Factors associated with the eruption of permanent teeth: A literature review

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ABSTRACT
Variation in normal tooth eruption is a common occurrence, but significant deviations from established norms should prompt the clinician to perform diagnostic procedures to assess the patient's health and development. Disturbances in tooth eruption time may be symptoms of general conditions or indicative of altered physiology in craniofacial development. The objective of this literature review is to analyze the general factors that may influence the complex dynamics of permanent tooth eruption. While the eruption of permanent teeth is under significant genetic control, it is important to recognize other general factors that may play a crucial role in this biological process. Other general factors, such as gender, socioeconomic status, craniofacial morphology, and body composition, can interact in complex ways and influence tooth eruption. This approach seeks to provide a comprehensive understanding of the multiple variables involved in the eruption of permanent teeth. It is noteworthy that the most striking disorders in tooth emergence are often associated with systemic diseases and syndromes, underlining the need for an integrated approach that considers both oral health and the general condition of the body.

Keywords: Dentistry, Pediatric dentistry, Tooth, Eruption.

1 INTRODUCTION

Tooth eruption is defined as the movement of the tooth from its site of development in the alveolar bone to the occlusal plane in the oral cavity. Tooth eruption is a complex and tightly regulated process, divided into five stages: pre-eruptive movements, intraosseous stage, mucosal penetration, pre-occlusal and post-occlusal stages (AKTOREN *et al*., 2010). Pre-eruptive movements occur during crown formation and are so small that they can only be observed by vital staining experiments (WISE *et al*., 2002; MCDONALD *et al*., 2004).

Active eruption movements occur when root formation begins, and the eruptive force was thought to come from the periodontal ligament. Although the mechanisms of tooth eruption are still under debate, it has been suggested that the periodontal ligament provides the eruptive force after the tooth pierces the gum, but not during the intraosseous stage (KJÆR, 2014; PANDEY *et al*., 2014). In order for active tooth eruption to begin, an eruption pathway must be formed by osteoclasts in the alveolar bone. In the surrogate dentition, this path follows the gubernacular canal above each tooth;

that is, bone resorption widens the canal to allow the crown to pass through it and exit the alveolar bone (WISE, 2009; AKTOREN *et al*., 2010).

The dental follicle (FD) plays an important role during the intraosseous stage of the eruption. Osteoclasts that create the eruption pathway are formed from mononuclear cells, which, in turn, are recruited into the FD by chemokines CSF-1 (functional colony-stimulating factor-1) and MCP-1 (monocyte chemotactic protein-1). Osteoblasts can also influence the eruption process by activating osteoclasts. The formation of the tooth eruption pathway is a localized, genetically programmed event that does not require pressure from the erupting tooth. The genes and putative eruption products are mainly located in the FD or the stellate reticulum (RICHMAN, 2019; WAGNER *et al*., 2023). During the intraosseous stage, there is a coordinated translocation of the tooth into the resorbed space, bony apposition at the bottom of the FD, and simultaneous elongation of the root. The formation of the eruption path is completed shortly after the cusps reach the alveolar crest, and at this point the eruption rate accelerates (RICHMAN, 2019; GOLDBERG, 2023).

The outer epithelium of the tooth bud enamel proliferates and fuses with the oral epithelium, creating the junction epithelium on the tooth surface. The erupting tooth penetrates the mucosa and begins the pre-occlusal stage. As the root grows and bone forms at the base of the bony crypt, the tooth reaches the plane of functional occlusion (AKTOREN *et al*., 2010). Most of the post-emergent eruption occurs during the night. Once occlusion is achieved, the speed of tooth eruption slows down dramatically, but continues at a slow rate throughout life, compensating for tooth wear. If the antagonist tooth is lost, the rate of eruption increases (KUROSAKA *et al*., 2022; ROULIAS *et al*., 2022).

Given the complexity surrounding the tooth eruption process, the aim of the present study is to review the literature on the factors associated with the eruption of permanent teeth.

2 MATERIALS AND METHODS

This study consists of a literature review, using articles from the following databases: Scientific Electronic Library Online (SCIELO), Latin American and Caribbean Health Sciences Literature (LILACS), Brazilian Bibliography of Dentistry (BBO), Google Scholar and National Library of Medicine (PUBMED/Medline). The descriptors used were "Dentistry", "Dental eruption" and "Influencing factors".

3 LITERATURE REVIEW

3.1 GENDER

Observations on tooth emergence indicate that, in girls, permanent teeth tend to erupt earlier than in boys. Significant differences were identified, especially for the lateral incisors and maxillary canines, as well as for the mandibular canines (MARJIANTO *et al*., 2019; RAHMAWATI *et al*., 2022).

The average discrepancy in eruption times varies between 4 and 6 months, being more pronounced in permanent canines. Earlier eruption of permanent teeth in women is associated with earlier onset of the maturation process. A difference in the eruption sequence was noted, particularly during the second phase, with classical orders occurring more frequently in males compared to females (POOJA *et* al., 2021).

3.2 NUTRITION

Despite the paucity of data on the impact of nutrition on the eruption of permanent teeth, there is evidence that chronic malnutrition, persisting beyond early childhood, is associated with delays in tooth eruption (REIS *et al*., 2021). Although one study observed an accelerated eruption of the first permanent molars and incisors in 6-year-old children with protein-energy malnutrition in early childhood, it is important to note that the sample was small and there was no report of nutritional status at the time of examination (REIS *et al*., 2021; ALFAH *et al*., 2023).

3.3 SOCIOECONOMIC FACTORS

In several studies, it has been observed that children from families with greater economic power tend to have an earlier tooth eruption than those from lower socioeconomic classes, although other studies have not supported this correlation (PRATAMAWARI *et al*., 2022). The assumption is that children belonging to higher social classes receive superior health care and nutrition, factors that influence earlier tooth development. The eruption sequence of permanent teeth differs among children from different socioeconomic classes (KARAM *et al*., 2023). In children from higher classes, the mandibular incisor is the first to emerge in the oral cavity, unlike the first mandibular molar, which is the first to erupt in children from lower classes (KUTESA *et al*., 2019).

3.4 HORMONAL FACTORS

Disorders in the endocrine glands often have a significant impact on the entire body, including the dentition. Conditions such as hypothyroidism, hypopituitarism, hypoparathyroidism, and pseudohypoparathyroidism are commonly associated with delays in the eruption of permanent teeth. Accelerated tooth development has been observed in connection with an increase in adrenal androgen secretion, although the effect of excess growth hormone and thyroid hormones on tooth development is less well understood (AL-YASIRY *et al*., 2020; LEITCH *et al*., 2020).

3.5 PREMATURE BIRTH

Preterm birth, defined as occurring before 37 weeks of gestation or with a birth weight of less than 2500g, is often used as a primary indicator of prematurity. This factor is directly linked to delays in the eruption of primary and permanent teeth in children born prematurely (SADAUSKAITĖ *et al*., 2021). However, when we adjusted for normal chronological age, we did not observe significant differences between children born preterm and those born at term. It is important to highlight that postnatal factors and a period of accelerated growth can influence tooth eruption, especially during a sensitive perinatal period. The associations between the maturation of the primary and permanent dentition underscore the relevance of gestational age and birth weight in this context (HERR *et al*., 2023; ZARKESH, 2021).

3.6 GENETICS

Tooth eruption is a complex biological process that marks the stage of development of permanent teeth in children. This phenomenon occurs when teeth, previously formed in the maxillary and mandibular bone, begin to emerge in the oral cavity, breaking through the gums (ROULIAS *et* al., 2022). The chronology of tooth eruption may vary between individuals, but there are general patterns that indicate the typical order of tooth appearance (BADRUDDIN *et al*., 2020). Genetic influence plays a significant role in this process by determining the genetic programming of tooth development. Genetic inheritance can affect not only the chronology of the eruption, but also the shape, size, and position of the teeth in the dental arch. Studies have revealed that certain genes are associated with the regulation of molecular events that trigger tooth eruption, highlighting the importance of genetics in the formation of each individual's dentition (BADRUDDIN *et al*., 2020; URZÚA *et al*., 2020).

Genetic variation influences not only tooth eruption, but may also contribute to predisposition to specific dental conditions, such as cavity formation and susceptibility to periodontal disease. In addition, genetic inheritance can influence dental characteristics such as tooth shape, inclination, and occlusion, thus affecting aesthetics and oral function (MUHAMAD & WATTED, 2019). Understanding the interplay between genetic and environmental factors in tooth eruption is crucial for a personalized approach in dentistry, allowing for better care planning and prevention of specific oral problems in patients based on their unique genetic characteristics (GRGIC *et al*., 2023; MADALENA *et al*., 2023).

4 CONCLUSION

In conclusion, the study of permanent tooth eruption and its associated factors highlights the complexity and uniqueness of this fundamental process in human development. The research shows that the chronology of tooth eruption is influenced by an intricate interplay between genetic and environmental factors, outlining specific patterns in each individual. Understanding these mechanisms is essential for a personalized approach in dentistry, allowing for the identification of potential variations and specific care needs in different patients. Additionally, the study underscores the importance of considering not only the timing of eruption but also the morphological and genetic characteristics associated with permanent teeth, providing valuable insights for the prevention and treatment of specific oral conditions. As research progresses, it is hoped that these findings will contribute to the continuous improvement of dental practice by promoting individualized oral health and enhancing the understanding of the interaction between genetics and environment in tooth development.

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