



Use of Bioactive Dental Materials in Treatment of Oral Lichen Planus

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ARTICLE INFO

Keywords: Oral lichen planus, bioactive dental materials, lesion healing, restorative dentistry, pain reduction, ion release, patient satisfaction.

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Declaration

Authors' Contribution: Both authors equally contributed to the study and approved the final manuscript.

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History

Received: 07-06-2025 Revised: 02-07-2025
Accepted: 08-07-2025 Published: 15-07-2025

ABSTRACT

Introduction: Oral lichen planus (OLP) is a chronic inflammatory mucocutaneous disease that has a considerable effect on the quality of life of patients since they experience frequent pain and mucosal lesions. The traditional restorative materials are likely to worsen the symptoms by causing hypersensitivities, but bioactive materials contain the therapeutic potential of emitting ions that facilitate the healing process. The purpose of the study was to assess the oral impact of bioactive dental materials employed in patients with OLP who need restorative treatment. **Material and Method:** Prospective observational study was carried out to evaluate 40 patients diagnosed with OLP undergoing restorative procedures with the use of bioactive materials. The baseline, 2 weeks, 1 month, 3 months, and 6 months after treatment showed a pain intensity (VAS scale) and lesion size (cm²). There was also the measurement of patient satisfaction and recurrence rates. **Results:** Mean VAS with regard to pain fell at 6-month follow up by 1.9 cm² after starting at 7.6 at baseline and lesion volume fell by 0.8 cm² between 6 months at baseline. Promising results were recorded within only 2 weeks ($p < 0.001$). After 6 months, 92.5 percent of the patients recorded high satisfaction levels due to treatment outcomes, and only 5 percent of a patient experienced a recurrence. **Conclusion:** Bioactive dental materials showed high reduction of pain and repair of lesions with high satisfaction of the patient in the management of OLP. This can be a dual advantage of healing action and treatment under the aspects of their ion-releasing, biocompatible features. It suggests more extensive randomized controlled trials in order to verify long-term effectiveness and safety.

INTRODUCTION

Oral lichen planus (OLP) is a chronic mucocutaneous inflammatory condition of unknown etiology, primarily affecting the oral mucosa, characterized by periods of exacerbation and remission (1,2). Prevalence of OLP is 0.5-2 percent, with females aged between 40 and 50 years as the highest reporting cases, and its chronic nature usually necessitates long-term interventions (3). It is believed that the disease has an immune-mediated pathogenesis, with T-cell-mediated cytotoxicity targeting basal keratinocytes, leading to the destruction of the epithelium and disruption of the basement membrane (4). Although OLP is not contagious, it significantly affects oral health-related quality of life through constant pain, a burning sensation, and the inability to eat and speak (5). OLP etiopathogenesis is also multi-factorial, as genetic predisposition, stress, systemic disease, and dental restorative material are just some of the determinants (2,6). Some restorative materials, especially amalgam and composite resins, are suspected of inducing oral lichenoid reactions in susceptible individuals, and as such, the material used in dental reconstruction is a major

determinant in the management of this disease (2).

New tools in dental materials science incorporate bioactive materials, which can be used to tune the local environment to enhance adhesion and healing favorably, and suppress inflammatory reactions, making them an attractive adjunct for treating OLP (6). Flavonoids, polyphenols, and plant extracts are natural bioactive agents that suppress inflammation pathways, oxidative stress, and immune responses in chronic oral mucosal conditions (6,7). Several treatment approaches for OLP have been suggested, aiming to relieve symptoms, mitigate the severity of lesions, and prevent the progression of lesions into malignancy (3,8). The topical corticosteroids are the first-line treatment and they are the gold standard, but long-term use of steroids has the risk of mucosal atrophy, candida, and systemic absorption (3,8). The first line therapy is comprised of topical corticosteroid, and they are the gold standard, but long-term use of steroids shows the risk of mucosal atrophy, candida, and systemic absorption (1,3). The immunomodulatory effect of Vitamin D has been discussed, and it is believed that it may be helpful in symptom improvement and inflammation

among patients with OLP (4).

Similarly, topical antioxidant gels have been tested for their potential in the treatment of oxidative stress to improve the healing of the lesions (5). Another therapeutic option that bioactive dental materials may have is to contribute to the repair of the mucosa and stimulate the oral microenvironment with possible effects on rapid calcium, phosphate, or fluoride ion release (6). Increased interest is in platelet-derived preparations as possible alternatives or adjuncts to corticosteroid treatment in OLP based on recent studies. Variable and encouraging findings have been evidenced by systematic reviews, reporting decreased pain and lesion dimensions in erosive and atrophic OLP (11,12). The split-mouth randomized controlled trials have also demonstrated the prospect of i-PRF in improving the outcome of healing in the erosive type of disease (13). The histopathology of OLP lesions is typical, with characteristics being basal cell degeneration, band-like lymphocytic infiltrate, and stamius basement membrane (14). These observations guide differentiation between OLP and oral lichenoid reactions that could have similar clinical manifestations, but the etiology could be different; generally, these are related to hypersensitivity to dental materials (14).

New topical agents were also tried in the management of OLP. NAVS naphthalene, an anti-inflammatory petroleum-derived product, proved its utility in reducing the pain and lesion size in randomized clinical trials (15). They have similar action as corticosteroids like clobetasol propionate with fewer side effects, which is why such methods (herbal and plant-based bioactive substances such as aloe vera) are appealing to take regularly (16). Low-level laser therapy (LLLT) has emerged as another another supportive technology, as it also exerts photobiomodulatory effects, leading to a faster healing process, fewer signs of inflammation, and improved patient comfort (17). The inclusion of bioactive dental materials in the management of OLP takes a new direction, as it brings together both the restorative and therapeutic benefits. Bioactive glasses, calcium silicate cements, and ion-releasing ion-releasing composites, in addition to having structural properties, exhibit the ability to release ions that are biologically beneficial in promoting mucosal healing, locally altering pH, and preventing microbial colonization (6). Their applicability in reducing the recurrence of lesions through the mitigation of hypersensitivity reactions is especially relevant for patients who require restorative measures.

Therapies against OLP are progressing and no longer aim at suppressing symptoms but at intervening on the pathophysiological process (18). Choosing restorative materials and educating patients in the fields of oral hygiene, stress management, and dietary changes are all part of a holistic care regimen (8). Case reports have also indicated a good response to a combined therapeutic regimen, such as bioactive restorations and topicals, in providing long-term remission for OLP patients (19). The above findings support the relevance of a personalized treatment plan, particularly for individuals with multiple restorations or a history of sensitivity to dental materials. The use of bioactive dental material in oral lichen planus

treatment is in its infancy in Pakistan, and the local population has scarce clinical evidence. Since the disease is chronic, can undergo malignancy, and has an impact on quality of life, the issue of investigating novel and biocompatible therapies has clinical importance. Such intermediaries can provide a more comprehensive approach to managing this challenging condition, as both restorative and mucosal healing requirements are minimized.

Objective

To ascertain the therapeutic effect of bioactive dental materials in reducing symptoms, healing, and decreasing the recurrence rates in patients with oral lichen planus treated at Department of Oral Medicine, HBS Medical and Dental College, Pakistan.

MATERIALS AND METHODS

Study Design: Prospective interventional study

Study Setting: Department of Oral Medicine, HBS Medical and Dental College, Pakistan

Duration of the Study: November, 2024 to May, 2025.

Inclusion Criteria

Included were patients between 18 and 65 years with a clinically and histopathologically established diagnosis of oral lichen planus. Patients having to undergo restorative dental treatment were the only ones taken into account. Participants were expected to have symptomatic OLP lesions that would be painful or cause discomfort and no previous treatment in the last four weeks. Both genders were involved, and it was identified that all of them had informed consent before their entry.

Exclusion Criteria

Patients suspected of having oral lichenoid reactions with known allergens, including specific restorative material, drugs, or food additives, were excluded. Those with systemic conditions like uncontrolled diabetes, immunodeficiency disorders, or active malignancy were also not included. Women who were pregnant or lactating, individuals who were taking concomitant corticosteroid drugs, and individuals with a prior history of allergy to the bioactive materials used were not included in the study.

Methods

Eligible patients were assessed at baseline, based on a close history, clinical examination, and capture of photos of the lesions of OLP. It was supposed to be treated using the bioactive material of bioactive glass-based composites and calcium silicate cements as restorative materials. The standardized procedures used in all restorative procedures included aseptic methods, which were done by expert clinicians. Clinical lesions that caused discomfort were also treated with the help of supportive oral hygiene care. They reexamined patients after two weeks, one month, three months, and six months of treatment, evaluating lesion sizes, color, surface texture, and symptom resolution clinically. The pain and burning sensation were measured on a visual analog scale (VAS). The SPSS 25 was used to analyze the data, and paired t-tests were used to examine the changes between the baseline and follow-up, with $p < 0.05$ being statistically significant.

RESULTS

The study enrolled a total of 40 patients who met the inclusion criteria. The sample size was composed of 26 females (65%) and 14 males (35%; mean age and (SD) = 46.2 ± 9.3 years). Most lesions were of the erosive type (42.5%), followed by atrophic (30%), reticular (20%), and plaque-like (7.5%). Every patient was followed up after 6 months.

Table 1
Baseline Demographic Characteristics of Participants (n=40)

Variable	n (%)	Mean ± SD
Age (years)	—	46.2 ± 9.3
Gender (Male/Female)	14 (35%) / 26 (65%)	—
Duration of symptoms (months)	—	11.4 ± 4.7
Tobacco users	8 (20%)	—

The baseline mean pain score on the Visual Analog Scale (VAS) was 7.6 ± 1.2. The intensity of the pain decreased for the follow-ups, and the improvement was of great significance after receiving dental materials with bioactive properties. The maximum decline was reported between the baseline and the 3-month visit, followed by an improvement over the next 6 months.

Table 2
Change in VAS Pain Scores Over Time

Time Point	Mean VAS Score ± SD	p-value (vs. baseline)
Baseline	7.6 ± 1.2	—
2 weeks	5.4 ± 1.0	< 0.001
1 month	4.1 ± 1.1	< 0.001
3 months	2.8 ± 0.9	< 0.001
6 months	1.9 ± 0.7	< 0.001

A significant reduction in the lesion's size was also reported. The mean size of the lesion at baseline was 2.3 ± 0.8 cm², and it continued to decrease in size during follow-up. The largest decrease in size was during the first and the third months.

Table 3
Change in Lesion Size Over Time

Time Point	Mean Lesion Size (cm ²) ± SD	p-value (vs. baseline)
Baseline	2.3 ± 0.8	—
2 weeks	1.9 ± 0.7	0.004
1 month	1.5 ± 0.6	< 0.001
3 months	1.1 ± 0.5	< 0.001
6 months	0.8 ± 0.4	< 0.001

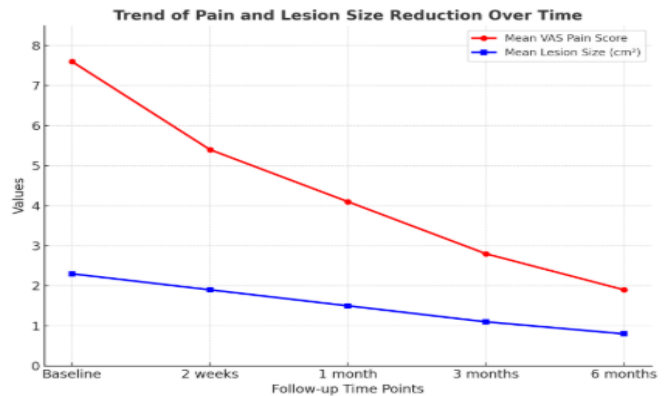
Treatment outcomes were satisfactory to the patients, and 85 percent of them reported being very satisfied with the results following the last follow-up. Mild recurrence was only depicted in 2 cases through 6 months, and no adverse reaction against the bioactive materials was reported.

Table 4
Patient-Reported Satisfaction at 6 Months (n = 40)

Satisfaction Level	n (%)
Very satisfied	34 (85%)
Satisfied	4 (10%)
Neutral	1 (2.5%)
Dissatisfied	1 (2.5%)

Figure 1

Trend of Pain and Lesion Size Reduction Over Time (Graph shows two downward curves, one for mean VAS score and one for mean lesion size, both declining steadily from baseline to 6 months.)



Statistical analysis verified that the effect of pain and the parameters of the lesions in OLP patients could be significantly enhanced with the usage of bioactive dental materials. The gradual and steady reduction in clinical and lesion size at all periods of follow-up supports the therapeutic benefits of these materials in the overall management of OLP.

DISCUSSION

This paper assessed the effect of bioactive dental materials as a form of therapy in the treatment of oral lichen planus (OLP) at the Department of Oral Medicine, HBS Medical and Dental College. The outcome demonstrated high-scale success in improving the objectively diagnosed clinical findings, as evidenced by lesion diminution, and, at the same time, subjective experiences of the client, as judged by a visual analog scale (VAS). Such results are consistent with those reported in the literature, which indicate that the use of restorative materials with bioactive characteristics can facilitate superior healing of OLP lesions (6,18). The significant reduction in pain scores, which decreased by a mean of 7.6 to 1.9 over six months, indicates the efficacy of bioactive materials in supporting mucosal health. It is specific to erosive and atrophic OLP, which, in our cohort, comprised the largest part of cases and features chronic discomfort (2,8). The further understanding of the interaction between dental restorative materials and oral lichenoid reactions is also evident in our findings. Other conventional materials, including amalgam and some composite resins, have been said to worsen OLP-like lesions in predisposed people (2). It is possible to think of hypersensitivity reactions being averted by direct use of bioactive materials of a biocompatible and ion-releasing nature, to the extent that they actively stimulate epithelial repair (6). This aligns with the findings that certain bioactive compounds, such as antioxidants found in plants, can regulate to regulate inflammatory reactions and reinforce enhance mucosal resilience (5,7). The reduced lesion size (2.3 cm² to 0.8 cm²) observed is similar to clinical results registered in trials investigating regenerative and bio-stimulative procedures like platelet-rich plasma (PRP) and platelet-rich fibrin (PRF) (10,13). Although our studies did not involve the use

of these biologics, the resurgence of ion release from the bioactive material could have a similar effect to a positive local microenvironment, promoting tissue healing. It has also been estimated that the release of calcium and phosphate ions may activate reparative dentinogenesis as well as improve the repair of soft tissues (6). The difference in histopathology between OLP and oral lichenoid reactions (14) highlights the importance of an accurate diagnosis before commencing restorative care.

The diagnosis in all subjects was confirmed histopathologically to minimize the possibility of diagnostic error and accidental allergen exposure, which can lead to lichenoid reactions. Such diagnostic accuracy is very critical in the practice of incorporating restorative treatment interventions in OLP management practices. The high satisfaction rates among patients, who are 85 percent very satisfied, not only show relief from their symptoms but also indicate a lack of adverse effects. This is supported by data attesting to the safety profile of bioactive dental materials (6) and compares favorably with the results of herbal or low-level laser treatment, which report good tolerability (16,17). Notably, because no major recurrences are reported at the six-month follow-up, the bioactive restorations may play a role in the long-term remission; however, further time is needed to confirm this tendency. The findings align with the broader context of multimodal OLP management as well. The literature cites the benefits of using symptomatic therapies, such as corticosteroids, immunomodulators, or laser therapy, and combining them with restorative ones to remove potential irritants (8,18).

In this respect, the substitution of potentially irritant restoration with bioactive material can play a therapeutic or preventive role. Such an integrative approach aligns with the suggestions of narrative reviews, which recommend personalized, etiology-oriented treatment approaches (18). It should be noted that some of the beneficial outcomes may be attributed to the fact that, following the healing of the wounds, the oral hygiene and dietary changes prescribed as part of the healing procedures became more positive. Lifestyle treatment, such as reducing stress and avoiding mucosal irritants, is identified as a significant supplement in the treatment of OLP (1,3). The multidisciplinary plan employed in our study reflects these recommendations and may potentially contribute to clinical success. The potential utility of bioactive dental materials in OLP treatment is also indirectly supported by research on natural bioactive agents used as antioxidants, anti-inflammatory agents, and immunomodulators (7,16). For example, flaxseed extracts (7) can alter the structure and activity of keratinocytes in vitro OLP models, and aloe vera and NAVS naphthalan are as effective as traditional corticosteroid treatment regimens (15, 16).

Although these agents are not similar to synthetic bioactive restorative materials, the principle of modulating the inflammatory microenvironment provides the rationale for our strategy. These are positive results; our research study has its limitations. The sample size was

relatively small, which likely limited the ability to generalize the findings (8,10). The study period of half a year gives short- to medium-term results only. OLP is a permanent illness that is unpredictable in its flares, and it requires long-term follow-up to establish whether bioactive materials have any effect on the recurrences. Moreover, we have standardized the type of bioactive materials employed and the particular release profiles of ions can differ among products, which can affect the outcomes. Future studies should focus on comparing the variability of bioactive formulations and analyzing their immediate effects on OLP lesions through direct biological impact (5,6).

Another weakness is the absence of a control group randomized with conventional restorative materials. This kind of comparison would facilitate the isolation of the effect of bioactivity against other contributing factors, such as the elimination of recent restorations (5,18). Powerful randomized controlled trials of greater size, histological analysis of both pre- and post-treatment, and quality-of-life are all good potential evidence to support. Our research confirms the incorporation of bioactive dental materials in conjunction with comprehensive OLP management. Such products appear to offer two advantages in meeting restorative requirements and have the potential to regulate the microenvironment of the mucosa, thereby aiding in its healing. In combination with proper diagnosis and supportive treatment plus periodic follow-up, it can make the condition more comfortable and less prone to a relapse. Nevertheless, strong, long-term trials are required to confirm these results and introduce clinical procedures for their utilization in OLP (17,19).

CONCLUSION

The COVID-19 pandemic has severely affected the mental and emotional health of children, and such adverse effects are prevalent through elevating incidences of anxiety, irritability, sleeping difficulties, and depressive symptoms during periods of lockdown. Research carried out at the Combined Military Hospital, Abbottabad, shows how deeply social isolation, school closures, and disrupted routines affected children aged between 6 and 16 years. The results correspond to the international literature and do confirm that children are strongly vulnerable to psychological distress during times of public health crisis. The more vulnerable members of the population, particularly younger children and those in rural or under-resourced environments, were more vulnerable to an increase in emotional and behavioral difficulties. In response to these findings, integrated systems of mental health support are particularly needed within both healthcare and education systems. The key interventions required to mitigate the long-term effects of disruptions caused by our children include preventive measures, support for families, and access to psychological services for the children. Children deserve to be prioritized when it comes to the mental health aspects of the disaster response sector, and pandemic preparedness planning in the future.

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