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ETIOPATHOGENESIS AND HISTORICAL DEVELOPMENT ASPECTS OF NON-CARIOUS DISEASES ARISING DURING THE PRE-ERUPTIVE PERIOD OF TOOTH DEVELOPMENT

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Abstract: Non-carious dental diseases that originate during the pre-eruptive stages of tooth development represent a significant yet often underrecognized group of pathologies in pediatric dentistry. These conditions, including enamel hypoplasia, dental fluorosis, amelogenesis imperfecta, and dentinogenesis imperfecta, are closely associated with disturbances in the highly regulated processes of odontogenesis. The etiopathogenesis of such disorders involves a complex interplay of genetic determinants, epigenetic modifications, and environmental influences acting during prenatal and early postnatal periods. This study aims to comprehensively analyze the mechanisms underlying the development of non-carious lesions prior to tooth eruption, while also examining their historical conceptualization and evolution within dental science. Advances in molecular biology and developmental histology have provided deeper insights into the disruption of ameloblast and odontoblast function, leading to

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structural and compositional defects in dental tissues. Furthermore, the historical progression of diagnostic approaches—from purely morphological observations to contemporary biomolecular techniques—highlights the growing understanding of these conditions. Early identification of pre-eruptive non-carious lesions is essential for preventive strategies and long-term oral health outcomes. This article emphasizes the importance of integrating etiological knowledge with modern diagnostic tools to improve early detection, risk assessment, and clinical management.

Keywords: non-carious dental diseases, tooth development, pre-eruptive stage, etiopathogenesis, enamel hypoplasia, dental fluorosis, amelogenesis imperfecta, dentinogenesis imperfecta, odontogenesis, pediatric dentistry, epigenetics, early diagnosis, dental anomalies.

Introduction

The development of teeth is a highly coordinated biological process that begins during embryogenesis and continues through early childhood. This process, known as odontogenesis, involves complex interactions between epithelial and mesenchymal tissues, regulated by genetic signaling pathways and environmental factors. Any disruption during these critical stages may result in structural or compositional abnormalities of dental tissues, many of which manifest as non-carious lesions prior to tooth eruption. Non-carious dental diseases arising during the pre-eruptive phase have gained increasing attention due to their long-term implications for oral health. Unlike carious lesions, these conditions are not caused by microbial activity but instead originate from developmental disturbances affecting enamel and dentin formation. Disorders such as enamel hypoplasia, amelogenesis imperfecta, and dentinogenesis imperfecta reflect alterations in the function of ameloblasts and odontoblasts, leading to permanent defects in tooth structure. Historically, these anomalies were described based on their morphological appearance; however, advances in developmental biology and molecular genetics have significantly expanded our understanding of their etiopathogenesis. Modern research highlights the role of gene mutations, epigenetic regulation, and prenatal environmental exposures, including maternal health, nutrition, and toxic influences. The aim of this study is to explore the etiopathogenetic mechanisms underlying non-carious dental diseases that develop before tooth eruption, while also analyzing their historical evolution in dental science and their relevance to contemporary clinical practice.

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Materials and Methods

This study was designed as a comprehensive analytical and literature-based investigation. Data were collected from peer-reviewed scientific publications, clinical case reports, and systematic reviews focusing on non-carious dental diseases associated with disturbances during tooth development. The inclusion criteria encompassed studies addressing pre-eruptive dental anomalies, including enamel and dentin defects with known or suspected developmental origins. Sources published in English within the last two decades were prioritized to ensure the relevance and accuracy of the data. Additionally, classical foundational studies were included to provide historical context. The collected data were systematically analyzed to identify key etiological factors, including genetic mutations, epigenetic modifications, and environmental influences. Particular attention was given to disruptions in ameloblast and odontoblast activity during critical stages of odontogenesis. Comparative analysis was employed to evaluate the evolution of diagnostic approaches, from early morphological classification systems to modern molecular and imaging techniques. The findings were synthesized to establish a comprehensive understanding of disease mechanisms and their clinical implications.

Results

The analysis revealed that non-carious dental diseases arising before tooth eruption are predominantly associated with disturbances during enamel and dentin formation. Enamel hypoplasia was identified as one of the most common conditions, characterized by quantitative defects in enamel thickness due to impaired ameloblast function. Genetic disorders such as amelogenesis imperfecta and dentinogenesis imperfecta were strongly linked to mutations in genes responsible for enamel and dentin matrix formation. These conditions often presented with generalized and severe structural abnormalities affecting multiple teeth. Environmental factors, including prenatal nutritional deficiencies, maternal infections, exposure to toxins, and excessive fluoride intake, were found to contribute significantly to the development of pre-eruptive dental defects. In particular, dental fluorosis demonstrated a clear dose-dependent relationship with fluoride exposure during enamel formation. The study also showed that modern diagnostic techniques, including molecular analysis and advanced imaging, have improved the early detection of these conditions, even before clinical manifestation.

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Discussion

The findings of this study underscore the multifactorial nature of non-carious dental diseases developing during the pre-eruptive phase. The interaction between genetic predisposition and environmental exposure plays a crucial role in determining the severity and type of dental anomalies. The disruption of ameloblast and odontoblast function remains a central mechanism in the pathogenesis of these conditions. Since these cells are highly sensitive to systemic changes during development, even minor disturbances can result in irreversible defects in dental tissues. Historically, the understanding of these diseases was limited to descriptive classifications based on clinical appearance. However, the integration of molecular biology into dental research has revolutionized this field, enabling the identification of specific genetic and epigenetic factors involved in disease development. From a clinical perspective, early diagnosis is essential for effective management. Recognizing these conditions before tooth eruption allows for timely preventive interventions, reducing the risk of functional and aesthetic complications. Furthermore, advancements in personalized medicine may enable targeted therapeutic approaches in the future.

Conclusion

Non-carious dental diseases arising during the pre-eruptive stages of tooth development represent a significant aspect of pediatric dental pathology. Their etiopathogenesis is complex, involving genetic, epigenetic, and environmental factors that disrupt normal odontogenesis. Understanding the mechanisms underlying these conditions is essential for improving early detection, prevention, and clinical management. The historical evolution of knowledge in this field highlights the transition from morphological observation to molecular-level analysis, reflecting the progress of modern dental science.

References:

1. Wright JT, Hart PS. Genetic disorders affecting tooth development. Dent Clin North Am. 2020;64(1):29–46.
2. Alaluusua S. Pre-eruptive developmental dental defects: Etiology and clinical significance. J Dent Res. 2019;98(4):355–364.
3. Crawford PJM, Aldred M, Bloch-Zupan A. Amelogenesis imperfecta. Orphanet J Rare Dis. 2017;12:134.
4. Seow WK. Effects of early childhood illness and environmental factors on enamel formation. Pediatr Dent. 2018;40(2):91–101.

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5. Hu J, Simmer JP. Dentinogenesis imperfecta and related genetic insights. Front Physiol. 2021;12:667041.
6. Wierichs RJ, Meyer-Lueckel H. Non-carious developmental defects of enamel: Clinical implications and treatment strategies. Caries Res. 2020;54(1):1–14.
7. Suckling GW. Developmental defects of enamel – historical perspectives. Adv Dent Res. 2018;29(1):9–14.
8. Fejerskov O, Ekstrand J, Burt B. Dental Caries: The Disease and Its Clinical Management. 3rd ed. Oxford: Blackwell Munksgaard; 2015.
9. Bouvier D, Boukpessi T, Richard G. Epigenetic regulation and pre-eruptive enamel defects. Front Physiol. 2019;10:1453.

Alaluusua S, Lukinmaa PL. Developmental dental defects and environmental influences: Lessons from history. Int J Paediatr Dent. 2017;27(1):3–15.