Oralprophylaxe & Kinderzahnheilkunde Journal

Tiny Teeth, Big Challenges- *Dental Trauma in the Primary Dentition*

Shimal M Némat, *MChD, BChD, MFDS RCPS(Glasg),* Specialty Trainee in Paediatric Dentistry, School of Dentistry, University of Leeds, UK

Peter F Day*, PhD, FDS (Paeds) RCS (Eng), FRCD (Canada), PGCLTHE, BDS, MFDS RCS (Eng), M Dent Sci, M Paed Dent RCS (Eng*), Professor and Consultant in Paediatric Dentistry, School of Dentistry, University of Leeds, UK and Community Dental Service, Bradford District Care NHS Foundation Trust, Bradford, UK, (ORCID Number <https://orcid.org/0000-0001-9711-9638> )

Correspondence email: p.f.day@leeds.ac.uk

Abstract

Paediatric dental trauma is a common occurrence internationally and its presentation in the primary dentition creates additional challenges. Beyond the dental implications, patients and families experience significant distress which impacts their ability to engage with treatment or access services. Patients in the primary dentition often have limited dental experience and are unlikely to be acclimatised to treatment. Compared to their adolescent peers, their ability to express themselves comprehensively or participate with verbal communication is reduced. The use of non-verbal behaviour management techniques is therefore crucial. A positive dental experience will contribute to good cooperation in the future. Examination and treatment can be challenging, and management significantly differs between the primary and permanent dentition. Involvement with a child orientated dental team is encouraged when appropriate, due to their expertise and access to sedation and general anaesthetics. In addition to the consequences of trauma to the primary dentition, there is also risk to the unerupted permanent successors. The likelihood of this damage can be predicted by the age of the child and nature of the traumatic injury. Parents should be supported and advised on oral hygiene, analgesia and understand the potential future consequences. This paper provides an overview of the management of dental trauma in the primary dentition.

**Key words**

Primary dentition, dental trauma, paediatric, challenges

Introduction
 **Background**

Primary dental trauma accounts for just under a quarter of dental trauma worldwide, with the mouth being the second most common location of physical injury in young children.[1] [2] Accidental falls and collisions are the most common aetiology which coincides with childhood developmental milestones of learning to crawl, walk, and run.[3] Central incisors, followed by lateral incisors are the most common teeth to be injured.[4], [5] The type of dental trauma sustained differs between the permanent and primary dentition. In the primary dentition, injuries tend to involve the periodontal ligament with injuries such as luxation injuries. This contrasts the permanent dentition with fractures to the crown or root being most prevalent.[6]

 **Challenges managing Dental Trauma in Primary Dentition**
Beyond the physical implications, dental trauma impacts the child socially, with self-reported decline in the ability to interact with peers and confidence to smile. [7]–[10]Parents also present with elevated levels of stress, concern, and emotion at the time of the injury which can become a barrier to effectively accessing emergency care or supporting their child through the initial appointments.[11] In general, parents are reported to have poor knowledge about how to manage paediatric dental trauma, and this directly influences their ability to access emergency care in a timely manner. [11] From the perspective of the clinicians, management of dental trauma can be challenging depending on the complexity of the injury, the clinicians experience, appointment time and cooperation of the child. [12] Successful management of primary dental trauma requires methodical examination, diagnosis, and treatment or referral when appropriate and careful follow-up.

 **Communication & Limited Experience**
Patients that suffer a traumatic dental injury (TDI) in their primary dentition tend to have limited dental experience beyond brief routine examinations. Furthermore, their ability to express themselves comprehensively or engage with verbal reasoning is reduced compared to older children presenting in the permanent dentition. This, in combination with their lack of acclimatisation and experience results in higher levels of anxiety which can make thorough examination or provision of treatment difficult. Behaviour management is paramount to successfully manage paediatric patients. [13] Clinicians should use simple language and non-verbal cues to engage the child. Techniques like knee-to-knee examinations can be helpful and involves parental support. Early recognition of patients that are pre-cooperative will ensure rapid referral to child orientated teams that have expertise and access to sedation or general anaesthetic.

Non-Accidental Injury and Safeguarding

When managing a paediatric patient with dental trauma, consideration should be given to the possibility of non-accidental injury. Dentists are in the position to identify injuries of concern,[14]with literature reporting over 50% of physical abuse cases involving injuries to the orofacial region. [14], [15] During the consultation, it is important to observe and record the child’s demeanour and their interactions with the accompanying adult. Clinicians should consider whether the reported mechanism of injury is consistent between parent and child, and the presentation of the injury. Any comments by the child or parent that gives concerns should be recorded. Suspicions of non-accidental injury should also be raised in cases of delayed presentation, inconsistent histories, previous concerns about the child or family, lack of supervision or repeated episodes of trauma[16]. Dentists are encouraged to follow their local safeguarding guidance if they have concerns regarding non-accidental injury.

Examination

An accurate assessment of dental trauma requires examination and diagnosis of both periodontal and hard tissue injuries. Care should be taken to identify any teeth that present with concomitant injuries as this will affect the prognosis.

**Clinical Photographs**Clinical photographs are encouraged and should be added to documentation in the initial assessment appointment. These baseline images can be later referred, especially when monitoring for infraocclusion, discolouration and general soft tissue healing. Clinical photographs can also be shared (with consent) to specialist paediatric dental teams at referral stage or when requesting advice.

**Soft tissues**Patients under the age of three years are most likely to sustain soft tissue injuries[17] and thorough examination should be undertaken to assess the lips, frenal attachments, oral mucosa, and gingivae[18]. These injuries typically present as bruising, lacerations, abrasions, or contusions. Wounds should also be assessed for the presence of foreign bodies such as tooth fragments or debris. Palpation or soft tissue radiographs are helpful in investigations. **Radiographs**
The use of radiographs, when tolerated, are important to confirm a diagnosis and establish a baseline. Follow-up radiographs in the primary dentition are only indicated where clinical pathology is suspected. [18] This is reflective of the difficulty with interpreting radiographs (with superimposed permanent teeth), child cooperation and the overarching principle of reducing radiation exposure for young children.

**Vitality Testing**Responses to vitality tests can be unreliable in young children, who may potentially misinterpret the sensation or miscommunicate because of their anxiety or understanding. Therefore, they are not recommended in the primary dentition.

Treatment

Dental trauma in the primary dentition generally favours conservative management initially, with a tendency to observe rather than intervene unless there is a risk of aspiration or ingestion. Where possible, minimising invasive treatment (such as extractions) at the first appointment is important to maintain patient cooperation and comfort.[18] A positive experience is valuable for continued cooperation and the prevention of future dental anxiety.[19], [20] In carefully selected patients, the provision of restorative treatment can be successfully achieved in the primary dentition.[21]
 Considerations like the patients age and maturity can guide on their likely cooperation with both urgent and long-term treatment. Other factors, like time until tooth exfoliation, and whether there is a significant impact to the occlusion can support the decision of whether to initiate treatment or closely monitor. Primary dental trauma involving alveolar fractures, severe luxation or crown/root fractures with pulpal exposure require rapid referral to child orientated teams with specialist skills, training, and experience.

Outcomes of primary dental trauma

**Tooth Loss**Premature tooth loss is a common outcome in some studies of severe primary tooth trauma as a result of interventions from clinicians, avulsion at the time of injury or early exfoliation. [22] Early loss of a primary tooth may have psychological and dental impacts, including movement of adjacent teeth into the area of tooth loss and changes to speech and mastication.

**Discolouration**
Temporary or permanent colour change can occur following TDI and can be an indicator of pulpal health.[22] Transient grey discolouration is typically diagnosed within the first month of trauma and can last several months.[22] Literature reports that between fifty to eighty percent of teeth with initial discolouration later fade or develop a yellow hue. [22], [23] This yellow hue is significantly associated with pulp canal obliteration (PCO), as a result of tertiary dentine being placed within the pulp canal. Less than five percent of teeth with PCO develop pulpal necrosis and generally its presence is a good indicator of pulpal healing.[24], [25] Teeth with persistent darkening or greyish hue six months after injury have a greater association with pulpal necrosis.[23]

**Pulpal Necrosis**

A diagnosis of pulpal necrosis should not be based on a single clinical feature alone and must be considered in combination with other clinical (mobility, discolouration, tenderness) or radiographic features (arrested root development). The exception to this is in cases of clear infection, such as presence of a sinus, or evidence of radiographic pathology. [18]
Concomitant injuries have an established risk of pulpal necrosis in a tooth presenting with both a crown fracture and luxation injury.[26] Pulpal necrosis risk is also higher in older children, luxation injuries with displacement of over 3mm, and significant mobility at initial presentation.[22]

 **Realignment**
Over 80% of intruded primary teeth spontaneously re-erupt within 12 months. [27], [28]. In most cases the new erupted position is considered normal, with a higher risk of ectopic re-eruption following complete intrusion compared to partial intrusion.[27] A small proportion of intruded primary teeth will present with complications, and therefore close follow up and review is paramount. IADT Guidelines therefore encourage clinicians to allow time for spontaneous repositioning for intrusion injuries. [18] Lateral luxation or extrusion injuries should also be given time for realignment, however where the new position of the tooth interferes with the occlusion, clinicians may consider extraction or repositioning and splinting.

**Damage to permanent dentition**

When sustaining a TDI in the primary dentition, there is a risk of damage to the unerupted permanent successor. Although most consequences to the permanent successor are reported as mild, the likelihood and severity of sequelae is dependent on many factors.[29] Age plays a significant role; the younger the child at the time of the injury, the more severe the sequelae with injuries sustained before two years old having the most influence.[29], [30] The type of TDI is also a risk factor, with avulsion, intrusion and extrusion injuries most associated with long-term sequelae, respectively. Outcomes include localised enamel defects, dilaceration, odontome formation, delay or change to eruption sequences.[31] [32]

Parental Advice

The IADT has published guidance regarding aftercare advice, and clinicians can refer to this when advising parents.[18] A written copy can be printed or signposted to online so parents can review the information after the appointment.
 **Analgesia**
Whether providing treatment or conservative management, the supporting adult should have access to and advised on appropriate analgesia.

**Oral Hygiene**
Clear and concise advice regarding hygiene following traumatic dental injury is important to reduce risk of infection and support healing. Patients and their supporting adults may be reluctant to clean the injured areas, and education on why and how to effectively clean is crucial. The use of Chlorohexidine mouthwash can be used in conjunction with a soft bristled toothbrush. Patients should also be reminded to continue to brush their remaining dentition.

**Antibiotics + Tetanus**
Antibiotics are not routinely required; however, this is at the clinician’s discretion, and may be considered in severe dental trauma with concomitant soft tissue injury. Thought should be given to tetanus risk and parents should follow-up with their medical practitioner if tetanus prophylaxis is required.

**Sequelae/ Consequences to future**Clinicians should signpost symptoms and signs that warrant an early return to clinic, such as unfavourable outcomes including pulpal necrosis or infection. Generally, detailed conversations regarding the potential consequences to the unerupted permanent dentition should be delayed to a follow up appointment, where supporting adults are in a better position to understand and retain the information.

Core Outcome Set

As the evidence base for dental trauma is continuously evolving, it is important that results and outcomes are recorded in a standardized way in the literature. The Core Outcome Set (COS) has been introduced internationally and specifies key outcomes to be measured and reported in clinical studies. [33] By presenting data in a consistent way, evidence can be more reliably compared, contrasted, and support our clinical practice more effectively. The COS is continuing to evolve for routine clinical practice.[34]

References

[1] S. Petti, U. Glendor, and L. Andersson, “World traumatic dental injury prevalence and incidence, a meta-analysis—One billion living people have had traumatic dental injuries,” *Dental Traumatology*, vol. 34, no. 2. Blackwell Munksgaard, pp. 71–86, Apr. 01, 2018. doi: 10.1111/edt.12389.

[2] Petersson EE, Andersson L, and Sórensen S, “Traumatic oral v non-oral injuries,” *Swed Dent J*, pp. 55–68, 1997.

[3] Andersson L, Petti S, Day P, Kenny K, Glendor U, and Andreasen JO, *Classification, epidemiology and etiology. Textbook and Colour atlas of traumatic injuries to the teeth* , 5th Edition. Copenhagen: Wiley Blackwell, 2019.

[4] U. Glendor, “Epidemiology of traumatic dental injuries - A 12 year review of the literature,” *Dental Traumatology*, vol. 24, no. 6, pp. 603–611, Dec. 2008, doi: 10.1111/j.1600-9657.2008.00696.x.

[5] O. K. Alonge, S. Narendran, and D. D. Williamson, “Prevalence of fractured incisai teeth among children in Harris County, Texas,” *Dental Traumatology*, vol. 17, no. 5, pp. 218–221, 2001, doi: 10.1034/j.1600-9657.2001.170507.x.

[6] E. B. Bastone, T. J. Freer, and J. R. McNamara, “Epidemiology of dental trauma: A review of the literature,” *Australian Dental Journal*, vol. 45, no. 1. Australian Dental Association Inc., pp. 2–9, 2000. doi: 10.1111/j.1834-7819.2000.tb00234.x.

[7] H. Rodd and F. Noble, “Psychosocial impacts relating to dental injuries in childhood: The bigger picture,” *Dentistry Journal*, vol. 7, no. 1. MDPI Multidisciplinary Digital Publishing Institute, Mar. 01, 2019. doi: 10.3390/dj7010023.

[8] M. I. De Souza Cortes, W. Marcenes, and A. Sheiham, “Impact of traumatic injuries to the permanent teeth on the oral health-related quality of life in 12-14-year-old children,” *Community Dent Oral Epidemiol*, vol. 30, no. 3, pp. 193–198, 2002, doi: 10.1034/j.1600-0528.2002.300305.x.

[9] K. S. Fakhruddin, H. P. Lawrence, D. J. Kenny, and D. Locker, “Impact of treated and untreated dental injuries on the quality of life of Ontario school children,” *Dental Traumatology*, vol. 24, no. 3, pp. 309–313, Jun. 2008, doi: 10.1111/j.1600-9657.2007.00547.x.

[10] M. L. Ramos-Jorge, V. L. Bosco, M. A. Peres, and A. C. G. P. Nunes, “The impact of treatment of dental trauma on the quality of life of adolescents - A case-control study in southern Brazil,” *Dental Traumatology*, vol. 23, no. 2, pp. 114–119, Apr. 2007, doi: 10.1111/j.1600-9657.2005.00409.x.

[11] K. Kenny, K. Vinall-Collier, G. Douglas, and P. F. Day, “‘He was distraught, I was distraught.’ Parents’ experiences of accessing emergency care following an avulsion injury to their child,” *Br Dent J*, vol. 227, no. 8, pp. 705–710, Oct. 2019, doi: 10.1038/s41415-019-0738-0.

[12] G. D. Taylor, O. Sumner, R. Holmes, and P. J. Waterhouse, “Primary Care Dentists’ management of permanent dentition traumatic dental injuries in 7- to 16-year-olds: A sequential mixed-methods study,” *Dental Traumatology*, vol. 37, no. 4, pp. 608–616, Aug. 2021, doi: 10.1111/edt.12676.

[13] C. Campbell, F. Soldani, A. Busuttil-Naudi, and B. Chadwick, “Update of Non-pharmacological behaviour management guideline Clinical Guidelines in Paediatric Dentistry,” 2011. [Online]. Available: http://www.rcseng.ac.uk/publications/docs/non\_pharmacological.html]

[14] D. B. Becker, H. L. Needleman, and M. Kotelchuck, “Child abuse and dentistry: orofacial trauma and its recognition by dentists,” *The Journal of the American Dental Association*, vol. 97, no. 1, pp. 24–28, Jul. 1978, doi: 10.14219/jada.archive.1978.0447.

[15] A. M. Cairns, J. Y. Q. Mok, and R. R. Welbury, “Injuries to the head, face, mouth and neck in physically abused children in a community setting,” *Int J Paediatr Dent*, vol. 15, no. 5, pp. 310–318, Sep. 2005, doi: 10.1111/j.1365-263X.2005.00661.x.

[16] J. Harris, Peter. Sidebotham, Richard. Welbury, Ranee. Townsend, and Great Britain. Committee of Postgraduate Dental Deans and Directors., *Child protection and the dental team : an introduction to safeguarding children in dental practice*. Committee of Postgraduate Dental Deans and Directors, 2009.

[17] T. R. C. Soares, A. C. U. Barbosa, S. N. S. de Oliveira, E. M. Oliveira, P. de A. Risso, and L. C. Maia, “Prevalence of soft tissue injuries in pediatric patients and its relationship with the quest for treatment,” *Dental Traumatology*, vol. 32, no. 1, pp. 48–51, Feb. 2016, doi: https://doi.org/10.1111/edt.12216.

[18] P. F. Day *et al.*, “International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 3. Injuries in the primary dentition,” *Dental Traumatology*, vol. 36, no. 4. Blackwell Munksgaard, pp. 343–359, Aug. 01, 2020. doi: 10.1111/edt.12576.

[19] Wright GZ, Alpern GD, and Leake JL, “A cross-validation of variables affecting children’s cooperative behaviour,” *J Can Dent Assoc (Tor)*, pp. 268–73, 1973.

[20] McTigue DJ, “Behaviour management of children,” *Dent Clin North Am*, pp. 81–93, 1984.

[21] P. F. Kramer and C. Feldens, *Traumatismo na Dentição Decidua* , 2nd ed. Santos, 2013.

[22] M. K. Borum and J. O. Andreasen, “Sequelae of trauma to primary maxillary incisors. I. Complications in the primary dentition,” *Endod Dent Traumatol*, vol. 14, no. 1, pp. 31–44, 1998, doi: 10.1111/j.1600-9657.1998.tb00806.x.

[23] G. Holan, “Development of clinical and radiographic signs associated with dark discolored primary incisors following traumatic injuries: a prospective controlled study,” *Dental Traumatology*, vol. 20, no. 5, pp. 276–287, Oct. 2004, doi: https://doi.org/10.1111/j.1600-9657.2004.00285.x.

[24] P. S. McCabe and P. M. H. Dummer, “Pulp canal obliteration: An endodontic diagnosis and treatment challenge,” *International Endodontic Journal*, vol. 45, no. 2. pp. 177–197, Feb. 2012. doi: 10.1111/j.1365-2591.2011.01963.x.

[25] Holan G and Fuks AB, “The diagnostic value of coronal dark gray discolouration in primary teeth following traumatic injuries,” *Paediatr Dent*, pp. 224–227, 1996.

[26] E. Lauridsen, P. Blanche, N. Yousaf, and J. O. Andreasen, “The risk of healing complications in primary teeth with extrusive or lateral luxation—A retrospective cohort study,” *Dental Traumatology*, vol. 33, no. 4, pp. 307–316, Aug. 2017, doi: https://doi.org/10.1111/edt.12340.

[27] Holan G and Ram D, “Sequelae and prognosis of intruded primary incisors: a retrospective study,” *Pediatr Dent*, pp. 242–247, 1999.

[28] Laurisden E, Blanche P, Yousaf N, and Andreasen JO, “The risk of healing complications in primary teeth with intrusive luxation: A retrospective cohort study,” *Dent Traumatol*, pp. 329–336, 2017.

[29] N. Tewari, V. P. Mathur, N. Singh, S. Singh, and R. K. Pandey, “Long-term effects of traumatic dental injuries of primary dentition on permanent successors: A retrospective study of 596 teeth,” *Dental Traumatology*, vol. 34, no. 2, pp. 129–134, Apr. 2018, doi: https://doi.org/10.1111/edt.12391.

[30] J. O. ANDREASEN and J. J. RAVN, “The effect of traumatic injuries to primary teeth on their permanent successors,” *Eur J Oral Sci*, vol. 79, no. 3, pp. 284–294, Jun. 1971, doi: https://doi.org/10.1111/j.1600-0722.1971.tb02014.x.

[31] M. T. Flores and J. E. Onetto, “How does orofacial trauma in children affect the developing dentition? Long-term treatment and associated complications,” *Dental Traumatology*, vol. 35, no. 6. Blackwell Munksgaard, pp. 312–323, Dec. 01, 2019. doi: 10.1111/edt.12496.

[32] M. M. Lenzi, A. K. Alexandria, D. M. T. P. Ferreira, and L. C. Maia, “Does trauma in the primary dentition cause sequelae in permanent successors? A systematic review,” *Dental Traumatology*, vol. 31, no. 2, pp. 79–88, Apr. 2015, doi: 10.1111/edt.12149.

[33] K. P. Kenny *et al.*, “What are the important outcomes in traumatic dental injuries? An international approach to the development of a core outcome set,” *Dental Traumatology*, vol. 34, no. 1, pp. 4–11, Feb. 2018, doi: 10.1111/edt.12367.

[34] K. P. Kenny, S. Pavitt, R. Foy, and P. F. Day, “Improving data quality from routine clinical appointments—Development of a minimum dataset for traumatic dental injuries in children and adolescents,” *Dental Traumatology*, 2023, doi: 10.1111/edt.12876.