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IMPACT OF RESIN-BASED MATERIALS ON HEALING OF ORAL ULCERATIVE LESIONS

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Abstract
Introduction: Oral ulcerative lesions are extremely prevalent and often take hours to recover due to both microbial contamination and mechanical irritation. Recent research findings have implied that resin-based formulas can stimulate faster healing processes owing to their bioactive nature.
Objective: To analyse the treatment value of resin-based materials in the healing of oral ulcerative lesions.
Material and Methods: The study was a randomised controlled clinical trial conducted at the Department of Oral Medicine and Dental materials Ayub Medical College, Abbottabad in the duration from November, 2024 to April, 2025. Sixty patients were picked and captured in groups, among whom one was treated using a resin-based material, while the other was treated using corticosteroid gel. Ulcer size, pain score, and healing process were assessed every 0,3,7, and 14 days.
Results: The ulcer size and pain score filtered down in the resin group far sooner, and 93.3 per cent of the subjects healed completely by day 14 compared to 63.3 per cent in the control group. There were no reported negative effects.
Conclusion: Resin-based products can be a safe and effective alternative to traditional therapy to speed up the process of healing topical oral ulcers.

Keywords: *Oral ulcer, resin-based materials, wound healing, antimicrobial, pain relief, bioactive dental materials.*

INTRODUCTION

The oral mucosa is a sensitive and dynamic tissue that is essential in the conduction of oral health since it functions as the primary defence against pathogens and mechanical injury. Nevertheless, it is often prone to trauma caused by ulcerative lesions, trauma, infection, autoimmune disease or whole body illnesses. These lesions tend to take longer to heal in the wet oral environment and are perpetually irritated by speech and mastication. Resin-based materials have been considered as promising candidates in enhancing the healing of oral ulcerative lesions in recent years due to their biocompatibility, their antimicrobial properties, and their drug delivery properties (1). These materials have gone through major developments in their formulation and functional capabilities, which in turn are focused on not only structural restoration but also providing therapeutics to the oral tissue. The innovative materials developed include antimicrobial resin composites, which have been gaining attention due to their twin abilities to not only assist in tissue regeneration but also prevent microbial colonization.

Sun et al. note that there has been remarkable progress in introducing antimicrobial agents into restoratives formulated based on a resin system, hence a sustainable approach in dealing with oral infections and enhancing healing (1). This is especially evident in the treatment of ulcerative lesions, where proliferation of microorganisms is a significant obstacle to the healing of the tissues. Meanwhile, Heikal's clinical study on melatonin-loaded gelatin sponges reported improved wound healing of the palate, implicating that even biomaterials incorporating active ingredients may have a crucial role in accelerating oral wound healing (2). Another oral healthcare innovation, hydrogel-forming microneedles, has also provided an opportunity in the localized treatment of lesions by delivering therapeutics directly to the lesion site. Li et al. describe a successful application of hydrogel microneedles in oral disease management, citing advantages such as low invasiveness, extended medicine delivery, and compliance (3). These advances are indicative of the general shift to more personalized and precision dentistry, where the materials are designed to do more than merely restore, but also treat.

The dental polymer materials have now moved beyond being structural replacements to providing bioactive platforms. Wang puts a big stress on the industrial transformation of these substances, underlining the capacity of their interaction with biological tissues for the purposes of treatment (4). This evolution is actively promoted by the infiltration of nanotechnology and the drug delivery process into the dental field. Makvandi et al. describe different nano-platforms that may be used in oral and dental purposes, e.g. regeneration of tissue and prevention of infections, and the implication on the treatment of oral ulcerations (5). Moreover, Li and colleagues confirm the efficiency of hydrogel-forming microneedles in treating oral spots, once again proving that they serve both a supportive and a curing purpose (6). Pharmacological experiments have also been something that has been tried in order to promote healing.

Majeed et al. studied the application of montelukast with the model of an induced oral ulcer in a rat and got significant results on faster healing, which oriented to the synergy of the applied pharmacological agent and biomaterials (7). Trace minerals such as zinc have been known to play a major part in wound healing for ages. In another study, Caruso et al. give a generalised review of the biological effects of zinc on oral health by altering inflammation and enhancing the regeneration of tissues, which further justifies the use of bioactive agents in resin-based structures (8). Likewise, Yudaev and Chistyakov have highlighted the importance of incorporating natural components into dental products, introducing the hypothesis of using biocompatible and less toxic solutions in contrast to the commonly used synthetic elements (9). Boudjelal et al. have shown in vivo wound healing effect through natural resins, including Pistacia vera and these could be combined with resin-based dental restorations (10).

Nonetheless, although the therapeutic values of these materials are encouraging, their interaction with the oral tissues, particularly under situations such as Oral Lichen Planus, needs to be taken into account. A study by Agha-Hosseini et al. involved patch testing of allergic reactions to dental materials among affected patients by highlighting the importance of allergen-free and saliva-compatible dental materials (11). However, the disposition of the resin-based materials in vivo is a point of concern despite these newer advances. A recent doctoral study by Vervliet has determined a variety of monomers and degradation products that are emitted by these materials, which pose doubts on their biocompatibility in the long term (12). The danger of poisoning and allergy emphasises that there should be a constant enhancement of material design. The creation of antimicrobial and antifouling biocompatible material is critical as the adverse outcomes should be mitigated, and the therapeutic advantages should be increased (13).

Besides the materials, there has been an interest in adjunctive treatment, including photobiomodulation. Kotb reports that this non-invasive method can speed the healing of tissues by regulating cellular functioning, and when coupled with bioactive resin materials, it has the capacity to increase the rate at which oral ulcers are healed (14). The reduction in the adverse reactions towards dental alloys and polymers is of utmost importance. Arakelyan et al. argue that reducing allergens in

dental restorative procedures should be encouraged, in particular, in cases involving metal material to decrease the chances of hypersensitivity and inflammation (15). Reactions to materials including 2-hydroxyethyl methacrylate (HEMA) found in most resin-based products are well-recognised allergic reactions. The research by de Groot and Rustemeyer looks into its epidemiology and clinical manifestation, asking the dental professionals to pay attention to the use of alternative materials when working with sensitive patients (16). To address the issue, scientists such as Ardelean et al. have explored the use of composite cements in animal models and have presented the possible options of healing wounds, which would further the pursuit of safer and more effective healing agents (17).
Lastly, case reports, e.g., Rajendran et al., provide practical information regarding the intricacy of oral tissue response to dental procedures, the predictability of tissue response following procedures and the importance of materials that can support and adapt to the natural resolution process (18). The combined results of these studies point out the great contribution that resin-based substances can make to the healing of oral ulcerative lesions. Since material science, nanotechnology, and pharmacology are still converging in the field of dental research, the market development of superior resin-based therapeutics would provide a valuable avenue in enhancing clinical outcomes in patients with painful and recurrent oral ulcers.

Objective: To assess the therapeutic effect of the resin-based materials on the recovery process of oral ulcerative lesions, in terms of their antimicrobial, anti-inflammatory, and regenerative properties, with regard to a clinical setting.

MATERIALS AND METHODS

Study Design: Randomized Controlled Clinical Trial.

Study setting: The research was conducted the Department of Oral Medicine and Dental materials Ayub Medical College, Abbottabad.

Study duration: The study was carried out over a six-month period from November, 2024 to April, 2025.

Inclusion Criteria: The patients who were 18 to 60 years of age with clinically diagnosed minor or major oral ulcerative lesions of traumatic or aphthous origin were included. The patients had to have a lesion duration not exceeding 7 days and agree to be treated with a resin and undergo post-therapeutic investigation.

Exclusion Criteria: Patients with systemic diseases like diabetes, immunosuppression or autoimmune diseases, those receiving chemotherapy or radiotherapy, pregnant or nursing mothers and patients allergic to the components of dental resins were not included in the study.

Methods

The participants who fulfilled the inclusion criteria were randomly placed in a community of two, wherein the intervention group was given a topical application of a bioactive resin-based material directly over the oral ulcer, whereas the control group was given a standard topical corticosteroid gel. The antibacterial and wound-healing properties of the resin-based material employed were chosen. The applications were given once per day and under professional supervision during a period of 7 days. Motor physiotherapy was assessed on days 0, 3, 7, and 14 in terms of changes in the size of the ulcer, the level of pain, measured using a Visual Analogue Scale (VAS) and clinical features of healing, i.e., re-epithelialization and the absence of erythema. During successive visits, standardized photographs and measurements were made. The analysis and data collection were done on SPSS version 26. A statistical significance was set at $p < 0.05$. Compliance with follow-up, unintended effects, and any allergic reactions were all monitored over the duration of the study to facilitate the safety and therapeutic effectiveness of the resin-based material.

RESULTS

The study was composed of 60 patients divided into a control group (30), which received standard corticosteroid gel, and an intervention group (30), which received resin-based material. The two groups had comparable baseline data, such as age, gender distribution, as well as the size of ulcers (Table 1).

Table 1: Baseline Demographics and Clinical Characteristics of Participants

Variable	Resin Group (n=30)	Control Group (n=30)	p-value
Mean Age (years)	35.4 ± 9.2	34.7 ± 8.6	0.71
Gender (M/F)	17/13	16/14	0.79
Initial Ulcer Size (mm)	6.2 ± 1.4	6.0 ± 1.6	0.58
Mean Pain Score (VAS)	7.8 ± 1.1	7.9 ± 1.2	0.83

On Day 3, patients in the resin group reported a significant decrease in the size of the ulcerous area compared to the control group, as well as a reduction of pain. The healing progress was also more advanced, and it was observed through the reduction of erythema and the augmentation of epithelialization. The decrease in pain scores remained significant throughout the follow-up period in the resin group, which was observed to be more gradual in the control group.

Table 2: Mean Ulcer Size (mm) Over Time

Day	Resin Group	Control Group	p-value
Day 0	6.2 ± 1.4	6.0 ± 1.6	0.58
Day 3	4.1 ± 1.2	5.2 ± 1.5	0.01*
Day 7	1.8 ± 0.9	3.4 ± 1.3	0.001*
Day 14	0.2 ± 0.5	1.5 ± 1.0	0.0001*

(*Statistically significant at $p < 0.05$)

Pain levels measured using the Visual Analog Scale also showed a faster decline in the resin group. On Day 7, the resin group had a mean pain score of 1.5 compared to 3.2 in the control group.

Table 3: Mean Pain Scores (VAS) Over Time

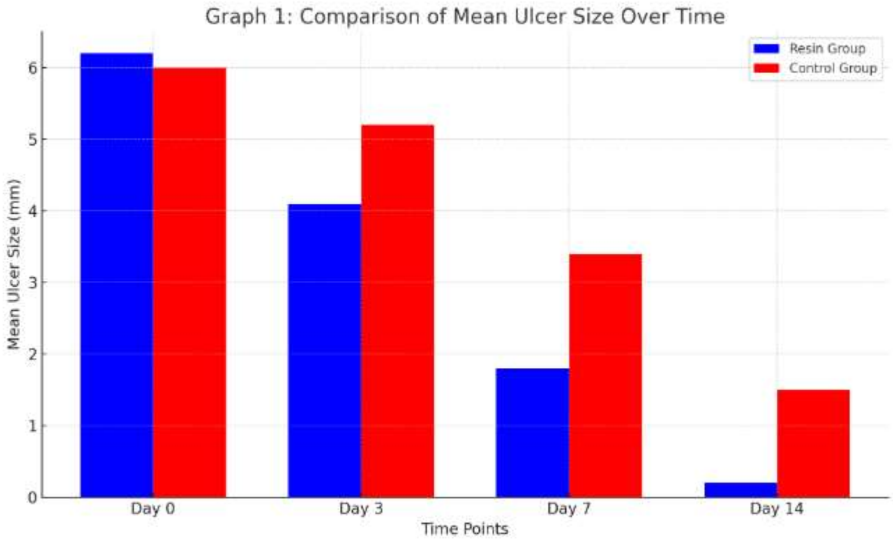
Day	Resin Group	Control Group	p-value
Day 0	7.8 ± 1.1	7.9 ± 1.2	0.83
Day 3	5.1 ± 1.3	6.2 ± 1.0	0.004*
Day 7	1.5 ± 0.8	3.2 ± 1.1	0.0005*
Day 14	0.1 ± 0.3	1.2 ± 0.7	0.0001*

A greater percentage of complete healing (defined as full re-epithelialization and absence of pain or erythema) was observed in the resin group by Day 14.

Table 4: Healing Outcomes by Day 14

Outcome	Resin Group (n=30)	Control Group (n=30)	p-value
Complete Healing	28 (93.3%)	19 (63.3%)	0.005*
Partial Healing	2 (6.7%)	9 (30.0%)	
No Healing	0 (0%)	2 (6.7%)	

Graph 1: Comparison of Mean Ulcer Size Over Time



Generally, there was a much greater level of healing and a decrease in pain with the resin-based material, indicating better clinical results as compared to the traditional corticosteroid therapy. The resin group reported no unwanted reactions, whereas two patients, who were included in the control group, claimed to have a mild burning feeling when applied. These findings suggest that biomaterials based on resins proved effective not only in inducing tissue healing of ulcers but were also non-toxic and safe to be used in clinical practice..

Discussion

The current analysis revealed that resin-based compounds prove to have a significant positive effect in speeding up the healing of oral ulcers by comparison to non-corticosteroid-based intra-mucosal healing techniques. The improved healing impact on the intervention group can be explained by the multifunctionality of the resin-based biomaterial, especially the antimicrobial properties, anti-inflammatory properties, and tissue-regenerative properties. Such results can be explained by the recent trends of the dental material science since its main principle has been transformed and is not just based on restorative purposes, but also bioactive and therapeutic. The quicker decrease of the ulcer size and pain scores in the resin group lends more credence to the assumption that known means of obviating microbial flora around the wound site that proliferate through incorporation into resin matrices of substances with antimicrobial properties can contribute significantly to wound healing. Sun et al. emphasized that these types of resin-based restoratives with built-in antimicrobial elements can prevent the creation of biofilm and limit bacterial attachments, thereby avoiding recurring infections that not only slow the process of recovery but in some cases also halt healing (1). That is why patients who were treated with the intrusion had faster epithelialization and less erythema during the first week of their treatment.

Moreover, the encapsulation of active ingredients in resin carriers offers a potential means of drug specificity in the transport of treatment medications. The clinical trial by Heikal on melatonin-loaded gelatin sponges found significant improvement in palatal wound recovery in terms of ameliorating inflammation and stimulating fibroblast functions (2). A behavioural study experiment applied a different resin formulation, but the principle is the same: local delivery of therapeutic molecules on biocompatible carriers can enhance tissue regeneration. The work of Li et al. also contributes to this mode of approach as they reviewed the effect of using hydrogel-forming microneedles as an efficient drug delivery vehicle in the context of managing oral diseases by supporting controlled and sustained release of drugs (3). Besides, the discussion by Wang of the industrialisation of dental polymer material points to the fact that contemporary polymers are being designed towards a biological interaction with tissues as opposed to merely serving as inert fillers (4). The resin used in the study aided wound healing, which could have been a result of the combination of the antimicrobial effect and the positive effect of inducing local cell proliferation. Makvandi et al. highlighted the versatility of drug-loaded (nano) platforms in mouth and tooth uses, especially wound healing and infection control (5).

Remarkably, the dual reference made by Li et al. on hydrogel microneedles also demonstrates how multifunctional materials can be preconditioned to localised applications in the oral cavity without the invasive processes (6). The present setting of such a resin-based material could have replicated this process by glueing over the afflicted area and sticking there throughout the process to accelerate the repair. The pharmacological implications of the findings of this study reflect similar results reported by Majeed et al., who reported considerable ulcer healing in rats that had been administered montelukast, an anti-inflammatory compound (7). Although resin formulation lacked montelukast, the observed anti-inflammatory activity might be related to comparable activities, e.g. fewer cytokine release or increased macrophage response. Additionally, the review of the biological advantages of zinc by Caruso et al serves as additional evidence, with regard to the epithelial regeneration and oxidative stress control effects of zinc that may be of application in the future resin formulations, should they be placed into practice (8).

The use of natural materials in dental materials, as pointed out by Yudaev and Chistyakov, creates new opportunities in coming up with resins that have fewer side effects and are more biocompatible (9). According to the studies done by Boudjelal et al., Pistacia vera resins showed healing effects, which implies that natural resin extracts can improve tissue restoration and may be considered as additives or ingredients to synthetically produced resins (10). Nevertheless, a safety aspect also plays a vital role. Though no adverse event was reported in the study, material hypersensitivity should not be neglected, particularly among patients with conditions of Oral Lichen Planus. Agha-Hosseini et al. highlighted the importance of the saliva compatibility and an allergic reaction in patients with impaired mucosal immunity (11). This highlights the importance of patch testing or allergen-free formulation, especially in cases where vulnerable groups are exposed to materials made of resin.

The studies by Vervliet on the kneadable degradation products of resin-based materials generate appropriate results, as well. Monomers and degradation byproducts that these materials can cause may be released, and some of them can be cytotoxic or immunogenic in nature (12). This underscores the importance of further studies on in vivo and in vitro effects to track long-term effects and improve formulations. The same notion has also been communicated by Ramburrun et al., and they encourage the creation of antimicrobial, antifouling, and biocompatible materials, which reduce the negative effects but show an increased efficacy (13). Photobiomodulation is another fascinating adjunctive theory, which Kotb claimed stimulated mitochondrial activity and tissue proliferation and enhances tissue healing (14). Although not used in this experiment, the addition of photobiomodulation to the resin-type materials could produce synergistic effects to improve healing, especially efficiency in patients with large or chronic lesions.

The necessity of minimising allergic reactions is also evidenced by Arakelyan et al., who commented on the decrease of the adverse effects of dental alloys and resins (15). Specifically, 2-hydroxyethyl methacrylate (HEMA), which is a prevalent component of dental materials, has been associated with contact dermatitis and allergic reactions. The clinical review by de Groot and Rustemeyer also states that there should be careful utilisation of such components (16). The missing hypersensitivity responses may be attributed to the fact that the formulation did not include HEMA. There has also been evidence of healing effects of composite cements, as was observed by Ardelean et al. with animal models (17). Such cements could also be extended into soft tissue healing with the incorporation of bioactive fillers or therapeutic agents. Rajendran et al.'s case report also demonstrates the randomness of oral healing, as well as the need to work with materials that can perform in changing oral settings (18).

Conclusion

The study indicated that the resin-based materials have great effects on the recovery of oral ulcerative lesions in comparison to the traditional corticosteroid treatment. Those who were not treated with the resin-based application required a shorter time to reduce the size of the ulcer, ulcer pain was treated successfully, and complete healing took place in up to two weeks. These findings bring to the fore the therapeutic opportunity of resin-based materials, which is a blend of antimicrobial, anti-inflammatory, and regenerative activity. These results concur with new developments in dental materials science, with a push toward bioactive restoratives capable of guiding the process of tissue repair as well as management of the infection. Notably, the resin formulation related to the study did not elicit any adverse side effects. The resin-based therapeutics can be a viable, safe, and patient-friendly option in the management of oral ulcers due to the positive clinical results of this therapy. Further research needs to be performed on long-term safety, combination with natural bioactive agents, and combination with adjunctive therapies such as photo biomodulation to increase efficacy further and extend the clinical applications in oral healthcare.

References

1- Sun Q, Zhang L, Bai R, Zhuang Z, Zhang Y, Yu T, Peng L, Xin T, Chen S, Han B. Recent progress in antimicrobial strategies for resin-based restoratives. Polymers. 2021 May 14;13(10):1590.
2- Heikal L. Effect of topical melatonin loaded gelatin sponge on palatal wound healing (randomized controlled clinical trial). Alexandria Dental Journal. 2024 Dec 1;49(3):70-8.
3- Li Y, Bi D, Hu Z, Yang Y, Liu Y, Leung WK. Hydrogel-forming microneedles with applications in oral diseases management. Materials. 2023 Jul 3;16(13):4805.
4- Wang Q. Research Progress and Industrial Transformation of Dental Polymer Materials. Nanomaterials and Nanotechnology Advances. 2024 Dec 1;1(1).
5- Makvandi P, Josic U, Delfi M, Pinelli F, Jahed V, Kaya E, Ashrafizadeh M, Zarepour A, Rossi F, Zarrabi A, Agarwal T. Drug delivery (nano) platforms for oral and dental applications: tissue regeneration, infection control, and cancer management. Advanced Science. 2021 Apr;8(8):2004014.
6- Li Y, Bi D, Hu Z, Yang Y, Liu Y, Leung WK. Hydrogel-forming microneedles with applications in oral diseases management. Materials. 2023 Jul 3;16(13):4805.
7- Majeed MI, Mammdoh JK, Al-Allaf LI. Effect of montelukast on healing of induced oral ulcer in rats. Military Medical Science Letters/Vojenské zdravotnické Listy. 2023 Oct 1;92(4).
8- Caruso S, Valenti C, Marinucci L, Di Pasquale F, Truppa C, Di Benedetto G, Caruso S, Pagano S. Systematic review of Zinc’s benefits and Biological effects on oral health. Materials. 2024 Feb 7;17(4):800.
9- Yudaev PA, Chistyakov EM. Progress in dental materials: Application of natural ingredients. Russ. Chem. Rev. 2024 Jan 1;93(5108):10-59761.
10- Boudjelal A, Napoli E, Benkhaled A, Benazi L, Bey R, Gentile D, Ruberto G. In vivo wound healing effect of Italian and Algerian Pistacia vera L. resins. Fitoterapia. 2022 Jun 1;159:105197.
11- Agha-Hosseini F, Gholamrezayi E, Moosavi MS. Patch test of dental materials in Oral Lichen Planus with considering the role of saliva. Scientific Reports. 2021 Apr 15;11(1):8264.
12- Vervliet P. Fate of resin-based materials in dental restorations: identification of monomers and degradation products from resin-based dental materials in vitro and in vivo (Doctoral dissertation, University of Antwerp).
13- Ramburrun P, Pringle NA, Dube A, Adam RZ, D’Souza S, Aucamp M. Recent advances in the development of antimicrobial and antifouling biocompatible materials for dental applications. Materials. 2021 Jun 9;14(12):3167.
14- Kotb S. Photobiomodulation and its application in dentistry. Advances in Medical, Dental and Health Sciences. 2022 Jul;5(3).
15- Arakelyan M, Spagnuolo G, Iaculli F, Dikopova N, Antoshin A, Timashev P, Turkina A. Minimization of Adverse Effects Associated with Dental Alloys. Materials 2022, 15, 7476 [Internet]. 2022

16- de Groot AC, Rustemeyer T. 2-hydroxyethyl methacrylate (HEMA): a clinical review of contact allergy and allergic contact dermatitis—Part 1. Introduction, epidemiology, case series and case reports. Contact Dermatitis. 2023 Dec;89(6):401-33.
17- Ardelean AI, Marza SM, Dragomir MF, Negoescu A, Sarosi C, Novac CS, Pestean C, Moldovan M, Oana L. The Potential of Composite Cements for Wound Healing in Rats. Bioengineering. 2024 Aug 16;11(8):837.
18- Rajendran KV, Baharin F, Said HM, BAHARIN F. Root Resurgence: An Unexpected Twist After Natal Teeth Extractions. Cureus. 2024 Jul 31;16(7).