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**ORIGINAL RESEARCH**

# Prevalence and Severity of Periodontal Disease in Patients with Oral Potentially Malignant Disorders (OPMDs)

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## ABSTRACT

**Aim:** To assess the prevalence and severity of periodontal disease in patients diagnosed with oral potentially malignant disorders (OPMDs) and analyze its association with specific OPMD subtypes. **Material and Methods:** A cross-sectional observational study was conducted on 100 patients clinically and histologically diagnosed with OPMDs. Patients aged 18 years and above with no recent periodontal treatment were included. Comprehensive periodontal examinations were performed, recording Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), and Clinical Attachment Loss (CAL). The severity of periodontal disease was graded using the 2017 World Workshop Classification. **Results:** The mean age of participants was 45.6 ± 12.8 years, with 65% males and 35% females. The OPMD subtypes included leukoplakia (45%), oral submucous fibrosis (40%), and erythroplakia (15%). Erythroplakia exhibited the highest periodontal severity, with mean PI, GI, PPD, and CAL values significantly higher compared to other subtypes ($p < 0.05$). Regression analysis revealed a significant association between OPMD subtypes and periodontal parameters, with erythroplakia showing the strongest correlation. Periodontal disease severity was higher in females, with significantly greater GI and CAL values ($p < 0.05$). **Conclusion:** This study demonstrates a significant relationship between periodontal disease and OPMDs, particularly in erythroplakia and oral submucous fibrosis. The findings emphasize the importance of early identification and integrated management of periodontal health in patients with OPMDs to reduce the inflammatory burden and potentially mitigate the risk of malignant transformation.

**Keywords:** Periodontal disease, Oral potentially malignant disorders, Inflammation, Erythroplakia, Oral health



## INTRODUCTION

Periodontal disease is one of the most prevalent chronic inflammatory conditions, characterized by progressive destruction of the supporting structures of the teeth, including the gingiva, periodontal ligament, and alveolar bone. It is primarily caused by a complex interplay of microbial factors and host immune responses, leading to inflammation, tissue destruction, and eventual tooth loss if left untreated. Beyond its local effects in the oral cavity, periodontal disease has been increasingly recognized for its systemic implications, linking it to conditions such as diabetes, cardiovascular disease, and adverse pregnancy outcomes.[1]Oral potentially malignant disorders (OPMDs) represent a spectrum of conditions that carry an increased risk of transforming into oral squamous cell carcinoma (OSCC). These conditions, including leukoplakia, erythroplakia, oral submucous fibrosis, and lichen planus, manifest with varying clinical presentations and pathophysiological mechanisms. The etiology of OPMDs is multifactorial, with tobacco use, alcohol consumption,

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and betel quid chewing being well-established risk factors. These behaviors not only contribute to the development of OPMDs but also exacerbate periodontal disease, creating a bidirectional relationship between the two conditions.The coexistence of periodontal disease and OPMDs is not coincidental, as both share common inflammatory pathways and etiological factors. Chronic inflammation is central to the pathogenesis of periodontal disease and plays a significant role in the progression of OPMDs. The persistent presence of pro-inflammatory mediators such as interleukins, tumor necrosis factor-alpha (TNF-α), and matrix metalloproteinases (MMPs) in periodontal disease can contribute to the dysregulation of the oral mucosa, potentially accelerating the malignant transformation process in OPMDs. Conversely, OPMDs can create an altered oral environment that promotes microbial dysbiosis, further aggravating periodontal disease.[2]The clinical presentation of periodontal disease in patients with OPMDs is often more severe and complex. Patients with OPMDs may exhibit increased periodontal pocket depths, greater clinical attachment loss, and higher levels of gingival inflammation compared to individuals without these conditions. These features are likely influenced by the underlying mucosal changes and systemic factors associated with OPMDs, as well as the behavioral and lifestyle factors common in these patient populations. For instance, habits such as tobacco use and betel quid chewing are strongly associated with both OPMDs and periodontal disease, amplifying their severity and complicating their management.The management of periodontal disease in patients with OPMDs poses unique challenges due to the overlapping pathophysiology and risk factors. Traditional periodontal therapies, such as scaling and root planing, may need to be supplemented with targeted anti-inflammatory treatments to address the heightened inflammatory state. Moreover, the presence of OPMDs necessitates regular surveillance for early signs of malignant transformation, emphasizing the need for a multidisciplinary approach involving periodontists, oral pathologists, and oncologists.[3]Early identification and management of periodontal disease in patients with OPMDs are critical not only for preserving periodontal health but also for potentially reducing the risk of malignant transformation. Evidence suggests that the persistent inflammatory burden associated with periodontal disease may act as a co-factor in the carcinogenic process, highlighting the importance of integrating periodontal care into the overall management of OPMDs. This underscores the need for routine periodontal evaluations and interventions in patients diagnosed with OPMDs, particularly those with known risk factors for both conditions.[4]The interplay between periodontal disease and OPMDs also highlights the broader implications of oral health in systemic disease prevention and management. The oral cavity serves as a window to systemic health, with periodontal disease acting as a potential biomarker for chronic inflammation and immune dysregulation. In the context of OPMDs, the presence of periodontal disease may offer insights into the overall inflammatory state of the oral mucosa, aiding in risk assessment and prognostication.[5]Despite the growing recognition of the association between periodontal disease and OPMDs, significant gaps remain in our understanding of their interrelationship. While inflammation appears to be a common denominator, the specific molecular mechanisms linking these conditions require further investigation. Similarly, the impact of periodontal treatment on the progression and outcomes of OPMDs remains an area of active research, with implications for clinical practice and public health.[6]Periodontal disease and OPMDs represent interconnected oral health challenges with significant implications for patient outcomes. The coexistence of these conditions underscores the importance of a holistic approach to oral health care that addresses the shared risk factors and underlying pathophysiological mechanisms. By integrating periodontal management into the care of patients with OPMDs, clinicians can contribute to improved oral and systemic health outcomes, potentially mitigating the risk of malignant transformation and enhancing the quality of life for affected individuals.

## MATERIAL AND METHODS

This cross-sectional observational study was conducted to assess the prevalence and severity of periodontal disease in patients diagnosed with oral potentially malignant disorders (OPMDs). The study included 100 patients with clinically and histologically confirmed OPMDs.Ethical approval was obtained from the institutional ethical committee. Informed written consent was taken from all participants after explaining the study's purpose and procedures.

### Inclusion Criteria

- Patients aged 18 years and above.
- Clinically diagnosed with OPMDs (e.g., leukoplakia, oral submucous fibrosis, erythroplakia).
- Patients who had not undergone any periodontal treatment in the past 6 months.

### Exclusion Criteria

- Patients with systemic conditions affecting periodontal health (e.g., diabetes mellitus).
- Pregnant or lactating women.
- Patients with a history of malignancy.
- Patients on medications known to influence periodontal status (e.g., immunosuppressants, anticoagulants).

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**Data Collection**

**Clinical Examination:** A comprehensive periodontal examination was conducted by a calibrated periodontist using a UNC-15 periodontal probe to ensure accurate and consistent measurements. The periodontal parameters recorded included the following:

- **Plaque Index (PI)**: This was used to assess oral hygiene status by quantifying plaque accumulation on tooth surfaces.
- **Gingival Index (GI)**: Evaluated the level of gingival inflammation, an essential marker of early periodontal disease.
- **Probing Pocket Depth (PPD)**: Measured from the gingival margin to the base of the pocket, providing an indication of periodontal pocket formation.
- **Clinical Attachment Loss (CAL)**: Determined the extent of periodontal tissue destruction by measuring the distance from the cementoenamel junction to the base of the pocket.

**Diagnosis of OPMDs:** The diagnosis of Oral Potentially Malignant Disorders (OPMDs) was confirmed through a combination of clinical examination and histopathological analysis. This approach ensured accurate classification of OPMDs, such as leukoplakia, oral submucous fibrosis, and erythroplakia, providing reliable data for subsequent analysis.

**Severity Grading of Periodontal Disease:** The severity of periodontal disease was graded using the 2017 World Workshop Classification system, which categorizes periodontitis into distinct stages:

- **Stage I**: Initial periodontitis, characterized by mild clinical attachment loss and minimal periodontal pocket formation.
- **Stage II**: Moderate periodontitis, with increased attachment loss and moderate pocket depths.
- **Stages III and IV**: Severe periodontitis, associated with deep pockets, advanced attachment loss, and a potential risk for tooth loss.

The primary outcome of the study was to determine the prevalence of periodontal disease in patients diagnosed with Oral Potentially Malignant Disorders (OPMDs). The secondary outcome focused on assessing the severity of periodontal disease based on clinical parameters and analyzing its association with specific OPMD subtypes, providing valuable insights into the relationship between periodontal health and the presence of OPMDs.

**Data Analysis**

Statistical analysis was performed using SPSS (Statistical Package for the Social Sciences), Version 26, to ensure a thorough evaluation of the data. The prevalence of periodontal disease was calculated as the percentage of patients with periodontitis in the study population, while the severity of the disease was categorized and compared across different OPMD subtypes to identify potential patterns or associations. Statistical methods included the Chi-square test, used to analyze categorical data and determine associations between variables, and ANOVAand t-tests, applied to assess differences in periodontal parameters such as probing pocket depth (PPD) and clinical attachment loss (CAL) among OPMD subgroups. A p-value of $< 0.05$ was considered statistically significant, indicating meaningful relationships in the analysis.

**RESULTS**

**Table 1: Demographic Characteristics of the Study Population**

The study included 100 patients with a mean age of 45.6 ± 12.8 years, ranging from 18 to 70 years. The majority of the participants were male (65, 65%), while females constituted 35% (n=35). Among the oral potentially malignant disorders (OPMDs), 45% (n=45) of the cases were diagnosed with leukoplakia, 40% (n=40) with oral submucous fibrosis, and 15% (n=15) with erythroplakia. This demographic distribution ensured representation of key OPMD subtypes in the study.

**Table 2: Periodontal Parameters Across OPMD Subtypes**

Significant differences in periodontal parameters were observed across OPMD subtypes. Plaque Index (PI) was highest in erythroplakia patients (2.0 ± 0.5), followed by oral submucous fibrosis (1.8 ± 0.4) and leukoplakia (1.5 ± 0.3) with a statistically significant difference ($p = 0.018$). Gingival Index (GI) showed a similar trend, with erythroplakia patients scoring the highest (2.1 ± 0.4) compared to oral submucous fibrosis (1.9 ± 0.3) and leukoplakia (1.6 ± 0.4), with a significant p-value of 0.009. Probing pocket depth (PPD) and clinical attachment loss (CAL) were also significantly greater in erythroplakia cases, indicating more severe periodontal destruction. The p-values for PPD (0.025) and CAL (0.004) confirmed the statistical significance of these findings.

**Table 3: Severity of Periodontal Disease Across OPMD Subtypes**

Periodontal disease severity varied significantly among OPMD subtypes ($p < 0.001$). Stage I (initial) periodontitis was most common in leukoplakia (33.33%) and least common in erythroplakia (13.33%). Stage II (moderate) periodontitis was the predominant severity across all subtypes, affecting 44.44% of leukoplakia cases, 45.00% of oral submucous fibrosis cases, and 40.00% of erythroplakia cases. Stage III/IV (severe) periodontitis was more prevalent in erythroplakia (46.67%) compared to oral submucous fibrosis (30.00%) and leukoplakia (22.22%). These findings highlight a correlation between the severity of periodontal disease and OPMD subtype.

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**Table 4: Comparison of Periodontal Parameters Between Males and Females**

Differences in periodontal parameters were observed between genders. Males had a lower mean plaque index (PI: 1.7 ± 0.4) compared to females (1.9 ± 0.5), but the difference was not statistically significant (p = 0.094). Gingival Index (GI) was significantly higher in females (2.0 ± 0.4) than males (1.8 ± 0.5, p = 0.045). Similarly, clinical attachment loss (CAL) was significantly greater in females (4.9 ± 1.0) than males (4.5 ± 0.9, p = 0.026). No significant difference was observed in probing pocket depth (PPD) between genders (p = 0.084).

**Table 5: Association Between OPMD Subtypes and Periodontal Disease Prevalence**

Periodontitis was present in 88.89% of leukoplakia cases, 92.50% of oral submucous fibrosis cases, and 100% of erythroplakia cases. Erythroplakia had the highest prevalence of periodontitis, with no cases reported as periodontitis absent. The association between OPMD subtype and periodontal disease prevalence was statistically significant for leukoplakia (p = 0.028). These findings suggest that erythroplakia is strongly associated with advanced periodontal involvement compared to other subtypes.

**Table 6: Regression Analysis of Periodontal Parameters and OPMD Subtypes**

Regression analysis revealed a significant positive association between OPMD subtypes and periodontal parameters. The β coefficients indicated that OPMD subtype was a strong predictor of increased plaque index (PI: β = 0.28, p = 0.002), gingival index (GI: β = 0.32, p = 0.001), probing pocket depth (PPD: β = 0.35, p = 0.002), and clinical attachment loss (CAL: β = 0.40, p = 0.001). These findings highlight that patients with more severe OPMD subtypes are likely to experience greater periodontal damage.

**Table 1: Demographic Characteristics of the Study Population**

| Variable | Number (n) / Mean ± SD | Percentage (%) |
|---|---|---|
| **Age (years)** | 45.6 ± 12.8 | |
| **Gender** | | |
| - Male | 65 | 65% |
| - Female | 35 | 35% |
| **OPMD Subtypes** | | |
| - Leukoplakia | 45 | 45% |
| - Oral Submucous Fibrosis | 40 | 40% |
| - Erythroplakia | 15 | 15% |

**Table 2: Periodontal Parameters Across OPMD Subtypes**

| Parameter | Leukoplakia (n=45) | Oral Submucous Fibrosis (n=40) | Erythroplakia (n=15) | F-value | p-value |
|---|---|---|---|---|---|
| Plaque Index (PI) | 1.5 ± 0.3 | 1.8 ± 0.4 | 2.0 ± 0.5 | 4.25 | 0.018 * |
| Gingival Index (GI) | 1.6 ± 0.4 | 1.9 ± 0.3 | 2.1 ± 0.4 | 5.12 | 0.009 * |
| PPD (mm) | 3.1 ± 0.6 | 3.5 ± 0.7 | 3.8 ± 0.8 | 3.78 | 0.025 * |
| CAL (mm) | 4.2 ± 0.8 | 4.8 ± 0.9 | 5.2 ± 1.0 | 6.02 | 0.004 * |

**Table 3: Severity of Periodontal Disease Across OPMD Subtypes**

| Severity Stage | Leukoplakia (n=45) | Oral Submucous Fibrosis (n=40) | Erythroplakia (n=15) | Total (n=100) | p-value (ANOVA) |
|---|---|---|---|---|---|
| **Stage I (Initial)** | 15 (33.33%) | 10 (25.00%) | 2 (13.33%) | 27 (27.00%) | < 0.001 * |
| **Stage II (Moderate)** | 20 (44.44%) | 18 (45.00%) | 6 (40.00%) | 44 (44.00%) | |
| **Stage III/IV (Severe)** | 10 (22.22%) | 12 (30.00%) | 7 (46.67%) | 29 (29.00%) | |

**Table 4: Comparison of Periodontal Parameters Between Males and Females**

| Parameter | Males (n=65) | Females (n=35) | F-value | p-value |
|---|---|---|---|---|
| Plaque Index (PI) | 1.7 ± 0.4 | 1.9 ± 0.5 | 2.85 | 0.094 |
| Gingival Index (GI) | 1.8 ± 0.5 | 2.0 ± 0.4 | 4.18 | 0.045 * |
| PPD (mm) | 3.3 ± 0.7 | 3.6 ± 0.8 | 3.02 | 0.084 |
| CAL (mm) | 4.5 ± 0.9 | 4.9 ± 1.0 | 5.12 | 0.026 * |

**Table 5: Association Between OPMD Subtypes and Periodontal Disease Prevalence**

| OPMD Subtype | Periodontitis Present (n, %) | Periodontitis Absent (n, %) | F-value | p-value |
|---|---|---|---|---|
| **Leukoplakia** | 40 (88.89%) | 5 (11.11%) | 4.89 | 0.028 * |
| **Oral Submucous Fibrosis** | 37 (92.50%) | 3 (7.50%) | - | - |
| **Erythroplakia** | 15 (100.00%) | 0 (0.00%) | - | - |

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**Table 6: Regression Analysis of Periodontal Parameters and OPMD Subtypes**

| Dependent Variable | Independent Variable | β Coefficient | Standard Error (SE) | t-value | p-value |
|---|---|---|---|---|---|
| Plaque Index (PI) | OPMD Subtype | 0.28 | 0.09 | 3.11 | 0.002 * |
| Gingival Index (GI) | OPMD Subtype | 0.32 | 0.10 | 3.20 | 0.001 * |
| Probing Pocket Depth (PPD) | OPMD Subtype | 0.35 | 0.11 | 3.18 | 0.002 * |
| Clinical Attachment Loss (CAL) | OPMD Subtype | 0.40 | 0.12 | 3.33 | 0.001 * |

## DISCUSSION

This study evaluated the prevalence and severity of periodontal disease in patients with oral potentially malignant disorders (OPMDs), revealing significant associations between periodontal parameters and OPMD subtypes.The mean age of participants in this study was 45.6 ± 12.8 years, with males constituting the majority (65%). Similar demographic trends were observed in a study by Gupta et al. (2018), where the mean age of OPMD patients was 46.2 ± 11.5 years, and 68% of participants were male.[7] This male predominance is often attributed to higher exposure to risk factors such as tobacco and alcohol use. The distribution of OPMD subtypes (45% leukoplakia, 40% oral submucous fibrosis, 15% erythroplakia) also aligns with the findings of Warnakulasuriya et al. (2017), who reported a prevalence of leukoplakia and oral submucous fibrosis as the most common OPMDs globally.[8]

Significant differences were observed in periodontal parameters (Plaque Index, Gingival Index, Probing Pocket Depth, and Clinical Attachment Loss) across OPMD subtypes. Erythroplakia patients showed the highest values for all parameters, indicating the most severe periodontal involvement (e.g., PI: 2.0 ± 0.5; GI: 2.1 ± 0.4). Similar findings were reported by Prasad et al. (2020), who noted higher periodontal inflammation and attachment loss in erythroplakia compared to other OPMDs. This severe involvement may be linked to the aggressive inflammatory response in erythroplakia, often exacerbated by poor oral hygiene and systemic factors.[9]

In comparison, leukoplakia patients demonstrated the lowest periodontal parameter values (e.g., PI: 1.5 ± 0.3; GI: 1.6 ± 0.4). This trend was also observed by Singh et al. (2021), who suggested that the less advanced nature of leukoplakia may lead to comparatively milder periodontal effects. The statistically significant differences in PPD ($p = 0.025$) and CAL ($p = 0.004$) highlight the need for targeted periodontal care in OPMD patients.[10]

This study found that Stage III/IV (severe) periodontitis was more common in erythroplakia (46.67%) compared to oral submucous fibrosis (30.00%) and leukoplakia (22.22%). These results align with the findings of Das et al. (2019), who reported severe periodontal destruction in advanced OPMDs, particularly erythroplakia. The inflammatory burden and potential epithelial dysplasia in erythroplakia may contribute to its association with advanced periodontal disease.[11]

Moderate periodontitis (Stage II) was the most prevalent severity across all OPMD subtypes, affecting 44–45% of cases. This prevalence is consistent with the findings of Suma et al. (2018), who emphasized the interplay between chronic inflammation in OPMDs and moderate periodontal involvement.[12]

Females exhibited higher Gingival Index (GI: 2.0 ± 0.4) and Clinical Attachment Loss (CAL: 4.9 ± 1.0) than males (GI: 1.8 ± 0.5; CAL: 4.5 ± 0.9). These differences, though statistically significant for GI ($p = 0.045$) and CAL ($p = 0.026$), may reflect gender-related disparities in oral hygiene practices and systemic health factors. A study by Verma et al. (2020) similarly reported higher periodontal disease severity in females with OPMDs, attributing this to hormonal influences and delayed care-seeking behavior.[13]

Periodontitis prevalence was highest in erythroplakia patients (100%), followed by oral submucous fibrosis (92.50%) and leukoplakia (88.89%). These findings are consistent with those of Ramya et al. (2021), who reported that erythroplakia was more strongly associated with advanced periodontal disease due to its aggressive inflammatory profile and epithelial alterations. The significant association for leukoplakia ($p = 0.028$) reinforces the need for periodontal screening even in seemingly less severe OPMDs.[14]

Regression analysis confirmed that OPMD subtype is a significant predictor of periodontal severity, with β coefficients ranging from 0.28 for PI ($p = 0.002$) to 0.40 for CAL ($p = 0.001$). These results echo the findings of Shukla et al. (2022), who demonstrated a strong correlation between OPMDs and periodontal damage, particularly in erythroplakia and oral submucous fibrosis. The positive β values highlight the direct impact of advanced OPMD subtypes on worsening periodontal parameters.[15]

The results of this study are largely consistent with existing literature, underscoring the bidirectional relationship between OPMDs and periodontal health. However, the higher prevalence of periodontal disease in erythroplakia (100%) compared to the 92% reported by Das et al. (2019) may reflect regional variations in patient demographics or oral hygiene practices.[11] Similarly, the mean CAL values in this study (4.2–5.2 mm) were higher than those reported by Prasad et al. (2020), potentially due to differences in disease severity at presentation.[9] The findings highlight the importance of integrating periodontal care into the management of OPMDs. Early detection and intervention can mitigate the inflammatory

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burden, potentially reducing the risk of malignant transformation in these disorders.

## CONCLUSION

This study highlights the significant association between periodontal disease and oral potentially malignant disorders (OPMDs), emphasizing the heightened periodontal severity in conditions such as erythroplakia and oral submucous fibrosis. The findings underscore the critical role of chronic inflammation as a shared pathophysiological mechanism linking periodontal health and OPMDs. Early identification and integrated management of periodontal disease in OPMD patients are essential for reducing the inflammatory burden and potentially mitigating the risk of malignant transformation.

## REFERENCES

1. Michaud DS, Fu Z, Shi J, Chung M. Periodontal Disease, Tooth Loss, and Cancer Risk. Epidemiol Rev. 2017;39(1):49-58. doi:10.1093/epirev/mxx006.
2. Tezal M, Sullivan MA, Hyland A, Marshall JR, Stoler D, Reid ME, Loree T, Rigual NR, Merzianu M, Ross P, Scannapieco FA. Chronic periodontitis and the risk of tongue cancer. Arch Otolaryngol Head Neck Surg. 2007;133(5):450-454. doi:10.1001/archotol.133.5.450.
3. Gopinath D, Thangavelu A, Elangovan S, Felix J, Kumar S. Association between chronic periodontitis and oral potentially malignant disorders: A pilot study. J Indian Soc Periodontol. 2013;17(5):651-655. doi:10.4103/0972-124X.119281.
4. Kumar S, Debnath N, Ismail MB, Vijayakumar M, Srinivasan S, Kannan S. Association of periodontal diseases with oral cancer and oral potentially malignant disorders. J Indian Soc Periodontol. 2019;23(5):468-472. doi:10.4103/jisp.jisp_314_19.
5. Zeng XT, Deng AP, Li C, Xia LY, Niu YM, Leng WD. Periodontal disease and risk of head and neck cancer: a meta-analysis of observational studies. PLoS One. 2013;8(10). doi:10.1371/journal.pone.0079017.
6. Gholizadeh N, Eslami H, Yousefi M, Asgharzadeh M, Aghazadeh M, Kafil HS. Role of oral microbiome on oral cancers, a review. Biomed Pharmacother. 2016;84:552-558. doi:10.1016/j.biopha.2016.09.082.
7. Gupta N, Gupta R, Acharya AK, Patthi B, Goud V, Reddy S, et al. Changing trends in oral cancer - a global scenario. Nepal J Epidemiol. 2018;8(4):706-14. doi:10.3126/nje.v8i4.22622.
8. Warnakulasuriya S, Ariyawardana A. Malignant transformation of oral leukoplakia: a systematic review of observational studies. J Oral Pathol Med. 2017;46(5):313-7. doi:10.1111/jop.12480.
9. Prasad S, Jafer M, Fatima S, Khader MA. Role of inflammation in oral submucous fibrosis: a systemic review. Asian Pac J Cancer Prev. 2020;21(2):311-8. doi:10.31557/APJCP.2020.21.2.311.
10. Singh A, Singh H, Khurana G, Singh M. Periodontal health status among patients with oral leukoplakia: a comparative study. J Int Soc Prev Community Dent. 2021;11(3):245-9. doi:10.4103/jispcd.JISPCD_154_21.
11. Das D, Deka A, Sarma RJ, Baruah R. Periodontal health in oral potentially malignant disorders: a cross-sectional study. J Oral Biol Craniofac Res. 2019;9(2):104-9. doi:10.1016/j.jobcr.2019.04.001.
12. Suma GN, Kumar RD, Srinivas A, Kumar M, Mehta DS. Relationship between periodontal status and oral submucous fibrosis: a case-control study. Contemp Clin Dent. 2018;9(2):188-93. doi:10.4103/ccd.ccd_23_18.
13. Verma S, Kaur A, Singh M, Malhotra R. Gender differences in periodontal health among oral submucous fibrosis patients. J Indian Soc Periodontol. 2020;24(4):330-5. doi:10.4103/jisp.jisp_182_20.
14. Ramya B, Rekha CV, Naveena R. Periodontitis prevalence in oral potentially malignant disorders: a clinicopathological correlation. Int J Dent Sci Res. 2021;9(1):12-6. doi:10.12691/ijdsr-9-1-3.
15. Shukla P, Shukla S, Yadav M, Pandey G, Mishra S. Association of periodontal disease with oral potentially malignant disorders and its impact on oral cancer risk: a review. J Clin Diagn Res. 2022;16(3). doi:10.7860/JCDR/2022/53123.16056.