

Knowledge and Misconceptions About White Patch Lesions Among Dental Undergraduates of Pakistan

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ABSTRACT

Background: Oral white patch lesions, particularly oral leukoplakia, require early recognition because some lesions may represent oral potentially malignant disorders. Dental undergraduates are expected to identify suspicious lesions and initiate appropriate referral, but misconceptions may affect clinical decision-making. **Objective:** This study aimed to assess knowledge and misconceptions regarding oral white patch lesions among dental undergraduates in Pakistan and to identify educational gaps relevant to early detection. **Methods:** A multicenter cross-sectional descriptive study was conducted among third- and final-year BDS students across Pakistan from November 2025 to January 2026. Data were collected through a structured self-administered questionnaire covering demographic characteristics, awareness, clinical responses, diagnostic confidence, and misconceptions. Descriptive statistics were reported as frequencies and percentages. **Results:** A total of 391 students participated. Most respondents identified tobacco as the main etiological factor for leukoplakia (69.3%), recognized the association of areca nut and betel quid with oral submucous fibrosis (90.8%), and agreed that oral white lesions may be precancerous (85.9%). Referral or biopsy was selected by 49.9% after observing a white patch, while 32.5% preferred observation. Misconceptions were frequent: 82.1% considered leukoplakia and candidiasis clinically similar, and 68.0% believed leukoplakia is painful in early stages. **Conclusion:** Dental undergraduates showed adequate awareness of selected concepts but had important misconceptions and variable clinical decision-making. Strengthened case-based training, differential diagnosis teaching, and biopsy-referral guidance are needed. **Keywords:** Oral leukoplakia; oral white lesions; white patches; dental undergraduates; knowledge; misconceptions; Pakistan.

INTRODUCTION

Oral cancer remains a major global public health concern and accounts for a substantial burden of morbidity and mortality, particularly in regions where exposure to tobacco, areca nut, betel quid, and related carcinogenic habits is common. In South Asia, including Pakistan, oral malignancies represent a particularly important clinical and public health problem because sociocultural patterns of smokeless tobacco, areca nut, and betel quid use increase population-level exposure to established oral carcinogens. In Pakistan, oral cancer has been reported among the most frequent malignancies in men and women, underscoring the need for stronger prevention, early detection, and referral strategies within routine dental care (1,2).

A large proportion of oral squamous cell carcinomas arise in association with clinically visible mucosal alterations, including oral potentially malignant disorders. Among these, oral leukoplakia is one of the most frequently encountered and clinically important oral white lesions. It is classically defined as a predominantly white patch or plaque that cannot be clinically or pathologically characterized as another definable disease. Although leukoplakia is not synonymous with cancer, it carries a variable risk of malignant transformation, and this risk is influenced by lesion characteristics, anatomical site, histopathological findings, and patient-level risk factors such as tobacco and areca nut exposure (3–6).

The oral cavity is readily accessible for visual and tactile examination, placing dentists and dental trainees in a strategically important position for early recognition of suspicious lesions. Early identification of oral leukoplakia and other oral potentially malignant disorders can support timely referral, biopsy, histopathological diagnosis, risk-factor counselling, and surveillance, all of which are essential components of oral cancer prevention. However, accurate clinical recognition requires not only theoretical awareness but also the ability to differentiate leukoplakia from other oral white lesions, including candidiasis, frictional keratosis, oral lichen planus, and other reactive or inflammatory conditions (7–10).

Dental undergraduates represent a key group for educational assessment because they are transitioning from theoretical learning to supervised clinical decision-making. If misconceptions are present during this stage, they may persist into clinical practice and contribute to delayed recognition, inappropriate reassurance, unnecessary empirical treatment, or missed referral for biopsy. Previous studies have evaluated knowledge and awareness of oral cancer and premalignant lesions among dental students, interns, and practitioners in different countries, but evidence from Pakistan remains limited, particularly regarding lesion-specific misconceptions about oral leukoplakia and clinically similar oral white lesions (8–10).

Despite the importance of undergraduate dental education in oral cancer prevention, there is insufficient local evidence on whether dental students in Pakistan can correctly identify the etiology, clinical significance, diagnostic approach, and management pathway of oral white patch lesions. This gap is particularly relevant in a high-risk regional context where tobacco, areca nut, and betel quid exposure are common. Therefore, the present study aimed to evaluate knowledge and misconceptions regarding oral white patch lesions among third- and final-year dental undergraduates in Pakistan and to identify educational and clinical training gaps that may affect early detection and appropriate referral of potentially malignant oral conditions.

MATERIALS AND METHODS

This multicenter cross-sectional descriptive study was conducted among undergraduate dental students enrolled in Bachelor of Dental Surgery programs across Pakistan. The target population consisted of third-year and final-year BDS students because these academic years are expected to have relevant exposure to oral pathology, oral medicine, and clinical dentistry. The study was conducted over a three-month period from November 2025 to January 2026 after approval from the relevant ethical review board.

The minimum required sample size was calculated as 375 participants using the World Health Organization sample size calculator, with a 95% confidence level and 5% margin of error. Participants were recruited through a non-probability convenience sampling technique. Students were eligible for inclusion if they were enrolled in the third year or final year of a BDS program and voluntarily agreed to participate. Students who declined informed consent, house officers, postgraduate trainees, and general dental practitioners were excluded to ensure that the study remained focused on undergraduate-level knowledge and misconceptions.

Data were collected using a structured, self-administered questionnaire developed after review of relevant literature and modified from previously published survey-based studies on oral cancer, potentially malignant disorders, and oral white lesions (11–14). The questionnaire contained 25 questions divided into four domains: demographic information, knowledge and awareness regarding oral white patch lesions, clinical knowledge and practice-related responses, and perceptions or misconceptions related to oral white lesions. The knowledge and clinical practice sections included multiple-choice, true/false, and yes/no items, whereas the misconception-related section used a five-point Likert scale ranging from strongly agree to strongly disagree.

Content validity of the questionnaire was assessed through expert review by senior faculty members in oral medicine and dental public health. The questionnaire was distributed electronically through social media and online communication platforms. Eligible students accessed the survey link and proceeded only after providing informed consent. Participation was voluntary, and respondents were informed that their responses would be used only for research purposes. Confidentiality and anonymity were maintained throughout data collection, storage, and analysis.

The primary study variables included demographic characteristics, academic year, gender, type of institution, prior lecture exposure regarding oral white patches, familiarity with leukoplakia, knowledge of etiological factors, awareness of potentially malignant risk, preferred clinical response to an observed white patch, confidence in diagnosis, recognition of biopsy and histopathological examination as diagnostic procedures, and misconceptions regarding leukoplakia, candidiasis, pain, smoking, fungal infection, and barriers to early detection. Oral leukoplakia knowledge was assessed through item-level responses rather than a composite knowledge score unless otherwise specified in the statistical output.

Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences version 27. Descriptive statistics were used to summarize categorical variables as frequencies and percentages. Continuous variables, where available, were summarized using appropriate measures of central tendency and dispersion. Associations between selected categorical variables, including academic year, gender, institution type, and knowledge-related responses, were planned using the chi-square test where cell-count assumptions were satisfied. A p-value less than 0.05 was considered statistically significant. Missing or incomplete responses were handled according to available-case analysis for each item.

Ethical approval was obtained from the PRIDE Center for Research and Learning Institutional Ethical Review Board under reference number PRIDE/ERB/2025/052. Written informed consent was obtained electronically before participation. Data were handled confidentially, stored securely, and used solely for research purposes in accordance with ethical principles for human-participant research.

RESULTS

A total of 391 undergraduate dental students participated in the study. The demographic and academic characteristics of the respondents are presented in Table 1.

Table 1. Demographic and Academic Characteristics of Study Participants

Variable	Category	n (%)
Gender	Female	224 (57.3)
	Male	165 (42.2)
	Not reported	2 (0.5)
Institution type	Private	288 (73.7)
	Government	103 (26.3)
Prior lecture on oral white patches	Yes	202 (51.7)
	No	189 (48.3)

Percentages are based on the total sample size of 391. Counts were derived from reported percentages where exact frequencies were not explicitly provided.

The study sample included a higher proportion of female students, with 224 female respondents and 165 male respondents. Most participants were from private dental institutions, accounting for 288 of 391 respondents. Slightly more than half of the students reported previous lecture-based exposure to oral white patches, while 189 students had not received such teaching, indicating substantial variation in formal academic exposure to this topic.

Table 2. Knowledge and Awareness Regarding Oral Leukoplakia and Oral White Lesions

Variable	Response Category	n (%)
Main etiological factor for oral leukoplakia	Tobacco	271 (69.3)
	Fungal infection	71 (18.2)
	Viral infection	33 (8.4)
	Other/not reported	16 (4.1)
Association of areca nut and betel quid with oral submucous fibrosis	Agree	355 (90.8)
	Disagree	36 (9.2)
Oral white lesions can be potentially serious conditions	Agree	358 (91.6)
	Disagree	33 (8.4)
Oral white lesions can be precancerous	Agree	336 (85.9)
	Disagree	55 (14.1)
	Strongly agree	211 (54.0)
	Agree	142 (36.3)
	Neutral	34 (8.7)
	Disagree	4 (1.0)

Percentages are based on the total sample size of 391. Counts were derived from reported percentages where exact frequencies were not explicitly provided.

Most respondents identified tobacco as the main etiological factor for oral leukoplakia, whereas smaller proportions attributed it to fungal or viral causes. Awareness of regionally important risk factors was high, with 355 students recognizing the association of areca nut and betel quid with oral submucous fibrosis. Similarly, most students recognized that oral white lesions may represent potentially serious or precancerous conditions. A total of 353 respondents agreed or strongly agreed that oral white lesions have several causes, showing broad awareness of multifactorial etiology.

Table 3. Reported Common Site and Preferred Clinical Response to Oral White Patch Lesions

Variable	Response Category	n (%)
Most common site of oral leukoplakia	Buccal mucosa	267 (68.3)
	Tongue	88 (22.5)
	Palate	19 (4.9)
	Floor of mouth	17 (4.3)
Clinical response after seeing a white patch	Referral to specialist/biopsy	195 (49.9)
	Observation for a few weeks	127 (32.5)
	Prescribe medication	62 (15.9)
	Ignore if asymptomatic	7 (1.8)

Percentages are based on the total sample size of 391. Counts were derived from reported percentages where exact frequencies were not explicitly provided.

The buccal mucosa was most frequently identified as the common site of oral leukoplakia, followed by the tongue. In response to a clinical scenario involving an oral white patch, 195 students selected referral to a specialist or biopsy. However, 127 students preferred observation for a few weeks, 62 selected medication, and 7 indicated that an asymptomatic lesion could be ignored. These responses show that although referral or biopsy was the most frequent response, a considerable proportion of students selected less definitive management approaches.

Table 4. Diagnostic Confidence and Biopsy-Related Awareness

Variable	Response Category	n (%)
Confidence in diagnosing white patch lesions	Very confident	95 (24.3)
	Somewhat confident	259 (66.2)
	Not confident	37 (9.5)

Variable	Response Category	n (%)
Necessity of biopsy for white patch lesions	Strongly agree	146 (37.3)
	Agree	174 (44.5)
	Neutral	50 (12.8)
	Disagree	17 (4.3)
	Strongly disagree	4 (1.0)

Percentages are based on the total sample size of 391. Counts were derived from reported percentages where exact frequencies were not explicitly provided.

Most students reported moderate rather than high diagnostic confidence. Only 95 respondents were very confident in diagnosing oral white patch lesions, while 259 were somewhat confident and 37 were not confident. Regarding biopsy, 320 students agreed or strongly agreed that biopsy is necessary for white patch lesions, whereas 50 were neutral and 21 disagreed or strongly disagreed. These findings indicate that biopsy-related awareness was present in most respondents, but certainty regarding diagnostic decision-making remained variable.

Table 5. Misconceptions Regarding Oral White Lesions

Misconception Statement	Response Category	n (%)
Leukoplakia and candidiasis are clinically similar	Agree	321 (82.1)
	Disagree	70 (17.9)
Leukoplakia is painful in early stages	Agree	266 (68.0)
	Disagree	125 (32.0)
All white patch lesions are caused by fungal infection	Strongly agree	30 (7.7)
	Agree	64 (16.4)
	Neutral	69 (17.6)
	Disagree	148 (37.9)
	Strongly disagree	80 (20.5)
All white patch lesions are caused by smoking	Strongly agree	30 (7.7)
	Agree	42 (10.7)
	Neutral	66 (16.9)
	Disagree	188 (48.1)
	Strongly disagree	65 (16.6)
	Strongly agree	182 (46.5)
Early detection can reduce risk of oral cancer	Agree	158 (40.4)
	Neutral	40 (10.2)
	Disagree	4 (1.0)
	Strongly disagree	7 (1.8)

Percentages are based on the total sample size of 391. Counts were derived from reported percentages where exact frequencies were not explicitly provided.

Clinically important misconceptions were common. A total of 321 students agreed that leukoplakia and candidiasis are clinically similar, and 266 agreed that leukoplakia is painful in its early stages. Although most respondents rejected the statement that all white patch lesions are caused by fungal infection, 94 students agreed or strongly agreed with this misconception and 69 remained neutral. Similarly, 72 students agreed or strongly agreed that all white patch lesions are caused by smoking, while 66 were neutral. In contrast, awareness of early detection was high, with 340 students agreeing or strongly agreeing that early detection can reduce the risk of oral cancer.

Table 6. Reported Barriers to Early Detection of Oral White Patch Lesions

Barrier	n (%)
Lack of patient awareness	113 (28.9)
Lack of clinical training in students	32 (8.2)
Limited screening in dental clinics	12 (3.1)
All listed barriers	234 (59.8)

Percentages are based on the total sample size of 391. Counts were derived from reported percentages where exact frequencies were not explicitly provided.

The most frequently selected response for barriers to early detection was the combined option including all listed barriers, reported by 234 respondents. Lack of patient awareness was the most frequently selected individual barrier, followed by lack of clinical training in students and limited screening in dental clinics. These findings suggest that students perceived early detection as being affected by both patient-level and training-related factors, rather than by a single isolated barrier.

Overall, the results show that dental undergraduates demonstrated awareness of several core concepts related to oral leukoplakia and oral white lesions, including tobacco exposure, precancerous potential, and the importance of biopsy or referral. However, misconceptions regarding clinical similarity with candidiasis, early-stage pain, and single-cause explanations were frequent. The combination of moderate diagnostic confidence, variable clinical response patterns, and perceived barriers to early detection highlights the need for stronger case-based clinical training, emphasis on differential diagnosis, and reinforcement of referral and biopsy indications in undergraduate dental education.

Knowledge, Clinical Decisions, and Misconceptions about Oral White Patch Lesions among Dental Undergraduates

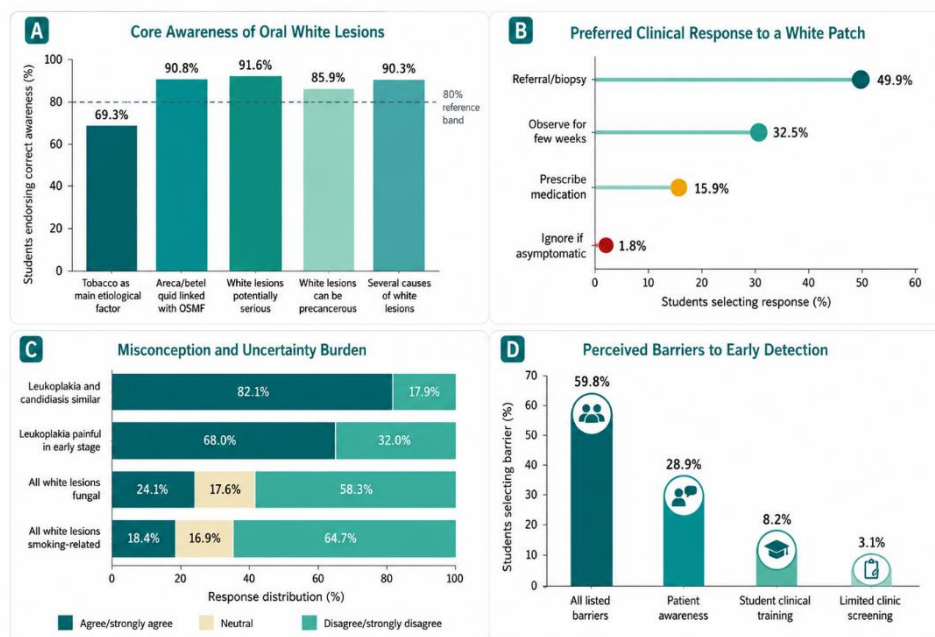


Figure 1 Knowledge, Clinical Decisions, and Misconceptions about Oral White Patch Lesions among Dental Undergraduates. Panel A shows core awareness indicators, with strongest awareness for the seriousness of oral white lesions, areca/betel quid association with oral submucous fibrosis, and multifactorial etiology. Panel B demonstrates preferred clinical responses after identifying a white patch, where referral or biopsy was selected by 49.9%, while 32.5% preferred observation and 15.9% selected medication. Panel C highlights the misconception burden, particularly the belief that leukoplakia and candidiasis are clinically similar and that leukoplakia is painful in early stages. Panel D presents perceived barriers to early detection, with 59.8% selecting all listed barriers. Percentages are based on n=391.

DISCUSSION

This multicenter cross-sectional study evaluated knowledge and misconceptions regarding oral white patch lesions among dental undergraduates in Pakistan. The findings show that students demonstrated reasonable awareness of several foundational concepts related to oral leukoplakia and oral white lesions, particularly the role of tobacco exposure, the association of areca nut and betel quid with oral submucous fibrosis, the potentially serious nature of oral white lesions, and their possible precancerous significance. However, the results also revealed clinically important misconceptions and uncertainty in diagnostic reasoning, especially regarding the clinical distinction between leukoplakia and candidiasis, the symptomatic presentation of leukoplakia, and appropriate early management pathways. This pattern suggests a gap between theoretical exposure and applied clinical competence, which is particularly relevant in a high-risk South Asian context where oral potentially malignant disorders and oral cancer remain major public health concerns.

Most students identified tobacco as the main etiological factor for oral leukoplakia, and a large majority recognized the association of areca nut and betel quid with oral submucous fibrosis. These findings are encouraging because both tobacco and areca nut-related exposures are central to the burden of oral potentially malignant disorders in South Asian populations. Previous literature has emphasized the role of undergraduate dental training in improving early recognition of oral cancer and potentially malignant lesions, but also shows that knowledge is often uneven when students are assessed on diagnostic application rather than general awareness (15,16). In the present study, the high level of agreement regarding the seriousness and precancerous potential of oral white lesions indicates that students were aware of the clinical importance of these lesions. Nevertheless, awareness alone may be insufficient unless students can translate this knowledge into appropriate differential diagnosis, risk assessment, referral, and biopsy-related decision-making.

A major finding of this study was the high frequency of misconceptions regarding clinically similar oral white lesions. More than four-fifths of respondents considered leukoplakia and candidiasis clinically similar, despite the fact that oral candidiasis is typically associated with a scrapable white pseudomembrane in many clinical presentations, whereas leukoplakia is characteristically a non-scrapable white patch or plaque that cannot be defined as another specific disorder. This misconception is clinically important because failure to differentiate between potentially malignant and infective or reactive lesions may lead to empirical treatment, delayed biopsy, or false reassurance. Standard oral pathology teaching emphasizes that leukoplakia is a diagnosis of exclusion and requires careful clinical assessment, removal of possible irritants where appropriate, and histopathological evaluation when clinically indicated (17,21,22). Therefore, undergraduate training should place stronger emphasis on lesion morphology, scrapability, persistence, risk factors, anatomical site, and referral thresholds.

Another important misconception was the belief that leukoplakia is painful in early stages. In this study, 68.0% of students agreed that leukoplakia is painful in its early stage, although leukoplakia is commonly asymptomatic and may be detected incidentally during routine oral examination. This misconception may have important implications for early detection because students who expect pain as a warning feature may underestimate the significance of asymptomatic white plaques. Previous literature on oral potentially malignant disorders and oral cancer prevention has repeatedly emphasized that early suspicious lesions may be painless and that reliance on symptoms alone can delay diagnosis (19,21,24). The present findings therefore support the need to reinforce the concept that absence of pain does not exclude potentially malignant pathology.

The clinical response pattern further supports the existence of a knowledge-application gap. Although referral or biopsy was the most frequently selected response when encountering a white patch, only 49.9% of students selected this option. A substantial proportion preferred observation for a few weeks, and smaller proportions selected medication or ignoring an asymptomatic lesion. In clinical practice, not every white lesion requires immediate biopsy, but suspicious, persistent, non-scrapable, high-risk, or unexplained white lesions require timely specialist assessment and histopathological confirmation where indicated. The finding that many students selected less definitive approaches suggests that undergraduate teaching may not be adequately reinforcing decision algorithms for oral white lesions. Similar concerns have been reported in studies assessing oral cancer awareness and diagnostic confidence among dental students and dental professionals, where theoretical knowledge did not always translate into appropriate clinical decision-making (23,24).

Diagnostic confidence was also variable. Most respondents reported being only somewhat confident in diagnosing white patch lesions, while fewer than one-fourth reported being very confident. This moderate confidence may reflect limited clinical exposure, insufficient case-based learning, or inadequate integration between oral pathology theory and clinical oral medicine practice. Confidence alone should not be interpreted as competence, but low or moderate confidence in recognizing potentially malignant lesions is educationally important because dental graduates are expected to

identify suspicious lesions and initiate referral pathways. Prior studies have shown that structured teaching, clinical exposure, and case-based training can improve awareness and confidence in oral cancer detection among dental students (13,15,16). The present findings support the integration of image-based case discussions, supervised oral mucosal screening, biopsy-indication teaching, and differential diagnosis exercises into the undergraduate curriculum.

The results also showed that most students recognized early detection as important for reducing oral cancer risk, yet perceived barriers remained substantial. The most frequently selected response was that all listed barriers contributed to delayed early detection, including lack of patient awareness, insufficient student clinical training, and limited screening in dental clinics. This finding indicates that students perceived oral cancer prevention as a multidimensional issue requiring both public health and educational interventions. In developing-country settings, delayed diagnosis of oral potentially malignant disorders may be influenced by low patient awareness, limited access to screening, insufficient professional training, and underuse of routine oral examination protocols (24,25). Therefore, strategies to improve early detection should include undergraduate curriculum strengthening, public awareness campaigns, routine oral mucosal screening in dental clinics, and clear referral systems for suspicious lesions.

The findings of this study have important educational implications. First, undergraduate teaching should move beyond factual awareness and include structured diagnostic frameworks for oral white lesions. Second, students should be trained to distinguish leukoplakia from candidiasis and other common white lesions using clinical features such as scrapability, persistence, lesion border, anatomical site, risk-factor profile, and symptom pattern. Third, biopsy and referral indications should be taught using case-based scenarios, especially for persistent, non-scrapable, unexplained, or high-risk lesions. Fourth, clinical postings in oral medicine and oral pathology should include supervised exposure to oral mucosal examination and documentation. Finally, formative assessment should include clinical vignettes and image-based diagnostic reasoning rather than relying only on recall-based questions.

This study has several limitations. The use of non-probability convenience sampling limits generalizability to all dental undergraduates in Pakistan. Online questionnaire distribution may have introduced selection bias, as students with greater interest in oral pathology or oral cancer may have been more likely to respond. The study relied on self-reported responses rather than objective clinical examination or observed diagnostic performance. The questionnaire assessed item-level knowledge and misconceptions, but a validated composite knowledge score was not reported. In addition, although associations with academic year, gender, and institution type were mentioned in the analysis plan, the available results did not provide inferential statistics or cross-tabulated outputs. Future studies should use validated tools, probability-based or stratified sampling, objective clinical case assessment, and multivariable analysis to identify predictors of knowledge, misconceptions, and diagnostic confidence.

Overall, this study shows that dental undergraduates in Pakistan have awareness of several important concepts related to oral leukoplakia and oral white patch lesions, but clinically significant misconceptions remain common. The findings highlight the need for improved undergraduate training focused on differential diagnosis, asymptomatic presentation, biopsy and referral indications, and practical oral mucosal screening skills. Strengthening these areas may improve early recognition of potentially malignant oral lesions and contribute to better oral cancer prevention in high-risk populations.

CONCLUSION

Dental undergraduates in Pakistan demonstrated awareness of several core concepts related to oral white patch lesions, including tobacco exposure, areca nut and betel quid association, multifactorial etiology, and the precancerous potential of oral white lesions; however, important misconceptions persisted regarding the clinical similarity of leukoplakia and candidiasis, early-stage pain in leukoplakia, and

appropriate management of suspicious white patches. The findings indicate a gap between theoretical knowledge and clinical decision-making, particularly in relation to differential diagnosis, diagnostic confidence, biopsy awareness, and referral practices. Undergraduate dental education should therefore place greater emphasis on case-based learning, oral mucosal screening, recognition of asymptomatic potentially malignant lesions, and structured referral or biopsy decision pathways to improve early detection and prevention of oral cancer.

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