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ORIGINAL RESEARCH

CORRELATION OF ORAL LESIONS WITH SYSTEMIC DISORDERS: A CLINICAL AND RADIOGRAPHIC STUDY

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ABSTRACT

Background: Oral lesions frequently serve as sentinel indicators of systemic diseases. Their recognition offers a valuable opportunity for early diagnosis and multidisciplinary intervention. Despite this potential, the clinical and radiographic correlation of oral lesions with systemic conditions remains underexplored in integrated healthcare.

Objectives: To clinically evaluate oral lesions in adult patients, assess the supportive role of radiographic imaging, and identify statistically significant correlations between specific oral lesion types and underlying systemic disorders.

Methods: A prospective, observational study was conducted over 12 months involving 150 adult patients with oral lesions. Clinical examinations were performed by calibrated specialists, and lesions were morphologically classified. Radiographic evaluations included digital orthopantomograms, intraoral periapical radiographs, and CBCT in selected cases. Systemic diagnoses were confirmed through laboratory investigations and medical consultation. Chi-square test was applied to analyze associations.

Results: Candidiasis, lichenoid reactions, and petechiae were the most frequent lesions. Systemic conditions most commonly identified included diabetes mellitus, hypertension, and hematological disorders. Radiographic findings such as alveolar bone loss and maxillary sinus opacification supported systemic correlation. Significant associations were established between candidiasis and diabetes mellitus ($p = 0.003$), petechiae and hematologic disorders ($p = 0.012$), and lichenoid lesions with hypertension ($p = 0.016$). Radiographic findings supported systemic diagnosis in 41% of participants.

Conclusion: Oral lesions can reflect underlying systemic pathology. Integration of clinical and radiographic assessment enhances diagnostic accuracy. Early identification and referral are crucial for improving patient outcomes. Training oral healthcare providers to recognize these correlations strengthens their role in systemic disease surveillance.

Keywords: *Oral lesions; Systemic diseases; Radiographic correlation; Oral diagnostics; Interdisciplinary screening; Preventive healthcare*

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1. INTRODUCTION

The oral cavity plays a fundamental role not only in mastication, phonation, and aesthetics but also in signaling the onset of systemic diseases. Owing to its rich vascularity and constant exposure to environmental and microbial stimuli, the oral mucosa often exhibits the first signs of systemic disturbances. These clinical indicators include ulcers, candidiasis, gingival bleeding, petechiae, pigmentations, and mucosal desquamation, which frequently precede or accompany systemic disease progression [1]. Conditions such as diabetes mellitus, leukemia, HIV/AIDS, and autoimmune diseases have consistently demonstrated oral involvement. In diabetic patients, oral signs such as dry mouth, angular cheilitis, and especially oral candidiasis are frequently encountered due to alterations in immune function and salivary gland output [2]. This fungal overgrowth is often exacerbated in uncontrolled diabetes, where hyperglycemia impairs neutrophil activity and mucosal defense mechanisms [3].

Lichenoid lesions, another common finding in the oral mucosa, have been associated with hypertensive individuals, particularly those on angiotensin-converting enzyme inhibitors, also known as ACE inhibitors [4]. Similarly, hematological disorders like thrombocytopenia and anemia are frequently associated with petechial hemorrhages, gingival bleeding, and mucosal pallor [5]. These signs may serve as the first indication of systemic imbalance, prompting further hematologic investigation. In immunocompromised patients, notably those with HIV, classic manifestations such as oral hairy leukoplakia, necrotizing gingivitis, and non-healing ulcers have been well-documented. Such lesions not only reflect disease severity but can also assist in monitoring treatment outcomes [6].

Pigmentations, whether drug-induced or physiological, are also indicative of systemic involvement. For instance, long-term antimalarial or chemotherapeutic use may result in mucosal melanosis, while systemic conditions such as Addison's disease can manifest through diffuse brown pigmentation of the gingiva [7]. While many of these presentations are benign in appearance, their underlying significance necessitates a thorough clinical evaluation. Despite the known associations between oral lesions and systemic conditions, their diagnostic importance is often underestimated in general medical settings [8]. This lack of awareness delays referrals, diagnosis, and ultimately treatment. The oral cavity, when routinely examined with clinical acumen, provides valuable opportunities for early systemic disease detection [9].

Radiographic imaging is a cornerstone in maxillofacial diagnostics, adding substantial value to clinical observations. Panoramic radiographs (OPGs) allow for wide-field visualization of bony structures, helping identify systemic influences on bone density, architecture, and pathology [10]. For instance, periodontal bone loss, often seen in diabetic or cardiovascular patients, can be clearly quantified on radiographs [11]. Additionally, intraoral periapical radiographs (IOPAs) are essential for evaluating local bone and root abnormalities, while CBCT offers high-resolution 3D imaging beneficial in detecting cortical plate expansion, sinus opacification, and jawbone radiolucencies [12]. Systemic diseases like osteoporosis, chronic kidney disease, and fungal infections such as mucormycosis can manifest radiographically as thinning of cortical plates, mottled trabeculae, and ill-defined osteolytic lesions [13]. A retrospective panoramic radiographic study showed significant associations between systemic health conditions and bone changes in the jaw, reinforcing the value of routine imaging in systemic disease surveillance [14].

Periodontal disease, a prevalent oral condition, is now recognized for its systemic implications. Studies have demonstrated its bidirectional relationship with diabetes and cardiovascular disease, implicating chronic inflammation and microbial dysbiosis as shared pathogenic mechanisms [15]. The role of the oral microbiome in modulating systemic immunity and contributing to systemic diseases has gained prominence, with research showing strong links between specific microbial shifts and the development of diseases such as inflammatory bowel disease, cancer, and atherosclerosis [16]. However, most existing studies have evaluated either the clinical presentation of oral lesions or their radiographic appearance in isolation. There remains a distinct gap in research integrating both aspects to draw robust diagnostic correlations with systemic diseases. One study found that oral manifestations in patients with inflammatory bowel disease were strongly correlated with intestinal symptoms, yet the role of radiographic findings was not explored [17].

This study aims to bridge this diagnostic gap by comprehensively evaluating oral lesions through both clinical and radiographic assessments and correlating them with confirmed systemic disorders. Such an integrative approach could

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enhance diagnostic accuracy, support early referral decisions, and encourage interdisciplinary collaboration between dentists, oral medicine specialists, and physicians.

Objectives of the Study

1. To evaluate the clinical spectrum of oral lesions associated with common systemic disorders in adult patients
2. To assess the diagnostic value of radiographic imaging in supporting clinical findings related to systemic diseases
3. To determine statistically significant correlations between specific oral lesion types and systemic disease categories

2. METHODOLOGY

2.1 Study Design and Population

This prospective, observational clinical study was conducted over a 12-month period at a tertiary care dental and medical teaching hospital. The study aimed to evaluate the clinical and radiographic correlation between oral lesions and systemic disorders. A total of 150 adult patients, aged between 18 and 75 years, who presented with either symptomatic or incidental oral lesions during routine outpatient visits, were recruited based on consecutive sampling.

2.2 Eligibility Criteria

Participants were included if they had clinically visible oral lesions and provided informed consent to undergo radiographic imaging and systemic health screening. Exclusion criteria included patients on immunosuppressive therapy, those with incomplete medical records, and individuals who declined either radiographic or systemic evaluations.

2.3 Clinical and Radiographic Evaluation

Each patient underwent a detailed extraoral and intraoral examination performed by calibrated oral medicine specialists. The lesions were clinically categorized into one of the following types: ulcerative, vesiculobullous, fungal, keratotic, hemorrhagic, or neoplastic.

Radiographic evaluation was performed using digital orthopantomograms (OPGs) for all participants. In cases requiring localized assessment, intraoral periapical radiographs (IOPAs) were taken. Cone-beam computed tomography (CBCT) was employed selectively in patients with complex or poorly demarcated lesions. Radiographic analysis focused on identifying signs of alveolar bone loss, radiolucent lesions, sinus opacification, cortical expansion, and root resorption. All images were interpreted independently by two experienced oral radiologists, with discrepancies resolved through consensus.

2.4 Systemic Correlation and Diagnosis

A comprehensive medical history was recorded for each participant. Laboratory investigations, including fasting blood glucose (FBS), complete blood count (CBC), liver function tests (LFT), and renal function tests (RFT), were performed. Systemic disorders were confirmed through documented diagnostic reports and consultations with appropriate medical specialists, ensuring an accurate correlation between oral findings and systemic conditions.

2.5 Ethical Clearance and Statistical Analysis

The study was conducted in compliance with the ethical standards, and written informed consent was secured from all participants. Data were compiled manually and analyzed using descriptive statistical methods. The distribution of oral lesions and systemic disorders was expressed as frequencies and percentages. The Chi-square test was applied to determine associations between lesion categories and systemic diagnoses. A p-value of less than 0.05 was considered statistically significant.

3. RESULTS

3.1 Demographic Profile of Participants

A total of 150 adult patients who presented with oral lesions during routine outpatient visits were enrolled in this study. The participant pool included both male and female patients with nearly equal distribution, as detailed in Table 1.

Table 1. Gender Distribution of Study Participants

Gender	Count	Percentage
Male	79	52.7 %
Female	71	47.3 %

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This table shows a slight predominance of male participants in the study population. To further illustrate this gender-based distribution visually, a pie chart has been included as Figure 1.

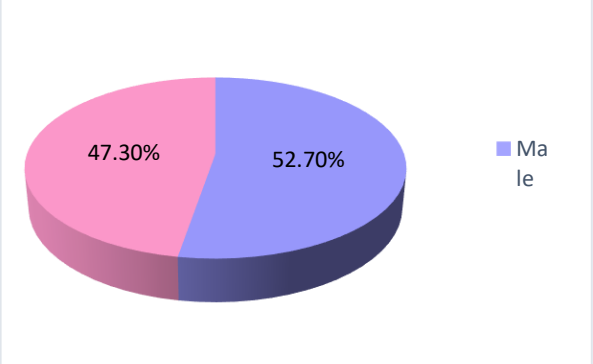

Figure 1. Pie Chart Showing Gender Distribution of Participants

This pie chart represents the gender composition of the 150 patients enrolled in the study. Males constituted 52.7% (n=79), while females accounted for 47.3% (n=71), reflecting a near-equal distribution of participants. The participants ranged in age from 18 to 75 years, indicating broad adult representation, with a mean age suggesting predominance of middle-aged individuals.

Regarding clinical presentation, several recurring symptoms were noted at initial visits. The most frequently reported issues were burning sensation, ulceration, and mucosal discoloration. Less common complaints included oral pain, spontaneous gingival bleeding, and the presence of visible intraoral growths. These clinical complaints are quantified in the following table. Table 2 outlines the percentage distribution of primary presenting complaints among the study participants.

Table 2. Distribution of Presenting Complaints

Complaint	**Percentage**
Burning sensation	31%
Ulceration	24%
Mucosal discoloration	18%
Oral pain	11%
Bleeding	9%
Visible growth/mass	7%

This table highlights the dominance of symptomatic burning and ulcerative lesions in the cohort's initial presentation. To complement these statistics, a visual presentation is given in Figure 2.

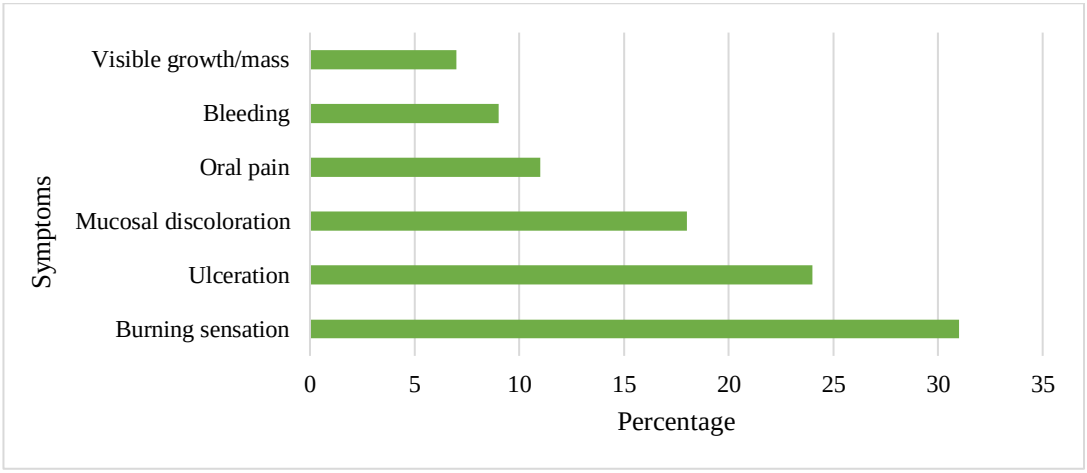

Figure 2. Horizontal bar chart displaying frequencies of presenting complaints among patients.

This horizontal bar chart displays the various symptoms reported by patients during their initial visit. Burning sensation was the most common complaint, followed by ulceration and mucosal discoloration. Less frequent symptoms included oral pain, bleeding, and visible intraoral growths or masses.

3.2 Distribution of Oral Lesions

The clinical examination of the study participants revealed a diverse range of oral lesions. These lesions were identified based on their morphological appearance and diagnostic criteria. A comprehensive tabulation of individual lesion types and their frequency of occurrence is presented below (Table 3), providing a categorized summary of the types of oral lesions diagnosed during clinical evaluation.

Table 3. Frequency of Specific Oral Lesion Types Identified During Clinical Examination

Lesion Type	Number of Cases
Candidiasis	32
Lichenoid Reactions	23
Petechiae	20
Aphthous Ulcers	18
Pigmentation	15
Periodontal Abscess	12
Oral Hairy Leukoplakia	6
Non-healing Ulcers	8

This table demonstrates that a spectrum of mucosal conditions was observed, with candidal and lichenoid presentations among the most common. To further enhance comprehension of lesion distribution patterns, a bar chart has been generated based on the tabulated clinical data. Figure 3 illustrates the comparative frequency of each type of oral lesion detected across the study sample.

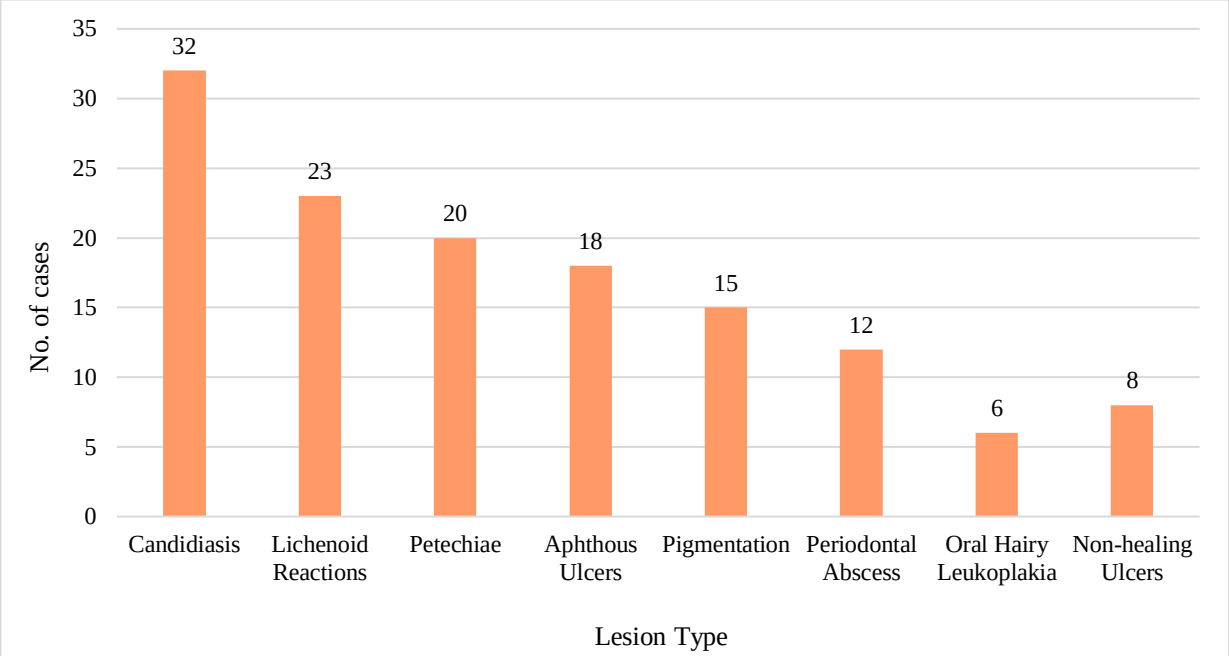

Figure 3. Frequency of Oral Lesion Types among participants

As shown in the chart, certain lesion categories, such as candidiasis and lichenoid reactions, were more prevalent, while others, like non-healing ulcers and leukoplakia, occurred less frequently. The visual representation helps to identify dominant lesion trends and their clinical relevance within the observed population.

3.3 Identified Systemic Disorders

Systemic evaluation of the study participants was conducted through a combination of laboratory investigations and physician-confirmed diagnoses. A variety of systemic conditions were identified, several of which are known to manifest with oral signs and symptoms. The breakdown of these conditions among the sample population is summarized below. Table 4 presents a detailed account of the systemic disorders identified among participants, organized by condition and corresponding case count.

Table 4. Frequency of Systemic Disorders Diagnosed in Study Participants

Systemic Disorder	Number of Cases
Diabetes Mellitus	39
Hypertension	33
Hematologic Disorders	26
Immunodeficiency (e.g., HIV)	14
Liver Cirrhosis/Hepatic Dysfunction	9
Autoimmune Disorders	6

This table highlights the predominance of metabolic and vascular conditions in the clinical population examined. To visualize these findings, Figure 4 graphically illustrates the distribution of systemic diseases among the patients enrolled in the study.

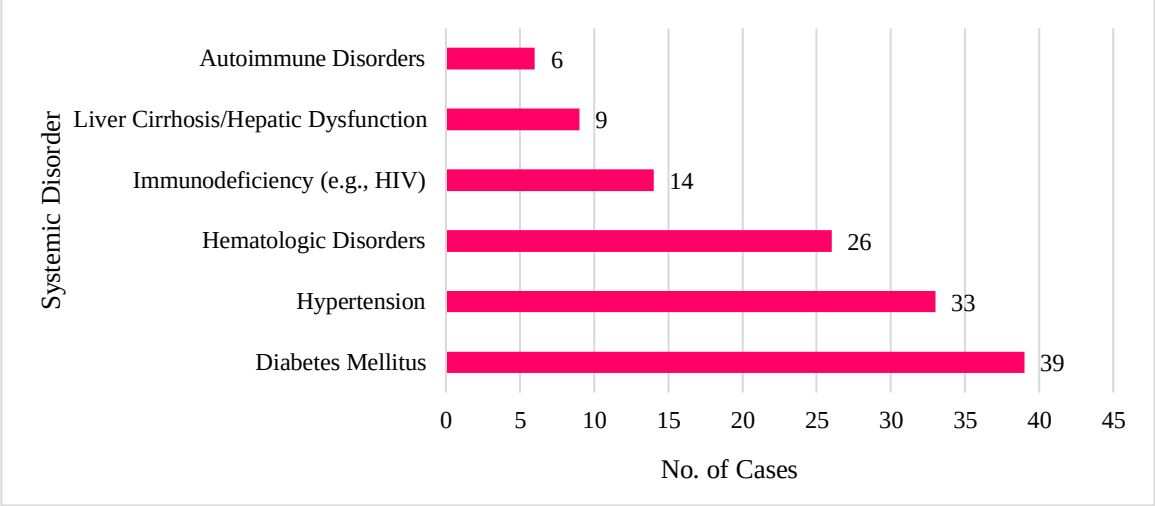

Figure 4. Distribution of Systemic Disorders Among Participants

As depicted in the figure, metabolic disorders such as diabetes and hypertension showed higher prevalence, followed by hematologic and immunologic conditions. The graphical layout offers an immediate visual comparison that underscores the clinical burden of these systemic illnesses about oral lesion presentation.

3.4 Radiographic Findings and Interpretations

All patients included in the study underwent panoramic radiography (orthopantomogram or OPG), and in select cases, additional imaging such as intraoral periapical radiographs (IOPAs) and cone-beam computed tomography (CBCT) was employed for further evaluation. Radiographic analysis was focused on detecting common maxillofacial features that could be indicative of systemic involvement. Table 5 presents the distribution of the major radiographic findings observed among the study participants. This tabulation highlights the spectrum of radiological manifestations that supported clinical impressions and contributed to the systemic correlation.

Table 5. Distribution of Radiographic Findings Among Participants (in %)

Radiographic Feature	Percentage
Alveolar Bone Loss	28%
Maxillary Sinus Opacification	11%
Periodontal Ligament Widening	5%
Root Resorption	5%
Mandibular Radiolucency	4%

The data in Table 5 shows that alveolar bone loss was the most commonly encountered radiographic change, while other features such as sinus opacification and mandibular radiolucencies were detected less frequently. A representation of these results is shown in Figure 5. This visual summary provides a quick comparative view of the frequency of different radiographic findings among the participants.

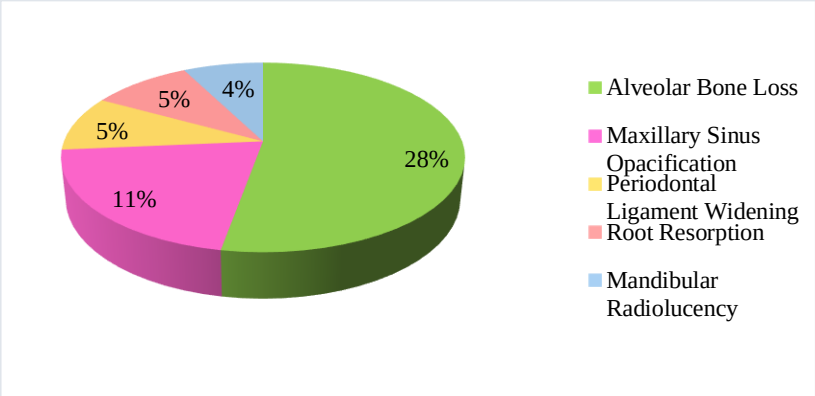

Figure 5. Distribution Percentage of Radiographic Findings in the Study Population

The graphical representation in Figure 5 illustrates that changes such as alveolar bone loss were more prevalent in the participants, with other findings like root resorption and periodontal ligament space widening occurring less frequently. The figure helps underline the relative contribution of radiographic features in clinical suspicion and systemic diagnostic support.

3.5 Correlation Between Oral Lesions and Systemic Disorders

Associations between specific oral lesions and systemic conditions were evaluated using the Chi-square test. A statistically significant correlation was observed between oral candidiasis and diabetes mellitus ($p = 0.003$). Gingival petechiae showed a significant association with hematological disorders ($p = 0.012$). Lichenoid lesions were significantly correlated with hypertension and long-term use of antihypertensive medications ($p = 0.016$). In total, radiographic features were found to support systemic diagnostic considerations in 41% of the study participants. To enhance the validity of these clinical patterns, inferential statistics were applied to assess the strength of observed associations between lesion types and systemic conditions. The Chi-square values, along with their corresponding significance levels, are summarized below in Table 6.

Table 6. Significant Associations Between Specific Oral Lesions and Systemic Disorders Based on Chi-square Analysis

Oral Lesion Type	Systemic Disorder	χ^2 Value	*p*-value	Significance
Oral Candidiasis	Diabetes Mellitus	8.82	0.003	Statistically Significant
Gingival Petechiae	Hematologic Disorders (Anemia, etc.)	6.31	0.012	Statistically Significant
Lichenoid Lesions	Hypertension / Antihypertensive Use	5.78	0.016	Statistically Significant

The results depicted in Table 6 confirm the diagnostic value of oral manifestations in systemic disease identification. These statistically robust correlations highlight the need for integrated diagnostic pathways involving dental and medical practitioners.

4. DISCUSSION

Oral manifestations frequently precede or mirror underlying systemic disorders and serve as critical early diagnostic indicators. The current findings affirm this interconnectedness, emphasizing that oral lesions are not merely localized events but often reflections of systemic pathology. This perspective aligns with the current understanding that oral health is intricately linked to systemic health. Emerging literature highlights that systemic conditions such as obstructive sleep apnea, diabetes, and cardiovascular disease often manifest with distinctive oral symptoms, including mucosal inflammation and periodontal changes [18]. In this study, a wide range of lesionsespecially candidiasis, lichenoid reactions, and petechiaewere significantly associated with underlying metabolic, vascular, and hematological disorders. This pattern corresponds with prior findings suggesting that inflammatory mediators and systemic immune dysregulation contribute to both oral and systemic pathology [19].

The association between oral candidiasis and diabetes mellitus, as established in the present study, is well-supported by previous investigations. Elevated glucose levels in saliva and immunosuppressive effects of diabetes promote the colonization of *Candida albicans*, leading to increased incidence of candidal lesions [4,5]. Moreover, the significant correlation between gingival petechiae and hematologic disorders echoes earlier studies that link thrombocytopenia and anemia to oral mucosal bleeding and petechial hemorrhages [20]. Lichenoid lesions were associated with hypertension and antihypertensive drug use, reinforcing existing evidence that medications such as beta-blockers and ACE inhibitors may provoke lichenoid mucosal reactions [6,21]. The relevance of such drug-induced lesions must not be underestimated in clinical settings, especially given the increasing prevalence of polypharmacy in elderly populations.

Radiographic evaluations further substantiated the diagnostic significance of oral findings. Alveolar bone loss, the most common radiographic anomaly, was observed across various systemic conditions, particularly diabetes mellitus. Hyperglycemia-induced microvascular changes and altered immune responses contribute to accelerated periodontal breakdown in diabetic individuals [7,22]. Similarly, sinus opacification and mandibular radiolucencies were occasionally associated with immunodeficiency and hepatic dysfunction, reflecting the potential of maxillofacial imaging in systemic disease surveillance [8]. The mechanistic role of the oral microbiome in systemic disorders also warrants attention. Studies demonstrate that microbial dysbiosis within the oral cavity can induce systemic inflammation and contribute to diseases such as cardiovascular disorders, rheumatoid arthritis, and adverse pregnancy outcomes [20,21]. The observed correlation between oral and systemic conditions in this cohort may be partially explained by microbial translocation and cytokine signaling, as previously described in mechanistic literature [10].

The varied clinical presentation of oral lesions nonetheless revealed specific patterns that may inform diagnostic pathways. Burning sensation emerged as the most commonly reported symptom and was frequently associated with candidiasis and mucosal atrophy, conditions often linked to metabolic disorders or immunosuppression. Likewise, mucosal pigmentation, though less frequently encountered, was observed in individuals with hepatic dysfunction or prolonged medication use, highlighting its potential role as an indicator of systemic toxicity or underlying organ impairment [12]. These findings support the assertion that oral lesions can serve as a non-invasive screening modality for systemic diseases when interpreted in conjunction with laboratory data and imaging. A transdisciplinary approachintegrating dentistry, radiology, and internal medicinethus becomes essential for timely detection and intervention [22].

Potentially malignant disorders (PMDs), such as leukoplakia and lichenoid lesions, were also identified within this cohort. PMDs may represent early indicators of systemic immune alterations or be influenced by chronic inflammation, reinforcing the need for vigilant oral surveillance in medically compromised patients [23]. Earlier identification and management of such lesions could reduce malignant transformation risk, particularly in populations with comorbidities. The diagnostic value of panoramic imaging, complemented by CBCT in selected cases, proved vital in correlating oral and systemic manifestations. Radiographic signs such as bone loss and root resorption offered additional clues about systemic bone metabolism and immunologic status. These observations are consistent with prior studies documenting the utility of radiographs in revealing subclinical

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features associated with systemic conditions like osteoporosis and viral infections [13].

The present study establishes important correlations, but several limitations must be noted. First, the cross-sectional nature of the analysis precludes temporal or causal inference. Second, variations in lesion identification could arise due to inter-observer differences, despite calibration efforts. Third, some systemic conditions with subtle or overlapping oral manifestations might have been underdiagnosed due to reliance on outpatient assessments. Furthermore, behavioral and lifestyle factors such as smoking, alcohol use, and nutritional deficiencies influence both systemic and oral health, but were not systematically recorded in this cohort. These factors may confound the observed associations and merit inclusion in future prospective studies. Longitudinal research incorporating microbiome profiling and immunological assays may elucidate the underlying biological pathways connecting oral lesions and systemic disease progression. Another consideration is the socioeconomic context of the participants. Limited access to healthcare and low oral health literacy can delay both dental and medical diagnoses, compounding disease severity at presentation. Integrating oral screenings into routine medical check-ups, especially for at-risk populations, could bridge this diagnostic gap and reduce healthcare burden.

The current study reinforces the diagnostic potential of oral lesions as indicators of systemic disorders. The strong correlations observed, particularly between candidiasis and diabetes, petechiae and hematologic abnormalities, and lichenoid reactions with hypertension, emphasize the need for systemic screening in patients presenting with atypical or persistent oral lesions. Radiographic evaluations offer valuable adjunctive evidence, supporting interdisciplinary collaboration between oral health professionals and medical practitioners for comprehensive patient care.

5. CONCLUSION

The findings of this prospective observational study underscore the critical diagnostic value of oral lesions as potential early indicators of systemic disease. Clinical evaluation revealed a wide spectrum of mucosal and periodontal abnormalitiesranging from candidiasis, lichenoid reactions, and petechiae to ulcerative and pigmented lesions that were significantly associated with underlying metabolic, hematologic, vascular, and immunologic disorders. Radiographic assessments further contributed to diagnostic accuracy by revealing changes such as alveolar bone loss, sinus opacification, and mandibular radiolucencies, many of which aligned with systemic pathology. These results highlight that oral lesions frequently serve as sentinel signs of systemic dysfunction, warranting timely investigation and interdisciplinary management. The strong correlations observed, particularly between oral candidiasis and diabetes mellitus, petechiae and hematological disorders, and lichenoid lesions with hypertension and long-term antihypertensive use, reinforce the relevance of integrated clinical and radiographic assessment. Early identification of systemic implications through oral examinations can facilitate prompt medical referral and intervention, ultimately improving patient outcomes. This underscores the essential role of dental professionalsespecially oral physicians and radiologists, in the broader preventive healthcare system. Comprehensive training and collaboration across medical and dental disciplines are vital to enhance early detection, risk stratification, and holistic care delivery for patients presenting with oral manifestations. In essence, the study affirms that oral healthcare should not be isolated from systemic health surveillance. Recognizing the diagnostic potential of oral lesions fosters a proactive approach, enabling clinicians to contribute meaningfully to the early detection and management of systemic disease.

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Competing Interests

The authors have no competing interests to declare.

Informed Consent

Not applicable.

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