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Review

Oral Health Challenges in Preterm Children: Current Evidence and Clinical Recommendations

Preterm Çocuklarda Ağız Sağlığı Sorunları: Güncel Kanıtlar ve Klinik Öneriler

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ABSTRACT

Preterm birth is a major global public health concern that affects not only neonatal morbidity and mortality but also long-term oral health outcomes. Preterm children have been reported to exhibit a higher prevalence of developmental defects of enamel, early childhood caries, delayed tooth eruption, and malocclusion compared with their term-born peers. Among these conditions, the association between prematurity and developmental defects of enamel is supported by the strongest evidence, whereas findings regarding other oral health outcomes remain inconsistent because of methodological heterogeneity and multiple confounding factors across studies. This narrative review summarizes the current evidence regarding the impact of preterm birth on oral and dental health, highlighting the underlying biological mechanisms, clinical manifestations, and evidence-based preventive strategies. Particular emphasis is placed on early assessment of dental health, individualized evaluation of caries-risk, parental education, preventive measures using fluoridated dental products, and long-term multidisciplinary follow-up. Close collaboration among neonatologists, pediatricians, pediatric dentists, and caregivers is essential for the early identification of oral abnormalities and the implementation of timely preventive interventions. Integrating oral health surveillance into routine follow-up programs designed for preterm infants may reduce the burden of oral diseases and improve long-term oral health outcomes in this vulnerable population.

Keywords: Preterm birth, oral health, developmental enamel defects, early childhood caries, preventive dentistry

ÖZ

Prematüre doğum, dünya genelinde önemli bir halk sağlığı sorunu olup, yalnızca neonatal morbidite ve mortaliteyi değil, uzun dönem ağız ve diş sağlığını da etkileyebilmektedir. Prematüre doğan çocuklarda gelişimsel mine defektleri, erken çocukluk çağı çürükleri, diş sürme gecikmeleri ve maloklüzyon gibi ağız sağlığı sorunlarının daha sık görüldüğü bildirilmektedir. Özellikle gelişimsel mine defektleri ile prematürite arasındaki ilişki güçlü bilimsel kanıtlarla desteklenirken, diğer ağız sağlığı sonuçlarına ilişkin bulgular çalışmalar arasındaki yöntemsel farklılıklar ve karıştırıcı faktörler nedeniyle daha değişkenlik göstermektedir. Bu derlemede prematüre doğumun çocukların ağız ve diş sağlığı üzerindeki etkileri güncel literatür ışığında değerlendirilmiş; olası biyolojik mekanizmalar, klinik bulgular ve koruyucu yaklaşımlar ele alınmıştır. Ayrıca erken diş hekimi değerlendirmesi, bireyselleştirilmiş çürük risk analizi, flor uygulamaları, ebeveyn eğitimi ve multidisipliner izlemin önemi vurgulanmıştır. Prematüre doğan çocuklarda ağız sağlığının korunabilmesi için yenidoğan uzmanları, çocuk hekimleri ve pedodontistler arasında yakın iş birliği sağlanması ve ağız sağlığı izleminin rutin çocuk takip programlarına entegre edilmesi önerilmektedir. Erken tanı ve kanıta dayalı koruyucu uygulamalar, bu yüksek riskli popülasyonda uzun dönem ağız sağlığı sonuçlarının iyileştirilmesine önemli katkı sağlayabilir.

Anahtar kelimeler: Prematüre doğum, ağız sağlığı, gelişimsel mine defektleri, erken çocukluk çağı çürükleri, koruyucu diş hekimliği

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INTRODUCTION

Preterm birth remains one of the leading global health challenges despite substantial advances in perinatal and neonatal care[1]. Although improvements in neonatal management have markedly increased the survival of preterm infants, these children —particularly those born at earlier gestational ages— continue to face an increased risk of short- and long-term health complications[2].

In addition to systemic complications, prematurity may adversely affect oral and dental development. Disturbances in mineralization during critical stages of tooth formation can impair enamel development, leading to developmental defects that increase plaque accumulation and susceptibility to dental diseases[3]. Furthermore, low birth weight (LBW), altered immune function, and feeding difficulties commonly observed in preterm infants may further contribute to an unfavorable oral environment[3,4].

Early childhood caries (ECC), defined as the presence of decayed (non-cavitated or cavitated), missing tooth due to caries, or filled tooth surfaces in any primary tooth of a child younger than 6 years of age, is a multifactorial disease influenced by biological, behavioral, nutritional, and socioeconomic factors[5]. Although several studies have suggested that preterm children are more likely to develop enamel defects and experience poorer oral health outcomes, the association between prematurity and dental diseases remains inconclusive, as many confounding factors may also contribute to their development[6].

Given the increasing number of children surviving preterm birth, understanding the impact of prematurity on oral health is becoming increasingly important. This review summarizes the current evidence regarding the effects of preterm birth on oral and dental health and discusses its clinical implications for both pediatricians and pediatric dentists.

DEFINITION AND EPIDEMIOLOGY OF PREMATURITY

As defined by the World Health Organization (WHO), preterm birth refers to the delivery of a live infant before 37 completed weeks of gestation[7]. According to gestational age, preterm birth is categorized into extremely preterm (<28 weeks), very preterm (28 to <32 weeks), and moderate-to-late preterm (32 to <37 weeks). This classification is clinically relevant because the likelihood of neonatal complications and long-term health problems increases as gestational age decreases[8].

Despite considerable improvements in perinatal and neonatal care, prematurity continues to represent a major global health challenge. It is estimated that approximately 13.4 million preterm infants were born in 2020, accounting for nearly 10% of all live births worldwide[7]. Prematurity also remains the leading cause of mortality among children younger than five years of age, contributing to almost 900,000 deaths annually[8]. Although survival rates have decreased substantially over recent decades, important disparities remain between countries. Extremely preterm infants born in low-resource settings still experience markedly higher mortality rates largely due to restricted access to specialized neonatal care facilities compared with those born in high-income countries[9].

Current evidence suggests that prematurity should be regarded as a complex clinical syndrome rather than a single disease entity. Preterm birth may occur spontaneously, following the onset of preterm labor or premature rupture of membranes, or it may be medically indicated when maternal or fetal adverse conditions necessitate early delivery. The biological mechanisms responsible for spontaneous preterm birth are highly complex and involve inflammatory, infectious, endocrine, placental, genetic, and environmental pathways. Nevertheless, no definitive cause can be identified in a substantial proportion of affected pregnancies, emphasizing the multifactorial nature of the condition[10].

A wide range of maternal and pregnancy-related factors have been associated with an increased risk of preterm birth including previous preterm delivery, multiple gestations, hypertensive disorders, diabetes mellitus, intrauterine infections, smoking, inadequate maternal nutritional status, extremes of maternal age, and short interpregnancy intervals. In addition, methodolıgical variations in the assessment of gestational age, birth registration system, and reporting criteria across countries may influence the reported prevalence of prematurity, making direct cross-national comparisons challenging[10].

Preterm birth frequently occurs together with LBW, although the two conditions represent different clinical concepts. Whereas prematurity is defined according to gestational age, LBW refers to a birth weight below 2,500 g, irrespective of gestational age[7]. Because both conditions may disrupt normal fetal growth and tissue maturation during critical developmental periods, they are commonly investigated together when evaluating childhood outcomes, including oral health[3].

Although prematurity is primarily recognized for its impact on neonatal morbidity and mortality, its

consequences may also extend to involve oral and craniofacial development. As tooth formation begins during fetal life, disturbances associated with premature birth may influence normal dental development and increase the risk of oral complications later in childhood[3]. Therefore, understanding the epidemiological and developmental aspects of prematurity provides an important basis for evaluating its relationship with oral health .

ORAL MANIFESTATIONS OF PREMATURITY

Developmental Enamel Defects (DEDs)

DEDs are the most consistently reported oral manifestations associated with preterm birth. Meta-analytic evidence indicates that preterm children have a significantly higher prevalence of DED than those born at term, although the reported prevalence rates vary among studies because of differences in study populations and diagnostic criteria used[2,11].

The association between prematurity and adverse oral health outcomes is primarily explained by disturbances in tooth development that occur during critical stages of prenatal and early postnatal life. Premature birth may disrupt several biological processes involved in odontogenesis and amelogenesis, predisposing affected children to DEDs and subsequent oral diseases.

Tooth development begins during intrauterine life and continues after birth, making this process highly susceptible to prenatal and early postnatal environmental influences. During odontogenesis, dysfuntion of ameloblasts and odontoblasts may interfere with enamel matrix formation, mineralization, or maturation, resulting in DED[12].

The timing of enamel development may explain the increased susceptibility of preterm infants to DED. Enamel formation process of the primary dentition begins during fetal life and continues throughout pregnancy and the first year of postnatal life; therefore, disturbances occurring during prenatal, perinatal, or postnatal periods may permanently affect enamel structure. Since enamel is not remodeled after its development is finalized, defects produced during amelogenesis are permanently recorded in the tooth[12,13].

DEDs comprise both quantitative and qualitative abnormalities. Quantitative defects, such as enamel hypoplasia, arise from incomplete enamel matrix formation during the secretory stage of amelogenesis[2], whereas qualitative defects, including enamel opacities and hypomineralization, result from disturbances in enamel mineralization or maturation[11].

Among different types of DED, enamel hypoplasia is the most frequently reported defect in preterm children, whereas qualitative defects such as demarcated and diffuse opacities have shown less consistent associations. The primary dentition appears to be more commonly affected than the permanent dentition, reflecting the timing of enamel development during fetal life[12].

The distribution of enamel defects follows the chronology of tooth development. Primary incisors, canines, and first primary molars are most commonly affected, while very preterm or very LBW children may also exhibit defects in the permanent dentition, particularly involving the first permanent molars and incisors[13].

DED has a multifactorial etiology. Maternal health, adverse intrauterine conditions, birth characteristics, and postnatal factors may all influence ameloblast activity during tooth development. Among these predisposing factors, preterm birth and LBW that may particularly disturb normal enamel formation during a critical developmental period have been extensively investigated. However, although numerous studies have reported a higher prevalence of DED among preterm children, inconsistencies in study designs, diagnostic criteria, and methodological quality of the investigations have resulted in conflicting findings, and the strength of this association remains under debate[2,11,12].

Clinically, DED may compromise both oral esthetics and function by increasing roughness of dental surfaces, plaque retention, and susceptibility to post-eruptive enamel breakdown[11]. These defects also represent important predisposing factors for ECC, highlighting the importance of early diagnosis, preventive care, and regular dental follow-up in preterm children[2].

Dental Caries

Although developmental defects of enamel increase the susceptibility of teeth to caries, the relationship between prematurity and ECC remains controversial. As a multifactorial disease, ECC is influenced by a complex interaction of biological, behavioral, environmental, and socioeconomic factors, making it difficult to determine the independent contribution of preterm birth to the development of caries[3].

Several biological mechanisms have been proposed to explain a possible association between prematurity and ECC. Disturbances in the development of enamel may

facilitate plaque accumulation and bacterial adhesion, while hypocalcemia, physiological stress during the perinatal period, altered immune responses, and earlier colonization by cariogenic microorganisms have also been suggested as potential contributors to increased susceptibility to caries in preterm children[14].

The available epidemiological evidence, however, remains inconsistent. Since Rosenzweig[16] first described the coexistence of enamel hypoplasia and dental caries in premature infants in 1962, numerous observational studies have investigated this association. While several studies have reported a higher prevalence of ECC among preterm children, others have failed to demonstrate a significant relationship, suggesting that delayed tooth eruption, closer medical follow-up, and improved parental awareness of oral health may partially counterbalance the biological risk[3,14,15].

Recent systematic reviews and meta-analyses indicate that prematurity alone should not be regarded as an independent predictor of ECC. Instead, development of caries appears to be strongly influenced by multiple confounding factors, including socioeconomic status, parental education, dietary habits, oral hygiene practices, exposure to fluoride containing compounds, and access to dental care. The considerable heterogeneity among published studies, together with differences in study designs and inadequate adjustment for confounding variables, likely explains the conflicting findings reported in the literature[14].

Overall, current evidence suggests that prematurity may increase susceptibility to ECC through several biological pathways; however, its clinical impact is largely modified by environmental and behavioral determinants. Therefore, assessment of individualized risk of caries and early preventive dental care are recommended for preterm children rather than assuming an inherently increased risk of caries based solely on birth history[3].

Tooth Eruption Disturbances

Alterations in the timing of tooth eruption have frequently been reported in preterm children. However, recent evidence suggests that the interpretation of its timing largely depends on whether chronological or corrected age is used for its assessment. According to recent systematic reviews, primary tooth eruption appears to be delayed when assessment was made based on chronological age, whereas this difference largely disappears after adjustment for corrected age[17,18].

The degree of prematurity, very LBW, neonatal complications, and early nutritional factors have all been proposed as modifiers of eruption timing. In particular, very LBW and the absence of breastfeeding have been associated with a greater delay in the eruption of primary teeth. Conversely, some studies have suggested that delayed eruption may reflect methodological differences in age calculation rather than true impairment of tooth development. Furthermore, timing of eruption in preterm children tends to approach that of full-term peers after approximately 18 months of age, indicating the occurrence of catch-up growth during early childhood[17].

Evidence regarding the permanent dentition remains limited and less consistent. While some studies have reported delayed dental maturation during early childhood, others have suggested that the eruption timing of permanent teeth, particularly the first permanent molars and incisors, is comparable to or even slightly earlier than that observed in children born at term. Consequently, the current evidence is insufficient to establish a definitive association between prematurity and delayed eruption of permanent teeth[17].

From a clinical perspective, delayed tooth eruption in preterm children should be interpreted with caution. The use of corrected age is recommended when evaluating eruption patterns during infancy, and mild delays in tooth emergence should not be considered pathological in the absence of other developmental abnormalities. Careful clinical follow-up remains essential, particularly for children with severe prematurity or very LBW[18].

Malocclusion and Craniofacial Development

Premature birth may influence not only dental development but also craniofacial growth and occlusal development. Craniofacial morphology is shaped by a complex interaction between genetic and environmental factors throughout childhood. In preterm infants, adaptation to extrauterine life, altered muscle function, and neonatal interventions may interfere with normal growth cycle and contribute to occlusal alterations[13].

Among the craniofacial abnormalities reported in preterm children, high-arched palate, palatal asymmetry, narrow maxillary arch, and posterior crossbite are the most frequently described findings[2]. These alterations have largely been attributed to prolonged orotracheal or nasotracheal intubation and mechanical ventilation during neonatal intensive care, which may exert continuous pressure on the developing palate and disrupt normal maxillary growth[13].

The long-term relationship between prematurity and malocclusion remains less clear. Although several studies have reported a higher prevalence of malocclusion traits and an increased need for orthodontic treatment among preterm children, the available evidence remains inconsistent. This variability may reflect differences in gestational age, birth weight, duration of neonatal care, and environmental factors such as oral habits, feeding practices, and orofacial muscle function[19-21]. In a case-control study by Paulsson et al.[19], preterm children exhibited not only a higher frequency of malocclusion traits but also a significantly greater professionally assessed need for orthodontic treatment compared with full-term controls.

From a clinical perspective, preterm children may benefit from periodic evaluation of craniofacial growth and occlusal development, particularly those with a history of prolonged neonatal intubation or severe prematurity. Early identification of developing malocclusion allows timely orthodontic referral and may help reduce the severity of future functional and esthetic problems. In addition, previous studies have demonstrated that children born preterm are more likely to require orthodontic treatment than their full-term counterparts, highlighting the importance of long-term dental follow-up[19,21].

CLINICAL MANAGEMENT

Early Dental Assessment and Caries Risk Evaluation

Preterm children should be considered a high-risk population requiring early dental assessment because of their increased susceptibility to DEDs, altered tooth eruption patterns, and a potentially greater risk of ECC[11,20]. Establishing a dental home during infancy allows early identification of oral abnormalities, implementation of individualized preventive measures, and continuous monitoring of oral development[20].

The American Academy of Pediatric Dentistry recommends that the first dental visit should take place within six months after the eruption of the first primary tooth and no later than 12 months of age[20,21]. During this visit, a comprehensive oral examination should include evaluation of the oral soft tissues, tooth eruption, enamel defects, developing occlusion, oral hygiene, feeding practices, fluoride exposure, and caries risk[21]. For preterm children, obtaining a detailed prenatal and neonatal history, including gestational age, birth weight, neonatal intensive care unit admission, prolonged mechanical ventilation, and endotracheal intubation, is particularly important because these factors may influence oral and craniofacial development[13,20].

Risk assessment of dental caries should be performed as soon as the first primary tooth erupts and should be reassessed regularly throughout childhood. Since the risk of develoing caries risk is a dynamic process and influenced by biological, behavioral, and environmental factors, recall intervals should be individualized according to each child's risk profile[17]. Preterm children presenting with DEDs, frequent feeding history, inadequate oral hygiene, or complex medical conditions may benefit from more frequent preventive visits than healthy term-born children[3,21].

Parental education represents another fundamental component of the first dental visit. Caregivers should receive guidance regarding appropriate feeding practices, oral hygiene measures, optimal fluoride exposure, and recognition of the early signs of dental disease[21]. Since pediatricians and neonatologists usually have the earliest and most frequent contact with preterm infants and their families, close interdisciplinary collaboration between medical and dental professionals is essential to facilitate timely referral, establish preventive care from infancy, and promote long-term oral health[20].

Preventive Oral Health Care

Preventive oral healthcare for preterm children should be individualized according to each child's medical history, oral findings, and overall caries risk. Because prematurity is associated with DEDs and an increased susceptibility to the development of ECC, preventive interventions should be initiated soon after the eruption of the first primary tooth and regularly reassessed throughout childhood[11,20].

Preventive counseling should focus on practical measures to reduce caries risk, including healthy infant feeding practices, limitation of free sugar intake, avoidance of prolonged nocturnal bottle-feeding, and establishment of effective oral hygiene routines from the eruption of the first primary tooth. Nutritional counseling and anticipatory guidance should be reinforced at every dental visit to support healthy oral habits during early childhood[20-25].

Current international guidelines recommend twice-daily toothbrushing with fluoridated toothpastes using an age-appropriate amount toothpaste starting from the eruption of the first primary tooth[26]. Professional topical fluoride varnish should be applied according to the child's individual risk of caries, while fluoride supplementation may be considered in children with inadequate systemic

fluoride exposure after evaluation of all potential fluoride sources[23].

Preterm children who present with DEDs require close clinical monitoring because hypoplastic or hypomineralized enamel facilitates plaque accumulation and increases the risk of caries progression[15]. Pit-and-fissure sealants should be considered for susceptible primary and permanent molars as soon as eruption permits adequate moisture control, particularly in children at moderate or high risk of caries[24].

Since the risk of caries changes over time, recall intervals should be tailored according to the child's individual risk profile rather than age alone. More frequent follow-up visits may be beneficial for children with multiple biological or behavioral risk factors, allowing reinforcement of oral hygiene practices, repeated applications of fluoride therapy, and early detection of newly developing lesions[21,22].

Multidisciplinary Management and Follow-up

Optimal oral healthcare for preterm children requires a multidisciplinary and family-centered approach involving pediatric dentists, neonatologists, pediatricians, obstetricians, nurses, and caregivers[20]. The WHO recommends coordinated multidisciplinary follow-up, developmental surveillance, family-centered care, support for breastfeeding, and kangaroo mother care as key components of comprehensive care for preterm and low-birth-weight infants[28]. Because many risk factors for oral diseases emerge during the prenatal and neonatal periods, collaboration among healthcare professionals is essential to ensure timely identification of at-risk children and implementation of individualized preventive strategies[20,27].

Pediatricians and neonatologists are often the first healthcare professionals to monitor preterm infants and therefore play a key role in recognizing risk factors such as DEDs, feeding difficulties, prolonged hospitalization, and medical conditions that may adversely affect oral health[20]. As preterm infants are routinely followed during infancy and early childhood, these encounters provide valuable opportunities for developmental surveillance and timely referral to pediatric dental services[28]. Early referral to a pediatric dentist facilitates comprehensive oral examination, individualized assessment of caries risk, parental counseling, and the establishment of a dental home during the first year of life[20,21].

Long-term follow-up should include periodic evaluation of tooth eruption, enamel defects, development of caries, craniofacial growth, and occlusal relationships[21]. Children presenting with severe enamel defects or developing malocclusion may require timely referral to orthodontists or other dental specialists to minimize future functional and esthetic complications[19,21]. Integrating oral health assessments into routine multidisciplinary follow-up programs may facilitate earlier diagnosis and more effective preventive care for this high-risk population[28].

Successful long-term management also depends on active participation of caregivers[25]. Parents should receive continuous education regarding oral hygiene, dietary practices, fluoride use, and the importance of regular dental attendance[20]. Reinforcing preventive advice at every follow-up visit within a family-centered model of care promotes adherence to oral health recommendations and contributes to reducing the long-term burden of oral diseases in preterm children[20].

CONCLUSION

Preterm birth may influence oral health through multiple biological and environmental pathways, resulting in an increased susceptibility to DEDs, ECC, delayed tooth eruption, and malocclusion. Among these conditions, the association between prematurity and DEDs appears to be supported by the most consistent evidence, whereas the relationships with other oral health outcomes remain less conclusive because of heterogeneity among available studies and the influence of numerous confounding factors.

Early identification of oral abnormalities and timely preventive interventions are essential to minimize the long-term oral health burden in preterm children. Establishing a dental home during infancy, assessment of individualized risks of caries, providing parental education, and implementing evidence-based preventive strategies, including fluoride therapy and regular follow-up, may substantially improve oral health outcomes.

The management of preterm children should extend beyond routine dental care and involve close collaboration among pediatric dentists, pediatricians, neonatologists, and caregivers. A multidisciplinary approach facilitates early diagnosis, planning of individualized treatment, and appropriate monitoring of oral and craniofacial development throughout childhood.

Overall, increasing awareness of the oral health needs of preterm children and integrating preventive dental care into routine neonatal and pediatric healthcare may contribute to reducing the incidence and severity of oral diseases and improving long-term quality of life for this vulnerable population.

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Footnotes

Authorship Contributions

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