

Clinical Utility of Fine-Needle Aspiration Cytology in Guiding the Management of Salivary Gland Swellings: A Prospective Observational Study

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Received: 01-07-2026 / Revised: 25-07-2026 / Accepted: 12-08-2026

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Conflict of interest: Nil

Abstract

Background: Fine-needle aspiration cytology (FNAC) is widely used for the initial evaluation of salivary gland swellings; however, its clinical value depends on whether cytological findings reliably stratify malignancy risk and influence subsequent management. This study evaluated the cytological spectrum, diagnostic performance and clinical implications of FNAC results in patients with salivary gland swellings.

Methods: This prospective observational study included 79 consecutive patients with salivary gland swellings undergoing FNAC at a tertiary-care hospital in Uttarakhand. Cytological findings were classified according to the Milan System for Reporting Salivary Gland Cytopathology. Intended management before FNAC and revised management following cytological reporting were compared. Histopathological correlation was available for 53 surgically managed participants, of whom 43 were eligible for the primary binary diagnostic-accuracy analysis. Sensitivity, specificity, predictive values, accuracy and Cohen's kappa were calculated.

Results: The mean age was 44.8±15.7 years, 43 (54.4%) participants were female, and the parotid gland was involved in 48 (60.8%). Benign neoplasm was the predominant Milan category in 31 (39.2%), while 11 (13.9%) aspirates were suspicious or malignant. FNAC modified the initially intended management in 50 (63.3%) participants, with significant variation across Milan categories ($p=0.002$). High-risk cytology was significantly associated with rapid enlargement, fixation, facial-nerve weakness, lymphadenopathy, skin or mucosal involvement and radiological suspicion. Histopathology identified 15 (28.3%) malignant lesions among 53 surgical specimens; the observed malignancy risk increased from 10.3% in category IVa to 40.0% in IVb, 75.0% in V and 100% in VI ($p<0.001$). FNAC demonstrated 75.0% sensitivity, 96.8% specificity, 90.0% positive predictive value, 90.9% negative predictive value and 90.7% overall accuracy, with substantial agreement with histopathology ($\kappa=0.76$).

Conclusion: Milan-based FNAC reporting provided clinically meaningful malignancy-risk stratification and substantially influenced the management of salivary gland swellings. Its high specificity and accuracy support its use for preoperative planning; however, benign or indeterminate results discordant with clinical or radiological findings require repeat image-guided sampling or further tissue diagnosis.

Keywords: Fine-needle aspiration cytology; salivary gland swelling; Milan system; clinical management; diagnostic accuracy.

DOI: 10.25258/ijcpr.18.8.332

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Introduction

Salivary gland swellings comprise a heterogeneous group of inflammatory, cystic and neoplastic lesions arising from the major or minor salivary glands. Salivary gland tumours are relatively uncommon, accounting for approximately 3–6% of head-and-neck neoplasms, with a reported annual incidence of 0.4–13.5 cases per 100,000 population [1]. Despite their rarity, these lesions present a diagnostic challenge because benign and malignant tumours

may have similar clinical and radiological appearances, while individual tumour types display considerable morphological overlap. Accurate preoperative assessment is therefore essential for selecting appropriate treatment and counselling patients regarding the extent and potential complications of surgery. Fine-needle aspiration cytology (FNAC) is a rapid, minimally invasive and cost-effective investigation widely used in the initial

evaluation of salivary gland swellings. It can differentiate non-neoplastic lesions from neoplasms and stratify neoplastic lesions as benign, indeterminate, suspicious or malignant. Published studies have reported sensitivity ranging from 54% to 92% and specificity from 86% to 100% for identifying malignancy [2]. Consequently, FNAC findings may influence decisions regarding conservative management, repeat or image-guided sampling, superficial versus total parotidectomy, facial-nerve counselling, neck management and referral to a specialised head-and-neck oncology unit. Current clinical guidelines recommend FNAC or core-needle biopsy to distinguish salivary gland malignancies from non-malignant lesions before definitive treatment [3].

The Milan System for Reporting Salivary Gland Cytopathology provides a standardised six-tier classification, with each category linked to an estimated risk of malignancy and a recommended management approach [4]. A meta-analysis of 35 studies reported malignancy risks of approximately 2.8% for benign neoplasms, 37.7% for salivary gland neoplasm of uncertain malignant potential, 83.8% for lesions suspicious for malignancy and 97.7% for malignant cytology [4]. Nevertheless, sampling inadequacy, cystic change, tumour heterogeneity and overlapping cytomorphological features may produce indeterminate or false-negative findings. Therefore, evaluating FNAC results against subsequent clinical management and histopathological diagnosis is important. The present study was undertaken to determine the cytological spectrum of salivary gland swellings and assess the clinical implications of FNAC findings in guiding their management.

Materials and Methods

Study Design and Setting: This hospital-based prospective observational study was conducted in the Departments of Pathology and Otorhinolaryngology at a tertiary-care teaching hospital of Uttarakhand, for a period of 18 months from January 2025 to June 2026. The study evaluated the cytological spectrum of salivary gland swellings, the influence of fine-needle aspiration cytology (FNAC) findings on clinical management and, where surgical specimens were available, the diagnostic agreement between FNAC and histopathology.

Study Participants and Sampling: All consecutive patients aged ≥ 18 years presenting with a clinically or radiologically identified swelling arising from the parotid, submandibular, sublingual or minor salivary glands during the study period were screened for eligibility. Patients undergoing FNAC for the first time and providing written informed consent were included. Patients with previously treated or recurrent salivary gland tumours, swellings proven

to originate from lymph nodes or other non-salivary structures, inadequate clinical records, uncorrected bleeding disorders, or refusal to participate were excluded. Consecutive sampling was employed to minimise selection bias. The final sample comprised 79 eligible participants.

Clinical and Radiological Assessment: A structured case-record form was used to document age, sex, duration and progression of swelling, pain, fever, xerostomia, relation to meals, previous radiation exposure and relevant personal history. Examination findings included anatomical site, size, consistency, mobility, tenderness, skin or mucosal involvement, facial-nerve function and regional lymphadenopathy. Ultrasonography was performed for superficial lesions, whereas contrast-enhanced computed tomography or magnetic resonance imaging was requested for deep-lobe, poorly defined or clinically suspicious lesions. Before FNAC, the treating clinician recorded the provisional diagnosis and intended management plan.

FNAC Procedure: FNAC was performed under aseptic precautions by a pathologist or trained clinician. Palpable superficial swellings were aspirated using a 22–25-gauge needle attached to a 10-mL disposable syringe. Two to four passes were made from different representative areas while avoiding visibly necrotic or vascular regions. Small, deep, cystic or ill-defined lesions were aspirated under ultrasonographic guidance. Cystic contents were completely aspirated, and any residual solid component was sampled separately. Direct smears were prepared immediately; air-dried smears were stained with May–Grünwald–Giemsa stain, while alcohol-fixed smears were stained using the Papanicolaou or haematoxylin and eosin method. Cell blocks and ancillary tests were prepared when sufficient material was available. No definitive treatment decision was based solely on an inadequate aspirate (Figure 1).

Cytological Interpretation: Smears were examined by experienced cytopathologists and classified according to the Milan System for Reporting Salivary Gland Cytopathology as: category I, nondiagnostic; category II, non-neoplastic; category III, atypia of undetermined significance; category IVa, benign neoplasm; category IVb, salivary gland neoplasm of uncertain malignant potential; category V, suspicious for malignancy; or category VI, malignant. Whenever possible, a specific cytological diagnosis was provided. Cases with inadequate cellularity were subjected to repeat FNAC, preferably with image guidance.

Assessment of Clinical Implications: Following receipt of the FNAC report, the treating clinician documented the revised management plan. Non-neoplastic lesions were managed medically,

observed or investigated further according to the underlying condition. Benign neoplasms were considered for elective, appropriately conservative surgery, whereas indeterminate or suspicious lesions underwent repeat image-guided FNAC, core-needle biopsy, surgical excision or multidisciplinary review.

Cytologically malignant lesions were evaluated for definitive oncological surgery, neck management and adjuvant treatment. FNAC was considered to have modified management when the post-FNAC plan differed from the pre-FNAC plan in terms of observation, additional investigation, operative extent, urgency or oncology referral.

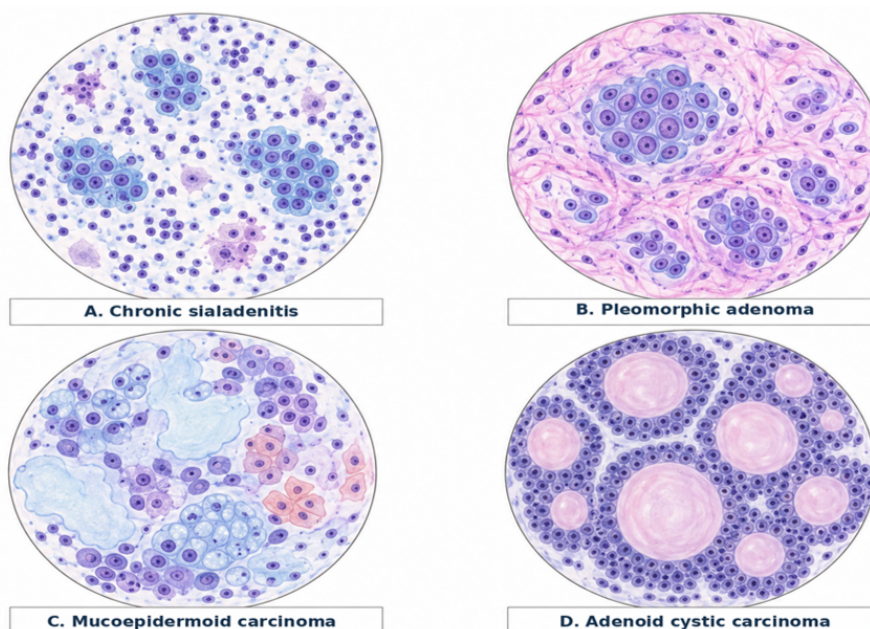


Figure 1: A: Chronic sialadenitis—mixed inflammatory background with ductal cells. B: Pleomorphic adenoma—epithelial/myoepithelial cells within fibrillary chondromyxoid stroma. C: Mucoepidermoid carcinoma—mucinous, intermediate and squamoid cells in a mucinous background. D: Adenoid cystic carcinoma—uniform basaloid cells surrounding hyaline globules

Histopathological Correlation: For patients undergoing surgery, specimens were fixed in 10% neutral-buffered formalin, routinely processed, sectioned and stained with haematoxylin and eosin. Immunohistochemistry was used when required. The final histopathological diagnosis was regarded as the reference standard. Cytological and histopathological diagnoses were compared for neoplastic status, benign-versus-malignant categorisation and specific tumour type.

Outcome Measures: The primary outcome was the proportion of patients in whom FNAC influenced or changed clinical management. Secondary outcomes included the distribution of Milan categories, cytohistopathological concordance, nondiagnostic rate, sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy for malignancy. Categories V and VI were considered cytologically positive for malignancy, while categories II and IVa were considered negative. Categories I, III and IVb were analysed separately as indeterminate results.

Statistical Analysis: Data were analysed using SPSS version 20.0. Continuous variables were

presented as mean $\pm$ standard deviation or median with interquartile range, and categorical variables as frequency and percentage. Agreement was assessed using Cohen's kappa. The chi-square or Fisher's exact test was used for categorical comparisons, with $p < 0.05$ considered statistically significant.

Ethical Considerations: The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from every participant, and confidentiality was maintained through anonymised data collection.

Results

The mean age was 44.8 ± 15.7 years, with 43 (54.4%) females and 45 (57.0%) rural residents. The parotid gland was most frequently involved in 48 (60.8%) participants, followed by the submandibular gland in 25 (31.6%). The median symptom duration was 5 months (IQR: 2–12), and mean swelling diameter was 3.1 ± 1.3 cm. Pain, rapid enlargement and radiological suspicion of malignancy were documented in 23 (29.1%), 17 (21.5%) and 20 (25.3%) participants, respectively.

Table 1: Baseline demographic, clinical and radiological characteristics of participants with salivary gland swellings (N=79)

Characteristic	Frequency (%) / mean $\pm$ SD / median (IQR)
Age, years	44.8 $\pm$ 15.7
Age group	
18–30 years	14 (17.7)
31–45 years	25 (31.6)
46–60 years	26 (32.9)
>60 years	14 (17.7)
Gender	
Male	36 (45.6)
Female	43 (54.4)
Residence	
Rural	45 (57.0)
Urban	34 (43.0)
Duration of swelling, months	5 (2–12)
Anatomical site	
Parotid gland	48 (60.8)
Submandibular gland	25 (31.6)
Sublingual gland	2 (2.5)
Minor salivary gland	4 (5.1)
Maximum diameter, cm	3.1 $\pm$ 1.3
Lesion diameter >4 cm	17 (21.5)
Pain	23 (29.1)
Rapid increase in size	17 (21.5)
Meal-related pain or swelling	14 (17.7)
Tenderness	16 (20.3)
Fixation to surrounding structures	15 (19.0)
Skin or mucosal involvement	5 (6.3)
Facial-nerve weakness	4 (5.1)
Clinically palpable regional lymph nodes	9 (11.4)
Radiologically suspicious for malignancy	20 (25.3)

IQR, interquartile range; SD, standard deviation.

Benign neoplasm was the most frequent FNAC category, accounting for 31 (39.2%) cases, followed by non-neoplastic lesions in 20 (25.3%). Pleomorphic adenoma was the most common individual diagnosis in 23 (29.1%) participants. Eleven (13.9%) aspirates were classified as

suspicious or malignant. Histopathology was available for 53 (67.1%) surgically managed participants; 43 entered the primary binary diagnostic analysis, while 10 nondiagnostic or indeterminate cases were analysed separately (Table 2 and Figure 2).

Table 2: Distribution of Milan FNAC categories, anatomical sites and participant flow through diagnostic evaluation (N=79)

Milan category	Overall (n=79)	Parotid (n=48)	Submandibular (n=25)	Sublingual (n=2)	Minor gland (n=4)	Principal cytological findings
	Frequency (%)	Frequency				
I: Nondiagnostic	5 (6.3)	2	2	0	1	Insufficient cellular material/blood only
II: Non-neoplastic	20 (25.3)	8	11	1	0	Chronic sialadenitis 11; abscess/acute sialadenitis 4; retention cyst 3; sialadenosis 2
III: AUS	6 (7.6)	4	2	0	0	Limited atypia not diagnostic of a neoplasm
IVa: Benign neoplasm	31 (39.2)	25	5	0	1	Pleomorphic adenoma 23; Warthin tumour 5; basal-cell adenoma 2; oncocytoma 1
IVb: SUMP	6 (7.6)	4	1	0	1	Cellular basaloid or oncocytic neoplasm of uncertain potential
V: Suspicious for malignancy	4 (5.1)	2	1	0	1	Cytological atypia strongly suggestive of carcinoma
VI: Malignant	7 (8.9)	3	3	1	0	Mucoepidermoid carcinoma 3; adenoid cystic carcinoma 2; acinic-cell carcinoma 1; carcinoma ex pleomorphic adenoma 1

AUS, atypia of undetermined significance; FNAC, fine-needle aspiration cytology; SUMP, salivary gland neoplasm of uncertain malignant potential. Milan categories I, III and IVb were considered nondiagnostic or indeterminate for the primary binary analysis.

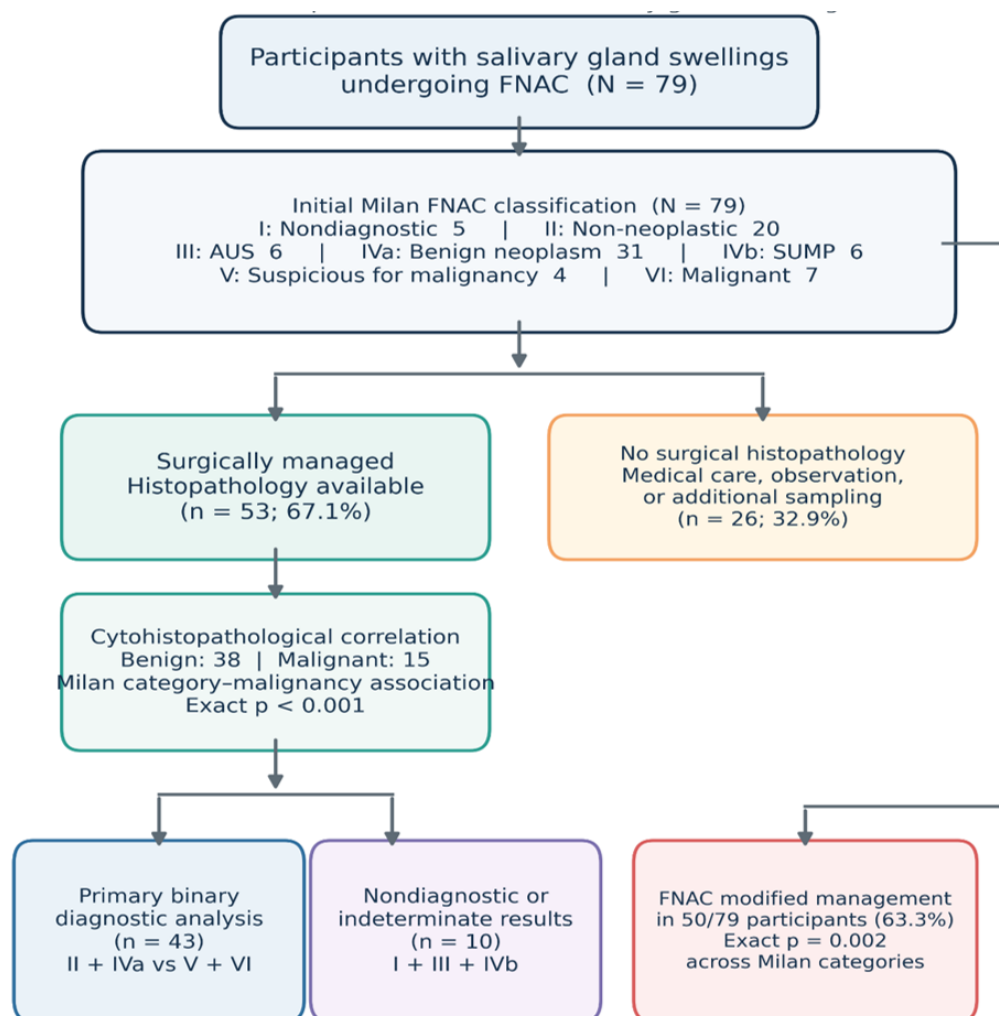


Figure 2: Flow of participants through FNAC evaluation, clinical management, histopathological correlation and diagnostic-accuracy analysis. FNAC, fine-needle aspiration cytology; AUS, atypia of undetermined significance; SUMP, salivary gland neoplasm of uncertain malignant potential

Compared with Milan categories I–IVb, high-risk categories V–VI were significantly associated with rapid enlargement (72.7% versus 13.2%; $p < 0.001$), fixation (63.6% versus 11.8%; $p < 0.001$), facial-nerve weakness (27.3% versus 1.5%; $p = 0.008$), regional lymphadenopathy (45.5% versus 5.9%;

$p = 0.002$), skin or mucosal involvement (27.3% versus 2.9%; $p = 0.018$) and radiological suspicion of malignancy (81.8% versus 16.2%; $p < 0.001$). Pain and lesion diameter > 4 cm did not reach statistical significance (Table 3).

Table 3: Association of clinical and radiological features with high-risk FNAC findings (N=79)

Feature	Milan V–VI (n=11)	Milan I–IVb (n=68)	p-value
	Frequency (%)		
Rapid increase in size	8 (72.7)	9 (13.2)	<0.001
Pain	6 (54.5)	17 (25.0)	0.071
Lesion diameter >4 cm	5 (45.5)	12 (17.6)	0.052
Fixation to surrounding structures	7 (63.6)	8 (11.8)	<0.001
Facial-nerve weakness	3 (27.3)	1 (1.5)	0.008
Regional lymphadenopathy	5 (45.5)	4 (5.9)	0.002
Skin or mucosal involvement	3 (27.3)	2 (2.9)	0.018
Radiological suspicion of malignancy	9 (81.8)	11 (16.2)	<0.001

High-risk FNAC was defined as Milan category V or VI. Comparisons were performed using Fisher's exact test; two-sided $p < 0.05$ indicated statistical significance.

Following FNAC, 19 (24.1%) participants received medical treatment or observation, 10 (12.7%)

underwent repeat FNAC or core biopsy, 39 (49.4%) underwent elective or limited surgery and 11

(13.9%) received oncological surgery or multidisciplinary care. FNAC modified the initially intended management in 50 (63.3%) participants, including all patients in categories V and VI, with significant variation across Milan categories

($p=0.002$). The principal effects were avoidance of surgery in 15 (30.0%), alteration of surgical extent or urgency in 12 (24.0%) and additional tissue sampling in 8 (16.0%) of the 50 affected participants (Table 4 and Figure 3).

Table 4: Influence of Milan FNAC categories on subsequent clinical management (N=79)

Milan category	Medical treatment/ observation	Repeat FNAC or core biopsy	Elective or limited surgery	Oncological surgery/MDT care	Management modified
	Frequency				Frequency (%)
I: Nondiagnostic (n=5)	0	5	0	0	4 (80.0)
II: Non-neoplastic (n=20)	17	0	3	0	15 (75.0)
III: AUS (n=6)	0	4	2	0	4 (66.7)
IVa: Benign neoplasm (n=31)	2	0	29	0	11 (35.5)
IVb: SUMP (n=6)	0	1	5	0	5 (83.3)
V: Suspicious for malignancy (n=4)	0	0	0	4	4 (100.0)
VI: Malignant (n=7)	0	0	0	7	7 (100.0)
Overall	19 (24.1)	10 (12.7)	39 (49.4)	11 (13.9)	50 (63.3)
Clinical implication of FNAC					Frequency (%)
Avoidance or deferment of initially contemplated surgery					15 (30.0)
Repeat image-guided FNAC or core-needle biopsy requested					8 (16.0)
Initiation or confirmation of elective surgery					8 (16.0)
Alteration in extent or urgency of surgery					12 (24.0)
Oncology referral or multidisciplinary management initiated					7 (14.0)
Overall					50 (100.0)

AUS, atypia of undetermined significance; FNAC, fine-needle aspiration cytology; MDT, multidisciplinary team; SUMP, salivary gland neoplasm of uncertain malignant potential. The p -value was obtained using the Fisher–Freeman–Halton exact test.

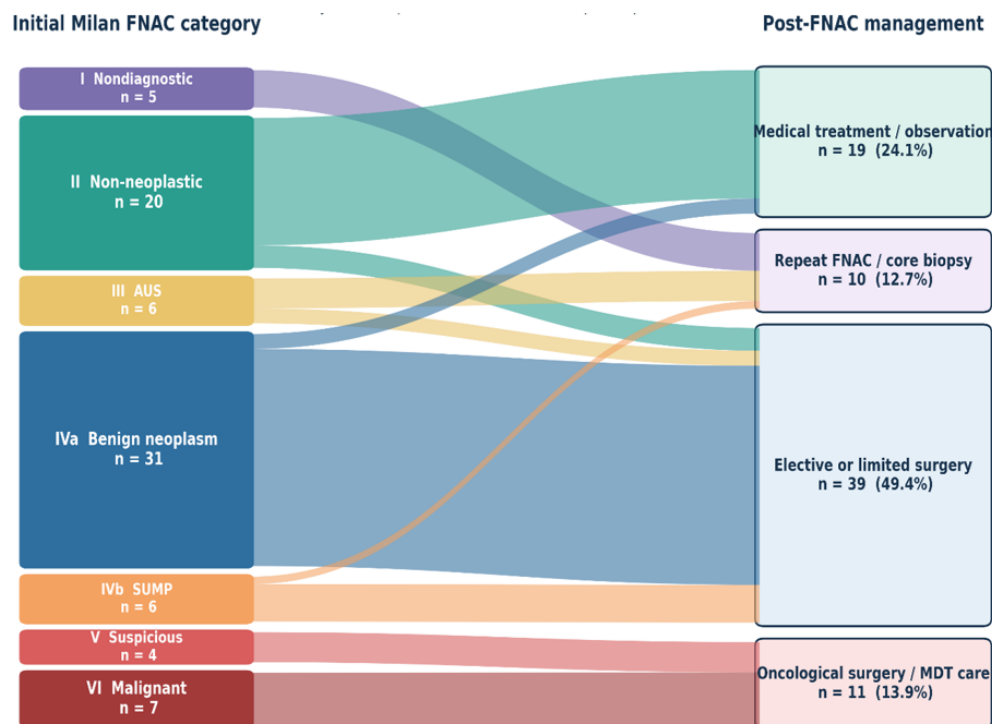


Figure 3: Influence of Milan FNAC categories on subsequent management of salivary gland swellings. The width of each connecting pathway represents the number of participants. MDT, multidisciplinary team

Histopathology demonstrated 38 (71.7%) benign and 15 (28.3%) malignant lesions. The observed malignancy rate increased from 10.3% in category IVa to 40.0% in IVb, 75.0% in V and 100.0% in VI ($p < 0.001$). Three category IVa lesions were malignant on histopathology—two low-grade mucoepidermoid carcinomas and one acinic-cell carcinoma—while one category V lesion was a cellular pleomorphic adenoma.

Table 5: Correlation of Milan FNAC categories with final histopathological diagnosis among surgically managed participants (n=53)

Initial Milan category	Surgical specimens (n=53)	Benign histopathology	Malignant histopathology	Observed risk of malignancy
	Frequency	Frequency (%)		%
I: Nondiagnostic	1	1 (100.0)	0	0.00%
II: Non-neoplastic	4	4 (100.0)	0	0.00%
III: AUS	4	3 (75.0)	1 (25.0)	25.00%
IVa: Benign neoplasm	29	26 (89.7)	3 (10.3)	10.30%
IVb: SUMP	5	3 (60.0)	2 (40.0)	40.00%
V: Suspicious for malignancy	4	1 (25.0)	3 (75.0)	75.00%
VI: Malignant	6	0	6 (100.0)	100.00%
Overall	-	38 (71.7)	15 (28.3)	28.30%

AUS, atypia of undetermined significance; SUMP, salivary gland neoplasm of uncertain malignant potential. Histopathology was the reference standard. The association was evaluated using the Fisher–Freeman–Halton exact test.

FNAC demonstrated a sensitivity of 75.0% (95% CI: 42.8–94.5), specificity of 96.8% (95% CI: 83.3–99.9), positive predictive value of 90.0%, negative predictive value of 90.9% and overall diagnostic accuracy of 90.7%. Agreement with histopathology was substantial, with a Cohen's kappa of 0.76 (Table 6).

Table 6: Diagnostic performance of FNAC for detecting salivary gland malignancy (n=43)

Diagnostic parameter	Estimate	95% CI
Sensitivity	75.0% (9/12)	42.8–94.5
Specificity	96.8% (30/31)	83.3–99.9
Positive predictive value	90.0% (9/10)	55.5–99.7
Negative predictive value	90.9% (30/33)	75.7–98.1
Overall diagnostic accuracy	90.7% (39/43)	77.9–97.4
Cohen's kappa	0.76	—

CI, confidence interval; FNAC, fine-needle aspiration cytology. Categories V–VI were considered positive and categories II and IVa negative for malignancy; categories I, III and IVb were excluded from the primary binary analysis. Exact binomial 95% CIs were used.

Discussion

The present study demonstrates that FNAC provides clinically actionable risk stratification rather than merely a preoperative morphological diagnosis in patients with salivary gland swellings. FNAC modified the intended management in 50 (63.3%) participants, while achieving 90.7% diagnostic accuracy and substantial cytohistopathological agreement ($\kappa=0.76$). This combination of high diagnostic confidence and direct influence on treatment supports FNAC as an effective triage investigation. Previous studies by Liu et al., and Feinstein et al., have similarly characterised salivary gland FNAC as having moderate sensitivity but consistently high specificity, making it particularly reliable for confirming malignancy and planning definitive treatment [5,6].

The parotid gland was involved in 48 (60.8%) participants, followed by the submandibular gland in 25 (31.6%), consistent with Indian studies by Omhare et al., and Arul et al., identifying the parotid as the predominant site [7,8]. Benign neoplasms constituted the largest Milan category (39.2%), and pleomorphic adenoma was the commonest specific diagnosis (29.1%). Gaikwad et al., similarly, reported 46.8% benign neoplasms and 13.9% malignant aspirates in a Western Indian cohort [9]. Pleomorphic adenoma predominance has also been documented by Pujani et al., Rohilla et al., and Kala et al., confirming its importance in the Indian cytological spectrum [10,11,12].

High-risk Milan categories V–VI were strongly associated with rapid enlargement, fixation, facial-nerve weakness, regional lymphadenopathy, skin or mucosal involvement and radiological suspicion. These findings are biologically plausible because malignant lesions exhibit infiltrative growth, perineural invasion and lymphatic dissemination. Pain and size >4 cm were not independently significant, probably because pain may accompany inflammatory lesions and benign tumours can attain large dimensions without malignant transformation. Thus, FNAC should be interpreted alongside clinical and radiological findings rather than as an isolated investigation. The principal clinical contribution of FNAC was its ability to direct patients towards

appropriate management: 19 (24.1%) received medical treatment or observation, 10 (12.7%) underwent additional sampling, 39 (49.4%) underwent elective or limited surgery and 11 (13.9%) received oncological surgery or multidisciplinary care. Management was modified in every category V and VI case, and the variation across Milan categories was significant ($p=0.002$). Sharma et al. reported that ultrasound-guided FNAC spared 40% of patients from surgery [13]. Rossi et al. demonstrated 91.3% accuracy and emphasised the usefulness of risk-based cytology for selecting surgical candidates, while Naz et al., highlighted its role in avoiding unnecessary operations [14,15]. The present findings extend this benefit beyond surgery avoidance to repeat sampling, alteration of operative extent and timely oncological referral.

Among 53 surgically verified lesions, malignancy risk increased from 10.3% in category IVa to 40.0% in IVb, 75.0% in V and 100% in VI ($p<0.001$). This stepwise increase validates the biological and clinical gradient intended by the Milan system. Wu et al., reported corresponding risks of 2.9%, 40.7%, 100% and 98.3% [16], while meta-analyses by Farahani et al., and Jalaly et al., reported approximately 4% for benign neoplasms, 39–42% for SUMP, 58–84% for suspicious lesions and 91–98% for malignant cytology [17,18]. The relatively elevated category IVa risk in the present study may reflect the small, selectively resected subgroup and consequent verification bias. Variability among centres may additionally result from sampling technique, cytopathologist experience and differences in category thresholds [19].

FNAC showed 75.0% sensitivity, 96.8% specificity, 90.0% positive predictive value and 90.9% negative predictive value. The high specificity supports proceeding with oncological planning after suspicious or malignant cytology, whereas the lower sensitivity cautions against excluding malignancy solely on a benign aspirate. The three false-negative category IVa lesions—two low-grade mucoepidermoid carcinomas and one acinic-cell carcinoma—can be explained by bland cytological features, cystic change and tumour heterogeneity. Conversely, cellular pleomorphic adenoma produced one false-positive result because epithelial

predominance and reduced stromal material may simulate carcinoma [20].

Such discrepancies are recognised limitations of salivary cytology [21]. Repeat ultrasound-guided sampling, cell-block preparation, core biopsy or ancillary testing should therefore be considered when cytology is inadequate, indeterminate or discordant with clinical and imaging findings.

Limitations

This single-centre study included a relatively small sample, particularly within the indeterminate and malignant Milan categories, limiting the precision of category-specific malignancy estimates. Histopathological verification was available only for surgically managed participants, introducing partial verification and selection bias. Diagnostic performance may also have been influenced by operator and cytopathologist experience. The study did not systematically evaluate interobserver agreement, ancillary testing, long-term outcomes or cost-effectiveness.

Conclusion

FNAC was a clinically useful, minimally invasive investigation for evaluating salivary gland swellings. Milan-based reporting provided progressive malignancy-risk stratification and significantly influenced decisions regarding observation, repeat sampling, elective surgery and oncological management. Its high specificity, positive predictive value and overall accuracy supported confident treatment planning, although moderate sensitivity indicated that benign cytology could not completely exclude low-grade malignancy. Integration of FNAC with clinical examination and imaging, followed by repeat image-guided aspiration, core biopsy or ancillary testing in discordant cases, may reduce diagnostic errors and avoid both unnecessary surgery and delayed cancer treatment in routine tertiary-care clinical practice.

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