The incidence and severity of dental trauma in intercollegiate athletes

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ABSTRACT

Background. The use of protective devices such as mouthguards during participation in contact sports may be effective in reducing the incidence or severity of dental injuries.

Methods. Dental injuries reported to the athletic department at the University of Southern California, Los Angeles, were recorded from 1996 through 2005. The authors classified each injury and determined the severity of the injury. Severity was defined in relation to the treatment required and the prognosis of the teeth and supporting tissues involved.

Results. Fifty-one traumatic dental injuries were reported. Basketball was the sport with the highest injury rate; it had an incidence rate (IR) of 10.6 injuries per 100 athlete-seasons among men, and an IR of 5.0 injuries per 100 athlete-seasons among women. The IR for men's basketball players was five times higher than that for football players for whom mouthguard use is mandatory.

Conclusions. Given the relatively high incidence of dental injury in basketball and the potential of mouthguard use to reduce the incidence and severity of the trauma, mandatory use of mouthguards among collegiate basketball players should be considered.

Clinical Implications. Dental professionals have a responsibility to educate patients and the public about the importance of using mouthguard protection in contact sports.

Key Words. Dental trauma; collegiate sports; incidence rate.
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The incidence of dental trauma due to falls, sports, automobile accidents and violence has increased significantly in recent decades, affecting children's and teenagers' anterior teeth.[1] Previous epidemiologic surveys of dental trauma have reported associations between the sex of the athlete and his or her participation in sports-related activities.[2] During childhood, boys show a higher prevalence of dental trauma than do girls, but this sex difference may change with age.[3,4] A 2003 study reported that 9 percent of young adults aged 18 to 19 years who have participated regularly in at least one sport had experienced dental injuries during sports participation at some point in their lifetimes.[4]

There is some evidence that preventive measures may be effective in reducing risk of dental trauma. For example, certain predisposing factors such as protruded maxillary incisors and insufficient lip closure may affect the extent of the trauma. Dental trauma has been found to be more prevalent among children with incisal overjet of more than 7 millimeters, insufficient lip closure or both.[5,6] In these patients, the maxillary anterior teeth are

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TABLE 1

Classification of injuries, by severity.

TYPE OF INJURY	SEVERITY LEVEL
Uncomplicated Crown Fracture	Mild
Concussion	Mild
Complicated Crown Fracture	Moderate
Subluxation	Moderate
Crown-Root Fracture	Severe
Root Fracture	Severe
Luxation	Severe
Avulsion	Severe

exposed directly to any impact without interposition of soft tissue. Therefore, early orthodontic treatment in predisposed children may be an effective prevention strategy. Protective devices such as mouthguards also may help reduce the incidence or severity of dental injuries if they are worn during participation in contact sports. In 1962, the National Collegiate Athletic Association (NCAA) mandated the use of mouthguards for football players at colleges and universities.[7,8] Before 1962, the annual incidence of football-related injuries to the face and mouth region was estimated to be 50 percent[9]; after 1962, injuries decreased to 1.4 percent.[10] Despite these results, the NCAA mandated the use of mouthguards for only five amateur sports: boxing, football, ice hockey, men's lacrosse and women's field hockey.[11] Recently, the American Dental Association Council on Access, Prevention and Interprofessional Relations and the Council on Scientific Affairs recommended that athletically active people of all ages use a properly fitted mouthguard in any sporting or recreational activity that may pose a risk of injury.[12]

We conducted a study to report the incidence and severity of dental trauma by sport among student athletes who participated in intercollegiate sports at the University of Southern California (USC), Los Angeles. We also report USC's mouthguard use policy by sport during the study period.

MATERIALS AND METHODS

The Injury Surveillance System (ISS) was developed in 1982 by the NCAA to provide current and reliable data on injury trends in intercollegiate athletics. ISS collects data on all types of injuries related to sports participation, including dental trauma. Injury data are collected yearly from a representative sample of member institutions, and the resulting data summaries are reviewed by the NCAA Committee on Competitive Safeguards and Medical Aspects of Sports. Injuries reported to the ISS occurred as a result of participation in an organized intercollegiate practice or game, required medical attention by a team athletic trainer or physician, and resulted in restriction of the student athlete's participation or performance for one or more days beyond the day of injury.[13]

We included in our study all dental injuries that met the ISS reporting criteria and that were reported to the athletic department at USC from 1996 through 2005. We did not identify less severe injuries that did not require attention from the team athletic trainer or physician or days lost due to the injury.

During the study period, USC had 19 teams participate in 15 different sports at the intercollegiate level, with an estimated 700 student athletes participating each year. We initially classified each injury by using Andreasen's classification[14] and then determined the severity of the injury. Although the severity of sports-related injuries typically are defined by the number of days of sport participation lost due to the injury,[15-17] in our study, we focused more on the dental implications of the injury. Thus, in our study, we defined "severity" in relation to the treatment required and the prognosis of the teeth and supporting tissues involved. Table 1 shows the severity level we assigned to each injury classification. When more than one type of injury occurred in a single injury incident, the more serious injury was reported for the analysis of injury severity; for example, if a student athlete experienced both a root fracture and a complicated crown fracture, we reported the root fracture.

We calculated incidence rates (IRs) per 100 athlete-seasons separately for each sport. We determined the number of seasons at risk as the number of athletes per team in each sport, multiplied by the number of years of injury data collec-

ABBREVIATION KEY. EVA: Ethylene vinyl acetate. **IR:** Incidence rate. **IRR:** Incidence rate ratio. **ISS:** Injury Surveillance System. **NCAA:** National Collegiate Athletic Association. **USC:** University of Southern California.

TABLE 2

Incidence rate of traumatic dental injuries, by sport.

SPORT	NO. OF ATHLETES PER SEASON	TOTAL NO. OF ATHLETE-SEASONS AT RISK	NO. OF INJURIES	INCIDENCE RATE (NO. OF INJURIES PER 100 ATHLETE-SEASONS)
Men's Teams				
Basketball	16	160	17	10.6
Football	106	1,060	21	2.0
Baseball	39	390	2	0.5
Track and field	43	430	1	0.2
Women's Teams				
Basketball	12	120	6	5.0
Volleyball	14	140	1	0.7
Crew	24	240	1	0.4
Water polo	31	310	1	0.3
Track and field	39	390	1	0.3

tion (10 years). We did not measure the number of hours or days of participation at the player or the team level. Therefore, the only measure of exposure-time available to calculate IRs was the athlete-season, which, in this context, is the average participation (exposure) in practices and games by athletes in each sport, during the course of one season.

To examine the hypothesis that wearing mouthguards can reduce the risk of injury, we examined the IRs among women's basketball players separately for 1996 through 1999 and 2000 through 2005. In 2000, the USC women's basketball team instituted a teamwide policy of mandatory mouthguard use when participating in practices and games. Before 2000, mouthguard use was not required. No other sport changed its team policy regarding mouthguard use during the 10-year reporting period. Therefore, women's basketball provided us a unique opportunity to examine the association between injury rate and mouthguard use.

We used injury counts and frequency distributions to describe injury severity and type by sport. We used the Fisher exact test to compare the proportion of injuries rated as severe among men's basketball and football athletes.

RESULTS

We identified 51 reportable traumatic dental injuries during the 10-year reporting period. Athletes from nine of 19 teams that participated in intercollegiate competition at USC reported dental trauma. No injuries were reported for men's or women's golf, tennis or swimming/diving; men's volleyball and water polo; or women's cross-country and soccer.

Table 2 summarizes the IR of dental injuries by sport for the nine teams that reported at least one injury. For both men and women, basketball had the highest injury rate. Seventeen injuries were reported in men's basketball, corresponding to an IR of 10.6 injuries per 100 athlete-seasons. The IR among men's basketball players was more than five times higher (incidence rate ratio [IRR] = 5.4; 95 percent confidence interval [CI], 2.7 to 10.7) than the IR reported among football players (IR = 2.0), which was the sport with the second highest IR and the highest total number of injuries (n = 21). Dental injury was infrequent (IR < 1.0) on the men's baseball and track and field teams.

The women's basketball team had a dental trauma IR of 5.0, approximately one-half the IR of the men's basketball team (IRR = 0.5; 95 percent CI, 0.2 to 1.3). Among women's sports, however, basketball had the highest dental injury rate (n = 6); all other women's sports had one or zero dental injuries during the reporting period. Table 3 reports the dental injury IR among female basketball players in years with and without a teamwide policy of mandatory mouthguard use. From 1996 through 1999, before mouthguard use was required, female basketball

TABLE 3

Incidence rate of traumatic dental injuries in women's basketball.

PARTICIPATION YEARS	NO. OF ATHLETES PER SEASON	TOTAL NO. OF ATHLETE-SEASONS AT RISK	NO. OF INJURIES	INCIDENCE RATE (NO. OF INJURIES PER 100 ATHLETE-SEASONS
1996-1999 (No Mandatory Mouthguard Use)	12	48	4	8.3
2000-2005 (Mandatory Mouthguard Use)	12	72	2	2.8

TABLE 4

Injury severity, by sport.

SPORT	MOUTHGUARD USE	NO. OF INJURIES	INJURY SEVERITY (%)		
			Mild	Moderate	Severe
Men's Teams					
Basketball	No	17	35	41	24
Football	Yes	21	19	67	14
Baseball	No	2	0	50	50
Track and field	No	1	0	100	0
Women's Teams					
Basketball (1996-1999)	No	4	25	75	0
Basketball (2000-2005)	Yes	2	50	50	0
Volleyball	No	1	100	0	0
Crew	No	1	0	100	0
Water polo	No	1	0	100	0
Track and field	No	1	100	0	0

players reported an injury IR of 8.3 per 100 athlete-seasons. After the policy went into effect, the injury IR was 2.8. The estimated IRR of 3.0 (95 percent CI, 0.4 to 33.2) suggests that the injury IR among female basketball players may be greater when mouthguards are not worn; however, the difference was not statistically significant. The small number of injuries we observed in this study limits the precision to which we could estimate the IRs and resulted in wide confidence limits around the risk estimates. Larger studies are necessary to determine if there is a significant protective effect.

Injury severity by sport and mouthguard-use status is shown in Table 4. The percentage of injuries rated severe was similar for men's basketball and football (24 percent versus 14 percent, $P = .68$). Men's baseball was the only other sport in which a severe dental injury occurred. Sixty-seven percent of football-related dental injuries were rated moderate, compared with 41 percent of men's basketball-related dental injuries. Among women's basketball players, 75 percent of dental injuries were rated moderate before the implementation of mandatory mouthguard use, compared with 50 percent after the change in team policy. The total number of women's basketball-related dental injuries (n = 6) was too small for us to compare statistically the injury severity before and after implementation of the mouthguard policy.

Injury type is summarized in Table 5. Complicated crown fractures (n = 18), uncomplicated crown fractures (n = 13) and subluxation (n = 11) were the most common types of injuries. Among the injuries rated as severe, root fractures were most common (n = 4). The most common type of injury among football athletes was complicated crown fractures (n = 11), whereas uncomplicated crown fractures were the most frequent injury type in men's basketball (n = 6). The women's basketball team reported an equal number of uncomplicated and complicated crown fractures, as well as subluxation injuries (n = 2).

DISCUSSION

In our study, basketball was the sport with the highest incidence of dental trauma. Dental injuries in basketball often are caused by hand or elbow contact with the facial area or by collision

with other players. The speed of the game and the close contact of the athletes on a relatively small court are predisposing factors for more injuries. The force of the impact that caused the trauma also causes crown fractures.

The results of a study conducted by Labella and colleagues[18] are in accordance with the results of our study; both studies showed that crown fractures were the predominant type of dental injury in men's college basketball. Although a crown fracture can be treated successfully by means of conservative therapy, irreversible damage to the pulp and periodontium is not uncommon. Perunski and colleagues[19] recently reported that of 331 basketball coaches and players, 102 (30.8 percent) had seen a dental trauma and 55 (16.6 percent) had already experienced a dental trauma. Unfortunately, only four (1.2 percent) of the interviewed players wore a mouthguard.

TABLE 5

Injury classification, by sport.

INJURY TYPE	ALL TEAMS COMBINED*	FOOTBALL	MEN'S BASKETBALL	WOMEN'S BASKETBALL
Uncomplicated Crown Fracture	13	3	6	2
Concussion	1	1	0	0
Complicated Crown Fracture	18	11	3	2
Subluxation	11	3	4	2
Crown-Root Fracture	2	1	1	0
Root Fracture	4	1	2	0
Avulsion	2	1	1	0
TOTAL	**51**	**21**	**17**	**6**

* Injuries for other sports included: men—baseball (root fracture, subluxation), track and field (complicated crown fracture); women—volleyball (uncomplicated crown fracture), water polo (complicated crown fracture), track and field (uncomplicated crown fracture), crew (subluxation).

Dental trauma frequently creates a need for lifelong follow-up treatment. Contemporary dentistry must address not only the prevention of caries, periodontal disease and oral cancer but also the prevention of oral injuries. Such a preventive approach involves education, early orthodontic treatment in predisposed children and the use of protective devices in contact sports. Education should focus on the prevention of dental trauma and on the implementation of therapeutic guidelines at the injury site. Studies have reported the need of such an education campaign for laypeople,[20] teachers,[21] coaches,[19,21] physicians,[22] nurses,[20] paramedics[23] and dentists.[24] Dental professionals have the responsibility to educate patients and the public about mouthguard protection in contact sports. It also is imperative that dentists provide inexpensive devices to the athletes or their parents or that the devices are easily accessible.

Athletic mouthguards have been recommended for decades with varying levels of athlete acceptance. Issues related to user compliance center on the user's ability to breathe and speak while wearing a mouthguard.[25,26] Mouthguards have changed over time from vacuum-formed mouthguards to two-layer ethylene vinyl acetate (EVA) mouthguards fabricated on a high-pressure machine. The EVA mouthguards' main advantages are that they fit better and have better protection owing to improved impact absorption. Research has indicated that 4 mm is the optimal thickness of EVA.[27] However, Duhaime and colleagues[28] recently reported that it might be possible to construct a thinner EVA mouthguard that provides protection equal to that offered by those currently in use. Overall, mouthguards are an inexpensive and noninvasive option for the prevention of sports-related dental injuries. However, more widespread use of mouthguards among athletes will require increased public acceptance and awareness, which can be gained through increased health education and promotion.[2,29]

Although our study provided useful information regarding the frequency of dental injuries among intercollegiate athletes, it was not without limitations. In accordance with the NCAA ISS reporting criteria, we considered only injuries that were severe enough to require medical attention by a team athletic trainer or physician and that resulted in restriction of the student athlete's participation or performance for one or more days beyond the day of injury. Therefore, we have no data on the incidence of less severe dental trauma.

The number of hours or days of participation was not captured at either the player or the team level, so IRs could be reported only with exposure-time measured as athlete-seasons of participa-

tion. This measure of exposure-time resulted in IRs that did not account for differences among sports in length of playing season or the frequency and duration of practices. In addition, the IRs did not measure differences in exposure-time by individual athletes in a sport owing to missed practices or differential playing time. The athlete-season measure of exposure for the IR calculations must be interpreted as the average exposure for athletes in that sport over the duration of one sport-season (year). Also, despite the 10-year duration of the study, the number of reported injuries was small. Therefore, it is important not to overinterpret the study results, since the small sample size limits the precision of incidence estimates.

Data on mouthguard use were not available at the individual athlete level. Therefore, our assessment of the protective effects of mouthguards was limited to the women's basketball team, which included data from before and after a change in team policy that made mouthguard use mandatory. Since the incidence of dental injury was low, the total number of injuries was too small for us to make a meaningful evaluation of the protective effects of mouthguard use in this study sample.

CONCLUSIONS

The incidence of dental trauma was low among intercollegiate athletes in most sports. We found the incidence to be highest among athletes playing basketball. Given the relatively high incidence of dental injury in basketball and the possibility of long-term follow-up treatment needs combined with the potential of mouthguard use to reduce the incidence and severity of dental trauma, the mandatory use of mouthguards among collegiate basketball players is a policy worthy of consideration. ■

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