Orofacial injuries in youth soccer

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Abstract

Purpose: The purpose of this study was to estimate the incidence of orofacial injuries in youth soccer in the 1995 fall and 1996 spring seasons for eight Dallas, Texas metropolitan area YMCA youth soccer leagues.

Method: Surveys requesting orofacial injury as well as game and practice information were sent to all soccer coaches of children 3 to 12 years of age in eight cooperating YMCA leagues in the Dallas metropolitan area.

Results: The incidence of orofacial injury was low. In 47,772 hours of games and practice only 17 orofacial injuries were reported by the 122 coaches who responded. All reported injuries were to soft tissue and none required professional attention.

Conclusion: The reported incidence of orofacial injury was very low suggesting that at the age and skill levels represented by these YMCA teams, soccer appears to be relatively safe to the maxillofacial complex.(Pediatr Dent 21:192-196, 1999)

Soccer has experienced phenomenal growth in the United States during the last 15 years. The number of youths less than 19 years of age playing in one of the three major American youth soccer organizations has increased from 880,705 in 1980 to 2,895,707 in 1995.[1] The Soccer Industry Council of America reported a yearly gain of 11% in the total number of Americans playing soccer one or more times in 1994—from 16.4 million in 1993 to 18.2 million in 1994.

In the Dallas metropolitan area, the North Texas Soccer Association, under the auspices of the United States Youth Soccer Association, has approximately 106,000 youths younger than age 19 organized into team play. The Young Men's Christian Association (YMCA) also organizes play and has 22,000 enrolled from ages 3 to 13 years.

According to the Centers for Disease Control and Prevention (CDCP), injuries are the leading cause of death in children from ages 1 to 19 years and a major cause of disability.[2] Within the category of head injury, CDCP lists sports and recreation as major causes.[2]

The incidence and severity of sports-related injuries to the orofacial area have been the subject of numerous investigations. Cathcart[3] found that 50% of all sports injuries reported among high school football players were orofacial injuries. Davis and Knott[4] found that sports activity was the second leading cause of dental injury after injuries that take place in the home. The greatest risk of dental trauma was experienced by the children within the age group from 6 to 12 years, an age group whose dental treatment could be very complicated and with a questionable outcome.[4] Järvinen[5] reported a higher rate of trauma to the dentition of children with a Class II, Division I (Angle) malocclusion, suggesting that the younger child's occlusion affects the likelihood of dental trauma.

Sports-related orofacial injury among adolescents has also been studied. Flanders and Bhat[6] monitored reports of injuries made by athletic trainers and found 18.3 orofacial injuries per 10,000 athletic exposures in basketball play at selected Illinois high schools. Only 1.4 per 10,000 injuries were reported for football, which mandated the use of athletic mouthguards. Lee-Knight et al. recorded 15 orofacial injuries during a two week competition involving 3411 Canadian athletes in 16 different sporting events.[7] Fractured teeth were the most common injury, accounting for 23.1% of the total injuries. Garon, et al.[8] interviewed 754 junior high school and high school football players in Birmingham, Alabama about sports-related oral trauma and found a number of athletes who had experienced trauma in sports other than football, particularly basketball and baseball where mouthguards were not required for play. The investigators also found that the use of athletic mouthguards in football did appear to help prevent injury to teeth but was less effective in preventing soft tissue damage such as lip laceration. Maestrello and Primosch[9] surveyed 301 Florida high school varsity basketball teams. Of the 1020 players who responded, 32% of those not reporting mouthguard use reported an orofacial injury as opposed to 5% of those who reported mouthguard use.

Studies of soccer-related orofacial injuries are limited. In a survey of collegiate athletic trainers reporting data on 21,564 female athletes playing soccer, basketball, lacrosse, field hockey, volleyball, and softball, Morrow and Bonci[10] found that 3% of 3181 soccer players experienced an orofacial injury, primarily a soft tissue laceration, during the reporting period. McMaster and Walter[11] categorize soccer injuries as resulting from kicks, direct contact from a kicked ball, and contact with the playing surface during falls. Further, trauma to the head and neck region was only 3-10% of the total reported injuries.[11] The incidence and severity of sports-related injuries to the orofacial area have been studied. Of 201,316 soccer players studied by Sane,[12] 8640 (4%) experienced some type of injury of which 391 (0.2% of players and 5% of injuries) were dental.

Tenvegert[13] reviewed medical records at the trauma department at the University Hospital of Gronigen, the Netherlands and found a higher rate of injury in soccer play than in the three other sports he investigated—volleyball, gymnastics, and martial arts. Schmidt-Olsen et al.[14] followed 496 male soccer players

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aged 12–18 years for a year and found the incidence of injury to be 3.7 injuries per 1000 hours of soccer per player. The incidence increased with age and for older youths it converged on the adult injury rate. Seventy percent of the injuries were to the lower extremities. Kibler[15] found similar higher rates of injury among females compared to males playing in an invitational soccer tournament in Kentucky during a period of four years from 1987 to 1990. All of these studies noted a preponderance of the injuries in the lower extremities, especially the ankle and foot. Schmidt-Olsen et al.[16] studied injuries suffered by young players 9-19 years of age involved in international soccer tournaments held in Denmark in 1984 and found a higher rate of injury among girls (29.9 injuries per 1000 playing hours) versus 16.1 injuries per 1000 playing hours for boys. The incidence of injury rose with age. Kibler[15] found similar higher rates of injury among females compared to males playing in an invitational soccer tournament in Kentucky during a period of four years from 1987 to 1990. All of these studies noted a preponderance of the injuries in the lower extremities, especially the ankle and foot.

While the few studies of soccer-related injuries focused on adolescents and young adults, none have dealt with younger children. With the rapid growth of organized youth soccer in the United States, public health practitioners need epidemiological data to make informed recommendations about the feasibility and cost-benefit of educational and clinical interventions to the incidence of orofacial injuries. This pilot study estimates the incidence of such injuries among children from age 4–12 years.

Method

Dallas area YMCA sports directors were asked to assist in the study—eight agreed to participate. These sports directors, who do not coach YMCA soccer teams but rather recruit and assist volunteer coaches, disseminated the survey forms to the volunteer coaches in their YMCA league.

A survey instrument was designed to gather information from the soccer coaches concerning injuries that occurred to players on their teams during the spring 1995 and fall 1996 soccer seasons. The survey was designed to minimize the time for completion by the coaches—approximately ten minutes or less. The survey protocol and instrument were approved by the Baylor College of Dentistry Institutional Review Board.

The survey form was two sided. On the front side, the coaches were asked to provide demographic information about their teams, such as age, sex, and numbers of players. Respondents were also asked the average length of games played in minutes, number of games played in a season, and approximate numbers of hours practiced during each season. Game time was multiplied by the number of games in the season to find a total team game time in hours. Since not all players on the team are on the field at one time and the number of players varies depending on age group, we multiplied total team game time by the proportion of a team's players on the field at one time. This yielded a figure of total individual player game hours. Because all players were assumed to be playing soccer during practice, such a calculation was not made to calculate practice hours. For example, a ten player team that fielded seven players, playing eight, one hour games would play 10 x 8 x 0.7, or 56 hours. Had the team practiced 1.5 hours per week for 10 weeks, it would practice 1.5 x 10 x 10, or 150 hours. We computed playing hours based on the number of players on the field and practice hours based on the number of players on the team (assuming all players practiced), so the majority of the time will be spent in practice.

Coaches were asked to complete the front page of the survey and return it even if no player on their team received any oral-related injury. If the players did experience any orofacial injury (injury to the teeth, lips, tongue, gingiva, or jaws) during either game or practice, the coaches were requested to complete the reverse side of the injury form which contained detailed discussion of injuries. Information requested pertained to the season the injury occurred, the type and cause of injury, and whether the injury required professional care and type of professional care needed. In addition, information about the age and sex of the injured player was requested. Finally the survey form asked whether the injury occurred during a game or practice and whether the injured player was wearing a mouth protector when the incident occurred.

Due to the policy of the YMCA central office concerning confidentiality of volunteer coaches' names and addresses, mailing lists of soccer coaches were not given to the investigators. Rather, the eight cooperating YMCA clubs were given the survey forms in blank, stamped envelopes with a Baylor College of Dentistry return address to which the clubs affixed mailing labels and sent the forms out directly to their local coaches. Also sent with the survey instrument was a cover letter explaining the research objective, a note of support from the local YMCA sport director, and a stamped, self-addressed envelope for return of the completed survey.

Results

Of the 552 survey forms sent to the coaches fielding teams for the eight YMCA clubs, a total of 122 useable forms were completed and returned–a 22% response rate. Due to the confidentiality issue and the inability to obtain mailing lists, no follow-up mail-outs were possible. The data were from the spring 1995 and fall 1996 seasons involving 2483 players. The players consisted of 1489 boys and 994 girls 3 to 12 years.

A determination of hours of exposure to risk of orofacial injury during soccer play was made by calculating total time of game and practice play from the coaches' recollections. Of the 44,772 hours of soccer play (Tables 1, 2), 36,498 hours (76%) was practice and 11,274 hours (24%) was game play. Since only two of the 17 injuries occurred in the spring, fall and spring data are combined. All the reported injuries were to soft tissue (cut lips, tongue, cheek, or gingiva) and resulted from either contact with another player (N=10) or from contact with the ball (N=7). None of the injuries required professional attention. No injured player was reported to be wearing a mouth protector at the time of injury.

The number of injuries was too low to determine any statistical significance between the sexes or between age groups. The rates of injury were calculated by dividing the number of injuries per age-sex group by the total number of hours (practice, game, or combined). The rates are reported as injuries per 1000 hours. Reported injury rates were low for all age groups but slightly higher for the girls aged 6–9 with the younger age category of 3–6 having a slightly higher rate of injury for boys. Combined ages yielded very similar rates of injury for boys and girls (0.37 injuries per 1000 hours for boys, compared to 0.33 injuries for girls per 1000 hours for girls).

Table 1. Injuries, Hours Practiced and Hours Played: Boys, 3 to 12 Years of Age

Age Groups	4-6	6-9	9-12	Total
N	582	667	240	1,489
Game Hours	1,920	3,396	1,348	6,664
Practice Hours	7,617	9,088	6,065	22,770
Total Hours	9,537	12,484	7,413	29,434
Injuries				
Game	5	1	1	7
Practice	2	2	0	4
Total	7	3	1	11
Game Injuries (per 1,000 hours)	2.60	0.29	0.74	1.05
Practice Injuries (per 1,000 hours)	0.26	0.22	0	0.18
Total Injuries (per 1,000 hours)	0.73	0.24	0.13	0.37

Table 2. Injuries, Hours Practiced and Hours Played: Girls, 3 to 12 Years of Age

Age Groups	3-6	6-9	9-12	Total
N	262	490	242	994
Game Hours	806	2,449	1,355	4,610
Practice Hours	3,410	6,874	3,444	13,728
Total Hours	4,216	9,323	4,799	18,338
Injuries				
Game	0	2	0	2
Practice	1	3	0	4
Total	1	5	0	6
Game Injuries (per 1,000 hours)	0	0.82	0	0.43
Practice Injuries (per 1,000 hours)	0.29	0.44	0	0.29
Total Injuries (per 1,000 hours)	0.24	0.54	0	0.33

Discussion

This study attempted to quantify level of risk to orofacial injury in soccer play by reporting injuries per 1000 hours of play. A denominator of 1000 hours of play facilitates comparisons of risk involved in playing different sports. Many studies of orofacial injury limit the interpretation of risk by reporting only numbers of injuries per numbers of players. This method provides no indication of the amount of time played in the particular sport by the players during which the injury occurred. The sport with the greater number of injuries per unit of time either in practice or game should be considered the higher risk activity. Without knowledge of time played per injury, comparison of risk is problematic.

Few studies of risk of orofacial injury during soccer play exist, especially for grade school and middle school players. Studies of the epidemiology of injury during soccer play suggest that a larger percentage of the total injuries suffered are localized to the lower extremities. This is reasonable, as it is largely played with the body's lower extremities—especially among children—with leg and foot in the actions of kicking and running.

We found an extremely low rate of injury to the oral area. The 17 injuries reported during the 47,772 hours of play seem to indicate that at this level of play, children are at low risk for soccer-related orofacial injury. Perhaps the younger players who comprise the YMCA teams studied do not have sufficient body mass and aggressive style of play to create an appreciable potential for injury. In addition, they use a lighter ball. Players from 3 to 7 years of age use a number three ball weighing about 11 ounces while players from ages 8 to 11 use a number four ball weighing 11-13 ounces. After age 12, the ball is larger and weighing 14-16 ounces. Perhaps the lighter ball is less likely to damage orofacial tissues if kicked into the face. Older players, for example, those in the teens or early twenties, may, because of larger and heavier body frames than their younger counterparts in this study, experience higher rates of injury when they collide with each other on the field or kick a heavier ball at greater velocity into the face of another player. A study by Sane and Ylipaavanien using medical records of injuries of soccer players in Finland indicated a trend of more orofacial injuries of greater severity suffered by older players.[12] Further study with these older age groups would be warranted in determining risk of these types of injury.

More competitive levels of soccer play exist in Dallas and other communities. In these leagues, players are chosen based on ability and the teams are described as club, premier, competitive, or select. Soccer play among these teams is generally more aggressive and injuries may occur more frequently. We did not study such teams and further study into orofacial injury among these players is indicated.

The major limitations of this study are the low (22%) response rate and the lack of a follow-up mailing. Moreover, there is also a possibility of recall or reporting bias. Robertson[18] lays the responsibility for such bias upon "unreliable memory, embarrassment regarding certain types of injury, and differences among people in perceptions of seriousness." Within this study, any of these factors may have contributed to the low response rate. The previously discussed confidentiality issue precluded the possibility of follow-up mailings to the nonresponders which would have increased the overall return rate and improved validity. Because this was a retrospective study, children were not instructed to report all orofacial injuries. Therefore, because our data understates the prevalence of such injuries, possible that some (nonapparent) hard tissue injuries might not have been reported.

Another issue related to poor response rates is the low representation of certain age bands. The middle age band of players reflected the largest number of players (1157) followed by the youngest (3–6) at 844, and the older players (9-12) with the fewest studied, 482. Higher numbers in these age bands would give more confidence in the survey results of teams of those age categories.

A final limitation to the study is the lack of baseline data on the use of mouthguards by all the players in the surveyed YMCA teams. Informal discussion with YMCA coaches and players' parents indicate an extremely low rate of player mouthguard use, probably less than 1% of all players. Nowjack-Raymer and Gift[19] in a recent analysis of data from the 1991 National Health Interview Survey found the use of mouthguards among elementary school age soccer players, (an age group similar to the YMCA teams) to be 4%. Future studies similar to this one should attempt to gather mouthguard use baseline data to assist in discussing results.

The boy and girl players combined rate of injury of 0.36 injuries per 1000 hours taken into the context of risk for an individual player during a soccer season would mean that the hypothetical young player who played the average 19.24 game and practice hours, determined from the study, would experience risk of less than one chance in a thousand (0.0007) of sustaining an orofacial injury during the season.

The American Dental Association (ADA) recommends wearing mouthguards for soccer, as well as for most other contact sports.[20] Public information programs concerning mouthguard use have been initiated in a number of states, notably in an Illinois Department of Public Health project that promotes mouthguard use state wide with educational videos, posters, and written brochures.[21] The ADA has urged dentists to act as "team dentists" and volunteer to provide mouth guards as a service to athletic teams involved in sports at risk of orofacial trauma.[22] Because of an extremely high incidence of football-related orofacial trauma noted in the 1950s in high school and collegiate players, governing bodies mandated the use of mouthguards for high school and junior high players in 1962 and for college players in 1973.[23] Other organized team sports, such as hockey, now have mandated mouthguard wear in many states. In 1994, the Minnesota state High School League mandated mouthguards for six additional sports.[24] Minnesota already required mouthguards for football and hockey. The League rescinded its decision after it experienced heavy opposition to the new mandates.

Another factor that should be taken into consideration in any recommendation for mouth protector use based on this study is the type and severity of the injuries that were experienced by the players affected. All of the reported injuries were soft tissue in nature. Other authors have remarked upon the limitations of mouthguards for oral soft-tissue protection.[8, 10] The greater protection afforded by current mouthguard designs is to hard tissue (dentition) trauma. Again, none of the orofacial injuries were to the teeth, which would have benefitted most from mouthguard protection.

A further consideration when recommending mouth protection for this level of soccer play, especially when considering mandating universal use due to a public health problem, are the involved costs . McCarthy[25] classified mouthguards (or mouth protectors) into three types: custom mouth protectors fabricated with a cast of the individual athletes teeth (requiring the involvement of a dentist); protectors formed directly in the players mouth with the use of thermoplastic materials; and stock mouth protectors (the least expensive) which require no fitting by the player or dentist. Of the three types, the custom mouthguard has been found to be the best fitting and most likely to be worn by the athlete.[26]

There is no doubt that mouthguards have led to substantial decreases in orofacial trauma in a number of sports. The use of mandated mouth protection for high school and collegiate football players has led to an estimated reduction of between 100,000 to 200,000 oral injuries annually.[20] Maestrello and Primosch[9] found basketball players wearing mouthguards seven times less likely to suffer orofacial injury. All sports, however, are not equal in level of risk to orofacial injury. Expected degree of contact between players, age, and size of players, level of game competition, and the likelihood of a ball, head, hand, or elbow in the orofacial region of the athlete's body during play action all contribute to the chance of orofacial injury.

While our study was focusing on young children, the results should be interpreted cautiously. The low frequency of orofacial injuries we found suggests that in this population mouthguard wear would not have reduced the number of injuries substantially. However, mouthguard wear is, of course, advisable and coaches and parents should consider mouthguards for youth playing contact sports, especially those at particular risk because of their occlusion or aggressive style of play.

Results

The players in our sample had few orofacial injuries, none of which was serious. This was most likely due to good coaching and officiating, low body mass, a light soccer ball, and low intensity of play. However, even the low injury rate in our sample, when projected to the almost three million youth soccer players in the United States, represents a substantial number of injuries. A prospective study of children playing at different levels of soccer should be done. Dentists should be knowledgeable about providing such a service, and should complete a risk analysis based on the child's occlusion and the parents' description of the child's intensity of play, and advise them about the benefits of mouthguard use.

Conclusion

1. The reported incidence of orofacial injury was very low suggesting that at the age and skill levels represented by these YMCA teams, soccer appears to be relatively safe to the maxillofacial complex.

References

1. Soccer in the USA: Statistical abstract on soccer participation. Soccer Industry Council of America North Palm Beach FL: September,1995.
2. Childhood injuries in the United States. Division of Injury Control, Center for Environmental Health and Injury Control, Centers for Disease Control. Am J Dis Child 144(6):627–46, 1990.
3. Cathcart JF: Mouth protectors for contact sports. Dental Digest 57:348–56, 1952.
4. Davis GT, Knott SC: Dental trauma in Australia. Aust Dent J 29:217–21, 1984.
5. Järvinen S: Traumatic injuries to upper permanent incisors related to age and incisal overjet: A retrospective study. Acta Odontolol Scand 37:335–38, 1979.
6. Flanders RA, Bhat M: The incidence of orofacial injuries in sports: A pilot study in Illinois. J Am Dent Assoc 126:491–96, 1995.

7. Lee-Knight CT, Harrison EL, Price CJ: Dental injuries at the 1989 Canada Games: an epidemiological study. J Can Dent Assoc 58:810–15, 1992.
8. Garon MW, Merkle A, Wright JT: Mouth protectors and oral trauma: A study of adolescent football players. J Am Dent Assoc 112:663–65, 1986.
9. Maestrello de Maya MG, Primosch RE: Orofacial trauma and mouth protector wearing among high school varsity basketball players. ASDC J Dent Child 56:36–39, 1989.
10. Morrow RM, Bonci TA: Survey of oral injuries in female college and university athletes. Athletic Training 24:336–37, 1989.
11. McMaster MD, Walter M: Injuries in soccer. Am J Sports Med 6:354–57, 1978.
12. Sane J, Ylipaavalnien P: Dental trauma in contact team sports. Endod Dent Traumatol 4:164–69, 1988.
13. Tenvegert EM, Ten Duis HJ, Klasen HJ: Trends in sports injuries, 1982–1988: An in-depth study of four types of sport. J Sports Med Phys Fit 32:214–20, 1992.
14. Schmidt-Olsen S, Jorgenson U, Kaalund S, Sorensen J: Injuries among soccer players. Am J Sports Med 19:273–75, 1991.
15. Kibler WB: Injuries in adolescent and preadolescent soccer players. Med Sci Sports Exercise 25:1330–32, 1993.
16. Schmidt-Olsen S, Bunemann LK, Lade V, Brassoe JO: Soccer injuries of youth. Br J Sports Med 19:161–64, 1985.
17. Kibler WB: Injuries in adolescent and preadolescent soccer players. Med Sci Sports Exercise 25:1330–32, 1993.
18. Robertson LS: Injury epidemiology. New York, Oxford University Press, 1992, p 28, .
19. Nowjack-Raymer RE, Gift HC: Use of mouthguards and headgear in organized sports by school-aged children. Public Health Reports 82–86, 1996.
20. American Dental Association Bureau of Health Education and Audiovisual Services, Council on Dental Materials, Instruments, and Equipment. Mouth protectors: Give your teeth a sporting chance. J Am Dent Assoc 109:84–87, 1985.
21. Kumamoto DP: Sports dentistry at the state level. J Am Dent Assoc 127:816, 1996.
22. American Dental Association Bureau of Health Education. Mouth protectors and sports team dentists. J Am Dent Assoc 109:84–87, 1984.
23. American Dental Association, Bureau of Health Education. Mouth protectors for football players: The dentist's role. J Am Dent Assoc 64:419–21, 1962.
24. Kalina S: Give teeth a sporting chance. Penn Dent J 62:15, 1995.
25. McCarthy MF: Sports and mouth protection. Gen Dent 38:343–46, 1990.
26. DeYoung AK, Robinson E, Godwin WC: Comparing comfort and wearability: Custom-made versus self-adopted mouthguards. J Am Dent Assoc 125:1112–17, 1994

Abstract of the Scientific Literature

Plasma levels of 2% lidocaine with epinephrine 1:100,000 with young children undergoing dental procedures

The purpose of this study was to determine the blood plasma concentrations of lidocaine in small children undergoing quadrant dentistry while deeply sedated. Data were reported descriptively.

It is commonly accepted that blood plasma concentrations of lidocaine between 5-10 micrograms/milliliter are toxic to children. Most dental texts on anesthesia use 4.4 mg/kg of lidocaine as the maximum safe dosage for children undergoing treatment with sedation. This study challenges these dosage limitations.

Twelve children ranging in age from 55-150 months were treated under IV sedation for are described as routine dental procedures. Half of the children had the IV started after a eutectic mixture of lidocaine and prilocaine (EMLA Cream©) was applied over the venipuncture site. The other half had only a small amount of lidocaine 2% injected subcutaneously prior to venipuncture. All children were sedated with midazolam, fentanyl, and propofol. Blood was drawn out of the IV catheter at 5-minute intervals after the IV was started and the blood plasma concentrations were measured. All children received local anesthetic sufficient to prevent responses to painful stimuli. The dosages ranged from 2.6-6.4 mg/kg. The blood plasma concentration ranged from 0.7-3.8 microgram/ml. The children for who the EMLA Cream© was used had higher plasma concentration than the children who did not. In no cases did any of the plasma concentrations reach the toxic level. The authors concluded that dental anesthesia using lidocaine is safe and that higher amounts could be used without reaching toxic levels.

Comments: A look at the actual data shows quite a wide range of peak blood plasma concentrations as compared to the dosage. In some cases there was no real correlation between dose and the plasma concentrations reported. The authors made no attempt to explain this phenomenon. Also noted is the fact that the data in this study was so random that no statistical analysis was possible. More research in this area is needed MGP

Plasma levels of 2% lidocaine with epinephrine11:100,000 with young children undergoing dental procedures. Jurevic, Richard, et al. Anesth Prog 45:87-90 1998.