

## Review

# Pediatric Autoimmune Disorders and Their Impact on Dental Development

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### Abstract

Pediatric autoimmune disorders, such as juvenile idiopathic arthritis, systemic lupus erythematosus, type 1 diabetes mellitus, and celiac disease, can significantly affect oral health and craniofacial development. These conditions disrupt normal dental and skeletal growth through chronic inflammation, immune-mediated tissue damage, and the side effects of therapeutic interventions. Common manifestations include delayed tooth eruption, enamel hypoplasia, periodontal disease, and temporomandibular joint involvement. Pro-inflammatory cytokines and systemic inflammation impair alveolar bone remodeling, leading to eruption delays and malocclusions, while nutrient deficiencies and altered bone metabolism further compromise enamel mineralization and craniofacial growth. Management is complicated by factors such as immunosuppressive therapy, xerostomia, and increased susceptibility to infections. Corticosteroids and biologics, while essential for controlling systemic disease, can exacerbate oral complications, including delayed wound healing and increased caries risk. Nutritional supplementation and the use of fluoride-releasing restorative materials are essential strategies to address these challenges. Periodontal care, orthodontic interventions, and regular monitoring are crucial to mitigate the effects of progressive inflammation and growth disturbances. Temporomandibular joint involvement is particularly problematic, as chronic arthritis can lead to significant mandibular asymmetry and occlusal discrepancies. Functional appliances and, in severe cases, surgical interventions are often required to manage these complications. Preventive care remains the foundation of long-term management, focusing on maintaining optimal oral hygiene, early detection of abnormalities, and minimizing the impact of systemic disease on oral tissues. Advances in salivary diagnostics and digital imaging provide opportunities for earlier diagnosis and personalized treatment. Interdisciplinary collaboration between dental professionals, pediatricians, and rheumatologists is essential to optimize outcomes. Understanding the multifactorial impact of pediatric autoimmune disorders on dental development highlights the need for tailored care strategies that address both systemic and oral health needs to improve the quality of life for affected children.

**Keywords:** *pediatric autoimmune disorders, dental development, enamel hypoplasia, temporomandibular joint, periodontal disease*

**Introduction**

Pediatric autoimmune disorders are a diverse group of conditions characterized by immune-mediated destruction of the body's tissues. Examples such as juvenile idiopathic arthritis (JIA), type 1 diabetes mellitus (T1DM), systemic lupus erythematosus (SLE), and celiac disease commonly emerge during childhood, significantly impacting overall health and development. Beyond systemic manifestations, these disorders have profound implications for dental and craniofacial growth. The pathophysiology of autoimmune diseases often disrupts critical processes such as tooth eruption, enamel mineralization, and craniofacial bone development, resulting in a range of dental anomalies and oral health complications (1).

Immune dysregulation in pediatric autoimmune diseases directly affects the tissues of the oral cavity. Inflammatory cytokines and immune complexes interfere with the growth of dental structures, leading to delayed eruption, enamel hypoplasia, and periodontal disease. In T1DM, for instance, chronic inflammation and altered glucose metabolism contribute to salivary gland dysfunction, which predisposes patients to caries and periodontal disease (2). Similarly, JIA is associated with mandibular growth restrictions and temporomandibular joint (TMJ) involvement, causing malocclusions and pain during mastication. Such manifestations highlight the systemic impact of autoimmune responses on craniofacial development (3).

Therapies used to manage autoimmune diseases, particularly corticosteroids and biologic agents, further influence dental health. Long-term corticosteroid use, common in conditions such as SLE and JIA, can suppress bone growth, delay dental development, and increase the risk of infections due to immunosuppression. Biologic therapies, while reducing systemic inflammation, may alter the oral microbial balance and affect the integrity of periodontal tissues. These therapeutic effects underscore the need for careful dental monitoring in children receiving immunosuppressive treatments (4).

Environmental and genetic factors play a crucial role in modulating the impact of autoimmune disorders on dental development. Nutritional deficiencies, such as those seen in celiac disease, impair calcium and vitamin D absorption, leading to weakened enamel and delayed tooth eruption. Chronic systemic inflammation and oxidative stress also affect the vascular supply to dental tissues, disrupting normal growth and mineralization processes. Genetic predispositions, including variations in human leukocyte antigen (HLA) genes, are known to contribute to both the onset of autoimmune diseases and associated dental anomalies, suggesting a shared biological pathway that warrants further investigation (5). This review aims to discuss pediatric autoimmune disorders and their impact on dental development.

**Review**

Pediatric autoimmune disorders significantly impact dental development through complex interactions involving immune dysregulation, chronic inflammation, and treatment side effects. Inflammatory mediators, including cytokines and chemokines, disrupt normal cellular processes necessary for the growth and maturation of dental and craniofacial structures. For instance, children with SLE often experience delayed tooth eruption, enamel hypoplasia, and increased susceptibility to periodontal diseases due to persistent systemic inflammation and immune-mediated tissue damage (6). Such effects are compounded by therapies commonly employed to manage these conditions, such as corticosteroids and biologic agents, which can impair bone metabolism and oral microbiome balance.

Nutritional deficiencies further exacerbate these effects. Conditions like celiac disease impair the absorption of essential nutrients, including calcium and vitamin D, critical for enamel mineralization and jaw development. Similarly, oxidative stress and vascular changes induced by chronic inflammation can hinder the blood supply to developing dental tissues, compounding the adverse effects on growth and mineralization (7). Genetic predispositions, such as variations in the HLA

complex, also play a role, influencing both autoimmune susceptibility and dental anomalies. Understanding these interactions requires continued research to identify biomarkers and interventions aimed at mitigating the oral health challenges faced by children with autoimmune disorders.

### ***Oral Manifestations of Pediatric Autoimmune Disorders***

Pediatric autoimmune disorders can present with a wide array of oral manifestations, many of which arise from the underlying inflammatory and immune dysregulation characteristic of these diseases. These manifestations may vary depending on the type and severity of the autoimmune condition, often complicating early diagnosis and management. One of the most common oral findings in pediatric autoimmune conditions is the presence of ulcerative lesions and mucosal inflammation. For instance, children with SLE frequently exhibit erythematous or ulcerative lesions on the oral mucosa, resulting from immune-mediated damage and vascular compromise in the affected tissues (8).

Salivary gland dysfunction is another significant feature in autoimmune disorders such as juvenile Sjögren's syndrome, which primarily affects the exocrine glands. This condition is characterized by xerostomia (dry mouth) and a consequent reduction in salivary flow, which predisposes patients to dental caries, periodontal disease, and oral candidiasis. Reduced salivary gland function can impair the natural cleansing mechanisms of the oral cavity, exacerbating bacterial colonization and biofilm accumulation (9). The chronic inflammation observed in such conditions also alters the composition of saliva, reducing its protective components, including immunoglobulin A and antimicrobial peptides, thereby increasing the risk of secondary infections. TMJ involvement is a notable feature in autoimmune conditions like JIA, which can lead to pain, restricted mouth opening, and altered mandibular growth. Chronic synovial inflammation within the TMJ contributes to osseous changes, leading to asymmetry and malocclusions that impact both functional and esthetic aspects of oral health. In severe cases, progressive joint degeneration may result in reduced mandibular

growth, complicating orthodontic management and necessitating surgical intervention to correct significant skeletal discrepancies (10).

Enamel defects and delayed tooth eruption are additional oral complications associated with autoimmune disorders, particularly in conditions affecting nutrient absorption or bone metabolism, such as celiac disease. Enamel hypoplasia, seen as pits, grooves, or discoloration on the enamel surface, is commonly observed in children with untreated celiac disease. The impaired absorption of calcium and other essential minerals contributes to the defective mineralization of enamel during development. Furthermore, chronic systemic inflammation and oxidative stress can disrupt odontogenic processes, leading to delayed eruption of primary and permanent teeth, which may affect normal dental arch development and spacing (11). Periodontal disease, characterized by gingival inflammation, alveolar bone loss, and periodontal pocketing, is prevalent in pediatric autoimmune conditions. In T1DM, chronic hyperglycemia enhances inflammatory pathways, promoting the destruction of periodontal tissues and impairing wound healing. Periodontal disease in children with T1DM often progresses more rapidly compared to their healthy counterparts, reflecting the heightened inflammatory response and increased susceptibility to infections observed in these patients (12). Additionally, medications used to manage autoimmune diseases, such as immunosuppressants and corticosteroids, may exacerbate periodontal complications by altering the host immune response and microbiome composition.

The diversity of oral manifestations in pediatric autoimmune disorders underscores the need for heightened vigilance and routine oral evaluations in affected children. Many of these manifestations not only impact oral health but also contribute to systemic complications, as the oral cavity often serves as a gateway to systemic infections. By understanding the underlying mechanisms and specific features of these oral manifestations, healthcare providers can improve early detection and initiate timely, multidisciplinary interventions

to mitigate their progression and associated complications.

### ***Impact on Dental Growth and Morphogenesis***

Pediatric autoimmune disorders frequently interfere with the complex processes of dental growth and morphogenesis, resulting in a spectrum of abnormalities affecting tooth development, eruption, and craniofacial growth. These disruptions arise from chronic systemic inflammation, impaired nutrient metabolism, and the adverse effects of therapeutic interventions. The effects are particularly pronounced during critical windows of dental and craniofacial development, making early identification and management essential.

Tooth eruption disturbances are among the most commonly reported developmental abnormalities in children with autoimmune conditions. Inflammatory diseases such as SLE and JIA can alter the normal bone remodeling processes that facilitate tooth eruption. Pro-inflammatory cytokines, including interleukin-1 (IL-1) and tumor necrosis factor-alpha (TNF- $\alpha$ ), interfere with osteoclast and osteoblast activity in the alveolar bone, leading to delayed eruption or ectopic eruption patterns (13). This disruption not only prolongs the retention of primary teeth but may also cause misalignment in the developing permanent dentition, creating long-term functional and aesthetic challenges.

Enamel hypoplasia, a defect in enamel formation, is also frequently observed in autoimmune conditions. Conditions such as celiac disease, which impair nutrient absorption, are particularly implicated in these defects. Reduced availability of essential minerals like calcium and phosphate, compounded by chronic systemic inflammation, leads to weak and poorly mineralized enamel. These defects present as pits, grooves, or discoloration and predispose the teeth to mechanical wear and dental caries (14). In addition to aesthetic concerns, enamel hypoplasia significantly increases the risk of sensitivity and fractures, complicating routine dental care for affected children.

Craniofacial growth abnormalities are another hallmark of autoimmune disorders with systemic bone involvement. Corticosteroid therapy, a cornerstone of treatment for many autoimmune diseases, plays a significant role in altering normal craniofacial development. Long-term corticosteroid use suppresses osteoblast function, leading to reduced bone density and growth. This effect is particularly evident in the maxilla and mandible, where slower growth can result in midfacial retrusion or mandibular deficiencies. Children with juvenile systemic lupus erythematosus often exhibit these craniofacial growth disturbances, which can compromise normal dental occlusion and necessitate orthodontic intervention (15).

The TMJ is frequently involved in autoimmune diseases such as JIA, further complicating craniofacial growth. Chronic synovitis within the TMJ leads to cartilage destruction and bone erosion, affecting condylar growth. Over time, this can result in asymmetry and mandibular hypoplasia, producing a retrognathic profile and contributing to malocclusions. TMJ involvement often presents with symptoms such as pain, limited range of motion, and joint sounds, which may further impact the quality of life and complicate dental treatment planning (16). These structural changes highlight the intricate relationship between systemic autoimmune activity and localized craniofacial effects. The multidimensional impact of autoimmune disorders on dental growth and morphogenesis reflects the interconnected nature of systemic and localized processes in pediatric patients. The involvement of inflammatory mediators, altered nutrient metabolism, and therapeutic side effects necessitates an integrated approach to monitoring and management, with particular emphasis on the early detection of developmental abnormalities.

### ***Treatment Challenges and Considerations in Dental Care***

Managing dental care in children with autoimmune disorders presents unique challenges due to the interplay between systemic disease activity, medication effects, and the vulnerability of oral tissues. These challenges necessitate an



individualized approach that accounts for both the underlying condition and its dental manifestations, while also minimizing risks associated with treatment interventions. One of the foremost considerations in dental care for children with autoimmune diseases is the management of immunosuppression. Many of these patients are on long-term immunosuppressive therapy, such as corticosteroids, methotrexate, or biologic agents, which significantly increase their susceptibility to oral infections. Dental procedures, particularly invasive ones, require careful planning to prevent complications such as delayed wound healing or secondary infections. Prophylactic antibiotic coverage may be recommended in specific cases, especially for procedures involving soft tissue manipulation or bone exposure, to reduce the risk of bacteremia and sepsis (17).

Bleeding disorders and altered coagulation profiles are another concern in this population. Autoimmune diseases such as SLE and antiphospholipid syndrome can be associated with thrombocytopenia or anticoagulant use, increasing the risk of excessive bleeding during dental procedures. Preoperative evaluations, including coagulation studies, are critical to determine the need for modifying treatment protocols, such as adjusting anticoagulant dosages or using local hemostatic agents like tranexamic acid or fibrin sealants (18). The involvement of a multidisciplinary team, including the child's primary physician and hematologist, is often essential in these cases.

Dental material selection and restoration techniques also pose unique challenges due to the compromised oral environment in children with autoimmune diseases. Xerostomia, a common side effect of Sjögren's syndrome or medications such as antihistamines and antidepressants, exacerbates caries risk and complicates restorative procedures. The reduced salivary flow affects the retention of restorative materials, as the oral cavity lacks the necessary moisture to support optimal bonding. High-fluoride varnishes and sealants, along with restorative materials like glass ionomer cement that release fluoride, may offer better outcomes in these patients (19). Regular follow-ups are critical to

monitor the longevity and efficacy of such restorations. Another critical consideration is managing the impact of TMJ involvement on dental care. Conditions such as JIA frequently involve the TMJ, leading to pain, restricted jaw movement, and altered occlusion. These symptoms complicate dental procedures, particularly those requiring prolonged mouth opening, such as endodontic therapy or surgical extractions. Dental professionals must adopt strategies to minimize patient discomfort, such as shorter appointments, the use of bite blocks, and physical therapy referrals to improve TMJ function (20). Addressing TMJ issues early can help reduce long-term functional and aesthetic complications.

The psychological burden of autoimmune diseases on children further complicates dental care. Many children with these conditions experience anxiety or phobia related to both medical and dental procedures. Building trust through effective communication, creating a comfortable environment, and employing behavior management techniques are critical for ensuring treatment success. Sedation or general anesthesia may be considered in extreme cases, but these require careful risk assessment, especially in patients with cardiovascular or respiratory complications linked to their autoimmune condition. The interplay of systemic and oral health challenges necessitates a comprehensive, multidisciplinary approach to dental care for children with autoimmune diseases. Collaboration between dental professionals, pediatricians, and specialists in autoimmune disorders is crucial to optimize both dental and systemic outcomes for these patients.

### ***Long-Term Prognosis and Dental Management Strategies***

The long-term prognosis of dental health in children with autoimmune disorders is influenced by the severity of their condition, the effectiveness of systemic disease control, and the early implementation of preventive strategies. As these children are at a higher risk of developing progressive dental and craniofacial complications, a comprehensive approach that integrates medical and

dental care is essential to mitigate adverse outcomes.

A major determinant of long-term oral health is the impact of chronic inflammation on periodontal tissues and bone integrity. Prolonged inflammatory activity, commonly observed in conditions such as SLE and JIA, accelerates the progression of periodontal disease. This inflammatory milieu exacerbates alveolar bone loss and compromises the stability of the dentition. Strategies for managing these risks include early periodontal interventions, such as scaling and root planing, combined with systemic therapies that reduce inflammation, like non-steroidal anti-inflammatory drugs (NSAIDs) or biologics targeting cytokines such as TNF- $\alpha$  (21). Routine periodontal evaluations are also critical to monitor the progression of disease and adjust treatment plans accordingly.

Nutritional deficiencies, often a byproduct of autoimmune disorders like celiac disease or chronic inflammatory bowel diseases, further complicate the long-term prognosis of dental health. Insufficient absorption of key minerals such as calcium, phosphate, and magnesium can impair enamel mineralization and reduce bone density, increasing the risk of fractures and deformities in the jawbones. To counteract these effects, nutritional supplementation is often recommended, alongside dietary counseling to promote adequate intake of essential nutrients (22). Incorporating high-fluoride therapies can further strengthen enamel and reduce the risk of caries in these patients.

The management of craniofacial growth disturbances requires early identification and long-term monitoring to prevent severe structural anomalies. TMJ arthritis, a frequent complication of JIA, remains a critical area of focus due to its potential to significantly impact mandibular development and occlusion. Growth disturbances stemming from TMJ inflammation, such as mandibular hypoplasia or retrognathia, often necessitate orthodontic or surgical interventions. Functional appliances, such as mandibular advancement splints, may help guide growth in younger patients, while orthognathic surgery is

typically reserved for more severe cases in adolescence or adulthood (23). Close collaboration between orthodontists, oral surgeons, and rheumatologists is essential to optimize outcomes.

For children with autoimmune disorders, ensuring the longevity of dental restorations and prosthetics poses additional challenges due to altered salivary composition and oral hygiene limitations. Xerostomia, a common feature in conditions like juvenile Sjögren's syndrome, accelerates the wear and degradation of restorative materials. To address this, materials with enhanced durability and fluoride-releasing properties, such as glass ionomer cements or resin-modified composites, are often recommended. Additionally, custom night guards or protective splints may be prescribed to manage bruxism and reduce mechanical stress on restorations (24). Periodic maintenance and adjustments of prosthetic devices are crucial to ensure functional and esthetic success over time.

Preventive care remains the cornerstone of long-term management for these patients, with an emphasis on reducing the cumulative impact of systemic disease on oral health. Regular fluoride applications, sealants for caries-prone teeth, and meticulous oral hygiene practices are vital to minimizing complications. Furthermore, the integration of emerging technologies, such as salivary diagnostics and digital imaging, into routine care allows for earlier detection of disease progression and more personalized treatment approaches. Education of caregivers and patients about the specific oral health risks associated with their condition is equally critical in fostering adherence to preventive measures and improving overall outcomes.

## **Conclusion**

Pediatric autoimmune disorders significantly impact dental development, growth, and management, necessitating a multidisciplinary approach to care. Early identification and targeted interventions are crucial to mitigate long-term complications such as delayed tooth eruption, craniofacial abnormalities, and periodontal disease. Preventive strategies, including tailored dental care

and systemic disease control, can enhance both oral and overall health outcomes. Continued research is essential to refine management approaches and improve the quality of life for affected children.

**Disclosure**

***Conflict of interest***

There is no conflict of interest.

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Non applicable

***Data availability***

Data that support the findings of this study are embedded within the manuscript.

***Author contribution***

All authors contributed to conceptualizing, data drafting, collection and final writing of the manuscript.

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