Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies *NLM ID: 101716117*

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Indian Citation Index (ICI) Index Copernicus value = 100

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Review Article

Oral lesions Associated with Tobacco: Narrative Review

[1]Om Lalwani, [2]Hirenkumar Rajeshbhai Chavda, [3]Braina P. Jadav, [4]Lalbahadur Laxmandas Sadhu, [5]Nidhi Singh, [6]Vidhi Katira

[1]Senior Lecturer, Department of Oral Medicine and Radiology, Pacific Dental College and Research Center, Udaipur, Rajasthan, India;
[2]Senior lecturer, Department of Oral Medicine & Radiology, College of Dental Science and Hospital, Maharaja Krushnakumarsinhji University, Amargadh, Bhavnagar, Gujarat, India;
[3]Senior Lecturer, Department of Oral Medicine and Radiology, Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University, Visnagar, Gujarat, India;
[4]Senior Lecturer, Department of Oral and Maxillofacial Pathology, Ahmedabad Dental College and Hospital Bhadaj, Ahmedabad, India;
[5]Consultant Oral Medicine and Radiologist, Ahmedabad, India;
[6]Senior Lecturer, Department of Oral Medicine and Radiology, Goenka Research Institute of Dental Science, Gandhinagar, Gujarat, India

ABSTRACT:
Tobacco consumption is a significant risk factor for the development of various oral lesions, ranging from benign changes to malignant transformations. This narrative review explores the spectrum of oral lesions associated with tobacco use, including leukoplakia, erythroplakia, oral submucous fibrosis, smoker's melanosis, nicotine stomatitis, and oral squamous cell carcinoma. The pathophysiological mechanisms underlying these lesions, including the role of carcinogens, oxidative stress, and inflammatory responses, are discussed. Additionally, the review highlights diagnostic approaches, preventive strategies, and the importance of tobacco cessation in mitigating oral health risks. A better understanding of these lesions can aid in early detection, patient education, and improved treatment outcomes.
Keywords: Oral lesions, tobacco, leukoplakia, erythroplakia, oral submucous fibrosis, oral cancer, nicotine stomatitis, tobacco cessation.

Received: 19 January, 2025 Accepted: 22 February, 2025

Corresponding author: Om Lalwani, Senior Lecturer, Department of Oral Medicine and Radiology, Pacific Dental College and Research Center, Udaipur, Rajasthan, India

This article may be cited as: Lalwani O, Chavda HR, Jadav BP, Sadhu LL, Singh N, Katira V. Oral lesions Associated with Tobacco: Narrative Review. J Adv Med Dent Scie Res 2025; 13(3):16-20.

INTRODUCTION

Tobacco consumption, in both smoking and smokeless forms, remains a major global health concern, significantly contributing to oral and systemic diseases. The harmful effects of tobacco on oral tissues have been well-documented, with a strong association between its use and the development of various precancerous and malignant lesions (1). The oral mucosa is highly susceptible to the deleterious effects of tobacco, as it is directly exposed to toxic chemicals, carcinogens, and heat, leading to cellular alterations and tissue damage (2).

Among the most common oral lesions associated with tobacco use are leukoplakia, erythroplakia, oral submucous fibrosis (OSMF), smoker's melanosis, nicotine stomatitis, and oral squamous cell carcinoma (OSCC) (3,4). Leukoplakia, a white patch that cannot be clinically or histopathologically classified as any other disease, is considered a potentially malignant disorder (PMD) with a variable risk of malignant transformation (5). Erythroplakia, although less common, presents a higher risk of progressing to OSCC (6). OSMF, predominantly linked to areca nut and tobacco use, is a chronic progressive disorder characterized by fibrosis of the oral mucosa, leading to restricted mouth opening and an increased risk of malignancy (7).

Smokeless tobacco users are particularly at risk for tobacco pouch keratosis, a lesion that occurs at the site of chronic tobacco placement and may progress to dysplasia or carcinoma (8). In addition, tobacco-induced smoker's melanosis is frequently observed in long-term smokers due to the stimulation of melanin production in response to heat and chemical exposure (9). Nicotine stomatitis, a reversible condition characterized by palatal keratosis and minor salivary gland inflammation, is commonly seen in pipe and cigar smokers (10).

The pathophysiology of tobacco-related oral lesions involves complex mechanisms, including the direct cytotoxic effects of tobacco carcinogens, oxidative stress, inflammation, and genetic alterations (11). Early detection and cessation of tobacco use play a critical role in preventing disease progression and improving patient outcomes. Given the significant burden of these lesions on oral health, a comprehensive understanding of their etiology, clinical presentation, and management strategies is essential for clinicians and researchers.

According to the Global Youth Tobacco Survey (2009) 14.6% of students were using any form of tobacco out of which 4.4% of them smoked cigarettes and 12.5% used some other forms of tobacco. The incidence of oral cancer increases with age and is highest over 60 years, even though cases in people younger than 40 years are increasing. (12)

This narrative review aims to provide an overview of oral lesions associated with tobacco use, discussing their pathogenesis, clinical features, diagnostic approaches, and preventive strategies. Furthermore, it emphasizes the importance of public health interventions and tobacco cessation programs in reducing the incidence and severity of these conditions.

Tobacco consumption not only influences the occurrence of oral lesions but also exacerbates their severity and progression. The cumulative exposure to carcinogenic compounds such as nitrosamines, polycyclic aromatic hydrocarbons, and reactive oxygen species leads to DNA damage, genetic mutations, and disruption of cellular homeostasis (1,2). These molecular changes contribute to epithelial dysplasia, angiogenesis, and immune evasion, facilitating the transition from premalignant to malignant lesions (3). For instance, in leukoplakia and erythroplakia, tobacco-induced oxidative stress triggers mutations in tumor suppressor genes such as TP53 and promotes uncontrolled cellular proliferation, increasing the likelihood of malignant transformation into oral squamous cell carcinoma (4,5). Similarly, in oral submucous fibrosis (OSMF), areca nut and tobacco components stimulate fibroblast proliferation and collagen deposition, leading to tissue fibrosis, vascular compromise, and progressive loss of oral function (6). The severity of these lesions often correlates with the duration and frequency of tobacco use, underscoring the need for early intervention to mitigate long-term consequences (7).

Clinically, tobacco-related oral lesions exhibit a spectrum of presentations that vary based on the type, frequency, and method of tobacco consumption. Leukoplakia typically presents as homogenous or non-homogenous white patches with well-demarcated or irregular borders, often occurring on the buccal mucosa, tongue, or floor of the mouth (1). Erythroplakia, in contrast, appears as a red, velvety lesion with a high propensity for malignant transformation, necessitating prompt biopsy and histopathological evaluation (2). OSMF is characterized by progressive mucosal stiffness, blanching, burning sensation, and restricted mouth opening, severely impacting speech, mastication, and overall quality of life (3). In smokeless tobacco users, tobacco pouch keratosis manifests as a white, wrinkled lesion at the site of chronic tobacco placement, while smoker's melanosis appears as diffuse brown or black pigmentation, predominantly affecting the gingiva and buccal mucosa (4,5). Nicotine stomatitis, commonly observed in pipe and cigar smokers, presents as a diffuse palatal keratosis with inflamed minor salivary gland ducts, often resolving upon cessation (6). These diverse clinical manifestations necessitate a thorough oral examination, risk assessment, and histopathological evaluation to guide appropriate management strategies (7).

Prevention and management of tobacco-associated oral lesions require a multidisciplinary approach encompassing patient education, early detection, tobacco cessation programs, and targeted therapeutic interventions. Public health initiatives aimed at reducing tobacco use through awareness campaigns, legislative measures, and behavioralcounseling play a crucial role in mitigating the burden of tobacco-related diseases (1). Clinically, cessation strategies such as nicotine replacement therapy, pharmacological agents like varenicline and bupropion, and behavioral interventions have shown efficacy in helping individuals quit tobacco use and reducing lesion progression (2,3). In cases of potentially malignant disorders such as leukoplakia and OSMF, regular monitoring, biopsy, and adjunctive therapies such as antioxidants, intralesional steroids, and laser ablation are recommended to prevent malignant transformation (4,5). Given the rising global incidence of oral cancer, integrating comprehensive tobacco control policies and screening programs within routine dental and medical practice is imperative to enhance early diagnosis and improve patient outcomes (6,7).

REVIEW

Tobacco use is a leading risk factor for various oral diseases, significantly contributing to the development of both precancerous and malignant lesions. The oral cavity is directly exposed to harmful tobacco

constituents, including carcinogens such as benzopyrene, nitrosamines, and acetaldehyde, leading to cellular mutations and tissue alterations (1). Tobacco-related oral lesions range from benign conditions such as smoker's melanosis to potentially malignant disorders (PMDs) like leukoplakia and erythroplakia, as well as life-threatening oral squamous cell carcinoma (OSCC) (2). This review discusses the different types of oral lesions associated with tobacco use, their pathogenesis, clinical presentation, and management strategies.

TOBACCO-ASSOCIATED ORAL LESIONS

Leukoplakia

Leukoplakia is one of the most common PMDs linked to tobacco use and is characterized by white patches that cannot be wiped off and are not associated with any other disease (3). It predominantly affects smokers, with a reported malignant transformation rate of 0.1% to 17.5% (4). Histologically, leukoplakia presents with hyperkeratosis and epithelial dysplasia, and its progression to OSCC is associated with genetic alterations in tumor suppressor genes like p53 (5). Tobacco cessation significantly reduces the risk of progression, highlighting the importance of early intervention.

Erythroplakia

Erythroplakia is a less common but highly malignant PMD characterized by red, velvety lesions with a higher risk of dysplasia and carcinoma (6). Unlike leukoplakia, most erythroplakic lesions exhibit severe dysplasia or carcinoma in situ upon biopsy (7). The pathogenesis involves chronic exposure to tobacco carcinogens, leading to epithelial atrophy, increased angiogenesis, and DNA mutations (8). Management includes biopsy for early detection, tobacco cessation, and surgical excision if necessary.

Oral Submucous Fibrosis (OSMF)

OSMF is a chronic, progressive disease primarily associated with areca nut and tobacco use, leading to fibrosis of the oral mucosa and trismus (9). The disease is characterized by inflammation, fibroblast proliferation, and excessive collagen deposition, resulting in restricted mouth opening (10). The malignant transformation rate of OSMF ranges from 7% to 30% (11). Treatment focuses on tobacco cessation, physiotherapy, corticosteroids, and surgical intervention in severe cases.

Smoker's Melanosis

Smoker's melanosis is a benign pigmentation disorder caused by increased melanin production in response to chronic exposure to tobacco smoke (2). It commonly affects the gingiva, buccal mucosa, and palate, with higher prevalence among heavy smokers (3). The pigmentation is considered a protective response against tobacco-induced oxidative stress (4). Management involves smoking cessation, which often leads to gradual resolution of the pigmentation.

Nicotine Stomatitis

Nicotine stomatitis is a tobacco-related lesion primarily seen in pipe and cigar smokers. It presents as a diffuse white patch on the hard palate, often with inflamed minor salivary gland openings (5). The condition results from chronic heat exposure, leading to hyperkeratosis and salivary gland duct metaplasia (6). Although it is considered benign, persistent lesions require monitoring to rule out malignant transformation.

Tobacco Pouch Keratosis

Tobacco pouch keratosis is commonly seen in users of smokeless tobacco and appears as a wrinkled, white lesion at the site of tobacco placement (7). Histopathological changes include hyperplasia, acanthosis, and mild dysplasia (8). Chronic use increases the risk of transformation into verrucous carcinoma or OSCC (9). Discontinuation of tobacco use typically leads to lesion regression, but persistent or dysplastic lesions require biopsy and close monitoring.

Oral Squamous Cell Carcinoma (OSCC)

OSCC is the most severe consequence of chronic tobacco exposure, accounting for over 90% of oral malignancies (1). Tobacco carcinogens promote genetic mutations, oxidative stress, and chronic inflammation, leading to malignant transformation (2). Clinically, OSCC presents as a non-healing ulcer, exophytic mass, or indurated lesion with or without pain (4). Early detection through biopsy and imaging is crucial for effective treatment, which includes surgery, radiotherapy, and chemotherapy (3).

Pathophysiology of Tobacco-Induced Oral Lesions

The pathogenesis of tobacco-related oral lesions involves multiple mechanisms, including:

- **Direct Cytotoxic Effects**: Tobacco contains over 7,000 chemicals, including nitrosamines and polycyclic aromatic hydrocarbons, which cause DNA damage and apoptosis (4).
- **Oxidative Stress**: Tobacco use leads to the generation of reactive oxygen species (ROS), causing lipid peroxidation, protein denaturation, and DNA mutations (5).
- **Inflammatory Response**: Chronic exposure to tobacco triggers the release of pro-inflammatory cytokines such as TNF-α, IL-6, and IL-1β, promoting tissue damage and carcinogenesis (6).
- **Epigenetic Alterations**: DNA methylation and histone modifications induced by tobacco constituents contribute to the dysregulation of tumor suppressor genes and oncogenes (7).

DIAGNOSIS AND MANAGEMENT

Diagnosis[13-18]

- **Clinical Examination**: Careful assessment of lesion size, texture, color, and persistence.
- **Histopathological Evaluation**: Biopsy is essential for distinguishing benign, dysplastic, and malignant lesions.
- **Adjunctive Diagnostic Tools**: Techniques such as toluidine blue staining, autofluorescence imaging, and brush cytology aid in early detection (8).
- **Biomarker Identification**: Research into salivary biomarkers offers potential for non-invasive screening methods, facilitating early detection of malignant changes in OPMDs
- **CBCT:** radiographic examination of suspected lesions with CBCT can be extremely helpful in diagnosis.

Management Strategies

- **Tobacco Cessation**: The cornerstone of prevention and management; counseling, nicotine replacement therapy, and pharmacological interventions (e.g., varenicline) can aid in quitting (9).
- **Surgical Excision**: Required for lesions with moderate to severe dysplasia or early-stage OSCC (3).
- **Pharmacological Therapy**: Corticosteroids and antioxidants such as lycopene are used in conditions like OSMF (1).
- **Regular Follow-up**: Essential for monitoring lesion progression and recurrence.
- Patients with "recurrent or metastatic head and neck squamous cell carcinoma" (HNSCC) have had a poor prognosis.(19)
- Intraoral scanner and 3D Printing can be used for treatment planning in extensive lesions.
- Any potentially malignant disorders or any ulcer present than treat to prevent it to be converted in oral squamous cell carcinoma (20-22)

Public Health Implications

Tobacco-related oral lesions pose a significant public health burden. Efforts to reduce prevalence include tobacco control policies, health education, and routine screening programs (2). The incidence of oral cancer increases with age and is highest over 60 years, even though cases in people younger than 40 years are increasing.Educating school children about tobacco and its ill effects through a structured teaching method can be an effective way for preventing and controlling tobacco use among adolescents.(23) Health professionals play a significant role in tobacco control. Raising awareness about the harmful effects of tobacco and encouraging cessation can substantially reduce morbidity and mortality.

CONCLUSION

Tobacco use is a major etiological factor in the development of various oral lesions, ranging from reversible benign conditions to irreversible malignancies. Early diagnosis, preventive strategies, and comprehensive tobacco cessation programs are critical in reducing the burden of these lesions. Further research is needed to explore novel diagnostic biomarkers and targeted therapies for tobacco-related oral diseases.

REFERENCES

1. Gupta PC, Ray CS. Smokeless tobacco and health in India and South Asia. Respirology. 2003;8(4):419–31.
2. Sargaiyan V, Singh S, Shukla R, Tanwar AS, Mehta T, Manek PV, Patel BJ, Patel KJ. Hematological profile of OSMF patients with increasing severity. Bioinformation. 2024 Apr 30;20(4):353-357. doi: 10.6026/973206300200353.
3. van der Waal I. Potentially malignant disorders of the oral and oropharyngeal mucosa: terminology, classification, and present concepts of management. Oral Oncol. 2009;45(4–5):317–23.
4. Napier SS, Speight PM. Natural history of potentially malignant oral lesions and conditions: an overview of the literature. J Oral Pathol Med. 2008;37(1):1–10.
5. Ankit K, Khan Y, Jaiswal A, Rana D, Qurishi AA, Pandey S, Manek PV. Prevalence and Patterns of Oral Mucosal Lesions Among Geriatric Patients in India: A Retrospective Study. J Pharm Bioallied Sci. 2024 Jul;16(Suppl3):S2303-S2305.doi: 10.4103/jpbs.jpbs_211_24.
6. Kashyap P, Mehta T, Raval C, Manek PV, Kewalia K, Guruprasad Y, Arya S. Clinical Correlation of Types and Forms of Smokeless Forms of Quid (Tobacco and Arecanut) and Occurrence of Oro Mucosal Lesions: A Cross-Sectional Study. J Pharm Bioallied Sci. 2024 Jul;16(Suppl3):S2182-S2184.doi: 10.4103/jpbs.jpbs_135_24
7. Tilakaratne WM, Klinikowski MF, Saku T, Peters TJ, Warnakulasuriya S. Oral submucous fibrosis: review on aetiology and pathogenesis. Oral Oncol. 2006;42(6):561–8.
8. 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.
9. Hedin CA. Smokers' melanosis. Clinical and histologic features. ActaDermVenereol. 1977;57(4):289–96.
10. Pindborg JJ, Mehta FS, Daftary DK. Studies in oral leukoplakia: clinical and histologic aspects of nicotine palatinus. J Am Dent Assoc. 1967;74(4):876–84.
11. Gopalakrishnan R, Kamboj M, Niranjan K, Denny C, Vasudevan DM. DNA damage induced by tobacco-specific nitrosamines in oral cancer cells. Indian J BiochemBiophys. 2005;42(1):29–32.
12. Majumder P, Thomas PA, Motghare V, Manek PV, Nazneen L, Basak S, Acharya S. Effectiveness of Structured Teaching Program on Adolescent's Knowledge of Tobacco Consumption: A Randomized Control Trial. J Pharm Bioallied Sci. 2024 Dec;16(Suppl 4):S3464-S3466. doi: 10.4103/jpbs.jpbs_983_24.
13. Tarsariya VM, Mehta DN, Raval N, Patadiya HH, Vachhrajani K, Ashem A. Evaluation of serum immunoglobulin (IgG, IgM, IgA) in potentially

malignant disorders of oral cavity - A case control study. J Oral BiolCraniofac Res. 2020 Oct-Dec;10(4):665-669. doi: 10.1016/j.jobcr.2020.09.002.
14. Ashem A, Mehta DN, Singh DN, Singh KC, Anupriya C, Devi AN. Assessment of Serum Fucose Level among Oral Squamous Cell Carcinoma Patients: A Case-Control Study. J Pharm Bioallied Sci. 2023Jul;15(Suppl 2):S878-S880. doi: 10.4103/jpbs.jpbs_91_23
15. Tarsariya, Vivek M.; Raval, Nilesh; Mehta, Dhaval N.;Asrani, Mukesh K.; Asrani, Vijay K.; Barot, KaushikS.. Evaluation of Serum Immunoglobulin (IgG, IgM,IgA) in Oral Cancer Patients – A Case Control Study.Journal of Indian Academy of Oral Medicine andRadiology 33(2):p 189-194, Apr–Jun 2021. | DOI:10.4103/jiaomr.jiaomr_240_20
16. Mehta, Dhaval; Singh, Nidhi; Agrawal, Kshitij; Patel, Meghal; Shah, Vishwa; Oza, Deesha. Evaluation of Serum C-reactive Protein Levels in Patients with Oral Submucous Fibrosis and Control Group: A Comparative Study. Advances in Human Biology ():10.4103/aihb.aihb_188_24, January 28, 2025. | DOI: 10.4103/aihb.aihb_188_24
17. Hiren PatadiyaBhavi Thakkar, Dhaval Mehta. Cone Beam Compute Tomography: Applications in Orthodontics. Journal of Pacific Academy of Higher Education and Research 2011;3(2),22-25.
18. Patel M, Shah T, Mehta D Cone-beam computed tomography: Applications in dentistry. Int J Sci Res 2016; 5: 558–9
19. SoumyaAllurkar, Hiren HansrajPatadiya, HimaniMarmat, DebapriyaKundu, Satinder Pal Singh Tulsi& Satya Prakash Gupta. Survival outcomes and response rates among patients with recurrent or metastatic head and neck squamous cell carcinoma. Bioinformation 2025: 21(1); 44-47. available from; https://www.bioinformation.net/021/973206300210044.htm
20. Mukesh A, Hiren P, Sen S. Syndromes associated with aphthous ulcers. J Res Med Dent Sci, 2013; 1(2): 72-76
21. Bhatt, Sumit; Simre, Saurabh S; Patadiya, Hiren Hansraj; Yadav, Dipika; Deepti, Bitra; Sathvi, SushmaSai; Manamasa, Yadav. 3D Printing in Dentistry: A Review. Journal of Advanced Medical and Dental Sciences Research; Amritsar Vol. 13, Iss. 1, (Jan 2025): 11-15. DOI:10.21276/jamdsr
22. Intraoral Scanner in Dentistry: A Comprehensive Review Kaushik, Kanika; Bhatt, Sumit; Gupta, Radhika Yagnik; Patadiya, Hiren Hansraj; Luthra, Anisha; Rao, K Ananya. Journal of Advanced Medical and Dental Sciences Research; Amritsar Vol. 13, Iss. 1, (Jan 2025): 57-61. DOI:10.21276/jamdsr
23. Majumder P, Thomas PA, Motghare V, Manek PV, Nazneen L, Basak S, Acharya S. Effectiveness of Structured Teaching Program on Adolescent's Knowledge of Tobacco Consumption: A Randomized Control Trial. J Pharm Bioallied Sci. 2024 Dec;16(Suppl4):S3464-S3466. doi: 0.4103/jpbs.jpbs_983_24.