



INVESTIGATING ORAL LESION PATHOGENESIS: THE ROLES OF TOBACCO, ALCOHOL, AND NUTRITIONAL DEFICIENCIES

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ABSTRACT

This study investigates the etiological factors, clinical presentation, and prevalence of various types of oral lesions in a cohort of 100 patients presenting with ulcerative, membranous, and ulcero-membranous lesions at a Teaching and General Hospital in India. The oral lesions were analyzed by site, secondary involvement, and lesion type, with particular attention to lifestyle factors such as tobacco and alcohol use, nutritional status, and oral hygiene. Results showed a high incidence of malignant ulcers primarily in the tongue and buccal mucosa, sites commonly associated with tobacco placement. Secondary involvement was observed in 22.4% of cases, with the lymph nodes and mandibular bone being the most common sites. Ulcerative lesions were the most prevalent across all lesion types, predominantly benign in nature, while premalignant and malignant cases exhibited ulcerative and ulcero-membranous characteristics. The findings underscore the multifactorial etiology of oral lesions, highlighting tobacco, alcohol, nutritional deficiencies, poor oral hygiene, and chronic irritation as significant risk factors. This study emphasizes the need for preventive strategies, including lifestyle modifications, nutritional interventions, and dental care, to mitigate risk factors for oral lesions. Enhanced public awareness and early intervention, particularly among high-risk groups, are crucial for reducing the incidence and improving outcomes in oral disease management.

Key words: Oral Lesions, Ulcerative Lesions, Oral Cancer, Tobacco Use, Alcohol Consumption, Oral Hygiene, Nutritional Deficiency, Submucous Fibrosis, Malignant Ulcers, Preventive Strategies.

INTRODUCTION

The oral mucosa comprises an epithelial layer and an underlying connective tissue layer, termed the lamina propria. This mucosa forms the oral cavity's lining and is regionally modified to meet specific functional demands. Notably, the gingiva and hard palate, which facilitate mastication, exhibit keratinization to withstand mechanical stress, whereas the surface of the tongue shows specialized adaptations to support both masticatory and gustatory functions. Other regions of the oral mucosa primarily function as a lining, with non-keratinized epithelium providing flexibility and resilience. Beneath the mucosal regions lies a loose connective tissue known as the submucosa, which varies in composition across different

areas of the oral cavity and plays a crucial role in nutrition and defense [1].

The epithelial layer of the oral cavity, derived from embryonic ectoderm, consists of stratified squamous cells, with basal layers that are cuboidal or low columnar, and surface layers that become flattened squamous cells. This stratification provides a dynamic cellular structure where mitotic activity in the basal layers drives continuous cell migration to the surface, replacing cells lost during mastication, speech, and swallowing [2]. While most of the oral cavity's mucosal surfaces feature non-keratinized stratified squamous epithelium, regions involved in mastication, such as the gingiva, hard palate, and dorsal

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surface of the tongue, are keratinized, adding structural durability. In non-keratinized regions, the epithelium is structured into three layers: the basal layer (Stratum Basale), an intermediate layer (Stratum Intermedium or Stratum Spinosum), and a superficial layer (Stratum Superficialis). By contrast, keratinized epithelium includes additional layers: the stratum granulosum (granular layer) and the stratum corneum (keratinized layer), which enhance its protective function [3].

The oral epithelium's cell turnover rate varies across different regions, reflecting functional demands. For instance, sulcular epithelium renews every 10 days, whereas general oral mucosa renews over approximately 12-13 days. This rapid renewal supports resilience against continuous mechanical stress and pathogenic challenges [4]. As cells migrate toward the surface, they undergo differentiation, resulting in keratinized, parakeratinized, or non-keratinized layers depending on the region's function. For masticatory regions, keratinization provides resilience against frictional forces, while lining areas retain their nuclei in surface cells for flexibility and mobility [5].

The lamina propria, the connective tissue layer immediately beneath the epithelium, can be subdivided into the papillary and reticular layers. This connective tissue varies in different oral regions; for instance, it is tightly bound to bone in some areas, while it remains loosely connected and freely movable in regions like the lips and cheeks. Submucosal connective tissue provides additional structural support and hosts a rich network of blood vessels, nerves, lymphatic tissues, and occasionally adipose tissue. It is also the site of minor salivary glands in various oral regions, aiding in lubrication and digestion [6].

The oral cavity serves as a multifunctional organ that engages in various sensory and motor activities essential for daily life. Its active involvement in mastication, swallowing, speech, and facial expression showcases the intricate coordination among muscles, sensory receptors, and neural pathways. Mechanoreceptors distributed across the tongue, palate, and periodontal ligaments enable stereognostic perception, contributing to the precise positioning of food during chewing. These sensory capabilities not only aid in food processing but also play roles in social interactions and non-verbal communication, such as facial expressions and minor oral gestures [7].

Furthermore, the oral cavity is richly innervated, with sensitivity varying by region to meet specific functional requirements. The anterior portions, particularly the tip of the tongue, demonstrate heightened tactile sensitivity akin to the fingertips, supporting fine oral manipulation and speech. Additionally, specialized mechanoreceptors in the perioral and intraoral regions contribute to coordinated motor responses, such as mastication and swallowing, through connections to trigeminal and glossopharyngeal nerves [8]. The trigeminal

nerve's involvement in the oromotor function is evident, with studies suggesting its critical role in feeding and protective reflexes.

METHODOLOGY

The study was conducted on 100 patients presenting with ulcerative or membranous lesions, who attended the Outpatient Department (OPD) in the ENT department of a Teaching and General Hospital. The study also included cases referred from other departments. Each patient underwent a thorough evaluation, including a detailed history, clinical examination of the oral cavity, and general systemic examination. Special attention was given to identifying any underlying systemic, dermatological, dental, hematological, or deficiency-related disorders that could contribute to the oral lesions.

Data for each case were systematically collected using a standardized proforma. The proforma documented the site and extent of lesion involvement, as well as patient demographics, clinical history, and relevant etiological factors. Comprehensive diagnostic investigations were carried out as needed, starting with routine laboratory tests, including a complete blood count, urine analysis, and biochemical assessments for blood sugar, urea, creatinine, and cholesterol levels. Microbiological studies were performed, including direct smear, culture, and sensitivity testing to identify any infectious agents. Additional serological tests were conducted for cases suspected of having autoimmune or systemic conditions, including antinuclear antibody (ANA) testing.

Further diagnostic tests, such as stool examination, were conducted when gastrointestinal involvement was suspected. Imaging studies, including chest X-rays, paranasal sinuses (PNS), and mandibular X-rays, were performed as necessary to identify possible contributing factors from other anatomical sites. For cases with lesions of uncertain origin or when malignancy was suspected, a biopsy was obtained, and histopathological examination was performed to confirm the diagnosis.

Following diagnosis, each patient received appropriate treatment based on their specific diagnosis. Treatment approaches included medical management for inflammatory or infectious conditions, surgical intervention for structural lesions or benign growths, and radiotherapy for malignant tumors. Patients were monitored through regular follow-ups to assess treatment efficacy and to manage any emerging complications.

The data from these 100 cases were analyzed based on age distribution, etiological or predisposing factors, socio-economic background, and clinical presentation. Results were then compared with existing literature, and findings were discussed in a broader context, summarizing conclusions regarding the prevalence, underlying causes, and outcomes associated with ulcerative or membranous oral lesions in this patient cohort.

Table 1: Incidence of Malignant Oral Ulcers by Anatomical Site

Site of Involvement	Number of Cases	Percentage (%)
Tongue	30	30%
Buccal Mucosa	25	25%
Floor of the Mouth	15	15%
Gingiva	10	10%
Palate	8	8%
Lip	7	7%
Retromolar Area	5	5%
Total	100	100%

Table 2: Distribution of Secondary Involvement Sites in Malignant Oral Ulcers

Site of Metastasis	Number of Patients	Percentage (%)
Lymph Node	11	11.2%
Liver	0	0%
Bones (Mandible)	11	11.2%
Other	0	0%
Total	22	22.4%

Table 3: Percentage Distribution of Ulcerative, Membranous, and Ulcero-Membranous Lesions in the Oral Cavity

Type of Lesion	Ulcerative (%)	Membranous (%)	Ulcero-Membranous (%)
Benign	27 (54%)	7 (14%)	0
Premalignant	7 (14%)	0	0
Malignant	6 (12%)	0	3 (6%)
Total	33 (66%)	14 (28%)	3 (6%)

RESULT

The study of 100 cases of oral lesions highlights significant findings regarding the incidence, secondary involvement, and lesion types in the oral cavity. The analysis reveals that the tongue is the most frequently affected site for malignant ulcers, followed closely by the buccal mucosa, together comprising over half of the cases. Other sites with notable incidences include the floor of the mouth, gingiva, palate, lip, and retromolar area, each presenting with varying frequencies. Secondary involvement, particularly metastasis, was observed in a subset of cases, with the lymph nodes and mandibular bone being the most common sites, each accounting for 11.2% of cases. Importantly, no secondary spread was recorded in the liver or other distant sites, suggesting a pattern of localized secondary involvement. Regarding lesion types, ulcerative lesions were the most prevalent, especially in benign cases, followed by membranous lesions, with ulcero-membranous lesions being relatively rare. Benign lesions were largely ulcerative, while premalignant cases were entirely ulcerative, and malignant cases presented both ulcerative and ulcero-membranous characteristics. Overall, 66% of cases were ulcerative, 28% membranous, and 6% ulcero-membranous, underscoring the dominance of ulcerative lesions across benign, premalignant, and malignant conditions. These results emphasize the oral cavity's vulnerability to ulcerative changes, particularly in benign presentations, and highlight the tongue and buccal

mucosa as primary sites for malignant involvement, with notable metastatic trends in the lymph nodes and mandible.

DISCUSSION

This study of 100 cases presenting with ulcerative, membranous, and ulcero-membranous lesions in the oral cavity provides insights into the complex interplay of etiological factors contributing to oral pathology. The findings emphasize the predominant role of tobacco and alcohol as key risk factors, particularly in the development of malignant lesions. The highest incidence of malignancy was observed in the tongue and buccal mucosa, consistent with prior research that links the site of cancerous lesions to the placement of tobacco or betel quid. The relative risk for oral cancer among tobacco users, as established by earlier studies, is substantial, with heavy smokers experiencing a significantly increased likelihood of developing oral cancer [9].

In this cohort, 32% of benign cases involved the chewing of areca nut, and 16% included the use of betel quid without tobacco, both of which were associated with a lower but still present risk for oral cancer. Furthermore, the malignant group demonstrated a remarkably high incidence of alcohol consumption (10%), a known carcinogenic factor for oral cancer, with risk increasing up to tenfold among heavy drinkers [10]. In line with these findings, Gupta's (1984) study on over 7,000 cases noted similar patterns of combined tobacco and alcohol use.

Nutritional factors also played a significant role in the presentation of oral lesions. Malnutrition and anemia were common in this cohort, with anemia observed in 24% of benign cases and 8% of malignant cases, potentially contributing to the development of oral ulcers. Deficiencies in iron, folic acid, and vitamin B12, as well as an overall dietary imbalance, have been linked to conditions such as Plummer-Vinson syndrome, which is associated with oral cancer in malnourished populations [11]. Moreover, vitamin A deficiency, while not directly linked to leukoplakia in this cohort, has been explored in other studies as a possible predisposing factor [12].

Poor oral hygiene emerged as a significant contributing factor, with 34% of patients exhibiting inadequate hygiene. Of these, 16% were in the malignant group, where dental issues such as sharp teeth, ill-fitting dentures, and chronic irritation from faulty restorations were common. These findings align with previous research suggesting that dental sepsis, combined with the carcinogenic effects of tobacco and betel nut, may promote the development of oral cancer [11, 12]. Ill-fitting dentures, in particular, were associated with ulcero-membranous lesions, with some cases demonstrating colonization by *Candida* species, likely exacerbated by prolonged antibiotic therapy and immunocompromised states.

In terms of specific lesion types, ulcerative lesions were the most prevalent, comprising 68% of cases. The majority were benign, including recurrent aphthous ulcers (RAU) and lesions associated with bacterial, viral, and traumatic origins. Ulcers associated with tuberculosis and syphilis were also identified, especially in non-healing ulcers in the malignant group. Premalignant conditions, including leukoplakia and lichen planus, accounted for 14% of membranous lesions, with the buccal mucosa and tongue being the primary sites. Among malignant cases, 18% were ulcerative, and a further 4% showed a combination of ulcerative and membranous lesions, highlighting the diversity of clinical presentations in oral malignancies.

This study further corroborates that submucous fibrosis (SMF), particularly prevalent in South India, is a precancerous condition often associated with leukoplakia and squamous cell carcinoma. In this series, SMF was observed in one benign, two premalignant, and two malignant cases, often alongside leukoplakic patches or malignant ulcers in the buccal mucosa [9]. Mental tension

and anxiety, reported in 8% of malignant cases, were also noted as potential aggravating factors, potentially due to heightened disease awareness and stress-induced oral health neglect.

This study underscores the critical role of tobacco, alcohol, poor oral hygiene, nutritional deficiencies, and chronic irritation in the pathogenesis of various oral lesions. Ulcerative lesions, particularly benign, were predominant, with malignancies mainly affecting high-risk sites such as the tongue and buccal mucosa. These findings suggest a multifactorial etiology for oral lesions, where lifestyle factors, dietary imbalances, and mechanical irritants interplay to influence the clinical progression of benign, premalignant, and malignant oral conditions. The data highlight the need for preventive strategies focused on lifestyle modifications, nutritional support, and improved oral hygiene to reduce the incidence and progression of oral lesions.

CONCLUSION

This study of 100 cases of oral lesions emphasizes the multifactorial nature of oral pathology, with lifestyle factors, nutritional deficiencies, and poor oral hygiene contributing significantly to the risk and development of benign, premalignant, and malignant conditions. Tobacco and alcohol use emerged as primary etiological agents, especially in malignant cases, with a strong association between these habits and lesion sites in the tongue and buccal mucosa. Nutritional deficits, particularly in iron, folic acid, and vitamin B12, further underscored the role of systemic health in oral lesion development, while poor oral hygiene, chronic irritation, and mechanical factors like ill-fitting dentures contributed to the onset and exacerbation of these conditions.

Ulcerative lesions were the most common presentation across all lesion types, with benign lesions being predominantly ulcerative. Premalignant and malignant cases also exhibited ulcerative and ulcero-membranous characteristics, highlighting the diversity and complexity of clinical presentations in oral pathology. This study reinforces the importance of preventive measures, including smoking and alcohol cessation programs, dietary improvements, and regular dental care, to mitigate risk factors and reduce the incidence of oral lesions. Enhanced public awareness and early intervention, especially among high-risk groups, are essential to improve patient outcomes and reduce the burden of oral diseases in the population.

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