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Prevalence of traumatic injuries to permanent dentition and its association with overjet in a Swiss child population

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Abstract – *Objective*: Dental trauma is a very common issue in dentistry and its occurrence has been related to many factors. The aim of this study was to evaluate the prevalence of traumatic dental injuries in the permanent dentition among Swiss children and its association with overjet. *Material and methods*: A sample of 1900 children aged 6–13 years was prospectively evaluated to determine the number and types of injuries, the influence of overjet on the risk of suffering trauma and the relationships between trauma, age, gender and life conditions. *Results*: The observed prevalence of trauma was higher for boys, with a slight risk increase with age and a peak frequency at the age of 10 years. Most of the injuries (91.2%) involved the upper front teeth; 87.2% of all injuries were hard tissue injuries (enamel or dentin fractures), and 12.8% only subluxation and luxation injuries. Children with an overjet of 6 mm or more had a four times higher risk of suffering trauma, compared with those with less overjet. *Conclusion*: This cross-sectional study confirmed most of the results from earlier studies dealing with epidemiological factors of dental injuries to the permanent dentition. Of all the variables analysed, overjet stood out as the most significant risk factor: an increased overjet of 6 mm or more had a major impact on the risk of trauma, which would speak in favour of early orthodontic correction of an increased overjet to reduce the prevalence of dental trauma.

Dental injuries have been classified according to a wide variety of factors, and studies from different countries show that the prevalence ranges from 6% to 30% (1–3).

The causes and types of dentoalveolar traumatic injuries may differ, depending on the material investigated; for example, hospital material that includes more severe injuries (4–6).

Most epidemiologic investigations reveal high prevalence figures for dental injuries. These are usually related to predisposing factors, such as traffic accidents or individual or group contact sports (7–11). The majority of dental injuries involves the anterior teeth and usually affect a single tooth, although certain types of trauma predict multiple injuries. Many reports point out a precise sex and age distribution as well as seasonal variations; some of them also suggest that increased overjet and inadequate lip coverage may be predisposing factors for traumatic injuries to the upper anterior teeth (12–14).

The difficult therapeutic problems caused by traumatic loss of anterior teeth as well as the high socioeconomic cost of dental trauma highlight the need to collect valuable epidemiological data dealing with the causes and types of teeth injuries (15,16); an important tool when planning healthcare strategies in that field.

The aims of the present study were to determine the prevalence in children and adolescents of different kinds of traumatic tooth injury in the permanent dentition and to relate such injuries to age, gender and overjet.

Material and methods

A total sample of 1900 children aged 6–13 years was examined during routine consultations performed by the Geneva Dental School Service. The Dental School Service organizes yearly dental screening of all school children from primary school to the precollege year. Eight schools were randomly selected from a pool of 24 schools for the purpose of this research, the prerequisite being that each grade of the precollege years as well as both urban and suburban areas were represented. Urban and suburban areas were chosen to elucidate possible associations between living conditions and the prevalence of trauma. The sample included 1000 boys and 900 girls, accounting for more than 5% of all school children in Geneva's primary schools. Information was collected through a cross-sectional design to cover all age groups in primary schools, to determine the prevalence in each age group. All

children were examined once a year by the same investigator, and during the course of this examination, mostly aimed at diagnosing caries, special attention was devoted by the observer to discovering and recording any dental injuries sustained during the previous year.

Beginning from the 2001–2002 school year, a special registration was introduced in the records:

Patient history, name, age, sex, living conditions (urban or suburban areas) and grade level

Type of dental injuries

Overjet

The overjet was measured parallel to the occlusal plane, to the nearest half millimetre, as the distance from the incisal edge of the most labial maxillary central incisor to the most labial mandibular central incisor.

Data concerning the trauma cases were collected by a trained orthodontist through a semi-structured interview, with special care devoted to the precise definition of the direction of trauma impact and the consecutive displacement of the affected tooth. This allowed discrimination between different types of luxation injuries. Dubious cases were either excluded from the sample (two cases) or further investigated by data collected from the Dental School Service. Injuries were divided into hard or periodontal tissue (or luxation) injuries. Hard tissue injuries were defined as enamel fracture or enamel-dentin fracture, with or without pulp exposure (as demonstrated by history of pulp extirpation).

Luxation injuries were defined by the following criteria:

Subluxation, a periodontal injury leading to loosening but no displacement of the tooth;

Intrusion, forced impaction of the tooth into the alveolar socket;

Extrusion, partial displacement of the tooth out of the socket;

Lateral luxation, forced movement of the tooth in a lateral direction;

Exarticulation, total luxation of the tooth.

Each maxillary and mandibular incisor was scored for presence and type of traumatic injury according to the NIDR index, as stated in the Third National Health and Nutrition Examination survey in the United States (17): the data are based on clinical non-radiographic evidence of the tooth injury and the treatment received, including a positive history obtained from each subject.

The number of simultaneously injured teeth was an indicator for the severity of the injury. The number and percentage of subjects with dental trauma were calculated for the whole sample, for each of the six schools concerned, and separately for boys and girls.

The prevalence per age group was calculated and the frequency of subjects with trauma was evaluated according to the number and type of traumatized teeth. The frequency of traumatized teeth was calculated according to tooth type and type of injury. The frequency of subjects with increased OJ, with a cut-off point of 6 mm, according to Järvinen (12), was calculated for the sub-samples of children with and without incisor trauma.

Statistical analysis

The statistical analysis was performed using the chi-square test, the *t*-test, one-way analysis of variance and logistic regression for assessing risk indicators, such as gender, age and overjet in relation to dental trauma. The significance level was set at $P < 0.05$; the SPSS version 14 was used as the statistical computer software (SPSS, Inc., Chicago, IL, USA).

Results

A total of 272 children (14.3%) among the 1898 subjects examined during our study showed clinical signs of previous dental injuries.

The observed prevalence was higher in boys (16.1%) than in girls (12.1%): a logistic regression model showed that boys had a 1.35 (95% CI: 1.04–1.78, $P = 0.025$) times higher risk of trauma compared with girls, when age was taken into account in the model. The frequency of subjects with incisor trauma did not show any difference when environmental conditions of living were considered, that is, in an urban or suburban area. A statistically significant difference was only observed between two specific urban (Cayla) and suburban (Onex) schools: at Cayla, more traumas than expected were observed, while at Onex, the traumas were much less frequent than expected (χ^2=19.4, df = 7, $P = 0.007$) (Table 1).

The figures for age repartition were similar for boys and girls, and the results showed a slight risk increase for traumas with age (Table 2). The largest number of injuries for boys and girls were found between the ages of 9–12 years, with a peak frequency of 30.5% at the age of 11 years.

The 272 subjects with traumatized teeth have been grouped, based on the location of the trauma. The grouping showed that 91.2% of the injuries involved the upper front teeth, while 8.5% involved the lower front teeth and 0.4% other areas of the denture (Table 3). Single traumatized incisors were found in 74.6% of the sample, while only three patients had three or more injured teeth. Very few patients (2.6%) had injuries affecting incisors of the maxillary and mandibular arches at the same time.

As many as 39.4% of the recorded injuries were enamel fractures, 48.1% were combined enamel/dentin

Table 1. Environmental determinants: number of trauma in urban (Cayla, Meyrin Village, Vernier-Place and Vernier-Ranches) and suburban areas (Avully, Onex, Versoix-Argand and Versoix-Montfleury)

Area	No trauma	Trauma	Total
Avully	108	16	124
Cayla	197	52	249
Mayrin Village	250	51	301
Onex	320	32	352
Vernier-Place	188	29	217
Vernier-Ranches	262	44	306
Versoix-AmiArgand	199	35	234
Versoix-Montfleury	100	13	113
Total	1624	272	1896

Table 2. Number of trauma related to age (years)

Age	No trauma	Trauma	Total
6	32	1	33
7	197	2	199
8	286	23	309
9	296	48	344
10	301	71	372
11	231	83	314
12	228	36	264
13	53	8	61
Total	1624	272	1896

Table 3. Association of number of trauma and type of traumatized teeth (Group 1 = upper front teeth; Group 2 = lower front teeth; Group 3 = other teeth)

Group	Frequency	Per cent
1. Upper front teeth	248	91.2
2. Lower front teeth	23	8.5
3. Other teeth	1	0.4
Total	272	100.0

fractures, while subluxations and luxation injuries accounted for only 12.9% of the traumas. There were no patients with injuries combining hard tissues and luxation injuries at the same time. The age of the patient at the time of injury had a significant impact on the type of trauma experienced by the children, with hard tissue injuries affecting more older patients compared with luxation injuries ($F = 2.88$, df = 3, $P = 0.036$) (Table 4).

Children with an overjet of 6 mm or larger were more prone to traumatic injuries ($\chi^2 = 3.4$, df = 1, $P < 0.001$): they had a 4.03 (95% CI: 2.79–5.81) times higher risk of sustaining trauma than those who did not have an overjet of 6 mm or more.

Although an increased OJ had significant effects on the risk of trauma, it did not have any effect on the type of trauma experienced by the children ($\chi^2 = 3.4$, df = 3, $P = 0.33$) (Table 5).

Discussion

Although studies on the prevalence of traumatic dental injuries have been carried out in many countries, prevalence figures vary significantly, mainly as a result of different sampling procedures and methodological assessments. Prevalence estimates of 4% to as high as 30% have been reported for both primary and permanent dentition (18). The 14.3% prevalence found in the present study is in accordance with the most recent epidemiological reports (11,14,19) and confirms that traumatic dental injuries are a common and serious dental health problem. However, contrary to previous studies (20), recent surveys have failed to demonstrate a significant rise in the number of injuries affecting children and adolescents (21).

Table 4. Diagnostic distribution with respect to type of trauma

Diagnosis	*n*	Mean	SD	Min	Max
No trauma	1623	9.5	1.8	6	13
Enamel fracture	107	10.2	1.2	8	13
Enamel/dentin fracture	131	10.5	1.3	6	13
Subluxation	29	9.8	1.3	7	12
Luxation	9	9.9	1.5	8	13
Total	1896	9.6	1.7	6	13

Table 5. Influence of overjet on type of trauma

	Diagnosis				
Overjet	Enamel fracture	Enamel/ dentin fracture	Subluxation	Luxation	Total
Overjet $<$ 6 mm	88	103	19	9	219
Overjet $\geq$ 6 mm	19	27	7	0	53
Total	107	130	26	9	272

In agreement with previously published data, the observed prevalence in this study was higher for boys, with the logistic regression model showing a 1.35 times higher risk of sustaining trauma compared with girls. This clear gender distribution, described in most epidemiological studies, has even been shown to increase with age [Skaare and Jacobsen (21)]. Glendor et al. (22), Stockwell (23) and Schatz & Joho (24) also found that boys sustain multiple tooth injuries more often than girls.

No differences were observed when environmental conditions and the frequency of dental trauma were considered, which confirmed conflicting reports found in the literature (15,19). It should be noted that the difference between urban and suburban areas in Geneva is not as well defined as it may be in other countries. However, a recent study by Ärtun & Al-Azemi (25) indicated that high socio-economic status may reduce the risk of dental trauma among adolescents, but it may be speculated that differences in parent education and family income are more important in Arab countries than in Western Europe.

In most international surveys, early childhood and adolescence show the highest incidence peaks of dental traumatic injuries. In a prospective study on the incidence of dental trauma in the county of Västmanland, Sweden, Glendor et al. (22) concluded that there seems to be a critical period around 9 years of age for traumatic injuries to the permanent dentition. This statement was later confirmed in a prospective study by Skaare & Jacobsen (21), where children of 8–10 years of age were most often injured. Similarly, in our study, the largest number of injuries among boys and girls were sustained between the ages of 9–12, with a peak frequency of 30.5% at the age of 11. These findings, together with data on the peak prevalence of dental trauma at later ages reported by other investigators (26, 27), could speak in favour of early large overjet correction as a possible trauma-preventive strategy (14).

The relationship between overjet and traumatic dental injury has often been investigated but, so far, the findings appear to be inconclusive. The available data

either suggest increased odds ratios with large overjet or that excessive overjet is not a risk factor for dental trauma (12). In our study, children with increased overjet were significantly more prone to traumatic injuries. Individuals with an overjet of 6 mm or more had a 4.03 times higher risk of trauma compared with those who did not have such a large overjet. These findings tend to confirm recent research from Årtun et al. (14) and Bauss et al. (28), showing an increased risk of maxillary trauma in patients with a large overjet. It was not possible to determine the number of patients who had early orthodontic treatment to treat an overjet exceeding 6 mm: this may have resulted in a slight underestimation of the calculated risk factor if some of them experienced a trauma before the observation period.

Grouping within the sample was carried out and showed that 91.2% of the 272 subjects with traumatized teeth has upper front teeth involvement, while 8.5% of the injuries involved the lower front teeth and 0.4% other areas of the dentition; no differences between the right and the left side were observed. These figures are similar to the findings in various other reports (6, 21, 22).

Previous clinical observations have found the same trend in the distribution of dentoalveolar trauma: a high rate of periodontal injuries in the primary dentition, owing to the elasticity of the supporting tissues and the number of hard dental tissue injuries increasing with age (7, 21–23). In our study, as many as 39.2% of the recorded injuries were enamel fractures, 48% were combined enamel/dentin fractures, while subluxations and luxation injuries accounted for only 12.9% of the traumas. The age of the patient at the time of injury had a significant impact on the type of the trauma experienced by the children; hard tissue injuries affected older patients to a greater extent than luxation injuries. The finding that crown fracture was the most common dental trauma in our sample by far is in agreement with most earlier studies (7, 21–23), confirming that injuries to the supporting structures are rather infrequent in the permanent dentition. It should be pointed out, however, that cross-sectional studies tend to underestimate the occurrence of some minor injuries, such as concussion and subluxation (21).

On the contrary, Glendor et al. (22) and Skaare & Jacobsen (21) found a higher percentage of luxation injuries, with Glendor et al. (22) also showing that the severity of the injuries was not only dependent on age but also on gender.

The epidemiological data observed in this study were in accordance with most of the studies dealing with traumatic injuries. On one specific point, however, and despite conflicting findings in the literature (28–30), our results clearly showed that the risk of traumatic dental injuries was 4.03 higher in subjects with an overjet of 6 mm or more compared with children with an overjet of less than 6 mm.

Of the variables studied, only an overjet of 6 mm or more showed a significant impact on the risk of dental trauma: this result confirms the hypothesis that early orthodontic overjet correction in patients with occlusal risk factors may reduce the prevalence of dental trauma.

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