Traumatic Dental Injuries, Treatment and Complications in Children and Adolescents: A Register-Based Study

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Abstract

Objective Traumatic dental injury (TDI) is a common dental concern among children worldwide. We performed a retrospective patient register study among children under 18 years to investigate TDIs with respect to causes, treatment, and complications.

Materials and Methods We collected information on TDIs from the original patient records of 407 child patients visiting dental clinic of Lithuanian University of Health Sciences, Kaunas, Lithuania. We analyzed all child patients' (n = 407) background, cause, type of TDI, treatment, complications, and time elapsed from injury to visit to the dentist.

Statistical Analysis The χ²-test, analysis of variance (ANOVA), and Kruskal–Wallis and Mann–Whitney tests served in the statistical analyses.

Results A total of 579 TDI cases occurred during 2010 to 2016. Lateral luxation (19.8%) and intrusion (14.8%) occurred more often in the primary than the permanent dentition (p < 0.05). The most common cause of TDI was falling (56%). Avulsion occurred in approximately 10% of cases. Follow-up (44.5%) and tooth extraction (48.3%) were the most frequent treatments in the primary and splinting (25.3%) in the permanent teeth. Pulp necrosis was the most frequent complication in primary (92%) and permanent (54%) dentition. About 1% of the patients obtained dental care during the first hour after injury.

Conclusion The most frequent TDIs included lateral luxation in primary teeth and enamel-dentine fractures in permanent teeth. We observed a delay in patients obtaining emergency dental care.

Introduction

Dental traumas are injuries to the teeth, periodontium, and surrounding soft tissues. They are quite common in dentistry, comprising 5% of all traumatic injuries in people seeking first aid and up to 17% of all bodily injuries among preschool children.1

Children and adolescents experience mild or severe dental traumas from various causes, such as unsafe playing on playgrounds, accidents at schools, accidents in car crashes, or violence.2 According to Andersson,1 the prevalence of traumatic dental injuries (TDIs) in children and adolescents is approximately 20% and varies little. Petti et al1 found that traumatic dental injuries occur in both primary and
permanent dentitions, although the prevalence in primary dentition is higher. Prevalence differs with age and sex, with a global male-to-female ratio of 1.43, suggesting that men are more likely to develop TDI than are women.3

TDI in primary dentition can affect the development of permanent teeth.4 Damage and/or disturbances to permanent teeth and germs, depending on the mouth area affected,5 can range from mild to severe. TDI in permanent teeth can cause permanent complications, such as pulp necrosis and internal and/or external root resorption, and influence maxillofacial development.7

In most cases, emergency care after TDI is needed to improve tooth prognosis and prevent complications. Dental avulsion, for example, is one of a few emergency situations in dentistry where urgent help is needed to save the tooth.6 Even if an avulsed tooth is replanted immediately (within 5 minutes after TDI), the success rate may not be 100%. First aid should therefore be provided on site, ideally by medical personal, but also by parents, teachers, coaches, or capable available persons.6 However, studies indicate that teachers and coaches lack adequate knowledge of appropriate behavior in emergency situations involving dental trauma.9,10

Children with dental traumas are an important concern nowadays, not only for their possible negative outcomes and frequent common occurrence11 but also because they can reduce quality of life.12,13 In addition, people with untreated dental traumas more often experience chewing problems and difficulties with social interaction, such as excessive concern about what others think, avoiding smiling and laughing, and not talking to other children.14

In Lithuania, general dentists in primary health care centers or specialists in hospitals are the main providers of first aid for children who suffer TDI. Typically, TDI patients first visit their primary health care center or a private clinic of their choosing. General dentists usually refer patients with complicated or severe TDIs or both to pediatric dental specialists in hospitals. Yet, research on TDI is scarce in Lithuania. Thus, our aim was to investigate the causes of traumatic dental injuries (TDIs), time elapsed from injury to first visit to the dentist, treatment method, and complications in children under 18 years.

Materials and Methods

We conducted this retrospective patient register study at the Department of Preventive and Pediatric Dentistry, Lithuanian University of Health Sciences, Kaunas, Lithuania, in 2018. We analyzed the patient records of all patients under 18 years who visited the clinic due to dental trauma in the primary and/or permanent dentition between 2010 and 2016. The Biethics Centre of the Lithuanian University of Health Sciences approved the study protocol (number BEC-OF-11). The patients’ parents were informed about the study and the anonymous use of their child’s dental records at the time they visited the clinic for dental care. All patients or their parents provided their written informed consent.

Data Collection

We collected information on TDIs from the original paper records of 407 child patients. One researcher (A.A.) transferred the data from the patient records to a specifically designed SPSS template. We registered and categorized the information as follows: patients’ background information, cause and type of traumatic dental injury (TDI) according to Andreasen et al15 criteria, traumatized teeth, and time elapsed from injury to first visit to the dentist. Radiographs were used during patients’ examination and treatment. Photographs were not routinely taken of patients with TDI.

Thereafter, we registered the treatment method and complications and categorized the registered data (►Table 1).

Statistical Analysis

We used IBM SPSS Statistics for Windows (version 22.0; Armonk, New York, United States) package to perform the statistical data analysis. Statistics served to describe the basic features of the data in the study, with the Chi-square test for determining relationships between categorical variables, and one-way analysis of variance (ANOVA) for comparing the means between groups. We also used the Kruskal–Wallis and Mann–Whitney tests, and p < 0.05 was considered statistically significant.

Results

We analyzed the medical records of 407 TDI patients (62% boys and 38% girls) aged up to 18 years. ►Table 2 presents the demographic characteristics of the study participants. Of the 579 TDI cases, 281 (54.1%) involved permanent teeth and 238 (45.9%) involved primary teeth. The highest number of TDIs occurred among 0- to 3-year-old children (n = 160; 39.3%), though the numbers declined with age (4- to 8-year-old children, n = 134, 32.9%; and 9- to 17-year-old children, n = 113, 27.8%).

►Table 3 shows the distribution of the various types and frequency of TDI in primary and permanent dentition. Lateral luxation (19.8%) and intrusion (14.8%) were diagnosed significantly (p < 0.05) more often in primary than in permanent dentition (12.8 vs. 3.6%). Enamel-dentine fractures occurred significantly more often in permanent (33.5%) than in primary dentition (19.8%; p < 0.05). Avulsion occurred in 10% of permanent and 9.8% of primary teeth. Upper-central incisors were the most affected teeth in both dentitions (70.7% primary and 62.1% permanent), followed by upper-lateral incisors (13.8% primary and 26.6% permanent).

The number of TDIs varied across different age groups. Two age categories showed the highest number of dental traumas: 1- to 2-year-old children (n = 130; 31.9%) and 7- to 9-year-old children (n = 121; 29.7%). More girls (n = 74) suffered dental trauma at a younger age (0–3 years) than at an older age (9–18 years; n = 32). TDIs in boys showed no variance between age groups.

The most common cause of TDI was falling (56%), followed by riding a bicycle (10%), fighting (6%), and playing (5%; ►Fig. 1). Different causes dominated in different age groups: the younger children (mean age, 4.85 years, standard deviation...
[SD] = 3.36) experienced TDIs from falling, whereas fighting was the most common cause of TDI among the older children (mean age, 11.74 years, standard deviation (SD) = 2.94).

In our study, we observed a delay in obtaining care at a dental clinic. Less than 1% of the children came to the clinic during the first hour after injury, and about half of the patients came to the clinic within 1 to 7 hours after TDI. Only 3.9% of dental avulsion cases obtained dental emergency care during the first hour after injury. The time elapsed from dental trauma to obtaining emergency care at a dental clinic was shorter among older patients than among younger ones.

Table 4 shows treatment methods applied to the dental trauma in primary and permanent dentition. In 1.8% of cases involving avulsion of permanent teeth, the teeth were missing or unsuitable for replantation. Patient follow-up (44.5%) and tooth extraction (48.3%) were the most frequent treatments for TDI involving primary teeth. In permanent dentition, treatment of patients with TDI most often involved splinting of the traumatized tooth (25.3%), patient follow-up (22.5%), and temporary filling with glass ionomer cement (GIC) (21.4%).
More complications occurred in the early period (<3 months after TDI) than later, but the difference failed to reach statistical significance. Complications related to pulp necrosis (pulp necrosis, periapical periodontitis, and abscess formation) were the most frequent complications in primary (92%) and permanent (54%) dentition (Table 5). Enamel-dentin fractures without pulp involvement in primary and permanent dentitions, and dental avulsion in permanent dentition, caused complications more often than did other TDIs ($p < 0.05$).

Avulsion occurred in 10% of permanent and 9.8% primary teeth. The avulsed tooth storage media is very important for the successful treatment of the avulsed tooth. Half of the patients seeking first aid care stored the traumatized tooth in dry media or water. Two-thirds (68%) of the avulsed teeth developed complications; most complications (57.9%) occurred during the first 3 months after treatment (not shown in the tables).

Significantly, more TDIs occurred in summertime than in winter or spring ($p < 0.05$). The number of TDIs showed no significant differences between weekdays.

**Discussion**

This comprehensive register-based study analyzed the dental records of all child patients under 18 years visiting the University Clinic due to dental trauma over a 7-year period. TDIs occurred most frequently among boys, though a significantly higher number of TDIs among girls occurred in the youngest age group (0–3 years old). We observed a significant delay in patients obtaining emergency dental care.

Traumatic dental injury (TDI) is a common dental concern among children of various ages worldwide; its prevalence, however, unlike that of dental caries, dental development, or periodontium diseases varies depending on social and cultural factors. In our study, the number of dental traumas peaked among toddlers (1–2 years old) and 7- to 9-year-old school children. These findings are in line with the results of similar studies, though other studies have reported TDI peaks in older school children (8–10 years) and found no similarly high frequency of TDIs in toddlers. In our study, most TDIs (87.7%) occurred in children under 10 years, while only 13.3% of TDIs occurred in children over 10 years.

In our study, boys (62%) suffered dental trauma more often than did girls (38%), a finding reported earlier in other studies. In addition, 9- to 18-year-old boys were significantly more likely than girls to experience TDI, a tendency attributable to behavioral factors and expressions of emotion related to the different sexes, such as boys participate in contact sports more often than girls. A new and interesting finding in this study was that in the toddler group, girls suffered dental trauma more often than boys of the same age, though the reason for this phenomenon in our study remained unclear.

The most common cause of TDI was falls which is in line with other research findings. Though other studies have reported similar findings, since various sport activities among Lithuanian children...
and teenagers are increasingly popular, these have likely
attributed to the causes of TDIs. The most frequently injured
teeth in our study were the upper-central incisors in both
dentitions, a finding in line with earlier studies.\cite{16,17,20,23,28}

In our study, we observed a delay in patients obtaining
emergency dental care. Less than 1% of children obtained
emergency care within the first hour after trauma, and
about half of the patients did so within 1 to 7 hours after
injury. Unfortunately, this figure, as reported elsewhere,
is unexceptional.\cite{16,20,23} Immediate emergency care is crucial for
the successful treatment of dental trauma; the time lapse
between injury and first aid affects both tooth survival prog-
nosis and treatment outcome.\cite{24} This is especially important in
avulsion cases,\cite{23,25} yet our findings showed that patients
obtained emergency care during the first hour after injury in
only 4% of dental avulsion cases.

One reason for the observed delay in patients obtaining
emergency care could be that, at the time of trauma, the imme-
 diate help of health personnel is unavailable. Those available to
help are usually parents and teachers, but studies have shown
that their level of knowledge related to dental emergency care
and the importance of visiting a dentist immediately after TDI
are limited.\cite{9} A systematic review and meta-analysis by Tewari
et al showed that school teachers generally exhibited low
self-belief and knowledge level of TDIs.\cite{26}

We used Andeasen et al\cite{15} criteria to classify the TDIs.
Many authors of TDI studies widely recognize and use this
classification system.\cite{16,17} Lopez et al,\cite{27} for instance, used this
classification in their systematic review and meta-analysis of
the impact of TDIs on the quality of life of children and
adolescents. Several studies have shown that luxation inju-
ries occur more often in the primary dentition, while fracture
injuries are more likely to occur in the permanent
teeth.\cite{16,17,20,23,28} Our study showed that lateral luxation and
intrusion occurred more often in the primary dentition than
in the permanent dentition, while enamel-dentine fractures
occurred more frequently in the permanent dentition than in
the primary dentition.

Most TDIs (87.7\%) occurred in children younger than
10 years. The age period from 7 to 10 years is especially vul-
nerable because at that age, the root development of the per-
manent incisors is still incomplete, and delayed emergency
care after TDI will increase the risk for complications, mak-
ing vital tooth survival, and/or good treatment prognosis less
predictable. The most frequent treatment method for the
permanent dentition was splitting (25.3\%), followed by tem-
porary restoration of the fractured tooth with GIC. This find-
ing contrasts with some previous findings where, in cases of
delayed referral to a clinic, root canal treatment was the most
common treatment method.\cite{20} In our study, the most com-
mon (48.3\%) treatment method among patients with TDI in
the primary dentition was tooth extraction, possibly due to
efforts to avoid complicated operative treatment and to save
the germs of permanent teeth in cases of serious TDIs involv-
ing the primary teeth. Other reports identified follow-up as
the most frequent procedure after TDI,\cite{20,21} whereas in our
study, follow-up took place in less than half of the cases.

Dental avulsion occurred in 10\% of all TDIs. This is a higher
percentage than in other studies,\cite{8,16,17} though a tertiary teach-
ing hospital in Australia reported a similar finding,\cite{23} possibly
because dentists working in primary care refer only the
most severe cases to hospital care. In our study, patients
with avulsion went directly to the Department of Preventive
and Pediatric Dentistry rather than through primary care. A
recent survey among Lithuanian general dental practitioners
showed that they lacked sufficient knowledge of dental
trauma.\cite{28} Researchers have also observed similar findings in
other countries as demonstrated in the global study of dental
professionals’ knowledge by Tewari et al,\cite{29} possibly because
general dental practitioners may possess only moderate
knowledge of TDI, whereas specialists in endodontics and
pediatric dentistry possess greater knowledge.\cite{31} Medical doc-
tors also often lack sufficient knowledge of dental trauma.\cite{32}

The most frequent complications were pulp necrosis, peri-
apical periodontitis, and abscess formation, occurring in 94\% of
primary and 54\% of permanent teeth. This may at least partly
result from the delay in obtaining emergency care and the
fact that most TDIs occurred in children under 10 years.
The age period from 7 to 10 years is especially vulnerable
because at that age, the root development of the permanent
incisors is still incomplete.

Population-based epidemiological studies on the preva-
ence and severity of TDI, however, are lacking.\cite{33} Our com-
prehensive study was based on a sample of all TDI patients
at the Department for Preventive and Pediatric Dentistry,
Lithuanian University of Health Sciences, from 2010 to
2016 and included a relatively high number of dental trauma
cases. The Lithuanian University of Health Sciences Hospital
is the second largest in Lithuania, and patients from all
regions of the country seek care there. The data do not, how-
ever, include all emergency TDIs from the whole country.
On the other hand, use of the criteria by Andeasen et al\cite{15} to
classify the TDIs enables comparison of our findings to those
of other studies from different countries. Future studies on
the prevalence and severity of TDI, with emphasis on the rea-
sons for delays in obtaining emergency care, are necessary.

Conclusion

The most common cause of TDI was falling, followed by
riding a bicycle. The most frequent TDIs involved lateral
luxation and enamel-dentine fractures in the perma-
nent teeth. Complications related to pulp necrosis were
the most frequent complications in primary and perma-
nent dentition. Our study found a considerable delay in
patients obtaining dental emergency care, suggesting a
lack of knowledge among patients, parents, and teachers
of its importance immediately after TDI. We therefore rec-
ommend more community-level educational programs
related to TDIs.
Conflict of Interest
None declared.

References