

Teeth and Soft Tissue Injuries as Well as Wound Healing Quality Patterns Among Primary School Students of Prishtina Region

Naim Haliti¹, Ragip Shabani², Shefqet Mrasori³, Fatmir Dragidella⁴, Hrvoje Juric⁵,
Nora Shabani Behrami⁶, Dafina Doberdoli⁷, Fehim Haliti^{7*}

1. Department of Forensic Medicine, Faculty of Medicine, University of Prishtina, Clinical Centre N.N., 10000 Prishtina, Kosovo.
2. Department of Pathology, Faculty of Medicine, University of Prishtina, Clinical Centre N.N., 10000 Prishtina, Kosovo.
3. Department of Operative Dentistry and Ednodontics, School of Dentistry, Medical Faculty, University of Prishtina, 10000 Prishtina, Kosovo.
4. Department of Periodontology and Oral Medicine, School of Dentistry, Medical Faculty, University of Prishtina, 10000 Prishtina, Kosovo.
5. School of Dental Medicine - Department of Pediatric Dentistry and Prevntion, University of Zagreb, Gundulićeva 5, 10000 Zagreb, Croatia.
6. Johannes Wesling Klinikum Minden, Institut für Pathologie, Universitatlinikum Der Ruhr – Universität Bochum, Hans-Nolte-Straße 1, 32429 Minden, Germany.
7. Department of Pediatric Dentistry, School of Dentistry, Medical Faculty, University of Prishtina, 10000 Prishtina, Kosovo.

Abstract

The aim of this study is to analyze and record the frequency and distribution of Traumatic Dental Injuries (TDI) and soft tissue injuries treated at the Emergency Department among children with various head and neck trauma. Furthermore, the quality of soft tissue healing and its impact on public oral health is described through Pediatric Health-related quality of life index (POQL Index).

This prospective interventional study was carried out at the Emergency Department of the University Clinical Center of Kosovo and University Clinical Dentistry Center between September 2017 and September of 2018 (as a part of broader clinical research) exploring the prevalence of TDI among schoolchildren at public schools (III – IX grade) in urban and suburban areas of the Prishtina Region, Kosovo. In our study 124 with various head and neck trauma are treated in the ED, and 16 children are diagnosed with fractured teeth and injured soft tissue structures. Categorized data testing was done with the X2 test or the exact Fisher test. Testing quantitative data with normal distribution with t-test or One Way ANOVA, and those without normal distribution with Mann-Whitney test. The difference is significant if $P < 0.05$.

The most fractured tooth was the left first incisor (D21) in 50 % of cases followed by the right central incisor (D 11) in 25 % of cases and second left incisor (D 22) with 12.5 %, respectfully. Male subjects had more complicated wound healing compare to female participants in our study but there was no discrepancy with significant statistical difference in the quality of healing in children with gender-based injury differentiation ($X^2 = 1.342$, $P = 0.511$). The average value of the POQL index in children included in our research was 33.9% (DS \pm 16.9%), the range 11.0-87.0%. The average value of the POQL index in injured children involved in this research was 38.8% (DS \pm 19.0%), range 14.0-69.0%. The average value of the POQL index for non-injured children included in our study was 33.1% (DS \pm 16.6%), range 11.0-87.0%.

Data obtained from this study and methodology enables the dental professionals to address the problem of inconsistent procedure protocols in ED and the immanent need for gathering contribution data which will help the institutions to make preventive measures and early interventions.

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*Corresponding author:

Ass Prof Fehim Haliti DDS, PhD.
Department of Pediatric Dentistry,
School of Dentistry, Medical Faculty,
University of Prishtina, 10000
Prishtina, Kosovo.
E-mail: feimi18@hotmail.com

Introduction

Modern living trends are very dynamic and demanding and consecutively the accident rate is much higher compare to the end of twentieth century. Environments like for example school, the home, sports facilities and the road are where traumatic events occur with the

highest frequency. Both children and adults seek care at medical or dental centers for emergencies, such as dental pain, trauma, and infection. Reports have shown that 25% of school-aged children will experience some kind of dental injury. Trauma to the oral hard and soft tissues is frequently seen in children. Epidemiologic studies have focused on the investigation of the prevalence or incidence of dental injury. The frequency of dental injuries in preschool and school children is a continuing clinical and dental public health problem. Amongst all facial injuries, dental traumas are the most common. From the total of 18% of all injuries in children up to 6 years of age are seen in the oral region.¹ One third of all children in the primary dentition stage suffer from traumatic injuries to the mouth. This is possibly related to poor motor coordination and is sometimes due to the child's inability to evaluate risks.² Resilience of the alveolar bone in young children causes dental luxations of the intrusive type to be more common than crown fractures. The predominant cause of dental injuries in younger age groups is falls, such as falling from baby carriages, falling down stairs, or falling against hard objects, and is mainly indoor injury.

Injuries to the primary dentition are common, occurring with a significantly higher annual incidence than in the permanent dentition.³ Current literature has been well documented that the prognosis for traumatized teeth depends largely upon both timely and appropriate emergency management. Furthermore, it has been reported that up to 66% of all Emergency Department (ED) visits for dental issues are for the management of traumatic dental injuries (TDI), the number of ED visits for pediatric dental care has been increasing in the last two decades.^{4,5} In addition, child abuse is highly associated with head and tooth injuries.

Facial differences and dental malocclusion affect the self-esteem of children and young adults.⁶ Severe dental injuries, can cause immediate unexpected pain and disfigurement. In addition to the economic consequences of dental injuries, trauma produces acute and chronic pain as well as a range of socioeconomic effects that include quality-of-life insults that can lead to time off school and work, lost sleep and commuting for treatment. Moreover, children may experience

anxiety produced by the unwanted attention of their peers and the inability to take part in school activities such as sports and music.^{7,8,9}

In the current studies, the majority of dental injuries involve the anterior teeth, which may lead to limitations in biting, difficulty in speaking clearly, and feeling uncomfortable to show the teeth. Consensus is reached that traumatic injuries occur more often to the maxillary than the mandibular incisors and that the central incisors are affected more than the lateral incisors.^{10,11}

The surface of the oral cavity is covered by oral mucosa, a moist lining that communicates with the external environment. The oral mucosa consists of two separate tissue components: stratified squamous epithelium (the oral epithelium) and an underlying connective tissue layer (the lamina propria). Functions of the oral mucosa include protection, sensation and secretion.¹² One of the important aspect of our study is to analyze the wound healing, as a normal biological development, which can be achieved through four distinct and highly differentiated phases: hemostasis, inflammation, proliferation, and remodeling. In order to heal effectively, all four healing stages must arise in the proper order and time related period. Many factors can impede through one or more phases of this progression, and consecutively can cause inappropriate or diminished wound healing.¹³

Wound healing can be delayed by both local and systemic or general elements. Local elements are those that exist in the wound tissue and include: the amount of exudate (which can lead to maceration if too much, or desiccation if insufficient), an abnormal bacterial balance or local infection, the presence of foreign bodies exacerbating the inflammatory response, the vascular supply to the area, pressure, friction, and shear as well as repetitive trauma to the area and wound management practices that affect wound bed temperature reducing the cellular proliferation. There is limited literature or clinical studies quantifying the impact of systemic elements on wound healing times.¹⁴

The Pediatric Health-related quality of life (POQL Index) is a valid and reliable measure of oral health-related quality of life for use in preschool, school-age and pre-teen children. Our research will analyze the quality of general and oral health after trauma for all study participants through the use of modified POQL index - at the

end of the study for all subjects.^{15, 16, 17}

The objectives of this study were to analyze and record the pattern of teeth and soft tissue injuries treated in ED and later monitored at the University Dentistry Clinical Center of Kosovo in Prishtina for the fractured teeth treatment and the quality of surrounding soft tissue wound healing.

Materials and methods

Our prospective interventional study was conceded between September 2017 and September of 2018 (as a part of broader clinical research) exploring the prevalence of TDI among schoolchildren at public schools (III – IX grade) in urban and suburban areas of the Prishtina Region, Kosovo. The study protocol and informed consent document was approved by the University of Prishtina, Medical Faculty – School of Dentistry and Kosovo Ministry of Education and Science, also it's in full concordance with the World Medical Association Declaration of Helsinki (October 2, 2011, meeting number 5, decision number 5).

A total of 124 children were referred for treatment at the emergency room due to various head and neck trauma at the University Clinical Center of Kosovo, and 16 children are diagnosed with fractured teeth and injured soft tissue structures. The research data are presented as percentage, arithmetic mean and standard deviation and range. Categorized data testing was done with the X2 test or the exact Fisher test. Testing quantitative data with normal distribution with t-test or One Way ANOVA, and those without normal distribution with Mann-Whitney test. The difference is significant if $P < 0.05$. Data processing is done using the statistical package SPSS 22.0. The sample size was calculated to give a standard error of 2.0%. The minimum sample size needed to satisfy the requirements was estimated to be 112 individuals. A correction factor equal to 1.7 was applied for design effect (deff).

Results

As far as gender distribution 59 or 47.6% were female and 65 or 52.4% male. Using the X2-test we did not obtain a difference with significant statistical implication regarding gender in our research ($X^2=0.29$, $P=0.590$).

The students involved in the research were from grades III to grade IX, so all grades of junior high school and grades III, IV and V of primary school. The smallest number 6 or 4.8% were third grade students, then fifth to ninth grade students were 94 or 24.2%.

Based on gender, with X2-test we did not obtain a difference with significant statistical consequence in the presence of injuries (F 13.6% vs. M 12.3%), ($X^2 = 0.003$, $P = 0.951$), respectively. (Table 1)

Presence of injury	Gender				Total	
	F		M			
	N	%	N	%	N	%
Yes	51	86.4	57	87.7	108	87.1
No	8	13.6	8	12.3	16	12.9
Total	59	100.0	65	100.0	124	100.0
X ² -test, P-value	X ² =0.003, P=0.951					

Table 1. Schoolchildren included in research based on the presence of injuries and gender.

Further statistical analysis didn't show any correlation between the presence of injuries and grades or age. Injuries occurred in 16.7% of children in 3rd grade, then dropped to 4.2% in 4th grade, 6.9% in fifth grade, to increase again in sixth grade 18.8%, seventh grade 23.1% (Table 2).

Grade	Presence of Injuries				Total	
	Yes		No			
	N	%	N	%	N	%
III	1	16.7	5	83.3	6	100.0
IV	1	4.2	23	95.8	24	100.0
V	2	6.9	27	93.1	29	100.0
VI	3	18.8	13	81.3	16	100.0
VII	3	23.1	10	76.9	13	100.0
VIII	3	15.0	17	85.0	20	100.0
IX	3	18.8	13	81.3	16	100.0
Total	16	12.9	108	87.1	124	100.0

Table 2. Children included in the study based on injuries and grade.

From 124 children included in the study, 9 or 7.3% had allergies, one or 0.8% had anemia, one or 0.8% rheumatic fever, one or 0.8% heart problems, one or 0.8% peripheral blood circulation deficiency and one or 0.8 % was suffering from severe form of scoliosis. Without systemic disease were 110 or 88.7% of children included in this study.

The total number of children with teeth fractures and soft tissue injuries is 16, and eight of them or 50.0 % of children had the tooth 21 fractured, followed by 4 or 25.0% had dental injury of tooth 11, two or 12.5% had dental injuries of tooth 22. Tooth injuries on teeth 12; 31; 41; 61 and 62 were present in single cases or 6.3% (Table 3).

Fractured teeth	Total	
	N	%
*teeth number	16	100.0
11	4	25.0
12	1	6.3
21	8	50.0
22	2	12.5
31	1	6.3
41	1	6.3
61	1	6.3
62	1	6.3

Table 3. Fractured teeth among injured children.

In our study, the quality of wound healing was assessed independently by three evaluators' (Specialists of Pediatric Dentistry) which have scored the progression of wound healing in three categories (normal healing, healing with moderate difficulties and complicated healing), taking into consideration soft tissue laceration patterns, dehiscence, hematoma, presence of fibrin stripes above the wound, bleeding, traces of wound concussion, bone exposures and presence of foreign bodies inside the wound.

The first assessment was done 24 hours after the injury, the second assessment took place on the fourth day after the trauma and the third assessment was done on the seventh day. Photos and video recordings of wounds are well documented during the evaluation procedures for each subject included in this study. The overall score was calculated from all three evaluators and proceeded for further analysis.

In children with injuries included in the study based on the quality of wound healing, 37.5% of female had healing without difficulty compared to male subjects represented with 25.0%. While male with 37.5% had more healing with complications compared to female with only 12.5% complications during healing period. However, utilizing the X2-test we did not obtain a divergence with significant statistical difference in the quality of healing in children with gender-based injury differentiation ($X^2 = 1.342$, $P = 0.511$), (Table 4).

Wound Healing Quality	Gender				Total		
	F		M				
	N	%	N	%	N	%	
Normal Healing	3	37.5	2	25.0	5	31.3	
Healing with Moderate Difficulties	4	50.0	3	37.5	7	43.8	
Complicated Healing	1	12.5	3	37.5	4	25.0	
Total	8	100.0	8	100.0	16	100.0	
X ² -test, P-value		X ² =1.342, P=0.511					

Table 4. Gender related Quality of Wound Healing.

In children with injuries involved in the research based on quality of wound healing, healing without difficulty had 31.3%, healing with moderate difficulty was noted on 43.8% of subjects and recovery with complications in 25.0% of children.

Another statistical analysis between children in different grades demonstrated that the children of the 9th grade had more recovery without difficulty (66.7%), (Table 5).

Grade	Quality of Wound Healing						Total	
	Normal healing		Healing with moderate difficulties		Complicated Healing			
	N	%	N	%	N	%	N	%
III	-	-	-	-	1	100.0	1	100.0
IV	-	-	1	100.0	-	-	1	100.0
V	1	33.3	1	33.3	1	33.3	3	100.0
VI	-	-	1	50.0	1	50.0	2	100.0
VII	1	33.3	2	66.7	-	-	3	100.0
VIII	1	33.3	2	66.7	-	-	3	100.0
IX	2	66.7	-	-	1	33.3	3	100.0
Total	5	31.3	7	43.8	4	25.0	16	100.0

Table 5. Grade related quality of wound healing.

Children from third to sixth grade are more prone to complications during healing period (three children, 4.10 %)

Injuries in children included in this study most often in 43.8% of cases were caused by falls, in 12.5% were caused by accidents, in 6.3% of cases injuries were caused by very decayed teeth during mastication, 6.3% had fractures caused by stoning, 6.3% had intrusion of tooth 61 and in 25.0% of cases they don't remember or they don't know the injury mechanism (Table 6).

Injury Mechanism	Gender				Total	
	F		M			
	N	%	N	%	N	%
Fall	2	25.0	5	62.5	7	43.8
Accident	1	12.5	1	12.5	2	12.5
Decay/ followed by fracture	1	12.5	-	-	1	6.3
Stoning	-	-	1	12.5	1	6.3
Don't know or don't remember	3	37.5	1	12.5	4	25.0
Intrusion of D 61	1	12.5	-	-	1	6.3
Total	8	100.0	8	100.0	16	100.0

Table 6. Injury mechanism of children based on gender.

The average value of the POQL index in children included in our research was 33.9% (DS ± 16.9%), the range 11.0-87.0%. The average value of the POQL index in injured children involved in this research was 38.8% (DS ± 19.0%), range 14.0-69.0%. The average value of the POQL index for non-injured children included in our study was 33.1% (DS ± 16.6%), range 11.0-87.0%.

Utilizing the Mann-Whitney test we did not obtain a difference with significant statistical importance of POQL index values based on the presence of injuries (Table 7).

The average value of the POQL index in children with teeth fracture and soft tissue injuries included in our research was 38.8% (DS ± 19.0%), the range 14.0-69.0%. The average value of the POQL index in children involved in research with normal wound healing was 45.0% (DS ± 21.3%), range 24.0-69.0%. The average value of the POQL index in children included in research with moderate wound healing was 42.7% (DS ± 18.6%), range 17.0-67.0%. The average value of the POQL index in children involved in research with complicated healing

was 24.3% (DS ± 11.4%), range 14.0-36.0%.

With One Way ANOVA we did not obtain a difference with significant statistical difference between the POQL index values according to the quality of wound healing (F = 1.73, P = 0.578), (Table 8).

POQL Index (%)	Presence of Injury		
	Yes	No	Total
N	16	108	124
Median	38.8	33.1	33.9
DS	19.0	16.6	16.9
Min	14.0	11.0	11.0
Max	69.0	87.0	87.0
Mann-Whitney test, P-value	U'=1034.5, P=0.205		

Table 7. The results of POQL –index for all study participants.

POQL Index (%)	Wound quality of healing			Total
	Normal wound healing	Moderate wound healing	Complicated wound healing	
N	5	7	4	16
Median	45.0	42.7	24.3	38.8
DS	21.3	18.6	11.4	19.0
Min	24.0	17.0	14.0	14.0
Max	69.0	67.0	36.0	69.0
One Way ANOVA	F=1.73, P=0.578			

Table 8. Results of POQL-index based on wound quality of healing.

Based on available literature, POQL-index clustered best into four dimensions – Physical Functioning, Role Functioning, Social Functioning and Emotional Functioning. Meanwhile, all scales excluding for Role Functioning showed good consistency and strong associations with the total POQL for both groups (with and without injuries). The scales were discreetly inter-correlated, as projected, with the strongest association seen amongst the Social and Emotional scales.

Discussion

The incidence of teeth fractures and soft tissue injuries as a result of various trauma is well documented in the current available

literature. Epidemiological studies results showed that globally, the incidence/ year of dental trauma reaches 4.5%: approximately a third of children and toddlers and a quarter of adolescents and adults.¹⁸

In our study group the most fractured tooth was the left first incisor (D21) in 50 % of cases followed by the right central incisor (D 11) in 25 % of cases and second left incisor (D 22) with 12.5 %, respectfully.

Similar statistical data in comparison to our study was presented by Eigbobo et al., in their research have found that 59 (60.8%) of participants were male and 38 (39.2%) females presented with dental trauma, the commonest cause of TDI was falls (85.2%), and most (76.2%) incidents occurred in homes. The maxillary central incisors were the most (84.6%) commonly injured teeth, almost occurring equally on both sides of the jaw.¹⁹ In another study, similar results were found with 16.5% prevalence of dental trauma. Boys experienced double the number of girls' injuries. The maxillary central incisors were the teeth most affected, totaling 84.8%.²⁰

In another study conducted in Brazil, 1,650 patients were referred for treatment at the emergency room of the Oral and Maxillofacial Trauma and Surgery Service at Hospital das Clínicas. From this total, 78 (4.7%) patients presented some kind of dento-alveolar trauma, which is in vast discrepancy with our study findings 12.9% (but in much smaller sample).²¹

Involvement of soft tissue injuries as a part of multiple trauma injuries of head and neck was present in all subjects included in our study, Akuldiz et al. in their study, reported that cases of TDI including soft tissue injuries had lower percentages (22.5%).²² In another prospective study, Acton et al., analyzing the traumatic maxillofacial injuries in young bicycle riders reported that the most common oral/maxillofacial injuries were facial abrasions, cuts and lacerations (50.3%); soft tissue injuries to the mouth (30.9%); and dento-alveolar trauma (9.7%).²³

Study by Lygidakis et al., included 1271 children aged 8 months to 12 years, 680 boys and 591 girls presented as emergencies, and from this total number of children 142 (11%) subjects (90 males and 52 females) who presented following trauma had injuries to 20 primary and 221 permanent teeth, this results are

statistically similar to our findings regarding the overall patient percentage and involved teeth.²⁴ Majority of study reviews exposed the fact that the central maxillary incisors are the most frequently fractured teeth followed by maxillary second incisors.^{25, 26, 27,28,29}

Many times the private clinics receive patients with TDI and the treat them successfully, in a study done by Oulis et al., 68% of the patients sought treatment 3 days or more after the trauma had occurred (delayed treatment), while only 28% within the first days (delayed treatment). The main reasons for delayed treatment were neglect (50 %), unawareness (37%) and miscellaneous reasons (13%). The highest incidence of dental trauma was observed at the age of 10. Furthermore, important finding, which is in agreement with the literature, was that there was no difference in the probability of traumatizing teeth of one side of the oral cavity in comparison to the other.³⁰

In majority of cases documented in ED databases pediatric soft tissue injuries are commonly overlooked when discussing pediatric trauma. Yet they occur in association with facial fractures 29–56 % of the time. In our study the incidence of soft tissue injuries was 20.1 %. The modalities of management of such injuries are similar to that of adults but it has to be kept in mind that healing process starts faster so chances of formation of hypertrophic scar or keloid is more possible.³¹

The problem of very low number of children seeking medical and dental emergency treatment right after the injury was well described in a study conducted by Folakemi et al, based on the results majority of the injuries happened in the home followed by school. Only 36.4% of parents/caregivers sought dental care for their children/ward within one week after dental trauma. Parents and teachers are advised to be more safety conscious and provide protective appliances such as mouth guard for children during sporting activities.³²

Evidence regarding the importance of information technology for patient record and tracking was very well described in the paper published by Glendor et al., with the focus on promotion, prevention and curative care. An "individual risk profile", especially for younger individuals who have received their first trauma episode, may be useful in the co-operation

between the patient, parents and their caregiver. This risk profile could be a combination of systematic information from the “experts” on the dental trauma episode, the patient and parents, and standard trauma information in dental record. A database, consisting of systematically and continuously compiled information for such risk profile, would provide better knowledge about how to avoid multiple dental trauma episodes.³³ In addition, through this described ideas by Professor Glendor it is feasible to identify children with locomotor and neurologic system deficiencies and also to proceed with their treatment in specialized healthcare institutions. In a similar detailed epidemiologic study Alan et al. are emphasizing the role that emergency medicine can play in the initial management of tooth injuries, stressing that population-based epidemiologic data on injuries must be used to reassess conventional wisdom about injuries and to target future efforts at prevention of dento-alveolar injuries.³⁴

Tumen et al., also is focused on the idea that there is a great need for more focus and health promotion policies to encourage precautionary policies dedicated to parents and teachers to inform them about the significance of traumatic dental injuries and the benefit of instant respond for dental treatment.³⁵

In our study modified POQL for both groups (with and without injuries), was shown very balanced / equal for the obtained pattern for all study participants ($U=1034.5$, $P=0.205$), which are in agreement with the results found by Gilchrist and Traebert.^{36, 37}

The use of herbal products which have accelerating wound healing properties are not uncommon, some of those studies are done on humans and animals as well. All this herbal products are rich in chemical compounds, such as saponins, tannins, alkaloids, triterpenoid, flavonoid, phenolics, steroids, and glycosides. In the second phase of our research it's our intention to use this products too, and to measure their effectiveness. Many authors are presenting their research findings in which there is a significant increase of quantitative values of Tumor Growth Factor $\beta 1$ (TGF $\beta 1$) expression but with no significant reduction of inflammatory cells, proliferation of mature collagen is deposits, faster and compact wound closure, stimulation of fibroblast cell production, etc.^{38, 39, 40}

Based on the results of our research, the course of one week wound healing was evaluated by three evaluators' which have scored the progression of wound healing in three categories (normal healing, healing with moderate difficulties and complicated healing), further analysis demonstrated that the POQL index scores for both groups didn't show any significant statistical discrepancy. The results of our research are very similar to the studies carried out by Politis, Guo and Szpaderska.^{41,42,43}

Conclusions

Based on the findings of this study dental professionals need to address the problem of inconsistent procedure protocols in ED and the immanent need for gathering contribution data which will help the institutions to make preventive measures and early interventions. These efforts would enhance the long term outcomes for young patients sustaining dental trauma and treated in ED, private dental practice or tertiary treatment institutions.

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Declaration of Interest

The authors report no conflict of interest.

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