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Disorders related to dental eruption: A review

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Abstract
Introduction: Dental eruption is of great medical importance due to its crucial role in the proper development of the oral and general health of the individual.
Objective: A review was carried out in the databases Scopus, PubMed and Google Scholar with the keywords dental eruption, ectopic eruption, anodontia, and delayed eruption, accelerated tooth eruption.
Methodology: A search was carried out in the Pubmed, Google Schocar and Scopus databases using the keywords "dental eruption", "ectopic eruption", "delayed tooth eruption", "accelerated tooth eruption", "anodontia" and "hypodontia".
Results: The results on dental eruption disorders show that each condition has specific characteristics in diagnosis and management. Accelerated tooth eruption can cause misalignment, requiring orthodontics. Delayed eruption, associated with retained deciduous teeth, is often managed with extractions and orthodontics. Anodontia and hypodontia, usually of genetic origin, require radiographic diagnosis to plan prostheses or implants. Ectopic eruption can complicate dental alignment, and its management varies from observation to extractions. These findings emphasize the need for a multidisciplinary approach and early intervention to improve dental health in pediatric patients.
Conclusion: Early identification and proper management of these problems are essential to prevent long-term complications, such as malocclusions, infections, and functional difficulties in mastication and speech.

Keywords: Dental eruption, ectopic eruption, delayed tooth eruption, accelerated tooth eruption, anodontia, hypodontia

1. Introduction
Tooth eruption is of great medical importance due to its crucial role in the proper development of an individual's oral and general health [1]. During eruption, teeth emerge through the gum in a process that begins with the primary teeth at around six months of age and continues with the appearance of the permanent teeth between the ages of six and twelve years [2]. Correct eruption of teeth is essential for the development of essential functions such as chewing, speech and harmonious growth of the facial structure [3]. In addition, it can be an indicator of the general health status of the child, as certain systemic disorders, such as endocrine diseases or genetic syndromes, can manifest themselves through alterations in the eruption pattern [4].
Disorders related to dental eruption, such as pain, inflammation, eruption cysts and pericoronitis, can significantly affect the quality of life of children, generating discomfort, feeding difficulties and sleep problems [5]. Early detection and treatment of these complications are essential to prevent long-term effects, such as malocclusions or dental alignment problems, which could require costly and prolonged orthodontic interventions [6]. In some cases, an irregular or abnormal eruption may also interfere with oral hygiene, increasing the risk of caries and infections [7]. Tooth eruption is a physiological process in which teeth emerge through the gingiva to take their position in the dental arch. This phenomenon begins with the primary dentition, which typically begins around six months of age and is completed by the age of three years, followed by the eruption of the permanent teeth, which occurs between the ages of six and twelve years [8, 9].

Any deviation in the timing, sequence or morphology of eruption may be indicative of underlying pathologies. Local factors, such as infections or trauma, as well as systemic conditions, such as endocrine disorders or genetic syndromes (e.g., Down syndrome), can alter the normal course of tooth eruption [10,11].

There are also alterations in eruption time, such as early or late eruption, which may be related to systemic or hereditary factors, and pathological resorption of primary teeth, which affects the development of the permanent dentition [12,13].

It is extremely important to understand disorders related to dental eruption, given their significant impact on oral health and child development. These conditions are common in pediatric dentistry practice and can cause pain, discomfort and problems in masticatory function and facial growth. In this work we reviewed the literature on the physiological and pathological factors that affect the dental eruption process, as well as identifying and understanding the most common alterations, such as ectopic eruption, anodontia, and delays or accelerations in dental eruption.

2. Methodology

Bibliographic searches were conducted across PubMed, Scopus, and Google Scholar to identify relevant published studies. The selected articles were evaluated based on predefined criteria, including identification, screening, eligibility, and inclusion, with standardized measurement tools applied for quality assessment. A systematic search strategy was employed using Boolean operators (AND, OR, NOT) with keywords such as "dental eruption¨, ¨ectopic eruption¨, ¨delayed tooth eruption¨, ¨accelerated tooth eruption¨, ¨anodontia¨ and ¨hypodontia¨. Only high-impact journals were considered for inclusion.

3. Results

3.1 Ectopic Eruption

3.1.1 Etiology

Ectopic eruption (EE) of first permanent molars (FPMs) represents a local eruption anomaly that causes the permanent first molars to remain blocked under the distal surface of the deciduous second molar, leading to their inability to erupt to the level of the occlusal plane and to pathological resorption of the roots of the deciduous second molar [14]. The etiology of EE of FPMs is multifactorial, including local, genetic, and hereditary factors, and its prevalence is different in various populations worldwide. Generally, differences in prevalence are related to the size of the sample in which the study was conducted, the age range of the patients included in the study or the dental status of the patients investigated [15].

It is also often found in association with other dental anomalies, such as infroclusion of primary molars, small maxillary lateral incisors, congenitally missing second premolars and permanent canine [16].

In addition, the increased prevalence of EE of FPM among siblings indicates a genetic link. To prevent the subsequent development of malocclusions, early detection of EE of FPM is essential and can be achieved through a thorough examination of routine radiographic images taken for children between the ages of five and seven years (i.e., prior to the eruption of FPM). Dentists should also anticipate the EE of FPMs when there is a delay of more than six months or when at least one FPM has an abnormal eruption position compared to the other FPMs [17].

Ectopic eruption can be classified into two types: reversible and irreversible. In the reversible type, the molar is released from the ectopic position and erupts in normal alignment, with the second primary molar remaining in position. Most of the permanent molars in children with reversible patterns had been released by the age of 7 years. In contrast, when irreversible, the maxillary FPM remains unrotated and in contact with the cervical root area of the primary second molar. Therefore, until the age of 7 and 8 years, any ectopic eruption of FPM should be considered irreversibly blocked [18].

3.1.2 Clinical and radiological diagnosis.

Ectopic eruption of the FPM is diagnosed mainly by radiographs, either as an incidental finding after radiographic examination for a different dental complaint or after clinical suspicion when there is a delay of more than 6 months of eruption or asymmetry in FPM eruption. Radiographically, it appears that the ectopically erupted FPM is "impacted" on the distobuccal root of the primary second molar [19]. Early evaluation of the appropriate type of radiographs to monitor the timing of FPM eruption is important to detect the problem and propose the opportunity to avoid possible disadvantages. If diagnosed between 5 and 6 years of age, a "watchful waiting" observation approach with appropriate follow-up may be indicated, where up to two-thirds are expected to self-correct [20]. Self-correction becomes more unlikely approaching the age of 7 years, where continued "locking" of the FPM with the severely absorbed second primary molar usually requires intervention. Another important milestone is when the opposing molar reaches the level of the mandibular occlusal plane. At this point, intervention is indicated to establish adequate vertical control and prevent supraeruption. Therefore, the goal of treatment is to move the ectopically erupting tooth away from the absorbing tooth, allowing it to erupt and retaining the primary second molar [21].

3.1.3 Clinical management

The management of ectopic eruption depends on the severity of the case and the age of the patient. In some cases, especially in younger children, observation may be chosen, as the ectopic eruption may correct itself spontaneously. However, if the tooth affects neighboring structures, orthodontic spacers can be used to guide it into its proper position. When a deciduous tooth blocks eruption, extraction of the primary tooth may facilitate the process [19]. In more severe cases, orthodontic treatment is required to correct the malocclusion, and if the tooth is too displaced or impacted, surgical extraction may be necessary [17].

Ectopic eruption is a dental disorder in which teeth emerge in an abnormal position, which can affect dental alignment and occlusion. This phenomenon is most common in the first permanent molars and upper canines, and may be influenced by factors such as lack of space, tooth anatomy, or hereditary conditions.

3.2 Anodontia and hypodontia

3.2.1 Etiology: The main causes of anodontia and hypodontia are genetic in origin, as they are associated with mutations in genes involved in dental development, such as PAX9 and MSX1, which affect tooth formation [22]. These conditions can occur in isolation or as part of syndromes, such as ectodermal dysplasia syndrome, which also affects the growth of other structures, such as hair and nails. Environmental factors, such as severe infections or trauma during dental development, can also play a role, although genetic causes are the most common [23].

Most cases of congenital missing teeth have a genetic basis, and some forms of dental agenesis may be caused by one or more point mutations in a polygenic system closely linked to an autosomal dominant trait [24]. The absence of congenital teeth is caused by a disruption in tooth formation during the initiation and proliferation stages. Dental agenesis (missing teeth) occurs in more than 150 syndromes, but there are syndromic and non-syndromic variants [23].

3.2.2 Clinical and radiological diagnosis

The diagnosis of anodontia and hypodontia combines clinical evaluation with radiographic studies to obtain a complete picture. Clinically, the dentist identifies missing teeth in relation to the expected eruption sequence; in children in mixed dentition, the absence of permanent teeth after exfoliation of the primaries is a key sign [25]. Radiographically, a panoramic view allows visualization of the entire arch and confirmation of the absence of dental germs, while cone beam computed tomography (CBCT) may be necessary in complex cases to obtain a detailed image of the bone structure and tooth positions [26].

3.2.3 Clinical management.

It focuses on restoring function and esthetics on a temporary basis until the child reaches the bone maturity necessary for definitive treatments. In cases of mild dental absences, temporary removable prostheses can be used to allow masticatory function and maintain space for future treatment. Orthodontics is essential to align and prepare the dental arch, facilitating the proper development of the dentition and jaw. In addition, the dental team should provide psychological support, as these conditions can affect self-esteem in children [25]. A multidisciplinary approach, with pediatric dentists, orthodontists and, in the future, specialists in prosthodontics or implantology, is key to plan a comprehensive treatment adapted to the patient's growth [26].

Anodontia and hypodontia are conditions that can affect both primary and permanent dentition, and their origin is usually related to genetic factors and specific syndromes. The absence of teeth can compromise masticatory function, esthetics, and proper development of the mandible and maxilla.

3.3 Delayed eruption of teeth.

3.3.1 Etiology

Dental anomalies are the main manifestations of cleidocranial dysplasia (CCD), with most patients showing failure or delayed eruption of permanent teeth causing great physical and financial burdens. We previously reported ten independent cases of CCD presenting with delayed eruption of permanent teeth [27]. However, the molecular mechanism underlying the tooth eruption abnormality in CCD has not been fully elucidated [28].

The most common manifestations of congenital hypothyroidism, also known as cretinism, are thickened lips, macroglossia, malocclusion, and late eruption of both dentures [29]. Thickening of the lips and enlargement of the tongue (macroglossia) are due to increased accumulation of smooth subcutaneous mucopolysaccharides, which result from the breakdown of glycosaminoglycans [30].

3.3.2 Clinical and radiological diagnosis

The diagnosis of delayed tooth eruption combines clinical evaluation and radiographic studies [30]. Clinically, the dentist examines the development of the teeth in comparison with normal eruption times, detecting any teeth that have not yet appeared in the oral cavity in the expected period. The presence of factors that may influence the delay, such as retained deciduous teeth, malformations or a history of trauma and infection, is also considered. Radiographically, a panoramic radiograph allows visualization of the development and position of the teeth that remain in the bone [28]. In more complex situations, a CBCT provides three-dimensional images to assess the exact location of the tooth, bone density and possible obstructions, which is crucial in cases where teeth are impacted or other structural abnormalities are present.

3.3.3 Clinical management

If the delay is identified as being due to obstructive factors, such as prolonged retention of a primary tooth, extraction of the deciduous tooth may be chosen to facilitate eruption of the permanent tooth [27]. In other cases, early orthodontic treatment helps to create space in the dental arch, guiding the permanent teeth into their correct position. If the cause is systemic, such as hormonal deficiencies or nutritional problems, collaboration with specialists is undertaken to treat the underlying condition and promote eruption. In cases where the delay is severe or affects esthetics and function, temporary dentures are used until the permanent tooth erupts or is ready for definitive treatment [29].

Delayed dental eruption can affect the oral and general health of children, as missing teeth can hinder chewing and speech, in addition to contributing to problems with self-esteem and socialization. Adequate clinical follow-up is essential to identify underlying causes and determine if treatment is necessary.

3.4 Accelerated dental eruption

3.4.1 Etiology

Previously, the pathogenesis of natal teeth was thought to be due to aberrant anatomy with superficial positioning of tooth germs [31]. More recently, however, natal teeth are thought to be due to an accelerated or premature developmental pattern of normal primary deciduous teeth [32].

On the other hand, if tooth eruption is dependent on infant diet, then the effects of the infant formula group must be independent of or interact with trajectories of early weight gain. Anthropometric and dentition data collected during a trial in breastfed infants, most of whom were never fed infant formula and were breastfed for at least 10.5 months, were included to explore the effects of breast milk diet on primary tooth eruption, but only at age 10.5 months [33].

3.4.2 Clinical and radiological diagnosis

The diagnosis of accelerated tooth eruption combines clinical and radiographic evaluation to confirm that teeth have emerged before the average age of eruption. Clinically, the dentist observes the eruption sequence in comparison to normal standards of tooth development; early erupting teeth may create misalignment, spacing or occlusal difficulties. Radiographically, a panoramic radiograph allows assessment of whether erupting teeth are in advanced stages of development compared to the rest of the dentition [32]. In complex cases, the use of CBCT can help determine the exact position and status of the teeth, in addition to planning orthodontic treatment if accelerated eruption interferes with dental alignment and function [31].

3.4.3 Clinical management

The clinical management of accelerated tooth eruption

focuses on maintaining the alignment and function of the dentition, and varies according to the severity and impact on dental arch development. In mild cases, regular follow-up may be sufficient to monitor growth and detect possible complications. If accelerated eruption causes misalignment or spacing, early orthodontic treatment can be implemented to guide tooth position and prevent future malocclusions. In situations where the growth and eruption of other teeth may be affected, the placement of space maintainers helps to ensure that there is sufficient space for the eruption of the remaining permanent teeth, preserving arch harmony [33].

Accelerated eruption can result in a number of complications, including malocclusion problems, lack of space in the dental arch, and an increased risk of caries in teeth that emerge early.

3.5 Impacted or impacted teeth

3.5.1 Etiology

Although relevant benefits of interceptive treatment in the early mixed dentition have already been demonstrated, early diagnosis of potentially affected canines is not always performed in time [34]. Possibly because canine ectopic eruption is a silent developmental problem that may have associated genetic or environmental risk factors. A previous study reported that, in a sample of palatally displaced canines, 48% of patients had some anomaly of the maxillary lateral incisor, including a peg-shaped, small or absent lateral incisor, while 52% did not [35].

3.5.2 Clinical and radiological diagnosis.

Despite their great diagnostic relevance, the clinical signs associated with potentially affected canines at an early age may be subtle and less well known than the widely reported radiographic findings. From radiographic studies, it is known that the characteristics of the maxillary lateral incisor may influence and be influenced by the maxillary canine eruption pathway [36]. According to the Ericson and Kurol criteria, 8% of children older than 10 years may require a complementary radiographic examination [37]. However, when known genetic and environmental risk factors are not present, patients may have a lower risk of canine displacement and may have more restricted clinical signs. To our knowledge, no other non-radiographic study has excluded known genetic and environmental risk factors to assess whether clinical signs can still predict mesially displaced canines in low-risk patients [38].

3.5.3 Clinical management.

Previous studies reported conflicting results after deciduous canine extraction. Yoshihara *et al*. and Kau *et al*. reported significant improvement in mandibular incisor alignment after serial extraction. After extraction of lower primary canines, 72% of patients had no clinical improvement in incisor crowding, which meant that there was a 1 in 4 chance of real orthodontic benefit. Many drawbacks were found to be associated with early extraction of primary canines. Impaired eruption of permanent canines due to mesial migration of permanent molars, retrusion, and retroclination. Mandibular permanent incisors were observed. This created controversial opinions on serial extraction due to its drawbacks and effects of treatment outcomes.

Causes of tooth retention may include lack of space in the dental arch, anomalies in tooth position, or the presence of cysts and tumors. Retention can lead to significant complications, such as infections, pain, damage to adjacent teeth, and occlusion problems.

4. Conclusion

Disorders related to dental eruption, such as ectopic eruption, anodontia, hypodontia, delayed eruption, and accelerated eruption, can significantly impact oral health and overall well-being. These conditions may lead to functional, aesthetic, and psychosocial challenges, affecting chewing, speech, and self-esteem. Early diagnosis and appropriate clinical follow-up are crucial to address underlying causes and prevent complications such as malocclusion, dental misalignment, and jaw development issues. Treatment strategies should be tailored to each case, considering genetic, anatomical, and environmental factors. By implementing timely interventions, dental professionals can help restore proper function, improve aesthetics, and enhance patients' quality of life. Preventive care and patient education also play a key role in minimizing long-term consequences, ensuring optimal oral health development.

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6. Author’s Contribution

Not available.

7. Conflict of Interest

Not available.

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9. References

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