

Oral mucosal lesions associated with fixed orthodontic appliances: A review

Kawono¹, How Kim Chuan², Susanna Halim^{3*}

ABSTRACT

Orthodontic procedures enhance dental well-being, yet they can lead to painful sores due to irritation from devices. These sores, often found on the inner cheeks and lips, arise from friction caused by brackets, wires, and screws, resulting in discomfort and slow recovery. To prevent these issues, one can use orthodontic wax, materials that are friendly to the body, and make adjustments to the appliances. Innovative treatments like low-level laser therapy and personalized 3D-printed devices are proving to be promising options for relief. Regular check-ups and working together as a team are essential for providing effective care. Addressing issues early can lessen complications, boost comfort, and improve results of orthodontic care, emphasizing the importance of both preventive and treatment methods in practice.

Keywords: traumatic ulcers, orthodontic treatment, oral mucosal lesions, fixed appliances

INTRODUCTION

Orthodontic care not only improves oral health and functionality but also enhances appearance and boosts confidence. However, like any medical treatment, it comes with risks and complications, particularly affecting soft and hard tissues.¹⁻⁴ One of the risks during orthodontic procedures is the possibility of damage to the mouth's soft tissues.^{5,6} Common side effects include ulcerations, pain, and discomfort that mostly arise from irritation and trauma caused by orthodontic devices.⁷⁻⁹ Elements like archwires, brackets, bands, tubes, hooks, and mini screws can lead to these ulcerations. Increased muscle activity from the cheeks or tongue can worsen the situation.^{1,2,7} This type of irritation caused by orthodontic devices is known as traumatic ulceration.^{2,10-12} Traumatic ulceration refers to a soft tissue injury in the mouth triggered by acute or chronic physical, mechanical, thermal, or chemical damage.¹³ Managing traumatic ulcers that arise from orthodontic treatments involves a team approach between orthodontists and oral medicine specialists.²

This article review focuses on the causes and treatment of mucosal ulcers that may arise during orthodontic procedures. By exploring various contributing factors and recent advancements in research, we aim to offer insights that can improve patient care and outcomes. Besides, we encourage ongoing research and innovation in this field to provide better support for those undergoing orthodontic treatment.¹⁴

METHOD

We performed a thorough literature review to pinpoint relevant articles published in English. Our search spanned several highly regarded electronic databases, including PubMed/MEDLINE, Google Scholar, Scopus, and CrossRef. To ensure a focused and comprehensive retrieval of germane studies, our search strategy incorporated specific Medical Subject Headings (MeSH) terms. These terms were deliberately chosen to capture the core concepts of our investigation and comprised: "Oral mucosal lesions," "Orthodontic treatment," "Ulcers," and "Fixed appliances." This systematic approach to database searching, combined with the use of precise MeSH terms, aimed to maximize the retrieval of pertinent and high-quality evidence

Affiliation

¹World Stomatological Institute, Ambon, Indonesia

²M. Kandiah Faculty of Medicine and Health Sciences, Universiti Tunku Abdul Rahman, Sungai Long, Malaysia

³Faculty Medicine, Dentistry and Health Sciences, Universitas Prima Indonesia, Medan, Indonesia

Correspondence

susannahalim@unprimdn.ac.id

concerning the relationship between orthodontic treatment involving fixed appliances and the occurrence of oral mucosal lesions, particularly ulcers.

DISCUSSION

Traumatic ulcers can result from physical, heat, or chemical injuries. These lesions are quite common in everyday practice. A traumatic ulcer may develop due to sharp teeth, improper restorations, poorly fitting dentures, or fixed orthodontic devices, leading to chronic ulcers.² For individuals wearing orthodontic appliances, many mucosal injuries are linked to the trauma inflicted by these devices. The most common types of mucosal injuries observed among wearers of fixed orthodontic equipment include gingival inflammation, contusions, erosions, and ulcerations (see Figure 1). A study conducted by Kvam et al. indicated that inflammatory lesions of the oral mucosa were more prevalent than ulcers, which occur infrequently and are predominantly associated with fixed orthodontic devices.^{1,5,8,15}



Figure 1. Intense gum inflammation around the brackets and wires during fixed orthodontic treatment.⁶

According to the WHO classification, the oral mucosal lesions associated with fixed orthodontic appliances typically appear on the buccal and vestibular mucosa, where the brackets and archwires lead to erosions and desquamations, and on the lower lip due to ulcerations caused by the brackets and wires. As noted by Travess et al., in patients with fixed orthodontics, ulcerations or hyperplasia arise from irritation caused by the archwire and adhesive bonds, or from the wire pressing against the lips.^{2,5,6} Ulcers stemming from repeated trauma may be either symptomatic or asymptomatic, usually displaying well-defined edges and feeling firm when touched. Once the source of irritation is removed, these lesions can heal with or without leaving scars.^{2,13}

Traumatic conditions result in various types of lesions depending on the specific orthodontic appliance used. Brackets often lead to the formation of erosive and keratotic patches due to friction against surrounding mucosa. Archwires are frequently linked to ulcers that occur due to hooks penetrating the oral lining. Mini screws are commonly associated with redness and erosions.^{2,7}

Components of fixed orthodontic appliances that cause irritation include brackets, bracket hooks, bands, tubes, lingual arches, transpalatal arches, and wires, particularly the distal end of the wire. Mucosal irritation arises from friction between these components and the mucosal tissue. Unpredictable movements of the tongue and cheek muscles may exacerbate ulcer formation. While brackets can cause both erosion and desquamation of the mucosa, the wires are more likely to induce ulcerations.^{2,10}



Figure 2. Applying dental wax over a bracket can help alleviate the discomfort caused by ulcers on the lips and inner cheeks.⁶

Managing traumatic ulcerations involves both preventive measures and definitive treatment. Common therapies for traumatic ulcers associated with fixed orthodontic devices include chlorhexidine gluconate (CHx), topical corticosteroids, hyaluronic acid, and orthodontic wax as a protective agent. Applying dental wax over brackets can considerably lessen trauma and alleviate discomfort (see Figure 2). Using rubber tubing on unsupported archwires also minimizes the risk of unintended injury. Also, smoothly rounding off sharp appliance edges can be beneficial. The simplest way to address traumatic ulcers is to identify and remove the offending cause. Since brackets cannot be removed during fixed orthodontic treatment, a barrier is created between the source of irritation and the surrounding mucosa to reduce friction.

Orthodontists often apply medicated waxes to cover brackets or other irritative components. Alternatively, sensitive parts of the appliance can be altered. For instance, cutting or bending the wire end at the distal buccal tube towards the gingiva, or angling the ligature wire under the wire or bracket to prevent irritation, can be effective.^{1,2} Recent technological innovations and new methodologies have demonstrated potential in decreasing both the frequency and severity of mucosal ulcers among orthodontic patients:

- a) Laser treatment: Low-level laser therapy (LLLT) has become an exciting option for treating mucosal ulcers. Research has indicated that LLLT can expedite healing, alleviate pain, and lower the chances of ulcer reoccurrence by promoting cellular restoration and diminishing inflammation.^{14,16}
- b) Biocompatible materials: The innovation of biocompatible orthodontic materials, including nickel-free and hypoallergenic brackets and wires, has lessened the occurrences of allergic responses and mechanical irritation, thus lowering the risk of developing mucosal ulcers.^{14,17,18}
- c) Custom appliances via 3D printing: Employing 3D printing technology for creating personalized orthodontic appliances based on the individual's anatomy has proven effective in reducing irritation and enhancing comfort. These customize-made appliances fit more accurately, minimizing friction and the risk of ulcer development.^{14,19,20}

The articles we looked at provide a detailed look into oral mucosal issues that can come up with orthodontic treatments, emphasizing both the pros and cons. One of the positives includes a comprehensive risk assessment, where the researchers point out various concerns like oral sores, gum inflammation, and enamel loss. Importantly, the clinical relevance of these findings emphasizes the risk of traumatic ulcers caused by the friction of brackets and wires, giving clinicians useful insights for proactive management. Besides, several articles propose preventive measures such as fluoride treatments, orthodontic wax, and better hygiene practices. On the flip side, there are some drawbacks, like a lack of sufficient data since many studies rely on literature reviews, and a limited research scope, with a few studies featuring small or region-specific samples, which can limit their broader applicability.

CONCLUSION

Orthodontic treatments can lead to the formation of painful ulcers anywhere in the mouth. The ulcers resulting from orthodontic devices tend to be chronic, prolonging the healing process. Regular examinations of the oral mucosa alongside orthodontic care are essential. It is essential for every orthodontist to recognize the lesions that may arise due to treatment; neglecting this can result in treatment delays, patient discomfort, and the oversight of enduring ulcers like traumatic ones, which could develop into carcinoma. A comprehensive approach involving both an orthodontist and an oral medicine specialist is necessary for the effective management of traumatic ulcers.

REFERENCES

1. Mainali A. Occurrence of Oral Ulcerations in Patients Undergoing Orthodontic Treatment: A Comparative Study. *Orthodontic Journal of Nepal*. 2013 Dec 31;3(2):32–5.
2. Ossa YF, Ulfah K, Sitinjak RR. Treatment of Traumatic Ulcer Induced by Fixed Orthodontic Appliance: a Case Report. *Journal of Syiah Kuala Dentistry Society*. 2020; Available from: www.jurnal.unsyiah.ac.id/JDS
3. Richter GM, Kruppa J, Munz M, Wiehe R, Häsler R, Franke A, Martins O, Jockel-Schneider Y, Bruckmann C, Dommisch H, Schaefer AS. A combined epigenome- and transcriptome-wide association study of the oral masticatory mucosa assigns CYP1B1 a central role for epithelial health in smokers. *Clin Epigenetics*. 2019;11:105.
4. Chang J, Li X. Multivariate analysis of oral mucosal ulcers during orthodontic treatment. *World J Clin Cases* 2024; 12(26): 5868-5876.
5. Baricevic M, Mravak-Stipetic M, Majstorovic M, Baranovic M, Baricevic D, Loncar B. Oral Mucosal Lesions During Orthodontic Treatment. *Int J Paediatr Dent*. 2011 Mar;21(2):96–102.
6. Travess H, Roberts-Harry D, Sandy J. Orthodontics. Part 6: Risks in Orthodontic Treatment. *Br Dent J*. 2004 Jan 24;196(2):71–7.
7. Kumaran P, Ashok Kumar A, Maadasamy S. Oral Mucosal Lesions as a Consequence of Orthodontic Treatment. Vol. 11. 2023. Available from: www.ijcrt.org
8. Kvam E, Bondevik O, Gjerdet NR. Traumatic Ulcers and Pain in Adults During Orthodontic Treatment. *Community Dent Oral Epidemiol*. 1989 Jun 29;17(3):154–7.
9. Scheurer PA, Firestone AR, Bürgin WB. Perception of Pain as a Result of Orthodontic Treatment with Fixed Appliances. *The European Journal of Orthodontics*. 1996;18(1):349–57.
10. Akbari G, Dewi TS, Malik I. Traumatic Ulcer Distribution of Patients With Removable Orthodontic Appliance in Orthodontics Clinics of Dental Specialist Program. Vol. 26, *Padjadjaran Journal of Dentistry*. 2014.
11. Gupta R, Mahajan N, Jandial S, Kotwal B, Kaur S, Kharyal S. Incidence of Oral Ulcers in Patients undergoing Orthodontic Treatment. *International Journal of Preventive and Public Health Science*. 2017;3(2):31–4.
12. Widowati K, Nafiah N, Amanda A. Traumatic Ulcers in a Patient Using Fixed Orthodontic Appliances with Moderate Oral Hygiene. *Insisiva Dental Journal: Majalah Kedokteran Gigi Insisiva*. 2023 Jul 7;12(1).
13. Anura A. Traumatic Oral Mucosal Lesions: A Mini Review and Clinical Update. *Oral Health Dental Management*. 2014 Jun;13(2):254–9.
14. Ardila CM. Addressing mucosal ulcers during orthodontic treatment: An urgent call for preventive strategies. *World J Clin Cases* 2024; 12(30): 6420-6424.

15. Baranović M, Stipetić MM, Baričević D, Baranović M, Čimić A, Blažević A. Stanje Oralne Sluznice Kod Nositelja Ortodontskih Naprava Oral Mucosa Status of Patients Undergoing Orthodontic Treatment. Vol. 43, *Acta Stomatol Croat*. 2009. Available from: www.ascro.hr.
16. Radithia D, Mahdani FY, Bakti RK, Parmadiati AE, Subarnbhesaj A, Pramitha SR, Pradnyani IGAS. Effectiveness of low-level laser therapy in reducing pain score and healing time of recurrent aphthous stomatitis: a systematic review and meta-analysis. *Syst Rev*. 2024;13:192.
17. Di Spirito F, Amato A, Di Palo MP, Ferraro R, Cannatà D, Galdi M, Sacco E, Amato M. Oral and Extra-Oral Manifestations of Hypersensitivity Reactions in Orthodontics: A Comprehensive Review. *J Funct Biomater*. 2024;15.
18. Volkman KK, Inda MJ, Reichl PG, Zacharisen MC. Adverse reactions to orthodontic appliances in nickel-allergic patients. *Allergy Asthma Proc*. 2007;28:480-484.
19. Ardila CM, González-Arroyave D. Efficacy of CAD/CAM technology in dental procedures performed by students: A systematic scoping review of randomized clinical trials. *Heliyon*. 2023;9:e15322.
20. Ardila CM, González-Arroyave D, Zuluaga-Gómez M. Efficacy of three-dimensional models for medical education: A systematic scoping review of randomized clinical trials. *Heliyon*. 2023;9:e13395.