place, reason for playing, play position, and playing situation. Furthermore, the condition and kind of location have very often been discussed in the literature as an important factor in head injuries. Andersen et al. and Boden et al. published results that wet artificial turf was most commonly the reason for head injuries. Also Chomiak et al. reported that the type of playing surface was very important in the evaluation of head injuries. In our investigation, the injuries occurred on artificial turf for 60.2% (65 of 108) of the case group and for 74.6% (256 of 343) of the control group.

Our investigation of another external factor, the reason for playing, showed that the frequency of head injury increased during the match (84.2%) and not in training. Boden et al. also found that 79% of all head injuries occurred during the match and not in training. Peterson et al. published findings that almost all head injuries occurred during the match.

In our investigation, the playing position was not significant, which is consistent with previous investigations by Chomiak et al., Nielsen and Yde, and Hawkins and Fuller. The midfield players had the highest frequency of injury in our investigation (37%), similar to the results of Chomiak et al., at 32.9%. Berbig published the finding that goalkeepers suffered from head injuries more frequently than other players. In our investigation, however, similar to the findings for Chomiak et al., we found that a goalkeeper had suffered head injury in only 15.8% of cases. Therefore, in our opinion, the player in the midfield position is more frequently injured than a defensive or striker player. The frequency of the injuries also depends on their location on the playing field. The high frequency of injury in the midfield and in the defending penalty area has already been published by Andersen et al., which is confirmed by our investigation, but these results are opposite to the findings of Chomiak et al. and Ekstrand and Gillquist, who postulated a higher frequency of injury on the offensive side. However, in our investigation, head injuries occurred most frequently in the penalty and goal areas, as in the study published by Kirkendall et al. They pointed to ball duels and clashes between strikers and goalkeepers on that small area as a reason for the frequency of head injuries. Furthermore, in our study, the midfielders in the case group were injured on the head significantly more often than other players. Fuller et al. actually found that injuries most often occurred in the offensive half of the playing field but, as found in our results, they postulated that the outside section was very safe.

In our study, 93.5% of head injuries occurred as contact injuries, whereas Nielsen and Yde found that only 74% did. Boden et al. and Pickett et al. found contact head injuries in only 65% of cases. These results are self-explanatory because of the heterogeneity of the age groups and the size of the groups. Fouls are another reason for contact injuries. In our investigation, only 24.3% of contact injuries could be attributed to fouls. However, Chomiak et al. and Peterson et al. found that professional players reported that fouls were the reason for contact injuries (66.7% and 40%, respectively). This higher rate of fouls in the studies of these investigators was probably due to the players’ mastery of technique. However, almost the same rate of fouls occurred in the case and control groups. Therefore, fouls were not a significant cause of head injuries.

Arnason et al. reported that most injuries in soccer occurred through personal negligence, and that head injuries happened through contact with other players and through fouls in 52.7% of cases. In our study, duels were the reason and mechanism for 55.9% of all injuries. These mechanisms include an opponent treading on the player or player falls during duels. Bjordal et al. found that 46% of injuries of the cruciate ligament occur through this mechanism. Nielsen and Yde found contact head injuries in only 65% of cases. These results are self-explanatory because of the heterogeneity of the age groups and the size of the groups. Fouls are another reason for contact injuries. In our investigation, only 24.3% of contact injuries could be attributed to fouls. However, Chomiak et al. and Peterson et al. found that professional players reported that fouls were the reason for contact injuries (66.7% and 40%, respectively). This higher rate of fouls in the studies of these investigators was probably due to the players’ mastery of technique. However, almost the same rate of fouls occurred in the case and control groups. Therefore, fouls were not a significant cause of head injuries.

### TABLE 9: Symptoms of head injury in the present study compared with an earlier investigation in 29 patients

<table>
<thead>
<tr>
<th>Symptoms of Head Injury</th>
<th>Boden et al.</th>
<th>Present Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>headache</td>
<td>97%</td>
<td>91.7%</td>
</tr>
<tr>
<td>amnesia</td>
<td>76%</td>
<td>51.3%</td>
</tr>
<tr>
<td>poor concentration</td>
<td>62%</td>
<td>29.1%</td>
</tr>
<tr>
<td>vertigo/nausea</td>
<td>52%</td>
<td>72.1%/40.5%</td>
</tr>
<tr>
<td>personality change</td>
<td>14%</td>
<td>6.3%</td>
</tr>
</tbody>
</table>
among 248 professional soccer players. Andersen et al. also stated that this mechanism was a cardinal mechanism of head injuries for 58% of professional Norwegian and Icelandic soccer players. In our study, head-on-head was the most common mechanism of injury in duels (41.4%). Upper extremity–to-head only led to injury in 26.4% of cases. Boden et al. (28.0%), Fuller et al. (33.0%), and Pickett et al. (25.5%) also found that head-on-head in duels was the most common mechanism of head injury, not contact between the head and the upper extremities. However, the main mechanism of all head injuries is the collision of 2 players (93.5%) and, in 51.6% of cases, header duels.

Fuller et al. reported that the use of the upper extremities against the rules leads to significantly more head injuries than other actions during play. Boden et al. published findings that 14% of all collisions and head injuries occurred through the use of upper extremities to the head. According to Andersen et al., 43% of head injuries were also caused by the upper extremities of the opponent, with 34% using the elbow and 7% using the hand or arm. Head-on-head contact caused 33% of head injuries, as reported in the same investigation. The results were obtained by video analysis of professional players. Head-on-head contact is the second most common mechanism in the occurrence of head injuries. For only 6% of investigated players, a head injury happened because of the opponent.

We observed in our study that almost the same number of patients in the 2 groups were treated in hospital, although the treatment was different. In the case group, the treatment was almost always conservative, whereas the athletes in the control group got surgical treatment in 80.5% of cases. This suggests a high frequency of fractures of extremities, which have to be treated surgically.

Our study investigated the necessity of rehabilitation and found, significantly, that only 3.7% of the case group players and 80.2% of the control group players needed rehabilitation. This suggests that head injuries need an acute treatment and that rehabilitation is only necessary sporadically. Additionally, the conservative treatment of head injuries allows shorter rehabilitation periods. Hospitalization duration differences were only marginal between the case group and the control group. This kind of investigation has not been published until now. However, the moderate and severe head injuries were common occurrences, as suspected, and deserve more attention in the future.

The recent trend in soccer to protect players from head injuries is to forbid heading, or at least to limit it because of the opponent. The second trend is the use of headgear, which is permitted by FIFA (Fédération Internationale de Football Association). There are newly developed national standards for headgear.

Initially, in an experimental study conducted in 2003, Nauheim et al. showed that the use of headgear could reduce impact when heading, and that headbands may play a role in decreasing impact for more forceful blows. In 2006, Al-Kashmiri and Delaney published a report about head and neck injuries. They also postulated after their research that protective headgear may play a role in the prevention of concussions.

Jordan et al. published their findings that males have 0.14 concussions/1000 athletes and females have 0.15 concussions/1000 athletes. Another similar study with a comparable population suggested higher rates: 0.6 concussions/1000 athletes among men and 0.4 concussions/1000 athletes among women.

Some researchers believe that head injuries occur more commonly in certain areas of the playing field, and the penalty area is thought to be a high-risk area, especially when players are competing for a corner kick. Near the midfield, concussions occur from head-to-head impact, especially when players are competing for air balls.

Fuller et al. reported that most of the injuries occurred when players converged on a free ball and not, as usually believed, when one player is in possession of the ball and is tackled by another player. Furthermore, they reported that female soccer players may be more at risk for concussions than their male counterparts. A different study by Delaney et al. and a work by Biros suggested that younger players may be more at risk for concussions because of their thinner skulls or larger heads.

Conclusions

Seemingly trivial soccer head injuries can have a long and complicated course. Nevertheless, the temporary disability is shorter in most patients than in the group of players with an injury in other parts of the body.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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