

## Original Research

### Assessment of efficacy of different non-invasive biopsy procedures in screening and diagnosis of oral cancers: An original research

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#### ABSTRACT:

**Background:** Oral cancer remains a significant public health concern, particularly in regions with high tobacco and alcohol consumption. Non-invasive biopsy procedures have emerged as promising tools for early detection and diagnosis. **Objective:** To evaluate the efficacy of different non-invasive biopsy techniques in screening and diagnosing oral cancers, focusing on sensitivity, specificity, and patient acceptability. **Methods:** A comparative cross-sectional research was conducted among 200 participants, including 150 patients with clinically suspicious oral lesions and 50 healthy controls. Three non-invasive techniques—brush biopsy, liquid-based cytology, and oral exfoliative cytology—were assessed. Diagnostic accuracy, patient comfort, and procedural feasibility were evaluated. **Results:** Brush biopsy demonstrated the highest sensitivity (94%) and specificity (92%), followed by liquid-based cytology (sensitivity 88%, specificity 89%) and oral exfoliative cytology (sensitivity 82%, specificity 84%). Patient acceptability was highest for oral exfoliative cytology. **Conclusion:** Non-invasive biopsy methods are effective in screening and diagnosing oral cancers, with brush biopsy offering superior diagnostic accuracy. Further integration of these techniques into routine clinical practice could improve early detection rates.

**Keywords:** Oral cancer, Non-invasive biopsy, Brush biopsy, Liquid-based cytology, Diagnosis.

Received: 17 November, 2023

Accepted: 22 December, 2023

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**This article may be cited as:** Madhulika A, Reddy EP, Addla N, Vaghasiya KV, Thakkar HH, Burma T. Assessment of efficacy of different non-invasive biopsy procedures in screening and diagnosis of oral cancers: An original research. J Adv Med Dent Sci Res 2024;12(1):63-65.

#### INTRODUCTION

Oral cancer accounts for a significant portion of malignancies worldwide, particularly in developing countries where risk factors such as tobacco use and betel quid chewing are prevalent [1]. Despite advancements in treatment modalities, the prognosis of oral cancer remains poor due to delayed diagnosis. Traditional biopsy methods, while accurate, are invasive, time-consuming, and often associated with patient discomfort [2].

Non-invasive biopsy techniques, including brush biopsy, liquid-based cytology, and oral exfoliative cytology, have gained attention for their potential to detect premalignant and malignant lesions with minimal discomfort [3-5]. This research aims to assess the diagnostic efficacy of these techniques,

focusing on sensitivity, specificity, and overall patient experience.

#### MATERIALS AND METHODS

##### Research Design and Setting

A comparative cross-sectional research was conducted over 12 months at a tertiary care dental hospital. Ethical clearance was obtained from the institutional review board.

##### Research Population

A total of 200 participants were enrolled, comprising 150 patients with clinically suspicious oral lesions (e.g., leukoplakia, erythroplakia) and 50 healthy controls. Participants were aged between 18 and 70 years, with an equal distribution of genders.

**Inclusion and Exclusion Criteria**

- **Inclusion Criteria:** Patients with oral lesions suspected of malignancy and healthy controls with no clinical signs of oral lesions.
- **Exclusion Criteria:** Patients with known oral cancer, those undergoing chemotherapy, or with systemic conditions affecting oral mucosa.

**Procedures**

Three non-invasive biopsy techniques were employed:

1. **Brush Biopsy:** A disposable brush was used to collect cellular material from the lesion.
2. **Liquid-Based Cytology:** A spatula was employed to scrape cells, which were then suspended in a preservative solution for analysis.
3. **Oral Exfoliative Cytology:** Cells were collected using a moistened swab.

Samples were stained and analyzed by a pathologist blinded to clinical data. Conventional biopsy served as the gold standard for comparison.

**Data Analysis**

Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated. Patient comfort was assessed using a visual analog scale (VAS) ranging from 0 (no discomfort) to 10 (severe discomfort). Statistical significance was determined using chi-square and t-tests, with a p-value <0.05 considered significant.

**RESULTS**

The diagnostic accuracy of non-invasive biopsy techniques varied significantly. Brush biopsy exhibited the highest sensitivity (94%) and specificity (92%), ensuring reliable detection of dysplastic lesions. Liquid-based cytology followed with moderate sensitivity (88%) and specificity (89%), providing balanced diagnostic value. Oral exfoliative cytology had the lowest sensitivity (82%) and specificity (84%), making it less effective but still valuable as a screening tool. Positive and negative predictive values were consistently high across techniques, with brush biopsy performing best overall. These findings underscore brush biopsy's reliability in detecting oral cancer while highlighting the complementary role of other methods. Table 1

Patient comfort ratings revealed significant variations between techniques. Oral exfoliative cytology was rated as the most comfortable (mean VAS score 1.8), reflecting minimal procedural discomfort. Liquid-based cytology showed moderate acceptability (mean score 3.2), while brush biopsy, despite its diagnostic superiority, was the least comfortable (mean score 4.5). These results emphasize the trade-off between diagnostic accuracy and patient acceptability. The high comfort level of oral exfoliative cytology suggests its potential as an initial screening method, especially in apprehensive patients, while brush biopsy remains preferred for confirmatory diagnosis despite slightly higher discomfort. Table 2

**Table 1: Diagnostic Accuracy of Non-Invasive Biopsy Techniques**

Technique	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Brush Biopsy	94	92	90	95
Liquid-Based Cytology	88	89	85	91
Oral Exfoliative Cytology	82	84	80	86

**Table 2: Patient Comfort Scores**

Technique	Mean VAS Score (SD)
Brush Biopsy	4.5 (1.1)
Liquid-Based Cytology	3.2 (1.0)
Oral Exfoliative Cytology	1.8 (0.9)

**DISCUSSION**

The findings of this research underscore the potential of non-invasive biopsy techniques in the screening and diagnosis of oral cancers. Brush biopsy emerged as the most accurate diagnostic tool with high sensitivity (94%) and specificity (92%), making it an effective alternative to conventional methods for early detection. These results align with previous research, which highlights the superior diagnostic performance of brush biopsy in detecting dysplastic changes [1]. The ability to collect cells from deeper epithelial layers may explain its enhanced efficacy compared to other techniques.

Liquid-based cytology also showed considerable diagnostic value, with a sensitivity of 88% and specificity of 89%. This method's ability to preserve cellular morphology for cytological analysis offers

distinct advantages, particularly in resource-limited settings where advanced diagnostic tools may not be available [2]. Moreover, the reduced sample handling errors make it a reliable method for oral cancer screening.

Oral exfoliative cytology, while less accurate, demonstrated the highest patient acceptability, with a mean discomfort score of 1.8. This finding is consistent with studies emphasizing patient comfort as a key consideration in the adoption of non-invasive diagnostic tools [3]. The high acceptability of this method makes it an ideal choice for initial mass screenings, particularly in populations at high risk of oral cancer due to tobacco or alcohol use [4].

The integration of non-invasive biopsy methods into routine clinical practice has significant implications. These techniques not only reduce the need for

invasive procedures but also facilitate early detection, thereby improving treatment outcomes. Early-stage diagnosis of oral cancers is critical, as it significantly enhances the survival rate and reduces morbidity [5]. Furthermore, the role of adjunctive diagnostic aids, such as molecular markers and saliva-based biopsies, should be explored further to complement these techniques [6,7].

Despite the promising results, the research has limitations, including its single-center design and relatively small sample size. Multicentric studies with larger cohorts are needed to validate these findings and determine the cost-effectiveness of implementing non-invasive biopsies on a larger scale [8]. Additionally, advancing technologies, such as artificial intelligence, may enhance the diagnostic accuracy of these methods by automating and standardizing cytological analysis [9].

Future research should focus on the integration of non-invasive biopsies with molecular diagnostics to provide a comprehensive approach to oral cancer detection. This could include analyzing biomarkers in saliva, which is emerging as a potential liquid biopsy tool for head and neck cancers [10].

## CONCLUSION

Non-invasive biopsy techniques offer effective, patient-friendly alternatives for screening and diagnosing oral cancers. Brush biopsy provides superior diagnostic accuracy, while liquid-based cytology and oral exfoliative cytology offer complementary roles, particularly in resource-limited settings or for initial mass screenings. Integrating these methods into routine practice could enhance early detection rates, improving patient outcomes. Future studies should explore combining these techniques with molecular diagnostics and leveraging technological advancements to optimize accuracy and efficiency.

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