Section: Pathology

Original Research Article

DIAGNOSTIC UTILITY OF ORAL SCRAPE CYTOLOGY IN EVALUATING ORAL LESIONS AND APPLICATION OF PAPANICOLAOU'S ORAL CYTOLOGY CLASSIFICATION: A TERTIARY CARE HOSPITAL STUDY

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ABSTRACT

Background: Objective: To evaluate the cytological spectrum of oral epithelial lesions and to assess cytohistological correlation, diagnostic accuracy, and risk of malignancy (ROM) using histopathology as the reference standard. **Materials and Methods:** This retrospective study included 729 oral cytology samples. Cytological diagnoses were categorized as benign, dysplastic (mild, moderate, severe), highly suspicious for malignancy, or squamous cell carcinoma (SCC). Papanicolaou classification was applied. Histopathological correlation was available for 417 cases and was used to calculate sensitivity, specificity, predictive values, diagnostic accuracy, and ROM. **Result:** The mean patient age was 59.0 years, with a marked male predominance (male:female ratio 5.4:1). Ulcerative lesions were the most common clinical presentation (65.2%). SCC was the most frequent cytological diagnosis (51.2%). On cytohistological correlation, cytology demonstrated a sensitivity of 95.5%, specificity of 90.8%, and an overall diagnostic accuracy of 94.0%. ROM increased progressively with cytological severity: 0% for benign lesions, 4.9% for mild dysplasia, 20.0% for moderate dysplasia, 69.4% for severe dysplasia, 100% for highly suspicious lesions, and 99.6% for SCC. **Conclusion:** Exfoliative cytology is a highly sensitive and reliable diagnostic tool for the evaluation of oral epithelial lesions. Strong cytohistological correlation and increasing ROM with higher cytological grades underscore its value in early detection, risk stratification, and clinical decision-making.

INTRODUCTION

Oral cancers and potentially malignant disorders of the oral cavity constitute a substantial public health burden in India, particularly in northern states such as Uttar Pradesh. The widespread use of tobacco in smoked and smokeless forms, betel-quid chewing, alcohol consumption, nutritional deficiencies, and poor oral hygiene significantly contribute to the high incidence of oral squamous cell carcinoma (OSCC) in this region. Kanpur, being a major industrial and densely populated city of Uttar Pradesh, receives a large number of patients with chronic tobacco habits and varied oral mucosal lesions, many of which are clinically suspicious for dysplasia or malignancy. As a tertiary-care referral centre, GSVM Medical College and its associated hospitals cater to a wide population from Kanpur and surrounding districts, making early and accurate evaluation of oral lesions a crucial component of routine diagnostic services.

Histopathological examination of tissue biopsy remains the gold standard for diagnosing premalignant and malignant oral lesions. However, biopsy is invasive, may cause discomfort or anxiety to patients, and is not always feasible in certain clinical scenarios. In busy tertiary-level hospitals such as ours, the ability to offer a rapid, minimally invasive, and cost-effective preliminary diagnostic method can greatly enhance patient triage and reduce delays in management.

Conventional exfoliative cytology—obtained by gentle scraping or smearing of oral mucosal surfaces—has long been explored as such an adjunctive diagnostic tool. It is simple, inexpensive, well tolerated, and suitable for large-scale screening or follow-up of suspicious lesions.[3] Although earlier concerns centered around its variable sensitivity due

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to superficial sampling and occasional inadequate smears,[3] many studies have demonstrated that scrape-smear cytology can still provide meaningful diagnostic insight, particularly when evaluating epithelial atypia and malignant cytological features. In one study of 89 patients with clinically suspicious lesions, smear cytology showed adequacy in 87.6% and achieved a sensitivity of approximately 86.5% for detecting dysplasia or carcinoma.[4]

More recent investigations have emphasized that scrape cytology—performed using a spatula or similar instrument—remains a practical, rapid, and economical diagnostic adjunct in resource-limited tertiary centers.[2] A study from a tertiary hospital in Assam similarly highlighted its utility in evaluating white lesions and detecting early premalignant changes.[1] These observations support its relevance in Indian healthcare settings, particularly where oral cancer prevalence is high and patient load is substantial.

Given the high incidence of tobacco-associated oral lesions in Kanpur and the heavy patient burden at GSVM Medical College, there is a clear need to evaluate the usefulness of scrape cytology in our local context. The present study was therefore undertaken to assess the diagnostic utility of oral scrape cytology in identifying premalignant and malignant lesions in patients presenting to our tertiary care hospital. By comparing cytological findings with histopathology, we aim to determine the sensitivity, specificity, and overall reliability of this simple technique and explore its potential role in early diagnosis and patient triage in the Kanpur region.

MATERIALS AND METHODS

This hospital-based cross-sectional study was conducted in the Department of Pathology, GSVM Medical College, Kanpur, a tertiary care centre receiving a large volume of patients from Kanpur city and surrounding districts of Uttar Pradesh. The study was carried out over a period of one year.

A total of 729 patients presenting to the ENT, Dental, Surgery, and JK Cancer Institute outpatient departments with clinically evident oral mucosal lesions were included for scrape cytological evaluation. Out of these, 417 patients subsequently underwent biopsy, allowing cyto-histopathological correlation.

Inclusion Criteria

1. Patients of any age or sex presenting with clinically visible oral mucosal lesions.
2. Lesions clinically suspicious for premalignant disorders or malignancy, including leukoplakia, erythroplakia, lichen planus, oral submucous fibrosis, ulcerative lesions, nodular lesions, and proliferative growths.
3. Patients who provided written informed consent for cytology and biopsy (where indicated).

Exclusion Criteria

1. Lesions located in areas not accessible for scraping.
2. Previously treated oral malignancies or recurrent lesions.
3. Inadequate cytological smears despite repeat sampling.

Scrape Cytology Procedure

Sample Collection

- The lesion site was gently cleaned to remove debris and excess saliva.
- A sterile cytology spatula was used to scrape the most representative area of the lesion with firm, repeated strokes.
- The collected material was evenly spread onto clean glass slides.

Fixation and Staining

- Two smears were prepared per patient:
  - One immediately fixed in 95% ethanol and stained using Hematoxylin and eosin stain.
  - The second air-dried smear was stained with May–Grünwald–Giemsa (MGG) stain.

Cytological Interpretation

Slides were examined independently by two cytopathologists and reported according to Papanicolaou's Oral Cytology Classification, as follows:

Class I – Normal cytology

Class II – Atypical cytology but no evidence of malignancy

Class III – Cytology suggestive of dysplasia (possible malignancy)

Class IV – Cytology strongly suggestive of malignancy

Class V – Cytology positive for malignancy

For analysis, Classes I–II were considered negative/suggestive of benign lesion, Class III as suspicious (premalignant), and Classes IV–V as positive for malignancy.

Histopathological Evaluation

Among the 729 smear cases, 417 cases underwent incisional or excisional biopsy. Biopsy specimens were fixed in 10% buffered formalin, processed routinely, and stained with hematoxylin and eosin (H&E).

Histopathological diagnosis served as the gold standard for comparison with cytological findings.

RESULTS

1. Demographic Characteristics

A total of 729 patients were included in the study. The age of the patients ranged from 20 to 81 years, with a mean age of 59.0 years and a median age of 62 years, indicating a predominance of cases in the older age groups.

There was a marked male predominance, with 616 males (84.5%) and 113 females (15.5%), resulting in a male-to-female ratio of approximately 5.4:1.

2. Clinical Characteristics

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Clinically, lesions were categorized into two major types. Ulcerative lesions were the most frequent presentation, accounting for 475 cases (65.2%), while whitish lesions were observed in 254 cases (34.8%) (Table 2).

3. Cytological Diagnosis

Cytological examination revealed a broad spectrum of epithelial abnormalities. Squamous cell carcinoma (SCC) was the most common diagnosis, seen in 373 cases (51.2%). Dysplastic lesions included mild dysplasia in 160 cases (21.9%), moderate dysplasia in 87 cases (11.9%), and severe dysplasia in 58 cases (8.0%).

Additionally, 44 cases (6.0%) were reported as highly suspicious for malignancy, while 7 cases (1.0%) were categorized as benign (Table 3).

4. Papanicolaou Cytology Classification

According to the Papanicolaou classification system, Class V constituted 373 cases (51.2%), followed by Class III in 305 cases (41.9%) and Class IV in 44 cases (6.0%). Only 7 cases (1.0%) were categorized as Class I–II (Table 4).

5. Histopathological Findings

Histopathological correlation was available for a subset of cases. Of these, 287 cases were malignant, 103 were benign, and 27 showed premalignant changes (Table 5). Malignancy constituted the predominant histological diagnosis.

6. Cytology–Histopathology Correlation and Diagnostic Accuracy

For cytohistological correlation, SCC, highly suspicious for malignancy, and severe dysplasia were considered cytology-positive for malignancy, while benign, mild dysplasia, and moderate dysplasia were considered cytology-negative.

Cytology demonstrated a sensitivity of 95.5% and a specificity of 90.8% for detecting malignant lesions. The positive predictive value (PPV) was 95.8%, the negative predictive value (NPV) was 90.1%, and the overall diagnostic accuracy was 94.0%, indicating a high diagnostic reliability of cytology when correlated with histopathology.

7. Risk of Malignancy (ROM)

The risk of malignancy (ROM) increased progressively with increasing cytological severity (Table 6, Figure 1). Benign cytology showed a ROM of 0%. Mild dysplasia demonstrated a low ROM of 4.9%, while moderate dysplasia showed a ROM of 20.0%. Severe dysplasia was associated with a markedly higher ROM of 69.4%. All cases categorized as highly suspicious for malignancy showed malignant histology (ROM 100%). Cytological diagnoses of SCC demonstrated a ROM of 99.6%.

Table 1: Demographic Characteristics of the Study Population (n = 729)

Parameter	Value
Age range (years)	20–81
Mean age (years)	59.0
Median age (years)	62
Male	616 (84.5%)
Female	113 (15.5%)
Male : Female ratio	5.4 : 1

Table 2: Distribution of Clinical Lesion Types

Type of lesion	Number (%)
Ulcerative lesion	475 (65.2%)
Whitish lesion	254 (34.8%)

Table 3: Distribution of Cytological Diagnoses

Cytological diagnosis	Number (%)
Squamous cell carcinoma	373 (51.2%)
Mild dysplasia	160 (21.9%)
Moderate dysplasia	87 (11.9%)
Severe dysplasia	58 (8.0%)
Highly suspicious for malignancy	44 (6.0%)
Benign	7 (1.0%)

Table 4: Papanicolaou Category Distribution

Pap category	Number (%)
Class I–II	7 (1.0%)
Class III	305 (41.9%)
Class IV	44 (6.0%)
Class V	373 (51.2%)

Table 5: Histopathological Findings

Histopathology	Number
Malignant	287
Premalignant	27
Benign	103

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Table 6: Risk of Malignancy by Cytological Diagnosis

Cytological diagnosis	Biopsy-correlated cases (n)	ROM (%)
Benign	5	0.0
Mild dysplasia	81	4.9
Moderate dysplasia	45	20.0
Severe dysplasia	36	69.4
Highly suspicious for malignancy	27	100.0
Squamous cell carcinoma	223	99.6

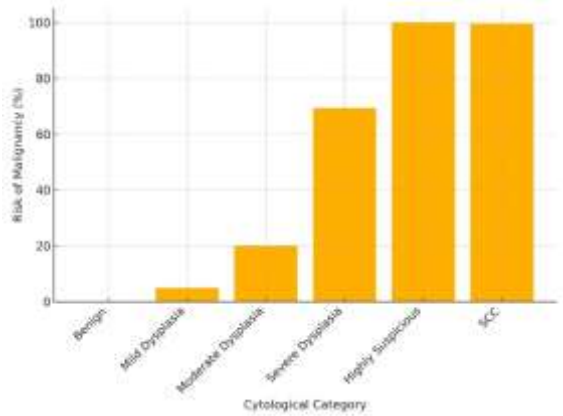


Figure 1: Bar chart depicting the risk of malignancy (ROM) across different cytological diagnostic categories, showing a progressive increase in malignancy risk with increasing cytological severity

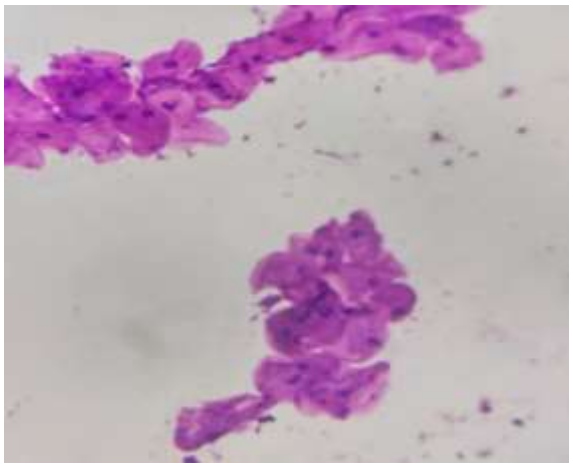


Figure 2: Low power view of sheets of benign squamous epithelial cells(100X)

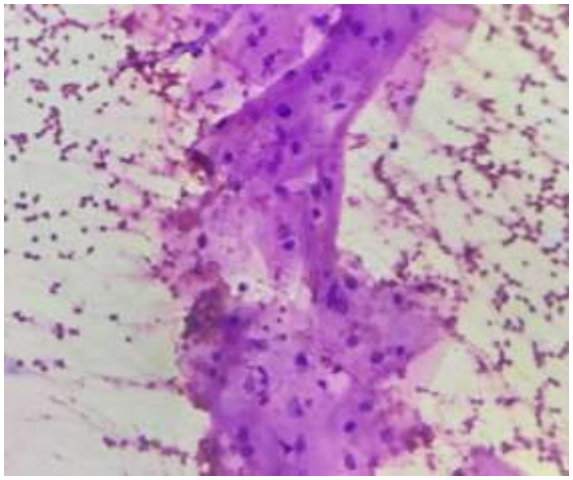


Figure 3: Low power view of squamous epithelial cells with few cells showing mild dysplasia (100X)

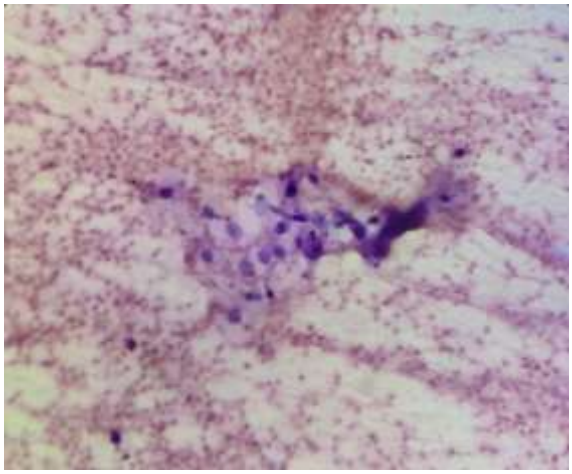
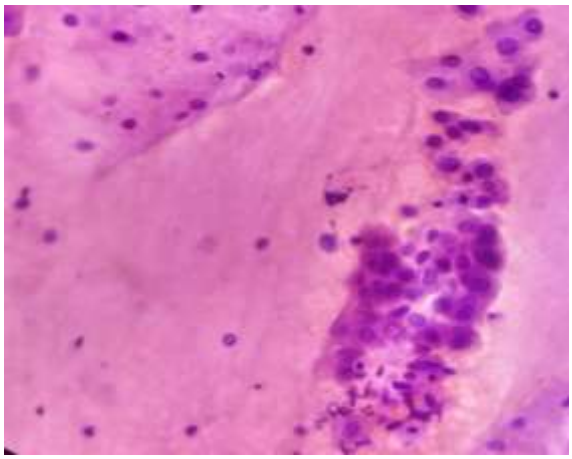


Figure 4: Low power view of squamous epithelial cells showing moderate dysplasia(100X)



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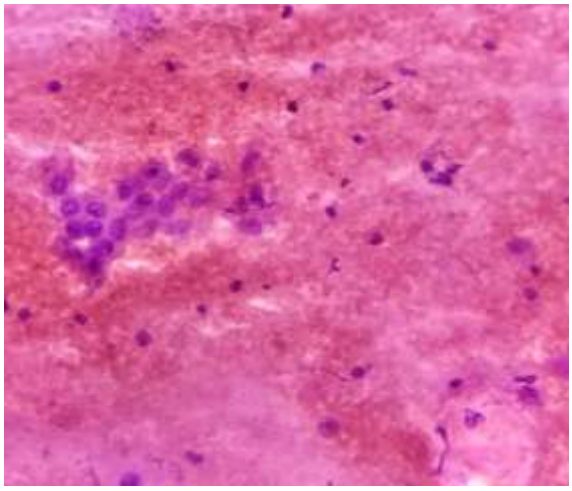

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Figure 5 (A and B): Low power view of clusters of squamous epithelial cells showing severe dysplasia(100X)

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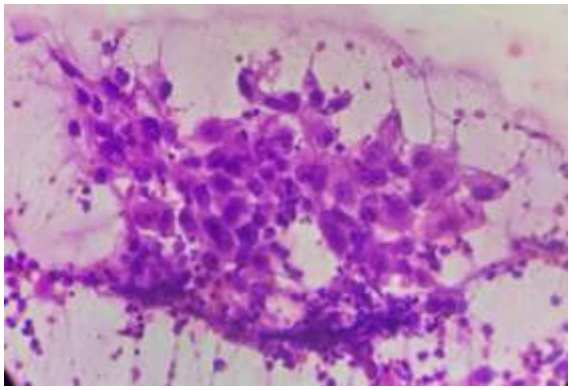

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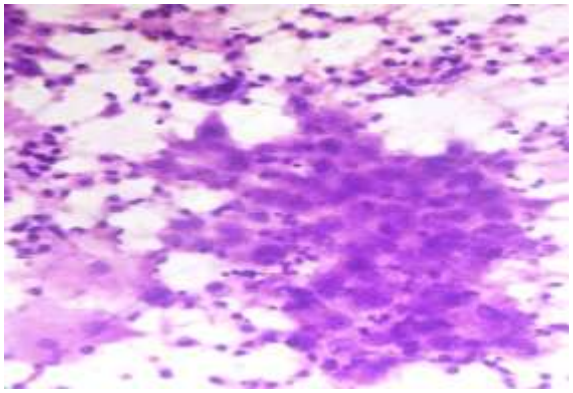

B

Figure 6 (A and B): Clusters of squamous epithelial cells showing squamous cell carcinoma (100X)

DISCUSSION

Oral and oropharyngeal cytology remains an important minimally invasive diagnostic modality for the early detection of malignant and premalignant lesions. In the present study, a large cohort of 729 cases was evaluated, allowing robust assessment of cytological patterns, cytohistological correlation, diagnostic accuracy, and risk of malignancy.

The demographic profile of the present study demonstrated a predominance of older males, with a mean age of 59 years and a male-to-female ratio of 5.4:1. This finding is consistent with several previous studies that have reported a higher incidence of oral epithelial malignancies among elderly males, likely reflecting greater exposure to tobacco, alcohol, and other carcinogenic habits in this population.[6,7]

Clinically, ulcerative lesions constituted the most common presentation, similar to observations by Singh et al. and Gupta et al., who reported ulceroproliferative lesions as the predominant clinical manifestation of oral squamous cell carcinoma.[8,9] This reinforces the importance of prompt cytological evaluation of ulcerative oral lesions.

Cytologically, squamous cell carcinoma (SCC) was the most frequent diagnosis, accounting for 51.2% of cases. Comparable proportions have been reported in earlier cytology-based studies, where SCC constituted between 45% and 60% of cases.[6,10] Dysplastic lesions formed a substantial proportion of the remaining cases, highlighting the role of exfoliative cytology in identifying premalignant conditions.

The Papanicolaou classification showed that more than half of the cases fell into Class V, indicating a high burden of malignancy in the study population. Similar distributions have been described by Dey et al., who emphasized the utility of higher Pap classes in predicting malignancy in oral cytology specimens.[11]

Histopathological correlation, considered the gold standard, revealed malignancy in the majority of biopsied cases. The cytohistological correlation in the present study was strong, particularly for high-grade cytological diagnoses. When SCC, severe dysplasia, and highly suspicious categories were grouped as cytology-positive, cytology demonstrated a high sensitivity (95.5%) and specificity (90.8%), with an overall diagnostic accuracy of 94.0%. These values are comparable to those reported in earlier studies, where sensitivity ranged from 85% to 96% and specificity from 80% to 92%.[7,10,12]

An important strength of the present study is the calculation of the risk of malignancy (ROM) for each cytological category. A progressive increase in ROM was observed with increasing cytological severity. Benign lesions showed a ROM of 0%, while mild and moderate dysplasia demonstrated low to intermediate ROMs (4.9% and 20.0%, respectively). Severe dysplasia showed a substantially higher ROM of 69.4%, while the highly suspicious and SCC categories showed ROMs of 100% and 99.6%, respectively. These findings closely mirror previously published ROM-based stratifications and underscore the clinical relevance of cytological grading in guiding patient management.[9,11,13]

Overall, the findings of the present study reaffirm the value of cytology as a reliable, sensitive, and cost-effective diagnostic tool, particularly in resource-limited settings where access to biopsy may be delayed.

CONCLUSION

The present study demonstrates that exfoliative cytology is a highly sensitive and accurate modality for the evaluation of oral epithelial lesions. The strong cytohistological correlation, high diagnostic accuracy, and progressively increasing risk of malignancy with higher cytological grades emphasize the clinical utility of cytology in both screening and diagnostic settings. Incorporation of risk of malignancy stratification further enhances the predictive value of cytological reporting and aids in timely clinical decision-making. Cytology should continue to play a pivotal role in the early detection and management of oral premalignant and malignant lesions.

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