

Dental trauma in primary dentition and possible outcomes on permanent successors

Ana-Maria Brandusan¹, Alexandrina Muntean¹, Mariana Pacurar², Ioana-Andreea Chis¹,
Emilia Prodea³, Alina Ormenisan⁴

¹Department of Paediatric Dentistry, Faculty of Dentistry, University of Medicine and Pharmacy "Iuliu Hatieganu", Cluj-Napoca, Romania

²Orthodontic Department, Faculty of Dental Medicine, "George Emil Palade" University of Medicine, Pharmacy, Science, and Technology, Targu Mures, Romania

³S.C. Aorys Dental & Care, Sibiu, Romania

⁴Department of Oral and Maxillo-Facial, "George Emil Palade" University of Medicine, Pharmacy, Science, and Technology, Targu Mures, Romania

ABSTRACT

Objectives. The aim of this study is to determine if there is a correlation between a traumatic dental injury suffered by a deciduous tooth and the alterations that may appear in the structure of the permanent one.

Materials and methods. For this narrative review, we collected articles written in English from PubMed, Scopus, and Embase. A total of 116 papers were assessed, with 20 included in the review.

Results. The review found that there is a strong relationship between a traumatic incident suffered by the temporary tooth and the developmental disturbances that appear in the permanent successors. The majority of traumatic dental injuries take place around the age of 1-3 years, when the child is learning how to walk. The developmental disturbances that may appear are categorized as mild or severe, with the difference between them being the age of the child when the trauma occurred, the type of trauma, the degree of root resorption, and the force of the impact.

Conclusion. The amount of injury to a primary tooth without address it when it happens has detrimental effects on the growth and emergence of permanent teeth, requiring more prolonged and costly treatment.

Keywords: traumatic dental injuries, primary teeth, developmental disturbances

INTRODUCTION

Traumatic dental injuries in primary dentition represent an important issue around the world, commonly manifesting during the child's early years of life. Cases of dental trauma are regarded as emergency situations as they need immediate attention and may have important medical, aesthetic, and psychological consequences for children [1-3].

Tooth tissue formation begins during intrauterine life. With the eruption of the teeth, they go through various stages of development, which differ between primary and permanent teeth.

For primary teeth, there are three stages of development, and understanding these stages is crucial for the correct treatment planning and follow-up implementation. The first stage is that of the young primary tooth, which is a period of development and growth until the complete formation of the root. This stage lasts 1-2 years until the apex is closed. The second stage is represented by the mature primary tooth. During this period, the pulp chamber is large, the root canals are narrower, and the pulp is well-vascularized, with the pulp horns located superficially. This period lasts as long as the apex remains closed. The third stage is that of the

Corresponding author:

Alexandrina Muntean

E-mail: alexandrina.muntean@umfcluj.ro

Article History:

Received: 28 August 2024

Accepted: 5 September 2024

primary tooth with the root in resorption. This period begins approximately one year before the physiological replacement of the primary tooth and is initiated by the contact between the permanent tooth bud and the apex of the primary tooth.

The stage of permanent tooth crown formation, the force of impact, and the type of trauma influence the type of disorders that may arise. There is a higher probability of developing enamel hypoplasia after an impact to the oral cavity if the trauma occurs before the age of 2 years [4,5].

MATERIALS AND METHODS

Search and item selection strategy

This review includes articles written in English published in the following databases: PubMed, Scopus and Embase. Articles published between 2000 and 2024 were selected. The search parameters and key-words used: “deciduous”, “teeth”, “trauma”, “Dental trauma temporary”, “dental injury temporary”. The search strategy yielded 147 articles: 50 from PubMed, 77 from Scopus and 20 from Embase.

After removing duplicate articles, 116 articles remain. After reading the title, we eliminated 66 articles. After reading the abstracts, 42 articles remain. After reading the full text of the remaining articles, we removed an additional 17 articles. Finally, 20 articles were found to be relevant to the topic, including 6 systematic reviews, 5 guidelines, 4 retrospective studies, 3 original papers, 1 longitudinal clinical study, and 1 research article.

RESULTS

Primary teeth injuries classification

Injuries to primary teeth can negatively impact a child's psychology due to the functional and aesthetic issues they may cause. Most dental injuries involve the anterior group, especially the maxillary central incisors [6].

Over time, there have been various classifications for dental injuries. One notable classification is the one from 1994 developed by the World Health Organization (WHO) [7].

This classification includes injuries to the tooth, periodontal tissue and oral mucosa, and is based on anatomical, therapeutic and prognostic considerations. It can be applied to both primary and permanent dentition [7,8].

Following trauma to the primary tooth, the permanent tooth may exhibit one of the following modifications, classified according to the age at which they occur, as shown in Table 1 [9].

The classification from Table 1 includes injuries to the tooth and periodontal tissue and is based on anatomical, therapeutic and prognostic considera-

tions. It can be applied to both primary and permanent dentition [7,8].

Following trauma to the primary tooth, the permanent tooth may exhibit one of the following modifications, classified according to the age at which they occur, as shown in Table 2 [7,8].

Etiology of injuries suffered by the primary teeth

Etiological factors are closely related to the age of the patient. In preschoolers, falls are the most common cause of oral injuries, while in school-aged children, injuries are most often caused by sports or by being fouled by others. Dental trauma occurred mostly during leisure time and weekends. This is particularly associated with the lifestyle of Western countries [10].

During the primary dentition period, a child's coordination and judgment are not fully developed at their young age, whilst their curiosity can lead to injuries from falls at home or around the house. Temporary teeth trauma occurs by direct or indirect mechanism. Direct trauma involves a frank tooth contact, which is common in the front teeth, while indirect trauma happens through strong impact between the two dental arches, such as from a blow to the chin. Factors influencing the nature and severity of the trauma include the energy of the blow, the shape and elasticity of the object and the angle of the impact. The prevalence of traumatic dental injuries is higher in males, especially in patients between 2 and 4 years old [9,11,12].

The most common cause of trauma is falls, especially when the child is learning to walk [13]. Other causes include sports accidents, road accidents, falls from bicycles, and last but not least, domestic violence [14]. In patients under 6 years of age, oral injuries were the second most frequent injuries according to literature [15].

A significant predisposing factor for frontal dental trauma is an increased overjet with the protrusion of the central incisors, where traumatic incidents are twice as common. This affects a larger number of teeth in a single incident [9,11].

DISCUSSIONS

Dental injuries are the most common among all oro-facial traumas, occurring in 11-30% of preschoolers and 22% of children up to 14 years old, more frequently in boys. The upper incisors, especially the central ones, are the most commonly affected teeth. Usually, only one tooth is affected unless the injury is from a road or sports accident [6,16].

Primary dentition is prone to luxation in 21-81% of total dental traumas. Luxation can vary in form depending on the degree of displacement, including

TABLE 1. Clinical classification of traumatic dental injuries including codes of the WHO International Classification

Trauma to hard dental tissue and pulp tissue		
WHO code	Lesion type	Diagnosis criteria
N 502.50	Enamel infraction	An incomplete fracture of the enamel without loss of dental tissue.
N 502.50	Enamel Fracture (Uncomplicated Crown Fracture)	A fracture with the loss of dental tissue localized only at the enamel level.
N 502.51	Enamel and Dentin Fracture (Simple Crown Fracture)	A fracture with the loss of dental tissue localized at the enamel and dentin levels, without affecting the pulp chamber.
N 502.52	Complicated Crown Fracture	Involves enamel and dentin, with involvement of the pulp chamber.
N 502.54	Uncomplicated Crown-Root Fracture	Involves enamel, dentin, and cementum, with the presence of a pulp chamber dehiscence.
N 502.54	Complicated Crown-Root Fracture	Involves enamel, dentin, and cementum, with damage to the pulp chamber.
N 502.53	Root Fracture	Involves dentin, cementum, and pulp. The fracture can be further classified based on the orientation of the coronal fragment (horizontal, vertical, or oblique).
Trauma to Periodontal Tissue		
WHO code	Lesion type	Diagnosis criteria
N 503.20	Contusion	Injury to the supporting tissue of the tooth without significant displacement or loosening, but with painful signs upon percussion.
N 503.20	Subluxation (loosening)	Injury to the supporting tissue of the tooth without tooth displacement.
N 503.20	Extrusive luxation (peripheral dislocation, partial avulsion)	Partial vertical displacement of the tooth out of the socket
N 503.20	Lateral Luxation	Displacement of the tooth in any direction except vertical, often accompanied by the fracture of the alveolar process
N 503.21	Intrusion luxation (central dislocation)	Apical displacement of the tooth, associated with the fracture of the alveolar process.
N503.22	Avulsion (exarticulation)	Complete expulsion of the tooth from the socket.
Trauma to the supporting bone		
WHO code	Lesion type	Diagnosis criteria
N 502.40	Comminution of the maxillary alveolar socket	Destruction and compression of the alveolar process, commonly seen in intrusion and lateral luxation.
N 502.60	Comminution of the mandibular alveolar socket	
N 502.40	Fracture of the maxillary alveolar socket wall	Fracture of the vestibular or palatal/lingual alveolar process.
N 502.60	Fracture of the mandibular alveolar socket wall	
N 502.40	Fracture of the maxillary alveolar process	Fracture of the alveolar process that may or may not involve the dental socket.
N 502.60	Fracture of the mandibular alveolar process	
N 502.42	Fracture of the maxilla	A fracture involving the base of the maxilla or mandible and often the alveolar process (jaw fracture). The fracture may or may not involve the alveolar socket
N 502.61	Fracture of the mandible	

TABLE 2. Potential developmental changes in permanent teeth

Child age	Dental stage of the temporary tooth	Potential developmental changes in permanent teeth
Between 1 and 3 years	I	Odontoma-like malformation
Around the age of 2 years	I	Coronal dilaceration
Between 2 and 5 years	II	Coronal duplication Dilaceration lateral or vestibular angulation of the root
Between 2 and 7 years	II OR III	White or yellow-brown enamel discoloration
Between 5 and 7 years	II OR III	Partial or complete cessation of root formation

contusion, subluxation, lateral luxation, extrusion, intrusion and avulsion. Avulsion of the tooth is one of the most severe forms of displacement, with the tooth being completely removed from its socket, making a prompt and correct treatment crucial for a favorable prognosis [17,18].

The root of the primary tooth is in close contact with the germ of the permanent tooth, which can lead to complications such as infection of the permanent tooth following infection of the primary tooth. Therefore, the prognosis of the trauma to the primary tooth and understanding the likelihood of complications is crucial before deciding on a treatment plan, whether that consists in extraction or preservation [16,19].

The severity of the lesion that may appear on the permanent tooth depends on a few factors, such as the age of the patient when the accident occurred, the type of the trauma, the extent of root resorption, and the developmental stage of the permanent tooth. If the permanent tooth germ is partially formed, the damage that may occur is greater in comparison to a fully formed germ [3,20].

Considering that the temporary roots are shortened, and the bone has a lower density, dental movements (luxation, intrusion, avulsion) are more common than fractures. The apex of the temporary tooth is located approximately 3 mm from the permanent tooth bud, and it consists of connective fibrous tissue. This is why the consequences are greater when trauma occurs in the first or second stage of tooth development, before the apex has started the resorption process. If the traumatic event happens when the tooth is in the first stage (1-2 years), the risk of sequelae is higher, and the most common injury that will appear on the permanent tooth is enamel discoloration and hypoplasia due to incomplete germ mineralization [15,21–23].

The bud of the permanent incisor is located lingual in comparison with the roots of temporary one, and in most of the cases, when an intrusion happens the bud will not be affected by this trauma, but if the intruded tooth is located lingual or in close proximity to the bud, the temporary one should be extracted. This anatomical relation can only be seen on a lateral radiograph of the anterior segment [21].

Dental malformations, tooth fractures, and eruption disturbances are just a few of the consequences that can affect the permanent tooth. White or yellow-brown spots and hypoplasia of the crowns of permanent incisors are the most common consequences following intrusion or avulsion of a primary tooth at the age of 1-3 years. Due to these consequences, treatment selection should aim to minimize the risk of further disturbances in the permanent teeth development [4,24].

The term "dilaceration" describes a deviation in the longitudinal axis of the crown or root. The deviation results from traumatic displacement of the already formed hard tissue compared to the hard tissue in formation.

The term "angulation" describes a curvature of the root resulting from a gradual change in the direction of root development without evidence of displacement of the dental bud during odontogenesis. Radicular displacement can be vestibular (e.g. labiopalatal) or lateral (e.g. mesiodistal).

A complete evaluation of complications following trauma should be conducted only after the complete eruption of the affected permanent tooth. However, more severe changes (dental morphology modification) can be diagnosed radiographically in the first year after the trauma.

Delays in dental eruption can occur due to thinning of the connective tissue between the permanent tooth bud and the primary tooth. Ectopic eruption can also occur due to the lack of eruption guidance and malformations in the crown or root [9].

Mild Developmental Disturbances in Permanent Dentition

Coronal discoloration is the most common consequence of dental trauma to primary incisors. Generally, there are three types of discoloration: pink, which can represent either internal hemorrhage or internal coronal resorption; yellow, often indicating root canal obliteration or the presence of pulp stones; and dark discoloration, the most frequent complication following trauma [25,26].

White or brown-yellow enamel discoloration and hypoplasia are the most common complications affecting the permanent tooth if its predecessor suffered a luxation-type trauma. Trauma-induced hypoplasia is an external defect with or without localized discoloration in the middle third of the dental crown. The location of the discoloration is closely linked to the child's age at the time of the trauma. For the discoloration to appear, the injury has to occur before 3 years of age, the age at which calcification of the central incisor's crown is completed.

Circular enamel hypoplasia is typically associated with the intrusion or the avulsion of the primary tooth. Usually, there is a horizontal groove encircling the crown, cervically to the discolored areas [9].

Both types of traumas associated with hypoplasia compromise aesthetics and should be diagnosed early to prevent further complications such as carious lesions. However, color changes and hypoplasia are considered minimal disturbances. These teeth can be restored minimally invasive using composite methods [27].

Critical points to consider when treating mild disturbances include: a correct diagnosis after the intrusion or the avulsion of the primary tooth; a referral to a pediatric dentist; an annual clinical and radiological follow-up of the affected tooth; and a composite restoration of the possible enamel hypoplasia when it becomes visible (or even after the tooth's eruption) [16,28].

Severe Developmental Disturbances in Permanent Dentition

A trauma to the buccal cavity at a young age can cause severe disturbances to the permanent teeth such as coronal dilaceration, radicular dilaceration and eruption disorders. Though these disturbances are not frequent, they present significant diagnostic and treatment challenges. They result from trauma experienced by a child over 5 years old with a histo-

ry of severe intrusion, avulsion, alveolar process fracture, or a combination of these.

Most studies suggest that the intrusion or the avulsion of primary incisors in children under 2 years old present a much higher risk regarding the development of permanent teeth. However, variables other than the type of trauma to the primary tooth can influence the development of the permanent tooth. These factors relate to the trauma history and the child's age at the time of injury, the force of impact, as well as the presence of an alveolar bone fracture. Sometimes, a strong trauma can cause severe damage to the permanent teeth without affecting the primary teeth. It is crucial to remember that a blow to the anterior region will be transmitted to all teeth, even if only 1 or 2 primary incisors show displacement. Therefore, clinical and radiological follow-up is mandatory when severe disturbances may arise from a serious oral cavity trauma [27,29].

Critical points to consider when treating severe disturbances include: early diagnosis of dilacerated incisors, multidisciplinary approach, surgical treatment, orthodontic treatment at the beginning of mixed dentition and conservative treatment whenever is possible [16].

CONCLUSIONS

The occurrence of trauma to a primary tooth and not treating it at the time it takes place has detrimental effects on the development and eruption of permanent teeth, necessitating longer and more expensive treatment. Trauma to primary teeth frequently causes positional changes in permanent

teeth, especially when it occurs around the age of 3 years.

There is a correlation between the intrusion of a primary tooth in stage I and the ectopic eruption of the replacement tooth located intraosseous, due to the proximity of the apex of the primary tooth to the bud of the permanent tooth.

Long-term monitoring of the patient is necessary to reduce the negative effects of trauma to the primary tooth on the permanent tooth. Oral hygiene is the key element that ensures the favorable evolution of the permanent tooth and controls the consequences on dental and periodontal structures.

Additionally, patient cooperation is very important, as understanding and compliance are absolutely necessary to achieve satisfactory results. Trauma to primary teeth is frequently neglected by parents, which is why its diagnosis is often retrospective, identified through the consequences on the permanent tooth.

Conflict of interest: none declared

Financial support: none declared

Author's contributions:

Conceptualization, A.M.B. and A.M.; methodology, M.P.; software, I.A.C.;

validation, A.O., A.M., A.M.B.;

formal analysis, I.A.C.; investigation, A.M.;

resources, A.M.B.; data curation, A.O.;

writing—original draft preparation, A.M.B.;

writing—review and editing, A.M.;

visualization, M.P., I.A.C.; supervision, A.O.

All authors have read and agreed to the published version of the manuscript.

REFERENCES

- Caeiro-Villasenín L, Serna-Muñoz C, Pérez-Silva A, Vicente-Hernández A, Poza-Pascual A, Ortiz-Ruiz AJ. Developmental Dental Defects in Permanent Teeth Resulting from Trauma in Primary Dentition. A Systematic Review. *Int J Environ Res Public Health* [Internet]. 2022;19(2).
- Zhang JL, Peng ZL, Huang J, Pan YJ, Sun ZW, Mai ZH. A two-year retrospective study on traumatic dental injury in the primary dentition. *Med U S*. 2023;102(45):E35750. <http://doi.org/10.1097/MD.00000000000035750>
- Assunção LR da S, Ferelle A, Iwakura MLH, Nascimento LS do, Cunha RF. Luxation injuries in primary teeth: a retrospective study in children assisted at an emergency service. *Braz Oral Res*. 2011;25(2):150-6. <https://doi.org/10.1590/S1806-83242011000200009>
- Day PF, Flores MT, O'Connell AC, Abbott PV, Tsilingaridis G, Fouad AF, et al. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 3. Injuries in the primary dentition. *Dent Traumatol*. 2020;36(4):343-59. <http://doi.org/10.1111/edt.12576>
- Mesaroş M, Muntean A. Caria dentară la copiii și tineri. In: *Medicină dentară pediatrică*. Ediția a 2-a, revăzută. Cluj-Napoca: Editura Medicală Universitară "Iuliu Hațieganu"; 2016.
- Lopes TS, Santin GC, Marengoni LA, Crispim JB, Ceron LC, Fracasso MLC. Clinical and radiographic sequelae in primary teeth due to dental trauma. *Pesqui Bras Em Odontopediatria E Clin Integrada* [Internet]. 2019;19(1). Available from: <https://www.scopus.com/inward/record.uri?eid=2-s2.0-85066753704&doi=10.4034%2fPBOCI.2019.191.95&partnerID=40&md5=c72ffd4fb76d28020ae7afe94c62add2>
- Weltgesundheitsorganisation, editor. Application of the international classification of diseases to dentistry and stomatology: ICD-DA. 3. ed. Geneva: World Health Organization; 1995. 238 p.
- Andreasen JO, Andreasen FM, Andersson L, Andreasen JO, editors. Classification, Epidemiology and Etiology. In: *Textbook and color atlas of traumatic injuries to the teeth*. 4th ed. Oxford, UK ; Ames, Iowa: Blackwell Munksgaard; 2007.
- Welbury R, Duggal MS, Hosey MT, editors. Traumatic injuries to the teeth. In: *Paediatric dentistry*. Fifth edition. Oxford: Oxford University Press; 2020.
- Trauma management. In: *Handbook of pediatric dentistry*. 4th edition, reprinted. Edinburgh [i 7 pozostałych]: Mosby/Elsevier; 2017.
- Bastone EB, Freer TJ, McNamara JR. Epidemiology of dental trauma: a review of the literature. *Aust Dent J*. 2000 Mar;45(1):2-9. <http://doi.org/10.1111/j.1834-7819.2000.tb00234.x>
- Ferrés-Amat E, Díaz-Martínez C, Herrera-Martínez S, Galofré-Kessler N, Astudillo-Rozas W, Aceituno-Antezana O, et al. Relationships between Clinical and Non-Clinical Variables concerning Traumatic Dental Injuries in Deciduous Teeth Attended in a Children's Hospital. *Child Basel Switz*. 2023;10(7):1098. <http://doi.org/10.3390/children10071098>

13. Avşar A, Topaloglu B. Traumatic tooth injuries to primary teeth of children aged 0-3 years. *Dent Traumatol Off Publ Int Assoc Dent Traumatol*. 2009;25(3):323-7. <http://doi.org/10.1111/j.1600-9657.2008.00695.x>
14. Al-Arfaj I, Al-Shammari A, Al-Subai T, Al-Absi G, Al-Jaffari M, Al-Kadi A, et al. The knowledge, attitude and practices of male sports participants to sports-related dental trauma in Khobar and Dammam, Saudi Arabia - A pilot survey. *Saudi Dent J*. 2016;28(3):136-41. <http://doi.org/10.1016/j.sdentj.2016.02.001>
15. Flores MT, Onetto JE. How does orofacial trauma in children affect the developing dentition? Long-term treatment and associated complications. *Dent Traumatol*. 2019;35(6):312-23. <http://doi.org/10.1111/edt.12496>
16. Goswami M, Rahman B, Singh S. Outcomes of luxation injuries to primary teeth-a systematic review. *J Oral Biol Craniofacial Res*. 2020;10(2):227-32. <http://doi.org/10.1016/j.jobcr.2019.12.001>
17. Levin L, Day PF, Hicks L, O'Connell A, Fouad AF, Bourguignon C, et al. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: General introduction. *Dent Traumatol Off Publ Int Assoc Dent Traumatol*. 2020;36(4):309-13. <http://doi.org/10.1111/edt.12574>
18. Yeng T, Parashos P. Dentists' management of dental injuries and dental trauma in Australia: a review. *Dent Traumatol Off Publ Int Assoc Dent Traumatol*. 2008;24(3):268-71. <http://doi.org/10.1111/j.1600-9657.2007.00543.x>
19. Lauridsen E, Blanche P, Amaloo C, Andreasen JO. The risk of healing complications in primary teeth with concussion or subluxation injury-A retrospective cohort study. *Dent Traumatol Off Publ Int Assoc Dent Traumatol*. 2017 Oct;33(5):337-44. <http://doi.org/10.1111/edt.12342>
20. Spinis E, Carboni L, Mallus T, Zerman N. Intrusive Luxation Injuries in deciduous teeth: Literature Review and Treatment Complications Update. *Eur J Paediatr Dent*. 2024;25(1):77-80. <http://doi.org/10.23804/ejpd.2024.25.01.02>
21. Soxman JA, editor. Traumatic Injury to the Primary Incisors. In: Handbook of clinical techniques in pediatric dentistry. Second edition. Hoboken, NJ: Wiley-Blackwell; 2022.
22. Day PF, Flores MT, O'Connell AC, Abbott PV, Tsielingaridis G, Fouad AF, et al. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 3. Injuries in the primary dentition. *Dent Traumatol*. 2020;36(4):343-59. <http://doi.org/10.1111/edt.12576>
23. Da Silva Assunção LR, Ferelle A, Iwakura MLH, Cunha RF. Effects on permanent teeth after luxation injuries to the primary predecessors: a study in children assisted at an emergency service. *Dent Traumatol Off Publ Int Assoc Dent Traumatol*. 2009;25(2):165-70. <http://doi.org/10.1111/j.1600-9657.2008.00759.x>
24. Bourguignon C, Cohenca N, Lauridsen E, Flores MT, O'Connell AC, Day PF, et al. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 1. Fractures and luxations. *Dent Traumatol Off Publ Int Assoc Dent Traumatol*. 2020;36(4):314-30. <http://doi.org/10.1111/edt.12578>
25. Holan G. Pulp aspects of traumatic dental injuries in primary incisors: Dark coronal discoloration. *Dent Traumatol Off Publ Int Assoc Dent Traumatol*. 2019 Dec;35(6):309-11. <http://doi.org/10.1111/edt.12483>
26. Bardellini E, Amadori F, Pasini S, Majorana A. Dental Anomalies in Permanent Teeth after Trauma in Primary Dentition. *J Clin Pediatr Dent*. 2017;41(1):5-9. <http://doi.org/10.17796/1053-4628-41.1.5>
27. Costa VPP, Goettens ML, Baldissera EZ, Bertoldi AD, Torriani DD. Clinical and radiographic sequelae to primary teeth affected by dental trauma: a 9-year retrospective study. *Braz Oral Res*. 2016;30(1):S1806-83242016000100702. <http://doi.org/10.1590/1807-3107BOR-2016.vol30.0089>
28. Needleman HL. The art and science of managing traumatic injuries to primary teeth. *Dent Traumatol Off Publ Int Assoc Dent Traumatol*. 2011;27(4):295-9. <http://doi.org/10.1111/j.1600-9657.2011.01005.x>
29. de Amorim L de FG, da Costa LRRS, Estrela C. Retrospective study of traumatic dental injuries in primary teeth in a Brazilian specialized pediatric practice. *Dent Traumatol Off Publ Int Assoc Dent Traumatol*. 2011;27(5):368-73. <http://doi.org/10.1111/j.1600-9657.2011.01011.x>