Intrusion injuries commonly occur in the primary dentition. They can be described as luxation injuries resulting from an axially directed impact, which drives the tooth deeper into the alveolar socket. The impact results in compression of and damage to the periodontal ligament as well as injury to the pulp of the intruded incisor. In addition to rendering treatment to the intruded primary tooth, the dentist must also be aware of the possibility of an injury to the developing permanent teeth germs located in close proximity to the roots of the injured primary teeth. This review will discuss the characteristics, implications, and management of intrusion injuries of primary incisors. (Quintessence Int 2000:31:327-334)

Key words: intrusion, primary tooth, tooth injury, trauma.

The reported prevalence of traumatic injuries in primary teeth varies among different studies and ranges between 11% and 50%. There are no significant differences in prevalence of dental injury between males and females during the first year of life. Studies suggest a higher prevalence of primary tooth injuries in males after the first year; reported male-female ratios range from 1.2:1 to 1.82:1.

The primary teeth most frequently injured are the maxillary central incisors; their percentage of injury ranges between 63% and 92%. Traumatic injuries in primary teeth result mainly from indoor injuries, such as falling from baby carriages, falling down stairs, or falling against hard objects. Less frequently, injuries may occur while a child is playing outdoors or as a result of road accidents. In addition, child abuse is highly associated with head and teeth injuries.

Traumatic injuries in primary teeth result mainly from indoor injuries, such as falling from baby carriages, falling down stairs, or falling against hard objects. Less frequently, injuries may occur while a child is playing outdoors or as a result of road accidents. In addition, child abuse is highly associated with head and teeth injuries. Suspicious traumatic signs should alert the dentist to the possibility of child neglect or abuse, and a comprehensive questionnaire and report should be completed.

Traumatic injuries are less frequent during the first year of life. Their frequency increases during the toddler stage, when the child starts crawling, walking, and exploring the surrounding environment. This increase is mainly due to a lack of motor coordination and the rudimentary stage of development of reflexes that function to protect the face from injuries.

The reported peak incidence period for occurrence of traumatic injuries to primary teeth varies. Some reports place that period between 1 and 2 years, while other studies indicate a peak incidence between the ages of 1.5 and 3.5 years. Intrusion of primary incisors rarely happens after the age of 4 years; the peak incidence is between 1 and 3 years of age. This is explained by the tendency for intrusion to occur when primary incisor roots are fully formed. After the beginning of root resorption, around the age of 4 years, other luxation injuries, such as avulsion, become more frequent.

Different types of traumatic injuries affect the primary dentition, but studies have shown that the primary incisors are highly susceptible to luxation (displacement) injuries, such as intrusion. This can be attributed to the presence of large bone marrow spaces, which are characteristic of growing skeletal tissues, resulting in elasticity of the alveolar bone surrounding the primary teeth. In addition, the short, resorbing roots and the high crown-root ratio of the primary teeth offer less resistance to intrusive displacement.

Luxation injuries constitute 21% to 81% of traumatic injuries of the primary teeth, and 4.4% to 22% are intrusive luxation injuries. The probability of a root or crown fracture increases as the child gets older because of the mineralization and increased rigidity of the alveolar bone.
EXAMINATION PROTOCOL

History

The child's medical history should always be discussed with the parents. The need for prophylactic antibiotic coverage for infective endocarditis as well as the current tetanus immunization status should be determined. Children gain active immunity from a series of injections of diphtheria, pertussis, tetanus (DPT) vaccine during the first 18 months of life. At age 6 years and every 10 years thereafter, a booster should be given. After a traumatic injury and contact with soil, a booster is indicated if the patient has not received an immunization within the last 5 years.

A dental history would indicate any past traumatic injury or other dental experiences. This helps in determining the child's maturation and the ability to cooperate during treatment. The history of the injury should be discussed with the parents. When, where, and how the injury happened should be recorded in detail. This information could be pertinent if future litigation is likely.

Behavioral considerations

Injury to the child patient is a traumatic experience on the physical level as well as on emotional and psychological levels. Managing traumatic injuries for a child is a challenging and demanding task that requires a great deal of confidence and experience. Making the task more difficult is the child's age.

Children younger than 3 years have a limited vocabulary that restricts their ability to communicate. Communicating with these children by words alone may be difficult. Allowing them to adapt to the new dental environment by smelling, touching, and handling objects is essential. In addition, because children at this age become easily frightened, avoidance of jerky movements and bright lights is critical. Most important, these young children fear strangers and are highly attached to their parents. Separating infants and toddlers from their parents is not advised. Parents should be informed that the child is expected to cry during the procedure and that gentle restraint might be necessary.

Examination of a young child who has sustained a traumatic injury is best performed in a private consultation room. The parents' help is essential to conduct this procedure, by coordinating an adequate examination position with the dentist. An efficient position is a knee-to-knee position in which the dentist and the parent are seated face-to-face and the child is lying on their laps. The dentist holds the child's head, while the parent restrains the child's legs and arms.

Another convenient position is having the parent sit on the dental chair with the child on the parent's lap. This position is adequate for both the clinical and the radiologic examinations and allows the parent to help restrain the child's movements and hold the radiographic films. Adequate shielding from x-rays is necessary for both child and parents.

Clinical examination

Clinical examination should commence with a neurologic assessment to detect signs of central nervous system damage. Cyanosis, nausea, vomiting, seizure activity, and loss of consciousness may be indicators of neurologic damage. Other signs are unsteadiness, abnormal respiration, slurred speech, rhinorrhea, otorrhea, and abnormal eye movements. In the presence of these signs, the child must be hospitalized for detailed neurologic evaluation.

Following the visual assessment, an extraoral evaluation is done, including an examination of the head and neck, temporomandibular joint, and mandibular functions. Lacerations or contusions on the face or the chin should be cleaned thoroughly. This will calm the child and parent and allow for better examination of the field of injury.

Intraorally, the lips, tongue, gingival tissues, and oral mucosa should be examined. Although intrusion of primary incisors is associated with both upper and lower lip injuries, contusions of the lower lip and the chin are more frequent. If soft tissue lacerations are present, and depending on the circumstances of the injury, a soft tissue radiograph may be helpful in detecting the presence of foreign bodies that may have been impacted within lip or tongue lacerations. A small-sized film is placed beneath the lip or tongue, and the radiograph is exposed at 25% of the normal exposure time. The embedded foreign object should be removed at this stage to lessen the risk of a chronic infection or exaggerated fibrosis.

The visual intraoral inspection of an intruded incisor shows a tooth that is submerged in the alveolar bone away from the normal line of occlusion. The degree of intrusion can be divided into 3 grades. Grade I represents mild partial intrusion in which more than 50% of the crown is visible (Fig 1). Grade II represents moderate partial intrusion in which less than 50% of the crown is visible (Fig 2). Grade III represents severe or complete intrusion of the crown (Figs 3 and 4).

Bleeding may be noticed around the intruded tooth, which is not usually mobile or sensitive to palpation. Percussion testing may reveal a metallic sound, but tenderness to percussion is a rare finding. Because of the resiliency of the alveolar bone, the tooth may...
GRADE I

Fig 1 Mild intrusion of the maxillary right central incisor (tooth 51[E]). Less than 50% of the crown is intruded.

GRADE II

Fig 2a Moderate intrusion of the maxillary left central incisor (tooth 61[E]). The incisal edge is visible, but a radiograph is essential to determine the direction of the intrusion.

Fig 2b Occlusal radiograph showing a palatal intrusion of tooth 61, which invaded the germ of its permanent successor. The palatally intruded incisor moves away from the x-ray source and appears elongated on the radiographic image.

become completely intruded and invisible as a result of the blood clot and the gingival edema surrounding the incisal edge. In this case, the parents or the dentist may think that the incisor is lost. A radiograph will confirm the presence of the tooth (Fig 4), which may be located buccal to the cortical plate or even in the nasal cavity.

When the tooth is partially intruded, it becomes easier to assess the orientation of displacement. A labial crown orientation indicates a palatal intrusion of the root toward the permanent tooth germ. Conversely, a palatal crown inclination indicates a buccal intrusion of the root away from the successor germ.

Crushing and compression of the alveolar bone is an integral part of an intrusive luxation injury. Fracture of the alveolar socket may accompany intrusion injuries of high impact, such as falling down a staircase. Signs of alveolar fracture can be detected by gentle palpation of the mucosa in the traumatized area. In this case, the injured teeth and the cortical bone will move as a unit. Furthermore, because of the natural prominent labial curvature of primary incisor roots, an axial impact may force the apex of the root through the thin labial cortical bone plate. Gentle palpation in this area helps to determine whether or not the root tip has penetrated the thin labial cortical plate. In the initial clinical examination, photographs may be indicated for legal records.
Fig 3a (above) Severe intrusion of tooth 61. The tooth is completely intruded into the socket. Note the swelling and redness of the gingiva.

Fig 3b (right) Occlusal radiograph showing a labial intrusion of tooth 61 away from the germ of its permanent successor. The labially intruded incisor moves closer to the x-ray source and appears foreshortened on the radiographic image.

Fig 4a (above) Complete intrusion of tooth 51. This 26-month-old child fell from his bed at home. The gingival and mucosal tissues are swollen, red, and painful.

Fig 4b (right) Periapical radiograph showing severe intrusive displacement of the intruded tooth 51, which invaded the permanent tooth germ.
Radiographic examination

Radiographs are an important baseline test in the case of traumatic injuries. They help in detecting bone and root fractures; evaluating the root development stage, the size and the state of the pulp, and the relationship with the permanent tooth germ; and determining the presence of foreign bodies in soft tissues. Periapical and occlusal radiographs are adequate to diagnose an intruded incisor, which will appear submerged in the bone with absence of periodontal ligament space (Fig 5). The possibility of detecting the intrusion increases from 80% when only an occlusal radiograph is taken to 91% when both occlusal and periapical radiographs are taken.

The occlusal image determines the direction of the intrusion (labial or palatal) by evaluating the dimension of the intruded incisor. A palatally intruded primary incisor that invaded the germ of its successor moves away from the x-ray source and appears elongated on the radiographic image (see Fig 2b). Conversely, a labially intruded primary incisor that displaced away from the developing germ moves closer to the x-ray source and appears foreshortened on the radiographic image (see Fig 3b).

In addition, an extraoral anterolateral exposure helps in determining the exact position of the intruded primary incisor and shows whether or not the root apex has pierced the labial cortical plate and the proximity of the intruded incisor to the succeeding permanent incisor. This view can be taken by taping an occlusal film onto the child’s cheek. The x-ray beam is directed from the opposite side of the face perpendicular to the film, and the exposure time is doubled from the normal periapical exposure time.

MANAGEMENT OF INTRUSION INJURIES

Management of an intruded primary incisor depends on many variables, such as the direction and severity of the intrusion and the presence of alveolar bone fracture. As mentioned earlier, appropriate diagnostic measures should be taken to ascertain the relationship between the intruded incisor and the developing tooth germ.

The orientation of the intrusion influences the management decision. Frequently, because of its labial curvature, the root of the primary incisor becomes forced through the labial bone away from the permanent tooth germ. In this case, spontaneous re eruption is anticipated within 1 to 6 months (see Figs 1 and 5). Pulpal necrosis and/or pathologic root resorption are common because of the marked injury to the pulpal tissue and the periapical structures. To minimize the possibility of such complications, some authors advocate prescribing a 1-week course of antibiotic therapy such as penicillin or erythromycin.

An experimental study in monkeys has shown that extraction of the intruded incisor results in less damage to the traumatized enamel epithelium of the permanent successors. With removal of the intruded tooth, the influence of subsequent intramedullary chronic inflammation is eliminated, reducing the possibility of further damage to the permanent tooth germ. However, application of these histologic findings to the clinical finding was not justified.

Other investigations have found no significant difference in the frequency or extent of developmental disturbances of the permanent successors, irrespective of whether the intruded tooth is extracted or allowed to re erupt. Ravn reported that 52% of the re erupted intruded incisors induced disturbances in their successors, compared with 72% of the extracted intruded incisors. This indicates that injury to the permanent tooth germ is sustained at the time of the actual intrusion.

Less frequently, an impact directed toward the lingual surface of the crown forces the root palatally, resulting in possible contact with or invasion of the follicle zone of the permanent tooth and encroachment on the developing permanent germ (see Figs 2 and 4). In this case, the preferred treatment would be careful removal of the tooth to relieve the pressure on the odontogenic tissues within the developing follicle.

In addition to orientation, the degree of intrusion plays an important role in deciding the appropriate management. Spontaneous re eruption is anticipated when the intrusion is mild (grade I or less than 50% of
Whenever the intrusion is moderate or severe (grades II and III, or more than 50% of the crown length), the tooth rarely reerupts and may become necrotic, indicating the need for extraction. In severe cases, extraction is recommended. In some cases, a severe intrusion impact may lead to perforation of the buccal cortical plate by the root apex of the intruded tooth. Likewise, the intruded primary incisor may become entirely positioned buccal to the cortical plate within the soft tissues of the mucobuccal fold. In both cases, extraction of the intruded tooth should be considered. The presence of an alveolar bone fracture is also crucial in the decision on how to manage intrusion. In a study by Borum and Andreasen, 54.5% of the intruded primary incisors were accompanied by fracture of the socket walls at the time of injury. The intruded incisors failed to reerupt more frequently when bone fracture was present. The fractured cortical bony plate should be repositioned immediately with gentle digital manipulation and the intruded tooth should be extracted. Other mobile teeth should be repositioned and possibly splinted.

In the case of socket bone fracture, the issue of splinting the luxated primary incisors is controversial. Some authors support the idea that primary incisors do not require splinting because of several factors, such as the rapid healing of bone in children, lack of patient cooperation, and avoiding further discomfort to the child. Other authors advocate splinting the mobile teeth to allow their restabilization and healing of the bone, which occurs in 3 to 6 weeks.

In patients of this age, the options for splint selection are somewhat limited, and a simple splint, such as the nonrigid, acid-etched resin composite splint, should be considered. The composite material can be applied between the mesial and distal surfaces of the incisors or applied to the incisal half of the labial surfaces with or without a monofilament fishing line embedded in the resin composite. Another option would be a cold-cure resin splint, which can be molded over the incisal edges of the incisors. If observation has been elected as a strategy to wait for spontaneous reeruption, it should be noted that failure of reeruption is possible. If signs of reeruption are not evident after 4 to 8 weeks, this may indicate ankylosis of the intruded tooth, and extraction should be considered. A child with a digit and thumb habit may apply a pressure, preventing the intruded teeth from reeruption. In addition, if the tooth was intruded with a rotated orientation, it may reerupt at the same rotated angle and create a crossbite or traumatic occlusion.

Another possible complication is an acute inflammation around the intruded tooth (Fig 6) or even a cellulitis. These result from a bacterial infection at the site of trauma, which induces swelling of the gingiva, spontaneous bleeding, pain, malaise, and fever. In the long term, a chronic abscess may form, generating a purulent exudate erupting from a fistula. In all these cases, extraction is recommended, along with antibiotic therapy to prevent spread of inflammation to the permanent tooth germ. Furthermore, even with complete spontaneous reeruption, the tooth may suffer pulpal necrosis at some point, and the appropriate treatment would be extraction.

Parents will frequently inquire about the possibility of damage to the permanent tooth. The dentist should be cautious in making these predictions. If the circumstances of the injury are such that the primary root is pushed toward the permanent tooth germ, any resulting damage will have occurred at impact. Consequently, therapy, including extraction of the primary tooth, will not prevent damage to the underlying permanent tooth.

**RECOMMENDATIONS TO PARENTS**

After a traumatic injury, some recommendations should be given to the parents, such as maintaining the child’s fluid intake and a soft diet for a few days after the injury. The traumatized area can be cleaned by wiping the injured teeth and the soft tissues with a swab dipped in an alcohol-free mouthwash. When reeruption of the intruded incisor is expected, the parents should pay particular attention to development of signs and symptoms such as swelling of the surrounding gingival tissues, redness, pain, purulent exudate, and systemic symptoms such as fever. If any of the aforementioned signs is noticed, the parents should contact the treating dentist immediately. In addition, parents should make appointments for periodic follow-up examinations.
FOLLOW-UP

Careful follow-up of intrusion injuries of primary teeth is very important. The frequency and extent of the visits depend on the type and severity of the injury. Recall examinations would detect any complications related to the intruded tooth, which consequently may induce damage to the developing permanent tooth. A first postinjury assessment should be undertaken 7 days after the injury. Recall examinations can be performed regularly every 2 weeks during the first month, then every month for the first 5 months, and then every 6 months. At each visit, a complete examination should be done to look for the presence of any unusual symptoms, for instance, spontaneous pain, malaise, fever, signs of abscess such as fistula, and swelling of the gingiva and the surrounding soft tissues.

The progress of reeruption and repositioning should be evaluated. Lack of reeruption movement and absence of physiologic mobility may indicate ankylosis. Any discoloration of the reerupted primary incisor should be noted. Yellow discoloration may indicate internal calcification, and black discoloration could be an indication of pulpal necrosis. In addition, a radiograph should be taken 1 to 2 months after the injury to discern any periapical radiolucency, pulpal calcification, or external or internal root resorption. If any of these clinical and/or radiologic complications is evident, extraction of the primary intruded incisor should be considered.

REFERENCES


