

Tooth Loss and Survival Analysis after Traumatic Injuries in Primary Dentition

SUMMARY

Background/Aim: The aim of the present study was to investigate the treatment options, survival rate of traumatized primary teeth and evaluate the factors influencing the outcome. **Material and Methods:** The sample consisted of all dental trauma cases treated over a 14 years period at the Department of Pediatric and Preventive Dentistry, Dental Clinic of Vojvodina, Novi Sad. Criteria for inclusion in this study were: dental trauma to primary teeth and age in the moment of injury up to seven years. Dental trauma records were analyzed in order to obtain the following: gender and age of the child at the time of trauma, type of trauma, as well as the type and timing of treatment received. After data analysis a survival rate of traumatized primary teeth was evaluated. **Results:** The study was designed as retrospective and it included 225 children, with 346 traumatized primary teeth. The occurrence of trauma was higher in male patients (60,4%) and in children up to 4 years of age. Luxations were more frequent (72.8%) compared to isolated teeth fractures (20.8%), while the two types of injury combined were rare (6,3%). One year following dental trauma 231 teeth (0.67%) developed complications. Falls were the main cause of trauma (68.9%) and the presence of more than one traumatized tooth was frequent. A percentage of 48.8 children received dental care during first 24 h after the injury. **Conclusions:** Survival of injured primary teeth is relatively low, regardless of trauma type, time interval between injury and treatment and the type of provided treatment.

Key words: Tooth, Deciduous Injuries, Pediatric Dentistry, Child

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Introduction

Dental trauma in children occurs mostly as an accident, during different activities in everyday life. The majority of trauma to the primary teeth occurs at 2 to 4 years of age, while children's motor coordination is still developing. The risk of trauma increases in the time when babies start to walk¹ with an incidence of trauma twice as high as the average incidence for all children². The reported prevalence of traumatic injuries in children up to 7 years of age varies from 11 to 30%^{3,4,5}, but there are also reports that the prevalence is even higher, up to 30-50%⁶. Dental trauma is mainly associated with outdoor and indoor physical activities, although the increasing popularity of computer devices, consoles and smart

phones can make children more prone to traumatic dental injuries⁷⁻¹⁰.

Primary teeth are important for appropriate development of oral structures and functions. Early teeth loss can cause orthodontic issues in permanent dentition; also primary frontal teeth have an aesthetic role and can be a social problem and have an impact on quality of life. Parents rarely seek urgent treatment for their child with dental trauma in primary dentition mainly due to poor awareness of the importance of management of traumatized primary teeth. Also the injury can be overlooked after treating the bleeding from soft tissues⁸⁻¹².

Traumatic injuries in primary teeth provide challenge for the therapist, and the treatment is often limited to extraction of the affected tooth¹³⁻¹⁷. Treatment strategy is

determined by the type of injury and should include the anticipation of possible consequences to the permanent dentition^{18,17}. A trauma to primary teeth may result in severe permanent teeth complications, affecting their development and eruption. Consequences can be structural disturbances such as enamel hypoplasia, hypocalcification, as well as short root and dilaceration of permanent teeth, possibly leading to various malformations^{3,15,19,20}.

Researchers are often unjustly focused on permanent teeth trauma, making primary teeth trauma seem less important. Epidemiological studies are essential for understanding the complexities of dental trauma¹⁸. Even though, there is a lack of data regarding the survival rate of injured deciduous teeth according to the type of trauma and there is no link between the age of children, type of injury and outcome. In addition, there is no consensus or guideline about the best treatment in all cases of primary teeth trauma¹⁷.

The aim of the present study was to investigate the treatment options, survival rate of traumatized primary teeth and to evaluate factors that might influence the outcome.

Materials and Methods

This was a retrospective study. The study protocol was revised and approved by the Research Ethical Committee of the Dental Clinic of Vojvodina, Faculty of Medicine, Novi Sad and was in accordance with the World Medical Association's Declaration of Helsinki. Data were collected from the dental trauma charts. The sample consisted of 225 children (136 boys and 89 girls) with trauma of 346 primary teeth that were referred from regional Health Care Centres at the Department for Paediatric and Preventive Dentistry, Dental Clinic of Vojvodina during the period of 2002-2016.

Obtained clinical data

The type of dental trauma was recorded according to the classification of Andreasen¹, but for all other analyses injuries were divided into three following groups: demographic data (age and gender of the patient), luxation injuries, fractures, and combination of luxation and fracture. The following parameters were analyzed: aetiology and mechanism of the injury, time elapsed from injury to treatment, number of affected teeth, the extent of tooth luxation, treatment provided, recall appointments, complications that occurred during the follow-up period, reasons for immediate and late tooth loss. When available, radiographs were used in order to confirm diagnosis. Survival analysis was performed in different age groups, and children up to 3 years were compared with patients aged 4-7 years.

The cause of dental injury was precisely recorded for each patient, and classified into three groups: fall, accidental contact, and unknown reasons. Regarding the time elapsed from injury to dental care, children who received dental care within first 24 hours after the injury were compared with those in which the treatment was delayed.

Depending on degree of root resorption, type of injury and child's age, treatment outcome was classified depending on whether the tooth was preserved or lost and if there were possible complications to the permanent dentition. Tooth loss was classified as early tooth loss if a tooth was lost at the moment of accident (tooth avulsion and root fracture) or extracted during the first 24 hours after trauma. All other teeth extractions were classified as late tooth loss.

Data obtained from findings on control examinations

Analysis was performed based on medical history and additional analyses of radiographs. The survival rate was analyzed 1 day, 7 days, 1 month, 3 months, 6 months and one year after the injury.

Statistical method

The data were analysed using the SPSS (Statistical Package for the Social Sciences) Windows version 12.0. Statistical analysis included descriptive analysis (mean value, standard deviation, frequency and proportion). The differences between frequency distribution of investigated variables were compared using Chi-square test. Kaplan-Meier survival analysis was used to determine tooth survival. All tests were performed at 5% level of significance.

Results

The study population included 225 children who have sustained dental trauma to 346 deciduous teeth. The occurrence of trauma was higher in male patients (60.4%), since the dental injury had been recorded in 136 boys and 89 girls. Luxations were more frequent (72.8%) compared to isolated teeth fractures (20.8%), while the two types of injury combined were rare (6.3%). Falls were the main cause of trauma (68.9%), followed by accidental contacts (27.9%) and unknown cause (3.2%).

The luxation injuries were the most frequent, but there was unequal proportion of luxation and fracture injuries with respect to age of the patient, and this difference was statistically significant (χ^2 test, $p < 0.05$) (Table 1). All avulsions and root fractures resulted in early teeth extractions. It has been recorded that clinical examination, diet and hygiene advices and further

observation was the most frequent procedure (73.3%) when treatment procedures were analyzed in all injured teeth. Tooth extractions were frequently performed (22.2%), followed splinting (1.6%) and reposition (2.9%) in luxations (Table 2).

Table 1. Relationship between types of dental injury and age of children

Age of child \ Type of dental injury	Luxation injury	Fracture injury	Combination luxation and fracture injury
0-1 year	0	2	0
1-2 year	4	31	21
2-3 year	5	70	28
3-4 year	4	44	9
4-5 year	6	30	12
5-6 year	2	42	2
6-7 year	0	31	0
7-8 year	1	2	0

($\chi^2=42.26$ p=0.0001)

Table 2. Treatment procedures in injured teeth

	Luxations		Fractures	
	N	%	N	%
Exam, advices and observation	201	73.3	34	36.2
Extraction	61	22.2	18	19.2
Crown restoration	0	0	42	44.6
Splinting	4	1.6	0	0
Reposition	8	2.9	0	0

Data collected from the initial examination records revealed that 67 teeth were lost at the moment of accident. Additional tooth loss of 74 teeth was recorded during next 24 hours after the initial treatment. After 7 days, 40 teeth were lost, 6 more teeth had been extracted within one month after the injury, tooth loss of 22, 13 and 41 teeth was recorded 3, 6 and 12 months after the accident, respectively. Overall survival rate was 0.79 at the moment of accident, 0.24 one year after injury (figure 1). The most common cause of early tooth loss were tooth avulsion and root fracture (47.5%) (Table 3) and for late tooth extraction was root resorption (50.8%) (Table 4). Forty-six teeth couldn't be included in complete survival analysis, because 26 patients did not appear in the period of observation.

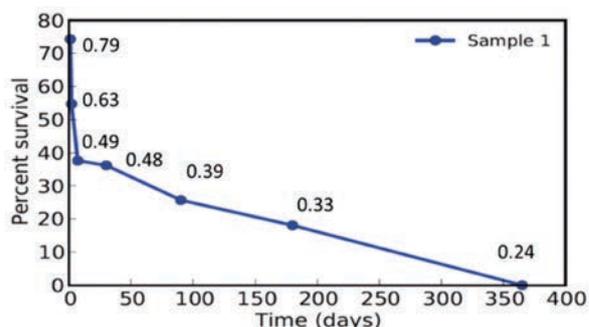


Figure 1. Kaplan-Meier survival analysis with rate of dental survival after traumatic dental injuries for the entire sample

Table 3. Reasons for early tooth loss

Reasons for early tooth loss: (141 teeth)	Number	Percentage
Advanced root resorption	26	18.4%
Possible interference with the normal eruption of the permanent successor	5	3.5%
Severe dislocation	23	16.3%
Malocclusion	8	5.6%
Tooth avulsion and root fracture	67	47.5%
Impossible treatment	12	8.5%

Table 4. Reasons for late tooth extraction

Reasons for late tooth extraction: (122 teeth)	Number of teeth loss	Percentage
Periapical pathology	13	10.6 %
Root resorption	62	50.8 %
Severe dislocation	24	19.6 %
Impossible treatment	23	18.8 %

Regarding the type of the injury, lower survival rates have been observed after luxation injuries in relation to fractures but without statistically significant differences ($p>0.05$, figure 2). Higher survival rates have been observed in younger patients ($p<0.05$, figure 3).

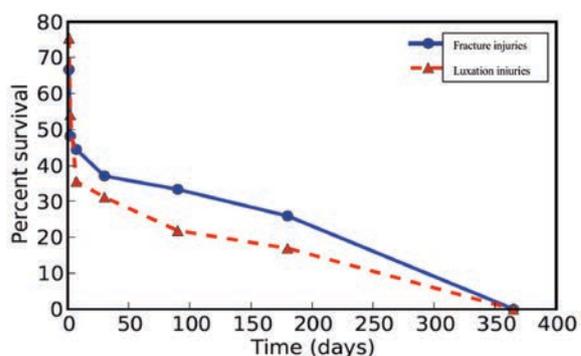


Figure 2. Comparative survival analysis for fracture and luxation injuries (Log rank test, chi squared test, Bonferroni p - value>0.05)

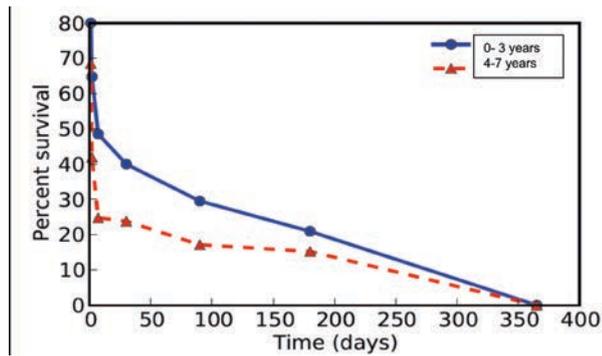


Figure 3. Comparative survival analysis for fracture and luxation injuries (Log rank test, chi squared test, Bonferroni p – value < 0.05)

Discussion

Traumatic dental injuries in preschool children represent an important public health problem²¹ due to high prevalence, psychological impact and high treatment costs. Despite the prevalence, the problem of dental trauma is inadequately addressed in the scientific literature and in everyday clinical practice. It has been reported that dental trauma in primary teeth should be viewed with concern, requiring the implementation of health policies aimed primarily at the prevention of these injuries²², and it is highly recommended to plan a community wide trauma prevention campaign targeting parents, children and medical/dental care providers²³.

Present study was a retrospective analysis of dental injuries in primary dentition in children aged up to 7 years. Contemporary research points out deficiencies of retrospective studies²⁴, such as: impossibility to perform longitudinal monitoring of patients, high percentage of censored respondents and insufficient information about overall prevalence of dental injuries. In addition, some injuries considered by the patients, parents or caregivers as not important cannot be recorded in the retrospective study, while some patients present only when complications occur. In that way, many traumatic dental injuries stay unregistered and overlooked. For that reason results of the study should be interpreted with caution taking into account all the shortcomings of retrospective studies. Still, retrospective analyzes have certain advantages, primarily due to the fact that a complete analysis of a particular phenomenon on a sufficiently large sample of respondents is provided, giving a rationale for the development of preventive strategy.

Trauma to the teeth occurs frequently in childhood immediately after the eruption of maxillary incisors in both primary and permanent dentition²⁵. Reported prevalence of traumatic dental injuries in primary dentition varies from is 4% to 30%^{3,4,6,5}. This wide range

is understandable, taking into account differences in sample population and design of these studies, but also makes comparison of obtained data difficult.

In the present investigation, boys had a higher rate of dental trauma than girls. These results are in concordance with numerous reports from other studies that showed a higher incidence of dental trauma of deciduous teeth in boys^{5,2}. This high ratio might be attributed to boys being more energetic and inclined towards vigorous outdoor activities than girls⁶.

The main causes of sports-related dental trauma are falls and collisions with people or objects¹. The most frequent cause of dental trauma in our sample was fall. Literature reports that the highest incidence of dental trauma is observed in children aged 1–3 years, because children of this age are gaining mobility, start to walk and run, while the motor coordination is not yet fully developed which results in frequent falls^{1,5,2,26}. These findings were confirmed in our study, as the injuries were most frequent in patients aged 2 years.

Luxation injuries were predominant in our sample. The literature reports that larger number of luxated teeth observed in primary teeth may have been associated with the morphology of deciduous teeth^{1,2,27}. Generally, all the facial skeleton and alveolar bone around deciduous teeth is resilient in these ages, alveolus is shallow and wide and deciduous tooth root is short and therefore primary teeth are more prone to luxations. Displacement injuries, particularly lateral luxation have been reported as the most common type of injury, which is explained by resilience of periodontal ligament and elastic bone surrounding the primary teeth due to ongoing process of development¹. In contrast to that, a high prevalence (around 43%) of primary teeth fractures has been recently reported, while luxation injuries accounted for 34.3% of all cases²⁸.

Children aged two or three years cannot describe the circumstances regarding the accident, cannot give adequate information about the symptoms and medical history is taken from the parents or the people present at the spot of the accident. As a consequence, dental treatment is often delayed. In addition, some severe dental injuries with possible consequences that may affect both primary and permanent teeth can be neglected or overlooked by the parents or caregivers, while even the superficial mucosal lacerations can be considered as emergency, and immediate health care is provided due to the parents' anxiety. All injuries should be considered as emergencies and it is well-known that the prognosis of dental trauma often depends on the time elapsed between the moment of the injury and the beginning of the treatment²⁸. In a comprehensive review²⁹ of the effect of treatment delay upon wound healing, dental approach in trauma has been classified as acute treatment (within a few hours), subacute (within the first 24 h), and delayed (after the first 24 h) and the subacute approach has been recommended for primary tooth injury, "unless

the primary tooth is displaced into the follicle of the permanent tooth or occlusal problems are present; in the latter instances, an acute approach should be chosen²⁹. Regarding the time elapsed from the injury to dental treatment, results of the present investigation show that almost 40% of the study population had been referred for treatment in a period exceeding 24 hours, and dental treatment had been provided within the subacute approach for the majority of patients. Delay in treatment can have adverse effects on long term outcomes in dental trauma³⁰, as shown in the investigations conducted in tertiary referral hospitals. In addition, there is a report that children who had trauma of soft tissues and luxations were brought to dental clinics faster and more frequently than children with fractures, because of bleeding tendency and interference with occlusion and chewing³¹. Our findings are in agreement with the observation that children who present to tertiary referral institutions for dental trauma treatment have more severe injuries than those treated elsewhere and that there is a large but potentially reducible delay between moment of injury and treatment³⁰.

There is an ongoing debate whether dental treatment in the primary dentition should be aimed at affected tooth preservation or prevention of complications in permanent successors. Although preservation of a primary tooth should be attempted as far as possible, clinical considerations must be taken into account³². In addition, the difficulty in managing behavior in preschool children and considerable risk of damaging permanent tooth germ, substantially affect the treatment possibilities³³. Consequently, two completely different approaches can be observed in clinical practice: less invasive (compared to treatment guidelines for permanent teeth) including observation, nutrition and oral hygiene counseling anticipating spontaneous healing; and more radical comprising tooth extraction as the treatment of choice for severe dental injuries and all complications in traumatized primary teeth. Our results confirm this observation and it has been recorded that clinical examination, diet and hygiene advices and further observation was the most frequent procedure. Following the emergency treatment parents must receive clear information about the diet, hygiene and further controls¹⁸. Teeth extractions were frequently performed as well, followed by crown restoration in fractures, splinting and reposition.

There is no consensus in the literature about all consequences of premature loss of primary incisors in young children. It has been shown that traumatic injuries to primary teeth represent one of the most common aetiologic factors of eruption disturbances of permanent teeth, including premature eruption, delayed eruption or impactions^{15,19,20}. There are reports, as well that some dental injuries have no significant impact on young children's quality of life³⁴.

In this study, tooth loss was calculated cumulatively, including early tooth loss caused by avulsion injuries, root fractures or extraction by dentist or parent and late tooth loss, which was the result of the extraction procedures when complications occurred. Analysis of these data suggests the fact that the teeth are lost in relatively high percentage no matter of type and the time of conducted treatment. Reasons for these results should be sought in a large dropout in the study sample and in assumption that the majority of the patients with complications occurred in treatment, while patients without symptoms often missed control examinations and necessary follow-up. Consequently, it can be assumed that the real values are higher than presented in the present investigation. In addition, the sample population studied in this investigation cannot be considered as representative for evaluation of tooth loss after dental trauma in primary teeth.

Conclusions

Within limitations of the present study, it can be concluded that major cause of dental trauma in primary dentition is fall. Luxations were more frequent compared to isolated teeth fractures. Two completely different therapy approaches were observed in majority of cases: observation, nutrition and oral hygiene counseling anticipating spontaneous healing, and more radical comprising tooth extraction as the treatment of choice for severe dental injuries and trauma complications. Primary teeth were lost in relatively high percentage regardless the type and the time of conducted treatment.

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