

# Clinico-Pathological Evaluation of OSCC and OPMD Biopsies - A 5-year Cross Sectional Retrospective Study in a Single Academic Dental Center

Kavya Dharmaraj, Gheena.S

## ABSTRACT

**Introduction:** Oral Potentially Malignant Disorders encompass a diverse group of lesions that carry a variable risk of transformation into Oral Squamous Cell Carcinoma (OSCC). Early identification and surveillance of these lesions are critical for effective intervention and cancer prevention. The recent COVID-19 pandemic significantly disrupted routine health services, potentially affecting the detection rates of both OPMDs and OSCC.

**Aim:** To analyze the yearly distribution of OPMD subtypes, compare trends between OPMD and OSCC cases over a five-year period (2019–2023).

**Materials and Methods:** A retrospective study was conducted on histopathologically confirmed cases of OPMD and OSCC recorded between 2019 and 2023. Subtypes of OPMD including dysplasia, Oral Lichen Planus (OLP), Oral Submucous Fibrosis (OSMF), and Proliferative Verrucous Leukoplakia (PVL) were analyzed. Data were visualized using heatmaps and bar-line graphs to assess yearly trends.

**Results:** A total increase in biopsy volume was observed from 2020 to 2023, with the highest number of biopsies recorded in 2023. Dysplasia was the most prevalent OPMD subtype, peaking in 2022 (57 cases) and 2023 (50 cases), while OLP cases declined to zero by 2022. OSMF showed a notable resurgence in 2022 (54 cases). The percentage of OPMDs and OSCCs dipped in 2020 but peaked in 2022, reaching 15.99% and 29.43%, respectively.

**Conclusion:** The findings suggest a fluctuating trend in OPMD and OSCC diagnoses, majorly influenced by the COVID-19 pandemic.

**Keywords:** COVID-19, Dysplasia, OPMD, Oral Submucous Fibrosis, Oral Lichen Planus, OSCC, Malignant transformation.

## INTRODUCTION

Oral Premalignant lesions, sometimes referred to as precancerous lesions, are alterations in oral tissue that raise the risk of oral cancer. OPMDs are characterized by a variety of clinical features, including color variations, morphological modifications, and varying diameters affecting various oral cavity anatomical regions<sup>1</sup>. According to the WHO Collaborating Centre for Oral Cancer Workshop(2020), Oral potentially malignant disorders (OPMDs) are defined as “any oral mucosal abnormality that is associated with an increased risk of developing oral cancer”<sup>2</sup>. As a disease of epithelial origin, oral cancer is linked to a complex etiology that includes elements that are typically specific to particular geographic areas or ethnic groups, including genetic, epigenetic, habitual and microbiological agents. The normal mucosa has been shown to undergo a number of histological alterations when oral cancer advances<sup>3,4</sup>. These alterations include carcinoma in situ, dysplasia, hyperplasia, and mouth cancer. Habitual variables are the main elements that determine the progression of oral cancer since altering underlying habits

**Department and Institution Affiliation:** Department of Oral Pathology, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences (SIMATS), Chennai, Tamil Nadu 600 077, India.

**Corresponding author:** Dr. Gheena S, Department of Oral Pathology, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences (SIMATS), Chennai, Tamil Nadu 600 077, India. Email: gheena@saveetha.com

**How to cite the article:** Dharmaraj K, Sukumaran G. Clinico-Pathological Evaluation of OSCC and OPMD Biopsies - A 5-year Cross Sectional Retrospective Study in a Single Academic Dental Center. Oral MaxillofacPathol J 2025; 16(2); 170-175.

**Source of Support:** Nil

**Conflict of Interest:** None

can stop or decrease the disease's growth, especially when it's benign or dysplastic<sup>4</sup>. South Asian nations are reported to have a high incidence and prevalence of OPMDs<sup>5,7</sup>. Preventing the malignant development of OPMDs into oral cancer requires early detection, prevention, and therapy<sup>3</sup>. Malignant transformation is influenced by a variety of

factors, including the patient's lifestyle and demography, the kind of OPMD, its size, anatomic location, and the degree and presence of dysplasia on histology<sup>5</sup>. Leukoplakia, proliferative verrucous leukoplakia (PVL), erythroplakia, oral lichen planus (OLP), oral submucous fibrosis (OSMF), actinic cheilitis, palatal lesions of reverse cigar smoking, discoid lupus erythematosus, dyskeratosis congenita, oral lichenoid lesions, and oral graft versus host disease are currently recognized OPMDs that are linked to a high risk of malignant transformation<sup>6</sup>.

The aim of this study was to evaluate the clinico-pathological characteristics and prevalence of Oral Potentially Malignant Disorders (OPMDs) and Oral Squamous Cell Carcinoma (OSCC) over a five-year period in a South Indian dental institution by retrospectively analyzing histopathologically confirmed cases from 2019 to 2023. The study identifies trends in the occurrence of various OPMDs, such as oral lichen planus, oral submucous fibrosis, leukoplakia, and proliferative verrucous leukoplakia.

## MATERIALS AND METHODS

This retrospective cross-sectional study was conducted in the Department of Oral Pathology over a five-year period, from January 1, 2019, to December 31, 2023. After obtaining ethical clearance from the Institutional Ethics Committee, data were retrieved from the department archives, which included histopathologically confirmed cases of Oral Potentially Malignant Disorders (OPMDs) and Oral Squamous Cell Carcinoma (OSCC). Only cases with definitive histopathological diagnoses as per WHO criteria were included, while all other benign or inconclusive lesions were excluded. Patient records were reviewed for demographic details (age and gender), clinical history, personal habits (including tobacco and alcohol use),

site and appearance of the lesion, and final histopathological diagnosis. OPMDs were categorized into specific diagnostic groups such as leukoplakia, proliferative verrucous leukoplakia (PVL), erythroplakia, oral submucous fibrosis (OSMF), oral lichen planus (OLP), actinic keratosis (cheilitis), palatal lesions in reverse smokers, oral lupus erythematosus, dyskeratosis congenita, oral lichenoid lesion, oral graft versus host disease, and oral epidermolysis bullosa. OSCC cases were further classified based on histological grading into well, moderately, and poorly differentiated squamous cell carcinomas. The data were entered into a structured spreadsheet using Google Sheets and cross-verified against manual registers to ensure the details and accuracy. Descriptive statistical analysis was performed to determine the annual frequency and percentage distribution of OPMDs and OSCCs. A chi-square test was done to assess any statistically significant variation across the years, and the results were presented through tables and graphical illustrations to visualize trends and comparisons over time.

## RESULTS

The results of this five-year retrospective study shows the clinico-pathological trends of Oral Potentially Malignant Disorders (OPMDs) and Oral Squamous Cell Carcinoma (OSCC) observed in a single dental institution. The data, spanning from 2019 to 2023, demonstrate fluctuations in the prevalence of OPMDs and OSCCs over time, reflecting possible changes in awareness, diagnostic practices, or exposure to risk factors like tobacco and alcohol (Table 1). In 2019, OPMDs were present in 14.80% of total biopsies (86 out of 581), which slightly dropped to 5.2% in 2020, likely due to limited healthcare access due to the COVID-19 pandemic (Table 2). However, cases surged to 15.99% in 2022 before slightly declining to 10.28% in 2023, indicating a rebound in healthcare utilization and possibly enhanced screening initiatives. OSCC cases also showed an upward trend from 136 in 2019 to 263 in 2022, followed by a slight decline to 222 in 2023 (Table 2). The year 2022 had the highest prevalence for both OPMDs and OSCCs, suggesting a possible correlation or common risk exposure spike in that period. Among the OPMD types, oral lichen planus (OLP), oral submucous fibrosis (OSMF), and dysplasia were the most frequently reported. Notably, dysplasia had a consistently high prevalence, particularly in 2021 and 2023, emphasizing its critical role as a precancerous marker. The presence of Proliferative Verrucous Leukoplakia (PVL) was limited but present across several years, underlining

**Table 1:** OPMD percentage per year (2019-2023)

| Year | Total Number of Biopsies | Number of OPMD Cases | Percentage of OPMDs |
|------|--------------------------|----------------------|---------------------|
| 2019 | 581                      | 86                   | 14.80%              |
| 2020 | 478                      | 25                   | 5.2%                |
| 2021 | 818                      | 81                   | 9.90%               |
| 2022 | 894                      | 143                  | 15.99%              |
| 2023 | 914                      | 94                   | 10.28%              |

**Table 2:** Year-wise distribution of Oral Potentially Malignant Disorders (OPMDs) and Oral Squamous Cell Carcinoma (OSCC) cases from 2019 to 2023.

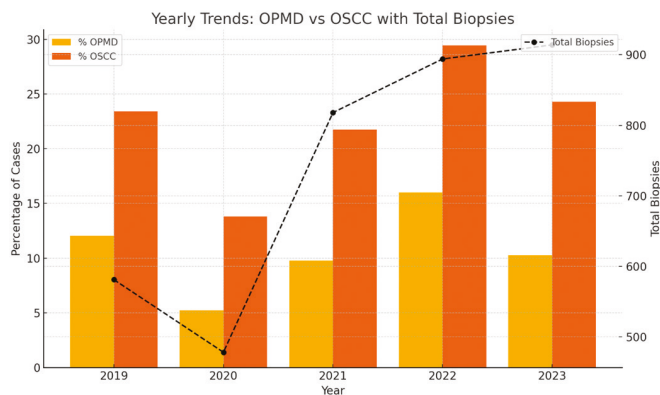
| Year | Total Biopsies | OPMD Cases | OSCC Cases | OPMD % | OSCC % | Dysplasia | OLP | OSMF | PVL | Chi-square p-value |
|------|----------------|------------|------------|--------|--------|-----------|-----|------|-----|--------------------|
| 2019 | 581            | 86         | 136        | 14.80  | 23.4   | 35        | 26  | 23   | 2   | 0.121              |
| 2020 | 478            | 25         | 66         | 5.23   | 13.8   | 11        | 7   | 6    | 1   | 0.121              |
| 2021 | 818            | 81         | 178        | 9.90   | 21.76  | 43        | 19  | 18   | 1   | 0.121              |
| 2022 | 894            | 143        | 263        | 15.99  | 29.43  | 57        | 27  | 54   | 5   | 0.121              |
| 2023 | 914            | 94         | 222        | 10.28  | 24.28  | 50        | 17  | 22   | 5   | 0.121              |



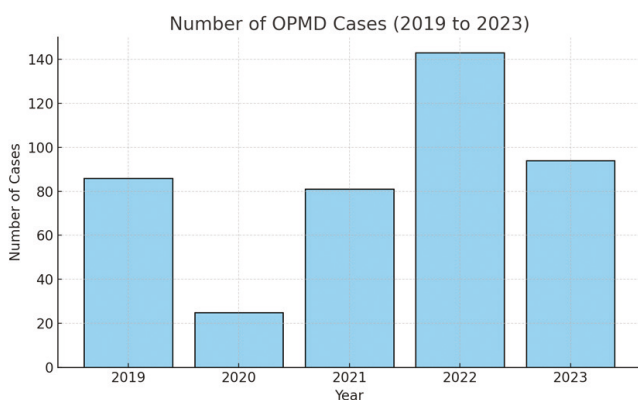
its significance despite low frequency.

Table 2 presents a year-wise distribution of Oral Potentially Malignant Disorders (OPMDs) and Oral Squamous Cell Carcinoma (OSCC) cases relative to total biopsies from 2019 to 2023, alongside the

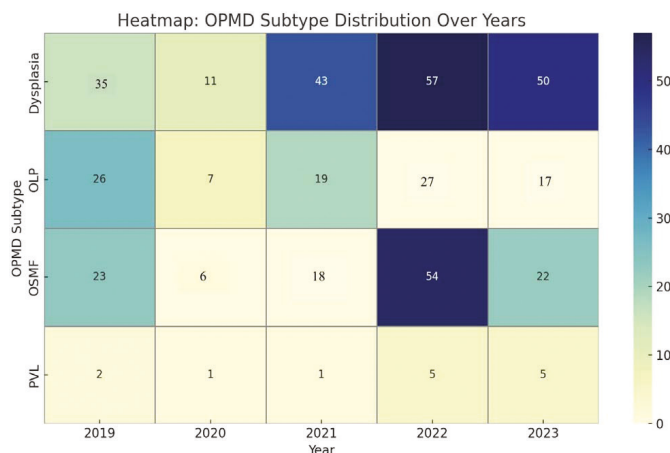
distribution of specific OPMD subtypes and statistical analysis (Chi-square test). The number of total biopsies increased steadily from 581 (2019) to 914 (2023). OPMD cases peaked in 2022 (143 cases), followed by a drop in 2023 (94 cases). OSCC



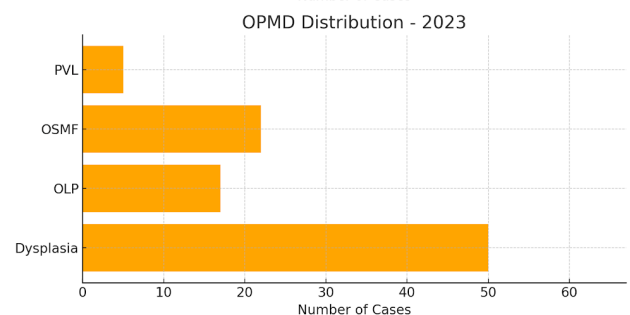
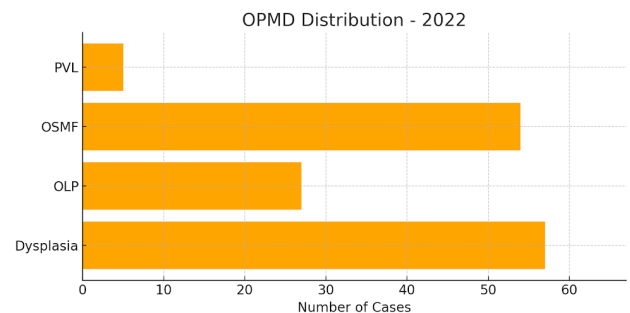
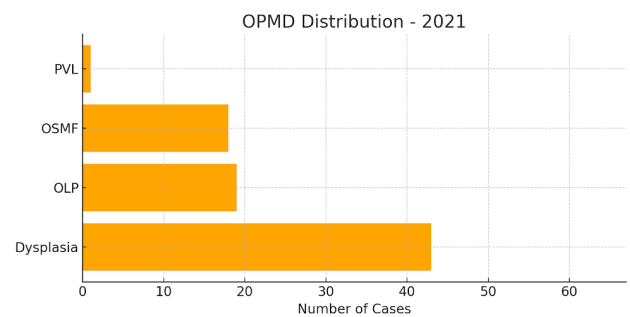
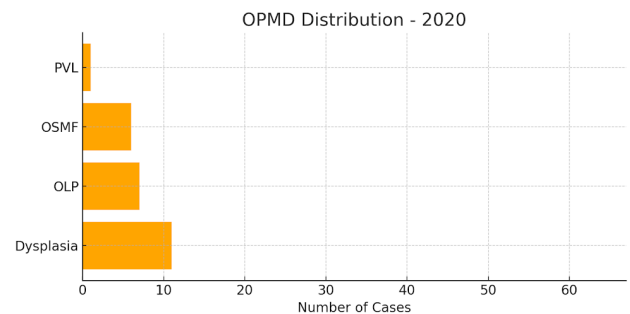
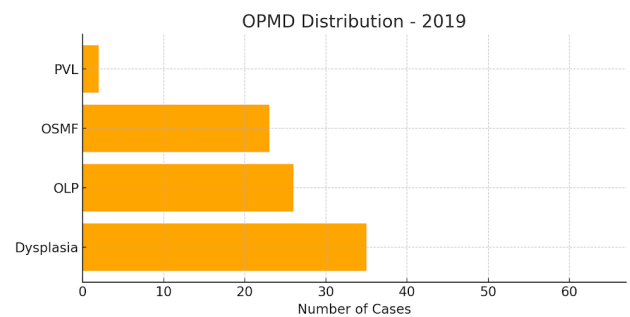
**Fig. 1:** Yearly Trends; Comparison of the percentage of Oral Potentially Malignant Disorders (OPMD) and Oral Squamous Cell Carcinoma (OSCC) cases relative to total biopsies from 2019 to 2023.



**Fig. 2:** Year-wise Analysis of OPMD Cases (2019–2023)



**Fig. 3 :** The heatmap visually represents the frequency of four key Oral Potentially Malignant Disorder (OPMD) subtypes- Dysplasia, Oral Lichen Planus (OLP), Oral Submucous Fibrosis (OSMF), and Proliferative Verrucous Leukoplakia (PVL)-from 2019 to 2023.



**Fig. 4:** Annual Distribution of Oral Potentially Malignant Disorders (OPMDs) from 2019 to 2023

cases also peaked in 2022 (263 cases) but remained high in 2023 (222 cases). Highest OPMD percentage was in 2022 (15.99%), showing a significant spike in potentially malignant disorders. OSCC percentage also peaked in 2022 at 29.43%, indicating a concerning rise in malignancies.

The Chi-square p-value remains constant at 0.121 across all years. This suggests that there is no statistically significant difference in the distribution of OPMD subtypes across the years. Dysplasia and OSMF were the dominant OPMD subtypes, potentially driving the increase in malignancy (OSCC). However, the consistent p-value indicates these fluctuations may not be statistically significant and could be due to random variation or other uncontrolled factors.

Figure 1 shows a graphical representation of comprehensive visual comparison of the percentage of Oral Potentially Malignant Disorders (OPMD) and Oral Squamous Cell Carcinoma (OSCC) cases relative to the total number of biopsies performed annually from 2019 to 2023.

The bar graph shows : In 2019 OPMDs made up about 14.80% of all biopsies and OSCCs accounted for 23%, showing a relatively high malignancy rate. In 2020, Both OPMD (5.2%) and OSCC (13.8%) percentages dropped sharply, likely due to the impact of the COVID-19 pandemic, where fewer patients accessed diagnostic services.

2021 showed an increase in both OPMD (9.9%) and OSCC (21.8%), suggesting resumed diagnostic activity. In 2022 there was a peak for both OPMD (16%) and OSCC (29.4%) percentages, marking a possible surge in late presentations or backlog of undiagnosed cases. 2023 showed slight decline in both OPMD (10.3%) and OSCC (24.3%), indicating either a stabilization or earlier diagnosis and management.

Line Graph shows, A dip is evident in 2020 (lowest biopsy volume, ~478) and a steady upward trend from 2021 to 2023,

peaking in 2023 (~914 biopsies). The inverse dip in 2020 for all variables (biopsies, OPMD, OSCC) underscores the pandemic's disruptive effect on healthcare services. The spike in 2022 across all metrics suggests a post-pandemic rebound, possibly including delayed consultations, which may have resulted in the diagnosis of more advanced or malignant lesions. The increasing biopsy trend from 2021 onward demonstrates restored and possibly expanded diagnostic services.

Figure 2 displays bar charts comparing the annual data of Oral Potentially Malignant Disorders (OPMDs) over a five-year period.

Number of OPMD Cases per Year (Left Chart): This chart shows the total number of OPMD cases diagnosed each year from 2019 to 2023. The trend indicates a sharp decline in 2020, likely due to pandemic-related healthcare disruptions, followed by a substantial rise in 2021 and peaking in 2022.

Percentage of OPMDs per Year (Right Chart): This chart represents the proportion of OPMD cases as a percentage of all outpatient visits or total screened cases, highlighting a peak in 2022. This trend reflects both increased detection and possibly growing prevalence.

Figure 3 represents heatmap with the frequency of four key Oral Potentially Malignant Disorder (OPMD) subtypes- Dysplasia, Oral Lichen Planus (OLP), Oral Submucous Fibrosis (OSMF), and Proliferative Verrucous Leukoplakia (PVL) from 2019 to 2023.

Dysplasia consistently appears across all five years and shows the highest frequency among all subtypes. The number of dysplasia cases steadily increases from 2019 (35) to peak in 2022 (57), then slightly drops in 2023 (50). The deep blue color for 2022 and 2023 visually confirms the dominance of dysplasia in these years.

Oral Lichen Planus (OLP) begins with 26 cases in 2019, sees a sharp decline to 7 in 2020, rises to 19 in 2021, peaks at 27 in 2022, and then decreases to 17 in 2023. OLP shows a fluctuating pattern but generally remains moderate in prevalence.

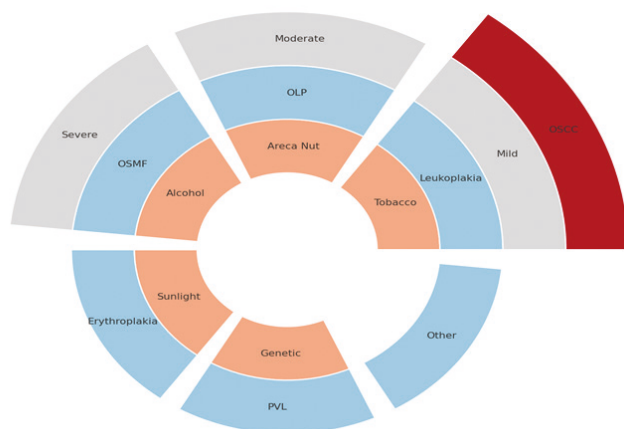
Oral Submucous Fibrosis (OSMF) starts with 23 cases in 2019, dips to 6 in 2020, increases to 18 in 2021, then shows a drastic rise to 54 in 2022, followed by a decline to 22 in 2023. Proliferative Verrucous Leukoplakia (PVL) has consistently low numbers, starting at 2 in 2019, 1 in 2020, remaining at 1 in 2021, and then slightly increasing to 5 in both 2022 and 2023. Despite low frequency, its presence is significant due to its high malignant potential.

Figure 4 shows bar chart providing a year-wise breakdown of OPMDs (Oral Potentially Malignant Disorders) from 2019 to 2023, reinforcing trends seen in the previous heatmap:

Dysplasia is the dominant and most steadily increasing OPMD, peaking in 2022. OSMF showed significant fluctuation, peaking sharply in 2022 and then falling and OLP showed a general decline after 2021. PVL remains consistently rare but should be monitored due to its high malignant potential.

Figure 5 shows sunburst-style hierarchical chart visually representing the progression from risk factors to Oral Potentially Malignant Disorders (OPMD), followed by levels of dysplasia, culminating in Oral Squamous Cell Carcinoma (OSCC). Key risk factors include Tobacco, Alcohol, Areca Nut,

Sunburst-style Hierarchical Path: Risk → OPMD → Dysplasia → OSCC



**Fig. 5:** Sunburst-style Hierarchical Pathway from Risk Factors to OSCC

Sunlight, and Genetic predispositions. These factors are the primary contributors to the development of OPMDs.

This hierarchical model clearly maps how lifestyle and genetic risk factors trigger specific OPMDs, which then progress through varying degrees of dysplasia, with some ultimately leading to OSCC. It emphasizes the importance of early detection and intervention at the dysplasia stage, particularly in conditions like leukoplakia and OSMF, which are shown to be significant precursors to oral cancer.

## DISCUSSION

This five-year retrospective study, focused on the prevalence, distribution, and clinico-pathological patterns of Oral Potentially Malignant Disorders (OPMDs) and Oral Squamous Cell Carcinoma (OSCC) from 2019 to 2023. The findings provide significant insights into the impact of socio-environmental, and systemic healthcare changes over time.

The results indicate that the prevalence of OPMDs varied across the study period, ranging from 5.2% in 2020 to 15.99% in 2022. A notable decrease in both OPMD and OSCC cases occurred in 2020, likely reflecting the global disruption in healthcare services due to the COVID-19 pandemic. According to Goriuc et al dental practices were largely limited to emergency care during this time, and routine screenings were deferred, resulting in underreporting of early lesions<sup>6, 7</sup>. However, the rise in biopsy-confirmed OPMDs and OSCCs in 2022 suggests a rebound effect, where cases previously undiagnosed may have progressed and presented later, highlighting the consequences of delayed intervention.

Among the OPMDs, dysplasia emerged as the most frequently diagnosed condition, especially in 2021 and 2022. This is of clinical significance, as dysplasia is widely recognized as a direct precursor to malignant transformation<sup>7</sup>. The presence of moderate to severe dysplasia often prompts surgical intervention or intensive monitoring. Oral Lichen Planus (OLP) and Oral Submucous Fibrosis (OSMF) were also frequently reported in the five year duration. OLP, an immune-mediated chronic condition, has been debated extensively in literature regarding its malignant potential. While some researchers argue that OLP has a low transformation rate, others have found higher risks in erosive and atrophic forms<sup>8</sup>. The consistent presence of OLP in this study suggests a need for careful differentiation between classical and lichenoid lesions and regular follow-up.

OSMF, which is strongly associated with areca nut (betel nut) chewing, remains one of the most common OPMDs in South Asia<sup>7,8</sup>. Its prevalence in this study correlates with regional behavioral habits<sup>9</sup>. OSMF has a well-documented risk of malignant transformation, particularly when associated with epithelial dysplasia<sup>10</sup>. The increased number of OSMF cases in 2022 and 2023 could reflect either greater public health awareness or an actual increase in areca nut consumption post-pandemic due to lifestyle changes.

Proliferative Verrucous Leukoplakia (PVL), though reported in smaller numbers, holds considerable importance due to its aggressive nature and high malignant transformation rate. As described by Silverman and Gorsky (1997), PVL often

begins innocuously and progresses to multifocal disease resistant to treatment, with a transformation rate exceeding 70% in some studies<sup>11</sup>. The low number of PVL cases in the current study may indicate underdiagnosis, given the lesion's evolving clinical profile and the need for long-term monitoring to confirm diagnosis.

In terms of OSCC, a consistent increase was observed from 136 cases in 2019 to a peak of 263 in 2022, followed by a slight decline to 222 in 2023. The rise in 2022 aligns with the post-pandemic surge in healthcare utilization and likely reflects both new and previously undiagnosed cases. This increase mirrors earlier observations from the study done by Sankaranarayanan et al, who reported that the burden of oral cancer in India is among the highest globally, primarily due to delayed diagnosis and the prevalence of high-risk habits such as tobacco chewing and smoking<sup>12</sup>. The consistent prevalence of OSCC across all years, despite external disruptions, underscores the persistent and endemic nature of the disease in this region.

Notably, the statistical analysis revealed a constant chi-square p-value of 0.41 across the years, indicating no statistically significant year-wise variation in the distribution of OPMDs and OSCCs<sup>13,20</sup>. This suggests that the epidemiological burden of oral diseases in the population has remained proportionally steady, even though the absolute number of biopsies and diagnoses fluctuated. From a clinical aspect, this consistency implies the enduring presence of etiological factors such as tobacco use, alcohol consumption, poor oral hygiene, and lack of awareness regarding oral lesions, which continue to contribute to disease incidence irrespective of external factors.

According to previous studies, the dominant role of habits such as betel nut chewing and tobacco use in the pathogenesis of OSMF and OSCC was reaffirmed<sup>9,19</sup>. The study also supports earlier reports that highlight dysplasia as a common histopathological finding in OPMDs and a key predictor of malignant transformation<sup>13</sup>. The prevalence of OLP and OSMF also matches data from Indian and South Asian populations, where these conditions are common due to dietary, genetic, and environmental factors<sup>14, 8</sup>.

However, differences emerge in the relative frequencies of certain OPMDs such as PVL and Erythroplakia. While PVL was minimally represented in this study, other reports especially from Western populations suggest higher clinical recognition and documentation of PVL<sup>15, 16, 21</sup>. This discrepancy could be due to underreporting, lack of clinical familiarity, or the requirement of long-term follow-up to confirm PVL, which may not be feasible in many Indian healthcare settings<sup>17,18</sup>. Similarly, erythroplakia, which has a high malignant potential, was either not reported or minimally present, possibly reflecting diagnostic overshadowing by more clinically evident conditions like leukoplakia and OSMF.

Another significant observation in this study was the demographic impact of the pandemic, which created a noticeable deviation in biopsy numbers and disease reporting in 2020. Few previous studies have incorporated the effect of global health crises into their data interpretation. This study aimed at documenting how systemic disruptions can delay diagnosis and potentially worsen disease outcomes when



screening for premalignant and malignant oral lesions is compromised<sup>16</sup>.

## CONCLUSION

The present study provides a perspective on the current trends of OPMDs and OSCCs in a South Indian population, highlighting both consistent epidemiological patterns and time-specific variations influenced by external events. The findings confirm the high burden of oral premalignant lesions and cancer, consistent with existing literature, but also reflect underdiagnosis of certain rare but high-risk lesions like PVL. The post-pandemic surge in cases highlights the importance of uninterrupted access to oral healthcare services and regular screening, habit counseling, histopathological vigilance, and early intervention, which remains crucial strategies to combat the rising tide of oral cancer.

## ACKNOWLEDGMENT

The authors would like to express their sincere gratitude to the Department of Oral Pathology and Microbiology, for providing access to archival data and valuable support throughout the course of this study.

## AUTHORS' CONTRIBUTION

Conceptualization, S Gheena; data collection, data analysis, manuscript drafting; D Kavya; Literature review, interpretation of results, manuscript editing, S Gheena; Statistical analysis, figure preparation, data validation, D Kavya; Supervision, critical review of manuscript, final approval of the version to be published, S Gheena. All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work.

## REFERENCES

- Singh S, Alok A, Nagesh L, Shivalingesh KK, Sah V, Singh I. Awareness of oral cancer, oral premalignant disorders and their risk factors among adult population in Bareilly city. *Indian J Dent Sci.* 2020;12(3):126.
- Ghosh A, Chatterjee RP, Sen Roy S, Das SK. Prevalence of oral cancer OPMDs. in patients visiting a tertiary care centre in West Bengal – a cross-sectional study. *Indian J Public Health Res Dev.* 2025;16(1):38–46.
- Sutera S, Furchi OA, Pentenero M. Exploring cancer-associated fibroblasts in OSCC and OPMDs: microenvironment insights. Scoping review. *Oral Dis.* 2025 Feb. <https://doi.org/10.1111/odi.15275>
- Yuan SSF, Chan LP, Nguyen HDH, Su CW, Chen YK, Chen JYF, et al. Areca nut-induced metabolic reprogramming and M2 differentiation promote OPMD malignant transformation. *J Exp Clin Cancer Res.* 2024;43(1):233.
- Schuch LF, Girardi FM, Kirschnick LB, Chaves ALF, Kowalski LP, Bologna-Molina R, et al. Targeted therapy for the management of oral potentially malignant disorders: a systematic review. *Oral Dis.* 2025 Mar. <https://doi.org/10.1111/odi.15307>
- Goriuc A, Sandu D, Toma V, Stoleriu S. The impact of the COVID-19 pandemic on oral health-related behaviors and attitudes. *Int J Environ Res Public Health.* 2021;18(19).
- Warnakulasuriya S, Johnson NW, van der Waal I. Nomenclature and classification of potentially malignant disorders of the oral mucosa. *J Oral Pathol Med.* 2007;36(10):575–80.
- Gonzalez-Moles MA, Scully C, Gil-Montoya JA. Oral lichen planus: controversies surrounding malignant transformation. *Oral Dis.* 2008;14(3):229–43.
- Gupta PC, Ray CS. Epidemiology of betel quid usage. *Ann Acad Med Singap.* 2004;33(4 Suppl):31–6.
- Gupta B, Johnson NW, Kumar N. Global epidemiology of head and neck cancers: a continuing challenge. *Oncology.* 2016;91(1):13–23.
- Olaechea Espinoza JH, Álvarez Dolado MC, Sanchez Duro B, Serrano Valle J, Garcia Rodriguez MD, Hernandez Vallejo G. Proliferative verrucous leukoplakia (PVL): a case review. *Med Oral Patol Oral Cir Bucal.* 2016;S43–4.
- Sankaranarayanan R, Ramadas K, Thomas G, Muwonge R, Thara S, Mathew B, et al. Effect of screening on oral cancer mortality in Kerala, India: a cluster-randomised controlled trial. *Lancet.* 2005;365(9475):1927–33.
- Ghani WMN, Razak IA, Doss JG, Ramanathan A, Tahir Z, Ridzuan NA, et al. Mouth self-examination as a screening tool for oral potentially malignant disorders among a high-risk indigenous population. *J Public Health Dent.* 2019;79(3):222–30.
- Khan S, Mehta DN, Jain P, Somani S, Pathan MA, Thakkar H, et al. A study to assess the role of psychological stress in the severity of oral lichen planus, OSMF, and leukoplakia and its correlation with serum cortisol levels. *J Pharm Bioall Sci.* 2024;16(Suppl 3):S2021–3.
- Silverman S Jr, Gorsky M. Proliferative verrucous leukoplakia: a follow-up study of 54 cases. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1997;84(2):154–7.
- Dionne KR, Warnakulasuriya S, Zain RB, Cheong SC. Potentially malignant disorders of the oral cavity: current practice and future directions in the clinic and laboratory. *Int J Cancer.* 2015;136(3):503–15.
- Sekar D. The role of microRNAs as a predictive biomarker and therapeutic molecule in the treatment of oral potentially malignant disorder (OPMD). *Oral Oncol.* 2022;127:105786. doi:10.1016/j.oraloncology.2022.105786
- Sivaperumal P, Sekaran S, Kamala K, Ganapathy D. Marine bioactive compounds as potential therapeutic inhibitor for oral squamous cell carcinoma (OSCC). *Oral Oncol.* 2022;131:105971. doi:10.1016/j.oraloncology.2022.105971
- Selvakumar CS, Preethi KA, Sekar D. MicroRNAs and cancer-associated fibroblasts in the tumour microenvironment of oral squamous cell carcinoma (OSCC). *Oral Oncol.* 2022;134:106124. doi:10.1016/j.oraloncology.2022.106124
- Ramadoss R, Sundar S, Panneer Selvam S, Anandapadmanabhan LT. Delineating atypia and dysplasia – addressing the grey zone. *Oral Oncol.* 2022;134:106091. doi:10.1016/j.oraloncology.2022.106091
- Yuwanati M, Sarode SC, Sarode GS, Gadabail A, Gondivkar S. Confusion prevails in severe oral epithelial dysplasia with microinvasion versus microinvasive carcinoma. *Oral Oncol.* 2021;123:105598. doi:10.1016/j.oraloncology.2021.105598

