

Traumatic dental injuries at a German University Clinic 2004–2008

Katharina Bücher*, Claudia Neumann, Reinhard Hickel, Jan Kühnisch

Department of Conservative Dentistry, Ludwig Maximilian University, Munich, Germany

Key words: dental trauma; aetiology; guidelines

Correspondence to: Katharina Bücher, Department of Conservative Dentistry, Ludwig Maximilian University, Goethestrasse 70, 80336 Munich, Germany
Tel.: +49 89 5160 9344
Fax: +49 89 5160 9349
e-mail: kbuecher@dent.med.uni-muenchen.de

Accepted 11 April, 2012

Abstract – Aim: This study was designed to analyse the distribution and treatment management of patients who presented at a German university dental emergency department for trauma in a 5-year period. *Materials/Methods:* Clinical and radiographical baseline data and recall of patients presenting from 2004 to 2008 for dental trauma were evaluated with regard to age, gender, type of injury and treatment strategies. In addition, trauma management as performed was compared with the guidelines of the International Association of Dental Traumatology (IADT). *Results:* A total of 361 teeth in 219 patients from 1 to 68 years were treated with 1.7 injured teeth per incident and patient. Over 75% of the patients were < 14 years. In 23% of all incidents, primary teeth were affected with a male-to-female ratio of 2.1:1. Luxation injuries were predominant in the deciduous dentition. The domestic environment was the most common trauma location (44%), followed by nursery schools (36%) and outdoors during recreational activities (20%) mainly caused by falls (72%). In 76% of all dental injuries, permanent teeth were involved; 65% of patients were men; and 35%, women (1.8:1). With permanent teeth, enamel-dentine fracture without pulp involvement was most common. Falls (38%), accidental contacts (21%) and sports accidents (18%) caused the most injuries. The majority of teeth were treated in concordance with the guidelines (89%). *Conclusions:* The distribution of traumatic injuries is similar to other national and international data with regard to gender, age and in relation to injury type, location and causes. International and national healthcare associations and teachers in under- and postgraduate education should put effort on increasing the awareness of the guidelines.

Dental trauma is frequent and mostly occurs at a young age, but is also observed in other age groups (1). The prevention of trauma and its lifelong consequences should be a considerable concern for the dental health professional. Regarding clinical intervention, dentoalveolar trauma is one of the most challenging dental emergency situations. It demands most precise diagnosis and correct treatment intervention to minimize undesired complications and to achieve favourable survival rates for the injured teeth. To provide recommendations for prevention and to improve the quality of care to minimize sequelae from traumatic insults, it would be useful to investigate the pattern of traumatic incidents and their treatment in a local population and to set data in the context of other populations.

More and more epidemiological data on dental trauma are being reported from different countries all over the world. Most data were collected from public health sources, although there were some from university dental services (2–7). Trauma is more prevalent in the permanent dentition with up to 58.6% (8) than in

the primary dentition, with prevalence of up to 36.8% (9). Published data on dental trauma pertaining to the population of Germany are sparse. Bauss et al. (10) suspected a prevalence of 10.3% for the permanent dentition. To increase the available data, the present study was designed to assess the pattern of traumatic dental injuries in patients seeking care for dental trauma in a university setting.

Over the last decade, international guidelines have been developed by the International Association of Dental Traumatology (IADT) as a consensus statement by an expert team to provide best practice recommendations on the basis of current scientific evidence. Although these guidelines are now considered to be the international standard of care (11–14), there is low evidence on the extent to which they are used in day-to-day practice.

The aim of this study was to investigate (i) types of dental trauma in patients who presented at the Emergency Service of the Department of Conservative Dentistry at the Ludwig-Maximilians University, Munich, Germany, from 2004 to 2008 with regard to age,

gender, type of injury and treatment strategies, and (ii) to evaluate trauma management in comparison with the IADT guidelines.

Materials and methods

A retrospective design was used to address the aim of this investigation. In adherence to the Declaration of Helsinki, ethical approval was obtained from the Human Ethics Committee of the Ludwig-Maximilians University, Munich (project no. 390-09). Patients' records and corresponding standard dental trauma forms from the years 2004 to 2008 were analysed retrospectively. All information regarding the dental trauma were carefully screened, classified and allocated according to age, gender, tooth type, cause, location, time elapsed between trauma and emergency care, and diagnosis including soft tissue and bone injuries. Dental trauma was classified according to the criteria published by Andreasen and Andreasen (15). The treatment protocol for the primary as well as the permanent dentition was evaluated according to the relevant IADT guidelines valid at the date of trauma and rated to conform to IADT or not (11,12,13,14). In cases where the treatment protocol was insufficiently documented, conformity to the guidelines could not be assessed, and those cases were grouped separately. Descriptive analysis was undertaken with Microsoft Excel V 12.8.3 for Macintosh and SPSS 17.0, university licensed. The chi-square test (χ^2), one-way ANOVA, Tukey's post hoc test and Student's *t*-test were used.

Results

The sample comprised 139 male (64.4%) and 77 female (35.6%) patients with a male-to-female ratio of 1.8:1. Men were highly significantly more trauma-prone than women (χ^2 test, $P < 0.001$). Patients were 1–68 years of age with a median of 9 years. A total of 361 affected teeth with a mean of 1.7 injured teeth per incident and patient were treated. In 45% of all patients with injured teeth ($n = 207$), a single tooth was involved; in 40% of the cases, two teeth were traumatized. The remaining patients had more injured teeth, as shown in

Table 1. Distribution of patients regarding number of injured teeth

Patients <i>N</i> / <i>%</i>	Number of injured teeth				Σ
	1	2	3	≥ 4	
Deciduous dentition	22/44.0	21/42.0	6/12.0	1/2.0	50/100
Permanent dentition	72/46.0	61/38.5	18/11.5	6/4.0	157/100
Σ (<i>N</i> / <i>%</i>)	94/45.0	82/40.0	24/11.5	7/3.5	207/100

Table 1. Soft tissue injuries were present in only 4 male and 5 female patients ($n = 9$). There was no significant influence of gender with regard to the type or cause of trauma (χ^2 test; $P = 0.095$; $P = 0.773$), but age had a significant influence on trauma causes (one-way ANOVA; $P = 0.005$) and location (one-way ANOVA, $P < 0.001$). Patients who suffered trauma caused by falls were significantly younger than patients who suffered trauma from violence and traffic accidents (Tukey's *post hoc* test). Distribution of luxations and fractures is statistically significant between the primary and the permanent dentition, with a predominance of luxations for the deciduous dentition (χ^2 test, $P < 0.001$). Figure 1 shows the distribution of trauma in relation to age. In 75.9% of the cases, patients were younger than 14 years with peaks of traumatic insults at the ages of two and eight years. There was a second peak for dental injuries for men only in the age group of 20 to 25 years.

Patients sought help for primary care at the emergency service of the Department of Conservative Dentistry in 65% of the cases. Referrals by private dental or medical doctors comprised 24% of the cases. The remaining patients (11%) were seen after primary trauma care, or for a second opinion or further treatment. For 148 injuries, it was possible to evaluate time elapsed between the trauma and the initial treatment. Within the first 24 hours, 54.8% of the patients sought consultation. The majority of these patients (93%) received medical advice within the following 36 hours after the trauma had occurred and the remaining number of patients within the following week (Table 2). Paediatric specialists treated the majority of patients (71.1%). University dentists or general dentists in private practice treated the remaining cases.

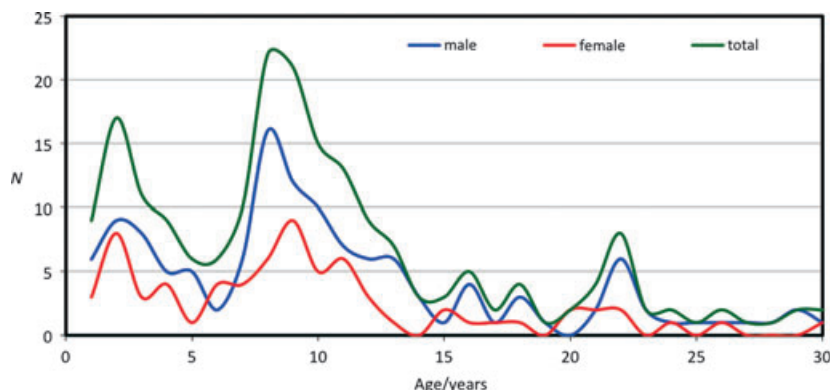


Fig. 1. Number of traumatic incidents according to gender and age. Beyond the age of 30, a number of 30 patients were treated.

Table 2. Time elapsed between trauma and professional consultation

Patients	Number of days							Σ
	0	1	2	3	5	7	Unknown	
N/%	120/54.8	17/7.8	4/1.8	4/1.8	2/0.9	1/0.5	71/32.4	219/100

Deciduous teeth

In 23% of all incidents, primary teeth were affected ($n = 86$). The male-to-female ratio of injured primary teeth was 2.1:1. The predominance of the upper left incisor (53%) was not significant with regard to cause (χ^2 ; $P = 0.86$) or type of trauma (χ^2 ; $P = 0.65$). Combined injuries were present in only three teeth. Two teeth had a combined enamel-dentine fracture without pulp involvement and subluxation, and one tooth showed a combination of root fracture and lateral luxation. Overall, luxation injuries were almost four times more frequent (79.8%) than fractures (20.2%). Within the luxation injuries, intrusion was most predominant, followed by lateral luxations, subluxations, avulsions, extrusions and concussions (Fig. 2). The domestic environment was the most frequent trauma location followed by injuries at nursery schools and during leisure time. It was mainly caused by falls, followed by sports activities, blows and others (Table 3).

Permanent teeth

Permanent teeth were injured in 76% of cases ($n = 275$). The overall male-to-female ratio of the 157 patients was 1.8:1. Of the injured teeth, 91% were located in the maxilla ($n = 249$); only 22 of the teeth were located in the mandible. The right central incisor ($n = 115$; 55%) was more often affected than the left central incisor ($n = 95$; 45%), with no significant difference regarding type or cause of trauma (χ^2 ; $P = 0.95$; $P = 0.382$). Fractures were the predominant form of injury (63.8%), followed by luxation injuries (36.2%).

The most frequent trauma was the enamel-dentine fracture without (44.1%) pulp involvement, followed by subluxation injuries (14.3%) (Fig. 2). Combined injuries were frequent: 40 permanent teeth had combined injuries, mostly a combination of subluxation with an enamel-dentine fracture without pulp involvement ($n = 16$) or with pulp involvement ($n = 6$). Most traumatic incidents were experienced during recreational activities and in school. Women sustained injuries more often at home and men more often during recreation, but without statistical significance (χ^2 ; $P = 0.206$). Falls and accidental contacts were the most common cause for traumatic dental injuries to permanent teeth. Violence was rare. Among the sports accidents, bicycling, winter sports (skiing, snowboarding, sledding, ice skating), ball games and swimming were the most common traumatic activities registered (Table 3).

Treatment in relation to IADT guidelines

The University Dental Emergency Department treated 77.3%, private practitioners, 11.9%; and other university clinics, 10.8% of the 361 teeth. The majority of all teeth were treated in accordance with the guidelines (89.2%). Non-conformly treated cases (4.8%) were mainly treated by the general dentist or other medical specialists. Only one non-conforming case underwent primary care at the Emergency Department of the University. For the remaining cases (6.1%), clear allocation was not possible. The emergency department showed 94.3% of adherence to the guidelines, while private practice showed 69.8%, and other clinics followed the guidelines in 74.4% of the cases (Table 4).

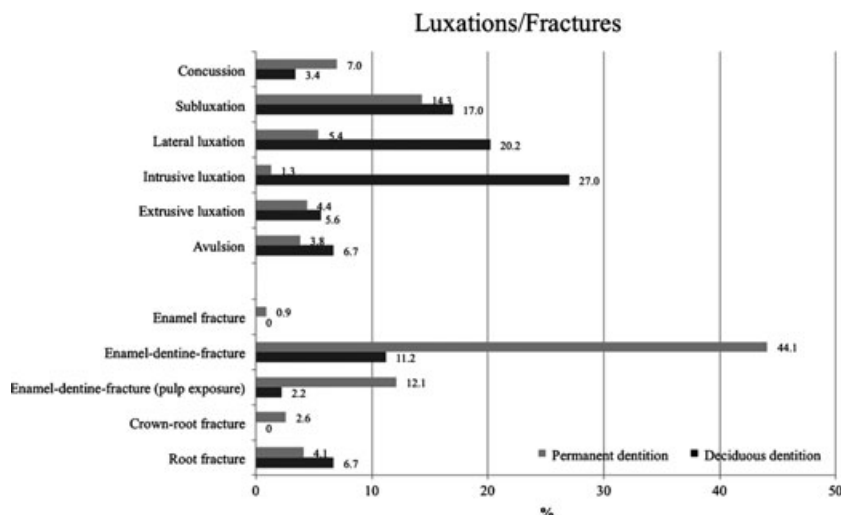


Fig. 2. Percentage of all diagnosis that affected the primary and permanent dentition.

Table 3. Type of trauma in relation to cause and location

N Type of trauma	Cause											Location											Total (n%)												
	Fall			Blow			Sports			Traffic		Violence			Intubation		Unknown			Home				Recreation			Kindergarten school, Work			Clinic			Unknown		
	DD	PD	DD	PD	DD	PD	DD	PD	DD	PD	DD	PD	DD	PD	DD	PD	DD	PD	DD	PD	DD	PD		DD	PD	DD	PD	DD	PD	DD	PD	DD	PD	DD	PD
Dentition	49	38	6	12	9	8	0	8	0	1	0	5	2	2	28	15	9	24	28	28	0	5	3	2	68	74									
Luxation	12	59	1	30	2	33	0	20	0	5	0	0	0	14	6	25	6	69	3	58	0	0	0	9	15	161									
Fracture	2	19	2	8	1	7	0	3	0	1	0	0	0	2	2	4	1	13	0	21	0	0	0	2	3	40									
Combined Injury	63/	116/	9/	50/	12/	46/	0/0	31/	0/0	7/	0/0	5/	2/	17/	36/	44/	16/	106/	31/	107/	0/0	5/	3/	13/	86/	275/									
Total (N%)	73.3	42.3	10.5	18.3	13.9	16.9	11.4	11.4	3.0	1.9	2.3	6.2	41.8	16.0	18.6	38.4	36.1	39.0	1.9	3.5	4.7	100													

Discussion

This study was based on a sample of several hundreds of single traumatic insults (n = 316) and reflects the type of dental trauma commonly seen at the Emergency Service of the University for the Munich region. Generally, the distribution of traumatic injuries is similar to published data (1). In contrast to several other publications that found fractures to be the most likely injury for the primary dentition, luxation injuries were predominant for the primary dentition in our population (5, 16–25).

Age distribution with the majority of traumatic injuries occurring in patients up to the age of 14 years with peaks for toddlers and around the age of 8 years supported the findings of the international literature (26, 27). It is assumed that trauma to the teeth is even most frequent during the first 10 years of life with a peak for the under 4-year-olds, decreasing gradually with age and occurring only rarely after the age of thirty (16, 18, 19, 28, 29). In our sample, dental trauma in the latter age group was rare; however, Thomson et al. report a higher frequency of dental trauma for the elderly (30, 31). Trauma in the elderly may be combined with facial injuries that demand surgical intervention. This might also contribute to the fact that the number of elderly patients seen in our emergency services for trauma is rather low.

With regard to gender distribution, Hasan et al. (16) reported no gender difference for the primary dentition. For the mixed dentition, two other publications found an almost equal gender distribution for 11- to 12-year-old patients (32, 33). Nevertheless, our findings do not support this tendency towards equal gender distribution. This is confirmed by other publications that also report gender to be a risk variable that puts men at a higher risk for dental trauma (1, 2, 22, 24, 29, 34–39). Unfortunately, available data from patients' records and corresponding trauma forms did not supply sufficient information contributing to other known risk factors (40). This study agrees that upper central incisors in both dentitions are most prone to traumatic insults because of their exposed position in the oral cavity, with up to 92% (16, 18, 21, 35, 40–43).

For the primary dentition, there was no significant preference for either central incisor. Some

Table 4. International Association of Dental Traumatology (IADT) guideline conformity of traumatized teeth in relation to treatment location

N/%	Treatment's conformity			
	IADT conform	IADT non-conform	Unknown	Total
Emergency dept.	263/94.3	1/0.4	15/5.4	279/100
Private practice	30/69.8	8/18.6	5/11.6	43/100
Other clinics	29/74.4	8/20.5	2/5.1	39/100
Total	322/89.2	17/4.8	22/6.1	361/100

authors report a slight predominance of injuries for the upper right central incisor (5, 16), while others report the left incisor to be more often affected, as we also found (21, 36). There is no concordance regarding the most frequent injury type for the primary dentition in the literature. While in some populations crown fractures or enamel fractures are most common (5, 16–25), our study confirms data from several studies that luxations are the predominant pattern of injury with a statistically different distribution of luxations and fractures in comparison with the permanent dentition (2, 7, 27, 28, 35, 36, 41, 43–48). The reason for these differences can only be speculative. Most studies that report a higher incidence of fractures for the primary dentition do not say whether the injured teeth were carious prior to trauma. This could be relevant because in the case of traumatic insult, caries weakens tooth structure and makes it susceptible to fractures. Although Jorge et al. (17) did not find any correlation between the presence of decay and tooth fractures, they conceded that evidence was low because of small sample size. A higher elasticity of the bone and relatively short roots of small children may favour luxation injuries (48). The real number of luxation injuries in both dentitions may be underestimated because minor luxations may neither be diagnosed nor even be seen by a dental professional because parents may not seek help.

The most common injury sustained by permanent teeth in our study was enamel-dentine fracture without involvement of the pulp. The frequency of 44.4% is within the range of other national and international reports, which found enamel-dentine fractures without pulp involvement to be the most predominant type of injury in 20.2% to 50.5% of cases (1, 10, 19, 26, 29, 35, 43, 44, 47).

Almost all teeth that showed combined injuries were permanent. The predominance of subluxation and dentine-enamel fracture for combined injuries is comparable with the literature, where ranges up to 49% are reported (1, 26). It is assumed that combined injuries for the primary dentition may be underreported because of difficulties in diagnosis in toddlers and infants.

In the permanent dentition, the prevailing environments in which the school-aged child sustains trauma are the outdoor setting and school, to an almost equal extent (3, 7, 10, 27). In all, women had more accidents at home, while men sustained their dental injuries outside of the domestic environment, which may reflect gender-specific behaviour. Most traumatic events take place in locations where preventive measures are not in effect, as in the home or outdoors during leisure time.

For both dentitions, falls are the prevailing causative event for dental injuries (21, 35, 36, 38, 43, 47). For the primary dentition, it can be assumed that the high percentage of falls is correlated with the developing gait coordination of the young child (16, 19, 28, 34, 35). Although other studies also reported comparably high percentages of up to 72.4% for falls in the permanent dentition, comparability between the different studies is

limited, because the underlying causes are not always differentiated (36). Hustling, stumbling as well as falling during sports activities or violence may contribute to this category. The frequencies of occurrence of other causes such as traffic accidents, collisions and blows as well as violations differ for diverse regions in the world (4, 7, 29, 49). In this study, the distribution of dental trauma in connection with violence was only represented in single male cases (1.8%) within the age group of 18–34 years. Bauss et al. (10) report for a national population that approximately 5% of trauma cases of patients aged 6–55.5 years had been caused by violence. It is well known that people who indulge in high-risk behaviour tend to have more dental traumas than those who do not (40). This may explain why men were more frequently injured during sporting activities than women. Some authors report an increase in injuries affecting women during sports or outdoor activities because of an increased female anticipation into risk sports (26, 33, 50).

In agreement with other international data, this study showed that most accidents involving the primary dentition take place in a domestic environment. Other locations where young children encounter trauma frequently are the kindergarten or outdoors (16, 21, 22, 25, 27, 28, 43). This correlates with the fact that for the primary dentition, most dental injuries take place at a very young age, when a high percentage of children are likely to be supervised at home.

The percentage of patients who sought help during the first 24 hours (54.8%) were rather high compared to other publications. Several studies are in agreement that one-third of the cases presented within 24 h after the injury and another third within 1 week (19, 43). In others, the percentage was even lower. Rajab reported that only 17.1% of the investigated trauma patients sought treatment the same day or the day after the injury, and Jorge et al. had only 4.1% of patients seeking help within the first day after the event (3, 5, 17). We conclude that for our study population, public education in combination with access to care has a rather high standard in comparison with other investigated populations.

Glendor states that treatment in emergency care performed by medical personnel and even dentists was often inadequate or inappropriate (40). IADT guidelines published in 2001 and 2007 were strictly followed for the cases treated in the university setting, while the treatment in private practice or other hospital settings was more vague. There is evidence that additional training and recent graduation have a positive influence on trauma treatment knowledge (51, 52).

Conclusion

For the population in this investigation, findings are mainly in agreement with other national and international data. Minor differences in outcome will reflect social, cultural and methodological differences between the investigations. Time elapsed between trauma and time of treatment is rather low. It could be concluded that patients/parents are reasonably well informed on

what to do in the case of dental trauma, but with room for improvement in this area. Conformity to treatment guidelines is unsatisfactory in private practice and other hospital departments. All international, national and local healthcare associations, authorities and educational staff will have to put an effort into improving awareness of content and accessibility of the IADT guidelines, especially for non-IADT-related institutions (free download via www.iadt-dentaltrauma.org). All in all, further enhancement of public and professional education for dental trauma is necessary to improve the quality of care.

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