

Brush Cytology: Need of The Present Hour in Early Detection of Oral Cancer.

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ABSTRACT

Background & Objectives

Oral Squamous Cell Carcinoma (OSCC) represents over 90% of all oral malignancies, with a particularly high burden in South Asia. Early detection of OSCC and Oral Potentially Malignant Disorders (OPMDs) is critical for improving patient outcomes. Oral brush cytology provides a non-invasive, cost-effective, and well-tolerated adjunctive tool that overcomes the superficial limitations of conventional exfoliative cytology by capturing transepithelial cells from basal, intermediate, and superficial layers. This study evaluated the utility and diagnostic patterns of oral brush cytology in patients presenting with suspicious oral lesions at a tertiary care center.

Materials & Methods

A prospective observational study was conducted at MGM Medical College & Hospital from May 2025 to April 2026. A total of 73 patients with suspicious oral mucosal lesions (including leukoplakia patches, ulcers, and growths) were evaluated. Informed consent and clinical histories were recorded. Cytological smears were harvested using a cytology brush, wooden spatula, or cotton swab, transferred to glass slides, and stained using Leishman, May–Grünwald–Giemsa (MGG), and Papanicolaou stains for microscopic evaluation. Smears were categorized using the Oral Bethesda System classification (2014).

Results

Among the 73 subjects, a pronounced male predominance was observed (88% males vs. 12% females), with the majority of patients aged between 35 and 60 years. Cytopathology identified 39 positive/atypical cases of OSCC and OPMDs. The most common anatomical site involved was the buccal mucosa (n = 44, 60.3%), followed by the gingival mucosa (n = 12, 16.4%), tongue (n = 6, 8.2%), lower lip (n = 3, 4.1%), floor of the mouth (n = 3, 4.1%), angle of the mouth (n = 3, 4.1%), and palate (n = 2, 2.7%). According to the 2014 Bethesda classification, cases were categorized as:

- Negative for Intraepithelial Lesion or Malignancy (NILM): **34** (46.6%)
- Low-grade Squamous Intraepithelial Lesion (LSIL): **2** (2.7%)
- High-grade Squamous Intraepithelial Lesion (HSIL): **4** (5.5%)
- Squamous Cell Carcinoma (SCC): **33** (45.2%)

Conclusion

Oral brush cytology serves as an efficient, highly acceptable screening and diagnostic tool for detecting OPMDs and OSCC, particularly in high-risk populations characterized by a strong male predilection in the 35–60 age group. The buccal mucosa remains the predominant site for oral lesions. Standardizing cytological reporting frameworks, combined with emerging digital imaging technologies, can further enhance diagnostic precision and clinical utility in routine practice.

Keywords

Oral Squamous Cell Carcinoma, Oral Potentially Malignant Disorders, Brush Cytology, Oral Bethesda System, Buccal Mucosa, Screening.

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I. Introduction

Brush cytology is a potential tool for early detection and monitoring of oral squamous cell carcinoma and oral potentially malignant disorders (OPMDs).

Cytology serves as a valuable adjunctive screening tool and good diagnostic accuracy for oral squamous cell carcinoma and oral potentially malignant disorders (OPMDs). Cytological study of oral cells was first

attempted by Montgomery and von Haam. (1) Cytological study is non-invasive, cheaper and is well accepted by the patient. Brush cytology remains an attractive option for screening and early diagnosis of various oral lesions. Oral cytology is microscopic examination of oral cells where smears can be taken from the buccal mucosa, the dorsum of tongue, the floor of the mouth, the hard and soft palate junction, and the lower labial region. Oral cancer is one of the 10 most common cancers as stated by World Health Organisation localised predominantly to the tongue however may also occur on the floor of the mouth, gingiva, lip and palate. (2) In India, oral cancer is a major health problem, accounting for 30%-40% of all cancers diagnosed. (3) The global incidence of cancers of the lip and oral cavity is estimated to be 389846 new cases and 188438 deaths in 2022. (4)

Oral squamous cell carcinoma represents the most common malignant neoplasm in the oral cavity, accounting for over 90% of oral malignancies. It is prevalent in south Asia countries, where it ranks among most frequent types of cancer. OSCC may develop from oral potentially malignant disorders (OPMD) with varying transformation rates, making early detection crucial for preventing cancer progression and treatment complications. (5) Tobacco, alcohol usage, a positive cancer history of the family, viral infections such as HPV are all frequent etiological factors. Conventional exfoliative cytology had limited diagnostic value because only superficial epithelial cells were obtained. The introduction of brush cytology improved transepithelial sampling by collecting cells from the superficial, intermediate, and basal epithelial layers. This advancement significantly increased the diagnostic accuracy of oral cytology.

Technological and medical innovations are essential to improving outcomes for individuals affected by oral cancer. The adoption of digital imaging, computational analysis, and machine learning (ML) has greatly enhanced the precision and effectiveness of diagnostic procedures in the medical and dental field [6]. The ability to generate high-resolution digital cytology images allows for clearer visualization, leading to more accurate interpretations and addressing drawbacks associated with physical slides. Digital slides can improve accessibility within the hospital, enhance multidisciplinary interactions, and even involve international specialists for expert opinion [7]

II. Materials & methods

The present study was conducted in MGM College and Hospital during a period of one year from May 2025 to April 2026.

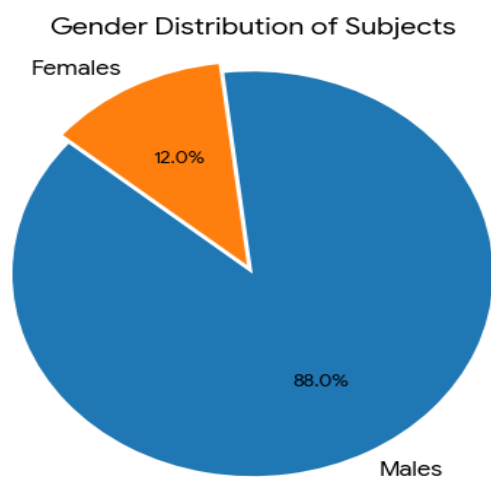
A total of 73 patients presenting to the dental department with suspicious oral lesions, including leukoplakia patches, ulcers, and growths were referred to the pathology department of MGM Medical College & Hospital for brush cytology.

Informed consent was obtained from all patients, and relevant clinical histories and patient details were recorded. Smear samples were collected using a cytology brush, wooden spatula, and cotton swab. The harvested material was then transferred onto clean glass slides without causing damage to the cells.

Finally, the smears were stained using Leishman's, May-Grünwald-Giemsa (MGG), and Papanicolaou stains, and subsequently examined under a light microscope.

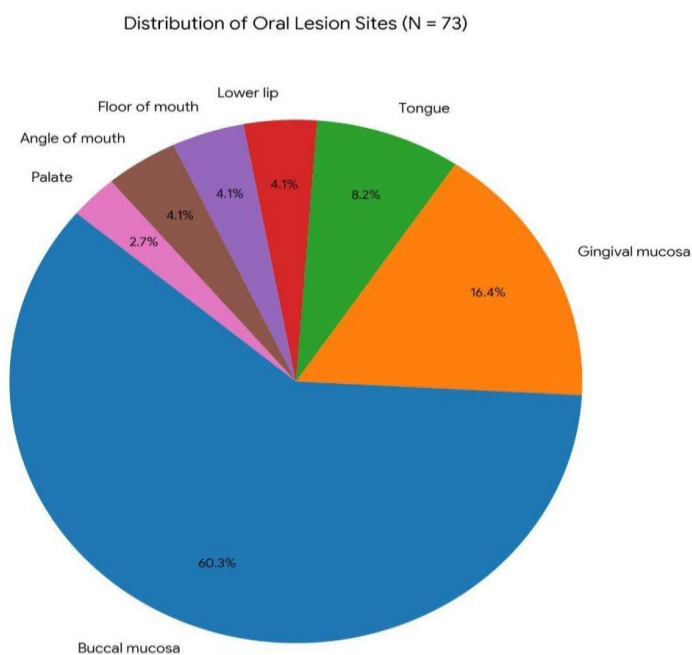
III. Results

Out of 73 cases of oral cytology, 39 cases are detected as of oral squamous cell carcinoma and oral potentially malignant disease. 88% of the subjects were males and 12% of the subjects were females with most of the subjects reporting to our tertiary care center to be around 35-60 years.



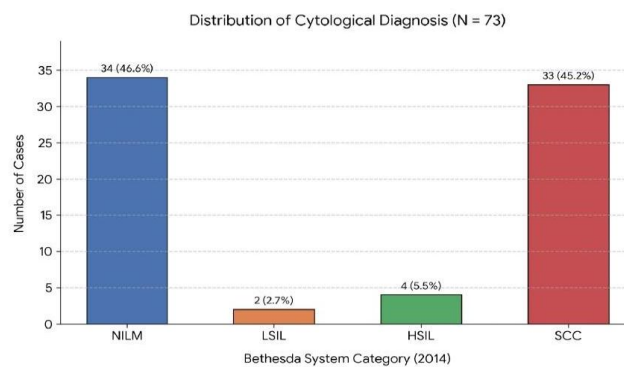
Site

Buccal mucosa - 44
Gingival mucosa-12
Tongue-06
Lower lip-3
Floor of mouth-3
Angle of mouth-3
Palate-2



Bethesda classification 2014

NILM -34
LSIL - 2
HSIL- 4
SCC -33



IV. Discussion

Pilot studies on oral cyto-morphometry (e.g., Journal of Cytology / PMC research) examining adult populations presenting with leukoplakia, erythroplakia, or oral submucous fibrosis (OSMF) report male proportions frequently exceeding 75% to 85%, with the mean and modal patient age falling squarely in the 35–50 and 41–60-year age brackets. (8)

Pioneering studies on oral brush/scrape cytology conducted in tertiary referral centers (e.g., R. Mehrotra et al.) highlight that patients reporting for screening and diagnostic cytology are overwhelmingly male (80–85%) due to gender disparities in habits like smokeless tobacco (gutkha, khaini) and bidi smoking. (9)

Waris et al. (2021) – Journal of Medical Sciences: In a study evaluating exfoliative cytological findings in patients with OPMDs (like leukoplakia and oral lichen planus), researchers found that the buccal mucosa was the most common site of lesions, accounting for 60% of all cases. (10)

Retrospective evaluation of over 1,000 oral cytology smears categorized by the Oral Bethesda System. Highlights sensitivity, specificity, and cellularity requirements across NILM, SIL, and OSCC categories. (11)

Rajsri et al. reviewed the role of cytology in dentistry and emphasized that oral cytology is a simple, painless, and non-invasive technique with applications in screening, diagnosis, and monitoring of oral lesions. However, histopathological examination remains the gold standard for definitive diagnosis. (12)

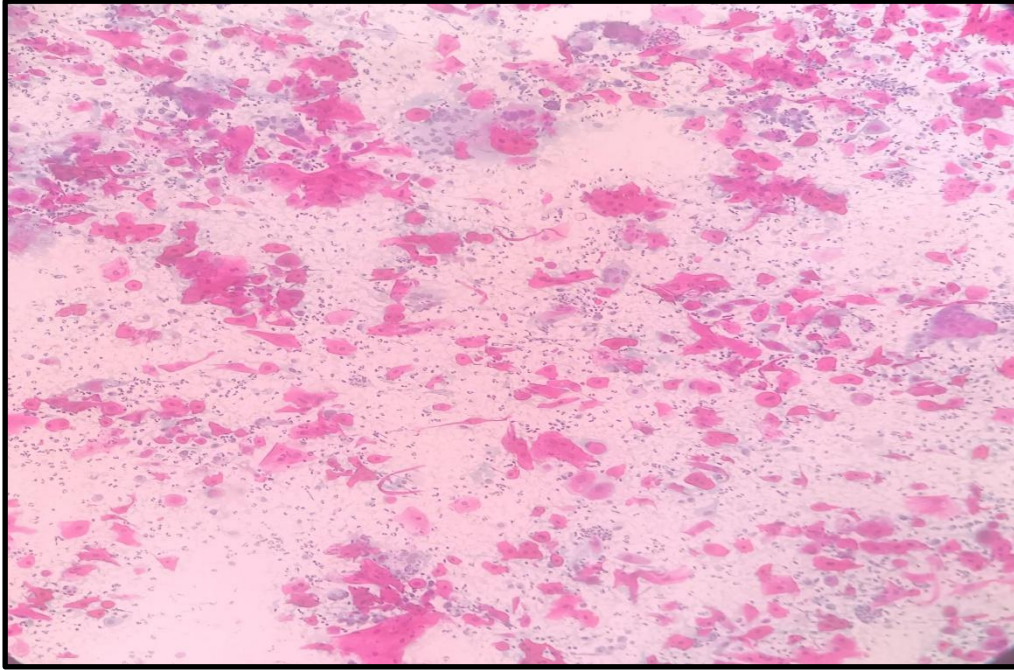
Although several studies support the utility of oral brush cytology, variability in sampling techniques, staining methods, and reporting criteria continues to limit universal acceptance. Therefore, further studies are necessary to standardize cytological grading systems and improve diagnostic accuracy.

V. Conclusion

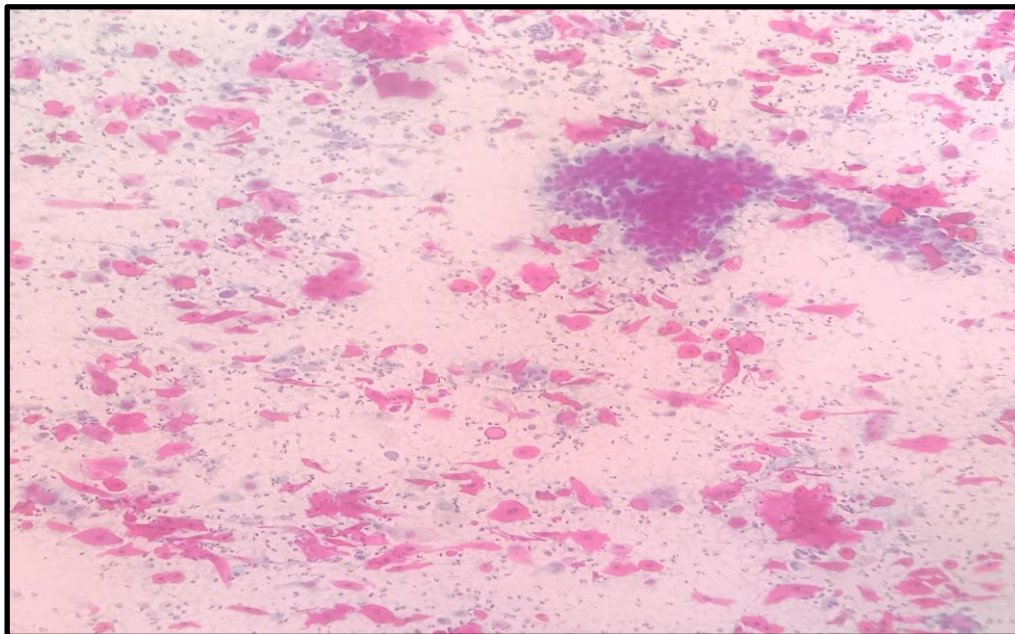
Oral brush cytology serves as a front-line screening instrument that is well-accepted by patients, painless, and highly efficient. Broadening its routine implementation in dental and primary care departments—coupled with standardized reporting frameworks like the Bethesda system—can significantly accelerate early detection, reduce treatment morbidity, and improve survival rates in high-incidence regions for oral cancer.

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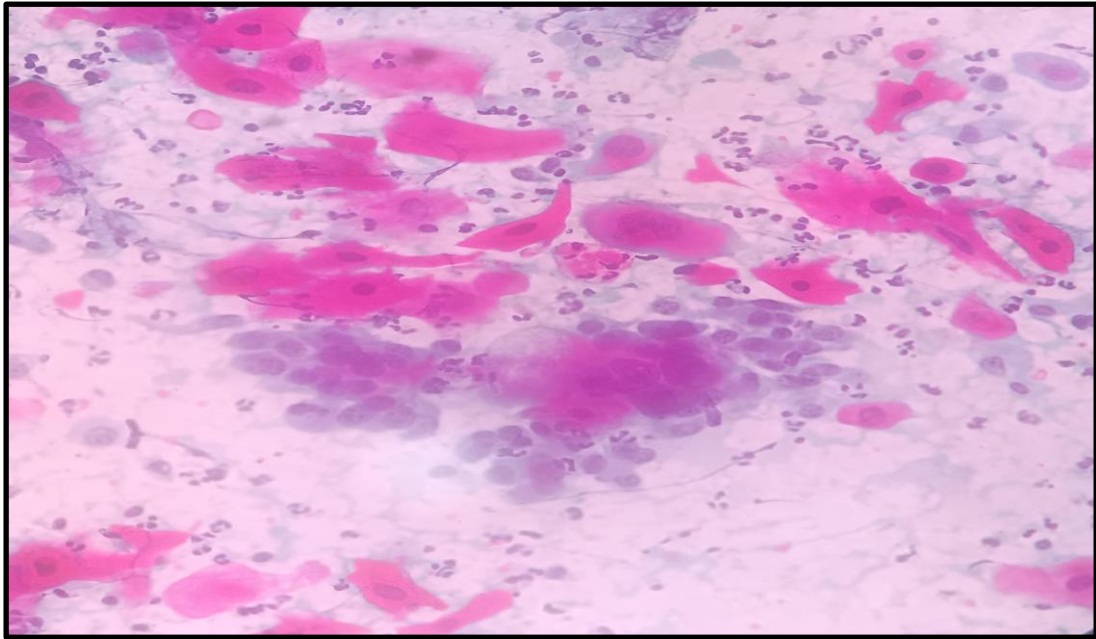
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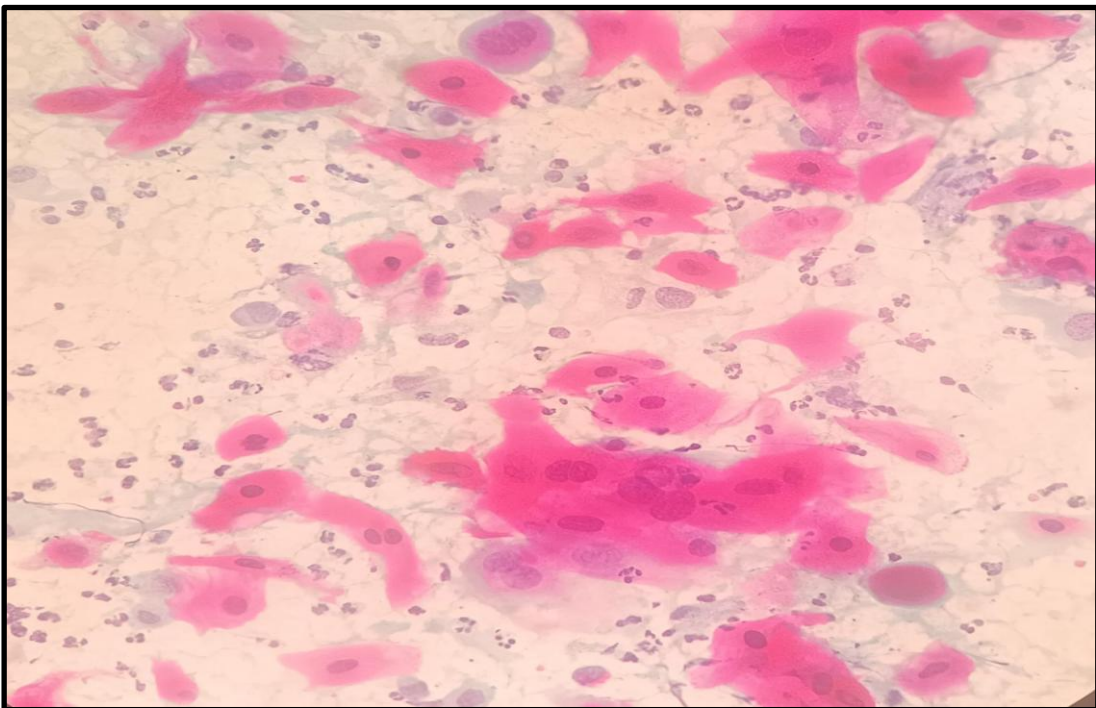
Low power showing hypercellular smear of squamous epithelial cells.



Low power showing increased cellularity with cells in clusters showing high N:C ratio, pleomorphism and hyperchromatism.



High power showing increased nucleocytoplasmic ratio along with presence of binucleate and multinucleate cells.



High power showing increased nuclear size, vesicular chromatin in the background of inflammatory cells.