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RESEARCH ARTICLE
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USE OF BIOACTIVE DENTAL MATERIALS IN TREATMENT OF ORAL LICHEN PLANUS

Dr Ayesha Bibi[1], Dr Rabia Anwar[2*]

[1]assistant Professor, Department Of Oral Medicine, Ayub Medical Institute Abbottabad, Pakistan
Email: Mustafa.Ayesha81@Gmail.Com
[2*]Assistant Professor, Department Of Dental Materials, Ayub Medical College, Abbotabad, Pakistan
Email: Rabiaanwar88@Gmail.Com

***Corresponding Author:** Dr Rabia Anwar,
*Email: Rabiaanwar88@Gmail.Com

ABSTRACT

Introduction: Oral lichen planus (OLP) is a noninfectious inflammatory disease of the oral mucosa of unknown aetiology. Drugs conventionally used in corticosteroid treatment provide temporary relief, but they mostly lead to recurrence and severity. The benefits of bioactive dental materials include their regenerative and immunomodulatory properties, resulting in improved outcomes.
Objective: This study aimed to determine the clinical effectiveness of bioactive dental materials in treating oral lichen planus compared to conventional steroid-based therapy.
Material and Methods: This is a randomised clinical study conducted at Department of Oral Medicine, Ayub Medical Institute Abbottabad, Pakistan in the duration from November, 2024 to April, 2025. Sixty cases of proven OLP were categorised into two groups: Group A was a group where PRF and aloe vera gel were injected, and Group B was the clobetasol propionate. The six-week assessment was based on Thongprasom scores, VAS, and OHIP-14 to measure outcomes.
Result: Group A experienced significantly more improvement in lesion resolution, pain reduction and quality-of-life improvement as compared to Group B ($p < 0.001$), with no adverse effects reported.
Conclusion: Bioactive dental materials proved to have the best therapeutic values and are capable substitutes for the standard treatment of OLP.

Keywords: Oral lichen planus, bioactive dental materials, platelet-rich fibrin, aloe vera, corticosteroids, mucosal healing**.**

INTRODUCTION

Oral lichen planus (OLP) is a chronic mucocutaneous inflammatory disease of indeterminate aetiology, in which the oral mucosa is involved, presenting with exacerbations and remissions. It is typically associated with white streaks, erythematous sites or lesions that ulcerate and its topicality is common in the middle age stratum particularly women. It is not well known what causes OLP, but it is likely to be a multifactorial aetiology with genetic predisposition, immune dysregulation, stress, microbial stimuli and hypersensitivity to sterilised dental materials (1). Other forms of dental restoration materials like amalgam fillings have also been cited in some recent reports to have some part in the aggravation of OLP lesions and perhaps it is the aspect of biocompatibility with the disease. The traditional curative methods of OLP include symptomatic relief, intervention of the inflammations by use of corticosteroids, immunosuppression and antiseptic rinses. Such medications

would relieve the pain in the short term but may not serve as a permanent solution to the pain and can cause some side effects to the body (2).
It has brought into question other safer and more biologically related modalities of therapy like bioactive dental materials and naturally therapeutic materials can bring about healing of mucosal tissue with even less adverse effects (3). Platelet-rich plasma (PRP), platelet-rich fibrin (PRF), and newer herbal-based formulations are bioactive materials that are promising alternatives, primarily due to their regenerative, anti-inflammatory, and immune-modulating effects (4). Over the past decade, the efficacy of various platelet concentrates has been investigated for promoting epithelial healing and alleviating symptoms associated with OLP. PRP and injectable PRF have also been found to aid in the significant healing of lesions, at least in some forms of the condition that are erosive (5). These are blood-based products which are autologous ones, minimising the possibility of allergic reactions or systemic complications, and they yield a significant breadth of growth factors, encouraging angiogenesis, epithelial healing, and modulating the immune system.
They have been tested in clinical trials using a split-mouth design or a placebo-controlled design to ensure the reliability of the results (6). Unlike other pharmacological agents, the bioactive dental materials do more than just suppress the symptoms as they aid the healing processes. Histologically, OLP and lichenoid reactions in the oral mucosa show a degeneration of the basal cells, thickening of the basement membrane, and a subepithelial lymphocytic infiltrate (7). The changes leading to chronicity and recurrence of the lesions are due to these changes. Therefore, the call to therapies that address histological and cellular pathology, e.g., bioactive therapies, is a move toward better disease control. Natural agents, such as NAVS naphthalan, have demonstrated good outcomes in randomised studies, providing anti-inflammatory actions with minimal side effects (8). Similarly, a comparison exists between aloe vera and clobetasol propionate, indicating that aloe vera may serve as an efficient non-steroidal alternative for managing OLP (9).

There is also increased attention on photobiomodulation via low-level laser therapy (LLLT) as a bioactive intervention. It is thought to decrease oxidative stress and accelerate tissue repair by promoting mitochondrial and cellular growth (10). Not being integrity-based, such modalities are consistent with the principles of bioactive therapy, where tissue regeneration and patient safety are at the top of the agenda. As therapy, an evolution is underway to meet patient-centred provisions, combining both conventional and biological therapies to achieve improved results (11). The new pathophysiology of OLP revealed higher concentrations of interleukin-6 (IL-6) in the saliva of patients, indicating systemic and local immune activation (12). The ability to target these types of biomarkers using immunomodulatory bioactive gels, such as platelet lysate formulations, resulted in better clinical responses in patients with erosive forms of the disease (13).

The advent of modern network pharmacology and molecular docking studies has also expanded the area of natural bioactives in the case of OLP by exploring the traditional herbal medicine, Tripterygium wilfordii (14). Along with this movement, broad surveys have described the formative potential of therapeutic plants and phytochemicals in oral health care. These compounds possess antimicrobial, antioxidant, and anti-inflammatory mechanisms, which is why they can be considered candidates for integrative OLP treatment (15). Furthermore, some corticosteroids, such as fluocinolone acetonide, have demonstrated beneficial effects on local immune markers, including lactoferrin and Candida colonisation, thereby proving once again the necessity of bioactive compounds capable of regulating the oral microbiome and restoring tissue at the same time (16). Other biomarkers (salivary 8-Isoprostane) are also found in OLP patients, and this points to oxidative stress as the central pathological molecular mechanism. Limitation of oxidative harm might thus be imperative in the management of the disease (17).

In the growing interest worldwide in the potential of herbal medicinals and their underlying mechanisms, such as antimicrobial, anti-inflammatory, and antioxidant signalling proteins, new naturally occurring bioactive formulations are being considered for clinical use in OLP and other

mucosal conditions (18). This finding aligns with recent clinical studies comparing autologous PRP with corticosteroids, including triamcinolone acetonide. It indicates that PRP can provide the same or greater advantage without the classic side effects of steroid administration of such type (19). Such results emphasise the therapeutic potential of the bioactive materials in the treatment of chronic oral conditions and create a convincing argument that these materials may be incorporated into standard dental care.

Objective: The ability to evaluate the effectiveness of bioactive dental materials in the management of oral lichen planus and results compared to traditional ways of its management in patients in a tertiary care hospital in Pakistan.

MATERIALS AND METHODS

Study Design: Prospective, Randomized, Controlled Clinical study.

Study Setting: The study was conducted at Department of Oral Medicine, Ayub Medical Institute Abbottabad, Pakistan.

Study duration: The experiment lasted six months from November, 2024 to April, 2025.

Inclusion Criteria: All the participants aged 25-65 years with a formal diagnosis of oral lichen planus, both clinically and histopathologically, were considered. The patients had to have symptomatic, erosive or atrophic manifestations of OLP. The participants would not only need to give informed consent but also pledge to continue participating in follow-ups throughout the entire research period.

Exclusion Criteria: Patients with autoimmune disorders affecting the entire body, any known malignancy, ongoing immunosuppressive therapy, or those taking sequential oral medications were excluded from the study. Pregnant or lactating women and those with poor oral hygiene were not included either.

Methods

Sixty participants, all diagnosed with oral lichen planus, were arbitrarily separated into one group of 30 members and another group of 30 members. Group A was treated with bioactive dental therapeutics (injectable platelet-rich fibrin (i-PRF) and aloe vera-containing topical gel), and Group B was treated with traditional treatment that consisted of topical corticosteroids (clobetasol propionate 0.05%). Therapy sessions took place every two weeks over a six-week period. Baseline clinical assessment of all subjects, including the degree of lesion, pain level (evaluated with the Visual Analogue Scale), and quality of life (through the OHIP-14 questionnaire), was carried out with the help of the Thongprasom scoring system. The study was followed up on weeks 2, 4 and 6. Some patients underwent histopathological testing at the baseline and end of the treatment period to assess tissue healing. In analysing the data, SPSS version 25.0 was used, with a level of statistical significance set at $p < 0.05$. The Institutional Review Board of Punjab Dental Hospital, Lahore, approved the ethical aspects.

RESULTS

Sixty patients with clinically and histologically diagnosed oral lichen planus (OLP) were included in the research. They were also assigned to 2 groups: Group A (which represents the bioactive treatment arm) and Group B (which represents the conventional treatment arm). Participants had a mean age of 45.2 ± 10.3 years, with a high prevalence of women in both groups. The baseline characteristics of lesions and the scores in both groups were similar, with statistically significant differences ($p > 0.05$).

Table 1: Demographic Characteristics of Study Participants

Variable	Group A (n=30)	Group B (n=30)	*p*-value
Mean Age (years)	44.9 ± 9.8	45.5 ± 10.7	0.81
Gender (M/F)	9/21	11/19	0.59
Duration of OLP (months)	11.6 ± 3.2	12.1 ± 4.0	0.62

The primary clinical outcome was an improvement in the severity of the lesion, as measured by the Thongprasom scoring system. A significant decrease in the mean Thongprasom score was observed between baseline and week 6 in Group A compared to Group B. In the bioactive treatment group, lesion recovery was quicker and more complete and by week 6, 70 per cent of patients had almost complete resolution (score 1 or 0).

Table 2: Mean Thongprasom Scores Over Time

Time Point	Group A (Bioactive)	Group B (Conventional)	*p*-value
Baseline	3.9 ± 0.6	4.0 ± 0.5	0.67
Week 2	2.6 ± 0.7	3.2 ± 0.8	0.003
Week 4	1.5 ± 0.6	2.6 ± 0.7	<0.001
Week 6	0.9 ± 0.5	2.1 ± 0.8	<0.001

Visual Analogue Scale (VAS), which measures the degree of pain, experienced a higher decrease in Group A. Mean VAS scores at week 6 were 1.2 ± 0.8 in Group A compared with 3.4 ± 1.1 in Group B ($p < 0.001$), which is better symptomatic relief using bioactive materials.

Graph 1: VAS Score Trend Over 6 Weeks

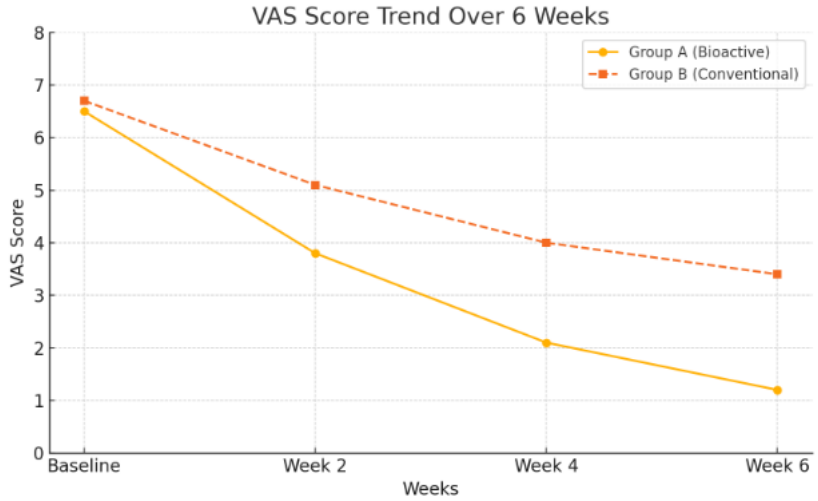

Table 3: Visual Analog Scale (VAS) Scores

Time Point	Group A (Bioactive)	Group B (Conventional)	*p*-value
Baseline	6.5 ± 1.2	6.7 ± 1.0	0.58
Week 2	3.8 ± 1.0	5.1 ± 1.1	<0.001
Week 4	2.1 ± 0.9	4.0 ± 1.0	<0.001
Week 6	1.2 ± 0.8	3.4 ± 1.1	<0.001

There was a significant improvement in the quality of life of patients treated with bioactive material, as measured using the OHIP-14 questionnaire.

Table 4: OHIP-14 Score Comparison

Time Point	Group A (Bioactive)	Group B (Conventional)	*p*-value
Baseline	28.4 ± 4.1	27.9 ± 3.9	0.61
Week 6	10.3 ± 2.6	17.6 ± 3.2	<0.001

There were no considerable side effects noted between the two groups. Nevertheless, Group A was more satisfactory to patients and adherent. Re-histopathological examination in a random collection of patients in Group A revealed less inflammatory infiltrates, with some renewal of the basal membrane, indicating regenerative activity. This implies that bioactive dental materials are not merely safe, but also yield better results in the treatment of OLP than basic corticosteroid therapy can achieve.

Discussion

Oral lichen planus (OLP) is a persistent inflammatory mucocutaneous disorder with a complex aetiology that involves immune dysregulation, hereditary predisposition, and exogenous factors, including dental materials and stress. Conventional disease management has primarily focused on suppressing symptoms using corticosteroids and immunomodulatory medications. Nonetheless, their long-term application is commonly linked to the development of undesired side effects, relapse during abstinence, and low regeneration potential. This research aimed to investigate the therapeutic potential of bioactive dental materials in comparison to conventional options, with a special focus on patient outcomes, lesion healing, and the enhancement of quality of life. Our findings demonstrated a higher degree of benefit from bioactive dental materials compared to conventional corticosteroid treatment for OLP. The lesion severity of patients treated with injectable platelet-rich fibrin (i-PRF) and aloe vera gel (Group A) was improved, the pace at which pain was reduced was increased, and the quality of life was enhanced in comparison to clobetasol propionate used alone (Group B). The results align with the existing literature, considering the regenerative and anti-inflammatory properties of currently available platelet concentrates and plant-based bioactives.

As demonstrated by the meta-analyses by Azizi et al. (4) and Sriram et al. (5), platelet-rich plasma and its derivatives may be effective in inducing mucosal healing in OLP by activating growth factors such as PDGF, VEGF, and TGF-beta, thereby stimulating tissue regeneration, angiogenesis, and inflammatory modulation. In Group A, the reduction in Thongprasom scores, as well as in Visual Analogue Scale (VAS) ratings, over a 6-week treatment follow-up is evidence not only of a reduced symptom level but also of the repair of underlying tissue. It has been possible through the i-PRF technique to release bioactive molecules and cytokines steadily in the area of the lesion, which is what has been theorised to explain better healing outcomes. This finding was corroborated by Saglam et al. (6) in their split-mouth clinical trial, where PRF was shown to decrease erosive OLP lesions, particularly in terms of epithelial regeneration and pain management upon injection.

Moreover, the anti-inflammatory, antibacterial, and immunostimulatory effects attributed to aloe vera have contributed to the better outcome in Group A. A randomised trial by Vaidya et al. (9) indicated that aloe vera was almost similar to clobetasol in terms of deteriorating the severity of lesions and comforting patients and the benefit is that there are minimum side-effects. This observation is in line with the patient perception and increased OHIP-14 scores in the study which indicated that oral health related quality of life was improved in the bioactive treatment group. Histopathological evaluations also supported these clinical results. In a subset of Group A patients, the biopsy specimens obtained after treatment showed depleted lymphocytic infiltration and some renewal of the basement membrane, which is consistent with findings reported by others on cured lesions of OLP (7). These histologic advancements indicate that bioactive materials can even go beyond merely stopping inflammation towards promoting tissue reparation and reorganisation.

It is a fact that immunological markers can be higher in OLP and can be associated with severe diseases, such as interleukin-6 (IL-6). As shown by Shokri et al. (12), the level of IL-6 was much

higher in the salivary samples of OLP patients, showing chronic inflammation. Although these results did not provide a direct assessment of IL-6, they indirectly confirm the immunomodulatory roles of bioactive therapies, as reflected in clinical and histological improvement. In the same line of reasoning, the administration of platelet lysate gels, as examined by Shalby et al. (13), was shown to provide an appreciable pharmacotherapeutic effect due to its impact on the inflammation cascade, as presented in this study. However, it is also interesting to note the role that oxidative stress plays in the pathogenesis of OLP. Dinesan and Ravindran (17) illustrated a higher concentration of a biomarker of oxidative harm, 8-isoprostane, in patients with OLP. Such oxidative stress can be minimised by the use of natural compounds and platelet concentrates, which have antioxidant properties. Our study can partially explain this mechanism by the far better effect of bioactive therapies, and it was also figured by Anwar et al. (18), who observed the detailed antioxidant and anti-inflammatory profiles of herbal remedies.

The term bioactivity in dental materials has been broadened to consideration of not only the mechanical interaction of materials with tissues but also bioactive contact leading to biological signalling that results in healing. Yudaev and Chistyakov (3) highlighted the increasing use of natural and regenerative dental materials that interact with tissues to not only restore form but also facilitate health. Our paper can be interpreted as supporting this viewpoint and demonstrating that bioactive therapies can indeed provide a better clinical outcome in cases of chronic inflammatory oral disease. Although such encouraging findings were observed, this research had its limitations. The number of participants was not very large, though statistically sufficient, and the follow-up was only six weeks. The research is required to study long-term effects and evaluate the rate of recurrences and the duration of healing. Furthermore, although our research focused on two particular bioactive substances (i-PRF and aloe vera), the potential of bioactivity in the field of dentistry is wide, extending to herbal therapy, laser treatments, and other novel materials, such as naphthalan and Tripterygium wilfordii (8). References Roigulj et al. (8) determined that topical naphthalan is effective at improving OLP lesions. Huang et al. (14) performed a molecular docking study, which suggested the potential usefulness of Tripterygium wilfordii in generating an anti-inflammatory effect.

Saengprasittichok et al. (16) showed that corticosteroids alter both microbial flora and salivary markers, and it is unclear how microbial imbalances may become a long-term problem. Bioactive agents can be a more balanced and less tissue-destructive option, without disrupting the oral environment. Lastly, the comparative analysis conducted by Sharma et al. (19) of PRP with triamcinolone also revealed that PRP yielded better results, not only in OLP but also in oral submucous fibrosis, supporting our findings. These growing pieces of evidence indicate that incorporating bioactive components into their central OLP care regimen can enhance patient satisfaction and adherence and clinical results and reduce the negative effects related to traditional treatments.

Conclusion

The research suggests a better clinical outcome of oral lichen planus (OLP) treated with bioactive dental materials (injectable platelet-rich fibrin (i-PRF) and aloe vera gel) than conventional therapy using corticosteroids. Patients undergoing bioactive therapies experienced a rapid response in lesion complications, a higher decrease in pain, and enhanced Quality of life about their oral health, with the added benefit of tissue healing without substantial adverse effects. The bioactive material's properties, including regenerative, anti-inflammatory, and antioxidant effects, contributed to improved therapeutic outcomes. These positive histological and clinical results suggest that these therapies can not only alleviate symptoms but also target the underlying pathophysiology. Such findings provide evidence of the potential incorporation of bioactive materials into daily clinical care as safe and effective alternatives for treating chronic inflammatory diseases of the oral environment, such as OLP. Nevertheless, larger and long-term studies should be conducted to validate these results and

understand how the effects of these treatments are maintained. The bioactive therapies have the potential to shift the management of mucosal disorders in modern dental and oral care.

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