Original Research

CYTOHISTOPATHOLOGICAL CORRELATION OF SALIVARY GLAND LESIONS: AN ANALYSIS OF FNAC AND HISTOPATHOLOGY

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ABSTRACT

Background: Salivary gland lesions comprise a heterogeneous group of inflammatory, benign, and malignant conditions that often present as glandular swellings. Fine Needle Aspiration Cytology (FNAC) is a minimally invasive, rapid, and cost-effective diagnostic technique widely used in the preoperative evaluation of salivary gland lesions. Histopathological examination remains the gold standard for definitive diagnosis. The present study was undertaken to evaluate the diagnostic accuracy of FNAC and correlate its findings with histopathological examination.

Methodology: This prospective observational study was conducted in the Department of Pathology at Sree Mookambika Institute of Medical Sciences, Kulasekharam, from December 2024 to October 2025. Patients presenting with salivary gland lesions who underwent both FNAC and subsequent surgical excision were included in the study. FNAC was performed using a 22–25 gauge needle under aseptic precautions, and smears were stained with Hematoxylin and Eosin, May-Grünwald-Giemsa, and Papanicolaou stains. Histopathological examination of formalin-fixed surgical specimens was carried out and used as the reference standard. Cytological findings were compared with histopathological diagnoses to assess diagnostic performance.

Results: FNAC demonstrated an overall diagnostic accuracy of 96% in differentiating benign and malignant salivary gland lesions. The sensitivity, specificity, positive predictive value, and negative predictive value were 77.0%, 98.9%, 90.9%, and 96.8%, respectively. Pleomorphic adenoma was the most common benign lesion, whereas mucoepidermoid carcinoma and adenoid cystic carcinoma were the predominant malignant tumors. Diagnostic discrepancies were mainly observed in cystic lesions and low-grade malignancies due to sampling limitations and overlapping cytological features.

Conclusion: FNAC is a reliable and highly accurate diagnostic modality for the initial assessment of salivary gland lesions. Although certain diagnostic pitfalls exist, particularly in cystic and low-grade malignant tumors, FNAC remains an excellent preoperative investigation. Histopathological examination continues to be essential for definitive diagnosis and accurate tumor classification.

Keywords: Fine Needle Aspiration Cytology, FNAC, Salivary Gland Lesions, Histopathology, Diagnostic Accuracy, Pleomorphic Adenoma.

INTRODUCTION

Salivary gland lesions comprise a diverse group of non-neoplastic, benign, and malignant disorders that pose a diagnostic challenge because of their varied clinical and morphological presentations. These lesions can arise from the major salivary glands, including the parotid, submandibular, and sublingual glands, as well as from numerous minor salivary glands distributed throughout the oral cavity.

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Although salivary gland tumors account for only a small proportion of head and neck neoplasms, accurate preoperative diagnosis is essential for determining appropriate management and predicting prognosis.[1]

Patients with salivary gland lesions commonly present with a painless swelling in the affected gland. However, clinical examination alone is often insufficient to differentiate inflammatory, benign, and malignant lesions. Imaging modalities such as ultrasonography, computed tomography, and magnetic resonance imaging provide valuable information regarding the size, location, and extent of lesions but are unable to establish a definitive tissue diagnosis. Therefore, cytological and histopathological evaluation remains fundamental in the diagnostic workup of salivary gland diseases. [2]

Fine Needle Aspiration Cytology (FNAC) has emerged as a valuable diagnostic tool in the evaluation of salivary gland lesions. It is a simple, minimally invasive, rapid, safe, and cost-effective procedure that can be performed on an outpatient basis with minimal discomfort to the patient. FNAC allows repeated sampling when necessary and provides valuable information regarding the nature of the lesion, thereby assisting clinicians in planning appropriate treatment strategies.[3] The technique has gained widespread acceptance because it can effectively distinguish neoplastic from non-neoplastic lesions and, in many cases, differentiate benign from malignant tumors. Consequently, FNAC has significantly reduced the number of unnecessary surgical procedures in patients with salivary gland masses.[4]

Despite its advantages, FNAC has certain limitations. Cytological interpretation may be challenging because of overlapping morphological features among various salivary gland lesions. Sampling errors, cystic degeneration, inadequate cellularity, and the heterogeneous nature of some tumors may contribute to false-negative or false-positive diagnoses.[5] In addition, certain low-grade malignancies may closely resemble benign lesions on cytology, leading to diagnostic pitfalls. Therefore, while FNAC serves as an excellent preoperative diagnostic modality, it cannot completely replace histopathological examination.[6]

Histopathological examination of excised specimens remains the gold standard for the definitive diagnosis of salivary gland lesions. It provides detailed architectural and cytological information necessary for accurate classification, grading, and assessment of tumor behavior. Histopathology not only confirms the cytological diagnosis but also helps identify discrepancies and limitations associated with FNAC. Correlation between cytological and histopathological findings is therefore essential for evaluating the reliability and diagnostic performance of FNAC.[7]

Assessment of the diagnostic accuracy of FNAC is important for optimizing patient management and minimizing unnecessary surgical interventions. Understanding the causes of discordance between cytological and histopathological diagnoses may further improve diagnostic precision and enhance clinical decision-making. Therefore, the present study was undertaken to evaluate the diagnostic accuracy of Fine Needle Aspiration Cytology in salivary gland lesions, compare the cytological findings with histopathological diagnoses, and identify the potential diagnostic pitfalls associated with FNAC.

Aim

To evaluate the diagnostic accuracy of Fine Needle Aspiration Cytology (FNAC) in salivary gland lesions by correlating cytological findings with histopathological diagnosis.

Objectives

1. To study the cytomorphological spectrum of salivary gland lesions diagnosed by Fine Needle Aspiration Cytology (FNAC).
2. To determine the histopathological spectrum of salivary gland lesions in excised specimens.
3. To correlate FNAC findings with histopathological examination findings in salivary gland lesions.
4. To assess the diagnostic performance of FNAC by calculating its sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of Pathology at Sree Mookambika Institute of Medical Sciences, Kulasekharam, Tamil Nadu, from December 2024 to October 2025. The study included patients presenting with clinically or radiologically suspected salivary gland lesions who subsequently underwent both Fine Needle Aspiration Cytology (FNAC) and surgical excision with histopathological examination. Prior approval was obtained from the Institutional Ethics Committee, and informed written consent was obtained from all participants before enrollment in the study.

A detailed clinical history was obtained, and a thorough physical examination was performed in all cases. Under strict aseptic precautions, FNAC was carried out using a 10 mL disposable syringe fitted with a 22–25 gauge needle. The needle was introduced into the lesion, and cellular material was aspirated. The aspirated material was smeared onto clean glass slides, and thin smears were prepared. Air-dried smears were stained with May-Grünwald-Giemsa (MGG) stain, while alcohol-fixed smears were stained with Hematoxylin and Eosin (H&E) and Papanicolaou (Pap) stains. Cytological diagnoses were recorded based on the observed cellular morphology.

All patients subsequently underwent surgical excision of the salivary gland lesion. The resected specimens were received in the Department of Pathology in 10% neutral buffered formalin. Gross examination was performed, followed by routine tissue processing, paraffin embedding, sectioning, and staining with Hematoxylin and Eosin. Histopathological examination was carried out to establish the definitive diagnosis. The cytological findings obtained from FNAC were then compared and correlated with the corresponding histopathological diagnoses.

Data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) version 26.0. Descriptive statistics were used to summarize demographic characteristics and the distribution of salivary gland lesions. Categorical variables were expressed as frequencies and percentages. Histopathological diagnosis was considered the gold standard for evaluation. The diagnostic performance of FNAC was assessed by calculating sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy. The degree of agreement between FNAC and histopathological findings was evaluated using appropriate statistical tests, and a p-value of less than 0.05 was considered statistically significant.

RESULT

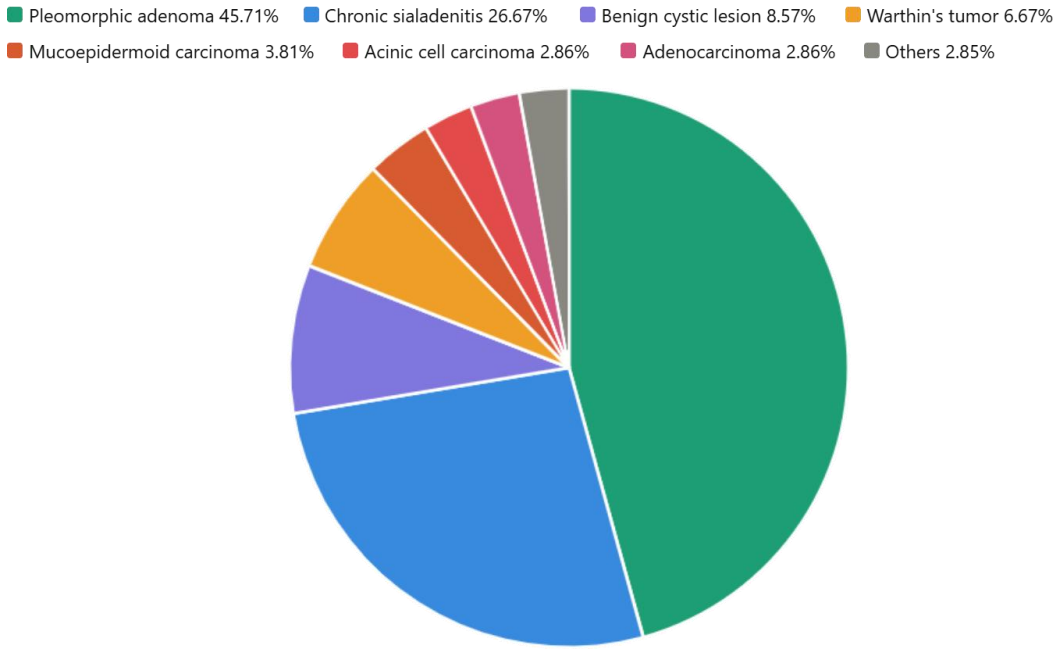
Table. FNAC Diagnosis of Salivary Gland Lesions

	Diagnosis	Total	%
Benign	Benign cystic lesion	9	8.57%
	Chronic sialadenitis	28	26.66%
	Pleomorphic Adenoma	48	45.71%
	Warthin's Tumor	7	6.66%
	Lymphangioma	1	0.95%
	Inconclusive	1	0.95%
	Total 94		89.52%
Malignant	M u c o e p i d e r m o i d Carcinoma	4	3.80%
	Acinic cell carcinoma	3	2.85%
	Adenocarcinoma	3	2.85%
	Adenoid cystic carcinoma	1	0.95%
	Total	11	10.48%
	Grand Total	105	100%

The results of FNAC were broadly categorized into inflammatory lesions, benign cystic lesions, benign neoplasms and malignant neoplasms. Of the 105 cases (94, 89.5%) were benign and 11 cases (10.5%) were malignant. Amongst the 105 cases, 68 cases (64.8%) were neoplastic while 37 cases (35.2%) were non-neo- plastic.

Pie Chart:

For the pie chart showing the distribution of FNAC diagnoses among 105 salivary gland lesions:



Among the 105 salivary gland lesions evaluated by FNAC, benign lesions predominated, accounting for 94 cases (89.52%), while malignant lesions constituted only 11 cases (10.48%). Pleomorphic

adenoma was the most common diagnosis, observed in 48 cases (45.71%), highlighting its status as the predominant salivary gland neoplasm in this study. Chronic sialadenitis was the second most frequent lesion, comprising 28 cases (26.66%), followed by benign cystic lesions in 9 cases (8.57%). Warthin's tumor accounted for 7 cases (6.66%), whereas lymphangioma and inconclusive diagnoses were rare, with one case each (0.95%).

Among the malignant lesions, mucoepidermoid carcinoma was the most common, representing 4 cases (3.80%), followed by acinic cell carcinoma and adenocarcinoma with 3 cases each (2.85%). Adenoid cystic carcinoma was the least common malignant lesion, observed in only one case (0.95%). Overall, neoplastic lesions constituted 68 cases (64.8%), whereas non-neoplastic lesions accounted for 37 cases (35.2%). The findings demonstrate that salivary gland lesions are predominantly benign, with pleomorphic adenoma being the most frequently encountered lesion. The low proportion of malignant tumors underscores the usefulness of FNAC as an initial diagnostic tool for distinguishing benign from malignant salivary gland pathologies.

Cytohistological Correlation

Histopathological correlation revealed one false-positive case in which FNAC diagnosed mucoepidermoid carcinoma, while histology confirmed pleomorphic adenoma. Three false-negative cases were identified: two cases diagnosed as pleomorphic adenoma on FNAC were confirmed as mucoepidermoid carcinoma on histology, and one case reported as a benign cystic lesion was subsequently diagnosed as adenoid cystic carcinoma. These discrepancies highlight the diagnostic challenges associated with cystic changes and overlapping cytomorphological features in salivary gland lesions.

DISCUSSION

Fine Needle Aspiration Cytology (FNAC) is widely accepted as an important preoperative diagnostic tool for salivary gland lesions because it is minimally invasive, cost-effective, rapid, and associated with minimal patient discomfort. The present study evaluated the diagnostic accuracy of FNAC by correlating cytological findings with histopathological diagnoses. Histopathology was considered the gold standard for confirmation of diagnosis.

In the present study, FNAC demonstrated an overall diagnostic accuracy of 96%, with a sensitivity of 77.0%, specificity of 98.9%, positive predictive value of 90.9%, and negative predictive value of 96.8%. These findings indicate that FNAC is highly reliable in differentiating benign from malignant salivary gland lesions. The diagnostic accuracy observed in our study is comparable to that reported by Jayaram et al., Das et al., Stramandinoli et al., Piccioni et al., Iqbal et al., Stow et al., Postema et al., Rehman et al., and Lukas et al., who reported diagnostic accuracies ranging from 73.6% to 97%.[8-16]

Although the overall diagnostic efficacy of FNAC was high, certain diagnostic limitations were encountered. The greatest challenge was observed in cystic salivary gland lesions. In the present study, nine cases were cytologically categorized as benign cystic lesions because the aspirates lacked definite cytological features of malignancy. However, subsequent histopathological examination revealed seven cases of chronic sialadenitis, one pleomorphic adenoma, and one Warthin tumor. Similar observations were reported by Postema et al., who emphasized that cytological diagnoses of cystic lesions should be interpreted cautiously because of the risk of inadequate sampling and low cellular yield.[15]

False-negative diagnoses constituted another important limitation. Among the malignant tumors identified on histopathology, three cases were initially interpreted as benign lesions on cytology. One case of adenoid cystic carcinoma was misdiagnosed as a benign cystic lesion because the aspirate yielded only straw-colored fluid containing foamy macrophages and a few ductal epithelial cells. Similarly, two cases of mucoepidermoid carcinoma were erroneously reported as pleomorphic adenoma with epithelial hyperplasia. These findings underscore the challenges associated with FNAC interpretation in cystic and low-grade malignant tumors.[17]

The relatively lower sensitivity of FNAC in accurately typing specific salivary gland neoplasms may be attributed to the considerable morphological overlap between various benign and malignant lesions. Salivary gland tumors exhibit remarkable histological diversity, and cytological specimens may not always represent the entire lesion. Sampling errors, cystic degeneration, metaplastic changes, and tumor heterogeneity can further complicate cytological interpretation.[18] Therefore, while FNAC is highly effective in distinguishing benign from malignant pathology, precise subtyping of certain lesions remains challenging.

Pleomorphic adenoma was the most common salivary gland lesion identified in the present study, followed by Warthin tumor. This finding is consistent with numerous previous studies, which have consistently reported pleomorphic adenoma as the most frequent benign salivary gland neoplasm.[19] Among malignant tumors, mucoepidermoid carcinoma, adenoid cystic carcinoma, and acinic cell carcinoma were the predominant lesions. Similar patterns have been documented in several published series, although the relative frequencies of individual malignant tumors vary among different populations.[20]

Overall, the findings of the present study confirm that FNAC is a highly valuable diagnostic modality for the initial evaluation of salivary gland lesions. Nevertheless, awareness of its diagnostic pitfalls, particularly in cystic and low-grade malignant lesions, is essential. Histopathological examination remains indispensable for definitive diagnosis, accurate tumor classification, and appropriate therapeutic planning.

CONCLUSION

The present study demonstrated that Fine Needle Aspiration Cytology (FNAC) is a highly effective, minimally invasive, rapid, and cost-efficient diagnostic tool for the evaluation of salivary gland lesions. FNAC showed high diagnostic accuracy, specificity, and negative predictive value in differentiating benign from malignant salivary gland lesions, making it a valuable preoperative investigation for clinical decision-making and treatment planning.

Pleomorphic adenoma was the most common benign salivary gland tumor, while mucoepidermoid carcinoma and adenoid cystic carcinoma were the predominant malignant lesions. A strong correlation was observed between cytological and histopathological findings in the majority of cases.

However, certain diagnostic pitfalls were encountered, particularly in cystic lesions and low-grade malignancies, resulting in occasional false-negative diagnoses. Sampling errors, inadequate cellularity, and overlapping cytomorphological features contributed to these discrepancies. Therefore, FNAC findings should always be interpreted in conjunction with clinical and radiological findings.

Histopathological examination remains the gold standard for definitive diagnosis, tumor classification, and assessment of biological behavior. The combined use of FNAC and histopathological evaluation enhances diagnostic precision and facilitates appropriate patient management. Awareness of the limitations of FNAC can further improve its diagnostic utility and reduce potential errors in the assessment of salivary gland lesions.

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