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Article:
Day, P orcid.org/0000-0001-9711-9638, Flores, MT, O'Connell, A et al. (14 more authors) (2020) International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 3. Injuries in the Primary Dentition. Dental Traumatology. ISSN 1600-4469

https://doi.org/10.1111/edt.12576

International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 3. Injuries in the Primary Dentition.

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This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/edt.12576

Keywords: Trauma, avulsion, tooth fracture, prevention, luxation

Short title: IADT traumatic dental injuries guidelines: Injuries in the Primary Dentition

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Acknowledgement and Competing Interest

The authors declare there are no competing interest for the above manuscript. No funding was received for the presented work.

Images Courtesy of the Dental Trauma Guide

Ethical Statement – No ethic approval was required for this paper.

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Article type : Comprehensive Review

International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 3. Injuries in the Primary Dentition.

Abstract:

Traumatic injuries to the primary dentition present special problems that often require far different management when compared to that used for the permanent dentition. The International Association of Dental Traumatology (IADT) has developed these Guidelines as a consensus statement after a comprehensive review of the dental literature and working group discussions. Experienced researchers and clinicians from various specialties and the general dentistry community were included in the working group. In cases where the published data did not appear conclusive, recommendations were based on the consensus opinions or majority decisions of the working group. They were then reviewed and approved by the members of the IADT Board of Directors.

The primary goal of these Guidelines is to provide clinicians with an approach for the immediate or urgent care of primary teeth injuries based on the best evidence provided by the literature and expert opinions. The IADT cannot, and does not, guarantee favorable outcomes from strict adherence to the Guidelines, However, the IADT believes their application can maximize the probability of favorable outcomes.

Introduction

Injuries to children are a major threat to their health and they are generally a neglected public health problem.[1] For children, aged 0-6 years, oral injuries account for 18% of all physical injuries and the mouth is the second most common area of the body to be injured.[2] A recent meta-analysis on traumatic dental injuries (TDIs) reveals a world prevalence of 22.7% affecting the primary teeth.[3] Repeated TDIs are also frequently seen in children.[4]

Unintentional falls, collisions and leisure activities are the most common reasons for TDIs, especially as children learn to crawl, walk, run and embrace their physical environment.[5] They most commonly occur between 2 to 6 years of age[4-7] with injuries to periodontal tissues occurring most frequently.[6, 8] Children with these injuries present to many health care settings, including general dental practitioners, emergency medical services, pharmacists, community dental clinics and specialist dental services. Consequently, each service provider needs to have the appropriate knowledge, skills and training in how to care for children with TDIs to their primary dentition.

The primary teeth Guidelines contain recommendations for the diagnosis and management of traumatic injuries to the primary dentition, assuming the child is medically healthy with a sound and caries-free primary dentition. Management strategies may change where multiple teeth are injured. Many articles have contributed to the content of these Guidelines and the treatment Table and these articles are not mentioned elsewhere in this introductory text.[9-15]

Initial presentation and minimising anxiety to the child and parent:

Management of TDIs in children is distressing for both the child and the parents. It can also be challenging for the dental team. A TDI in the primary dentition often may be the reason for the child's first visit to the dentist. Minimising anxiety for the child and parents, or other caregiver, during the initial visit is essential. At this young age, the child may resist co-operating for an extensive examination, radiographs and treatment. Knee to knee examination can be helpful in examining a young child. Information about how to undertake an examination of a child with a TDI involving their primary dentition can be found in current textbooks[16-18] or can be viewed in the following video

(https://tinyurl.com/kneetokneeexamination). Wherever possible the acute and follow-up dental care should be provided by a child-oriented team that has experience and expertise in the management of paediatric oral injuries. These teams are best placed to access specialist diagnostic and treatment services, including sedation and general anaesthesia, and pain management for the prevention or minimization of suffering.[19]

A structured approach:

It is essential that clinicians adopt a structured approach to managing traumatic dental injuries. This includes history taking, undertaking the clinical examination, collecting test results and how this information is recorded. The literature shows that the use of a structured history at the initial consultation leads to a significant improvement in the quality of the trauma records involving the permanent dentition[5, 20]. There are a variety of structured histories available in current textbooks [6-18] or used at different specialist centres.[21, 22] Extra-oral and intra-oral photographs act as a permanent record of the injuries sustained and are strongly recommended.

Initial assessment:

Elicit a careful medical, social (including those who attend with the child), dental and accident history. Thoroughly examine the head and neck and intra-orally for both bony and soft tissue injuries.[17, 18] Be alert to concomitant injuries including head injury, facial fractures, missing tooth fragments or lacerations. Seek a medical examination if necessary.

Soft tissue injuries:

It is essential to identify, record and diagnose extra-oral and intra-oral soft tissue injuries.[18, 23] The lips, oral mucosa, attached and free gingivae, and the frenula should be checked for lacerations and hematomas. The lips should be examined for possible embedded tooth fragments. The presence of a soft tissue injury is strongly associated with the pursuit of immediate care. Such injuries are most commonly found in the 0-3 year age group.[24] Management of soft tissues, beyond just first aid, should be provided by a child-oriented team with experience in paediatric oral injuries. Parental engagement with the homecare for soft

tissue injuries to the gingivae is critical and will influence the outcomes for healing of the teeth and soft tissues. Parental homecare instructions for intra-oral soft tissue injuries are described later in these Guidelines.

Tests, crown discoloration and radiographs:

Extra-oral and intra-oral photographs are strongly recommended.

Pulp sensibility tests are unreliable in primary teeth and are therefore not recommended.

Tooth mobility, color, tenderness to manual pressure and the position or displacement should be recorded.

The color of injured and un-injured teeth should be recorded at each clinic visit.

Discoloration is a common complication following luxation injuries.[8, 25-27] This discoloration may fade and the tooth may regain its original shade over a period of weeks or months.[8, 28-30] Teeth with persistent dark discoloration may remain asymptomatic clinically and radiographically normal, or they may develop apical periodontitis (with or without symptoms).[31, 32] Root canal treatment is not indicated for discolored teeth unless there are clinical or radiographic signs of infection of the root canal system.[18, 33]

Every effort has been made in these Guidelines to reduce the number of radiographs needed for accurate diagnosis, thus minimising a child's exposure to radiation. For essential radiographs, radiation protection includes the use of a thyroid collar where the thyroid is in the path of the primary x-ray beam[34] and a lead apron for when parents are holding the child. Radiation-associated risks for children are a concern as they are substantially more susceptible to the effects of radiation exposure for the development of most cancers than adults. This is due to their longer life expectancy and the acute radiosensitivity of some developing organs and tissues.[35, 36] Therefore, clinicians should question each radiograph they take and cognitively ask if additional radiographs will positively affect the diagnosis or treatment provided for the child. Clinicians must work within the ALARA (As Low As Reasonably Achievable) principles to minimize the radiation dose. The use of CBCT following TDI in young children is rarely indicated.[37]

Diagnosis:

A careful and systematic approach to diagnosis is essential. Clinicians should identify all injuries to each tooth including both hard tissues injuries (e.g. fractures) and periodontal injuries (e.g. luxations). When concomitant injuries occur in the primary dentition following extrusion and lateral luxation injuries, they have a detrimental impact on pulp survival.[27] The accompanying Table and the trauma pathfinder diagram (www.dentaltraumaguide.org) help clinicians identify all possible injuries for each injured tooth.

Intentional (non-accidental) injuries:

Dental and facial trauma can occur in cases of intentional injuries. Clinicians should check if the history of the accident and the injuries sustained are consistent or match. In situations where there is suspicion of abuse, prompt referral for a full physical examination and investigation of the incident should be arranged. Referral should follow local protocols, which is beyond the scope of these Guidelines.

Impact of orofacial and primary tooth trauma on the permanent dentition:

There is a close spatial relationship between the apex of the primary tooth root and the underlying permanent tooth germ. Tooth malformation, impacted teeth, and eruption disturbances in the developing permanent dentition are some of the consequences that can occur following injuries to primary teeth and the alveolar bone.[38-44] Intrusion and avulsion injuries are most commonly associated with the development of anomalies in the permanent dentition.[38-43]

For intrusive and lateral luxation injuries, previous Guidelines have recommended the immediate extraction of the traumatised primary tooth if the direction of displacement of the root is toward the permanent tooth germ. This action is no longer advised due to 1) evidence of spontaneous re-eruption for intruded primary teeth,[8, 10, 26, 44-46] 2) the concern that further damage may be inflicted on the tooth germ during extraction, and 3) the lack of evidence that immediate extraction will minimise further damage to the permanent tooth germ.

It is very important to document that parents have been informed about possible complications to the development of the permanent teeth, especially following intrusion, avulsion, and alveolar fractures.

Management strategy for injuries to the primary dentition:

In general, there is limited evidence to support many of the treatment options in the primary dentition. Observation is often the most appropriate option in the emergency situation unless there is risk of aspiration, ingestion or interference with the occlusion. This conservative approach may reduce additional suffering for the child[18] and the risk of further damage to the permanent dentition.[18, 47 48]

A summary of the management of TDIs in the primary dentition includes the following:

- A child's maturity and ability to cope with the emergency situation, the time for shedding of the injured tooth, and the occlusion are all important factors that influence treatment.
- It is critical that parents are given appropriate advice on how best to manage the acute symptoms to avoid further distress.[49, 50] Luxation injuries, such as intrusion and lateral luxation, and root fractures may cause severe pain. The use of analgesics such as ibuprofen and/or acetaminophen (paracetamol) is recommended when pain is anticipated.
- Minimising dental anxiety is essential. Provision of dental treatment depends on the child's maturity and ability to cope. Various behavioural approaches are available[51-53] and have been shown to be effective for managing acute procedures in an emergency situation..[54, 55] TDIs and their treatment have the potential to lead to both post-traumatic stress disorder and dental anxiety. The development of these conditions in young children is a complex issue[56 57] with little research specifically examining either condition following TDIs in the primary dentition. However, evidence from the wider dental literature suggests that the multi-factorial nature of dental anxiety, its fluctuating nature and the role of dental extractions are exacerbating factors.[58-60] Where possible, avoidance of dental extractions. especially at the acute or initial visit is a reasonable strategy.
- Where appropriate and the child's cooperation allows, options that maintain the child's primary dentition should be the priority,[61] Discussions with parents about the different treatment options should include the potential for further treatment visits and consideration for how best to minimise the impact of the injury on the developing permanent dentition,[62]

- For crown and crown-root fractures involving the pulp, root fractures and luxation injuries, rapid referral within several days to a child-orientated team that has experience and expertise in the management of dental injuries in children is essential.
- Splinting is used for alveolar bone fractures[41, 63] and occasionally may be needed in cases of root fractures[64] and lateral luxations.[64]

Avulsed primary teeth:

An avulsed primary tooth should not be replanted. Reasons include a significant treatment burden (including replantation, splint placement and removal, root canal treatment) for a young child as well as the potential of causing further damage to the permanent tooth or to its eruption.[41, 42, 65, 66] However, the most important reason is to avoid a medical emergency resulting from aspiration of the tooth. Careful follow up is required to monitor the development and eruption of the permanent tooth. Refer to the accompanying Table for specific guidance.

Antibiotics and Tetanus:

There is no evidence for recommending the use systemic antibiotics in the management of luxation injuries in the primary dentition. However, antibiotic use does remain at the discretion of the clinician when TDIs are accompanied by soft tissue and other associated injuries or significant surgical intervention is required. Finally, the child´s medical status may warrant antibiotic coverage. The child's paediatrician should be contacted where questions arise in these situations.

A tetanus booster may be required if environmental contamination of the injury has occurred. If in doubt, refer to a medical practitioner within 48 hours.

Parental instructions for homecare:

Successful healing following an injury to the teeth and oral tissues depends on good oral hygiene. To optimize healing, parents or caregivers should be advised regarding care of the injured tooth/teeth and the prevention of further injury by supervising potentially hazardous

activities. Clean the affected area with a soft brush or cotton swab and use alcohol-free chlorhexidine gluconate 0.12% mouth rinse applied topically twice a day for one week to prevent accumulation of plaque and debris and to reduce the bacterial load. Care should be taken when eating not to further traumatize the injured teeth while encouraging a return to normal function as soon as possible.

Parents or caregivers should be advised about possible complications that may occur, such as swelling, increased mobility or a sinus tract. Children may not complain about pain, but infection may be present. Parents or caregivers should watch for signs of infection such as swelling of the gums. If present, they should take the child to a dentist for treatment. Examples of unfavorable outcomes are found in the Table for each injury.

Training, skills and experience for teams managing the follow-up care:

During the follow-up phase of treatment, dental teams caring for children with complex injuries to the primary dentition should have specialist training, experience and skills. These attributes enable the members of the team to respond appropriately to the medical, physical, emotional and developmental needs of children and their families. In addition, skills within the team should also encompass health promotion and access to specialist diagnostic and treatment services including sedation, general anaesthesia and overall pain management for the prevention or minimization of suffering.[19]

Prognosis:

Factors relating to the injury and subsequent treatment may influence pulp and periodontal outcomes and they should be carefully recorded. These prognostic factors need to be carefully collected at both the initial consultation and at follow-up visits. This is most likely achieved using the structured history form described previously. The dental literature and appropriate websites (e.g. www.dentaltraumaguide.org) provide clinicians with useful information on the probable pulp and periodontal prognosis. These sources of information can be invaluable when having conversations with the parents or caregivers and the child.

Core Outcome Set:

The International Association for Dental Traumatology (IADT) recently developed a core outcome set (COS) for traumatic dental injuries (TDIs) in children and adults.[68] This is one of the first COS developed in dentistry and is underpinned by a systematic review of the outcomes used in the trauma literature and follows a robust consensus methodology.[69] Some outcomes were identified as recurring throughout the different injury types. These outcomes were then identified as "generic" (i.e, relevant to all TDIs). Injury-specific outcomes were also determined as those outcomes related only to one or more individual TDIs. Additionally, the study established what, how, when and by whom these outcomes should be measured. Table 1 in the General Introduction section of the Guidelines shows the generic and injury specific outcomes to be recorded at the follow-up review appointments recommended for the different traumatic injuries. Further information for each outcome is described in the original article[68] with supplementary materials available on the *Dental Traumatology* journal's website.

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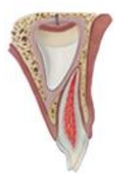
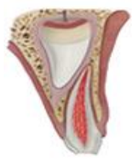
Treatment guidelines for fractures of primary teeth and alveolar bone

Table 1 – Treatment guidelines for enamel fractures in the primary dentition

				Favorable and Unfavorable Outcomes include some, but not necessarily all, of the following:	
ENAMEL FRACTURE	**Radiographic Recommendations**	**Treatment**	**Follow-up**	**Favorable Outcomes**	**Unfavorable Outcomes**
 **Clinical findings:** Fracture involves enamel only	• No radiographs recommended	• Smooth any sharp edges. • Parent / Patient Education: - Exercise care when eating not to further traumatize the injured tooth while encouraging a return to normal function as soon as possible. - Encourage gingival healing and prevent plaque accumulation by parents cleaning the affected area with a soft brush or cotton swab combined with an alcohol-free 0.1 to 0.2% chlorhexidine gluconate mouthrinse applied topically twice a	• No clinical or radiographic follow-up recommended	• Asymptomatic • Pulp healing with: - Normal color of the remaining crown - No signs of pulp necrosis and infection - Continued root development in immature teeth	• Symptomatic • Crown discoloration • Signs of pulp necrosis and infection - such as: - Sinus tract, gingival swelling, abscess or increased mobility - Persistent dark gray discoloration with one or more other signs of infection - Radiographic signs of pulp

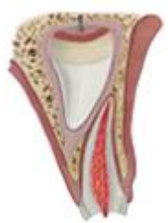
		day for one wee			necrosis and infection • No further root development of immature teeth

Table 2 – Treatment guidelines for enamel-dentin fractures (with no pulp exposure) in the primary dentition

				Favorable and Unfavorable Outcomes include some, but not necessarily all, of the following:	
ENAMEL-DENTIN FRACTURE (with no pulp exposure)	**Radiographic Recommendations**	**Treatment**	**Follow-up**	**Favorable Outcome**	**Unfavorable Outcome**
 **Clinical findings:** Fracture involves enamel and dentin. The pulp is not exposed • The location of missing tooth fragments should be explored during the trauma history and examination,	• Baseline radiograph optional • Take a radiograph of the soft tissues if the fractured fragment is suspected to be embedded in the lips, cheeks or tongue	• Cover all exposed dentin with glass ionomer or composite • Lost tooth structure can be restored using composite immediately or at a later appointment • Parent / Patient Education: - Exercise care when eating not to further traumatize the injured tooth while encouraging a return to normal function as soon as possible - Encourage gingival healing and prevent plaque accumulation by parents cleaning the affected	• Clinical examination after 6-8 weeks • Radiographic follow-up indicated only when clinical findings are suggestive of pathosis (e.g. signs of pulp necrosis and infection) • Parents should watch for any unfavorable outcomes. If seen, the child needs to return to the clinic as soon as possible. When unfavorable outcomes are identified,	• Asymptomatic • Pulp healing with: - Normal color of the remaining crown - No signs of pulp necrosis and infection - Continued root development in immature teeth	• Symptomatic • Crown discoloration • Signs of pulp necrosis and infection - such as: - Sinus tract, gingival swelling, abscess or increased mobility - Persistent dark gray discoloration with one or more other signs of root canal infection - Radiographic signs of pulp necrosis and

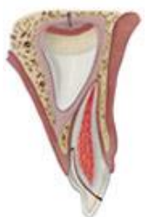
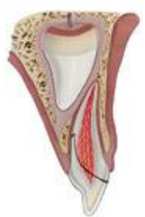
especially when the accident was not witnessed by an adult or there was a loss of consciousness • Note: while fragments are most often lost out of the mouth, there is a risk of that they can be embedded in the soft tissues, ingested or aspirated		area with a soft brush or cotton swab combined with an alcohol-free 0.1 to 0.2% chlorhexidine gluconate mouthrinse applied topically twice a day for one week	treatment is often required • The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines		infection • No further root development of immature teeth

Table 3 – Treatment guidelines for complicated crown fractures (with pulp exposure) in the primary dentition

				Favorable and Unfavorable outcomes include some, but not necessarily all, of the following:	
COMPLICATED CROWN FRACTURE (i.e. with exposed pulp)	**Radiographic Recommendations**	**Treatment**	**Follow-up**	**Favorable Outcome**	**Unfavorable Outcome**
 **Clinical findings:** Fracture involves enamel and dentin plus the pulp is exposed. • The location of missing tooth fragments should be explored during the trauma history and examination, especially when the accident was not	• A periapical radiograph (using a size 0 sensor/film and the paralleling technique) or an occlusal radiograph (with a size 2 sensor/film) should be taken at the time of initial presentation for diagnostic purposes and to establish a baseline • Take a radiograph of the soft tissues if the fractured fragment is suspected to be embedded in the lips, cheeks or tongue	• Preserve the pulp by partial pulpotomy. Local anaesthesia will be required. A non-setting calcium hydroxide paste should be applied over the pulp and cover this with a glass ionomer cement and then a composite resin. Cervical pulpotomy is indicated for teeth with large pulp exposures. The evidence for using other biomaterials such as non-staining calcium silicate based cements is emerging. Clinicians should focus on appropriate case selection rather than the material used • Treatment depends on the child´s maturity and ability to tolerate procedures. Therefore, discuss different treatment options (including pulpotomy) with the parents. Each option is invasive and has the potential to cause long-term dental anxiety. Treatment is best performed by a child-oriented team with	• Clinical examination after: - 1 week - 6-8 weeks - 1 year • Radiographic follow-up at 1 year following pulpotomy or root canal treatment. Other radiographs are only indicated where clinical findings are suggestive of pathosis (e.g. an unfavorable outcome) • Parents should watch for any unfavorable outcomes. If seen, the child needs to return to the clinic as soon as possible. Where unfavorable outcomes are	• Asymptomatic • Pulp healing with: - Normal color of the remaining crown - No signs of pulp necrosis and infection - Continued root development in immature teeth	• Symptomatic • Crown discoloration • Signs of pulp necrosis and infection - such as: - Sinus tract, gingival swelling, abscess or increased mobility - Persistent dark gray discoloration with one or more signs of root canal infection - Radiographic signs of pulp necrosis and infection • No further root development of immature teeth

witnessed by an adult or there was a loss of consciousness • Note: while fragments are most often lost out of the mouth, there is a risk of that they can be embedded in the soft tissues, ingested or aspirated		experience and expertise in the management of paediatric dental injuries. Often no treatment may be the most appropriate option in the emergency situation, but only when there is the potential for rapid referral (within several days) to the child-oriented team • Parent / Patient Education: - Exercise care when eating not to further traumatize the injured tooth while encouraging a return to normal function as soon as possible. - To encourage gingival healing and prevent plaque accumulation, parents should clean the affected area with a soft brush or cotton swab combined with an alcohol-free 0.1 to 0.2% chlorhexidine gluconate mouthrinse applied topically twice a day for one week	identified, treatment is often required. • The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines		

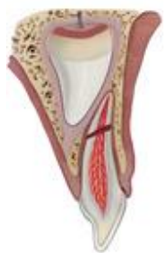
Table 4 – Treatment guidelines for crown-root fractures in the primary dentition

				Favorable and Unfavorable Outcomes include some, but not necessarily all, of the following:	
CROWN-ROOT FRACTURE	**Radiographic Recommendations**	**Treatment**	**Follow-Up**	**Favorable Outcome**	**Unfavorable Outcome**
  **Clinical findings:** Fracture involves enamel, dentin and root; the pulp may or may not be exposed (i.e.	• A periapical radiograph (using a size 0 sensor/film and the paralleling technique) or an occlusal radiograph (with a size 2 sensor/film) should be taken at the time of initial presentation for diagnostic purposes and to establish a baseline	• Often no treatment may be the most appropriate option in the emergency situation, but only when there is the potential for rapid referral (within several days) to a child-oriented team • If treatment is considered at the emergency appointment, local anaesthesia will be required • Remove the loose fragment and determine if the crown can be restored • **Option A:** - If restorable and no pulp exposed, cover the exposed dentine with glass ionomer - If restorable and the pulp is exposed, perform a pulpotomy (see crown fracture with exposed pulp) or root canal treatment, depending on the	• Where tooth is retained, clinical examination after: - 1 week - 6-8 weeks - 1 year • Radiographic follow-up after 1 year following pulpotomy or root canal treatment. Other radiographs only indicated where clinical findings are suggestive of pathosis (e.g. an unfavorable outcome) • Parents should watch for any unfavorable outcomes. If seen, the child needs to return to the clinic as soon as	• Asymptomatic • Pulp healing with: - Normal color of the remaining crown - No signs of pulp necrosis and infection - Continued root development in immature teeth	• Symptomatic • Crown discoloration • Signs of pulp necrosis and infection - such as: - Sinus tract, gingival swelling, abscess or increased mobility - Persistent dark gray discoloration with one or more signs of root canal infection - Radiographic signs of pulp necrosis and infection • No further root development of immature teeth

complicated or uncomplicated) • Additional findings may include loose, but still attached, fragments of tooth		stage of root development and the level of the fracture. • **Option B:** - If unrestorable, extract all loose fragments taking care not to damage the permanent successor tooth and leave any firm root fragment in situ, or extract the entire tooth • Treatment depends on the child´s maturity and ability to tolerate the procedure. Therefore, discuss treatment options (including extraction) with the parents. Each option is invasive and has the potential to cause long-term dental anxiety. Treatment is best performed by a child-oriented team with experience and expertise in the management of paediatric dental injuries • Parent / Patient Education: - Exercise care when eating not to further traumatize the injured tooth while encouraging a return to normal function as soon as possible - To encourage gingival healing and prevent plaque accumulation, parents should clean the affected area with a	possible. Where unfavorable outcomes are identified, treatment is often required. • The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines		

		soft brush or cotton swab combined with an alcohol-free 0.1 to 0.2% chlorhexidine gluconate mouthrinse applied topically twice a day for one week			

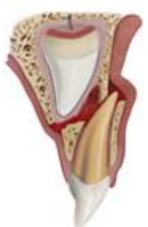
Table 5 – Treatment guidelines for root fractures in the primary dentition

				Favorable and Unfavorable Outcomes include some, but not necessarily all, of the following:	
ROOT FRACTURE	**Radiographic Recommendations and Findings**	**Treatment**	**Follow-Up**	**Favorable Outcome**	**Unfavorable Outcome**
 **Clinical findings:** Depends on the location of fracture • The coronal fragment may be mobile and may be displaced	• A periapical (size 0 sensor/film, paralleling technique) or occlusal radiograph (size 2 sensor/film) should be taken at the time of initial presentation for diagnostic purposes and to establish a baseline • The fracture is usually located mid-root or in the apical third	• If the coronal fragment is not displaced, no treatment is required • If the coronal fragment is displaced and is not excessively mobile, leave the coronal fragment to spontaneously reposition even if there is some occlusal interference • If the coronal fragment is displaced, excessively mobile and interfering with occlusion, two options (under local anaesthesia) are available, both of which require local anaesthesia • **Option A:** - Extract only the loose coronal fragment. The apical fragment should be left in place to be resorbed	• Where no displacement of coronal fragment, clinical examination after: - 1 week - 6-8 weeks - 1 year and where there are clinical concerns that an unfavorable outcome is likely. - Then continue clinical follow-up each year until eruption of permanent teeth • If coronal fragment has been repositioned and splinted, clinical examination after: - 1 week	• Asymptomatic • Pulp healing with: - Normal color of the crown or transient red/gray or yellow discoloration and pulp canal obliteration - No signs of pulp necrosis and infection - Continued root development in immature teeth • Realignment of the root-	• Symptomatic • Signs of pulp necrosis and infection - such as: - Siinus tract, gingival swelling, abscess or increased mobility - Persistent dark gray discoloration with one or more signs of root canal infection - Radiographic signs of pulp necrosis and infection - Radioraphic signs of infection-related

• Occlusal interference may be present		• **Option B:** - Gently reposition the loose coronal fragment. If the fragment is unstable in its new position, stablize the fragment with a flexible splint attached to the adjacent uninjured teeth. Leave the splint in place for 4 weeks • The treatment depends on the child´s maturity and ability to tolerate the procedure. Therefore, discuss treatment options with the parents. Each options is invasive and has the potential to cause long-term dental anxiety. Treatment is best performed by a child-oriented team with experience and expertise in the management of paediatric dental injuries. Often no treatment may be the most appropriate option in the emergency scenario, but only when there is the potential for rapid referral (within several days) to the child-oriented team • Parent / Patient Education: - Exercise care when eating not to further traumatize the injured tooth while encouraging a return to normal function as soon as possible - To encourage gingival healing and prevent plaque accumulation, parents should clean the affected area with a soft brush or cotton	- 4 weeks for splint removal - 8 weeks - 1 year • Where there are concerns that an unfavorable outcome is likely, then continue clinical follow-up each year until eruption of permanent teeth • If coronal fragment has been extracted, clinical examination after: - 1 year • Where there are concerns that an unfavorable outcome is likely, then continue clinical follow-up each year until eruption of permanent teeth • Radiographic follow-up only indicated where clinical findings are suggestive of pathosis (e.g. an unfavorable outcome) • Parents should be informed to watchfor any unfavorable outcomes and the need to return to the clinic as soon as possible. Where unfavorable outcomes are identified, treatment is often required.	fractured tooth • No mobility • Resorption of the apical fragment	(inflammatory) resorption • No further root development of immature teeth • No improvement in the position of the root-fractured tooth

		swab combined with an alcohol-free 0.1 – 0.2% chlorhexidine gluconate mouthrinse applied topically twice a day for one week	• The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines		

Table 6 – Treatment guidelines for alveolar fractures in the primary dentition

				Favorable and Unfavorable Outcomes include some, but not necessarily all, of the following:	
ALVEOLAR FRACTURE	**Radiographic Recommendations and Findings**	**Treatment**	**Follow-Up**	**Favorable Outcome**	**Unfavorable Outcome**
 **Clinical findings:** The fracture involves the alveolar bone (labial and palatal/lingual) and may extend to the adjacent bone • Mobility and	• A periapical (size 0 sensor/film, paralleling technique) or occlusal radiograph (size 2 sensor/film) should be taken at the time of initial presentation for diagnostic purposes and to establish a baseline • A lateral radiograph may give information about the relationship between the maxillary and mandibular dentitions and if the segment is displaced in a labial	• Reposition (under local anesthesia) any displaced segment which is mobile and/or causing occlusal interference • Stabilise with a flexible splint to the adjacent uninjured teeth for 4 weeks • Treatment should be performed by a child-oriented team with experience and expertise in the management of paediatric dental injuries • Parent / Patient Education: - Exercise care when eating not to further traumatize the injured teeth while encouraging a return to normal function as soon as	• Clinical examination after: - 1 week - 4 weeks for splint removal - 8 weeks - 1 year - Further follow-up at 6 years of age is indicated to monitor eruption of the permanent teeth • Radiographic follow up at 4 weeks and 1 year to assess impact on the primary tooth and the permanent tooth germs in the line of the alveolar fracture. This radiograph may indicate a more frequent follow-up regimen is needed. Other radiographs are	• Asymptomatic • Pulp healing with: - Normal crown color or transient red/gray or yellow discoloration and pulp canal obliteration - No signs of pulp necrosis and infection - Continued root development in immature teeth • Periodontal healing • Realignment of the alveolar	• Symptomatic • Signs of pulp necrosis and infection - such as: - Sinus tract, gingival swelling, abscess or increased mobility - Persistent dark gray discoloration plus one or more signs of root canal infection - Radiographic signs of pulp necrosis and infection including: infection related (inflammatory)

dislocation of the segment with several teeth moving together are common findings • Occlusal interference is usually present	direction • Fracture lines maybe located at any level, from the marginal bone to the root apex or beyond, and they may involve the primary teeth and/or their permanent successors. • Further imaging maybe needed to visualise the extent of the fracture(s), but only where it is likely to change the treatment provided.	possible. - To encourage gingival healing and prevent plaque accumulation, parents should clean the affected area with a soft brush or cotton swab combined with an alcohol-free 0.1- 0.2% chlorhexidine gluconate mouthrinse applied topically twice a day for one week	indicated only where clinical findings are suggestive of pathosis (e.g. an unfavorable outcome) • If the fracture line is located at the level of the primary root apex, an abscess can develop. A periapical radiolucency can be seen on the radiograph. • Parents should be informed to watch for any unfavorable outcomes and the need to return to the clinic as soon as possible. Where unfavorable outcomes are identified, treatment is often required. • The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines	segment with the original occlusion restored • No disturbance to the development and/or eruption of the permanent successor	resorption • No further root development in immature teeth • Limited or no improvement in the position of the displaced segment and the original occlusion is not re-established • Negative impact on the development and/or eruption of the permanent successor

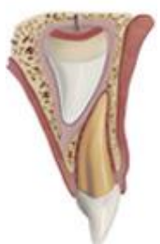
Treatment guidelines for luxation injuries of primary teeth

Table 7 – Treatment guidelines for concussion of primary teeth

				Favorable and Unfavorable Outcomes include some, but not necessarily all, of the following:	
CONCUSSION	**Radiographic Recommendations**	**Treatment**	**Follow-Up**	**Favorable Outcome**	**Unfavorable Outcome**

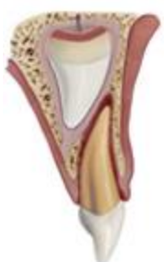
 **Clinical findings:** The tooth is tender to touch but it has not been displaced • It has normal mobility and no sulcular bleeding	• No baseline radiograph recommended	• No treatment is needed. • Observation. • Parent / Patient Education: - Exercise caare when eating not to further traumatize the injured tooth while encouraging a return to normal function as soon as possible. - To encourage gingival healing and prevent plaque accumulation, parents should clean the affected area with a soft brush or cotton swab combined with an alcohol-free 0.1 – 0,2% mouthrinse chlorhexidine gluconate applied topically twice a day for one week	• Clinical examination after: - 1 week - 6-8 weeks • Radiographic follow up only indicated where clinical findings are suggestive of pathosis (e.g. an unfavorable outcome) • Parents should be informed to watch for any unfavorable outcomes and the need to return to the clinic as soon as possible. Where unfavorable outcomes are identified, treatment is often required. • The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines	• Asymptomatic • Pulp healing with: - Normal color of the crown or transient red/gray or yellow discoloration and pulp canal obliteration - No signs of pulp necrosis and infection • Continued root development in immature teeth • No disturbance to the development and/or eruption of the permanent successor	• Symptomatic • Signs of pulp necrosis and infection - such as: - Sinus tract, gingival swelling, abscess or increased mobility - Persistent dark gray discoloration plus one or more other signs of root canal infection • Radiographic signs of pulp necrosis and infection • No further root development of immature teeth • Negative impact on the development and/or eruption of the permanent successor

Table 8 – Treatment guidelines for subluxation of primary teeth

				Favorable and Unfavorable Outcomes include some, but not necessarily all, of the following:	
SUBLUXATION	**Radiographic Recommendations and Findings**	**Treatment**	**Follow-Up**	**Favorable Outcome**	**Unfavorable Outcome**
 **Clinical findings:** The tooth is tender to touch and it has	• A periapical (size 0 sensor/film, paralleling technique) or occlusal radiograph (size 2 sensor/film) should be taken at the time of initial presentation for diagnostic purposes and to establish a baseline • Normal to slightly widened periodontal ligament space will be visible	• No treatment is needed. • Observation • Parent / Patient Education: - Exercise care when eating not to further traumatize the injured teeth while encouraging a return to normal function as soon as possible - To encourage gingival healing. Parents should clean the affected	• Clinical examination after: - 1 week - 6-8 weeks • Where there are concerns that an unfavorable outcome is likely, then continue clinical follow-up each year until eruption of the permanent teeth • Radiographic follow up only indicated where clinical findings are suggestive of pathosis (e.g. an	• Asymptomatic • Pulp healing with: - Normal color of the crown or transient red/gray or yellow discoloration and pulp canal obliteration - No signs of pulp necrosis and infection • Continued root development in immature	• Symptomatic • Signs of pulp necrosis and infection - such as: - Sinus tract, gingival swelling, abscess or increased mobility - Persistent dark gray discoloration plus one or more signs of root canal infection • Radiographic signs of pulp

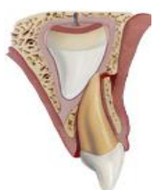
increased mobility, but it has not been displaced • Bleeding from gingival crevice may be noted		area with a soft brush or cotton swab combined with an alcohol-free 0.1 – 0.2% chlorhexidine gluconate mouthrinse applied topically twice a day for one week	unfavorable outcome) • Parents should be informed to watch for any unfavorable outcomes and the need to return to the clinic as soon as possible. Where unfavorable outcomes are identified, treatment is often required. • The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines	teeth • No disturbance to the development and/or eruption of the permanent successor	necrosis and infection • No further root development of immature teeth • Negative impact on the development and/or eruption of the permanent successor

Table 9 – Treatment guidelines for extrusive luxation of primary teeth

				Favorable and Unfavorable Outcomes include some, but not necessarily all, of the following:	
EXTRUSIVE LUXATION	**Radiographic Recommendations and Findings**	**Treatment**	**Follow-Up**	**Favorable Outcome**	**Unfavorable Outcome**
 **Clinical findings:** Partial displacement of the tooth out of its socket • The tooth appears	• A periapical (size 0 sensor/film, paralleling technique) or occlusal radiograph (size 2 sensor/film) should be taken at the time of initial presentation for diagnostic purposes and to establish a baseline • Slight increase to substantially widened periodontal ligament space apically	• Treatment decisions are based on the degree of displacement, mobility, interference with the occlusion, root formation and the ability of the child to tolerate the emergency situation • If the tooth is not interfering with the occlusion - let the tooth spontaneously reposition itself • If the tooth is excessively mobile or extruded >3mm, then extract under local anesthesia • Treatment should be performed by a child-oriented team with experience and	• Clinical examination after: - 1 week - 6-8 weeks - 1 year • Where there are concerns that an unfavorable outcome is likely, then continue clinical follow-up each year until eruption of the permanent teeth • Radiographic follow up only indicated where clinical findings are suggestive of pathosis (e.g. an	• Asymptomatic • Pulp healing with: - Normal color of the crown or transient red/gray or yellow discoloration and pulp canal obliteration - No signs of pulp necrosis and infection • Continued root development in immature teeth • Realignment of the extruded	• Symptomatic • Signs of pulp necrosis and infection - such as: - Sinus tract, gingival swelling, abscess or increased mobility - Persistent dark gray discoloration plus one or more signs of root canal infection • Radiographic signs of pulp necrosis and infection • No further root development

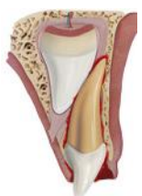
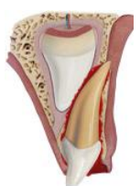
elongated and can be excessively mobile. • Occlusal interference may be present		expertise in the management of paediatric dental injuries. Extractions have the potential to cause long-term dental anxiety • Parent / Patient Education: - Exercise care when eating not to further traumatize the injured tooth while encouraging a return to normal function as soon as possible. - To encourage gingival healing and prevent plaque accumulation, parents should clean the affected area with a soft brush or cotton swab combined with an alcohol-free 0.1 – 0.2% chlorhexidine gluconate mouthrinse applied topically twice a day for one week	unfavorable outcome) • Parents should be informed to watch for any unfavorable outcomes and the need to return to the clinic as soon as possible. Where unfavorable outcomes are identified, treatment is often required • The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines	tooth • No interference with the occlusion • No disturbance to the development and/or eruption of the permanent successor	of immature teeth • No improvement in the position of the extruded tooth • Negative impact on the development and/or eruption of the permanent successor

Table 10 – Treatment guidelines for lateral luxation of primary teeth

				Favorable and Unfavorable Outcomes include some, but not necessarily all, of the following:	
LATERAL LUXATION	**Radiographic Recommendations and Findings**	**Treatment**	**Follow-Up**	**Favorable Outcome**	**Unfavorable Outcome**
  **Clinical findings:** The tooth is displaced, usually in a palatal/lingual or labial	• A periapical (size 0 sensor/film, paralleling technique) or occlusal radiograph (size 2 sensor/film) should be taken at the time of initial presentation for diagnostic purposes and to establish a baseline • Increased periodontal ligament space apically (most clearly seen on an occlusal radiograph, especially if tooth is displaced labially)	• If there is minimal or no occlusal interference, the tooth should be allowed to spontaneously reposition itself - Spontaneous repositioning usually occurs within 6 months • In situations of severe displacement, two options are available, both of which require local anesthesia: • **Option A:** - Extraction when there is a risk of ingestion or aspiration of the tooth • **Option B:** - Gently reposition the tooth. - If unstable in its new position, splint for 4 weeks using a flexible splint attached to the adjacent uninjured teeth • Treatment should be performed by a child-oriented team with experience and	• Clinical examination after: - 1 week - 6-8 weeks - 6 months - 1 year • If repositioned and splinted, review after: - 1 week - 4 weeks for splint removal - 8 weeks - 6 months - 1 year • Where there are concerns that an unfavorable outcome is likely then continue clinical follow-up each year until eruption of the permanent teeth	• Asymptomatic • Pulp healing with: - Normal color of the crown or transient red/gray or yellow discoloration and pulp canal obliteration - No signs of pulp necrosis and infection • Continued root development in immature teeth • Periodontal healing • Realignment of the laterally luxated tooth • Normal occlusion • No disturbance to the development and/or	• Symptomatic • Signs of pulp necrosis and infection - such as: - Sinus tract, gingival swelling, abscess or increased mobility - Persistent dark gray discoloration plus one or more signs of root canal infection • Radiographic signs of pulp necrosis and infection • Ankylosis • No further root development of immature teeth • No improvement in position of the laterally luxated tooth

direction • The tooth will be immobile • Occlusal interference may be present		expertise in the management of paediatric dental injuries. Extractions have the potential to cause long-term dental anxiety. • Parent / Patient Education: - Exercise care when eating not to further traumatize the injured teeth while encouraging a return to normal function as soon as possible. - To encourage gingival healing and prevent plaque accumulation, parents should clean the affected area with a soft brush or cotton swab combined with an alcohol-free chlorhexidine gluconate 0.1 – 0,2% mouthrinse applied topically twice a day for one week	• Radiographic follow up only indicated where clinical findings are suggestive of pathosis (e.g. an unfavorable outcome) • Parents should be informed to watch for any unfavorable outcomes and the need to return to the clinic as soon as possible. Where unfavorable outcomes are identified,treatment is often required. • The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines	eruption of the permanent successor	• Negative impact on the development and/or eruption of the permanent successor

Table 11 – Treatment guidelines for intrusive luxation of primary teeth

				Favorable and Unfavorable Outcomes include some, but not necessarily all, of the following:	
INTRUSIVE LUXATION	**Radiographic Recommendations and Findings**	**Treatment**	**Follow-Up**	**Favorable Outcome**	**Unfavorable Outcome**
 	• A periapical (size 0 sensor/film, paralleling technique) or occlusal radiograph (size 2 sensor/film) should be taken at the time of initial presentation for diagnostic purposes and to establish a baseline • When the apex is displaced toward or through the labial bone plate, the apical tip can be seen and the image of the tooth will appear shorter (foreshortened) than the contralateral tooth	• The tooth should be allowed to spontaneously reposition itself, irrespective of the direction of displacement. - Spontaneous improvement in the position of the intruded tooth usually occurs within 6 months. - In some cases it can take up to 1 year • A rapid referral (within a couple of days) to a child-oriented team that has experience and expertise in the management of paediatric dental injuries should be arranged	• Clinical examination after: - 1 week - 6-8 weeks - 6 months - 1 year - Further follow-up at 6 years of age is indicated for severe intrusion to monitor eruption of the permanent tooth • Radiographic follow up only indicated where clinical findings are suggestive of pathosis (e.g. an unfavorable outcome)	• Asymptomatic • Pulp healing with: - Normal color of the crown or transient red/gray or yellow discoloration and pulp canal obliteration - No signs of pulp necrosis and infection • Continued root development in immature teeth • Periodontal healing • Re-eruption/re-alignment of the intruded tooth	• Symptomatic • Signs of pulp necrosis and infection - such as: - Sinus tract, gingival swelling, abscess or increased mobility - Persistent dark gray discoloration with one or more signs of infection • Radiographic signs of pulp necrosis and infection • No further root development of

Clinical findings: The tooth is usually displaced through the labial bone plate, or it can impinge on the permanent tooth bud • The tooth has almost or completely disappeared into the socket and can be palpated labially	• When the apex is displaced towards the permanent tooth germ, the apical tip cannot be visualized and the image of the tooth will appear elongated	• Parent / Patient Education: - Exercise care with eating not to further traumatize the injured tooth while encouraging a return to normal function as soon as possible - To encourage gingival healing and prevent plaque accumulation, parents should clean the affected area with a soft brush or cotton swab combined with an alcohol-free 0.1 – 0.2% chlorhexidine gluconate mouthrinse applied topically twice a day for one week	• Parents should be informed to watch for any unfavorable outcomes and the need to return to the clinic as soon as possible. Where unfavorable outcomes are identified, treatment is often required • The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines	• No disturbance to the development and/or eruption of the permanent successor	immature teeth • Ankylosis • Negative impact on the development and/or eruption of the permanent successor

Table 12 – Treatment guidelines for avulsion of primary teeth

				Favorable and Unfavorable Outcomes include some, but not necessarily all, of the following:	
AVULSION	**Radiographic Recommendations and Findings**	**Treatment**	**Follow-Up**	**Favorable Outcome**	**Unfavorable Outcome**
 **Clinical findings:** The tooth is completely out of the socket • The location of the missing tooth should be explored during the trauma history and examination, especially when the accident was not witnessed	• A periapical (size 0 sensor/film, paralleling technique) or occlusal radiograph (size 2 sensor/film) is essential where the primary tooth is not brought into the clinic to ensure that the missing tooth has not been intruded • The radiograph will also provide a baseline for assessment of the developing permanent tooth and to determine if it has been displaced	• **Avulsed primary teeth should not be replanted** • Parent / Patient Education: - Exercise care when eating not to further traumatize the injured soft tissues - To encourage gingival healing and prevent plaque accumulation, parents should clean the affected area with a soft brush or cotton swab combined with an alcohol-free 0.1 – 0.2% chlorhexidine gluconate mouthrinse applied topically	• Clinical examination after: - 6-8 weeks - Further follow-up at 6 years of age is indicated to monitor eruption of the permanent tooth • Radiographic follow up only indicated where clinical findings are suggestive of pathosis (e.g. an unfavorable outcome) • Parents should be informed to watch for any unfavorable outcomes and the need to return to the clinic as soon as possible. Where unfavorable	• No signs of disturbance to development and/or eruption of the permanent successor.	• Negative impact on the development and/or eruption of the permanent successor

by an adult or there was a loss of consciousness. • While avulsed teeth are most often lost out of the mouth, there is a risk of that they can be embedded in soft tissues of the lip, cheek or tongue, pushed into the nose, ingested or aspirated. • If the avulsed tooth is not found, the child should be referred for medical evaluation to an emergency room for further examination, especially where there are respiratory symptoms		twice a day for one week	outcomes are identified, treatment is often required • The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines		