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Review Article

Preventing and management of mouth ulcers caused by orthodontic

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ABSTRACT

Orthodontic-induced mouth ulcers are a common complication arising from mechanical irritation and increased plaque accumulation during treatment. These painful lesions significantly impact the comfort and compliance of patients undergoing orthodontic care. Various factors contribute to their development, including appliance design, oral hygiene, dietary habits, stress, and systemic conditions like nutritional deficiencies. Effective prevention and management strategies are essential to mitigate these effects and enhance patient outcomes. Prevention focuses on minimizing mechanical trauma through improved appliance designs such as rounded brackets and self-ligating systems, and the use of protective barriers like orthodontic wax and silicone strips. Maintaining optimal oral hygiene with adjunctive tools, antimicrobial rinses, and dietary adjustments plays a pivotal role in reducing plaque accumulation and preventing mucosal injuries. Behavioral interventions, including stress management and addressing parafunctional habits, further support ulcer prevention. Management approaches include the use of topical treatments like corticosteroid-based ointments and bio-adhesive gels to alleviate pain and promote healing. Low-level laser therapy (LLLT) accelerates tissue repair and provides analgesic effects, emerging as an effective adjunctive treatment. In more severe cases, systemic antibiotics or anti-inflammatory medications may be employed to control secondary infections and support immune responses. Patient education is critical in ensuring adherence to these strategies, emphasizing the importance of dietary modifications, stress control, and consistent oral care. Comprehensive care combining innovative technologies, evidence-based treatments, and personalized patient support addresses both the etiology and impact of orthodontic-induced ulcers. These integrated strategies not only reduce the incidence and severity of lesions but also improve overall patient satisfaction and treatment compliance. As advancements in materials and therapeutic modalities continue, the potential for enhanced outcomes in orthodontic care grows, ensuring better quality of life for patients during treatment.

Keywords: Orthodontic-induced ulcers, Mouth ulcer management, LLLT, Oral hygiene strategies, Orthodontic appliance irritation

INTRODUCTION

Mouth ulcers, also known as aphthous ulcers, are a common issue associated with orthodontic treatment, significantly impacting patients' oral health and quality of life. These painful lesions occur due to continuous irritation and trauma from orthodontic appliances, such as brackets and wires, which make maintaining oral hygiene more challenging. The prevalence of such ulcers among orthodontic patients is notably high, with factors like appliance design, individual mucosal sensitivity, and improper maintenance of oral hygiene playing contributory roles.[1]

Orthodontic appliances create new retention areas for plaque and food debris, which exacerbate the irritation of oral mucosa. Studies have demonstrated that the inflammation caused by plaque, combined with mechanical trauma, increases the susceptibility of soft tissues to ulcerations.[2] Additionally, systemic factors, including nutritional deficiencies and stress, can worsen the condition, making effective management a multidisciplinary concern. Preventing these ulcers often involves a combination of appliance design optimization and patient education on oral hygiene practices. Advances in orthodontic materials, such as the introduction of self-ligating brackets and rounded archwires, have reduced the friction and trauma to soft tissues, thereby decreasing the incidence of ulcers.[3] Concurrently, the application of protective barriers like wax and silicone, as well as the use of topical treatments containing anti-inflammatory agents, have proven effective in managing minor ulcers caused by orthodontic appliances.

The management of these ulcers also emphasizes the use of systemic and topical interventions to accelerate healing and alleviate pain. The role of antimicrobial and anti-inflammatory medications, such as chlorhexidine mouthwash and corticosteroid ointments, has been extensively studied. For more severe cases, adjunctive treatments like laser therapy have shown promising results in reducing inflammation and promoting tissue repair.[4] This review aims to consolidate current knowledge on the etiology, prevention, and management of mouth ulcers caused by orthodontic appliances, providing evidence-based strategies to improve patient care and outcomes.

Orthodontic treatment often leads to complications such as mouth ulcers, which significantly affect patient comfort and compliance. Effective management strategies focus on reducing mechanical trauma and promoting tissue healing. The role of patient education in maintaining meticulous oral hygiene has been highlighted as a key preventive measure. Ensuring minimal plaque accumulation reduces the inflammation and friction caused by fixed appliances, subsequently lowering the likelihood of ulcer formation.[5]

Innovative approaches, such as LLLT, have gained prominence for their ability to enhance ulcer healing and alleviate pain. LLLT stimulates cellular repair mechanisms, reduces inflammation, and accelerates epithelial regeneration. Recent studies have confirmed its efficacy in both clinical and experimental settings, positioning it as a valuable adjunctive treatment during orthodontic care.[6] Additionally, the use of protective barriers like orthodontic wax and the integration of smoothened appliance edges further diminish the risk of mechanical injuries. Topical agents containing anti-inflammatory and antimicrobial properties, such as corticosteroids and chlorhexidine, complement these strategies by addressing local irritation and infection risks. A combination of preventive and therapeutic measures remains essential for comprehensive management, ensuring better patient outcomes and adherence to treatment protocols.

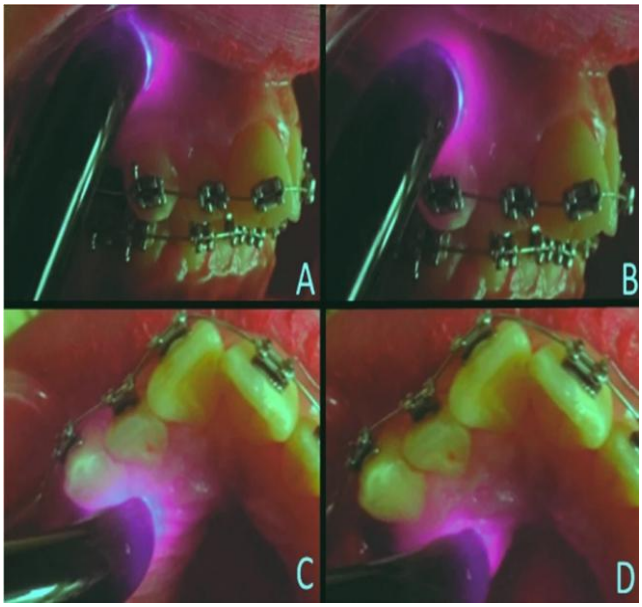

Figure 1 (A-D): Example of LLL application points in orthodontics.[7]

ETIOLOGY AND RISK FACTORS FOR ORTHODONTIC-INDUCED MOUTH ULCERS

Orthodontic-induced mouth ulcers are a multifactorial phenomenon influenced by the interplay of mechanical, biological, and environmental factors. These ulcers are a direct consequence of the trauma inflicted by orthodontic appliances, including brackets, wires, and bands, on the soft tissues of the oral cavity. The constant friction caused by these devices disrupts the mucosal layer, leading to localized inflammation and ulceration. Poorly contoured edges, ill-fitting appliances, or over-tightened wires exacerbate this trauma, making the oral mucosa more susceptible to injury.[8] A significant contributor to the occurrence of ulcers is the patient's oral hygiene. Orthodontic appliances create numerous niches that harbor food debris and bacterial plaque. The resulting

bacterial proliferation triggers an inflammatory response in the gingiva and surrounding mucosa. Research has shown a strong correlation between increased plaque accumulation and the frequency of ulcer formation in orthodontic patients. Furthermore, inadequate cleaning practices lead to persistent gingival irritation, aggravating the risk of mucosal lesions.[9] Educating patients on maintaining optimal oral hygiene, coupled with the use of adjunctive tools like interdental brushes and antimicrobial mouth rinses, is essential in mitigating this risk.

Biological predispositions also play a significant role. Individuals with thinner oral mucosa or genetic hypersensitivity are more likely to experience ulceration. These predispositions are often linked to systemic conditions such as iron deficiency anemia, vitamin B12 deficiency, and autoimmune disorders like Behçet's disease. In such cases, the mucosa lacks the resilience needed to withstand mechanical forces, making even mild irritation a trigger for ulcer development.[9,10] Additionally, the presence of systemic conditions like diabetes can slow down wound healing, further complicating the management of orthodontic-induced ulcers. Dietary habits are another influential factor in ulcer etiology. Acidic, spicy, or rough-textured foods can irritate compromised mucosa, worsening existing lesions or causing new ones. Foods such as citrus fruits, tomatoes, and crunchy snacks are frequently reported by patients as aggravating their ulcers. Similarly, inadequate hydration compromises mucosal elasticity and reduces the production of protective saliva, leaving the mucosa vulnerable to mechanical trauma. Smoking introduces yet another layer of complexity, as tobacco products delay wound healing by constricting blood vessels and reducing the delivery of essential nutrients and oxygen to affected areas.[11]

Psychological stress also plays a subtle but impactful role. Elevated stress levels have been linked to both physiological and behavioral changes in patients undergoing orthodontic treatment. Stress-induced immune suppression can impair the healing of mucosal lesions, while increased parafunctional habits such as bruxism may exacerbate mechanical irritation in the oral cavity. Studies have noted a higher prevalence of ulcers among orthodontic patients during stressful life events, highlighting the need for holistic management approaches that address both physical and emotional health.[12]

Certain medications used by orthodontic patients can predispose them to ulcers. For instance, nonsteroidal anti-inflammatory drugs, commonly used to manage pain during treatment, may irritate the gastrointestinal tract and indirectly increase the sensitivity of oral tissues. Similarly, medications that reduce saliva production, such as antihistamines and decongestants, diminish the protective barrier function of saliva, making the oral mucosa more prone to trauma. The design and material of orthodontic appliances themselves contribute to ulcer formation. Traditional brackets and wires, especially those made of nickel, have been shown to cause hypersensitivity reactions in some individuals. Nickel allergies, although uncommon, can lead to localized erythema, swelling, and eventual ulceration. Modern advancements, such as ceramic brackets and memory wires, aim to reduce these adverse effects, but their efficacy varies depending on patient-specific factors and the orthodontist's expertise.[8]

PREVENTIVE STRATEGIES AND INTERVENTIONS

Preventive strategies and interventions to mitigate orthodontic-induced mouth ulcers have garnered significant attention in dental research and practice. These approaches, aimed at reducing both the incidence and severity of mucosal injuries, incorporate innovations in appliance design, patient education, and therapeutic modalities. A well-rounded preventive framework addresses not only mechanical factors but also underlying biological and behavioral contributors. Advancements in orthodontic appliance design play a pivotal role in ulcer prevention. Modern brackets with rounded edges and smoothened surfaces reduce mucosal irritation during treatment. Additionally, self-ligating brackets minimize pressure points and friction, promoting patient comfort. For cases requiring extensive adjustments, the application of orthodontic wax over sharp or protruding components provides an effective barrier, significantly lowering the risk of trauma to the oral tissues.[13] Protective silicone strips have also emerged as a viable alternative, offering increased adherence and durability compared to traditional wax.

Oral hygiene education is another cornerstone of preventive care. Orthodontic appliances inherently increase plaque retention, necessitating enhanced cleaning protocols. Regular use of interdental brushes and water flossers ensures the removal of food debris and plaque from hard-to-reach areas, thereby mitigating inflammation that could predispose tissues to ulcers. Topical fluoride treatments and antimicrobial mouth rinses, such as those containing chlorhexidine, are particularly effective in maintaining a balanced oral microbiome during orthodontic treatment.[14] These measures not only reduce ulcer formation but also promote overall oral health. Dietary modifications further enhance prevention efforts. Soft, non-irritating foods are recommended to prevent mechanical injury to the oral mucosa. Acidic and spicy foods, which exacerbate mucosal sensitivity, are best avoided during active orthodontic adjustments. Ensuring adequate hydration also supports mucosal resilience, reducing friction-related trauma. Nutritional counseling that addresses deficiencies in vitamins such as B12 and folate is often integrated into preventive protocols, as these nutrients are critical for maintaining mucosal integrity and promoting healing.[15] LLLT has gained traction as a preventive and therapeutic tool in orthodontic practice. This non-invasive modality reduces inflammation and promotes tissue repair by

stimulating cellular activity. Studies have demonstrated the efficacy of LLLT in accelerating wound healing and alleviating discomfort associated with ulceration. Moreover, the application of LLLT around high-risk areas, such as the inner cheeks and lips, prior to appliance adjustments has shown promising results in preventing the onset of mucosal injuries.[16]

Behavioral interventions complement mechanical and therapeutic strategies in a comprehensive prevention plan. Managing stress, which has been linked to increased ulcer susceptibility, is essential for long-term success. Stress-relief techniques, including mindfulness and relaxation exercises, help patients cope with the psychological demands of orthodontic treatment. Additionally, addressing parafunctional habits such as bruxism, which exacerbate mucosal injuries, through the use of night guards or behavioral therapy, enhances protective outcomes.[12] Through the integration of tailored appliance modifications, improved oral hygiene protocols, dietary adjustments, therapeutic technologies, and behavioral interventions, the incidence and severity of orthodontic-induced mouth ulcers can be significantly reduced.

MANAGEMENT APPROACHES: EVIDENCE-BASED TREATMENTS AND PATIENT CARE

Management of orthodontic-induced mouth ulcers necessitates a multi-pronged approach that integrates evidence-based treatments with personalized patient care. Effective management strategies focus on alleviating pain, promoting healing, and preventing secondary infections, thereby enhancing overall patient comfort and compliance. Topical treatments are commonly utilized in managing oral ulcers caused by orthodontic appliances. Corticosteroid-based ointments such as triamcinolone acetonide provide anti-inflammatory effects that help reduce swelling and pain in affected areas. Additionally, protective barriers like bio-adhesive gels are applied to shield the ulcerated mucosa from further irritation caused by appliances, ensuring a conducive environment for healing. These treatments are widely regarded as the first line of defense in ulcer management due to their localized efficacy and minimal systemic side effects.[11] LLLT has emerged as a novel intervention for managing orthodontic-induced ulcers. This non-invasive technique promotes cellular repair and accelerates tissue regeneration by stimulating mitochondrial activity in the affected area. Clinical trials have demonstrated significant reductions in ulcer healing time and pain scores following the application of LLLT. This therapy not only enhances the reparative processes but also provides immediate analgesic effects, making it an invaluable adjunct in orthodontic care.[13]

Systemic therapies are reserved for cases where local treatments prove insufficient or when multiple ulcers are present. Antimicrobial agents, such as systemic antibiotics, are used to prevent or control secondary infections in severe ulcerations. These medications are particularly crucial when lesions become infected or when patient comorbidities, such as diabetes, compromise immune responses. However, the judicious use of systemic treatments is emphasized to avoid potential resistance and adverse effects.[17] Maintaining optimal oral hygiene plays a critical role in both the management and prevention of orthodontic-induced ulcers. Daily use of chlorhexidine mouthwash helps to reduce bacterial load and minimize inflammation around ulcer sites. Furthermore, fluoride-based rinses and re-mineralizing agents are often recommended to strengthen the enamel and improve the overall oral environment. These interventions help mitigate the cumulative effects of plaque accumulation, which can exacerbate irritation and delay healing.[8,18]

However, patient education and behavioral modifications form an integral part of comprehensive care. Counseling patients on dietary adjustments, such as avoiding acidic or spicy foods, is essential in minimizing discomfort during healing. Stress management techniques are also introduced, as psychological stress has been linked to delayed recovery and heightened ulcer susceptibility. Orthodontists and healthcare providers work collaboratively to address these factors, ensuring a holistic treatment approach that caters to individual needs.[19]

CONCLUSION

In managing orthodontic-induced mouth ulcers, integrating advanced therapeutic techniques with patient-centered care proves essential for achieving optimal outcomes. Preventive strategies, innovative treatments like LLLT, and systemic approaches effectively address the multifaceted nature of these lesions. Emphasizing patient education and holistic care further enhances healing and compliance. Comprehensive management ultimately improves the quality of life during orthodontic treatment.

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