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Management of Ellis Class IX Fracture in Primary Dentition: Review with a Case Report

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Abstract

Introduction: Ellis Class IX type of luxation injuries are frequently observed in the primary dentition. The pulp and periodontium are damaged as a result of intrusion, which forces the tooth to go more deeper into the tooth socket. The care of these injuries is difficult due to the chances of harming the permanent tooth germ. It is crucial to conduct a thorough clinical and radiographic assessment and to follow up often. A case of Ellis Class IX fracture i.e., Intrusive Luxation of Incisors of a 3 years old child was reported. Intrusion was grade III Hence, teeth underwent extraction and anterior esthetic fixed space maintainer was placed with a pontic natural tooth offers a replacement of a main anterior tooth, which is important for speech development, appearance, and self-esteem.

Keywords: Intrusive Luxation, Dental Traumatic Injuries, Primary Dentition, Anterior Esthetic Fixed Space Maintainer.

1. INTRODUCTION

Dental injuries are the most frequent facial injuries. Injuries to the oral hard and soft tissues are frequently encountered in young patients. Up to 18% of all injuries in children under the age of six occur to the oral region [1]. Injury rates in the primary dentition are much greater than those in the permanent dentition on an annual basis [2, 3]. In young children, dental luxation of the intrusive type is more common than crown fractures due to the resilience of the alveolar bone [4]. Parents frequently fail to notice traumatizing injuries to their child's primary teeth; it is because they focus very less on the child's inability to handle the circumstance and the ignorance ultimately leads to injury of dentition. The growth of permanent teeth may be impacted by traumatic dental injuries sustained during the primary dentition [5]. Traumatic dental injuries in permanent teeth can affect the development of the maxillofacial structure and result in long-term consequences such as pulp necrosis and internal or external root resorption [6, 7]. These days, dental traumas in children are a major issue due to their potential for harm and frequent occurrence, as well as the potential to lower quality of life [8-10]. Furthermore, individuals with untreated dental traumas are more likely to struggle with chewing as well as social interaction issues, such as extreme shyness around other people, aversion to laughing and smiling, and avoidance of talking [11].

2. REVIEW OF LITERATURE

A tooth that has been dislocated axially into the alveolar bone is known as an intrusive luxation. When the tooth is completely enveloped by surrounding tissues, the dislocation is considered complete; otherwise, it is partial when the incisal border of the crown is visible [12].

2.1 Epidemiology

According to researches and studies the reported prevalence of traumatic injuries in primary teeth varies from 11% to 30% [13-15]. In 62-69% of cases, trauma to the deciduous dentition, which occurs predominantly in the anterior region, results in luxation [16-20]. Other authors have found prevalence rates of 15.3% [21], 21% [22], 34% [23], and 54% [24], respectively.

During the first year of life, traumatic injuries are less common [23-25]. Their frequency rises through the stage of toddlers, when the child begins crawling, walking and investigating his or her surroundings. At this age, there is also a lack of motor coordination [26]. Primary incisor intrusion injuries are most common in children aged one to three years [27]. Other luxation injuries including as avulsion, extrusion and lateral luxation become more common after the start of root resorption at the age of 4 years [28].

The maxillary central incisors are the most commonly injured primary teeth, accounting for 63% to 92% of all injuries [29-31].

2.2 Etiology

In the primary dentition, the predominant cause of injuries is falls [32]. The most frequent cause of oral injuries in children is falls, which can occur from baby carriages, stairs, or hard objects. The child's age, the permanent tooth germ's developing stage, the trauma's severity and direction, and other critical factors all influence how much of tooth damage in developing teeth.

2.3 Pathogenesis

It has been discovered that the variation in the trauma pattern favoring luxation rather than fracture is normal for the primary dentition because the surrounding bone is less thick and calcified. Because of mineralization and increasing hardness of the alveolar bone in older children, the likelihood of a root or crown fracture increases [33]. Large bone marrow gaps—a hallmark of increasing skeletal tissues—are the reason of the alveolar bone's flexibility surrounding the main teeth. This means that a traumatically injured tooth can be readily moved rather than shattered [34]. When a tooth falls with an axial component, its labial curve will cause an intrusion. This intrusion typically causes an axial and labial displacement where the apex meets the labial bone plate. When a child falls with an object in his or her mouth (e.g., a pacifier or toy), the impact direction has a strong lingual component. In certain circumstances, the wounded tooth's apex may be driven into the follicle of the permanent successor, causing serious injury to the growing permanent tooth germ [35]. Soon after injury, pulpal alterations such as edema, odontoblastic layer breakdown, and pulp cell nuclear pyknosis are observed. A partial or whole rupture of the pulpal neurovascular supply is the source of this reaction. This response is caused by a partial or complete rupture of the pulpal neurovascular supply. If the pulp survives or is revascularized, a number of regressive alterations such as hyalinization and the deposition of amorphous, diffuse calcifications might occur [36].

Additionally, due to the fact that the apices of the primary teeth and the growing permanent teeth are so near to one another that stressful injury to the primary dentition may have an adverse effect on the permanent teeth as they grow. There can be a range of deformities, from a small amount of mineralization disruption to the complete sequestration of the tooth germ [37].

2.4 Examination Protocol

2.4.1 History

The medical history of the child should always be shared with the parents. It is vital to ascertain whether preventive antibiotic coverage against infective endocarditis is required in addition to the current tetanus vaccination. Children receive active immunity from the diphtheria-pertussis-tetanus (DPT) vaccine at the age of eighteen months. After a traumatic injury and dirt contact, a booster dose is advised if the patient has not received an immunization in the last five years. When and how the injury occurred should all be meticulously documented?

2.4.2 Behavioral Considerations

Injury to a kid patient is a distressing experience on both the physical and emotional and psychological levels. Youngsters under the age of three can communicate less effectively due to their limited vocabulary. The kids should therefore be allowed some time to become used to their new dental surroundings. As a result, the children should be given time to adjust to their new dental environment. It is also not advisable to separate these young youngsters from their parents. Parents have been told that their child will most likely cry during the procedure and that moderate restraining may be required.

2.4.3 Clinical Examination

It is best to start by doing a neurologic examination to look for signs of damage to the central nervous system. Symptoms of neurological injury include cyanosis, nausea, vomiting, and unconsciousness. Unsteadiness, abnormal respiration, slurred speech, rhinorrhea, and abnormal eye movements are symptoms [38].

2.4.3.1 Extraoral Examination

The head and neck, temporomandibular joint, and mandibular functions should all be examined. Facial asymmetry, swelling of the lips, skin lacerations and wounds, and scars must all be examined. Bleeding from the nostrils and subcutaneous bleeding near the nostrils may indicate an alveolar bone fracture.

2.4.3.2 Intraoral Examination

Tissues within the mouth must be thoroughly checked. Check for lacerations and hematomas in the surrounding soft tissues (lips, oral mucosa, connected and free gingivae, and frenum). An injury to the periodontal ligament is indicated by bleeding from the sulcus around the injured tooth [1]. Intrusion type of injuries is more commonly to cause contusions of the lower lip and chin. A blood clot or gingival edema which are surrounding the incisal edge may cause the tooth to

be totally intruded and undetectable, making the parent or even the dentist to believe that the tooth is lost.

The Degree of Intrusion Can Be Divided Into 3 Grades [39]:

- Grade I Mild or partial incursion that exposes more than 50% of the crown.
- Grade II Moderate or partial incursion with less than 50% of the crown showing
- Grade III Severe or full crown intrusion.

2.4.3.3. Radiographic Examination

Radiographs are an important part of the clinical assessment because they provide vital information that can influence the treatment approach for the injured primary tooth. It depicts the growth of the primary tooth and its permanent successor, as well as the relationship between the two. Physiological and pathological root resorption, as well as the position of displaced primary teeth, can also be detected. If the tooth seems foreshortened in comparison to its non-injured antimere, labial displacement of the root can be assumed with minimal risk to the permanent successor. If, on the other hand, a misplaced primary tooth appears elongated on radiographs, it has most certainly intruded into the follicle of the permanent tooth and must be extracted [40].

Furthermore, an extraoral, anterolateral exposure shows if the apex of the intruded primary incisor has pierced the labial cortical plate and how close the intruded incisor is to its permanent replacement. The link between the permanent tooth germ and the apex of the displaced tooth can also be seen by using the extraoral lateral image of the tooth in question as the direction of dislocation (size 2 film, vertical view), according to "Guidelines for the Management of Traumatic Injuries to Primary Teeth [41]. A lateral extraoral radiograph should be conducted in cases of 1 intruded tooth when the crown has totally vanished and clinical results are ambiguous to reveal the labial position of the apex and allow spontaneous re-eruption [42].

The disadvantages of two-dimensional (2-D) imaging include intrinsic magnification, distortion, and superimposition of underlying structures, as well as the fact that it produces a two-dimensional image of a three-dimensional object [43].

2.4.3.4 Factors Affecting the Choice of Therapy for Damaged Primary Teeth

It is important that the roots of primary teeth be close to those of their developing permanent counterparts. This means that permanent tooth damage can occur not only when the initial tooth is harmed, butalso later as a result of the therapy. As a result, the treatment with the least chance of harming the permanent tooth should be considered. Additionally, saving the impacted primary teeth should be tried. Very young children are more likely to suffer trauma to their primary teeth, which makes it difficult for them to cooperate during examination and treatment.

2.5 Objectives of Trauma Management

- To console the child and parents during this difficult time.
- To avoid instilling dental fear and anxiety in young children who may be dealing with their first dental issue.
- To reduce the possibility of further irreversible tooth damage

2.6 Treatment regimens

The overarching concept of treatment is to avoid causing harm to the permanent successor which usually entails taking a very conservative approach. Proper oral hygiene followed by soft diet should be followed.

The Following Factors Influence How A Primary Incisor Is Managed:

1. Intrusion Direction
2. Intrusion Degree
3. The presence of an alveolar bone fracture.

2.6.1. Intrusion Direction

There is a labial curvature on the root of the main incisor. Because of this, the permanent tooth germ is frequently displaced from the primary incisor by being forced through the labial bone. Possible aftereffects of incursion include ankylosis, periapical inflammation, pulp canal obliteration, external root resorption, and necrosis of the pulp. When Altun *et al*., (2009) conducted follow up testing on 78 children with invasive luxation, 138 of their main incisors were present. One hundred and two primary incisors were conservatively handled; 78% fully erupted, 15% partially erupted, and 7% remained impacted [44]. When an intruded incisor is predicted to re-erupt, parents should keep in mind about the development of signs and symptoms such as enlargement of the surrounding gingival tissues, redness, pain, purulent exudate, and systemic symptoms like fever. If any of the aforementioned symptoms are observed, parents should contact the treating dentist as soon as possible. In these circumstances, prompt extraction and antibiotic medication are required to avoid infection spreading to the permanent tooth germ.

In this case, a cautious tooth extraction would be the better course of action to ease the load on the odontogenic tissues within the developing follicle.

Elevators should never be employed since they have the potential to invade the follicular space. Furthermore, the intruded incisor must be held proximally with narrow forceps and extracted with the root pointing labially [1]. To prevent coming into contact with the growing tooth germ, certain safety measures are necessary. Lastly, using digital pressure, the palatal and frontal bone plates should be gradually adjusted after the

tooth has been removed. Suturing may be required in more serious injuries, particularly when there is bleeding of the lips or intraoral soft tissue or fracture of the face and lingual plates [41].

2.6.2. Intrusion Degree

When the incursion is modest (grade I or less than 50% of the crown length), spontaneous re-eruption is expected. When an incursion is moderate or severe (grade II or III), the tooth seldom re-erupts and may become necrotic, necessitating extraction [45]. If the youngster has a digit or thumb habit, he or she can apply pressure to keep the intruded tooth from re-erupting.

2.6.3. Presence of Alveolar Bone Fracture

It is advised to extract the intruded tooth if the intrusion results in a perforation of the buccal cortical plate or if the intruded primary incisor entirely penetrates the cortical plate inside the mucobuccal fold's soft area.

According to current standards, depending on the radiographic examination, the treatment regimen of the intruded primary incisor can be broadly classified into two categories. If the apex is shifted towards or through the labial bone plate, the intruded tooth is left to emerge spontaneously. To monitor recovery, we should re-examine the tooth clinically and radiographically once a month. However, if the intruded tooth has been driven into the follicle of the permanent tooth germ, the primary tooth must be extracted. As a result, the prognosis is affected by a variety of parameters, including the direction, severity, and intensity of the incursion.

Cunha *et al*., (2001) observed that the amount of time between the tooth trauma and seeking treatment is an essential factor in determining prognosis [46].

2.7 Follow-Up

Primary tooth intrusion injuries should be closely monitored. Recall exams can be performed every two weeks for the first month, then every month for the next two months, and finally every six months [47]. The rate of reeruption should be monitored. Ankylosis may be indicated by a lack of reeruptive movement or a lack of physiological mobility [48].

The International Association of Dental Traumatology (Flores *et al*., 2007) recommends the following follow-up program for injured primary teeth [41]:

- 1 week: Clinical
- 3–4 weeks: Clinical, radiographic
- 6–8 weeks: Clinical
- 6 months: Clinical, radiographic
- 1 year: Clinical, radiographic

CASE REPORT

A 3-year-old boy was brought with his parents to the Department of Pediatric and Preventive Dentistry, KD Dental College and Hospital, Mathura, Uttar Pradesh, India on 12 SEP 2023 at 1PM just 1 hour after dental trauma. The primary complaint was missing anterior teeth, bleeding from gums and pain in the upper front region. The parents stated that four front teeth had gone inside the jaw. There was no evidence of a head injury or other bodily injuries. The patient was fully immunized against tetanus. When question was asked to the parents, it was told that the child had fallen off from the see-saw an hour prior. This was the patient's first visit to the dentist.

The initial inspection was performed with the child sitting on the parent's lap. All the debris and blood were cleaned from the site of injury. The position was suitable for both clinical and radiological tests, and it enabled the parent to assist limit the child's movements while still holding the RVG sensor. To elicit the child's cooperation, the "tell, show, do" method was used at all appointments.

Extraoral examination revealed swelling over both of the lips and cheeks area but there was no any contusion. The Visual intraoral examination revealed that the all four maxillary incisors were buried outside of the occlusion line in the alveolar bone (Fig. 1) as grade II wrt 51 and grade III intrusion wrt 52, 61, 62. The intruded tooth was linked with gingival sulcus bleeding. Although the tooth was immobile, it was painful to touch. Gentle palpation of the mucosa in the damaged region revealed no evidence of alveolar fracture.

RVG of the maxillary anterior area revealed intruded incisors (Fig. 2), which appeared foreshortened on the RVG picture. Clinically, they were somewhat palatally inclined. This indicates that the intruded teeth were pushed far from the growing tooth germ.

Infection is one of the most serious consequences of an injury. The attached gingiva protects the supporting system of a healthy tooth from oral microbial invasion. If there is rupture of this attachment, bacteria from the mouth can easily invade and infect the injured tissue. Furthermore, unlike adults, when reducing oral bacteria is crucial, youngsters between the ages of 2-4 are unable to rinse their mouth with a chlorhexidine solution. To minimize the possibilities of pulpal necrosis or pathologic root resorption after intrusive luxation type of injuries due to bacterial invasion, antibiotic therapy such as penicillin or erythromycin can be given [17-19].

Meanwhile, the patient was given amoxicillin and Ibugesic orally for three days. Along with recommending a soft diet for 10–14 days, oral rinsing after every meal, and warm saline gargling, the parents were also urged to maintain good dental hygiene. They were advised to brush their teeth with a soft brush after every meal. Informed, valid consent was obtained from the patients before starting of minor surgical treatment.

Hence, all intruded incisors were retrieved while under local anesthesia, with the use of 2% lignocaine hydrochloride, a 1:1,000,000 adrenaline vasoconstrictor, and sutures were given (Fig. 3) (Fig. 4).

Antibiotics and Analgesics were recommended post-extraction for 7 days. In next appointment, extraction site was completely healed (Fig. 5). The extracted teeth were perfectly fine without any root resorption (Fig. 6).

Fabrication of Fixed Functional Space Maintainer

The loss of anterior teeth not only causes an esthetic problem, but also causes trouble speaking and a significant deal of psychological stress to the child. Taking these considerations into account, a fixed aesthetic space maintainer was created. To boost the patient's self-esteem, his own teeth were utilized as the pontic for the prosthetic. Accordingly, the root of all teeth was sectioned, and the maxillary deciduous second molars were fitted with stainless steel bands. After taking of impression and pouring cast, the cast was modified to fit a circular, 0.036-inch stainless steel wire in order to create a prosthetic appliance frame (Fig. 7). Acrylic resin was used to secure the pontic to the wire section and wire was soldered to the bands (Fig.8). Glass ionomer cement was used to secure the space maintainer, and postinsertion instructions were provided (Fig.9). As a result, the patient's confidence was boosted by the prosthetic replacement in addition to its improved phonetics and aesthetics (Fig.10).

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9

Fig. 10

DISCUSSION

In the first three years of life, trauma to the child is very common which leads to intrusive luxation of the deciduous anterior teeth. High flexibility of the bone leads to intrusion instead of other fracture to the primary teeth. Physiological root resorption makes the roots of primary anteriors shorter, contributing to intrusive luxation instead of root fractures.

Spontaneous re-eruption of intruded primary tooth up to 4 months has been reported by Bennett, (1964) and Soporowski *et al*., (1994). In our case, after analysing clinically and radiographically, there was close relationship between intruded primary teeth and permanent teeth. Crown discoloration, pulp necrosis, gingival recession, displacement of tooth, internal or external pathological root resorption, abscesses or cellulitis, or premature loss of primary teeth [49-51], are the consequences of the trauma to the primary teeth. The severity and impact of the trauma, the type of care provided, and the presence or absence of disorders all affect these outcomes.

Holan and Ram [52], conducted a retrospective study on 172 intruded primary incisors, in which they showed that the root tips were moved towards the labial bone plate in more than 80% of the cases. Alveolar bone fractures, the direction of the displaced tooth, the extent of the injury, and ruling out damage to the permanent dentition are all crucial to determine. According to the International Association of Dental Traumatology [53], an extraoral lateral radiograph should be obtained to aid such diagnosis. In our case, there were no such complications, but the intruded primary teeth were unable to re-erupt simultaneously because, it was grade-III Intrusion and RVG revealed Intruded Incisors which appeared foreshortened on the RVG picture that's why extraction was planned accordingly.

Kenny and Yacobi (1988) [54], Andreasen and Andreasen (1994), Wilson (1995), and Andreasen *et al*., (2007) advised prescription of antibiotics after extraction to limit the spread of the infection to permanent tooth bud, as advocated, it was prescribed in this case too. Early extraction of the anterior teeth might cause speech difficulties, the formation of tongue-related habits, and a decline in the child's confidence and self-worth. To overcome these demerits, fixed functional space maintainer with natural teeth or tooth-coloured replacements should be fabricated and luted as applied in our case too. Fixed Functional space maintainers imply better patient's compliance than removable one in toddlers and young children. In our case, patient's own extracted primary teeth were served as fixed pontics after vertical sectioning as supported by the study of (Avdin and Kargul, 2004) [55], and as presumed it saved timings in fabrication, absence of allergy to metal, ease of cleaning, and feeling of naturalness to the child. After the delivery of the appliance, proper oral hygiene

maintenance instructions were given to the parents and regular follow-up visits were emphasised.

CONCLUSION

Intrusive luxation is a complex trauma in primary teeth. Numerous factors need to be considered before formulating a treatment plan in these types of cases. The direction and degree of the intrusion as well as the presence of an alveolar bone fracture are the most crucial variables. A comprehensive assessment of all these factors will allow the clinician to narrow down to a particular treatment plan.

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