International Association of Dental Traumatology Guidelines for the Management of Traumatic Dental Injuries: 3. Injuries in the Primary Dentition

Endorsed by the American Academy of Pediatric Dentistry

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Abstract
Traumatic injuries to the primary dentition present special problems that often require for 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. (Dental Traumatology 2020;36(4):343-359; doi: 10.1111/edt.12576)

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KEYWORDS: AVULSION, LUXATION, PREVENTION, TOOTH FRACTURE, TRAUMA

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 and 6 years of age4,6 with injuries to periodontal tissues occurring most frequently.7,8 Children with these injuries present to many healthcare 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 tables (1-12) and these articles are not mentioned elsewhere in this introductory text.9,10

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Dental Traumatology is published for the International Association of Dental Traumatology (IADT) by John Wiley and Sons Ltd.
1.1 | Initial presentation and minimizing anxiety to the child and parent
Management of TDI 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. Minimizing anxiety for the child and parents, or other caregivers, 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 or can be viewed in the following video (https://tinyurl.com/kneeetokneeexamination). 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 pediatric oral injuries. These teams are best placed to access specialist diagnostic and treatment services, including sedation and general anesthesia, and pain management for the prevention or minimization of suffering.21

1.2 | 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. There are a variety of structured histories available in current textbooks or used at different specialist centers. Extra-oral and intra-oral photographs act as a permanent record of the injuries sustained and are strongly recommended.

1.3 | 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. Be alert to concomitant injuries including head injury, facial fractures, missing tooth fragments, or lacerations. Seek a medical examination if necessary.

1.4 | Soft tissue injuries
It is essential to identify, record, and diagnose extra-oral and intraoral soft tissue injuries. 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- to 3-year age group. Management of soft tissues, beyond just first aid, should be provided by a child-oriented team with experience in pediatric 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.

1.5 | 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. Discoloration is a common complication following luxation injuries. The color of injured and uninjured teeth should be recorded at each clinic visit. This discoloration may fade, and the tooth may regain its original shade over a period of weeks or months. Teeth with persistent dark discoloration may remain asymptomatic clinically and radiographically normal, or they may develop apical periodontitis (with or without symptoms). Root canal treatment is not indicated for discolored teeth unless there are clinical or radiographic signs of infection of the root canal system. Every effort has been made in these Guidelines to reduce the number of radiographs needed for accurate diagnosis, thus minimizing 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 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. Therefore, clinicians should question each radiograph they take and cognitively ask whether 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.

1.6 | Diagnosis
A careful and systematic approach to diagnosis is essential. Clinicians should identify all injuries to each tooth including both hard tissue injuries (eg, fractures) and periodontal injuries (eg, luxations). When concomitant injuries occur in the primary dentition following extrusion and lateral luxation injuries, they have a detrimental impact on pulp survival. The accompanying tables and the trauma pathfinder diagram help clinicians identify all possible injuries for each injured tooth.

1.7 | Intentional (non-accidental) injuries
Dental and facial trauma can occur in cases of intentional injuries. Clinicians should check whether 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.

1.8 | 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. Intrusion and avulsion injuries are most commonly associated with the development of anomalies in the permanent dentition.

Intrusive and lateral luxation injuries, previous Guidelines have recommended the immediate extraction of the traumatized primary tooth if the direction of displacement of the root is toward the permanent tooth germ. This action is no longer advised due to (a) evidence of spontaneous re-eruption for intruded primary teeth and (b) the concern that further damage may be inflicted on the tooth germ during extraction, and (c) the lack of evidence that immediate extraction will minimize 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.

1.9 | 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 and the risk of further damage to the permanent dentition.
### TABLE 1  Treatment guidelines for primary teeth: Enamel fractures

<table>
<thead>
<tr>
<th>Enamel fracture</th>
<th>Radiographic recommendations</th>
<th>Treatment</th>
<th>Follow up</th>
<th>Favorable outcomes</th>
<th>Unfavorable outcomes</th>
</tr>
</thead>
</table>
| 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 mouth rinse applied topically twice a day for 1 wk | - 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 necrosis and infection  
- No further root development of immature teeth |

**Clinical findings:**
- Fracture involves enamel only

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### TABLE 2  Treatment guidelines for primary teeth: Enamel-dentin fractures (with no pulp exposure)

<table>
<thead>
<tr>
<th>Enamel-dentin fracture (with no pulp exposure)</th>
<th>Radiographic recommendations</th>
<th>Treatment</th>
<th>Follow up</th>
<th>Favorable outcome</th>
<th>Unfavorable outcome</th>
</tr>
</thead>
</table>
| Fracture involves enamel and dentin. The pulp is not exposed | - 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 area with a soft brush or cotton swab combined with an alcohol-free 0.1 to 0.2% chlorhexidine gluconate mouth rinse applied topically twice a day for 1 wk | - Clinical examination after 6-8 wk  
- Radiographic follow up indicated only when clinical findings are suggestive of pathosis (eg, 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, 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 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 infection  
  - No further root development of immature teeth |

**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, 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 that they can be embedded in the soft tissues, ingested, or aspirated

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### TABLE 3  Treatment guidelines for primary teeth: Complicated crown fractures (with pulp exposure)

<table>
<thead>
<tr>
<th>Complicated crown fracture (ie, with exposed pulp)</th>
<th>Radiographic recommendations</th>
<th>Treatment</th>
<th>Favorable outcome</th>
<th>Unfavorable outcome</th>
</tr>
</thead>
</table>
| 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. | Preserve the pulp by partial pulpotomy. Local anesthesia 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. | Clinical examination after:  
- 1 wk  
- 6-8 wk  
- 1 y  
Radiographic follow up at 1 y following pulpotomy or root canal treatment. Other radiographs are only indicated where clinical findings are suggestive of pathosis (eg, an unfavorable outcome). | Asymptomatic | Symptomatic  
Pulp healing with:  
- Normal color of the remaining crown  
- No signs of pulp necrosis and infection  
- Continued root development in immature teeth  
Pain |  
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 |
| Note: While fragments are most often lost out of the mouth, there is a risk that they can be embedded in the soft tissues, ingested, or aspirated. | 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 experience and expertise in the management of pediatric 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. | 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 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  
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 mouth rinse applied topically twice a day for 1 wk.
### Table 4: Treatment guidelines for primary teeth: Crown-root fractures

<table>
<thead>
<tr>
<th>Crown-root fracture</th>
<th>Radiographic recommendations</th>
<th>Treatment</th>
<th>Follow up</th>
<th>Favorable outcome</th>
<th>Unfavorable outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>A periapical radiograph losing 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</td>
<td>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</td>
<td>- Where tooth is retained, clinical examination after: - 1 wk - 6-8 wk - 1 y</td>
<td>- Asymptomatic - Pulp healing with: - Normal color of the remaining crown - No signs of pulp necrosis and infection - Continued root development in immature teeth</td>
<td>- 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</td>
<td>- No further root development of immature teeth</td>
</tr>
<tr>
<td>Additional findings may include loose, but still attached, fragments of tooth</td>
<td>If treatment is considered at the emergency appointment, local anesthesia will be required</td>
<td>Radiographic follow up after 1 y following pulpotomy or root canal treatment. Other radiographs only indicated where clinical findings are suggestive of pathosis (eg, an unfavorable outcome)</td>
<td>Parent should watch for any unfavorable outcomes. If seen, the child needs to return to the clinic as soon as possible. Where unfavorable outcomes are identified, treatment is often required</td>
<td>- The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines</td>
<td>- No further root development of immature teeth</td>
</tr>
</tbody>
</table>
### TABLE 5  Treatment guidelines for primary teeth: Root fractures

<table>
<thead>
<tr>
<th>Root fracture</th>
<th>Radiographic recommendations and findings</th>
<th>Treatment</th>
<th>Follow up</th>
<th>Favorable outcome</th>
<th>Unfavorable outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td>If the coronal fragment is not displaced, no treatment is required.</td>
<td>Where no displacement of coronal fragment, clinical examination after:</td>
<td>Asymptomatic.</td>
<td>Symptomatic.</td>
<td></td>
</tr>
<tr>
<td>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 are available, both of which require local anesthesia.</td>
<td>If the coronal fragment has been repositioned and splinted, clinical examination after:</td>
<td>Normal color of the crown or transient red/grey or yellow discoloration and pulp canal obliteration.</td>
<td>Pulp healing with:</td>
<td>Signs of pulp necrosis and infection—such as:</td>
<td></td>
</tr>
<tr>
<td>This includes discomfort during childbirth.</td>
<td>- 1 wk</td>
<td>- No signs of pulp necrosis and infection.</td>
<td>- Normal color of the crown or transient red/grey or yellow discoloration and pulp canal obliteration.</td>
<td>- Sinus tract, gingival swelling, abscess, or increased mobility.</td>
<td>- Continued root development in immature teeth.</td>
</tr>
<tr>
<td>This includes discomfort during childbirth.</td>
<td>- 6-8 wk</td>
<td>- No signs of pulp necrosis and infection.</td>
<td>- Pulp healing with:</td>
<td>Persistent dark gray discoloration with one or more signs of root canal infection.</td>
<td>- Realignment of the root-fractured tooth.</td>
</tr>
<tr>
<td>This includes discomfort during childbirth.</td>
<td>- 1 y and where there are clinical concerns that an unfavorable outcome is likely.</td>
<td>- Pulp healing with:</td>
<td>- Pulp healing with:</td>
<td>Radiographic signs of pulp necrosis and infection.</td>
<td>- No mobility.</td>
</tr>
<tr>
<td>This includes discomfort during childbirth.</td>
<td>- Then continue clinical follow up each year until eruption of permanent teeth.</td>
<td>- Pulp healing with:</td>
<td>- Pulp healing with:</td>
<td>Radiographic signs of infection-related (inflammatory) resorption.</td>
<td>- Resorption of the apical fragment.</td>
</tr>
<tr>
<td>This includes discomfort during childbirth.</td>
<td>- If coronal fragment has been extracted, clinical examination after 1 y.</td>
<td>- Where there are concerns that an unfavorable outcome is likely, then continue clinical follow up each year until eruption of permanent teeth.</td>
<td>- Where there are concerns that an unfavorable outcome is likely, then continue clinical follow up each year until eruption of permanent teeth.</td>
<td>No further root development of immature teeth.</td>
<td>- No improvement in the position of the root-fractured tooth.</td>
</tr>
</tbody>
</table>

Clinical findings: Depends on the location of fracture.
- The coronal fragment may be mobile and may be displaced.
- Occlusal interference may be present.
### Table 6: Treatment guidelines for primary teeth: Alveolar fractures

<table>
<thead>
<tr>
<th>Alveolar fracture</th>
<th>Radiographic recommendations and findings</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A periodontal (pulpal) infection or periapical radiographic (size 2 sensor/film) should be taken at the time of initial presentation for diagnostic purposes and to establish a baseline.</td>
<td>Radiographic follow-up at 4 wk.</td>
<td>Radiographic follow-up at 4 wk.</td>
</tr>
<tr>
<td>A lateral radiograph may give indications about the mobility and vascularity of the maxillary and mandibular dentitions if the fracture line is located in a labial direction.</td>
<td>Radiographic follow-up at 4 wk.</td>
<td>Radiographic follow-up at 4 wk.</td>
</tr>
<tr>
<td>Fracture lines may be located at any level, from the marginal bone to the root apex.</td>
<td>Radiographic follow-up at 4 wk.</td>
<td>Radiographic follow-up at 4 wk.</td>
</tr>
<tr>
<td>Further imaging may be needed to visualize the extent of the fracture(s) and to confirm the need to perform the treatment.</td>
<td>Radiographic follow-up at 4 wk.</td>
<td>Radiographic follow-up at 4 wk.</td>
</tr>
<tr>
<td>Children should be informed on the need to perform the treatment.</td>
<td>Radiographic follow-up at 4 wk.</td>
<td>Radiographic follow-up at 4 wk.</td>
</tr>
<tr>
<td>Temporary restorations should be performed as needed to provide temporary stability.</td>
<td>Radiographic follow-up at 4 wk.</td>
<td>Radiographic follow-up at 4 wk.</td>
</tr>
<tr>
<td>Oral hygiene and comfort should be provided.</td>
<td>Radiographic follow-up at 4 wk.</td>
<td>Radiographic follow-up at 4 wk.</td>
</tr>
<tr>
<td>Moderate soft tissue injury:</td>
<td>Radiographic follow-up at 4 wk.</td>
<td>Radiographic follow-up at 4 wk.</td>
</tr>
<tr>
<td>Severe soft tissue injury:</td>
<td>Radiographic follow-up at 4 wk.</td>
<td>Radiographic follow-up at 4 wk.</td>
</tr>
</tbody>
</table>

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### TABLE 7  Treatment guidelines for primary teeth: Concussion

<table>
<thead>
<tr>
<th>Concussion</th>
<th>Radiographic recommendations</th>
<th>Treatment</th>
<th>Follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No baseline radiograph recommended</td>
<td>No treatment is needed.</td>
<td>Clinical examination after:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Observation</td>
<td>1 wk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Parent/patient education:</td>
<td>6-8 wk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Exercise care when eating not to further traumatize the injured tooth while encouraging a return to normal function as soon as possible</td>
<td>Radiographic follow up only indicated where clinical findings are suggestive of pathosis (eg, an unfavorable outcome)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 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% mouth rinse chlorhexidine gluconate applied topically twice a day for 1 wk</td>
<td>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</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines</td>
<td>The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines</td>
</tr>
</tbody>
</table>

**Clinical findings:** The tooth is tender to touch but it has not been displaced
- It has normal mobility and no sulcular bleeding

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### TABLE 8  Treatment guidelines for primary teeth: Subluxation

<table>
<thead>
<tr>
<th>Subluxation</th>
<th>Radiographic recommendations and findings</th>
<th>Treatment</th>
<th>Follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>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</td>
<td>No treatment is needed.</td>
<td>Clinical examination after:</td>
</tr>
<tr>
<td></td>
<td>Normal to slightly widened periodontal ligament space will be visible</td>
<td>Observation</td>
<td>1 wk</td>
</tr>
<tr>
<td></td>
<td>Bleeding from gingival crevice may be noted</td>
<td>Parent/patient education:</td>
<td>6-8 wk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Exercise care when eating not to further traumatize the injured teeth while encouraging a return to normal function as soon as possible</td>
<td>Radiographic follow up only indicated where clinical findings are suggestive of pathosis (eg, an unfavorable outcome)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- To encourage gingival healing. Parents should clean the affected area with a soft brush or cotton swab combined with an alcohol-free 0.1%-0.2% chlorhexidine gluconate mouth rinse applied topically twice a day for 1 wk</td>
<td>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</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines</td>
<td>The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines</td>
</tr>
</tbody>
</table>

**Clinical findings:** The tooth is tender to touch and it has increased mobility, but it has not been displaced

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**Favorable and unfavorable outcomes include some, but not necessarily all, of the following:**
- 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 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>
<thead>
<tr>
<th>Extrusive luxation</th>
<th>Radiographic recommendations and findings</th>
<th>Treatment</th>
<th>Follow up</th>
<th>Favorable outcome</th>
<th>Unfavorable outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 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</td>
<td>• 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</td>
<td>• Clinical examination after:</td>
<td>• Asymptomatic</td>
<td>• Symptomatic</td>
<td></td>
</tr>
<tr>
<td>• Slight increase to substantially widened periodontal ligament space apically</td>
<td>• If the tooth is not interfering with the occlusion—let the tooth spontaneously reposition itself</td>
<td>• 1 wk</td>
<td>• Signs of pulp necrosis and infection—such as:</td>
<td></td>
<td>• Sinus tract, gingival swelling, abscess, or increased mobility</td>
</tr>
<tr>
<td>• Treatment should be performed by a child-oriented team with experience and expertise in the management of pediatric dental injuries. Examinations have the potential to cause long-term dental anxiety</td>
<td>• If the tooth is excessively mobile or extruded &gt; 3 mm, then extract under local anesthesia</td>
<td>• 6-8 wk</td>
<td>• Persistent dark gray discoloration plus one or more signs of root canal infection</td>
<td></td>
<td>• Radiographic signs of pulp necrosis and infection</td>
</tr>
<tr>
<td>• Parent/patient education:</td>
<td>• Treatment is often required</td>
<td>• 1 y</td>
<td>• No signs of pulp necrosis and infection</td>
<td></td>
<td>• No further root development of immature teeth</td>
</tr>
<tr>
<td></td>
<td>• Exercise care when eating not to further traumatize the injured tooth while encouraging a return to normal function as soon as possible.</td>
<td></td>
<td>• Continued root development in immature teeth</td>
<td></td>
<td>• No improvement in the position of the extruded tooth</td>
</tr>
<tr>
<td></td>
<td>• 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 mouth rinse applied topically twice a day for 1 wk</td>
<td></td>
<td>• Realignment of the extracted tooth</td>
<td></td>
<td>• Negative impact on the development and/or eruption of the permanent successor</td>
</tr>
</tbody>
</table>

Clinical findings: Partial displacement of the tooth out of its socket
• The tooth appears elongated and can be excessively mobile.
• Occlusal interference may be present

Favorable and unfavorable outcomes include some, but not necessarily all, of the following:
### TABLE 10  Treatment guidelines for primary teeth: Lateral luxation

<table>
<thead>
<tr>
<th>Lateral luxation</th>
<th>Radiographic recommendations and findings</th>
<th>Treatment</th>
<th>Follow up</th>
<th>Favorable and unfavorable outcomes include some, but not necessarily all, of the following</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>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</td>
<td>If there is minimal or no occlusal interference, the tooth should be allowed to spontaneously reposition itself</td>
<td>Clinical examination after:</td>
<td>Asymptomatic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Spontaneous repositioning usually occurs within 6 mo</td>
<td>- 1 wk</td>
<td>Pulp healing with:</td>
</tr>
<tr>
<td></td>
<td>Increased periodontal ligament space apically (most clearly seen on an occlusal radiograph, especially if tooth is displaced labially)</td>
<td>If repositioned and splinted, review after:</td>
<td>- Normal color of the crown or transient red/grey or yellow discoloration and pulp canal obliteration</td>
<td>- Signs of pulp necrosis and infection—such as:</td>
</tr>
<tr>
<td></td>
<td>The tooth will be immobile</td>
<td>- 1 wk</td>
<td>- Sinus tract, gingival swelling, abscess, or increased mobility</td>
<td>- 4 wk for splint removal</td>
</tr>
<tr>
<td></td>
<td>Occlusal interference may be present</td>
<td>- 8 wk</td>
<td>- Radiographic signs of pulp necrosis and infection</td>
<td>- 6 mo</td>
</tr>
<tr>
<td></td>
<td>Clinical findings: The tooth is displaced, usually in a palatal/lingual or labial direction</td>
<td>- 1 y</td>
<td>- No further root development of immature teeth</td>
<td>- Where there are concerns that an unfavorable outcome is likely, then continue clinical follow up each year until eruption of the permanent teeth</td>
</tr>
<tr>
<td></td>
<td>• The tooth will be immobile</td>
<td>- Radiographic follow up only indicated where clinical findings are suggestive of pathosis (eg, an unfavorable outcome)</td>
<td>- No disturbance to the development and/or eruption of the permanent successor</td>
<td>- 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</td>
</tr>
<tr>
<td></td>
<td>• Occlusal interference may be present</td>
<td>- The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 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% mouth rinse applied topically twice a day for 1 wk

### Table 11: Treatment guidelines for primary teeth: Intrusive luxation

<table>
<thead>
<tr>
<th>Intrusive luxation</th>
<th>Radiographic recommendations and findings</th>
<th>Treatment</th>
<th>Follow up</th>
<th>Favorable and unfavorable outcomes include some, but not necessarily all, of the following</th>
<th>Favorable outcome</th>
<th>Unfavorable outcome</th>
</tr>
</thead>
</table>
|                    | • 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 tooth should be allowed to spontaneously reposition itself, irrespective of the direction of displacement | • Clinical examination after:  
  - 1 wk  
  - 6-8 wk  
  - 6 mo  
  - 1 y  
  - Further follow up at 6 y of age is indicated for severe intrusion to monitor eruption of the permanent tooth | • Asymptomatic  
• Pulp healing with:  
  - Normal color of the crown or translucent red/grey or yellow discoloration and pulp canal obliteration  
  - No signs of pulp necrosis and infection | • 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 immature teeth  
• Ankylosis  
• Negative impact on the development and/or eruption of the permanent successor |
|                    | • 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 | • Spontaneous improvement in the position of the intruded tooth usually occurs within 6 mo | • Radiographic follow up only indicated where clinical findings are suggestive of pathosis (e.g., an unfavorable outcome) | • Continued root development in immature teeth  
• Periodontal healing  
• Re-eruption/realignment of the intruded tooth  
• No disturbance to the development and/or eruption of the permanent successor | • Radiographic signs of pulp necrosis and infection  
• No further root development of immature teeth  
• Ankylosis  
• Negative impact on the development and/or eruption of the permanent successor |
|                    | • When the apex is displaced toward 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 mouth rinse applied topically twice a day for 1 wk | • 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 further root development of immature teeth  
• Ankylosis  
• Negative impact on the development and/or eruption of the permanent successor |
### TABLE 12  Treatment guidelines for primary teeth: Avulsion

<table>
<thead>
<tr>
<th>Avulsion</th>
<th>Radiographic recommendations and findings</th>
<th>Treatment</th>
<th>Follow up</th>
<th>Favorable and unfavorable outcomes include some, but not necessarily all, of the following</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A perisapical (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 whether it has been displaced.</td>
<td>Avulsed primary teeth should not be replanted.</td>
<td>Clinical examination after:</td>
<td></td>
</tr>
<tr>
<td>Clinical findings: The tooth is completely out of the socket.</td>
<td>Parent/patient education:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The location of the missing tooth should be explored during the trauma history and examination, especially when the accident was not witnessed by an adult or there was a loss of consciousness.</td>
<td>- Exercise care when eating not to further traumatize the injured soft tissues.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>While avulsed teeth are most often lost out of the mouth, there is a risk that they can be embedded in soft tissues of the lip, cheek, or tongue, pushed into the nose, ingested, or aspirated.</td>
<td>- 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 mouth rinse applied topically twice a day for 1 wk.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td>Radiographic follow up only indicated where clinical findings are suggestive of pathosis (eg, an unfavorable outcome).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td>- No signs of disturbance to development and/or eruption of the permanent successor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The follow-up treatment, which frequently requires the expertise of a child-oriented team, is outside the scope of these guidelines.</td>
<td>Negative impact on the development and/or eruption of the permanent successor.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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 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.  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.

• Minimizing dental anxiety is essential. Provision of dental treatment depends on the child’s maturity and ability to cope. Various behavioral approaches are available and have been shown to be effective for managing acute procedures in an emergency situation. 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 with little research specifically examining either condition following TDIs in the primary dentition. However, evidence from the wider dental literature suggests that the multifactorial nature of dental anxiety, its fluctuating nature, and the role of dental extractions are exacerbating factors. 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. Discussions with parents about the different treatment options should include the potential for further treatment visits and consideration for how best to minimize the impact of the injury on the developing permanent dentition.

• For crown and crown-root fractures involving the pulp, root fractures, and luxation injuries, rapid referral within several days to a child-oriented team that has experience and expertise in the management of dental injuries in children is essential.

• Splinting is used for alveolar bone fractures and occasionally may be needed in cases of root fractures and lateral luxations.

1.10 | 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. 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.

1.11 | Antibiotics and Tetanus

There is no evidence for recommending the use of 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 pediatrician 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.

1.12 | Parental instructions for home care

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 (Tables 1-12).

1.13 | 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 anesthesia, and overall pain management for the prevention or minimization of suffering.

1.14 | 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 follow-up visits. This is most likely achieved using the structured history form described previously. The dental literature and appropriate websites (eg, 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.

1.15 | 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. 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. Some outcomes were identified as recurring throughout the different injury types. These outcomes were then identified as “generic” (ie, 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.

CONFLICT OF INTEREST

The authors declare there is no competing interest for the above manuscript.

ETHICAL STATEMENT

No ethics approval was required for this paper.