

From the medical press

Epidemiology of traumatic injuries to the permanent incisors of 9–12-year-old schoolchildren in Damascus, Syria

Marcenes W, Al Beiruti N, Tayfour D, Issa S.
Epidemiology of traumatic injuries to the permanent incisors of 9–12-year-old schoolchildren in Damascus, Syria. *Endod Dent Traumatol* 1999; 15: 117–123. © Munksgaard, 1999.

Abstract This cross-sectional survey was carried out to assess epidemiological data concerning dental injuries to the permanent incisors of Syrian children. It included 1087 children aged 9 to 12 years, of both sexes, randomly selected from public and private primary schools in Damascus. The response rate was 100%. The prevalence of traumatic injuries to the permanent incisors rose from 5.2% at the age of 9 years to 11.7% at the age of 12 years ($P = 0.007$). The difference in prevalence between boys and girls was not statistically significant ($P > 0.05$). The majority (59.8%) of children who had experienced injuries to the permanent incisors reported that they were not taken to the dentist for evaluation or treatment of the damage. Among those children who had experienced traumatic injuries to the teeth 93.1% presented with untreated damage. Because some injuries were minor, such as small enamel fractures, the proportion of children who needed treatment was 63.2%. There was a tendency for children with an incisal overjet greater than 5 mm to have experienced dental injuries ($P = 0.06$). Children with inadequate lip coverage were more likely to have experienced dental injuries than those with adequate lip coverage ($P = 0.000$). The most common reported cause of injuries to the permanent incisors was violence (42.5%), followed by traffic accidents (24.1%) collisions with people or inanimate objects (16.0%) and falls (9.1%). In conclusion, traumatic dental injury may pose a serious dental public health problem.

W. Marcenes^{1,2}, N. Al Beiruti³, O. Tayfour³, S. Issa³

¹Department of Epidemiology and Public Health, University College London Medical School.

²Department of Dental Public Health, St Bartholomew's and the Royal London School of Medicine and Dentistry, London, UK. ³Regional WHO, Demonstration, Training and Research Centre for Oral Health, Damascus, Syria.

Key words: crown fractures; dental injury; dental trauma; epidemiology

Wagner Marcenes, Department of Epidemiology and Public Health, 1–19 Torrington Place, London WC1 681 UK

E-mail: w.marcenes@public-health.ucl.ac.uk

Accepted January 13, 1999

This article is reproduced with kind permission of Munksgaard. It was published in Endodontics & Dental Traumatology, 1999, 15:117–123.

This section contains scientific material reproduced with kind permission in accordance with a collaborative agreement between EMHJ and other journals.

The combined impact of violence, traffic accidents and sporting activities has contributed to the establishment of traumatic dental injuries as a public dental health problem. In addition, the remarkable decline of the prevalence and severity of dental caries amongst children in many countries (1-5) may have made traumatic dental injuries the most serious public dental health problem among youth in those countries (6).

A number of factors need to be taken into account when assessing whether or not a condition is a public dental health problem. The condition should be wide-spread in a population; it may be life-threatening or have a significant impact on individuals and society; and a body of knowledge should exist about its causation factors and treatment.

The prevalence of dental injuries is high (7). A prospective research design study carried out in Denmark, one of the few of this type, has shown that half of all children are likely to experience at least one dental injury before leaving school (8). Recently, a carefully carried out retrospective research design using reliable dental records from Sweden showed that 35% of 16-year-old children studied had on one or more occasions sustained dental injury (9). Lower percentages were reported when the prevalence of dental injuries was assessed using a cross-sectional design, which probably grossly underestimated the prevalence (7).

Dental injury may have an impact on children's quality of life. The majority of dental injuries involve the anterior teeth (7), which may lead to restriction in biting, difficulty speaking clearly, and feeling embarrassed to show the teeth.

Due to its high prevalence, dental injury accounts for a high percentage of complaints in emergency dental services. Results of the analysis of the emergency dental service at The Royal Belfast Hospital for Sick Children during 1987 showed that while toothache with

or without abscess resulting from caries represented 49% of the dental complaints, damage to the teeth represented 39% (10). Similarly, data from a consecutive series of patients in an urban paediatric department in the United States showed that of 1459 children treated, 541 (37%) had dental injuries (11). Furthermore, data from patients requiring after-hours dental emergency services at the Children's Hospital of Buffalo, United States, showed that the most commonly observed condition presented for emergency care was traumatic injury to the teeth (12).

The treatment for dental injuries is known (7). However, previous studies have reported that treatment of dental injury tends to be neglected. In the United Kingdom, less than 20% of damaged teeth were treated among children age 12 years or younger (13). Since the most common type of injury to teeth is enamel or enamel and dentine fractures (7,12), it could be argued that minor damage does not require treatment and thus treatment was not neglected. This matter needs clarification. Other types of injuries are fracture of the teeth involving the pulp, discoloration, luxation, intrusion and avulsion (7,13,14).

A body of knowledge exists on the causes of dental injury. It is known that increased incisal overjet of the teeth (7,13) and inadequate lip coverage are significant predisposing factors for traumatic dental injury (7,15). Dental clinics and hospital-based studies have reported that falls and collisions, sporting activities, violence and traffic accidents are the main causes of injury to permanent incisors (7,16). However, these data are not representative of the population and selection bias may determine the frequency distribution of causative factors for dental injury.

In summary, traumatic dental injury is widespread in the population; it has both physical and psychological effects, it is treatable; and, most importantly, it is preventable.

Thus, traumatic dental injury is a public dental health problem.

Despite the importance of this problem, there are few reports available on the epidemiology of injuries to the teeth of children in developing countries, in particular when compared to epidemiological data on dental caries and periodontal diseases. Also, the causes of dental injuries have rarely been studied in cross-sectional surveys including both developing and developed countries.

This study was carried out to obtain epidemiological data concerning accidental and non-accidental injuries to the permanent incisors in Damascus, Syria.

Material and methods

A cross-sectional survey was carried out including children aged 9 to 12 years, of both sexes, attending public and private primary schools in Damascus. These children were randomly selected to represent the population of schoolchildren living in Damascus.

The size of the sample was calculated to give a standard error of less than 25%. The 95% confidence interval level and a prevalence of dental injury of 10% were used for the calculation (17). A correction factor equal to 1.2 was applied to increase precision because a multi-stage rather than a random sampling technique (18) was adopted. The minimum sample size to satisfy the requirements was estimated to be 165 children at each age.

A multi-stage sampling technique was adopted to select the children. The first-stage unit comprised all private and public primary schools in Damascus. The second-stage unit comprised all children within the selected schools. Schools were selected at random. Because the number of children differed from school to school, an equal probability scheme was adopted by sampling with a probability

proportional to school size. For example, if one school had twice as many pupils as another it was given twice the chance of being selected. All children enrolled in the selected schools were invited to participate in the survey. A total of 1087 children were selected and invited to participate. Local authorities (Health Council and the Education Council) provided the necessary information for the construction of a sample frame. The following information was obtained: names of all schools in Damascus, their addresses, and total number of students in each school by age.

A letter was sent to the parents of the selected children explaining the aim, characteristics and importance of the study, and asking for their participation. Negative consent was adopted, without any prejudice being attached to the children who had opted not to participate.

Dental examinations were carried out by two dentists who participated in a training and calibration exercise for the criteria used to identify dental injuries. Children were examined at school during class hours in a predetermined order. Examiners wearing gloves carried out the clinical examinations using a plane mouth mirror and periodontal probe WHO 621. A spot head-light provided a standardised source of light for the examinations. The dental examination included only upper and lower permanent incisors. The criteria for traumatic dental injuries used in the Children's Dental Health Survey in the United Kingdom were adopted (13). Examiners recorded the type of damage sustained, any treatment which had been carried out, the treatment need, the size of incisal overjet and whether lip coverage was adequate. Intra- and inter-examiner variability was checked through duplicate examinations of every 10th subject. Sociodemographic data included age and sex. Other non-clinical data collected were the causes of the dental injury and dental visits due to the dental injury.

Table 1. Frequency distribution of age and sex in a sample of 1087 schoolchildren, amascus

Age and sex	Frequency (n)	Relative frequency (%)
9 years		
Boys	131	12.1
Girls	117	10.8
All	248	22.9
10 years		
Boys	203	18.7
Girls	140	12.9
All	343	31.6
11 years		
Boys	207	19.0
Girls	127	11.7
All	334	30.7
12 years		
Boys	99	9.1
Girls	63	5.8
All	162	14.9
9-12 years		
Boys	640	58.9
Girls	447	41.1
All	1087	100.0

Data analysis included descriptive statistics (frequency distribution and cross-tabulation). Statistical significance for the association between the occurrence of dental injuries and sex, age, incisal overjet size and lip coverage was carried out using the chi square test and Fisher's exact test. The level of significance set was $P < 0.05$.

A sample of 90 children was used to test administration, dental examination procedures and questionnaires, as well as to train the examiners. Research instruments were shown to be applicable to Syria.

Results

A total of 1087 schoolchildren representing 165 000 children aged 9 to 12 years living

Table 2. Prevalence of traumatic injuries to the permanent incisors in a sample of 1087 schoolchildren aged 9 to 12, by age and sex, Damascus

Age and sex	Dental injury n (%)	No dental injury n (%)	P-value for Fisher's exact test
9 years			
Boys	9 (6.9)	122 (93.1)	0.264
Girls	4 (3.4)	113 (96.6)	
All	13 (5.2)	235 (94.8)	
10 years			
Boys	13 (6.4)	190 (93.6)	0.828
Girls	10 (7.1)	130 (92.9)	
All	23 (6.7)	320 (93.3)	
11 years			
Boys	24 (11.6)	183 (88.4)	0.128
Girls	8 (6.3)	119 (93.7)	
All	32 (9.6)	302 (90.4)	
12 years			
Boys	12 (12.1)	87 (87.9)	1.0
Girls	7 (11.1)	56 (88.9)	
All	19 (11.7)*	143 (88.3)	

*P-value for χ^2 test for trend for age = 0.007.

in Damascus, Syria, were examined and interviewed in this cross-sectional survey; 58.9% of them were boys and 41.1% girls (Table 1). Frequency distribution by age is presented in Table 1. The response rate was 100%. Because all the children enrolled in selected schools wanted to participate in the study, the sample size for the ages of 9 to 11 years was bigger than the estimated minimum size to satisfy the requirements, 165 children of each age. However, only 162 12-year-old children were selected. This was due to a smaller number of children at this age attending school. Kappa values were calculated for clinical measures on a tooth-by-tooth basis and all scores were greater than 0.80, indicating a very good intra- and inter-examiner agreement.

The prevalence of injuries to the teeth increased with age. It rose from 5.2% at the age

of 9 years to 11.7% at the age of 12 years. A statistically significant ($P = 0.007$) trend was observed (Table 2). The difference in prevalence between boys and girls was not statistically significant ($P > 0.05$) (Table 2). There was a tendency for children with an incisal overjet greater than 5 mm to have experienced dental injuries, but the difference was not of statistical significance (Table 3). Children with inadequate lip coverage were more likely to have experienced dental injuries than those with adequate lip coverage ($P = 0.000$) (Table 3).

Children who had experienced any dental injury were asked when the traumatic injury to the teeth had happened. The great majority of dental injuries happened at the ages of 9 and 10 years old (Fig. 1).

Most of the children (78.2%) who had experienced traumatic dental injuries had only one tooth damaged; 17.2% had two teeth damaged and only 4.6 had three or more teeth damaged. A total of 12.8 per 1000 incisors were damaged (Table 4). Only seven teeth out of 105 presenting any damage were treated. The type of treatment identified was acid-etch restoration and crowns, four and three inci-

sors respectively (Table 4). Fractures in enamel only (5.6 per 1000 incisors) together with fractures in enamel and dentine (5.5 per 1000 incisors) were the most commonly sustained type of damage. The occurrence of other types of injury was not significant (Table 4). Acid-etch composite was the most common type of treatment needed after traumatic injury to the permanent incisors (6.8 per 1000 incisors) (Table 4). Among all children who had experienced traumatic injuries to the teeth, 93.1% presented with untreated damage (Table 5). Since some injuries were minor, such as small enamel fractures, the proportion of children who needed treatment was smaller than the proportion of children presenting with untreated dental injuries, 63.2% compared with 93.1% (Table 5).

Some enamel fractures were not minor and needed treatment. The majority (59.8%) of children who had experienced injuries to the permanent incisors reported that they were not taken to the dentist for evaluation or treatment of the damage.

The most commonly reported cause of injuries to the permanent incisors was violence (42.5%), followed by traffic accidents

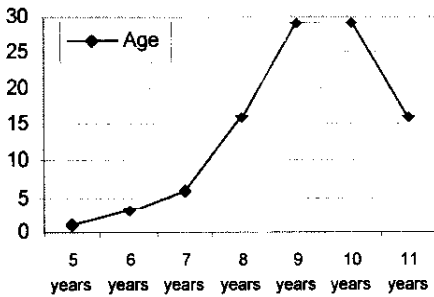


Fig. 1. Frequency distribution of age of occurrence of injuries to the permanent incisors in a sample of 76 schoolchildren aged 9 to 12, Damascus.

Table 3. Prevalence of injuries to the permanent incisors in a sample of 1087 schoolchildren aged 9 to 12, by incisal overjet size and lip coverage, Damascus

	Dental injury n (%)	No dental injury n (%)	P-value
Overjet size			
< 5 mm	77 (7.6)	941 (92.4)	0.06*
> 5 mm	10 (11.5)	59 (85.5)	
All	87 (8.0)	1000 (92.0)	
Lip coverage			
Adequate	58 (6.5)	835 (93.5)	0.000**
Inadequate	29 (14.9)	165 (85.1)	
All	87 (8.0)	1000 (92.0)	

*Fisher's exact test.

**Chi-square test.

Table 4. Rate per 1000 incisors of different types of treatment for clinical damage due to injuries to the permanent incisors in a sample of 1007 schoolchildren aged 9 to 12, Damascus (n = 8696 incisors)

	Frequency (n)	Relative frequency per 1000 incisors
Treated injury		
Acid-etch restoration	4	0.5
Permanent crown	3	0.3
Denture due to trauma	0	0
Untreated injury		
Enamel fracture		
Enamel fracture alone	49	5.6
Enamel fracture and discoloration	0	0
Enamel fracture and fistulus tract	0	0
Enamel fracture, discoloration and fistulus tract	0	0
Enamel/dentine fracture		
Enamel/dentine fracture alone	48	5.5
Enamel/dentine fracture and discoloration	0	0
Enamel/dentine fracture and fistulus tract	0	0
Enamel/dentine fracture, discoloration and fistulus tract	0	0
Enamel/dentine fracture with pulp exposure		
Enamel/dentine fracture with pulp exposure alone	2	0.2
Enamel/dentine fracture with pulp exposure and discoloration	0	0
Enamel/dentine fracture with pulp exposure and fistulus tract	0	0
Enamel/dentine fracture with pulp exposure, discoloration and fistulus tract	1	0.1
Missing due to injury	0	0
Discoloration alone	0	0
Fistulus tract alone	0	0
Other injuries	5	0.6
Treatment need		
Acid-etch restoration	59	6.8
Acid-etch restoration and endodontic treatment	0	0
Acid-etch restoration, endodontic treatment and bleaching	0	0
Permanent crown	3	0.3
Permanent crown and endodontic treatment	3	0.3
Denture	0	0

Note: The difference between untreated incisors and incisors needing treatment is due to small enamel fractures.

(24.1%), collisions with people or inanimate objects (16.0%) and falls (9.1%) (Table 6). Other causes than those reported accounted for only 3.4% and no more than four children (4.6%) failed to report the cause of the dental injury (Table 6). Half of the dental injuries recorded as collisions were due to pushing, a minor form of violence (Table 6). Thus, violence may account for at least 50.5% of traumatic dental injuries (Table 6).

Nearly half (48.3%) of the dental injuries occurred at home, the others occurring at

school (26.4%), in the street (8%) or in parks (1.1%). Fourteen children (16.1%) could not remember where the accidental or non-accidental damage to the teeth had occurred.

Discussion

This cross-sectional survey identified a moderate prevalence of dental injuries to the permanent incisors of children living in Damascus — 5.2% at the age of 9 years reach-

Table 5. Proportion of children with untreated dental injuries and treatment needed in a sample of 87 schoolchildren aged 9 to 12 who have experienced injuries to the permanent incisors, Damascus

	Frequency (n)	Relative frequency (%)
Untreated	81	93.1
Treated	6	6.9
Need treatment	55	63.2
Do not need treatment	32	36.8

Note: The difference between untreated incisors and incisors needing treatment is due to small enamel fractures.

Table 6. Frequency distribution of causes of injuries to the teeth in a sample of 87 schoolchildren aged 9 to 12 who have experienced injuries to the permanent incisors, Damascus

Type of accident	Frequency	Percent
Fall (all types of fall)		
Fall from stairs	6	6.9
Fall from playground equipment	1	1.1
Other types of fall	1	1.1
Collision with objects or people	14	16.0
Collision with water tap	4	4.6
Collision with person's head	3	3.4
Collision with other objects	7	8.0
Traffic accidents	21	24.1
Violence	37	42.5
Other causes	3	3.4
Missing information	4	4.6

ing 11.7% at the age of 12 years. However, caution should be exercised when comparing prevalence figures owing to variations in sampling and diagnostic criteria between different studies. The present study represents the population of children enrolled at school, but not the whole population of children living in Damascus, Syria. According to local custom, more boys than girls are enrolled in schools. This was reflected in the unequal distribution

of boys (58.9%) and girls (41.1%) in our random sample of schoolchildren.

In the United Kingdom, the prevalence of injuries to teeth among children increased from 6% among 8-year-old children to 19% among 13-year-old children, and thereafter it remained at around 20% (13). In the United States, the prevalence of injuries to teeth among persons age 6 to 20 years was 18.4% (19).

Studies carried out in developing countries also showed a large range in prevalence. A study carried out among boys attending four private schools in Monterrey, Mexico, reported a high prevalence of dental injuries: 20% at age of 8 years rising to 40% at the age of 12 years (20). In San Pedro de Macoris, Dominican Republic, the prevalence of dental injury among boys and girls rose from 7.4% at the age of 7 years to 19.4% at the age of 14 years (21). In Santo Domingo, Dominican Republic, the prevalence of dental injury among 12-year-old boys and girls was 10.2% (22).

The prevalence of dental injuries in Damascus was lower than in most Arabian countries. In Amman, Jordan, the prevalence of dental injuries reached 15% at the age of 11–12 years (23); in Iraq it reached 19.5% and 16.1% for boys and girls respectively at the age of 12 years (24). The same study assessed the prevalence of dental injuries among Sudanese boys and girls; it was 16.5% and 3.6% respectively at the age of 12 years (24).

As observed in previous studies, the prevalence of dental injuries increased with age, and most of the children who experienced dental injuries had only one tooth damaged. The most common form of damage identified were enamel only or enamel/dentine fractures (7). The fact that the prevalence of dental injury increased with age did not mean that the oldest were the most vulnerable. The characteristics of traumatic injuries mean that the measurement of this type of dental injury is cumulative. This study identified the 9–10

year age as the period of life when most of the recorded damage occurred (Fig. 1). These results corroborated the findings of previous studies (8,9).

Differences in prevalence between boys and girls were not of statistical significance. This finding differed from most other reports (7). Nevertheless, some studies have also reported similar prevalences for boys and girls (21-23). Behavioural and cultural diversity may explain differences in findings between countries. The view that boys sustain more injuries than girls should be challenged. It is possible that, nowadays, there may be more girls and fewer boys getting involved in rough activities than in the past.

As in other countries, the treatment of dental injuries has been neglected in Syria. It is important to note that this study evaluated treatment need as well as untreated damage. Previous studies have reported the amount of untreated damage without taking into consideration the need for treatment. It is possible that they overestimated treatment need because some injuries are minor and may not need treatment. This study showed that not all untreated dental injuries required treatment. However, treatment need due to dental injuries was high. While 93.1% of children presented with untreated dental injuries, 63.2% needed treatment (Table 5).

Violence, followed by traffic accidents, collision with people or inanimate objects and falls, was the main cause of dental injuries in Damascus. Previous studies have reported falls and collisions as the main causes of dental injuries (7,16). This difference can be explained. Firstly, "falls" is a broad category that includes many causes of dental injury. Falls due to pushing is a minor form of violence which may have been recorded as "falls" in previous studies. It is common for a child to be pushed against another child or object, in particular the school water tap. This should be recorded as minor violence rather than collision.

Since this study asked participants to specify the cause of the dental injury, the percentage of falls identified was smaller than those reported in previous studies. Secondly, this study evaluated the causes of treated and untreated dental injuries in a randomly selected sample. Most of the previous studies were carried out on dental surgery populations. It is known that most of the time dental care is not sought immediately if violence is the cause of the dental injury. Thirdly, it is also known that when the damage is due to violence, the victim tends to report "unknown cause". Taking as an example a retrospective study carried out over 18 years in an endodontic practice (16), one can observe that 17.3% of all dental injuries were reported to be due to falls, 15.9% due to altercations! assaults/blows, 21.2% due to traffic accidents and 12.1% due to sporting activities. Of concern are the 17.7% who reported "unknown cause". Thus, previous studies may have underestimated violence as a causative factor for dental injuries.

Injuries to teeth due to sporting activities were not prevalent in Damascus. This may be because sports facilities are not widely available in Syria. Soccer is the most popular sporting activity. Aggressive contact sports are not commonly engaged in by Syrian children. However, rough play seems to be common among children in Syria.

The causes of dental injuries vary in different countries according to local customs. Thus, comparison between countries should take local customs into account.

Because traumatic dental injury is a public dental health problem, public health action should be taken. Prevention through health education and health promotion may play a major role in reducing damage to teeth. It must be stressed that treating dental injuries may cost more than treating dental - caries among children. Most damage may represent uncomplicated crown fractures, but other damage may be serious and require more

complex treatment such as endodontic treatment and a crown, or the replacement of missing teeth. Because the prevalence and severity of caries have been reduced dramatically at young ages, treatment of caries is limited mainly to occlusal cavities. Thus, the treatment of caries at this age is simple.

Since the main causes of traumatic dental injuries are violence and accidents, which are also the main causes of other injuries and death in several countries, a common risk-factor approach should be considered. This prevention strategy would reduce all types of injuries and mortality owing to accidents and violence. Due to their importance, accidents were included in the five key targets outlined in the Health of the Nation strategy in England along with coronary heart disease and stroke, cancers, mental illness and HIV/AIDS. This example should be followed by other countries.

Health promotion policies should aim to create an appropriate and safe environment as well as to enact and enforce legislation to prevent accidents and violence. Guidelines, legislation or both should be developed in respect of housing, furniture, playgrounds and toy design and construction. School crossing patrols, marked pedestrian crossings and bicycle lanes would help create a safe environment. Also speed limits for cars, use of seat belts, air bags, special car seats for smaller children and bicycle helmets should be enforced. Bicycle helmets should be redesigned, since they do not offer enough protection. Mouthguards should be used when playing sports, in particular contact sports.

Health education should aim at increasing the awareness of hazards in the home, school

and street environment as well as reducing the engagement in unsafe activities. For example, road safety behaviour and skills should be learned at school. Also, oral health education programmes should teach the lay public, in particular those who are likely to be involved in an emergency, the correct management of damaged teeth. This would help to prevent further damage such as tooth loss.

Finally, dental professionals should be able to recognise the signs and symptoms of physical abuse, and develop office policies and procedures for documenting and reporting suspected cases (25–29). Child abuse is an international problem and over 50% of all physical injuries from child abuse occur in the head and neck region. Thus, dental professionals are the group of professionals most likely to identify it (25–29).

In conclusion, traumatic dental injury is a public dental health problem and dental professionals must press for legislation and educational campaigns to prevent dental injuries as well as to provide the necessary information to help policy-makers create an appropriate and safe environment.

Acknowledgements — This study was supported by a grant from the Eastern Mediterranean Office of the World Health Organization.

The authors wish to thank Professor Aubrey Sheiham for his invaluable comments; Dr Hazem Seirawan — Ministry of Health; and Dr A. Akram Al-Harash — Director of School Health Department for their support as well as the members of the staff of the Department of Planning and Statistics in the Ministry of Education and the computer division in the DTRCOH for their assistance.

References

1. Barmes DE. Epidemiology of dental disease J Clin Periodontol 1979; 4:80-93.
2. Glass RL. The first international conference on the declining prevalence of dental caries J Dent Res 1982;61(Spec Iss):1301-83.
3. FDI/WHO. Changing patterns of oral health and implications for oral health manpower: Part I. Int Dent J 1985;35:235-51.
4. Burt BA. The future of the caries decline J Public Health Dent 1985; 45:261-9.
5. Petersson HG, Bratthall D. The caries decline: a review of reviews. Eur J Oral Sci 1996;104:436-43.
6. Andreasen JO, Andreasen FM. Dental traumatology: quo vadis. Tandlaegebladet 1989; 93:38 1-4.
7. Andreasen JO, Andreasen FM. Textbook and color atlas of traumatic injuries to the teeth. 3rd ed. Copenhagen: Munksgaard; 1994.
8. Andreasen JO, Ravn JJ. Epidemiology of traumatic dental injuries to primary and permanent teeth in a Danish population sample. Int J Oral Surg 1972;1:235-9.
9. Borssen A, Holm AK. Traumatic dental injuries in a cohort of 16-year-olds in northern Sweden. Endod Dent Traumatol 1997;13:276-80.
10. Fleming P, Gregg TA, Saunders ID. Analysis of an emergency dental service provided at a children's hospital. Int J Paediatr Dent 1991;1:25-30.
11. Wilson S, Smith GA, Preisch J, Casamassimo PS. Epidemiology of dental trauma treated in an urban pediatric emergency department. Pediatr Emerg Care 1997;13:12-5.
12. Majewski RF, Snyder CW, BernatJE. Dental emergencies presenting to a children's hospital. ASDC J Dent Child 1988;55:339-42.
13. O'Brien M. Children's dental health in the United Kingdom 1993. In: Report of Dental Survey, Office of Population Censuses and Surveys. London: HMSO; 1994.
14. Oikarinen K, Kassila O. Causes and types of traumatic tooth injuries treated in a public dental health clinic. Endod Dent Traumatol 1987;3:172-7.
15. O'Mullane DM. Some factors predisposing to injuries of permanent incisors in school children. Br Dent J 1973; 134:328-32.
16. Gutmann JL, Gutmann MSE. Cause, incidence and prevention of trauma to teeth. Dent Clin North Am 1995;39:1-13.
17. Kish L. Survey sampling. New York: J Wiley; 1965.
18. Kirkwood BR. Essentials of medical statistics, 1st ed. Oxford: Blackwell Scientific; 1988. p. 171.
19. Kaste LM, Gift HC, Bhat M, Swango PA. Prevalence of incisor trauma in persons 6-50 years of age: United States, 1988-1991. J Dent Res 1996;75(Spec Iss):696-705.
20. Sanchez AV, Garcia-Godoy F. Traumatic dental injuries in 3- to 13-year-old boys in Monterrey, Mexico. Endod Dent Traumatol 1990;6:63-5.
21. Garcia-Godoy F, Sanchez R, Sanchez JR. Traumatic dental injuries in a sample of Dominican schoolchildren. Community Dent Oral Epidemiol 1981;9:193-7.
22. Garcia-Godoy F, Morban-Laucer F, Corominas R, Franjul RA, Noyola M. Traumatic dental injuries in schoolchildren in Santo Domingo. Community Dent Oral Epidemiol 1985;13:177-9.

23. Jamani KD, Fayyad MA. Prevalence of traumatized permanent incisors in Jordanian children. *Odontostomatol Trop* 1991;14:17-20.
24. Baghdady VS, Ghose U, Enke H. Traumatized anterior teeth in Iraqi and Sudanese children — a comparative study. *J Dent Res* 1981;60:677-80.
25. Beckcr DB, Needleman HL, Kotelchuck M. Child abuse and dentistry: orofacial trauma and its recognition by the dentist. *J Am Dent Assoc* 1978;91:24-8.
26. Davis GR, Domoto PK, Levy RL. The dentist's role in child abuse and neglect: issues, identification and management. *ASDCJ Dent Child* 1979;46:185-92.
27. Needleman HL. Orofacial trauma in child abuse: types, prevalence, management, and the dental profession's involvement. *Pediatr Dent* 1986;8:71-80.
28. Graitier PL. Beyond mouthguards: an overview of injury preventions and control. *Dental Hyg News* 1994;7:21-2.
29. Golder M. Non-accidental injury in children. *Dent Update* 1995;3:75-80.