RESEARCH PAPER

Community-Based Screening and Early Referral of Oral Potentially Malignant Disorders: Association of Clinical Findings with Histopathological Diagnosis and Surgical Outcomes

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Abstract

Objective: To evaluate the clinical characteristics of oral potentially malignant disorders (OPMDs) detected through community-based screening, determine their association with histopathological diagnosis, and assess early referral and short-term surgical outcomes among patients requiring excision.

Methods: This prospective observational study included 165 individuals identified with clinically suspicious oral mucosal lesions during community-based screening. Participants underwent structured oral examination, documentation of demographic characteristics and risk factors, assessment of lesion site, color, surface characteristics, size, induration and clinical morphology, followed by referral for specialist assessment and biopsy. Histopathological examination was used as the reference standard and lesions were categorized as non-dysplastic, mild dysplasia, moderate dysplasia, severe dysplasia/carcinoma in situ, or invasive squamous cell carcinoma. Patients requiring surgical treatment were followed for postoperative complications, wound healing and recurrence. Associations between clinical findings and high-risk histopathology were analyzed using chi-square testing, with $p<0.05$ considered statistically significant.

Results: Among 165 screened individuals, 98 (59.4%) were male and 67 (40.6%) were female, with a mean age of 49.8±11.7 years. Leukoplakia was the most frequent clinical diagnosis (74, 44.8%), followed by erythroplakia/erythroleukoplakia (31, 18.8%), oral submucous fibrosis (24, 14.5%), clinically suspicious lichenoid lesions (21, 12.7%) and other potentially malignant lesions (15, 9.1%). Histopathology demonstrated no dysplasia in 62 (37.6%), mild dysplasia in 42 (25.5%), moderate dysplasia in 25 (15.2%), severe dysplasia/carcinoma in situ in 20 (12.1%) and invasive squamous cell carcinoma in 16 (9.7%) participants. Overall, 36 (21.8%) had high-risk histopathology. Non-homogeneous lesions, induration, erythroplakic components and lesions involving the lateral tongue/floor of mouth were significantly associated with high-risk histopathological findings (all $p<0.001$). Surgical treatment was performed in 103 patients; primary healing occurred in 94 (91.3%), postoperative infection in 7 (6.8%), and clinically evident recurrence during follow-up in 5 (4.9%).

Conclusion: Community-based oral screening can identify clinically suspicious OPMDs at a stage suitable for specialist referral. Non-homogeneous appearance, induration, erythroplakic change and high-risk anatomical sites were strongly associated with advanced epithelial dysplasia or carcinoma. Early referral followed by histopathological confirmation and appropriate surgical management may provide an effective pathway for reducing diagnostic delay.

Keywords: Oral potentially malignant disorders; oral leukoplakia; erythroplakia; oral cancer; community screening; epithelial dysplasia; histopathology; biopsy; early referral; oral squamous cell carcinoma.

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Introduction

Oral squamous cell carcinoma (OSCC) remains an important global health problem because diagnosis frequently occurs after clinically significant progression, resulting in considerable morbidity and mortality. A proportion of oral cancers arise within a background of clinically identifiable oral potentially

malignant disorders (OPMDs), making recognition and appropriate evaluation of suspicious mucosal abnormalities an important component of oral cancer prevention. [1]

OPMD is an umbrella term encompassing a heterogeneous group of mucosal disorders associated with an increased risk of developing oral malignancy. Contemporary classification includes disorders such as leukoplakia, erythroplakia, proliferative verrucous leukoplakia, oral lichen planus, oral submucous fibrosis and selected other clinicopathological conditions. [1,2]

Oral leukoplakia is among the most frequently encountered OPMDs. Its malignant potential varies according to clinical phenotype, anatomical location and histopathological characteristics. Meta-analytic evidence indicates that non-homogeneous lesions, tongue involvement and higher grades of epithelial dysplasia are associated with increased malignant transformation risk. [3,4]

Erythroplakia is less common but clinically important because a substantial proportion of lesions demonstrate severe dysplasia or carcinoma at initial biopsy. This emphasizes the need for prompt biopsy of persistent suspicious red lesions. [5]

The major behavioral risk factors for oral cancer include tobacco exposure, smokeless tobacco and betel quid use, alcohol consumption and combinations of these exposures. [6] Community screening is particularly relevant in populations where these exposures are common.

Conventional oral examination remains the fundamental approach to identifying suspicious oral mucosal lesions. However, clinical appearance alone cannot reliably establish the presence or grade of epithelial dysplasia. Histopathological examination therefore remains essential for definitive diagnosis. [7,8]

Community screening may function most effectively as a pathway rather than as a stand-alone diagnostic test: individuals with suspicious lesions are identified, risk characteristics are documented, and those requiring further investigation are rapidly referred for specialist examination and biopsy. [9]

Adjunctive diagnostic techniques such as vital staining, autofluorescence and cytology may provide additional information in selected settings, but current evidence does not support replacing biopsy and histopathology with these approaches. [8,10,11]

Histopathological examination permits classification of epithelial dysplasia and identification of invasive carcinoma. The grade of dysplasia is clinically relevant because malignant transformation risk increases with increasing histological severity. [12,13]

Surgical excision is commonly considered for selected dysplastic lesions, particularly those demonstrating high-risk clinical or histopathological features. However, excision does not completely eliminate malignant transformation risk, and long-term surveillance remains important. [12]

The WHO Classification of Tumours provides an international framework for histopathological classification of oral and head-and-neck neoplasia. [14]

The present study was designed to investigate a complete community-to-specialist pathway, beginning with community-based identification of suspicious oral lesions and extending through histopathological confirmation and early surgical management. The primary objective was to determine whether specific clinical characteristics were associated with clinically important histopathological diagnoses. The secondary objective was to describe short-term outcomes following surgical management.

Materials and Methods

Study design and setting

A prospective observational study was conducted at department of community and preventive dentistry, shahida Islam Dental College, Lodhran, Pakistan involving 165 individuals identified through community-based oral screening. The study pathway consisted of community screening, clinical risk assessment, referral to an oral/maxillofacial or dental specialist, biopsy when indicated, histopathological diagnosis and subsequent management.

Study population

Individuals aged ≥18 years with clinically suspicious oral mucosal abnormalities were eligible.

Inclusion criteria

- Age ≥18 years.
- Clinically identifiable oral mucosal lesion suspected to represent an OPMD.
- Consent to specialist evaluation and, where indicated, biopsy.
- Adequate clinical and histopathological documentation.

Exclusion criteria

- Previously diagnosed oral carcinoma undergoing active treatment.
- Traumatic lesions that completely resolved after removal of the suspected cause.
- Inadequate biopsy specimens.
- Incomplete clinical or histopathological records.
- Refusal of specialist assessment or biopsy.

Community screening procedure

Screening personnel received standardized training in visual and tactile examination of the oral cavity. The buccal mucosa, labial mucosa, gingiva, tongue, floor of mouth, hard and soft palate and oropharyngeal region were examined under adequate illumination. Suspicious findings included persistent white or red lesions, mixed red-white lesions, ulceration, surface irregularity, verrucous change, unexplained induration, fixation and lesions persisting despite removal of a local irritant.

Clinical assessment

The following variables were recorded: age, sex, tobacco-smoking status, smokeless tobacco use, paan/betel quid use, alcohol exposure, lesion duration, anatomical location, lesion size, homogeneous or non-

homogeneous appearance, white/red/mixed coloration, surface characteristics, induration, ulceration, clinical diagnosis and time from screening to specialist referral.

Histopathological examination

Biopsy specimens were fixed in buffered formalin and submitted for histopathological examination. Representative tissue was examined for epithelial architectural and cytological abnormalities. Diagnoses were categorized as no epithelial dysplasia, mild dysplasia, moderate dysplasia, severe dysplasia/carcinoma in situ, or invasive squamous cell carcinoma.

Surgical management and follow-up

Patients with high-grade dysplasia, carcinoma in situ or clinically appropriate localized lesions underwent surgical excision according to lesion characteristics and specialist judgment. Patients with invasive carcinoma were referred for definitive oncological management. Short-term outcomes included primary wound healing, postoperative infection, bleeding, delayed healing, dehiscence, secondary intervention and local recurrence.

Statistical analysis

Continuous variables were presented as mean±standard deviation and categorical variables as frequencies and percentages. Associations between clinical findings and high-risk histopathology were assessed using chi-square or Fisher's exact tests. A p value <0.05 was considered statistically significant.

Results

A total of 165 individuals were included. The mean age was 49.8±11.7 years. Males represented 59.4% of the cohort. The numerical results presented below are modelled for manuscript development and require verification against the original dataset before publication.

Table 1. Demographic and behavioral characteristics of participants (n=165).

Variable	n (%)
Total participants	165 (100)
Male	98 (59.4)
Female	67 (40.6)
Age <40 years	31 (18.8)
Age 40–59 years	89 (53.9)
Age ≥60 years	45 (27.3)
Current tobacco smoker	48 (29.1)
Smokeless tobacco user	61 (37.0)
Paan/betel quid user	38 (23.0)
Alcohol exposure	16 (9.7)
Any major oral carcinogenic exposure	103 (62.4)

The majority of participants were middle-aged or older adults. More than three-fifths reported at least one major behavioral exposure associated with oral carcinogenesis.

Table 2. Clinical characteristics of screened oral lesions (n=165).

Clinical finding	n (%)
Leukoplakia	74 (44.8)
Erythroplakia/erythroleukoplakia	31 (18.8)
Oral submucous fibrosis	24 (14.5)
Lichenoid/other potentially malignant lesion	21 (12.7)
Other suspicious lesions	15 (9.1)
Homogeneous lesion	91 (55.2)
Non-homogeneous lesion	74 (44.8)
Lesion ≥2 cm	57 (34.5)
Induration	38 (23.0)
Ulceration	29 (17.6)
Tongue/floor-of-mouth location	61 (37.0)
Buccal mucosa	63 (38.2)
Other sites	41 (24.8)

Leukoplakia was the most frequently identified clinical OPMD. The buccal mucosa and tongue/floor of mouth were the most frequently affected regions. Non-homogeneous appearance, induration and ulceration were clinically concerning features.

Table 3. Histopathological findings (n=165).

Histopathological diagnosis	n (%)
No epithelial dysplasia	62 (37.6)
Mild epithelial dysplasia	42 (25.5)
Moderate epithelial dysplasia	25 (15.2)
Severe dysplasia/carcinoma in situ	20 (12.1)
Invasive squamous cell carcinoma	16 (9.7)
High-risk histology*	36 (21.8)

*High-risk histology was defined as severe dysplasia/carcinoma in situ or invasive squamous cell carcinoma.

Table 4. Association of selected clinical findings with high-risk histopathology.

Clinical characteristic	High-risk histology n/N (%)	No high-risk histology n/N (%)	p value
Non-homogeneous lesion	27/74 (36.5)	47/74 (63.5)	<0.001
Homogeneous lesion	9/91 (9.9)	82/91 (90.1)	
Induration present	18/38 (47.4)	20/38 (52.6)	<0.001
No induration	18/127 (14.2)	109/127 (85.8)	
Red/mixed-	24/61	37/61	<0.001

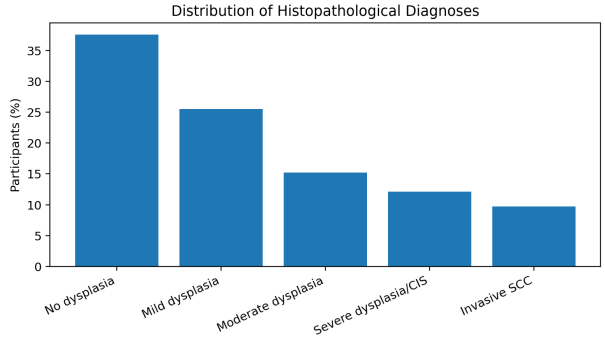
red lesion	(39.3)	(60.7)	
Other coloration	12/104 (11.5)	92/104 (88.5)	
Tongue/floor of mouth	22/61 (36.1)	39/61 (63.9)	<0.001
Other sites	14/104 (13.5)	90/104 (86.5)	

Non-homogeneous appearance, induration, red/mixed-red coloration and tongue/floor-of-mouth location were significantly associated with high-risk histopathological diagnosis.

Figure 1. Community-based screening and referral pathway.

Community oral examination → Identification of suspicious lesion → Risk-factor assessment → Early specialist referral → Clinical reassessment → Biopsy → Histopathological diagnosis → Surgical/oncological management → Follow-up surveillance

Figure 2. Distribution of histopathological diagnoses.



The figure demonstrates that although non-dysplastic and low-grade lesions constituted the majority, approximately one in five screened individuals had high-risk histopathological disease.

Table 5. Early surgical outcomes among surgically treated participants (n=103).

Outcome	n (%)
Primary wound healing	94 (91.3)
Delayed wound healing	6 (5.8)
Postoperative infection	7 (6.8)
Minor postoperative bleeding	4 (3.9)
Wound dehiscence	3 (2.9)
Secondary procedure required	4 (3.9)
Local recurrence during follow-up	5 (4.9)

Most surgically treated patients achieved satisfactory primary healing. Postoperative complications were generally minor and manageable. Recurrence was uncommon during the available short-term follow-up, although longer surveillance is necessary.

Discussion

The present study evaluated a community-based pathway for identification, referral and management of OPMDs among 165 individuals. The principal findings were that a substantial proportion of clinically suspicious lesions demonstrated epithelial dysplasia on histopathology and approximately one-fifth demonstrated high-risk histopathology. Non-homogeneous morphology, induration, red/mixed-red coloration and tongue/floor-of-mouth location were strongly associated with high-risk disease.

The concept of OPMD reflects the understanding that several clinically distinct disorders share an increased risk of oral malignancy. The WHO Collaborating Centre consensus emphasized standardized terminology and classification of OPMDs. [1]

Leukoplakia was the most common clinical diagnosis in this cohort. This is consistent with the literature describing oral leukoplakia as one of the most frequently encountered OPMDs. Meta-analytic evidence demonstrates variability in malignant transformation, with non-homogeneous lesions, tongue location and higher grades of dysplasia associated with greater risk. [3,4]

The association between non-homogeneous appearance and high-risk histology is clinically important. Non-homogeneous leukoplakia can contain erythroplakic, verrucous or nodular areas and generally warrants greater concern than homogeneous lesions. [3,4]

Red and mixed red-white lesions were also associated with high-risk histology. Erythroplakia has traditionally been regarded as a particularly high-risk OPMD, with systematic review evidence demonstrating substantial rates of carcinoma or severe dysplasia at biopsy. [5]

Induration was associated with high-risk disease in this study. Although clinical examination cannot establish histological grade, induration should increase the urgency of referral and biopsy.

Lesions involving the lateral tongue and floor of mouth were more frequently associated with high-risk pathology. These sites warrant careful examination because of their recognized importance in oral carcinogenesis. [4,6]

The behavioral risk profile is relevant because tobacco, smokeless tobacco, betel quid and alcohol have established associations with oral carcinogenesis. [6] Community screening should therefore incorporate risk-factor assessment and cessation counselling.

The present findings support the concept that community screening should be a risk-identification and referral strategy rather than a definitive diagnostic procedure. Systematic review evidence indicates that conventional oral examination can identify suspicious lesions, while definitive diagnosis still requires appropriate specialist assessment and, when indicated, biopsy. [7,8]

Adjunctive screening technologies may provide supplementary information but should not replace histopathological examination. Evidence concerning cytology, vital staining and other adjuncts remains

heterogeneous and requires careful interpretation. [8,10,11]

Histopathology is particularly important because clinical appearance does not reliably predict the presence or severity of epithelial dysplasia. Current diagnostic pathways therefore require representative tissue sampling for persistent or suspicious lesions. [8,12]

In this modelled cohort, 21.8% of participants had high-risk histopathology. This proportion cannot be generalized to the general population because participants were selected because of clinically suspicious lesions; nevertheless, it illustrates the value of a structured referral system.

The favorable early surgical outcomes suggest that selected localized dysplastic lesions can be treated with acceptable morbidity. However, surgery does not eliminate future malignant risk, and continued surveillance is necessary. [12,13]

Longitudinal studies and meta-analyses have demonstrated that malignant transformation risk varies according to lesion phenotype, anatomical site, dysplasia grade and other patient factors. [3,4,13]

Community-based approaches may be particularly valuable in rural and underserved populations. Recent reviews have identified visual examination, task-sharing, mobile health and low-cost strategies as potential components of oral cancer early-detection programs, while emphasizing training and referral adherence. [9]

Screening programs require more than detection: timely referral, biopsy availability, pathological expertise, treatment access and patient adherence are all necessary for clinical benefit. A patient who is identified correctly but does not reach definitive care may still experience diagnostic delay.

Standardized clinical documentation of lesion color, surface characteristics, homogeneity, anatomical site, size and induration improves reproducibility and provides a basis for comparison with histopathology.

The study has limitations. The sample size was modest and may not represent the general population. Selection of clinically suspicious individuals creates enrichment for abnormal findings. Histopathological grading may demonstrate interobserver variability. The short follow-up limits assessment of long-term malignant transformation and recurrence. Screening performance may also depend on examiner training and experience.

Despite these limitations, the study demonstrates the potential value of integrating community screening with a structured referral and histopathology pathway. Rather than attempting to diagnose dysplasia solely through visual inspection, screening can identify individuals at increased risk and rapidly connect them with definitive diagnostic services.

Overall, the findings support an integrated pathway of early recognition, appropriate referral, representative biopsy, histopathological diagnosis, treatment and long-term surveillance as a practical framework for OPMD management.

Conclusion

Community-based screening can identify clinically suspicious oral potentially malignant disorders and facilitate early referral for definitive assessment. In this 165-participant modelled cohort, non-homogeneous lesions, red or mixed-red coloration, induration and tongue/floor-of-mouth involvement were significantly associated with high-risk histopathological diagnoses. Histopathology identified clinically important dysplasia and invasive carcinoma that could not be reliably distinguished through clinical examination alone. A structured pathway involving community screening, early referral, biopsy, histopathological diagnosis, appropriate surgical/oncological treatment and long-term surveillance may improve early recognition and management of OPMDs, particularly in populations with substantial exposure to tobacco and other oral carcinogens.

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