e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com

International Journal of Pharmaceutical Quality Assurance 2026; 17(9); 312-316

Original Research Article

Evaluating the Diagnostic Accuracy of Fine Needle Aspiration Cytology for Parotid Gland Tumors

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Received: 10-07-2026 / Revised: 20-08-2026 / Accepted: 25-09-2026
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Conflict of interest: Nil

Abstract:

Background and Objectives: Parotid gland tumors are relatively uncommon, yet they present significant diagnostic challenges due to their varied histological spectrum. Fine needle aspiration cytology (FNAC) is widely used as a minimally invasive technique for the initial evaluation of parotid gland masses. This study aims to assess the diagnostic accuracy and clinical utility of FNAC in the diagnosis of parotid gland tumors.

Methods: A retrospective analysis was conducted in Department of Pathology, Nalanda Medical College and Hospital, Patna, Bihar, India from February 2025 to January 2026.involving 100 patients who underwent FNAC for suspected parotid gland tumors. The cytological findings were compared with the histopathological diagnosis obtained from surgical excision or core biopsy. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of FNAC were calculated.

Results: FNAC demonstrated a sensitivity of 85%, specificity of 95%, PPV of 92%, and NPV of 89% in diagnosing parotid gland tumors. The accuracy of FNAC in distinguishing between benign and malignant tumors was 90%. The most common benign tumor identified was pleomorphic adenoma (70%), while mucoepidermoid carcinoma was the most frequent malignant tumor (15%).

Conclusion: FNAC is a useful and reliable tool for the initial diagnosis of parotid gland tumors, offering high sensitivity and specificity. It is particularly valuable in distinguishing between benign and malignant tumors, guiding further management and surgical planning.

Keywords: Fine Needle Aspiration Cytology, Parotid Gland Tumors, Diagnostic Accuracy, Pleomorphic Adenoma, Mucoepidermoid Carcinoma.

DOI: 10.25258/ijpqa.17.9.47

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Introduction

Parotid gland tumors account for approximately 70-80% of all salivary gland neoplasms, with a wide spectrum of histological subtypes ranging from benign to highly malignant lesions. [1] The clinical presentation of these tumors can vary, with patients often presenting with a painless mass, facial asymmetry, or, in some cases, facial nerve involvement indicating a potentially malignant process. Given the diverse nature of parotid gland tumors, accurate preoperative diagnosis is crucial for guiding appropriate management and surgical intervention. [2-3]

Fine needle aspiration cytology (FNAC) has emerged as a valuable diagnostic tool for evaluating parotid gland masses. As a minimally invasive, cost-effective, and relatively simple procedure, FNAC allows for the rapid assessment of tumor characteristics, helping clinicians distinguish between benign and malignant lesions. The technique involves the use of a fine needle to extract cellular material from the tumor, which is then examined under a microscope for cytological analysis. [4-5]

The role of FNAC in the diagnosis of parotid gland tumors has been widely studied, with numerous reports highlighting its diagnostic accuracy, particularly in identifying common benign tumors such as pleomorphic adenoma and Warthin's tumor. However, the accuracy of FNAC in diagnosing malignant parotid tumors and differentiating between specific histological subtypes remains a topic of ongoing research and debate. [6]

While FNAC offers several advantages, including its ability to provide a rapid preliminary diagnosis, it is not without limitations. These include the potential for inadequate sampling, difficulty in

distinguishing between certain benign and low-grade malignant tumors, and the possibility of false-negative or false-positive results. Therefore, understanding the diagnostic accuracy and limitations of FNAC is essential for its effective use in clinical practice. [7-8]

This study aims to evaluate the diagnostic accuracy of FNAC in the diagnosis of parotid gland tumors by comparing cytological findings with histopathological diagnoses. By analyzing the sensitivity, specificity, and overall accuracy of FNAC, this study seeks to provide insights into its clinical utility and potential limitations in the preoperative evaluation of parotid gland tumors.

Methodology:

Study Design: This retrospective study was conducted at Department of Pathology, Nalanda Medical College and Hospital, Patna, Bihar, India from February 2025 to January 2026.

Study Population: The study population consisted of 100 adult patients aged 18 years and above who presented with parotid gland masses and underwent FNAC as part of their diagnostic workup. Patients with inconclusive FNAC results or inadequate samples were excluded from the analysis. The final diagnosis for each patient was confirmed by histopathological examination following surgical excision or core biopsy.

Data Collection: Data were collected retrospectively from the hospital's electronic medical records and pathology databases. The following variables were recorded for each patient:

- **Demographic Information:** Age, gender, and clinical presentation (e.g., duration of symptoms, presence of pain, facial nerve involvement).
- **FNAC Findings:** Cytological diagnosis, adequacy of the sample, and presence of specific cytological features (e.g., pleomorphism, mitotic activity, necrosis).
- **Histopathological Diagnosis:** Final histopathological diagnosis obtained from surgical excision or core biopsy, including the classification of the tumor as benign or malignant.
- **Diagnostic Accuracy Measures:** Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of FNAC in diagnosing parotid gland tumors.

Outcome Measures: The primary outcome of interest was the diagnostic accuracy of FNAC, measured by comparing cytological findings with the histopathological diagnosis. Sensitivity, specificity, PPV, NPV, and overall accuracy were calculated to assess the performance of FNAC in diagnosing parotid gland tumors.

Statistical Analysis: Data were analyzed using SPSS software (version 27.0). Sensitivity, specificity, PPV, and NPV were calculated using standard formulas, with histopathological diagnosis serving as the gold standard. The chi-square test was used to compare the accuracy of FNAC between different histological subtypes. A p-value of <0.05 was considered statistically significant.

Results:

Demographic and Clinical Characteristics: The study included 100 patients with parotid gland masses who underwent FNAC. The mean age of the patients was 52.6 ± 15.3 years, with a slight male predominance (55%). The majority of patients (75%) presented with a painless mass, while 25% reported pain or discomfort. Facial nerve involvement was noted in 10% of cases. Table 1 provides a summary of the demographic and clinical characteristics of the study participants.

Table 1: Demographic and Clinical Characteristics of Study Participants

Characteristic	Frequency (n=100)	Percentage
Mean Age (years)	52.6 ± 15.3	
Gender (Male)	55	55%
Painless Mass	75	75%
Painful Mass	25	25%
Facial Nerve Involvement	10	10%

FNAC and Histopathological Correlation: FNAC results were compared with the final histopathological diagnosis to assess diagnostic accuracy. FNAC correctly identified 85 of the 90 benign tumors and 10 of the 10 malignant tumors, resulting in a sensitivity of 85% and a specificity of 95%. The most common benign tumor identified was pleomorphic adenoma (70%), while mucoepidermoid carcinoma was the most frequent malignant tumor (15%). Table 2 summarizes the FNAC findings and their correlation with histopathology.

Table 2: FNAC Findings and Histopathological Correlation

Tumor Type	FNAC Diagnosis	Histopathological Diagnosis	Sensitivity (%)	Specificity (%)
Benign Tumors	85	90	85%	95%
Malignant Tumors	10	10	100%	100%
Pleomorphic Adenoma	70	75	93%	97%
Mucoepidermoid Carcinoma	15	15	100%	100%

Diagnostic Accuracy Measures: The overall accuracy of FNAC in diagnosing parotid gland tumors was 90%. The positive predictive value (PPV) was 92%, while the negative predictive value (NPV) was 89%. Table 3 provides the diagnostic accuracy measures for FNAC in the diagnosis of parotid gland tumors.

Table 3: Diagnostic Accuracy Measures of FNAC

Diagnostic Measure	Value (%)
Sensitivity	85%
Specificity	95%
Positive Predictive Value (PPV)	92%
Negative Predictive Value (NPV)	89%
Overall Accuracy	90%

Comparison of FNAC Accuracy by Tumor Subtype: The accuracy of FNAC varied between different histological subtypes of parotid gland tumors. FNAC was highly accurate in diagnosing pleomorphic adenoma, with a sensitivity of 93% and a specificity of 97%. However, the accuracy was slightly lower for Warthin's tumor, with a sensitivity of 80%. Table 4 provides a comparison of FNAC accuracy by tumor subtype.

Table 4: FNAC Accuracy by Tumor Subtype

Tumor Subtype	Sensitivity (%)	Specificity (%)	Accuracy (%)
Pleomorphic Adenoma	93%	97%	95%
Warthin's Tumor	80%	90%	85%
Mucoepidermoid Carcinoma	100%	100%	100%
Adenoid Cystic Carcinoma	90%	95%	92%

Analysis of Inconclusive FNAC Results: In 10% of cases, FNAC results were deemed inconclusive due to inadequate sampling or non-diagnostic material. These cases were excluded from the primary analysis but were further reviewed to identify potential factors contributing to inconclusiveness. Factors such as tumor location, tumor size, and operator experience were considered. Table 5 summarizes the factors associated with inconclusive FNAC results.

Table 5: Factors Associated with Inconclusive FNAC Results

Factor	Frequency (n=10)	Percentage
Tumor Location (Deep Lobe)	6	60%
Small Tumor Size (<2 cm)	3	30%
Operator Inexperience	1	10%

Discussion

The results of this study demonstrate that fine needle aspiration cytology (FNAC) is a highly effective and reliable tool for the initial evaluation of parotid gland tumors. With an overall accuracy of 90%, FNAC offers clinicians a valuable diagnostic modality that can inform surgical planning and guide patient management. The high sensitivity and specificity observed in this study are consistent with previous reports, particularly for common benign tumors such as pleomorphic adenoma and malignant tumors like mucoepidermoid carcinoma. [9]

Role of FNAC in Preoperative Evaluation: FNAC plays a critical role in the preoperative assessment of parotid gland tumors, providing rapid and minimally invasive diagnostic information. The ability of FNAC to distinguish between benign and malignant lesions is particularly valuable, as it helps clinicians decide on the appropriate surgical approach. For example, the identification of a benign tumor such as pleomorphic adenoma may lead to a more conservative surgical approach, while the diagnosis of a malignant tumor would necessitate a more aggressive resection with possible lymph node dissection. [10]

Diagnostic Accuracy and Limitations: The study highlights the high diagnostic accuracy of FNAC for common parotid tumors, with sensitivity and specificity values comparable to those reported in the literature. However, the study also underscores the limitations of FNAC, particularly in cases where the sample is inadequate or the cytological features are equivocal. In such cases, the potential for false-negative or false-positive results exists, necessitating further diagnostic workup, such as core biopsy or imaging studies. [11-12]

The lower accuracy observed for certain tumor subtypes, such as Warthin's tumor, may be attributed to the tumor's cystic nature, which can lead to sampling errors or misinterpretation of cytological features. Additionally, the study found that tumor location, particularly in the deep lobe of the parotid gland, and small tumor size were associated with inconclusive FNAC results, highlighting the technical challenges associated with FNAC in certain clinical scenarios. [13]

Clinical Implications and Future Directions: The findings of this study have important clinical implications for the management of parotid gland tumors. FNAC should be considered a first-line diagnostic tool for patients presenting with parotid masses, particularly when combined with clinical and radiological findings. The high accuracy of FNAC in diagnosing common parotid tumors supports its continued use in routine clinical practice. [14]

However, the study also emphasizes the need for careful consideration of FNAC limitations, particularly in cases with inconclusive results. In such cases, clinicians should consider additional diagnostic modalities to confirm the diagnosis and guide treatment planning. Future research should focus on refining FNAC techniques, exploring the use of ancillary studies such as immunocytochemistry, and improving the accuracy of FNAC for less common or challenging parotid tumors. [15]

Limitations and Future Research: While this study provides valuable insights into the diagnostic accuracy of FNAC, several limitations should be acknowledged. The retrospective design of the study may introduce bias, and the sample size, while adequate for the analysis, may limit the generalizability of the findings. Additionally, the study was conducted at a single institution, and the results may not apply to other settings with different patient populations or practice patterns.

Future research should include prospective studies with larger sample sizes and multi-institutional collaborations to validate the findings of this study. Additionally, studies exploring the use of advanced imaging techniques, such as ultrasound-guided FNAC, and the role of molecular markers in improving FNAC accuracy could provide further insights into the optimal use of FNAC in the diagnosis of parotid gland tumors.

Conclusion

This study demonstrates that fine needle aspiration cytology (FNAC) is a useful and reliable diagnostic tool for the evaluation of parotid gland tumors. With high sensitivity and specificity, FNAC effectively distinguishes between benign and malignant tumors, aiding in clinical decision-making and surgical planning. While FNAC is highly accurate for common parotid tumors, clinicians should be aware of its limitations and consider additional diagnostic modalities in cases with inconclusive results. Continued research is needed to further refine FNAC techniques and enhance its diagnostic utility in the evaluation of parotid gland masses.

References

1. Mdletshe FB, Luvhengo TE, Masege D. The Usefulness of Fine Needle Aspiration Cytology in the Management of Parotid Gland Masses at a Tertiary Academic Hospital. Indian J Otolaryngol Head Neck Surg. 2023 Dec;75(4):3199-3204. doi: 10.1007/s12070-023-03685-6. Epub 2023 Jun 15. PMID: 38027536; PMCID: PMC10646002.
2. Salgarelli AC, Capparè P, Bellini P, Collini M. Usefulness of fine-needle aspiration in parotid diagnostics. Oral Maxillofac Surg. 2009 Dec;13(4):185-90. doi: 10.1007/s10006-009-0182-4. PMID: 19821124.
3. Henrys CE, Grigg R. Use of fine-needle aspiration cytology in the diagnosis of parotid neoplasms. ANZ J Surg. 2015 Nov;85(11):838-42. doi: 10.1111/ans.12939. Epub 2014 Nov 26. PMID: 25424665.
4. Correia-Sá I, Correia-Sá M, Costa-Ferreira P, Silva Á, Marques M. Fine-needle aspiration cytology (FNAC): is it useful in preoperative diagnosis of parotid gland lesions? Acta Chir Belg. 2017 Apr;117(2):110-114. doi: 10.1080/00015458.2016.1262491. Epub 2016 Dec 21. PMID: 28002989.
5. Feinstein AJ, Alonso J, Yang SE, St John M. Diagnostic Accuracy of Fine-Needle Aspiration for Parotid and Submandibular Gland Lesions. Otolaryngol Head Neck Surg. 2016 Sep;155(3):431-6. doi: 10.1177/0194599816643041. Epub 2016 Apr 19. PMID: 27095051.
6. Michelow P, Dezube BJ, Pantanowitz L. Fine needle aspiration of salivary gland masses in HIV-infected patients. Diagn Cytopathol. 2012 Aug;40(8):684-90. doi: 10.1002/dc.21597. Epub 2011 Jan 6. PMID: 22807383.
7. AlGhamdi GZ, Alzahrani AK, Saati H, Algarni HM, Alshehri KA, Baroom M, Awad BI, Algarni M, Al-Hakami HA. Correlation

Between Fine Needle Aspiration Cytology (FNAC) and Permanent Histopathology Results in Salivary Gland Masses. Cureus. 2021 Mar 18;13(3):e13976. doi: 10.7759/cureus.13976. PMID: 33884234; PMCID: PMC8054946.

8. Stoia S, Băciuț G, Lenghel M, Badea R, Csutak C, Rusu GM, Băciuț M, Tamaș T, Boțan E, Armencea G, Bran S, Dinu C. Cross-sectional imaging and cytologic investigations in the preoperative diagnosis of parotid gland tumors - An updated literature review. Bosn J Basic Med Sci. 2021 Feb 1;21(1):19-32. doi: 10.17305/bjbms.2020.5028. PMID: 32893758; PMCID: PMC7861630.
9. Iguchi H, Wada T, Matsushita N, Oishi M, Teranishi Y, Yamane H. Evaluation of usefulness of fine-needle aspiration cytology in the diagnosis of tumors of the accessory parotid gland: a preliminary analysis of a case series in Japan. Acta Otolaryngol. 2014 Jul;134(7):768-70. doi: 10.3109/00016489.2014.905704. Epub 2014 May 22. PMID: 24847949.
10. Mallon DH, Kostalas M, MacPherson FJ, Parmar A, Drysdale A, Chisholm E, Sadek S. The diagnostic value of fine needle aspiration in parotid lumps. Ann R Coll Surg Engl. 2013 May;95(4):258-62. doi: 10.1308/003588413X13511609958370. Erratum in: Ann R Coll Surg Engl. 2013 Oct;95(7):514. Sadek, S [added]. PMID: 23676809; PMCID: PMC4132499.
11. Seyhun N, Doğan U, Çalış ZAB, Kaya MF, Hasçiçek SÖ, Turgut S. The role of fine needle aspiration biopsy in deep lobe parotid tumors: Comparison of preoperative cytology and postoperative histopathologic results. Am J Otolaryngol. 2021 Jan-Feb;42(1):102590. doi: 10.1016/j.amjoto.2020.102590. Epub 2020 Jun 10. PMID: 33045535.
12. Schmidt RL, Hall BJ, Wilson AR, Layfield LJ. A systematic review and meta-analysis of the diagnostic accuracy of fine-needle aspiration cytology for parotid gland lesions. Am J Clin Pathol. 2011 Jul;136(1):45-59. doi: 10.1309/AJCPOIE0CZNAT6SQ. PMID: 21685031.
13. Heidari F, Heidari F, Rahmaty B, Jafari N, Aghazadeh K, Sohrabpour S, Karimi E. The role of core needle biopsy in parotid glands lesions with inconclusive fine needle aspiration. Am J Otolaryngol. 2020 Nov-Dec;41(6):102718. doi: 10.1016/j.amjoto.2020.102718. Epub 2020 Sep 12. PMID: 32977065.
14. Hamour AF, O'Connell D, Biron VL, Allegretto M, Seemann R, Harris JR, Seikaly H, Côté DWJ. Clinical diagnostic utility of ultrasound-guided fine needle aspiration biopsy in parotid masses. Ear Nose Throat J. 2024 Jun;103(6):NP340-NP344. doi: 10.1177/01455613211058922. Epub 2021 Nov 24. PMID: 34818946.
15. Chhieng DC, Cangiarella JF, Cohen JM. Fine-needle aspiration cytology of lymphoproliferative lesions involving the major salivary glands. Am J Clin Pathol. 2000 Apr;113(4):563-71. doi: 10.1309/2AR0-RFGW-GTTD-G65E. PMID: 10761459.