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Original Research Article

Spectrum of Histopathological Findings in Oral Cavity Lesions: A Cross-Sectional Study from a Tertiary Care Centre in Western India

Anand Chouhan[1], Nidhi Chitlangia[2], Heena Goyal[3]

[1]3rd Year Resident, Department of Pathology, Sardar Patel Medical College and Associated Group of Hospitals, Bikaner, Rajasthan, India

[2]Senior Professor, Department of Pathology, Sardar Patel Medical College and Associated Group of Hospitals, Bikaner, Rajasthan, India

[3]3rd Year Resident, Department of Pathology, Sardar Patel Medical College and Associated Group of Hospitals, Bikaner, Rajasthan, India

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Corresponding author: Dr. Anand Chouhan

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Abstract

Background: Oral cavity lesions range from inflammatory and reactive conditions to cystic, benign, potentially malignant and frankly malignant neoplasms, and represent a major public health burden in India due to widespread tobacco and betel quid use.

Objective: To describe the histopathological spectrum of oral cavity lesions and correlate lesion category with age, sex and anatomical site in a tertiary care setting.

Methods: Cross-sectional study of all oral cavity biopsies received in the Department of Pathology, Sardar Patel Medical College and associated hospitals, Bikaner, from 1 April 2025 to 28 February 2026. Clinical data (age, sex, and site) were abstracted from requisition forms and hospital records; tissues were processed by routine paraffin technique, stained with haematoxylin-eosin, classified into broad histopathological categories, and analyzed using descriptive statistics and chi-square tests.

Results: A total of 360 oral cavity lesions were examined (mean age 48.42 years, range 7–86 years), with peak frequency in the 51–60 year age group (26.11%). Males comprised 71.94% (male: female ratio 2.56:1). Buccal mucosa (36.67%) and tongue (23.89%) were the most commonly involved sites. Malignant lesions predominated (64.45%), followed by inflammatory/reactive (18.89%), potentially malignant (8.61%), cystic (4.44%) and benign lesions (3.61%). Squamous cell carcinoma accounted for 92.67% of malignant lesions, most commonly moderately differentiated (66.51%). Age, sex and site showed highly significant associations with histopathological category ($p<0.001$ for all).

Conclusion: There is a high burden of tobacco-associated oral squamous cell carcinoma in this population, with predominance in middle-aged and elderly males and preferential involvement of buccal mucosa and tongue. Early detection of potentially malignant lesions and strong habit-cessation strategies are essential to reduce progression to invasive carcinoma.

Keywords: HPV, Tobacco Use, Squamous Cell Carcinoma, Oral Cavity Cancers.

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Introduction

The oral cavity is structurally and functionally complex and continuously exposed to physical, chemical and biological insults, making it susceptible to a wide spectrum of lesions ranging from inflammatory and reactive conditions to benign and malignant neoplasms. [1] Globally, oral diseases affect an estimated 3.7 billion people, and oral squamous cell carcinoma (OSCC) accounts for over 90% of oral cancers, ranking among the top ten cancers worldwide and being particularly common in developing nations such as India, Sri Lanka and Bangladesh. [2,3] In South and Southeast Asia, the predominant etiological factors for oral cavity lesions include smoked and smokeless tobacco, betel quid, areca nut and alcohol, often accompanied by poor oral hygiene and chronic mechanical irritation from teeth or dentures. [4,5] Clinical diagnosis based only on gross morphology is frequently misleading due to overlapping features, and histopathological examination remains the gold standard for distinguishing benign, potentially malignant and malignant conditions and for grading dysplasia and invasion. [6] Despite multiple international series,

region-specific data on the histopathological spectrum of oral lesions from high-risk Indian populations remain limited. The present study was undertaken to: (1) evaluate the histopathological spectrum of oral cavity lesions in a tertiary care centre in Western India, and (2) analyze their age, sex and site distribution and statistical association with broad lesion categories.

Material and Methods

Study Design and Setting: This was a hospital-based cross-sectional descriptive study conducted in the Department of Pathology, Sardar Patel Medical College and associated group of hospitals, Bikaner, Rajasthan, India. The study period extended from 1 April 2025 to 28 February 2026.

Study Population and Sampling: All tissue specimens of oral cavity lesions submitted to the Department of Pathology during the study period, irrespective of patient age or sex and fulfilling the inclusion criteria, were included. Autolysed and inadequate specimens were excluded. The final sample comprised 360 consecutive biopsies of oral cavity lesions received from various clinical departments of PBM and associated hospitals.

Data Collection: Demographic and clinical details including patient age, sex and anatomical site of the lesion were obtained from histopathology requisition forms and hospital records. Site categories included buccal mucosa, tongue, lip, alveolus, palate, floor of mouth, gingiva, retromolar trigone, mandible, angle of mouth, gingivobuccal (GB) sulcus and tonsilo-lingual sinus.

Tissue Processing and Histopathology: All specimens were fixed and processed by standard paraffin wax technique, including fixation and grossing, tissue processing, block making, microtomy and slide preparation. Sections were stained with haematoxylin and eosin; special stains were used where required. Light microscopic examination under low and high power was performed to identify lesion type and categorize each case into broad histopathological groups: inflammatory/reactive, cystic, benign neoplastic, potentially malignant (oral epithelial dysplasia, verrucous hyperplasia, leukoplakia) and malignant. Squamous cell carcinoma cases were graded as well, moderately or poorly differentiated based on standard histological criteria.

Statistical Analysis: Data were entered into an Excel worksheet and analyzed using frequency distributions, percentages, means and standard deviations. Associations between age group and lesion category, between sex and lesion category, and between anatomical site and lesion category were assessed using chi-square tests. A p-value <0.001 was considered statistically highly significant.

Results

The study included 360 cases of oral cavity lesions, with patient ages ranging from 7 to 86 years and a mean age of 48.42 years. The highest proportion of cases occurred in the 51–60 year age group (94 cases, 26.11%), followed by 41–50 years (84 cases, 23.33%) and 31–40 years (69 cases, 19.17%), collectively accounting for more than two-thirds of all lesions.

Of the 360 patients, 259 were males (71.94%) and 101 were females (28.06%), yielding a male: female ratio of 2.56:1.

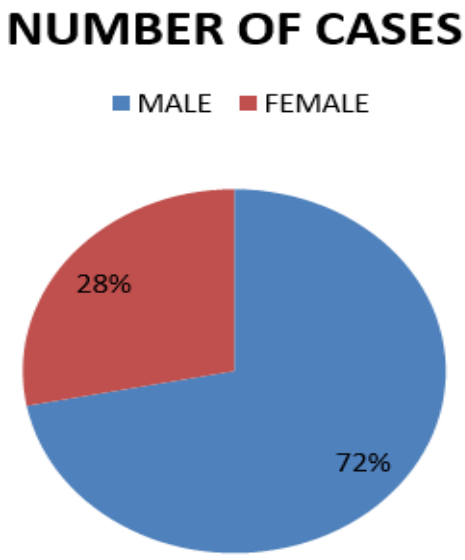

Figure 1: Distribution of cases according to gender

Buccal mucosa was the most frequently involved site, with 132 cases (36.67%), followed by tongue with 86 cases (23.89%). Lip lesions comprised 35 cases (9.72%), while palate and alveolus each accounted for 27 cases (7.50%). Lesions of the floor of mouth, gingiva and retromolar trigone were seen in 12 cases (3.33%) each; mandibular lesions comprised 11 cases (3.06%), and angle of mouth, GB sulcus and tonsilo-lingual sinus were least often involved. [Fig 2]

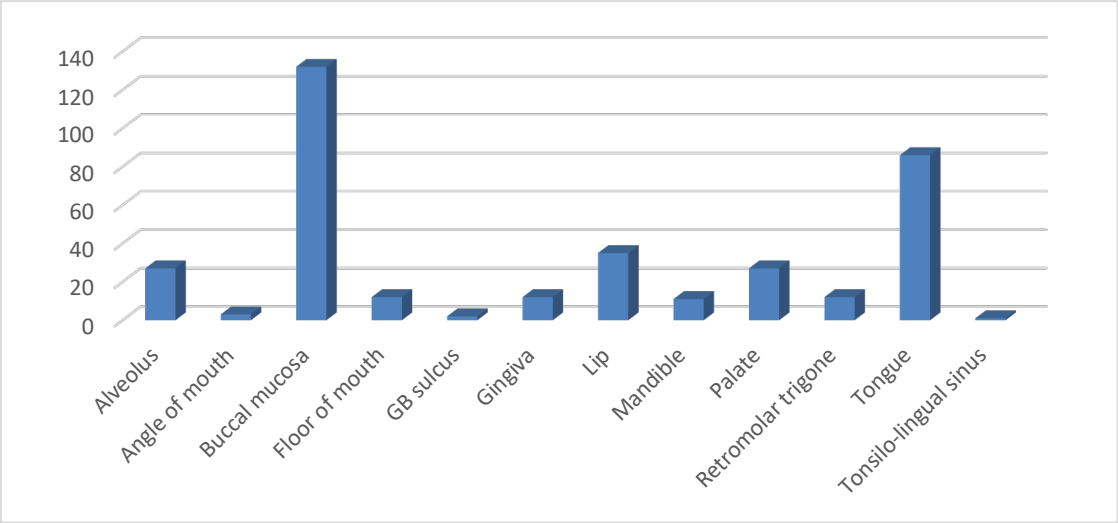

Figure 2: Site-Wise Distribution of Oral Lesions

Malignant lesions formed the largest category with 232 cases (64.45%). Inflammatory/reactive lesions constituted 68 cases (18.89%), potentially malignant lesions 31 cases (8.61%), cystic lesions 16 cases (4.44%) and benign neoplastic lesions 13 cases (3.61%).

Age-wise analysis showed that inflammatory/reactive lesions occurred over a wide age range (7–85 years; mean 39.15 years), cystic lesions had the youngest mean age (30.25 years), benign lesions clustered in middle age (mean 47.16 years), and potentially malignant and malignant lesions predominated in later decades (mean 53.16 and 51.82 years, respectively).[Table 1]

The association between age group and lesion category was highly significant (χ^2=120.77, df=32, p<0.001). Similarly gender wise distribution of cases is shown in Table 2. A statistically highly significant association was observed between gender and histopathological category of oral cavity lesions (p < 0.001). Male predominance was particularly marked in potentially malignant and malignant lesions, whereas cystic lesions demonstrated relative female predominance.

Table 1: Age Wise Distribution of Different Categories of Lesions

Age group	Inflammatory/Reactive	Cystic	Benign	Potentially malignant	Malignant
≤10	03	01	0	0	0
11-20	09	06	01	0	01
21-30	12	01	0	0	05
31-40	15	04	02	06	42
41-50	10	02	04	06	62
51-60	10	01	05	11	67
61-70	05	0	01	06	36
71-80	03	01	0	02	15
81-90	01	0	0	0	04
Total	68	16	13	31	232

χ^2: 120.77; df: 32; p-value: <0.001

Table 2: Gender Wise Distribution of DifferentCategories of Lesions

Gender	Inflammatory/Reactive	Cystic	Benign	Potentially malignant	Malignant
Male	46	04	06	22	181
Female	22	12	07	09	51
Total	68	16	13	31	232

χ^2: 26.63; df: 04; p-value: <0.001

Among inflammatory/reactive lesions (n=68), mucocele was most common (16 cases, 23.53%), followed by squamous hyperplasia (12 cases, 17.65%) and pseudoepitheliomatous hyperplasia (11 cases, 16.18%). Other lesions included fibroepithelial polyp, pyogenic granuloma, epulis, focal fibrous hyperplasia, ruptured mucocele, candidiasis, chronic nonspecific sialadenitis, giant cell reparative granuloma, pemphigus vulgaris, periapical granuloma and tuberculous granulomatous lesion. [Table 3]

Benign neoplastic lesions (n=13) showed considerable histomorphological diversity: lobular haemangioma (4 cases, 30.77%) and pleomorphic adenoma (2 cases, 15.38%) were most frequent, with single cases each of ameloblastoma, benign calcifying odontogenic tumour, lipoma, ossifying fibroma, osteochondroma, salivary cystadenoma and squamous papilloma. [Table 3] Cystic lesions (n=16) were predominantly odontogenic: radicular cyst was the most common (9 cases, 56.25%), followed by dentigerous cyst and odontogenic keratocyst (3 cases each, 18.75%) and a single epidermal cyst (6.25%). [Table 3] Potentially malignant lesions (n=31) comprised mainly oral epithelial dysplasia (20 cases, 64.51%), followed by verrucous hyperplasia (8 cases, 25.81%) and leukoplakia (3 cases, 9.68%). These were concentrated in buccal mucosa and tongue and displayed a male predominance and higher mean age. [Table 3]

Malignant lesions (n=232) were overwhelmingly squamous cell carcinoma (215 cases, 92.67%), with carcinoma in situ (10 cases, 4.31%), verrucous carcinoma (6 cases, 2.59%) and a single chondrosarcoma (0.43%). Among squamous cell carcinoma, moderately differentiated tumours predominated (143 cases, 66.51%), followed by well differentiated (70 cases, 32.56%) and poorly differentiated (2 cases, 0.93%). [Table 3]

Table 3: Spectrum of lesions in the present study.

Category	Diagnosis	Number	Category Percentage	Overall Percent
Inflammatory /Reactive Lesions	Candidiasis	1	1.47%	0.28%
	Chronic nonspecific sialadenitis	1	1.47%	0.28%
	Epulis	4	5.88%	1.11%
	Fibroepithelial polyp	5	7.35%	1.39%
	Focal fibrous hyperplasia	4	5.88%	1.11%
	Giant cell reparative granuloma	1	1.47%	0.28%
	Mucocele	16	23.53%	4.44%
	Necrotic lesion with botryomycotic	1	1.47%	0.28%
	Pemphigus vulgaris	1	1.47%	0.28%
	Periapical granuloma	1	1.47%	0.28%
	Pseudoepitheliomatous hyperplasia	11	16.18%	3.06%
	Pyogenic granuloma	5	7.35%	1.39%
	Ruptured mucocele	4	5.88%	1.11%
	Squamous hyperplasia	12	17.65%	3.33%
	Tuberculous granulomatous lesion	1	1.47%	0.28%
	Total	**68**		**18.89%**
Benign Lesions	Ameloblastoma	1	7.69%	0.28%
	Benign calcifying odontogenic tumor	1	7.69%	0.28%
	Lipoma	1	7.69%	0.28%
	Lobular haemangioma	4	30.77%	1.11%
	Ossifying fibroma	1	7.69%	0.28%
	Osteochondroma	1	7.69%	0.28%
	Pleomorphic adenoma	2	15.38%	0.56%
	Salivary cystadenoma	1	7.69%	0.28%
	Squamous papilloma	1	7.69%	0.28%
	Total	**13**		**3.61%**
Cystic Lesions	Dentigerous cyst	3	18.75%	0.83%
	Epidermal cyst	1	6.25%	0.28%
	Odontogenic keratocyst	3	18.75%	0.83%
	Radicular cyst	9	56.25%	2.50%
	Total	**16**		**4.44%**
Potentially Malignant Lesions	Leukoplakia	3	9.68%	0.83%
	Oral epithelial dysplasia	20	64.51%	5.56%
	Verrucous hyperplasia	8	25.81%	2.22%

	Total	**31**		**8.61%**
Malignant Lesions	Carcinoma in situ	10	4.31%	2.78%
	Chondrosarcoma	1	0.43%	0.28%
	Squamous cell carcinoma	215	92.67%	59.72%
	Verrucous carcinoma	6	2.59%	1.67%
	Total	**232**		**64.44%**
	Grand Total	**360**		**100%**

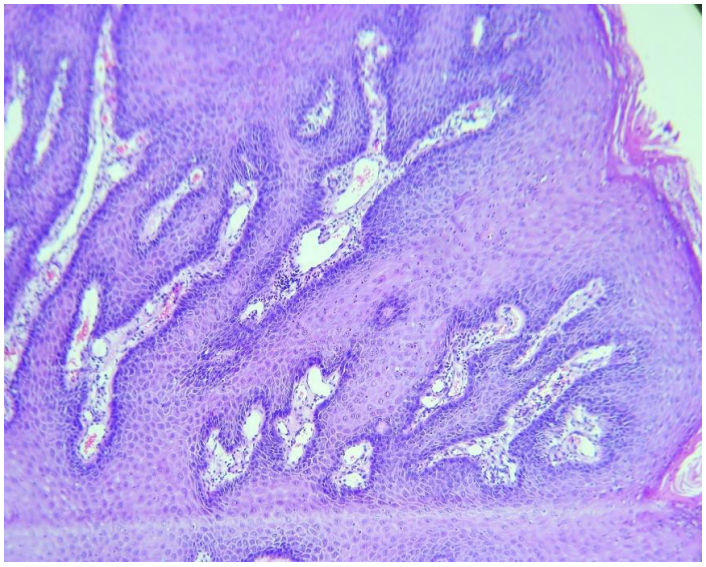

Figure 3: Photomicrograph showing marked acanthosis with irregular elongation and downward proliferation of rete ridges into the underlying stroma, consistent with pseudoepitheliomatous hyperplasia (H&E, x10)

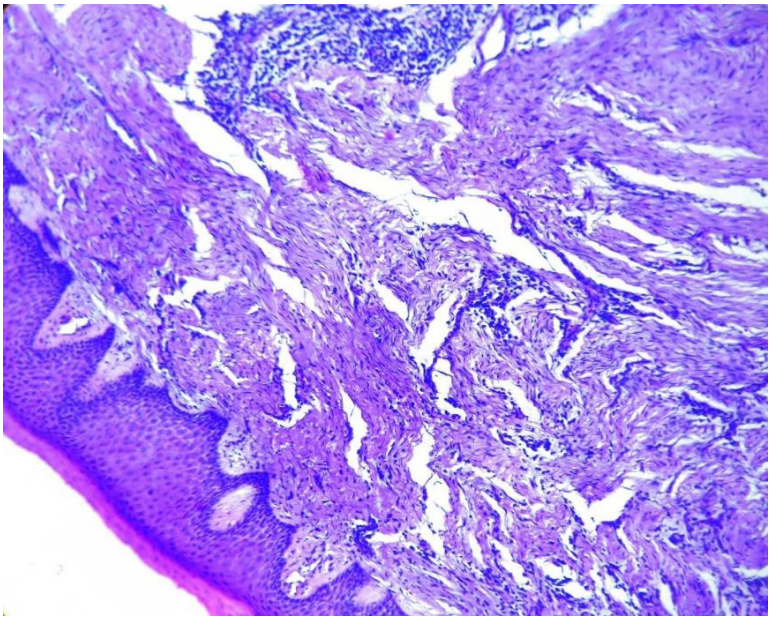

Figure 4: Photomicrograph showing fibrovascular connective tissue coveredby hyperplastic stratified squamous epithelium with chronic inflammatory cell infiltrate, consistent with epulis (H&E, x10)

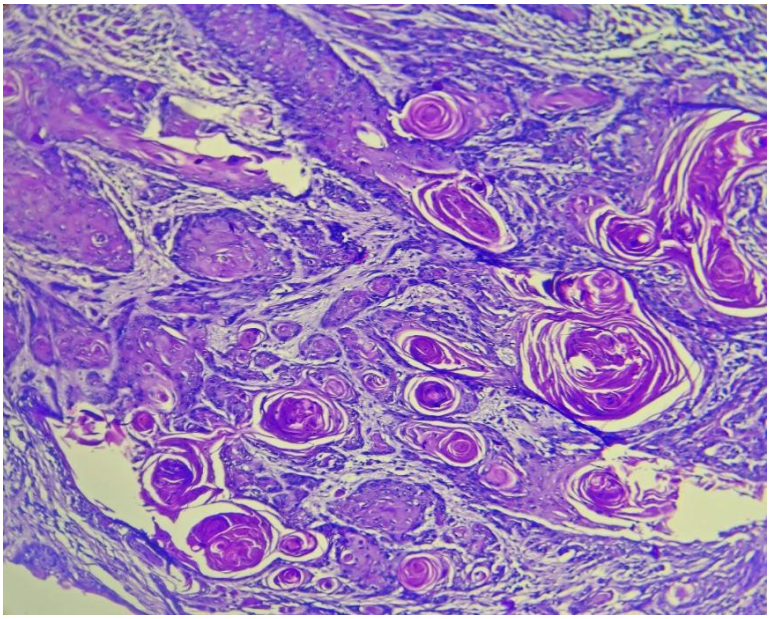

Figure 5: Photomicrograph showing infiltrating cords and nests of malignant squamous epithelial cells with abundant keratin pearl formation,suggestive of well differentiated squamous cell carcinoma (H&E, x10)

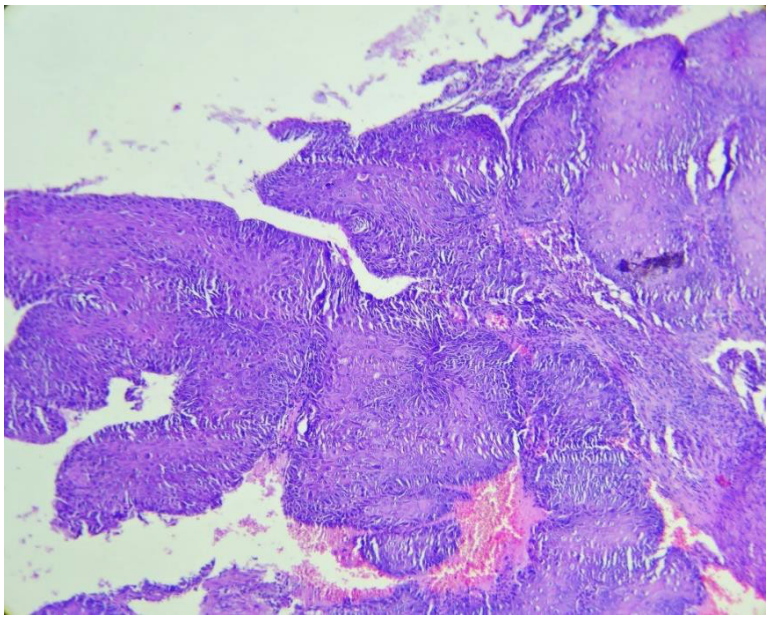

Figure 6: Photomicrograph showing hyperplastic epithelium with minimaldysplastic features, broad rete ridges with pushing border, consistent with verrucous carcinoma (H&E, x10)

Discussion

This study demonstrates a broad histopathological spectrum of oral cavity lesions in a high-risk Indian population, with malignant lesions—predominantly squamous cell carcinoma—forming nearly two-thirds of all biopsied cases. The age and sex distributions, as well as site patterns, emphasize the cumulative impact of tobacco and betel quid habits, chronic irritation and delayed healthcare-seeking behavior on oral carcinogenesis.

The predominance of lesions in middle-aged and elderly individuals, particularly in the 51–60-year age group, aligns with previous reports that oral cavity and oropharyngeal lesions are chiefly diseases of later life, reflecting prolonged exposure to carcinogens and progressive genetic and epigenetic changes. The results of our study are comparable to studies by Gowthami et al. [7], Kak et al. [8] and Sofizadeh et al. [9], which also report peak incidence in fifth to sixth decades and similar mean ages. The marked male predominance observed (2.56:1 overall; even higher in potentially malignant and malignant lesions) is consistent with Indian and regional literature attributing higher risk to greater tobacco, areca nut and alcohol use among

males. In contrast, some international series show more balanced gender distribution. Gaire et al. [10] reported a slight female predominance, with females accounting for 52% of cases and males 48%. Sofizadeh et al. [9] also demonstrated a relatively balanced gender distribution, with 47% males and 53% females. The pronounced male predominance observed in the present study may be attributed to the higher prevalence of deleterious oral habits among males, including tobacco chewing, smoking, betel nut consumption, gutka use, alcohol intake, and poor oral hygiene practices.

In the present study, buccal mucosa was the most commonly affected site (132 cases, 36.67%), followed by tongue (86 cases, 23.89%), lip (35 cases, 9.72%), and palate and alveolus (27 cases, 7.50% each). Lesions involving the floor of mouth, gingiva and retromolar trigone accounted for 3.33% each, while angle of mouth, gingivobuccal sulcus and tonsilo-lingual sinus were least frequently involved. This predominance of buccal mucosal lesions closely parallels the findings of Gowthami et al. [7] and Kak et al. [8], who also reported buccal mucosa as the most common biopsy site, whereas Gaire et al. [10] observed tongue (45%) as the principal site and Sofizadeh et al. [9] emphasized mandibular and periapical regions for specific inflammatory and cystic entities.

The high frequency of buccal mucosal involvement in the present series is likely related to widespread habits such as smokeless tobacco chewing, betel quid and gutka placement, and chronic local irritation within the buccal vestibule, resulting in prolonged contact with carcinogenic substances and increased risk of epithelial dysplasia and malignant transformation. Tongue, the second most commonly involved site, is similarly vulnerable because of its thin non-keratinized mucosa, rich vascularity and continuous exposure to mechanical and chemical irritants. Although lesions of the floor of mouth and retromolar trigone were relatively infrequent, these sites are clinically important as lesions here often present late and behave aggressively. Regional differences in predominant sites among published studies probably reflect variation in tobacco usage patterns, cultural habits, socioeconomic status and referral practices. Overall, our findings highlight buccal mucosa and tongue as principal high-risk areas in oral cavity, underscoring the need for meticulous examination of these sites during routine oral screening and for targeted histopathological evaluation of suspicious lesions.

In the present study, inflammatory/reactive lesions formed a substantial subset of oral cavity pathology, accounting for 68 cases (18.89%) of all lesions. The spectrum was broad, encompassing inflammatory, infective, traumatic, hyperplastic and reactive proliferative entities. Mucocele was the single most common lesion (16 cases, 23.53%), followed by squamous hyperplasia (12 cases, 17.65%) and pseudoepitheliomatous hyperplasia (11 cases, 16.18%). Fibroepithelial polyp and pyogenic granuloma each contributed 5 cases (7.35%), while epulis, focal fibrous hyperplasia and ruptured mucocele contributed 4 cases (5.88%) each; candidiasis, chronic nonspecific sialadenitis, giant cell reparative granuloma, pemphigus vulgaris, periapical granuloma and tuberculous granulomatous lesion were individually rare but clinically significant.

These findings are concordant with reports by Gowthami et al. [7] and Kak et al. [8], who also identified mucocele as a common non-neoplastic/tumour-like lesion, usually resulting from trauma or rupture of minor salivary gland ducts with mucin extravasation. Pyogenic granuloma and irritation fibroma/fibroepithelial polyp, observed frequently in our series, have similarly been highlighted by Gaire et al. [10] and Aladily et al. [11] as typical reactive proliferations driven by chronic irritation, trauma, calculus deposition or hormonal influences.

Inflammatory/reactive lesions were more frequently encountered in younger and middle-aged patients (mean age 39.15 years) and showed male predominance, likely related to greater exposure to trauma, inflammatory conditions, tobacco use, smoking, alcohol consumption and poor oral hygiene in this group. The inclusion of uncommon lesions such as candidiasis, pemphigus vulgaris, tuberculous granulomatous lesion and giant cell reparative granuloma underlines the need to consider infective and immune-mediated diseases in the differential diagnosis of chronic oral ulcerative and proliferative lesions, especially in endemic regions. Overall, the wide histopathological spectrum and frequent clinical simulation of malignancy underscore the essential role of histopathological examination in accurately classifying inflammatory/reactive oral lesions, excluding dysplasia or carcinoma and guiding appropriate patient management.

In the present study, benign lesions constituted a relatively small proportion of oral cavity biopsies (13 cases, 3.61%), but demonstrated marked histomorphological diversity, including lesions of vascular, epithelial, mesenchymal, salivary gland, odontogenic and osseous origin. Lobular haemangioma was the most common benign lesion (4 cases, 30.77%), followed by pleomorphic adenoma (2 cases, 15.38%), while ameloblastoma, benign calcifying odontogenic tumour, lipoma, ossifying fibroma, osteochondroma, salivary cystadenoma and squamous papilloma were encountered as single cases. This broad benign spectrum reflects the complex anatomical

composition of the oral cavity and underscores the need for precise histopathological diagnosis because biological behaviour, treatment and prognosis differ substantially among these entities.

Alongside benign lesions, cystic lesions accounted for 16 cases (4.44%) of all oral cavity lesions, most being odontogenic in origin. Radicular cyst was the predominant lesion (9 cases, 56.25%), followed by dentigerous cyst and odontogenic keratocyst (3 cases each, 18.75%), with epidermal cyst being least frequent. Similar predominance of radicular cyst has been reported by Aladily et al. [11], reinforcing the link between chronic dental infection, untreated pulpitis and inflammatory periapical pathology. In our series, benign and cystic lesions were mainly seen in middle-aged individuals (benign mean age 47.16 years; cystic 30.25 years) and showed near-equal gender distribution for benign lesions, suggesting that their occurrence is less directly tied to tobacco-related carcinogenic exposure than to developmental, infective and local tissue factors.

Potentially malignant lesions formed an important subset, comprising 31 cases (8.61%) of all lesions. Oral epithelial dysplasia was the predominant entity (20 cases, 64.51%), followed by verrucous hyperplasia (8 cases, 25.81%) and leukoplakia (3 cases, 9.68%). These findings partially align with Gowthami et al.[7], who reported leukoplakia-associated keratotic lesions and verrucous hyperplasia as common premalignant lesions, and with Aladily et al. [11] and Khan AS et al. [12], who emphasized epithelial dysplasia and leukoplakia as major oral potentially malignant disorders linked to tobacco exposure and increased malignant transformation risk.

In the present study, potentially malignant lesions were predominantly seen in middle-aged and elderly individuals (mean age 53.16 years, peak in the 51–60 year group) and showed marked male predominance (22 males, 9 females), consistent with prolonged exposure of males to tobacco and other carcinogens. Given the risk of progression to invasive carcinoma, early recognition and histopathological grading of epithelial dysplasia, together with habit cessation, close follow-up and patient counselling, are critical components of management in this group.

Malignant lesions constituted the largest category, accounting for 232 cases (64.45%) of all oral cavity lesions. Squamous cell carcinoma (SCC) overwhelmingly predominated (215 cases, 92.67%), followed by carcinoma in situ (10 cases, 4.31%) and verrucous carcinoma (6 cases, 2.59%), with a single chondrosarcoma (0.43%). This pattern is in concordance with the established epidemiology of oral cancer, and with series by Gowthami et al. [7], Gaire et al. [10] and Kak et al. [8], where SCC similarly accounted for more than 90% of malignant oral lesions. The high burden of SCC in our cohort reflects strong associations with chronic exposure to smokeless and smoked tobacco, betel nut and gutka, alcohol, poor oral hygiene and persistent mucosal irritation, and is further influenced by the tertiary-care referral nature of the institution, which receives clinically advanced and suspicious lesions for biopsy.

Carcinoma in situ and verrucous carcinoma together formed a small but clinically significant subset, highlighting the importance of detecting severe dysplasia before stromal invasion and recognising verrucous carcinoma as a low-grade yet locally aggressive SCC variant associated with smokeless tobacco and areca nut use. Malignant lesions were concentrated in middle-aged and elderly patients (mean age 51.82 years, peak in 51–60 years), with pronounced male predominance (181 males vs. 51 females), mirroring previous reports and underscoring gender-linked exposure to high-risk habits.

Among SCC cases, moderately differentiated carcinomas formed the majority (143 cases, 66.51%), followed by well-differentiated (70 cases, 32.56%) and poorly differentiated tumours (2 cases, 0.93%), suggesting that most patients present with tumours of intermediate differentiation at diagnosis. Differences in predominant histological grades across studies likely reflect variation in patient demographics, duration of carcinogen exposure and stage at presentation.

Overall, the malignant spectrum observed in this study highlights a substantial burden of tobacco-associated oral cancer in the population. Histopathological examination remains the gold standard for definitive diagnosis, grading and prognostication, and must be complemented by early clinical suspicion, targeted screening of high-risk individuals and robust tobacco-cessation and public health programmes to reduce oral cancer-related morbidity and mortality.

Conclusion

This cross-sectional study from a tertiary care centre in Western India demonstrates that malignant lesions—predominantly moderately differentiated squamous cell carcinoma—constitute the major histopathological category among biopsied oral cavity lesions, with strong male predominance and peak incidence in middle-aged and elderly patients. Buccal mucosa and tongue are the principal sites affected, reflecting local tobacco and betel quid usage patterns.

Inflammatory/reactive, cystic, benign and potentially malignant lesions collectively represent an important precursor and differential diagnostic spectrum, emphasizing the critical role of

histopathology in early detection and appropriate management. Strengthened community awareness, routine oral screening of high-risk groups, and aggressive habit-cessation programs are essential to reduce the burden of oral cancer in similar settings.

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