

# Orofacial Injury and Oral Hygiene in Handball Players

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## ABSTRACT

The objective was to assess the oral hygiene and injury experience in handball players in relation to the gender, league level, and game position. 105 players (25 females, 80 males) were interviewed in trauma experience; additionally the oral hygiene behavior, consumption of sports drinks, and the impact of oral health on sporting performance were investigated. 52.4 % of the 105 handball players had orofacial injuries; soft tissue (mostly lip injuries) accounted for 67.6 %, nasal bone fracture for 13.5 %, dental trauma for 9.1 %, followed by jaw fracture 6 %, tongue injuries 5.3 %, chin injuries 4.5 %, and temporomandibular joint injuries 3.8 %. Main injury causes were collisions with other players (67 %), and fall (17 %). No significant gender specificity was found. The circle players had the highest prevalence of orofacial injuries (72.7 %), followed by goalkeepers (62.5 %), backcourt players (54 %), and outside position (34.6 %). Only 6 athletes used a mouthguard. Women performed a significantly better oral hygiene. More female athletes (52 %) than male (26.2%) drank weekly 4 liters sports beverages. Handball has a high prevalence of orofacial trauma, particularly lip injuries, tooth and jaw fractures, but athletes did not use mouthguards. More education, safety standards, and mouthguard use are required.

**Keywords:** Orofacial injuries, handball, oral hygiene, mouthguard

## INTRODUCTION

In sports, the oral health can be described by three major factors: injuries, inflammation, and tooth surface integrity. All factors have local and systemic consequences.

Orofacial injuries constitute 4-18 % of all sports-related injuries (1). Reports on dental trauma due to sports showed higher percentages, between 13 % and 39 % (2-6). Results of Tuli et al. (7) indicated that sports accidents were responsible for six times as many facial injuries as work accidents and accounted

for three times more injuries than violence or traffic accidents.

Handball injuries often occur as a result of direct or indirect player-to-player contact. Due to the dynamic characteristics of the handball game there is also a high risk of head injuries.

Contact sports may cause dental trauma, and mouthguards are considered an essential equipment for athletes and an effective device to soften the impacts and to prevent injuries and their consequences (8-10). Guidelines for mouthguard use in sports have been developed by the Academy for Sports Dentistry and The American Academy of Pediatric Dentistry (11, 12). The National Collegiate Athletic Association suggests the use of mouthguards in 4 sports (football, ice hockey, field hockey and lacrosse), and the American Dental Association recommends the use of mouthguards in 29 sports/activities (13). The German Society for Oral and Maxillofacial Medicine/Dentistry identifies 15

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sports (also handball) where the mouthguard use is recommended (14). Among other reasons sport is a frequent cause for traumatic dental injuries (15). The Federation Dentaire International subdivides organized sports into two categories based on the risk of traumatic dental injuries: High-risk sports (such as American football, hockey, ice hockey, lacrosse, martial sports, rugby, inline skating, skateboarding and mountain biking) and medium-risk sports (such as basketball, soccer, team handball, diving, squash, gymnastics, parachuting and water polo) (16).

Dental trauma ranges from simple bruises or tooth fractures to complete loss of teeth and avulsion. Frequent body contact of the opponents, the high speed of arm, hand and ball are always a risk for injuries in the head and mouth area. Although orofacial injuries are common, the use of mouthguards in handball appears to be low. Many players do not use mouthguards since they expect negative effects on performance such as breathing and speaking interferences. So one purpose of this study was to evaluate the use of mouthguards by handball players and to describe their experience and causes of orofacial injuries in comparison to the league status and gender.

### Oral Health and Hygiene

Inflammation of the gum depends on the interactions between bacterial plaque and personal factors, such as immune response, oral hygiene and other habits and behaviors. In sports, special exercise effects on the immune system and saliva may further impair oral health. Due to an intense, long-term training certain defense factors are reduced in the blood and saliva, which provides favorable conditions for bacteria in the oral cavity. Susceptibility to infections is therefore increased.

Another risk factor for the athletes' susceptibility for oral and throat infections is a reduction and thickening of saliva due to mouth breathing during exercise. Thereby the quality of saliva is changed, which may reduce the natural defense mechanisms. The poor level of oral health in athletes is not a new finding (17). Ashley et al. (18) showed in their study that in contrast to the common perception that athletes are healthy "all over", the oral health of sampled athletes was poor. Caries occurred in up to 75 % of athletes surveyed. The investigated athletes also experienced other oral problems such as dental erosion and dental trauma. Frese et al. (19) observed no difference with regard to

caries prevalence, but a correlation between the caries prevalence and the cumulative weekly training time.

So it was a further aspect of this study to check the oral hygiene behavior in a selected group of handball players.

### METHODS

As one part of the study, a questionnaire was handed out to 105 handball players in eight teams from Saxony, Saxony-Anhalt and Brandenburg. This included 59 players from elite leagues (25 females, 17-37 years old, and 34 males, 15-19 years old), 21 male players from semi-professional leagues (17-37 years old), and 25 male recreational players (18-49 years old). The answers of all players were analyzed according to age, gender, cause and type of orofacial injuries during sport practice. The sampling frame was the incidence of trauma recorded over the entire career of an athlete (usually retrospective). Additionally the use of mouthguards was checked. Another purpose and part of the questionnaire was the assessment of the oral health and hygiene behavior. Similar questions have been used in previous studies (7, 20).

The questionnaire consisted of a short section of general information and 26 items, divided into three complexes. General data were gender, age, height, weight, together with handball specific informations, such as league membership, training volume (weekly playing time), position in the game, course content, and medical care by the association.

In the first complex the use of mouthguard was addressed. If a mouthguard was used, the type, costs and the personal reasons for the use were requested.

The second complex of questions concerned the dental hygiene behavior of the athletes as well as the frequency and the reasons for dentist visits. Further questions were related to tooth brushing frequency, the use of dental floss, the number of dental fillings as well as the consumption of tobacco and sports drinks. Furthermore, the athletes should assess their personal oral situation regarding satisfaction and limitations (in the range: not at all, a little, somewhat, a fair amount or a great deal).

The third complex addressed the injury problem in the face and mouth. The athletes were offered a choice of

orofacial injuries to answer. Also the causes of accidents were recorded.

### Statistical Analysis

The statistical evaluation of the athletes was done with respect to league and gender. By means of a general linear model, ANOVA was used in order to determine the significance of differences. The level of significance was set at  $p < 0.05$ . For the statistical analysis a descriptive data analysis was performed to check if the incidence of injuries was associated with the following parameters: league level, age, gender and game position. The data were checked with the Shapiro Wilk-Test for normal distribution and then examined with the Spearman-Test for correlation. In the evaluation of the correlation coefficient  $r < 0.4$  was set for a low correlation,  $0.4 < r < 0.6$  for a medium correlation,  $0.6 < r < 0.8$  for a strong correlation. All analyzes were performed using the Statistical Package of Social Science (SPSS) Version 21.0.

## RESULTS

The data set of 105 subjects (25 females and 80 males) was divided into four groups according to gender and level of performance (elite to recreational). Baseline characteristics of the groups are given in Table 1. No smokers were found in the elite groups, 7 in the semi-professional, and 3 in the recreational group.

Table 2 shows the distribution of the study participants on the various playing positions. The backcourt and outside positions were most common and double filled in a team; the third most was the goalkeeper position with 15 %, followed by circle position.

### Oral Hygiene Behavior and Gender Differences in the Elite Groups

Female elite players ( $n = 25$ ) brushed their teeth significantly more frequently ( $p < 0.04$ ) and used dental floss markedly more often than the male elite players

( $n = 34$ ;  $p < 0.005$ ). The importance of dental hygiene was significantly higher rated by women ( $p < 0.001$ ). Another significant difference was the higher and more frequent consumption of sports drinks in the female elite group ( $p < 0.05$ ), while the diet-regimen in both groups was similar (20 to 25 % (f: m)). 13 of the female players (52 %) drank an average of 4 liters sports beverages per week and the 9 male elite players an average of 5 liters. 74 % of the male elite players did not drink sports beverages. The loss of tooth substance in the front was reported by 16 % of the female and 11 % of the male elite players.

Other parameters between the elite groups showed no significant differences: Average number of dentist visits in the last 12 months: 1.6 times, and the last dentist visit before approximately 5 months. 44 % of the female players ( $n = 11$ ) and 38 % ( $n = 13$ ) of the male elite players had a professional tooth-cleaning. 36 % of the female and 33 % of the male players regarded their training regimen too time consuming as to access preventive dental care. Oral health-related illness was hardly a reason to miss a competition. One elite male player felt a moderate restriction in the training regimen due to dental problems.

### Oral Hygiene Behavior and Gender Differences in all Groups

#### Female elite versus male semiprofessional group

The male semiprofessional players were significantly older ( $23.24 \pm 5.37$  years;  $p < 0.02$ ), brushed significantly less their teeth per day ( $p < 0.03$ ), used less frequently dental floss ( $p < 0.02$ ), and oral hygiene was less important ( $p < 0.04$ ). No significant differences were seen in the number of fillings, professional tooth-cleaning regimen and the restriction to assess preventive dental care due to sport. Regarding the sport drinks consumption significantly more females had an average of 4 liters per week ( $p < 0.008$ ), whereas 3 semiprofessional males had an average of 8 liters per week. No significant differences were seen in the diet

**Table 1:** Baseline characteristics of the groups

Parameter	Female elite (n=25)	Male elite (n=34)	Male semi-professional (n=21)	Male recreational level (n=25)
Age	20.26±4.44	16.59±1.18	23.24±5.37	29.44±8.60
Weight	69.12±6.58	81.06±15.82	83.95±8.87	85.18±12.82
Height	1.76±7.18	1.86±8.38	1.85±6.85	1.84±8.09
Training volume	13.38±2.69	12.84±2.42	5.88±2.85	3.2±1.20

Mean values and standard deviation of age (years), weight (kg), height (m), and weekly training volume (hours) in the groups according to the level of performance

**Table 2:** Distribution on the various game positions

Position	n (%)		
	Male (n=80)	Female (n=25)	Total (n=105)
Goalkeeper	12 (15)	4 (16)	16 (15.2)
Outside	19 (23)	7 (28)	26 (24.8)
Backcourt (r/l)	15 (20)	7 (28)	22 (20.9)
Backcourt (c)	9 (11)	4 (16)	13 (12.4)
Circle	8 (10)	3 (12)	11 (10.5)
Not specified	17 (21)	0 (0)	17 (16.2)

Frequency (n) and percentage (%) distribution for the game positions (r=right, l=left, c=center) separated by gender

regimen or the awareness of dental erosions at the anterior teeth.

### **Female elite versus male recreational players**

The male recreational handball players were significantly older ( $29.44 \pm 8.60$  years;  $p < 0.0001$ ), brushed significantly less their teeth per day ( $p < 0.01$ ), oral hygiene was significantly less important ( $p < 0.008$ ), and the number of fillings was markedly higher ( $p < 0.001$ ). The demanding training regimen of the female athletes made it significantly more difficult to have preventive dental care ( $p < 0.005$ ). No significant differences were seen in the use of dental floss, professional tooth-cleaning regimen, diet regimen, notice of dental erosions, and in the sport drinks consumption. The female elite and all male players who consumed regularly sports beverages ( $n = 34$ ) had the same weekly consumption of 4 liters, and 5 from these (3 females and 2 males) noticed tooth substance loss in the anterior teeth.

An average of one third of all elite players felt limited in time due to the handball sport. This was in contrast to 19 % of the semiprofessional and 4 % of the recreational group. The difference between the elite and recreational group was very significant.

No differences between the groups regarding the satisfaction with their oral situation were seen. From all elite and semiprofessional players ( $n = 80$ ), 5 athletes (6 %) could not attend the training due to tooth or oral problems, and 2 athletes (2.5 %) could not participate in a competition for this reason.

### **Oral Hygiene Behavior and Differences in the Male Groups**

The participants from the elite male handball group had significantly less fillings than the males from the semiprofessional ( $p < 0.05$ ) and recreational

group (0.0001). So the recreational players had the most fillings, also significantly more than the semi-professional players ( $p < 0.04$ ). On the other hand more than 50 % of the recreational players had a professional tooth-cleaning in the last 12 month, which was significant when compared to the semi-professional group ( $p < 0.01$ ). A comparison of the time limitation for dentist visits showed a significant limitation of the elite versus the recreational group ( $p < 0.007$ ).

92.5 % of the 80 male players reported to brush their teeth twice per day, one brushed his teeth 3 times and the remaining 6 % cleaned their teeth 1 time per day. Dentist visits in the last 12 months were: 2 visits in 41.2 %, one visit in 37.5 %, none in 5 %. 10 % of the male players reported 3 to 5 visits. A small portion of 3.7 % had 8 to 12 dentist visits. The most common reasons were the biannual control ( $n = 34$ ) und annual control ( $n = 27$ ), followed by tooth pain ( $n = 9$ ), professional tooth-cleaning ( $n = 7$ ), problems with the wisdom teeth ( $n = 4$ ), and the loss of a filling ( $n = 2$ ). Multiple nominations were possible.

### **Orofacial Trauma**

Since there were very young players with high training volumes but with a short sporting career, and also older athletes with a low training volume but a long sporting career, age groups were configured.

The age groups were: 10–19 years ( $n = 57$ ), 20–29 years ( $n = 35$ ), and 30–49 years ( $n = 13$ ). The distribution of orofacial injuries according to the age and gender is shown in Table 3. From the 105 participants were 16 goalkeepers (4 females and 12 males). About 50 % of the participants reported orofacial injuries.

133 orofacial injuries were documented, and multiple answers were possible (Table 4). Most frequent lesions were lip injuries, facial lacerations, bruises, and nasal bone fractures. Tooth loss occurred once. No one had a fracture of the cheek bone. Nasal bone fractures occurred in 13.5 %, tooth fracture in 8.3 % and jaw fracture in 6 %. Temporomandible joint (TMJ) injuries occurred in 3.8 %. Collisions with other players were accounted for the majority of the injuries (67 %), followed by fall (17 %), ball contact (11 %), and collisions with obstacles (5 %).

In the following the orofacial injuries frequencies are considered in relation to gender, league level,

**Table 3:** Handball related orofacial injuries - distribution by age and gender

Age	Female players		Percentage of injured female players	Male players		Percentage of injured male players
	Injured (n)	Total (n)		Injured (n)	Total (n)	
10–19	6 (incl. 1 GK)	14	42.8	19 (incl. 4 GK)	43	48.7
20–29	6 (incl. 1 GK)	9	42.8	13 (incl. 2 GK)	26	33.3
30–49	2 (incl. 1 GK)	2	14.4	7 (incl. 1 GK)	11	18
Total	14	25	100	39	80	100

Gender and age (years) related orofacial injuries in handball. Abbreviations: incl.= inclusive, GK=goalkeeper

**Table 4:** Category of injuries in the groups

	Female elite (n)	Male elite (n)	Male semi-professional (n)	Male recreational level (n)	Number	Percentage
Orofacial trauma in the career	14 (56%)	17 (50%)	13 (62%)	11 (44%)	55 (52.4%)	
Lips injuries	5	8	5	4	22	16.5
Oral laceration	2	8	5	4	19	14.3
Nasal bone fractures	8	2	4	4	18	13.5
Facial laceration	6	4	4	4	18	13.5
Facial bruise	5	5	3	5	18	13.5
Tooth fracture	3	1	3	4	11	8.3
Tongue injuries	4	1	2	0	7	5.3
Chin injuries	2	1	2	1	6	4.5
Mandible fracture	2	3	1	0	6	4.5
TMJ injuries	2	2	1	0	5	3.8
Maxillary fracture	0	2	0	0	2	1.5
Tooth loss	0	0	0	1	1	0.8
Cheek bone fracture	0	0	0	0	0	0
Total	39	37	30	27	133	100

Number (n) and percentage (%) of orofacial injuries in all groups. Abbreviation: TMJ=temporomandibular joint

player`s position in the game, age, and amount of sports activities. The male players had an average of 1.18 orofacial injuries per subject and the female players an average of 1.56. No gender specificity could be established. According to the league level of male players we found an incidence of 1.09 orofacial injuries in the elite, 1.43 in the semiprofessional, and 1.08 in the recreational group. Correlation analysis showed no significance between the amount of sports activities and the incidence of injuries, and also between the age and incidence of orofacial injuries.

We also looked at the player`s position and relation to the average rate of orofacial injuries. 17 from 105 handball players reported no specific game position. With the game positions (n= 88), the following differences in the incidence and distribution of 99 injuries was seen:

- **Circle position:** 8 (72.7 %) of 11 circle players had a sum of 17 orofacial injuries, i.e. 1.5 injuries per subject: Soft tissue injuries (n= 13): Facial laceration: 3, lip injuries: 2, oral laceration: 3, tongue injuries: 1, chin injuries: 0, bruise: 4. Bone, tooth, joint injuries (n= 4): Nasal bone fracture: 3, maxillary fracture: 0, mandible fracture: 0, tooth fracture: 1, TMJ: 0.
- **Goalkeeper position:** 10 (62.5 %) of 16 goalkeepers had a sum of 24 orofacial injuries, i.e. 1.5 injuries per subject: Soft tissue injuries (n= 15): Facial laceration: 5, lip injuries: 5, oral laceration: 3, tongue injuries: 1, chin injuries: 1, bruise: 0. Bone, tooth, joint injuries (n= 9): Nasal bone fracture: 3, maxillary fracture: 1, mandible fracture: 0, tooth fracture: 1, TMJ: 4.
- **Backcourt side position:** 12 (54.5 %) of 22 backcourt side players had a sum of 37 orofacial injuries, i.e. 1.7 injuries per subject: Soft tissue injuries (n= 29): Facial laceration: 3, lip injuries: 9, oral laceration: 7, tongue injuries: 4, chin injuries: 2,

bruise: 4. Bone, tooth, joint injuries (n= 8): Nasal bone fracture: 3, maxillary fracture: 0, mandible fracture: 1, tooth fracture: 4, TMJ: 0.

- **Backcourt center position:** 7 (53.8 %) of 13 backcourt center players had a sum of 12 orofacial injuries, i.e. 0.9 injuries per subject: Soft tissue injuries (n= 3): Facial laceration: 1, lip injuries: 1, oral laceration: 0, tongue injuries: 0, chin injuries: 1, bruise: 0. Bone, tooth, joint injuries (n= 9): Nasal bone fracture: 2, maxillary fracture: 1, mandible fracture: 4, tooth fracture: 1, TMJ: 1.
- **Outside position:** 9 (34.6 %) of 26 outside players had a sum of 9 orofacial injuries, i.e. 0.3 injuries per subject: Soft tissue injuries (n= 5): Facial laceration: 2, lip injuries: 1, oral laceration: 1, tongue injuries: 0, chin injuries: 1, bruise: 0. Bone, tooth, joint injuries (n= 4): Nasal bone fracture: 2, maxillary fracture: 0, mandible fracture: 1, tooth fracture: 1, TMJ: 0.

So from the incidence of injuries a game position specificity was revealed: players at the backcourt side, goal and circle position are particularly susceptible to injuries. Players at the backcourt side position had the highest average rate of 1.7 orofacial injuries, players at the goal and circle position had an average rate of 1.5, followed by the backcourt center position with an average rate of 0.9, and outside position with an average rate of 0.3.

### Mouthguard

5 (5.7 %) from 89 handball players and 1 (6 %) from 16 goalkeepers used an individual mouthguard in handball games with an average cost of 140 € (100 – 200 €). 2 female players of the elite and 1 goalkeeper of the recreational group had a tooth fracture and decided therefore to wear a mouthguard, and 3 male players of the semi-professional group wore an individual mouthguard for prophylactic reasons.

## DISCUSSION

The overall objective of the present investigation was to study the differences in oral health behavior and frequency of orofacial injuries in handball players of different league level, training volume, and gender.

### Oral Health Behavior

Appearance and determinants of social life such as self-confidence, attractiveness and life quality are markedly

influenced by the oral health. Furthermore, oral health may impair general health significantly. For example, rheumatic or acute inflammatory heart valve diseases and coronary artery disease may arise from bacteria in the oral cavity (21, 22).

Out of 105 surveyed athletes 46 (43.8 %) reported that oral hygiene is “very important “ and 53 athletes (50.5 %) described the oral hygiene as “important. Proper dental care can be assessed by specific parameters. Important for an optimal oral hygiene is at least a daily twice tooth cleaning and the use of dental floss or interdental brushes. According to the Market Research Institute Novia Data 81 % of German people brushed their teeth daily, 39 % use dental floss and 46 % use mouthwash. Only 4 out of 5 men brushed their teeth regularly.

The statement that men care less to oral hygiene was to be checked. Female elite players brushed their teeth significantly more frequent and used dental floss significantly more often than the male elite players. All men groups brushed significantly less frequent, oral hygiene was less important for them, and the semiprofessional players used dental floss significantly less frequent than the females.

The oral hygiene habits for the primary prevention of tooth caries and periodontal diseases in regard to infectious plaque control have a prominent position. Out of the 80 examined male handball players 93.5 % brushed their teeth twice a day or more often, and 6 % only one time every day; considering the females alone, all brushed their teeth twice or more every day.

According to DMS IV (23) 84 % of the 15 year old and 35 to 44 year old subjects brushed their teeth twice a day. The present study showed an even more positive image of 100 % in females and 93.5 % in males who brushed teeth daily twice or more in a range of 3 minutes.

In this present study the women performed significantly better in comparison to the male groups with respect to oral hygiene and its importance, regardless of the age. This is in line with other reports about apparent gender effects on oral hygiene behavior. Data concerning worse oral hygiene behavior in males were also found in the following studies: Alcouffe (24) reported in a very small group (26 women, 28 men) a better oral hygiene in women. Karikoski et al. (25) assessed the effects of oral self-care on periodontal health indicators among adults.

Women reported brushing their teeth more frequently, and had significantly less plaque than men. Strauss and Stefanou (26) reported in 573 adults that females practise more often daily interproximal cleaning. Schulze and Busse (27) reported in 517 adults (obese, diabetic and non-diabetic) that females performed a better oral hygiene.

In the present study only 26 participants (24.8 %), 13 females (40 %) and 13 males, used floss at least twice a week. Though tooth-cleaning twice a day is performed by the majority of the participants, the fewer use of dental floss may increase the probability for approximal or interdental caries or gingivitis. The responses of DMS IV (23) in the adult cohort showed a use of dental floss in 40 %, so in the present study were only the women in line with this study and men performed significantly worse. Tooth brushing may be effective in removing plaque on buccal and lingual surfaces, but it will not reach the interdental plaque. A number of other hygiene devices are available to accomplish this: dental floss, interdental brushes, and toothpicks. Periodontal and gingival lesions are predominantly observed in the interproximal or interdental sites; these sites are most frequently coated with plaque. A toothbrush cannot completely clean the interdental surfaces, so interproximal cleaning represents an important aspect of oral self-care and has beneficial effects on plaque and gingival health (28, 29). Due to the importance of interproximal cleaning, it is surprising that only few studies exist on this topic. Anyway, the present study shows very plainly that the frequency of interproximal cleaning in all groups was far below the recommendations of daily practice, and the men were worse than in the results in DMS IV (23).

Sports can also have negative consequences on the oral situation. Particularly competitive sports athletes spend a lot of time in training and competitions, which may have the consequence that they have less time for other activities or health care. The majority of subjects in this study felt not restricted in oral health care by the sport, probably as an effect of the predominantly good dental hygiene behavior. The athletes had only few acute dental problems, and the majority was not limited in the performance and training ability by their teeth and mouth situation in the last 12 months.

### Consumption of Acidic Sports Drinks

The consumption of isotonic drinks was also reported in this study. More female athletes (52 %) than male (26.2

%) drank 4 liters acidic sports beverages per week. All together (n=105) drank an average of 1 liter per week. However, the use of these beverages may cause dental erosion. Rees et al. (31) reported that sports drinks based on acidic fruits popular in the United Kingdom have low pHs, and are erosive when enamel is immersed in the sports drink. So sports beverages can produce substantial surface loss and surface softening (32).

In the present study, 14 athletes (13.3 %; 10 males and 4 females) claimed to notice a substance loss at the anterior teeth, but only 3 women and 2 men of these consumed regularly acidic sports beverages. So also other reasons for tooth substance loss, e.g. such as eating disorders, can be considered. Prolonged beverage holding habits, or mouth breathing may also increase the risk for dental erosion (33). Further causes include the diet (34), decreased salivary flow during exercise (35), and exercise-induced immune suppression (36). Substance loss of the anterior teeth can also be seen in traumatic injuries, which also were investigated.

### Orofacial Injuries

Accidents cannot be avoided in handball. The head in particular is an extremely sensitive part of the body, and serious injuries can occur. A strategy of prevention, however, is unlikely to realize its full potential unless there are reliable data about the incidence, and localization of injuries.

To obtain an overview of orofacial injuries, 105 handball players were investigated. 52.4 % (n= 55) had suffered from orofacial injuries. Soft tissue injuries occurred in 68 %; lip injuries were most prevalent (16.5 %), followed by oral lacerations (14.3 %), contusions, facial lacerations (each 13.5 %), and chin injuries (4.5 %). Hard tissue, bone and joint injuries accounted for nearly one third (32.4 %), in which nasal bone fracture was most prevalent (13.5 %), followed by dental trauma (9.3 %), with emphasis on maxillary central incisors, followed by jaw fracture (6 %) and temporomandibular joint (TMJ) injuries (3.8 %). This means that the orofacial region is extremely vulnerable. Two-thirds of the orofacial injuries were soft tissue injuries. The tissue absorbs the forces, and thus acts as a buffer for the teeth and jaws. 11 from 105 handball players have experienced dental injuries. This is in line with Lang et al. (37), who found 12 from 112 handball players with dental injuries (10.7 %). The use of a mouthguard may prevent or attenuate dental and oral injuries. Despite

its positive effects, mouthguards are rarely used. Only a very small percentage (5.7 %, n= 6) of the surveyed subjects actually used a mouthguard in the handball games, 3 of them after tooth fracture, and the other 3 just as a preventive tool. Obviously former accidents resulted in the willingness to use mouthguards in 50 % of the handball players with dental injuries. This shows that new motivating tools must be developed to improve the acceptance for mouthguards in the future.

The differentiation between the league levels showed the highest prevalence of orofacial trauma in the semiprofessional group (62 %), followed by the elite groups (53 %), when compared with the control recreational group (44 %). This resulted in an average of 1.09 orofacial injuries in the elite, 1.43 in the semiprofessional, and 1.08 in the recreational group. A gender-specificity was not seen in the present investigation. The male players had an average of 1.18 orofacial injuries and the female players an average of 1.56. No specificity was also reported by Wedderkopp et al. (38) and Olsen et al. (39).

The athletes gave retrospective information about the sum of injuries in their sporting career. For this reason, no comparison of the incidence of injuries in a given period was possible. Furthermore, only a minimum number of injuries in the orofacial complex could be seen from the responded data. Multiple nominations were not provided in the questionnaire.

In the present study, no correlation was seen between the frequency of orofacial injuries and the age. Also, the training volume was not decisive for the athletes' frequency of orofacial injuries based on this investigation. It is recommended to train several times in the week, so the body can adapt to the workloads and is prepared in the game for various situations. Nevertheless unpredictable situations often occur, such as the action of the opponent player in the jump or personal deficient reflexes. The most frequent cause of injury was a blow from another player and fall (84 %).

We also looked at the players' position and relation to the average rate of previous orofacial injuries. The circle players had the highest prevalence of orofacial injuries with an average of 72.7 %. The circle player is in constant contact with the defenders. Holding, pulling and pushing are the normal movements in the defense. The permanent contact between aggressive opponents and circle players increases the injury risk.

Circle players must block the attacks in a variety of conditions, catch passes and throw at the goal. Many times the circle players jump into the circle respectively perform a drop throw at the goal. If the player loses the balance and his body is out of control, he is no longer able to intercept the fall optimally. In the present study the orofacial injuries in this position were mainly bruises, lacerations and nasal bone fractures. In most cases these accidents happened due to a collision with the opponent's defenders.

Goalkeepers had also a high incidence of orofacial injuries (62.5 %). Specific injuries were facial lacerations, lip injuries, and oral lacerations. Nasal bone fractures and furthermore the most TMJ injuries occurred in this position (n= 4). Associated with this position is a high risk of a collision with the ball or with the goal post.

The backcourt players on the half positions had an injury incidence of 54.5 %. Forced jumps with fast vigorous throws are typical for this position. This investigation revealed lip and tongue injuries, lacerations to the mouth and the face. Nasal bone and the most tooth fractures (n= 4) were reported, and also bruises and chin injuries. In all other positions we found only one tooth fracture.

53.8 % of the backcourt center players had orofacial injuries. In this position nasal bone fractures and a relatively high number of jaw fractures (n= 5) were reported, also one tooth fracture, tooth loss, and one TMJ injury. Significantly fewer orofacial injuries were observed in the outside positions.

The risk of injuries in handball is extremely high due to the dynamic and powerful game character. Fast movements with many changes of the direction and frequent opponent contacts make the game attractive and exciting for the spectators. Due to direct and partly hard contacts with the opponents a relevant risk of traumatic injuries is always present. In particular aggressive defensive behavior with pushing and pulling of the opponents is a trigger for injuries. Throws at the goal can miss their target and cause serious injuries.

A dental crown fracture is irreversible. Tooth dislocation or avulsion may result in a tooth loss due to ankylosis or infection-related root-resorption (40). Even a minor tooth injury like a concussion can potentially cause pulp necrosis.



An injured tooth often requires extensive treatment just to become functional again and can create a lifetime of expensive, long-term problems for the affected athlete (41-43). In terms of the high rate of orofacial injuries, shown in this study, the use of a mouthguard is recommended.

## CONCLUSION

In handball more information and education of the coaches, clubs and players about the high risks of orofacial injuries and their prevention is necessary. Circle players had the highest prevalence of orofacial injuries (72.7 %), followed by goalkeepers (62.5 %) and backcourt players (54.5 %). Only 6 of 105 investigated players used a mouthguard, 3 of them after dental trauma. New motivating tools have to be developed to improve the acceptance for mouthguards in handball, where the most frequent cause of orofacial injury was a blow from another player or fall. Females performed a better oral hygiene than the male players.

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