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EPIDEMIOLOGY, ETIOLOGY, AND PATHOGENESIS OF HARD DENTAL TISSUE DISEASES.

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Abstract: Hard dental tissue diseases, particularly dental caries, remain among the most prevalent chronic diseases worldwide and continue to represent a major public health challenge. According to recent global epidemiological data, billions of people are affected by oral diseases, with dental caries being the most widespread condition among both children and adults. The prevalence of caries is especially high in developing countries, where inadequate oral hygiene, unhealthy dietary habits, and limited preventive measures contribute significantly to disease progression. Dental caries is a multifactorial disease associated with bacterial biofilm activity, demineralization of enamel, and destruction of hard dental tissues. This article reviews the epidemiology, etiology, and pathogenesis of hard dental tissue diseases and highlights the importance of preventive strategies, early diagnosis, and modern technological approaches in improving oral healthcare outcomes.

Keywords: dental caries, oral health, epidemiology, etiology, pathogenesis, Streptococcus mutans, hard dental tissues.

Introduction

Oral health is established throughout all stages of human life, beginning in childhood and continuing into old age. Many dental diseases, particularly dental caries, belong to the group of conditions that can be prevented if detected at an early stage. In particular, oral health in children significantly influences their physical development, growth, academic performance, and social activity [14, 33, 71].

Dental caries is defined by the World Health Organization as the destruction of the tooth enamel layer caused by acids produced through the bacterial metabolism of carbohydrate-containing foods. Despite the development of preventive and therapeutic approaches, dental caries remains a major public health concern, especially in developing countries where its prevalence continues to remain high. For example, the widespread occurrence of caries among children in India highlights the necessity of improving measures for the control, prevention, and effective treatment of this disease [22, 49, 88, 130].

According to the Global Oral Health Status Report published in 2022, approximately 3.5 billion people worldwide suffer from oral diseases, the majority of whom live in middle-income countries. Statistical data indicate that around 514 million children are affected by caries of primary teeth, while more than 2 billion people suffer from caries of permanent teeth. These figures further confirm the high global prevalence of this disease and the urgent need to strengthen preventive measures [7, 35, 64, 97, 142].

Dental caries is one of the most widespread diseases worldwide, affecting approximately 3.5 billion people and representing one of the most common pathological conditions in humans. It occurs in 60–90% of children and in the majority of adults, thereby imposing a significant economic burden on healthcare systems and reducing quality of life [1,2]. Dental caries has a

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complex pathogenesis primarily associated with dental plaque and results in the destruction of hard dental tissues. This process is dynamic in nature: initially, salivary proteins adhere to the tooth surface, creating favorable conditions for bacterial adhesion and the initial formation of plaque. Subsequently, acids produced by bacterial activity lead to demineralization, which contributes to the development of caries [3].

One of the principal etiological factors of dental caries, Streptococcus mutans, forms part of the biofilm and creates a highly acidic environment with a pH below 5.0. This acidic environment dissolves apatite crystals in the tooth enamel and initiates the carious process [4].

The epidemiology of hard dental tissue diseases currently represents one of the most pressing issues for the global healthcare system, since these diseases are among the most prevalent chronic pathologies worldwide. According to the World Health Organization and contemporary epidemiological studies, more than 2 billion individuals are affected by caries of permanent teeth, and the disease occurs across nearly all age groups, with prevalence increasing with age. In addition, more than 3 billion people worldwide are affected by dental caries, clearly demonstrating the substantial global epidemiological burden of this disease [112].

In the Asian region, the prevalence of hard dental tissue diseases, particularly dental caries, remains consistently high. In some countries, the prevalence of caries among children ranges from 46% to 60%, while in certain regions this indicator exceeds 70%. For instance, meta-analyses conducted in India have demonstrated that the average prevalence of dental caries exceeds 50%, whereas in Pakistan this figure is estimated to be close to 56%. Furthermore, studies have revealed that the prevalence of dental caries among children and adolescents in certain Asian populations reaches 60–65%, which is associated with inadequate oral hygiene practices, unhealthy dietary habits, and insufficient preventive measures [122].

Overall, because the Asian region encompasses territories with varying levels of socio-economic development, considerable differences are observed in the epidemiology of dental caries. Nevertheless, the general trend of a high prevalence rate continues to persist [23]. In view of the above, an in-depth investigation of the etiology and pathogenesis of hard dental tissue diseases, a comprehensive evaluation of their developmental mechanisms, and the development of individualized diagnostic and treatment algorithms constitute one of the major objectives of modern dentistry. In particular, the integration of clinical and functional assessment methods, together with the application of digital technologies and artificial intelligence to enhance treatment effectiveness, is regarded as a highly relevant and promising scientific direction [21, 60, 109, 147].

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