Dento-Alveolar Trauma in the Primary Dentition

6

Laura Gartshore

Learning Outcomes
By the end of this chapter, readers will:

- Be able to identify injuries that may require medical investigation and management
- Be confident to identify safeguarding concerns
- Able to diagnose dental injuries and providing acute care for the distressed child and family
- Understand and communicate to children and their families the impact of injury to the primary dentition on the unerupted, developing permanent dentition
- Refer to specialist paediatric dentistry services when indicated.

6.1 Incidence and Presentation

One in three children experience trauma to the primary dentition.

Traumatic injuries to the primary dentition often occur between the ages of 2 and 6 years, with a peak at 2–3 years, when children are learning to walk, run, and become more independently active. The primary teeth most commonly affected by traumatic dental injuries are the upper primary central incisors. This is due to the relatively prominent position in the arch of these teeth, and the tendency of injuries to occur when young children fall and are playing, rather than their being commonly involved in assaults or sporting events.

L. Gartshore (✉)
School of Dentistry, University of Liverpool, Liverpool, UK
e-mail: lauramg@liverpool.ac.uk

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A majority of injuries to the primary dentition will initially present to primary care dental services, rather than to acute and specialist services. Most of the time, injury involves the periodontal tissues rather than crown fracture.

Young children, and their families, may be distressed following a traumatic injury to the primary dentition. Bleeding from the injured tissues may continue whilst a child is upset and resistant to the application of haemostatic pressure to the area. It is important to take a calm and reassuring approach to the situation, during which you might also take the opportunity to assess the child's likely cooperation for any investigations or interventions that are planned.

Whenever a child presents with a traumatic dental injury, clinicians should be open minded and aware that trauma is common, yet also aware of 'red flags' that may give rise to safeguarding concerns. In the case of trauma to the primary dentition, red flags might include delayed presentation for care, repeat trauma, inconsistent history on repeat questioning, the presence of other injuries, and a child who is hesitant to share their story. The responsibility of the clinician is to the child first. Further details about safeguarding will be discussed in Chap. 7.

Clinical Tip
Families of young children may require careful explanation as to the limited nature of treatment that is often necessary for injuries of the primary dentition. Prepare to carefully explain, for example, the reasons why avulsed primary teeth should not be replanted, why moisture control is necessary for restoration of fractured incisal edges, and why extraction of affected teeth may be indicated if injury results in pulp necrosis.

6.2 History and Examination

A thorough history is important for three key reasons following trauma to the primary dentition:

1. Excluding other injuries that may require medical investigation and management
2. Identifying safeguarding concerns
3. Diagnosing dental injuries and providing acute care for the distressed child and family

A thorough history, coupled with a systematic extraoral and intraoral examination and the results of special investigations, will help you to determine factors affecting prognosis, such as the mechanism of injury, the amount of time passed since the injury occurred, and the dental tissues affected, from which the management plan can be decided.

6.2.1 Taking a History: Questions to Ask

A thorough history can be determined by asking clear questions, which also allow you to identify or exclude any safeguarding concerns you may have about a child's safety and risk of repeat injury. Contemporaneous and complete records are important in cases of litigation, and for best practice. Clear documentation of questions and answers may be useful in the future for repeat questioning if safeguarding concerns later arise. Table 6.1 summarises the information that can be gained during a structured history taking process.

A note about tetanus: Tetanus is a life-threatening and preventable infection caused by a neurotoxin produced by Clostridium tetani, an anaerobic spore-forming bacterium, commonly found in soil. Tetanus is a notifiable disease in accordance with the amended Public Health (Control of Disease) Act 1984. A majority of reported cases in the UK occur in adults with a history of traumatic injury, usually a laceration or puncture wound. The incubation period is usually 3–21 days. Treatment at the time of exposure with tetanus immunoglobulin, wound debridement and antimicrobials improves prognosis. Since 1961, children born in the UK are eligible for vaccination. Tetanus vaccines are included in the NHS Childhood Vaccination Programme. Vaccine coverage has varied over time between 70 and 95%, with a number of people not completing the full vaccination schedule of five injections required for long-lasting protection. There is no herd immunity effect and individual vaccination is essential. Diagnosis is often clinical. Symptoms include trismus, painful muscle spasms, pyrexia, tachycardia, and sweating.

Table 6.1 History taking following a traumatic incident

Question	Clinical tips
What happened?	Make a note of the child and carer's own words used to describe the incident
When did it happen?	Identify delay in presentation and consider the impact on prognosis
Where did it happen?	Important for assessing risk of preventable tetanus infection and identifying other injuries
Who saw it happen?	Witnessed injuries may have a more accurate history. Be aware of repeat injures with the same witness
How did it happen?	Identify whether the history 'fits' the injury, or in other words, whether a given history is a reasonable explanation for the injury that you see. The mechanism and force of injury are important in determining the likely injury sustained and the prognosis
Were there any other injuries?	Identify any injuries that may require referral, medical investigation or review
Was there loss of consciousness, headache or vomiting?	Identify a head injury that may require urgent medical investigation
Is the child normally well?	Identify medical conditions, allergies or medications that may impact on immediate or longer-term management
Is there a history of previous dental injury?	Identify repeat incidences of trauma that may affect prognosis, management and safeguarding concerns
Is the child immunised against tetanus?	Determine the risk of preventable tetanus infection and any requirement for referral to medical colleagues

6.2.2 Extraoral Examination

A thorough and informed extraoral examination (Table 6.2) is key for recognising injuries that may require urgent and multidisciplinary care (Fig. 6.1).

Assessment of cranial nerves in children aged under 6 years requires a systematic approach and excellent communication skills (Table 6.3). Practice undertaking these tests on well children who have not experienced dental trauma, to prepare for acute, traumatic presentations. Any negative responses to a basic cranial nerve examination should be taken seriously, and a prompt referral for medical investigation is advised.

Table 6.2 Extraoral examination of a young child following a traumatic incident

Facial skeleton, mandible and skull	Visual examination followed by palpation to identify asymmetry, deformity, trismus and depression of bones. Subconjunctival haematoma, epistaxis, and description of 'pins and needles' or numbness, indicating paraesthesia or anaesthesia, should be excluded. Management of bony fractures in young children is often conservative, with the aim of avoiding damage to the developing dentition and disturbance of bony growth. Referral to a maxillofacial unit is indicated if any of the above findings are positive
Soft tissues	Identify lacerations, grazes, bruises and wounds that may require haemostatic management or be at risk of infection. In the case of tooth fracture, soft tissue wounds may contain dental hard tissues and should be radiographically investigated if this is suspected. Further details are provided in Chap. 11
Assessment of cranial nerves	A basic cranial nerve examination provides essential information to assess for head injury in a young child who may not complain of lack of sensation or motor function

Fig. 6.1 Extraoral injuries are often evident on examination. A structured approach to examination aids identification of the hard and soft tissues involved to ensure that no injury is missed

Table 6.3 Assessment of the cranial nerves in children

No.	Cranial nerve	Function	Basic test
I	Olfactory	Sense of smell	Behaviour response to smell of coffee, soap, orange peel. Test one nostril at a time
II	Optic	Vision	Pupil and head turning response to a moving small item such as a small toy or light. Snellen picture charts or picture books can be accessed online
III	Oculomotor	Eye movements	Diplopia indicates concern and can be identified most easily if a child is able to read and you have a name badge to hand. Eye movements can be tested by asking a child to follow the movement of a small object moved slowly in the shape of an 'H'
IV	Trochlear		
VI	Abducent		
V	Trigeminal	Sensory to face and eyes, motor to muscles of mastication	Test the sensation of forehead, cheeks and chin with a lightly applied cotton wool roll. Ask the child to clench their teeth and open their mouth wide to exclude deviations
VII	Facial	Motor to facial muscles, taste to anterior two-third of tongue	Ask the child to pull funny faces with you. First, raise the eyebrows, then squeeze eyes tightly shut and open them wide, smile a big cheesy grin, and puff up their cheeks by holding air in their mouth
VIII	Vestibulocochlear	Sound perception and balance	Identify sudden change and cessation in activity and movement. Check that very young children turn their heads towards sounds
XI	Accessory	Motor to trapezius and sternomastoid	Ask the child to turn their head and raise their shoulders against the resistance of your hand
XII	Hypoglossal	Motor to the tongue	Ask the child to protrude their tongue to exclude deviation to the affected side
The glossopharyngeal (IX) and vagus (X) nerves are not easily tested in young children, however, deviation of the uvula or loss of the gag reflex may be noted			

6.2.3 Intraoral Examination

A systematic intraoral examination of the hard and soft tissues is key for recognising injuries that support or dispute the history, and in ensuring that all injuries are addressed (Table 6.4). Knee to knee examination of a young child, as described in Chap. 1, may be employed.

6.2.4 Special Investigations

Intraoral radiographs are useful for diagosis, for identifying intruded teeth, and for determining the position of the apices of displaced primary teeth in relation to the permanent successors. Young children presenting following traumatic injury may be resistant to intraoral radiography, and extraoral radiographs may be indicated if bony tissue injuries are suspected. The initial baseline response to

Table 6.4 Intraoral examination of a young child following a traumatic incident

Bony tissues	Fractures of the alveolus are uncommon in young children unless the mechanism of injury was of high impact or the child is susceptible to bone fractures e.g. osteogenesis imperfecta
Soft tissues	Identify lacerations, fraenal tears (Fig. 6.2) and degloving injuries that may require haemostatic management or be at risk of infection
Dental tissues	Identify loss of tooth tissue, missing teeth and tooth fragments, exposure of dentine and pulp
Mobility	Identify mobile teeth that may present an airway compromise or give rise to difficulty eating
Occlusion	Disturbances to the occlusion may occur due to tooth displacement, bony fracture or dislocation of the temporomandibular joints
Displacement	Identify tooth displacements that may give rise to difficulty eating, disturbances to the occlusion, and impact on the developing permanent successors

Fig. 6.2 This toddler presented with a torn labial fraenum following a fall. The fraenum was managed conservatively and the child presented a second time 1 week later as the wound continued to ooze. Haematologcal investigations confirmed a factor IX deficiency

sensibility testing of traumatised teeth may be unreliable. Furthermore, sensibility testing in young children may be unreliable. Nevertheless, it is recommended that a baseline trauma chart is recorded at the initial presentation of dental trauma, and at subsequent follow-up visits, in order that response to trauma and any treatment delivered can be monitored and managed effectively. In the event that a young child is unable to tolerate intraoral radiographs, a clinical diagnosis of pulp necrosis may

be made for a persistently discoloured primary tooth that remains tender to percussion at follow-up, subsequent to healing of any injured periodontal ligament.

Clinical Tip
Record a baseline trauma chart including all traumatised teeth and at least one apparently uninjured tooth on either side of any traumatised teeth. In young or nervous children, it is sufficient to test tooth mobility with a gloved finger against the incisal edge. Percussion can be tested in the same way with gentle apical and lateral pressure applied.

6.2.5 Trauma Chart

Completion of a trauma chart is helpful to ensure that the complications of traumatic dental injuries are consistently and clearly documented. A trauma chart should be completed at baseline; at the time of first presentation, and then at subsequent review visits, enabling straightforward comparison over time. A trauma chart includes clinical signs of pulp necrosis, inflammatory resorption, and replacement resorption, and should include all teeth which the history and examination suggest may have been traumatised. It should also include the adjacent teeth, which may have also suffered injury, but which may not be contributing to frank clinical symptoms at the presentation stage. It is sensible to record tooth mobility, tenderness to percussion, colour, response to sensibility testing, and signs of soft tissue infection such as the presence of a sinus. In young children, sensibility testing may give rise to false positive or false negative responses. Transient discolouration of the crown of a tooth is noted on a frequent basis in young children. If discolouration of a traumatised primary tooth is noted in the absence of any other clinical or radiographic signs of loss of vitality, and in the absence of any concern about the developing permanent successor, careful review is indicated. A trauma chart is presented in Chap. 11.

Clinical Tip
When carrying out sensibility testing for young children with a cold test such as ethyl chloride, ask children to describe the response using child friendly language which they can interpret. For example, asking children to describe the sensation as not cold, a little bit cold, or very cold may be helpful, as although subjective, the responses are likely to be consistent for an individual and present a degree of reliability for each tooth of the same child. If a child complains of a very cold sensation, dispel concerns by discussing whether the cold sensation tastes like their favourite ice cream.

6.2.5.1 Medical Concerns

Completion of a full and comprehensive medical history can be complicated at the time of acute presentation of injury; however, it must not be forgotten or postponed.

It is possible that injury to the mouth, head and neck, may present the first haemostatic challenge that a young child experiences, and it is therefore important to ascertain whether there is any suggestion, or family history, of a coagulopathy. Likewise, childhood cancer is unfortunately relatively common, affecting at least 1000 newly diagnosed children per year in the UK, with a peak rate for children aged under 4 years. Cancer, and its treatment, renders children at risk of bleeding, infection and impaired healing following injury.

In cases of serious systemic disease, referral to a specialist paediatric dentistry service for management of traumatic dental injuries may be indicated, however, there is much that can be done at the time of initial presentation to alleviate symptoms and prevent deterioration of a child's condition. Inclusion of a comprehensive medical and injury history with a referral to specialist services will likely improve the patient's experience and aid shared care.

Asthma, and other respiratory disorders, are common chronic diseases of childhood and may impact longer-term management of traumatic injuries when sedation or general anaesthetic is required to facilitate behaviour management of young and anxious children who require surgical interventions. Further details are discussed in Chaps. 4 and 8.

6.3 Fracture Injuries

Uncomplicated crown fracture: Often presents as a sharp incisal edge with little or no ongoing complaint. May be restored with composite for a compliant child, or the sharp edges smoothed if preferred. Attrition of the incisal edges of primary teeth is often present, and dentine exposure rarely gives rise to sensitivity or functional difficulty.

Prognosis: Good. Likely to exfoliate as expected without intervention or follow-up required.

Complicated crown fracture: Often extends subgingivally and may extend to the root. Crown-root fractures are unrestorable and extraction is indicated (Fig. 6.3). Supragingival fractures may be restorable and it may be possible to preserve the pulp with pulp therapy. Success is often determined by a young child's ability to cooperate with extensive restorative care.

Prognosis: The prognosis of these teeth is usually poor and the majority will require extraction. However, if the fracture is supragingival and the child is cooperative then pulp therapy can be considered as outlined in Chap. 5.

Root fracture: If root fracture occurs towards the apical portion of the root and there is negligible displacement or mobility, the tooth may be retained and monitored. If root fracture occurs towards the coronal portion of the root, this injury commonly presents as an extruded, displaced or mobile crown. In this case, the mobile coronal fragment should be extracted and the retained root left in situ to

Fig. 6.3 Complicated crown fractures of the primary dentition which extend subgingivally often have a poor prognosis. Note the uncomplicated crown fracture on the adjacent incisor

avoid iatrogenic damage to the permanent successor. Retained root fragments will commonly resorb without the need for intervention. If a patient presents subsequent to loss of the coronal fragment, efforts should be made to locate the fragment radiographically in traumatised soft tissues such as lip lacerations. Inhalation of the fragment should also be considered.

Prognosis: Depends on the position of the fracture and presenting signs. Extraction of any extruded, displaced or mobile coronal fragment is often indicated.

Dento-alveolar fracture: Fracture of the labial plate may occur with trauma to the upper or lower primary incisors. Efforts should be made to preserve and reposition the fractured labial plate in place by splinting adjacent, uninjured teeth, even if the traumatised incisors are to be extracted.

Prognosis: If appropriately managed, preservation of the labial plate will aid healing and avoid complications of eruption of the permanent successors.

6.4 Luxation Injuries

In the primary dentition, luxation injuries are more common than fractures injuries. This is due partly to the most common mechanism of injury arising from falls when young children are active, and often less stable on their feet than older children, who are more likely to suffer fracture injuries. The size and structure of the hard tissues of the primary dentition also plays a part in this pattern of injury experience.

There are usually only two options for any luxated primary tooth: extraction or monitor. The decision as to which is most appropriate will be determined by the results of the history, examination and special investigations. Repositioning of primary teeth is contraindicated due to the likelihood of causing damage to the permanent successors, and the limited ability of young children to tolerate repositioning followed by placement, maintenance and removal of a splint.

Luxated teeth that do not interfere with the occlusion and that are not mobile or tender to percussion to interfere with function may often be monitored. In this case, it is important to warn children and their families that retained luxated teeth may

Fig. 6.4 Concussed primary teeth may not exhibit any obvious signs of injury. Careful examination of the labial soft tissues in this case revealed a minor grazing injury

discolour, develop pulp necrosis and require extraction at a later date. It is also important that clinicians ensure that the possible consequences of trauma to the developing permanent dentition are discussed and understood.

Concussion: No tooth displacement but may be tender to percussion (Fig. 6.4).

Prognosis: Good. Likely to exfoliate without intervention required. Pulp necrosis or pulp canal obliteration may occur in a minority of cases. Follow-up is recommended to confirm resolution of symptoms, pulp health, and eruption of the permanent successors.

Subluxation: No tooth displacement but may be tender to percussion and mobile. Bleeding around the gingivae may be noted if there is no delay in presentation. Periapical radiographic investigation would exclude a differential diagnosis of root fracture.

Prognosis: Good. Likely to exfoliate without intervention required. Pulp necrosis or pulp canal obliteration may occur in a minority of cases. Follow-up is recommended to confirm resolution of symptoms, pulp health, and eruption of the permanent successors.

Lateral luxation: Displacement of a tooth in a lateral (commonly labial or palatal) direction (Fig. 6.5a). The luxated tooth is often immobile. If the crown is displaced lingually or palatally it may interfere with occlusion. The direction of displacement of the apex of the primary tooth in relation to the permanent tooth is also important to record. If the crown is displaced labially, the apex is displaced lingually or palatally, towards the follicle of the developing permanent successor, where it may cause a developmental disturbance and longer-term complications.

Prognosis: Depends on the degree and direction of displacement. Luxation injuries which are excessively mobile or displaced resulting in fracture of the labial plate (Figure 6.5b), or which are interfering with the occlusion or function require extraction. Minor luxation injuries which are not mobile or disrupting function may be monitored. Pulp canal obliteration may occur in up to 50% of cases. Pulp necrosis may occur in approximately 25% of cases. Follow-up is recommended to confirm resolution of symptoms, pulp health, and eruption of the permanent successors. It is important that the patient and their family are informed about the possibility of disruption of normal development or eruption of the permanent successor.

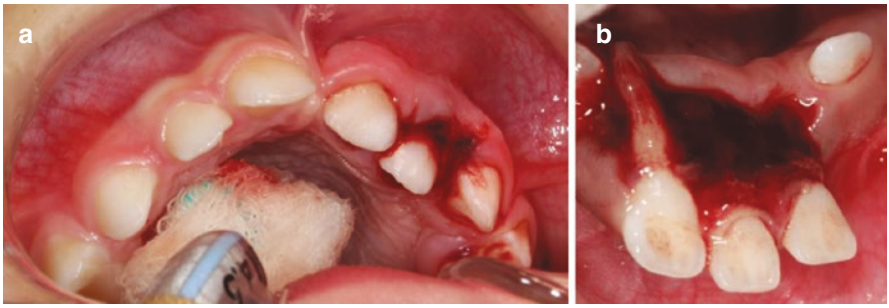


Fig. 6.5 (**a**) Luxation injuries vary in severity and direction, (**b**) Luxation injuries may present with alveolar fracture or soft tissue injury but the affected teeth may still be immobile

Extrusive luxation: Displacement of a tooth in a coronal, extruded, direction. This injury may cause disturbance to the occlusion and function. An extruded tooth may be mobile at presentation due to loss of periodontal support, or at follow-up due to its experiencing increased occlusal forces. Exposure of the root and cementum may cause symptoms of sensitivity. Pulp health is frequently compromised.

Prognosis: Depends on the degree of extrusion and mobility. In more severe cases of extrusion of a primary tooth (>3mm) , extraction is indicated. If a mildly extruded, asymptomatic tooth is not excessively mobile and not interfering with the occlusion it may be monitored. If left in situ, the extruded tooth may undergo spontaneous repositioning. Pulp canal obliteration may occur in up to 75% of cases. Pulp necrosis may occur in approximately 25% of cases. Follow-up is recommended to confirm resolution of symptoms, pulp health, and eruption of the permanent successors.

Intrusive luxation: Displacement of a tooth in an apical, intruded, direction is the most common luxation injury of the primary dentition. This injury is likely to cause a developmental disturbance of the permanent successor and longer-term complications (Fig. 6.6). Traditionally, it was recommended that immediate extraction of an intruded primary tooth might help to minimise damage to the underlying, developing, permanent successor. Guidelines have recently evolved to recommend monitoring of intruded primary teeth as they are likely to spontaneously re-erupt, and because it is not known to what degree extraction of an intruded primary tooth may inflict further damage on the developing permanent tooth. Nevertheless, it is important to note that a lack of evidence for extraction does not equate to a lack of evidence of complication following intrusion injuries. It is important that children and their families are informed about the possibility of disruption of normal development or eruption of the permanent successor as a result of intrusion occuring, as discussed in the next section. Radiographic investigation may be useful in determining the extent of vertical displacement and relationship of the primary tooth apex with the developing permanent tooth.

Prognosis: It is currently advised that intruded primary teeth should be monitored and allowed to spontaneously reposition. This usually completes within 6 to 12 months. Pulp necrosis and ankylosis may occur. Follow-up is recommended to

Fig. 6.6 (**a**) Intrusion of a maxillary primary incisor is a common consequence of a fall for a toddler. (**b**) Intrusion of single rooted anterior teeth, such as the primary canine in this case, is more commonly encountered than intrusion of posterior teeth. (**c**) Completion of a trauma chart aided recognition of intrusion of the primary lateral incisor in this case where there has also been intrusion of the partially erupted, right sided permanent central incisor

confirm resolution of symptoms, pulp health and eruption of the permanent successors.

Avulsion: Primary teeth with extensive physiological root resorption that are due to exfoliate are easily lost. Injuries sustained when children fall against a hard surface, such as a coffee table, may also result in avulsion of primary teeth with intact roots (Fig. 6.7). Severely intruded teeth, or crown-root fractures in which the coronal portion is lost prior to presentation, may be misdiagnosed as avulsion injuries. A careful clinical examination, coupled with radiographic investigation, is recommended to confirm tooth loss. It is wise to ask any witnesses to the injury whether a suspected avulsed tooth has been found. This will confirm the diagnosis and dismiss concerns that an avulsed tooth might have been inhaled.

Prognosis: Avulsed primary teeth should not be replanted. Follow-up is recommended to confirm normal development and eruption of the permanent successors.

A note about accidental inhalation of a tooth: Foreign body aspiration in children is relatively common. Symptoms include choking, cough, wheeze, or stridor, with decreased or abnormal breath sounds. Delay in diagnosis may occur if clinicians and parents are unaware of the risks and the symptoms are attributed to

Fig. 6.7 In an avulsion injury a tooth is completely displaced from the socket

common respiratory tract infections. Prompt referral to a children's hospital for bronchoscopy is appropriate if you suspect that a child may have inhaled a tooth, or tooth fragment. Radiological investigations, such as chest x-ray, may be helpful to confirm aspiration, but they are not routinely used in children to exclude it.

Clinical Tip
A soft diet and optimal oral health are advised following a traumatic dental injury to aid healing and to avoid further stress to the healing soft tissues and periodontal ligament. Assisted toothbrushing with a soft toothbrush should be encouraged. An alcohol-free chlorhexidine gluconate mouthwash applied twice daily and topically, for example with a cotton gauze, can be helpful.

6.5 Prognosis

6.5.1 Complications of Traumatic Injury to the Primary Teeth

Traumatic injuries of the primary dentition are subject to complications of pulp necrosis, inflammatory resorption and replacement resorption (Fig. 6.8). Furthermore, injuries of the primary incisors may cause developmental disturbance of the permanent successors (Table 6.5). Developmental disturbances to the permanent teeth may occur at the time of injury to the primary teeth, or as a result of delayed presentation or inappropriate management. Such disturbances occur as a result of the position of the permanent tooth bud in relation to the primary tooth root. Consequently, traumatic developmental disturbance of the permanent incisors is most commonly a complication of luxation and avulsion injuries of the primary incisors.

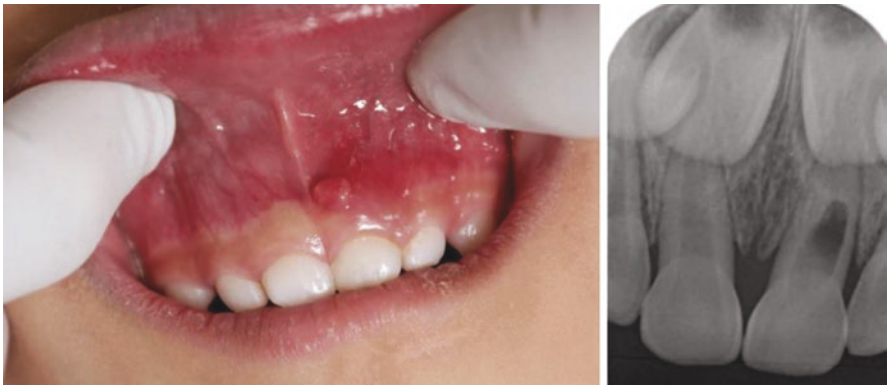


Fig. 6.8 Internal inflammatory resorption may be a consequence of pulp necrosis. In this case, clinical and radiographic examination confirmed the diagnosis

Table 6.5 Risk of complications for the developing permanent successors following traumatic injury of the primary incisors

Injury	Risk of complications for the permanent successor
Concussion	Low
Subluxation	Low
Lateral luxation	Depends on direction of luxation—If the crown of the tooth is displaced labially the apex is displaced palatally, towards the developing successor
Extrusive luxation	Moderate
Intrusive luxation	High
Avulsion	High

At least 50% of traumatic injuries to the primary teeth may result in complications of developmental disturbance for the permanent successors. This is somewhat unsurprising as a result of the close relationship between the apices of the primary teeth and the follicles of the developing teeth.

Complications of primary tooth trauma affecting the permanent successors can be broadly categorised as the three Ds (Table 6.6):

- *Disturbance* of hard tissue mineralisation of the developing permanent successor
- *Displacement* of the follicle of the developing permanent successor
- *Dilaceration* of the developing permanent successor (Fig. 6.9)

Clinical Tip

Suspect delayed eruption if a period of time greater than 6 months passes following eruption of the contralateral permanent tooth *or* if eruption of permanent teeth occurs out of sequence, for example if the lateral incisor erupts prior to the central incisor. Eruption out of sequence is a particularly useful sign of delayed eruption when both upper permanent central incisors are affected and there is no contralateral tooth for comparison.

Table 6.6 Developmental disturbances of the permanent teeth following traumatic injury to the primary teeth

Complication	Suspicious features	Management
Disturbance of hard tissue mineralisation of the developing permanent successor	Hard tissue defect visible following eruption. Usually recognisable as enamel hypomineralisation or hypoplasia. Usually affecting the labial surface due to the previous relationship with the primary tooth apex. Arrest of root development is a possible, yet less frequent complication	If a child voices aesthetic concerns: Most defects can be managed conservatively and restoratively as indicated
Displacement of the follicle of the developing permanent successor (Fig. 6.10)	Delayed eruption	Multidisciplinary specialist care may be required
Dilaceration of the developing permanent successor	Delayed eruption	Multidisciplinary specialist care may be required

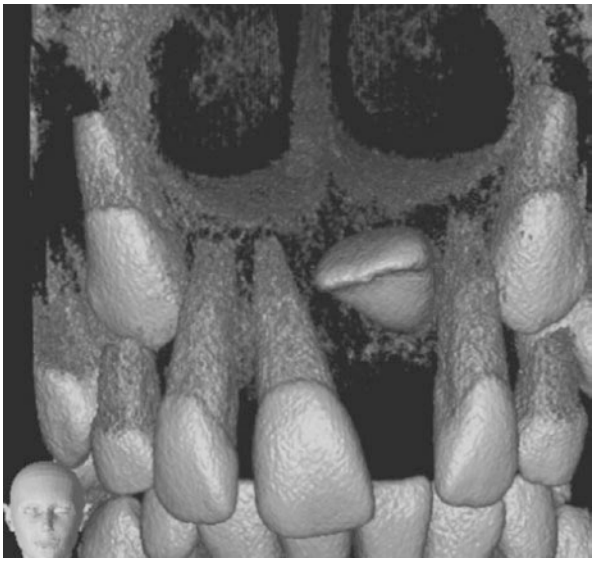


Fig. 6.9 Dilaceration of the maxillary permanent left central incisor in this case occurred following lateral luxation of the primary predecessor

6.5.2 Prevention and Limitation of Complications Affecting Permanent Successors

It is difficult to prevent traumatic dental injuries to the primary dentition, however it is possible to limit the impact, of complications arising from these injuries to the permanent successors. Appropriate management of pulp necrosis and periodontal healing prevents further injury to the close proximity, developing dentition. Likewise, timely review of the developing permanent teeth is necessary to ensure that any complications that have occured are diagnosed without delay in order that investigation and intervention can be planned as necessary.

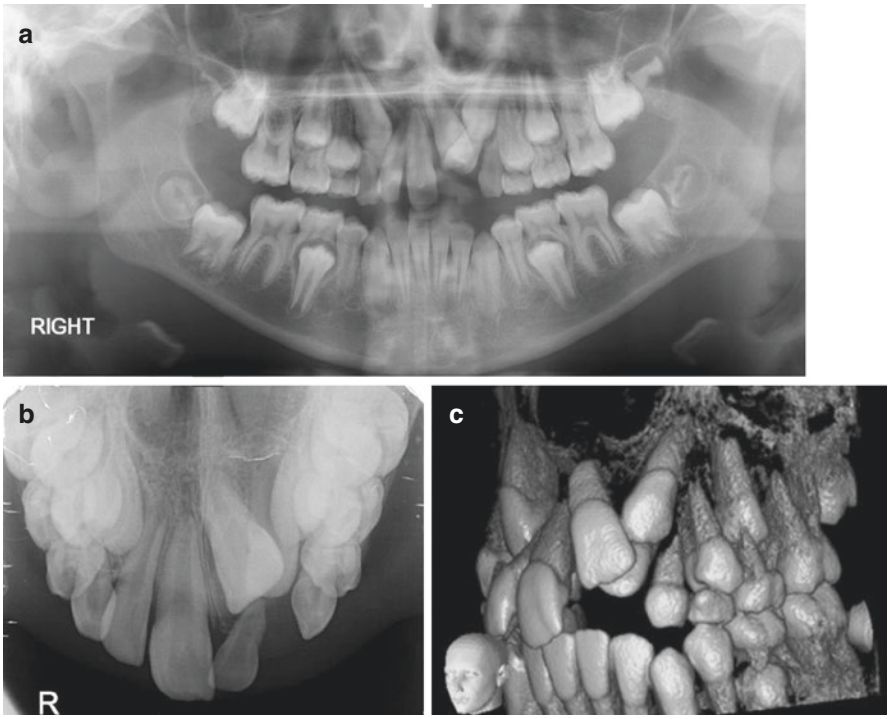


Fig. 6.10 (**a**) Displacement of the developing maxillary permanent left central incisor may present as delayed eruption of multiple teeth if they become impacted. (**b**) A standard maxillary occlusal radiograph confirmed the absence of supernumerary teeth which should be considered in the differential diagnosis of delayed eruption of a permanent incisor. (**c**) Cone beam CT scan may aid surgical planning for the exposure of impacted teeth

Intraoral radiographs are useful for determining the position of the apices of displaced primary teeth in relation to the permanent successors. A displaced primary tooth that appears *shortened* in length on an intraoral radiograph, indicates that the primary tooth apex has been displaced *away* from the developing permanent tooth. On the other hand, an apparently *elongated* appearance of the displaced primary tooth, indicates that the primary tooth apex has been displaced *towards* the developing permanent tooth.

Intraoral radiographs are also useful for recognising displacement of the follicle of the developing permanent successor. The developing teeth should usually appear symmetrical. Lack of symmetry indicates displacement of the affected developing tooth.

If pulp necrosis of the traumatised primary tooth presents with signs or symptoms of periapical periodontitis, the primary tooth should be extracted without delay to avoid, or reduce the likelihood of, future complications.

Clinical Tip
Remember, when assessing intraoral radiographs of luxated primary teeth to assess the relationship of the primary tooth apex with the permanent successor:
Primary tooth appears *shorter* = *safer*
Primary tooth appears *elongated* = *endangered*

Multidisciplinary specialist care may be required for the management of complications affecting the permanent dentition.

6.5.3 Interesting Cases

The following cases are included to illustrate the presentation, management and complications of traumatic dental injuries to the primary dentition.

6.5.3.1 Case 1

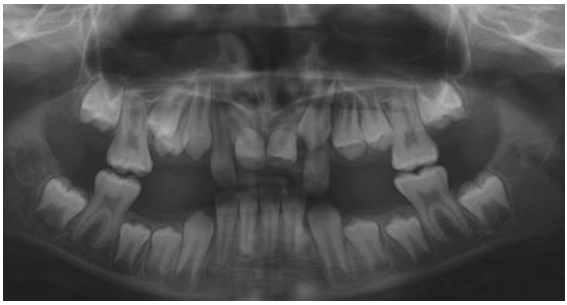
Six-year-old Jake was playing at school when he fell and suffered a knock to his chin. The fall was witnessed by his teacher. He presented later the same day complaining of pain on biting. Extraoral examination revealed a bruise to the soft tissues underneath the chin. Intraoral examination revealed no injury to the anterior teeth, however there was a fracture of the crown of the mandibular right second primary molar. The fracture extended subgingivally. A bitewing radiograph confirmed the presence of a complicated crown fracture. Options for management included pulp therapy and placement of an extra-coronal restoration, however, the prognosis was considered to be poor due to the extent of the fracture and Jake's lack of dental experience. The tooth was extracted with local anaesthetic aided by inhalation sedation. Following an excellent response to preventive care, a fixed band and loop space maintainer was provided.

6.5.3.2 Case 2

Four-year-old Thomas was bouncing on his bed when he missed his footing and fell to the floor. He presented 1 h following injury with a slow, persistent bleed from a wound above his chin. He complained that his front teeth were a little wobbly. Extraoral examination revealed a soft tissue laceration on the skin below his lower lip. Intraoral examination with eversion of the lower lip revealed that the laceration was a through and through injury, likely resulting from Thomas biting completely through the soft tissues during his fall. The maxillary left primary central and lateral incisors were tender to percussion and mobile, however they had not moved in position and were not interfering with occlusion. Gingival haemorrhage was noted. A diagnosis of subluxation injury was made. The lip was cleansed and sutured with general anaesthetic. The injured teeth maintained pulpal and periodontal health and there were no longer-term complications.

6.5.3.3 Case 3

Nine-year-old Lincoln presented to his dentist complaining of missing front teeth. Lincoln had a history of dental trauma at age 3 when severe intrusive luxation of the maxillary primary central incisors occurred. The intruded teeth remained in situ for 3 months until they were extracted. Clinical examination revealed that the incisal edges of the unerupted incisors were palpable in the labial sulcus. Radiographic examination confirmed that the maxillary incisors were dilacerated.



Following multidisciplinary planning, Lincoln underwent open surgical exposure of the dilacerated permanent central incisors, carried out by a specialist in paediatric dentistry. Spontaneous repositioning of the exposed teeth occurred over a 6 month period.

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Further Reading

British Society of Paediatric Dentistry and Dental Trauma UK Guidelines: primary dentition acute management of traumatic injuries and follow-up care during the COVID-19 pandemic.

Day P, Djemal S, Albadri S. British Society of Paediatric Dentistry and Dental Trauma UK guidelines: primary dentition acute management of traumatic injuries and follow-up care during the COVID-19 pandemic. 2020. https://www.bspd.co.uk/Portals/0/Guidelines/Primary%20Dentition%20Trauma%20Guideline%20COVID-19_NEW%20ns.pdf.

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International Association of Dental Traumatology Guidelines for the management of traumatic dental injuries: 3. Injuries in the primary dentition 2020.