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Prevalence and Etiology of Dental Ankylosis in Primary Teeth

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Abstract

Dental ankylosis is a condition characterized by abnormal fusion of the cementum of the tooth with the surrounding alveolar bone, leading to the loss of the periodontal ligament (PDL). This fusion disrupts the normal tooth eruption process, especially in primary teeth, and prevents them from reaching the correct occlusal plane. The exact cause of ankylosis in primary teeth is not fully understood and is the subject of ongoing research. However, it is believed to be multifactorial, including potential contributing factors such as trauma, genetic predisposition, bone disorders, systemic diseases, and infections. Research shows that ankylosis predominantly affects the first lower primary molars, with secondary ankylosis sometimes occurring due to traumatic events. Following the first lower primary molars, the first upper primary molars, second lower primary molars, and second upper primary molars are also frequently affected. Infra-occlusion is approximately 10 times more common in the mandible than in the maxilla and often occurs bilaterally. Clinically, ankylosed teeth cannot be exposed to post-eruption movements and can remain fixed in the infra-occlusion position. The severity of infra-occlusion can vary from mild to complete retention. Histological examinations of ankylosed teeth reveal that resorbed root areas may be replaced by both cementum and bone, establishing a direct connection between the tooth and the surrounding bone. In addition, PDL remnants may be present despite fibrosis and reduced cell number. Treatment goals for infra-occluded primary molars with successive teeth include facilitating the natural eruption of the permanent tooth while protecting the affected tooth and surrounding gum and bone tissue. The goals in the treatment of ankylosed teeth are to preserve the affected tooth as much as possible, protect adjacent tissues, prevent interference with normal growth, enable orthodontic interventions, preserve the aesthetic appearance, and restore normal function.

Keywords: Ankylosis, primary teeth, management

What is already known on this topic?

- *Dental ankylosis prevents permanent teeth from erupting normally and leads to long-term issues.*

What this study adds on this topic?

- *Early diagnosis helps prevent complications.*
- *The causes of dental ankylosis are complex and multifactorial.*
- *Treatment depends on the presence of a permanent tooth and requires careful planning for long-term outcomes.*

INTRODUCTION

Dental anomalies in pediatric dentistry present both challenges and opportunities for clinicians. Among these anomalies, dental ankylosis stands out as a condition with important clinical consequences, especially when it affects primary teeth. Ankylosis refers to the fusion of the tooth root with the surrounding alveolar bone, leading to cessation of normal tooth eruption and potential complications in tooth development. While ankylosis can occur in both primary and permanent teeth, its appearance in primary teeth requires special attention due to its potential impact on growth, occlusion, and future dental health.[1]

Understanding the etiology, diagnosis, and treatment of dental ankylosis in primary teeth is crucial for pediatric dentists, orthodontists, and oral surgeons. Despite its

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relatively low incidence compared to other dental anomalies, the consequences of untreated ankylosis can be very serious, ranging from aesthetic concerns to functional impairments. Additionally, the complex interaction between primary and permanent teeth further emphasizes the importance of early diagnosis and appropriate intervention in the treatment of ankylosed primary teeth.[2]

This review aims to comprehensively investigate various aspects of dental ankylosis in primary teeth, examining in depth its pathogenesis, clinical symptoms, diagnostic methods, and treatment methods. By synthesizing existing literature and clinical evidence, this study attempts to provide information on optimal treatment strategies for the management of ankylosed primary teeth, thereby optimizing outcomes for pediatric patients.[2]

ERUPTION MECHANISM

Tooth eruption, an important process in tooth development, involves a series of complex stages that result in the functional position of the tooth within the oral cavity. Understanding the stages and factors affecting tooth eruption is essential in elucidating the etiology of anomalies such as ankylosis.[3]

The tooth eruption process can be divided into 5 distinct stages: pre-eruption movements, intraosseous eruption, mucosal penetration, pre-occlusal movement, and post-occlusal movement. Each stage is characterized by specific cellular and tissue dynamics that regulate the tooth's journey from its developmental niche within the alveolar bone to its emergence into the oral cavity.[2]

During the pre-eruption phase, teeth are exposed to micromovements within the jaws as they develop within the alveolar bone. As crown formation progresses, intra-osseous movements begin and guide the tooth towards its functional position while root formation occurs. Mucosal penetration marks the transition to accelerated eruption, resulting in the emergence of the tooth in the occlusal plane.[3]

Post-occlusion movements that occur at a slower rate continue throughout life, serving to compensate for wear and maintain the vertical dimension of the occlusion. Numerous theories have been proposed to elucidate the numerous factors affecting tooth eruption, from cellular processes such as the proliferation of the Hertwig epithelial root sheath to the dynamic interaction between the dental papilla and connective tissue. In addition, the pressure applied during the continuous development of the jaw and root movement plays a significant role in regulating the eruption process.[3]

To elucidate the etiology of anomalies such as ankylosis, it is imperative to know the multifaceted nature of tooth eruption. By studying the complex mechanisms that govern tooth movement and development, we can gain invaluable insight into the pathogenesis of ankylosis and design more effective management strategies for this challenging dental condition.[4]

ANKYLOSIS

Dental ankylosis, a pathological fusion phenomenon, entails the fusion of the cementum of the tooth with the surrounding alveolar bone, leading to the destruction of the periodontal ligament (PDL), which is gradually replaced by bone tissue.[5] This abnormal fusion process disrupts the normal course of tooth eruption, especially in the context of the primary dentition, and prevents the teeth from reaching the intended occlusal plane.[4]

The consequence of ankylosis during the eruption of primary teeth is that the teeth stop moving upwards, resulting in what is clinically referred to as infra-occlusion. This infra-occlusion occurs as a distinct anomaly, with the severity of the condition categorized by the position of the tooth relative to the occlusal plane. A simple classification system helps determine the extent of the abnormality, usually designated as "mild," "moderate," or "severe."[2]

The definition of "slight" in this classification scheme relates to the region between the occlusal surface and the proximal contact point and indicates a slight deviation from the expected position. The "moderate" classification covers dimensions that extend from the occlusal surface to the gingival aspect of the interproximal contact points and reflects a more pronounced displacement of the tooth. On the other hand, the "severe" classification indicates areas that extend below the level of the interproximal contacts and indicates a significant deviation from normal occlusal alignment. A demonstration of this classification can be seen in Figure 1.[2]

This classification system serves as a practical tool for clinicians to assess and categorize the severity of infra-occlusion due to dental ankylosis, facilitating communication and guiding treatment planning. By characterizing the extent of the anomaly, clinicians aiming to alleviate the functional and aesthetic consequences associated with ankylosed primary teeth can tailor interventions to meet the specific needs of affected patients.[2]

Primary molars with permanent teeth underneath and slight to moderate infra-occlusion should be observed clinically at 3-6 month intervals. Teeth in this condition may not require any intervention.[6] In case of slight or moderate infra-occlusion, realignment of the mesio-distal dimension and occlusal table may be recommended. This treatment can be performed with composite crowns and onlays or stainless steel crowns, without reducing the gingivo-occlusal distance. If a tooth exhibits rapid development of infra-occlusion, especially at an early age, it can adversely affect the development

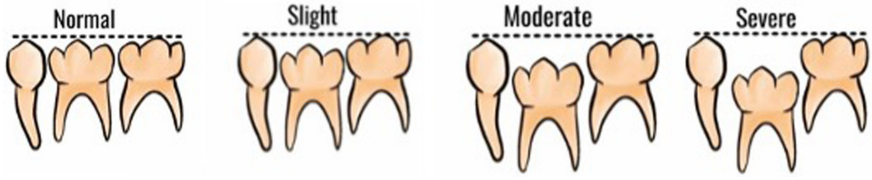

Figure 1. Demonstration of classification by infra-occlusion level.

of the alveolar bone, regardless of whether a permanent tooth is present underneath. Teeth demonstrating rapid infra-occlusion development may be extracted to limit the vertical defects in the alveolar bone. The need for intervention increases with the earlier age at which the diagnosis is made and the severity of the infra-occlusion classification.[7]

ETIOLOGY

The precise etiology underlying ankylosis in primary teeth remains an area of ongoing research, with various theories proposed to elucidate its multifactorial nature. Trauma, genetics, bone disorders, systemic diseases, and infections are among the numerous factors hypothesized to contribute to this pathological fusion phenomenon.[8]

Trauma is an important predisposing factor; damage to the primary tooth can disrupt the integrity of the periodontal membrane and prevent the normal healing process. Such disturbances due to trauma to the periodontal tissues can lead to the eventual replacement of the PDL with bone tissue, resulting in ankylosis.[9]

Infections also arise as potential catalysts for ankylosis through direct invasion of periodontal tissues or secondary spread through the root canal of the tooth. Infections arising from the root canal can spread to surrounding tissues, triggering inflammatory responses that compromise the periodontal membrane and promote bone replacement. Similarly, infections arising directly from periodontal tissues can disrupt the normal periodontal architecture and predispose the tooth to ankylosis.[4,9]

Genetic predisposition and underlying bone disorders also contribute to the complexity of ankylosis etiology. Changes in genetic makeup or abnormalities in bone metabolism may increase susceptibility to ankylosis by disrupting the delicate balance of cellular activities involved in tooth eruption and periodontal maintenance.[10]

Systemic diseases that affect bone metabolism represent another potential pathway by which ankylosis may occur. Diseases such as osteogenesis imperfecta or metabolic bone disorders can compromise the structural integrity of the alveolar bone and interfere with the normal eruption of primary teeth, predisposing them to ankylosis.[11]

The interplay of these factors underscores the multifaceted nature of the etiology of ankylosis and requires a comprehensive understanding of both local and systemic effects on tooth development. Further research aimed at unraveling the complex mechanisms underlying ankylosis will be crucial to developing targeted preventive and therapeutic strategies to alleviate the impact of ankylosis on pediatric dental health.[11]

PREVALENCE

According to the American Academy of Pediatric Dentistry, ankylosis (infra-occlusion) is most commonly seen in the lower first primary molar. Additionally, it is seen at primary and permanent anterior teeth as a result of trauma. Following the first lower primary molar, the first upper primary molar, the second lower primary molar, and the second upper primary molar are often affected by ankylosis. Infra-occlusion resulting from ankylosis is approximately 10 times more common in the mandible than in the maxilla and often occurs bilaterally.[1]

The incidence of ankylosed primary teeth tends to peak between the ages of 7 and 11, with a particularly significant increase in incidence between the ages of 8 and 9.[12,13] Mandibular primary first molars have a higher prevalence before age 9, while maxillary primary first molars are more commonly affected after age 9.[14]

Research shows that the occurrence of infra-occlusion due to ankylosis varies between 1.3% and 8.9% as children get older.[2,15] Gender distribution does not significantly affect the occurrence of ankylosis, as studies show no significant differences between men and women. Interestingly, racial disparities in the prevalence of ankylosis have been noted, with lower incidence observed in black children compared to white children. Specifically, rates of ankylosis were lower in black children at 0.93%, while white children experienced ankylosis at 4.10%.[12]

Ankylosis-related infra-occlusion often occurs in association with other dental anomalies, particularly the absence of consecutive permanent teeth, and has a prevalence rate of 65.7%. In addition, a variety of other dental abnormalities have been documented in association with infra-occlusion, including ectopic eruption of permanent first molars,

cuneiform markings on lateral incisors, enamel hypoplasia, and palatal displacement of maxillary canines.[2,6,16]

The occurrence of infra-occlusion between siblings indicates a potential genetic component in some cases, suggesting a familial predisposition to dental anomalies such as ankylosis. This genetic predisposition underscores the need for comprehensive familial dental evaluations to identify and address potential hereditary factors contributing to dental abnormalities.[17]

DIAGNOSE

Clinical Findings

Clinically, ankylosed teeth cannot be exposed to post-eruption movements and remain fixed in an infra-occluded position under the gum tissue, varying in severity from mild to complete retention. This infra positioning often results in observable clinical consequences, including vertical bone defects, tipping of adjacent teeth, tooth asymmetry, and potential interference with the eruption of permanent successors. Some examples of clinical results are seen in Figures 2 and 3.[18]

During clinical evaluation, specific symptoms may indicate the presence of ankylosis. Percussion testing may produce a distinct, high-pitched sound, suggestive of the lack of PDL elasticity typically associated with ankylosed teeth. Additionally, ankylosed teeth typically exhibit a lack of physiological mobility upon palpation, confirming their immobility. Extensive root resorption may also be observed, indicating the pathological replacement of the PDL by bone tissue.[18,19]

Radiologic Findings

Radiographically, ankylosis is characterized by fusion between the bone and root surface, absence of periodontal space, and opacity loss in severe cases. Radiographic evaluation can reveal dentinal resorption areas and aid in confirming the diagnosis. Radiographically, angular bone defects may be observed. The degree of infra-occlusion is associated with the presence of other dental anomalies. Conventional radiographs and computed tomography (CT) scans are used for diagnosis and treatment planning, with CT preferred for better visualization and localization of impacted teeth.[4,10,19,20]

Figure 2. Mesial tipping of the upper first permanent molar.

Figure 3. Lateral open bite partially due to the ankylosed teeth.

On regular x-rays, it is often possible to see that the ligaments around the teeth are missing.[16] However, if the affected area is very small, it may not be visible. In ankylosis, the roots of attached teeth become difficult to separate from the surrounding bone due to decreased density on the x-ray.[19] Ankylosis of the upper second primary molar can be seen on a routine orthopantomogram radiograph, as shown in Figure 4.[19] In Figure 4, a 12 year old patient, presented to the Accident and Emergency department with facial swelling. On examination, the case showed lateral open bites bilaterally, mesial tipping of the first permanent molars, and over-eruption of the upper second molars. The patient's upper second molars are severly infraoccluded.

Different types of x-rays, such as panoramic, occlusal, and intraoral periapical radiographs, bitewing radiographs, and CT scans, are available to examine people information about the amount of bone present, which is crucial for identification and planning of classification.[18] Examples of ankylosis in periapical radiography and bitewing radiography are seen in Figures 5 and 6.[18,21]

Some researchers have also suggested using dental MRI to pinpoint the location of the nerve. This can help prevent healing and nerve damage.[22]

Histological Findings

Histological observations have revealed that in cases of dental ankylosis, resorbed root areas can be replaced by both cementum and bone, creating a direct link to the psychological socket of the tooth. In addition, PDL remnants associated with fibrosis and paucity of cells may also be present. It is noteworthy that the fusion between bone and dentin

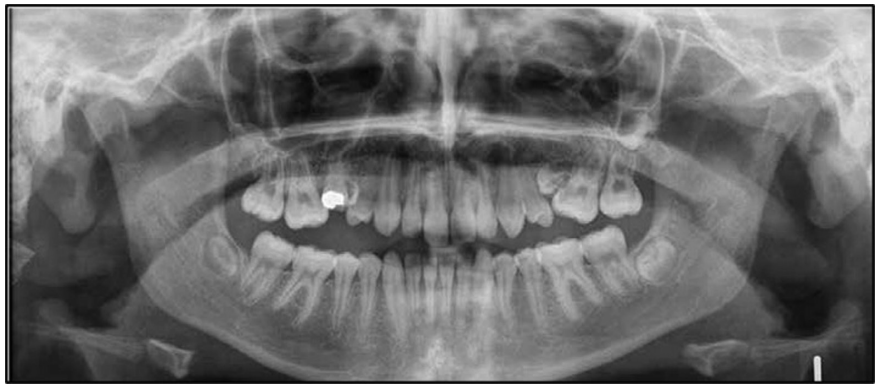

Figure 4. Orthopantomogram showing infraoccluded upper second deciduous molars.

may not occur evenly throughout the entire process of an ankylosed tooth.[23]

Active mucopolysaccharidoses are crucial for the natural process of root resorption during the emergence of permanent successors. However, this activity cannot be detected in cases of ankylosis. Studies have shown that osteoid features accumulate with minimal osteoclastic activity in many ankylosed and few furcation areas. Additionally, teeth without successors exhibit ankylosis closer to the apex.[4]

According to a histological study examining 58 children and 62 infraoccluded teeth, histological findings were examined under 9 headings. In summary, histological examination of all bone samples revealed a normal appearance, and there was no discernible difference between bone samples from the infra-occlusion class and bone samples from the control group. Additionally, using enzyme histochemical methods to investigate metabolic differences, no differences were observed between bone samples from the two groups of teeth. This shows that bone structure and metabolic activity are similar in both groups, and the overall functioning of bone structure or metabolism may contribute to the observed dentition.[5]

Histological examinations revealed cases of ankylosis in 38 of 48 primary molars with infra-occlusion and successors (aged 6-15 years) and in 12 of 14 infraoccluded molars without successors (aged 8-17 years). No signs of ankylosis were observed in any of the 40 control teeth. Ankylosis occurred as a repair process as hard bone-like tissue replaced the previously resorbed root areas and came into direct contact with the dentin. Cell debris was visible within this hard tissue, and distinct rest lines were especially noticeable on the teeth of older subjects.[5]

In all cases, ankylosis was located on the inner surface of the roots. In young children with minimal root resorption, ankylosis usually occurred in a small area (1-2 mm) on the inner surface of the apical third of the root, typically sparing the apex. However, in older individuals with more advanced root resorption, a significant portion of the pulp base may be replaced by hard tissue interpreted as bone, which is in direct contact with the remaining pulp tissue.

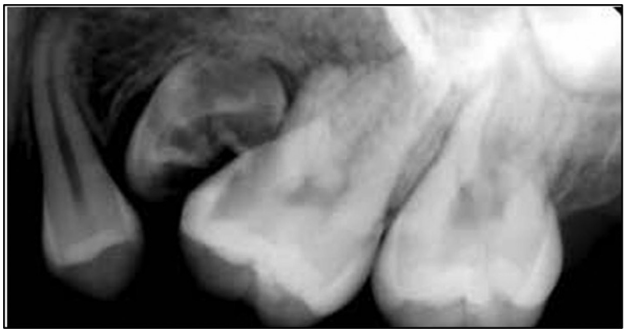

Figure 5. Periapical showing severe infra-occlusion of tooth numbered 65.

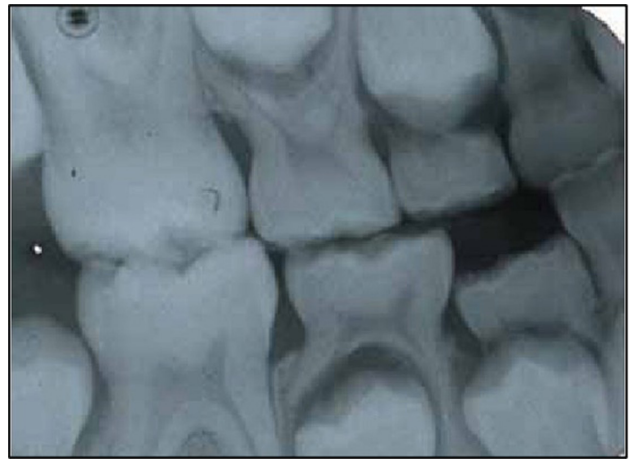

Figure 6. Successive bitewing radiographs showing an angular defect adjacent to the mildly infra-occluded mandibular left first primary molar.

Ankylosis, in which the hard tissue came into direct contact with the pulp tissue, was observed in 24 of the 48 infraoccluded and successive teeth and in one of the 14 non-consecutive teeth. Pulpo-periodontal canals were not observed near the areas of ankylosis.[5]

In cases of infra-occlusion, approximately one-third of cases exhibited an overall reduction in odontoblasts. Additionally, diffuse calcifications, pulp stones, and fibrosis were observed more frequently in infraoccluded teeth than in control teeth. Moreover, aplasia (lack of development) was associated with higher levels of fibrosis compared to cases in which the successive tooth was present. Older teeth tended to exhibit more fibrosis and calcification than younger teeth. These calcifications were found predominantly within the root pulp and at the base of the crown pulp.[23] An example histological section can be seen in Figure 7.[23]

MANAGEMENT

The primary objective in treating infraoccluded primary molars with successors is to facilitate the natural and unimpeded eruption of the succeeding permanent tooth. The treatment goals for ankylosed teeth include protecting the affected tooth as much as possible, safeguarding the surrounding gum and bone tissue of adjacent teeth from damage, preventing any hindrance to normal growth, facilitating orthodontic interventions, preserving the aesthetic appearance, and restoring normal function.[18,21] Deciding on the appropriate course of action can be determined by several variables, including the location and extent of any injury or resorption, the individual's stage of growth, whether orthodontic fittings are necessary, and whether other teeth are suitable for replantation.[20]

When ankylosis is present, orthodontic healing alone cannot be treated effectively, and surgical treatments are required. If tooth resorption exceeds 20% of dentin loss, it becomes mechanically brittle and typically requires extraction. Replacement options include temporary bridges for individuals of continuing gender, replantation of another suitable tooth, implant-supported crowns, or orthodontic foundation closure for individuals of the same gender.[18]

If the tooth is strong enough, it can be relocated to either the original position or a position suitable for the modified orthodontic intervention, usually about two months after the transplant. The ankylosis-resorption can be filled with some surgically accessible amounts of non-resorbable and biocompatible material such as mineral trioxide aggregate or intermediate restorative material. Following this procedure, tooth extraction may proceed once the ankylosis has resolved, but this approach is rarely feasible. It is emphasized that the rapid weakening of teeth affected by ankylosis, especially impacted teeth, does not respond to orthodontic treatment and when combined with the intrusion of adjacent teeth, early diagnosis is expanded.[18]

Ankylosed teeth can be caused by treatment in a variety of ways. When skeletal growth occurs, this can suddenly be

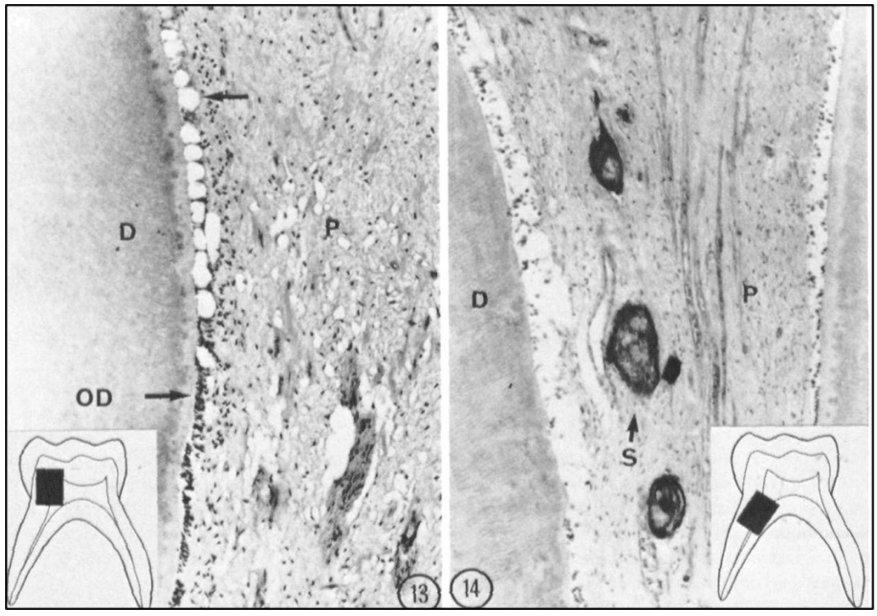

Figure 7. Primary mandibular second molar with infra-occlusion in 8 years-old boy. Pulpal changes with degeneration in odontoblastema (OD), hyalinization, and moderate inflammation are seen in pulp (P), H&E, original magnification ×125. Primary mandibular second molar in 10 years old boy. Section from root pulp (P). Pulpal stones (S) are present. H&E, original magnification ×125.

triggered by neighbors' teeth erupting further, exacerbating the underocclusion. The early appearance of ankylosis and infra-occlusion was described by Becker. It increases the risk of various issues. These include ground avulsion due to the tipping of adjacent teeth, the release of vertical eruption of adjacent teeth, and midline deviation in unilateral cases. Severe ankylosis in the late primary or early mixed dentition may cause greater problems, especially if the second primary molars next to the first permanent molars are affected. Ankylosed second primary molars also pose a periodontal threat to adjacent first molars.[21]

Leave an ankylosed primary molar occluded for too long, making it difficult to surgically remove and potentially compromising the alveolar area of the underlying premolar. This delay can also increase the likelihood of the appearance of loss and severe tipping of teeth and may leave both and buccolingual alveolar bone levels, which may complicate denture replacements. It is very important for ankylosed primary molars to erupt as permanent teeth, as natural exfoliation usually occurs, although in some countries interventions may be necessary to prevent foreign teeth and negative effects on occlusion.[21]

In decisions regarding treatment, issues such as the condition of the primary molar tooth, relations with neighboring teeth, and general occlusion are taken into account. The long-term plan includes preserving the primary tooth, ligating it, and separating subsequent areas or transplanting a tooth. Various interventions, such as interproximal reduction of retained primary molars, repair to maintain occlusal integrity, and preservation of alveolar ridges for prosthetic replacements, should be considered on an individual case basis. Close monitoring and timely intervention are essential to prevent adverse outcomes and achieve the best results for the costs. An example of treatment is shown in Figure 8.[21] In this case, it is important to preserve the mesio-distal width in the restoration. If there is a mistake in this regard, a class 2 molar relationship may occur despite a class 1 canine relationship. Therefore, attention should be paid to the reduction, and the width of the underlying missing tooth should also be taken into account. Pulp horns should also be taken into consideration during reduction.

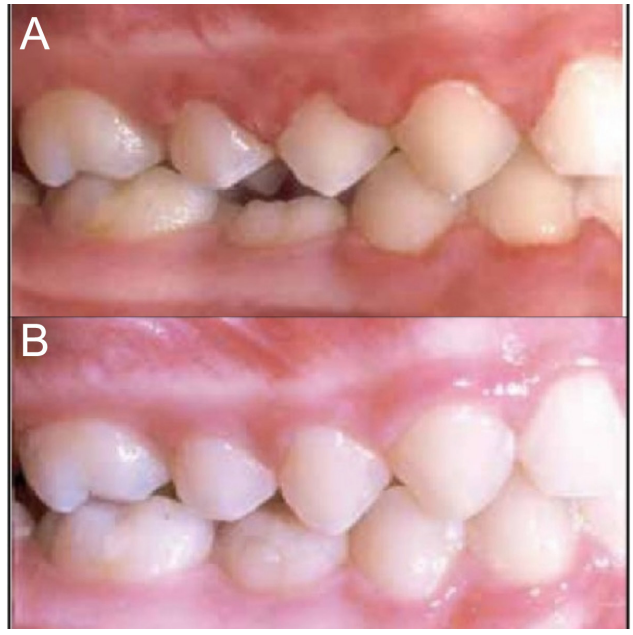

Figure 8. Post de-band photograph showing: (A) mild infra-occlusion and interproximal reduction of mandibular second primary molar; (B) occlusal surface has been restored with composite to maintain arch integrity and prevent supra-eruption of opposing teeth.

Treatment of Infraoccluded Primary Molars with Successor

The normal process by which small teeth become present involves their natural distribution as subsequent teeth emerge and the gradual resorption of the cooling of sunken primary teeth. However, when extensive bone ankylosis occurs, this natural shedding process can be disrupted, potentially leading to alignment problems in the future. Research shows that a delay of up to 6 months in the shedding process can generally be considered acceptable, and the severity of treatment corresponds to the length of the delay. Therefore, the first step in addressing this situation is to determine when the problem first occurs.[24] Decision tree of treatment for infraoccluded primary molar with successors, shown as Figure 9.[20]

According to Kurol,[23] a cautious approach that includes watchful waiting and patient observation is recommended. Late-onset cases typically present with minor infra-occlusion. Here, the treatment goal focuses primarily on facilitating the spread of the ankylosed primary tooth. However, early-onset cases can be further classified depending on whether they are diagnosed immediately or later in development.

Early-onset disorders are more likely to be diagnosed late, adjacent teeth to be knocked out, and the opposing tooth to be over-erupted. This can be attributed to malocclusion and other orthodontic issues. To effectively address such problems, orthodontic intervention followed by extraction of the affected primary tooth may be necessary.[20]

In addition, the loss of space caused by the teeth being bent can be eliminated by removing the fragmentation area. This device helps eliminate further misalignments, preserving the necessary space for permanent successors to emerge. By addressing these issues early and effectively, clinicians can alleviate the potential long-term occurrence of ankylosed primary teeth and promote proper tooth development and alignment.[20]

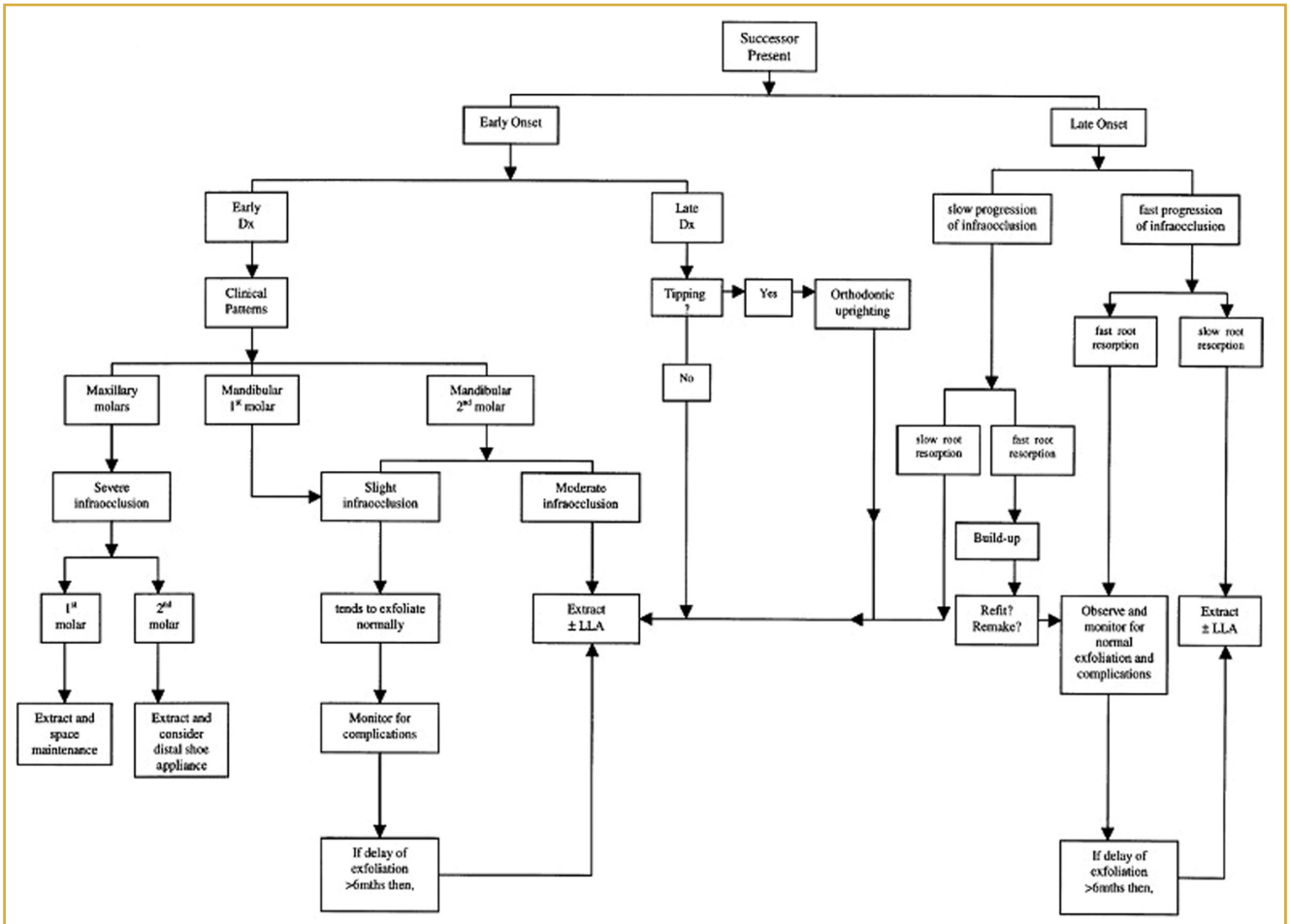

Figure 9. Treatment decision-making model for infraoccluded primary molars with successors.

Where premolars are present, the normal process involves their natural shedding as subsequent teeth emerge and the roots of sunken primary teeth gradually resorb. However, when extensive bone ankylosis occurs, this natural shedding process can be disrupted, potentially leading to alignment problems in the future. Research shows that a delay of up to 6 months in the shedding process is generally considered acceptable, and the severity of infrared blockage corresponds to the length of the delay. Therefore, the first step in addressing this situation is to determine when the problem first appeared.[20]

In cases where early-onset disorders are diagnosed late, there is a higher chance that the adjacent teeth will be overturned, and the opposite tooth will be over-erupted. This can lead to malocclusion and other orthodontic problems. In such cases, orthodontic intervention followed by extraction of the affected primary tooth may be necessary to effectively address these problems.[20]

In addition, space loss caused by the bending of adjacent teeth can be eliminated by using a removable space maintainer. This device helps prevent further misalignment by preserving the necessary space for permanent successors to emerge. Addressing these issues early and effectively can alleviate the potential long-term consequences of leaking, ankylosed primary teeth and promote proper tooth development and alignment.[20]

Treatment of Infraoccluded Primary Molars Without Successor

Ankylosed primary molars without permanent successors typically do not fall out spontaneously and exhibit slow root resorption over time. This slow resorption process can, in some cases be associated with the absence of premolars, further complicating the situation. In 17% of cases where deciduous molar teeth are infraoccluded, there is a distinct pattern of missing premolars. Decision tree of treatment for infraoccluded primary molars without successors, shown as Figure 10.[20]

Early intervention through proactive removal of these ankylosed teeth is often recommended, especially after a thorough evaluation taking into account factors such as the degree of root resorption, loss of adjacent periodontal support, and the

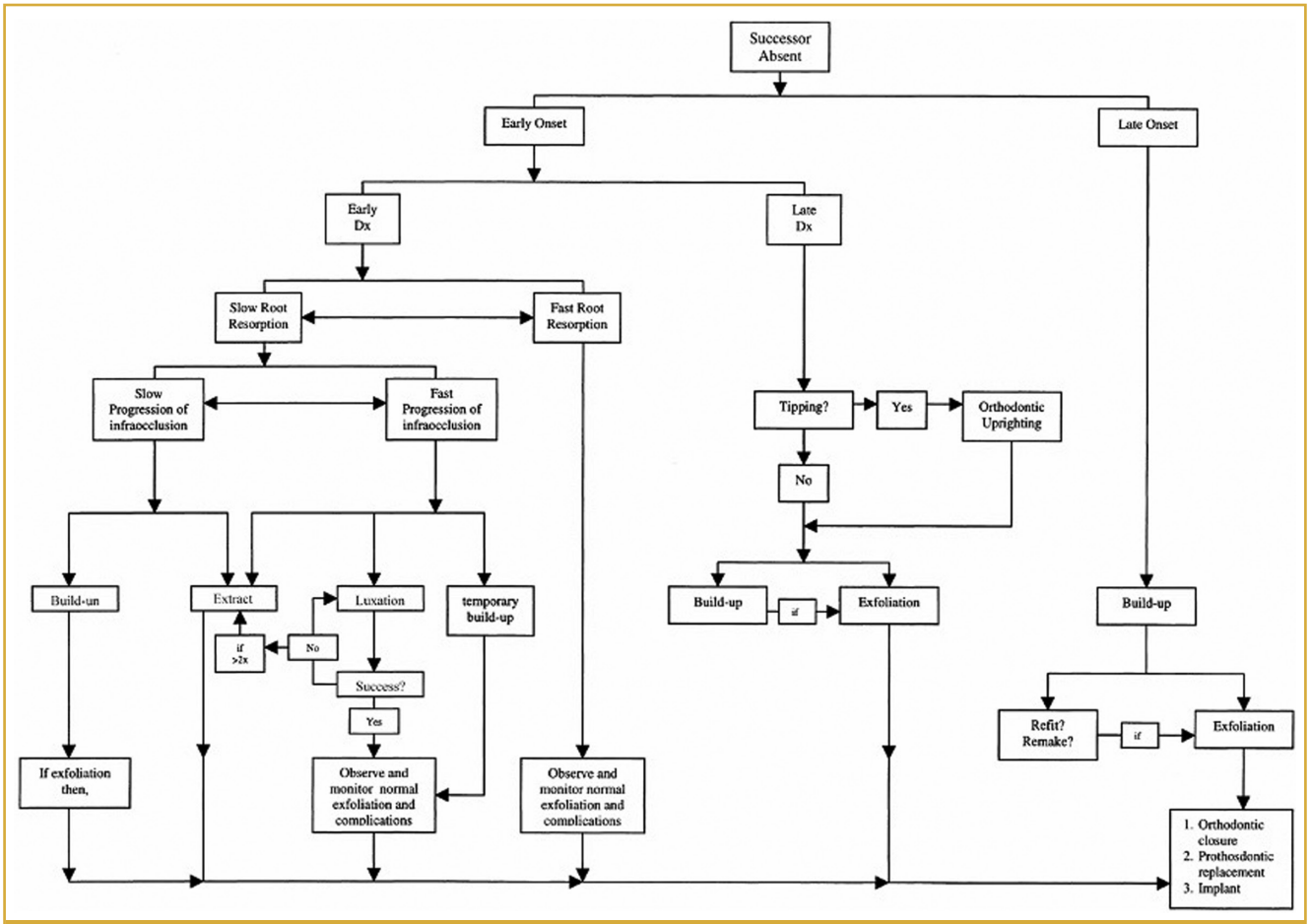

Figure 10. Treatment decision-making model of infraoccluded primary molars without successors.

age at which the condition is identified. Cases in which infra-occlusion coincides with the absence of permanent successors are considered atypical and require careful evaluation because of their potential to worsen the condition.[20]

Although severe infra-occlusion is relatively rare, it is more often associated with the absence of permanent successors. Consequently, such cases require special care and attention during treatment planning, taking into account the patient's age, occlusal condition, and the general condition of the affected tooth.[22]

When infra-occlusion progresses slowly and the primary molar remains functional, it can be retained in the dental arch and used as a natural space maintainer. However, measures such as increasing crown height and increasing proximal contacts may be necessary to prevent occlusal disorders. Delaying extraction should be avoided to prevent further loss of alveolar bone, and orthodontic intervention may be necessary to eliminate gaps that appear after extraction.[22]

Conversely, if an ankylotic primary tooth without a successor remains functional, various restorative options can be explored. For example, vertical lengthening of the crown using a stainless steel crown or the addition of posterior composite material to restore acceptable occlusion may be considered. These interventions help preserve mesiodistal size and maintain oral function until a more permanent solution, such as dentures can be found.[25,26]

Ankylosed primary molars often overlap missing premolars, causing concerns about maintaining adequate bone support and retention methods. Research shows that bone healing is only possible if the successor tooth is present. The onset of ankylosis can be predicted by plotting infra-occlusion measurements against normal occlusion levels over time using the Darling and Levers method. Estimation of the age of onset of ankylosis by the Darling and Levers method is seen in Figure 11.[27] Early-onset cases may require procedures to restore tooth height and occlusion. Different methods can be used for this, such as composite resin, crowns, and onlays. Delayed diagnosis of early-onset cases can lead

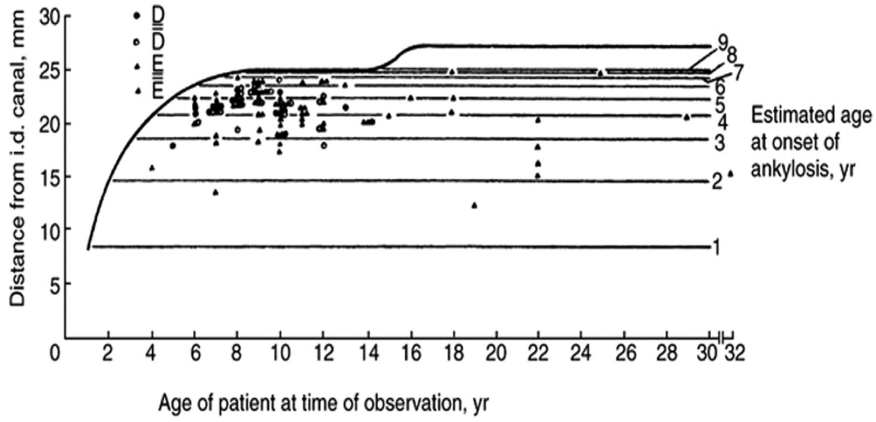

Figure 11. Estimation of the age of onset of ankylosis using the normal occlusal plane.

to complications requiring orthodontic correction and subsequent restoration. The rate of root resorption varies, but lower teeth tend to have a slow rate of exfoliation. Rapid absorption requires monitoring until hatching, while slow absorption may allow longer survival with regular assessment and possible stocking procedures. Ridge defects should be monitored, and treatment options may include orthodontic closure, denture replacement, or implants; this requires collaboration with specialists such as orthodontists, implantologists, prosthodontists, and periodontists. Rapid progression of infra-occlusion with slow resorption may require urgent measures such as extraction or luxation to facilitate evacuation. However, luxation is less popular due to its invasive nature and uncertain results.[28]

RESULT

Dental ankylosis, characterized by the fusion of tooth cementum with surrounding alveolar bone, poses significant challenges in primary dentition. This pathological fusion disrupts the normal process of tooth eruption by replacing the PDL with bone tissue. Consequently, affected teeth fail to reach the intended occlusal plane, resulting in infra-occlusion.[29-31]

Infra-occluded primary teeth, unable to undergo post-eruption movement, remain fixed below the gum line, presenting varying degrees of severity. Clinically, this condition increases the risk of complications such as adjacent tooth tipping, hindered vertical eruption, and midline deviation, particularly in unilateral cases. The impact intensifies when second primary molars adjacent to first permanent molars are involved.[31]

Effective management of dental ankylosis demands consideration of multiple factors, including tooth location, shape, extent of injury or resorption, stage of individual growth, necessity for orthodontic interventions, and suitability for replantation of adjacent teeth. In orthodontic treatment, ankylosis is broken mechanically by luxating the tooth. The aim here is to protect the feeding vessels during the procedure. After the tooth is grasped with appropriate forceps, it is gently rocked buccolingually and mesiodistally, and the continuity of the PDL is allowed after the reparative process. Orthodontic force is then applied.[32] Decisions regarding treatment modalities should be tailored to each patient's unique circumstances to optimize outcomes and minimize complications.[20]

Understanding the clinical implications and appropriate management strategies for dental ankylosis in primary dentition is crucial for dental practitioners to provide optimal care and prevent potential long-term sequelae.[20,25]

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