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Review

Clinical Approaches to Treating Dental Erosion in Children with Gastroesophageal Reflux Disease

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Abstract

Dental erosion in children with gastroesophageal reflux disease (GERD) is a multifaceted challenge requiring an integrated approach to prevention and treatment. The acidic environment caused by GERD leads to demineralization of enamel, increasing the risk of structural damage and sensitivity. Pediatric teeth, with their developing and porous nature, are particularly vulnerable to such erosion. The role of gastric acids, combined with dietary and behavioral factors, exacerbates enamel breakdown, making early diagnosis and intervention essential. Preventive strategies emphasize minimizing acidic exposure and enhancing enamel resistance. Pharmacological control of GERD using proton pump inhibitors reduces gastric acidity, while dietary modifications, such as limiting acidic foods and beverages, mitigate further enamel damage. Fluoride applications and remineralizing agents, including casein phosphopeptide-amorphous calcium phosphate, aid in enamel recovery. Tailored oral hygiene practices, such as delaying tooth brushing post-acid exposure, play a critical role in protecting softened enamel. Restorative treatment options are tailored to the severity of erosion. Composite resins and glass ionomer cements provide effective solutions for mild to moderate cases, offering aesthetic and functional benefits. In advanced cases, indirect restorations like veneers and crowns are employed, leveraging advancements in materials such as hybrid ceramics. Digital technologies, including CAD/CAM systems, enable precise and efficient restorative solutions, reducing treatment times and enhancing outcomes. Multidisciplinary collaboration between pediatricians, gastroenterologists, and dental professionals ensures comprehensive care for children with GERD-induced dental erosion. Emphasizing preventive measures, leveraging advanced restorative materials, and utilizing digital dentistry contribute to effective management. This holistic approach preserves oral health, restores functionality, and improves the quality of life for affected children.

Keywords: *Dental erosion, pediatric GERD, enamel demineralization, preventive strategies, restorative dentistry*

Introduction

Dental erosion is a progressive loss of tooth enamel caused by acid exposure, leading to structural damage and increased sensitivity. In children, this condition is of particular concern due to the developmental stages of their dentition and its susceptibility to acidic environments. One significant etiological factor of dental erosion in pediatric populations is gastroesophageal reflux disease (GERD). GERD, a chronic digestive disorder characterized by the regurgitation of gastric contents into the esophagus, poses multifaceted health challenges, including oral manifestations such as enamel erosion (1).

The prevalence of dental erosion in children with GERD varies globally but demonstrates a consistent association with the severity of reflux symptoms. The acidic content of gastric fluids, primarily hydrochloric acid, can directly dissolve the mineralized surface of teeth, accelerating erosion when compounded by dietary acids or poor oral hygiene practices. Studies have shown that enamel surfaces exposed to gastric acid become more susceptible to abrasion from mechanical forces, such as tooth brushing or mastication (2). As a result, early diagnosis and targeted interventions are paramount in preventing irreversible damage.

The clinical presentation of dental erosion in GERD-affected children often includes smooth and shiny tooth surfaces, rounded cusps, and loss of occlusal morphology. Over time, this can progress to dentin exposure, resulting in pain and heightened sensitivity to thermal and chemical stimuli. Additionally, the psychosocial implications of dental erosion, such as compromised aesthetics and functional impairment, highlight the need for multidisciplinary management (3).

Management of dental erosion in pediatric GERD patients necessitates a comprehensive approach, addressing both systemic and local contributing factors. Pharmacological management of GERD using proton pump inhibitors (PPIs) or H2 receptor antagonists has shown efficacy in reducing gastric acid exposure and subsequent oral manifestations. Concurrently, dietary counseling, improved oral hygiene practices, and fluoride application have emerged as critical adjuncts in minimizing erosion progression (4).

Restorative treatment strategies also play an integral role in addressing the aesthetic and functional impairments caused by advanced erosion. The selection of restorative materials depends on the extent of enamel loss and the need for long-term durability. Composite resins, glass ionomers, and ceramics are commonly employed to restore the structural integrity of eroded teeth while maintaining an esthetically pleasing appearance. This review aims to explore the clinical approaches for managing dental erosion in children with GERD, emphasizing preventive measures, pharmacological treatments, and restorative interventions.

Review

Dental erosion in children with gastroesophageal reflux disease (GERD) presents a significant challenge, as it intertwines systemic and local factors that exacerbate enamel degradation. GERD-induced erosion primarily stems from the frequent exposure of teeth to gastric acid, which demineralizes enamel, rendering it more vulnerable to mechanical wear and chemical dissolution. Studies have emphasized that the acidic pH of gastric contents, typically below 4, accelerates the breakdown of hydroxyapatite, the mineral component of enamel, leading to irreversible damage (5). This highlights the critical need for early identification and comprehensive management strategies to prevent progression.

Preventive measures, such as dietary modifications to reduce acidic food and beverage consumption, have proven effective in mitigating further enamel loss. Additionally, fluoride treatments remain a cornerstone of management, promoting remineralization and increasing enamel resistance to acid attacks. Recent evidence underscores the effectiveness of casein phosphopeptide-amorphous calcium phosphate in enhancing enamel repair in

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children with GERD, further supporting its integration into treatment protocols (6). For advanced cases, restorative interventions tailored to the extent of damage are essential to restore function and aesthetics. The success of these approaches depends on early diagnosis, regular monitoring, and collaboration between healthcare providers to address both the systemic and dental aspects of GERD comprehensively.

Mechanisms of Dental Erosion in Pediatric GERD Patients

Dental erosion in children with GERD is the result of complex interactions between gastric acids and oral environments. Acid reflux, a hallmark of GERD, allows stomach acids to enter the oral cavity, where the low pH significantly undermines enamel integrity. This intrinsic acidic exposure is particularly detrimental to pediatric teeth due to the immature and porous nature of their enamel, which is more susceptible to demineralization than adult enamel (7).

Saliva plays a vital protective role in buffering acids and aiding remineralization. However, studies indicate that children with GERD often experience reduced salivary flow or altered composition, impairing its protective capacity (8). The compromised buffering mechanism prolongs the contact time of gastric acids with dental surfaces, exacerbating enamel dissolution. Furthermore, the frequent occurrence of nocturnal reflux episodes reduces saliva production during sleep, intensifying the erosive effects.

Enamel demineralization occurs when gastric acids lower the oral pH below the critical threshold of 5.5. The acids dissolve hydroxyapatite crystals, the primary mineral in enamel, leading to surface softening and subsequent wear from mechanical forces such as tooth brushing or chewing. Research highlights that repeated acid exposures without adequate recovery time intensify cumulative damage, causing progressive enamel thinning and dentin exposure (9). Beyond direct acid effects, GERD-induced dental erosion may be amplified by behavioral and dietary factors common among affected children. Studies link dietary preferences for acidic beverages and citrus fruits with increased enamel erosion in GERD patients. These external acids, when combined with intrinsic acids from reflux, create a highly erosive oral environment, further accelerating dental degradation (10). Additionally, behavioral responses to GERD symptoms, such as excessive brushing to counteract reflux-induced halitosis, can aggravate enamel loss.

Systemic factors also influence the severity of erosion in pediatric GERD. Developmental enamel defects, commonly observed in children with chronic illnesses or nutritional deficiencies, have been associated with increased vulnerability to acid attacks. These defects create surface irregularities that trap acidic residues, prolonging their contact with enamel and heightening the risk of erosion (11). Moreover, certain medications used to manage GERD, such as PPIs, may inadvertently alter oral microbial composition, potentially affecting enamel integrity.

The role of oral microbiota in dental erosion has recently garnered attention. Acidic environments foster shifts in microbial populations, favoring acidogenic and aciduric bacteria. These microbes not only tolerate low pH conditions but may also contribute to acid production, compounding the erosive effects of refluxed gastric acids (12). This synergistic interaction underscores the need for targeted antimicrobial interventions in the management of GERD-related dental erosion. Pediatric GERD patients often exhibit distinct patterns of erosion, with palatal surfaces of maxillary anterior teeth being most affected. This localization is attributed to gravitational flow and the anatomical proximity of these teeth to the esophagus. Over time, such erosion may compromise tooth morphology and aesthetics, significantly impacting the child's oral function and psychological well-being (13).

Efficacy of Preventive Strategies in Managing Dental Erosion

Preventing dental erosion in children with GERD requires strategies that encompass systemic control of reflux, dietary modifications, and oral hygiene practices tailored to protect vulnerable enamel. One

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of the cornerstones of prevention is reducing the frequency and intensity of acidic exposure in the oral cavity. In this context, pharmacological control of GERD plays a significant role. As established in the literature, PPIs have been demonstrated to lower the risk of erosion by reducing the acidity and volume of refluxed gastric contents (14).

Saliva's role as a natural defense mechanism against acid-induced enamel damage is another critical factor in prevention. Enhancing salivary flow through the use of chewing gums containing xylitol or bicarbonates has been shown to increase oral pH and facilitate enamel remineralization. Such interventions are particularly beneficial in counteracting the nocturnal effects of GERD, during which salivary flow is naturally diminished (15). Additionally, the application of remineralizing agents, such as fluoride varnishes or casein phosphopeptide-amorphous calcium phosphate, can further enhance enamel resistance to acid dissolution and support surface repair in early stages of erosion (16).

Dietary modifications form another pillar of prevention. Parents and caregivers of GERD-affected children are often advised to limit the consumption of acidic foods and beverages, such as citrus fruits, carbonated drinks, and sugary snacks. These dietary changes not only reduce exogenous acid exposure but also complement the management of reflux symptoms. Emerging evidence suggests that incorporating non-acidogenic snacks, such as cheese or milk, into meals can buffer oral acidity and protect enamel (12). Customizing oral hygiene practices for GERD-affected children is equally important. Avoiding abrasive toothpastes and hard-bristled toothbrushes reduces mechanical wear on acid-softened enamel. Recommendations to delay brushing for at least 30 minutes after a reflux episode or the consumption of acidic foods are supported by studies demonstrating the protective effect of allowing enamel to re-harden before mechanical cleaning (17). Using soft-bristle toothbrushes and gentle brushing techniques also minimizes the risk of exacerbating enamel wear in already eroded areas.

Regular dental monitoring remains a cornerstone of prevention, ensuring early detection and intervention for erosion. Pediatric dentists often employ diagnostic tools such as intraoral cameras and quantitative light-induced fluorescence to document and monitor erosion progression. This allows for timely reinforcement of preventive measures and individualized treatment planning. Moreover, clinicians can apply protective resin-based sealants to vulnerable tooth surfaces as an additional barrier against acid attacks (18). Incorporating educational programs for patients and families has also proven beneficial. Raising awareness about the multifactorial nature of dental erosion and the importance of compliance with both medical and dental recommendations encourages adherence to preventive strategies. Engaging families in active prevention creates a holistic approach to managing GERD-related dental erosion, ensuring better outcomes in long-term oral health.

Comparative Analysis of Restorative Treatment Modalities

The management of dental erosion in pediatric GERD patients often necessitates restorative interventions to address both functional and aesthetic impairments. The choice of restorative materials and techniques is critical, as it directly influences the durability, biocompatibility, and success of the treatment. Composite resins are frequently employed due to their aesthetic properties and minimally invasive application. Their adaptability to the specific contours of eroded surfaces makes them particularly suitable for anterior restorations. Studies highlight their ability to provide satisfactory short- to medium-term outcomes in cases of mild to moderate erosion (19). In contrast, glass ionomer cements are valued for their fluoride-releasing properties, which can help prevent further demineralization in GERD patients. These materials are especially advantageous in pediatric populations, where enhancing enamel resistance is a priority. Despite their benefits, glass ionomer cements may lack the wear resistance and aesthetic appeal of composite resins, limiting their

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use in areas subject to significant occlusal forces or aesthetic demands (20).

For severe cases of dental erosion involving substantial enamel and dentin loss, indirect restorations such as veneers or crowns are considered. Porcelain veneers, for instance, provide exceptional durability and aesthetics, offering a long-term solution for heavily eroded teeth. However, the invasive nature of tooth preparation required for veneers raises concerns about further compromising already weakened dental structures. In contrast, minimal preparation or no-prep veneers have emerged as viable alternatives, reducing the extent of tooth reduction while maintaining high aesthetic outcomes (20).

Advances in restorative materials, such as hybrid ceramics and resin nanocomposites, have further expanded treatment options. Hybrid ceramics combine the aesthetic benefits of traditional ceramics with the flexibility and shock absorption properties of polymers, making them suitable for pediatric applications where preservation of tooth structure is critical. These materials also demonstrate favorable wear characteristics, closely mimicking the natural tooth (21). The use of adhesive systems has revolutionized restorative dentistry by enhancing the bond strength between restorative materials and the eroded tooth surface. Self-etching adhesive systems are particularly effective in pediatric GERD cases, as they simplify application protocols while ensuring reliable adhesion. These systems are less dependent on moisture control, a significant advantage when treating uncooperative pediatric patients. Moreover, recent developments in universal adhesives allow compatibility with various restorative materials, streamlining clinical workflows (22).

Digital dentistry has further transformed the management of dental erosion, offering precision and customization in restorative treatments. Computer-aided design and manufacturing (CAD/CAM) technology facilitates the fabrication of highly accurate restorations with optimal fit and finish (23). This technology reduces chair time, which is especially beneficial for pediatric patients, and allows for same-day restorations in many cases. The integration of CAD/CAM systems with advanced materials such as zirconia ensures the delivery of restorations that are both durable and aesthetically pleasing (24).

Conclusion

Managing dental erosion in pediatric GERD patients requires a multidisciplinary approach integrating preventive, pharmacological, and restorative strategies. Early diagnosis and tailored interventions are crucial in minimizing enamel loss and preserving oral health. Advances in restorative materials and technologies offer promising solutions for long-term management. Collaborative care ensures improved outcomes and quality of life for affected children.

Disclosure

Conflict of interest

There is no conflict of interest.

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Ethical consideration

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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