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Diagnostic Value of Intraoperative Frozen Section in Parotid Gland Tumors: A Retrospective Study of 74 Cases

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Abstract

Objective: Parotid gland tumors present diagnostic and therapeutic challenges due to their wide histopathologic spectrum. This study aimed to evaluate the diagnostic accuracy of intraoperative frozen section (FS) examination in parotid tumors by comparing FS results with final histopathology, and to assess its utility in guiding surgical management.

Methods: We conducted a retrospective observational study of 74 patients who underwent parotidectomy with intraoperative FS at the Mohammed VI University Hospital in Marrakech between January 2018 and December 2023. FS diagnoses were compared with final histopathological results. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), accuracy, and error rates were calculated.

Results: Among 74 patients (mean age: 47 years), FS suggested a benign tumor in 52 cases (70.3%) and a malignant tumor in 22 cases (29.7%). Final histology confirmed 50 benign neoplasms (67.6%) and 24 malignant tumors (32.4%). FS showed a sensitivity of 90%, specificity of 89%, PPV of 80%, NPV of 96%, and an overall accuracy of 89%. Discrepancies occurred in 7 cases (9.5%), mainly due to misclassification of low-grade malignancies as benign neoplasms. The most common benign tumor was pleomorphic adenoma (59.4%) and the most frequent malignancy was mucoepidermoid carcinoma (12.1%).

Conclusion: Intraoperative frozen section is a reliable tool for distinguishing between benign and malignant parotid tumors. When integrated with clinical and radiological findings, FS can significantly improve intraoperative decision-making, allowing for appropriate surgical planning and minimizing the risks of over- or under-treatment.

Keywords: Parotid gland; Frozen section; Salivary gland tumor; Diagnostic accuracy; Intraoperative pathology; Histopathology

1. Introduction

Parotid gland tumors encompass a wide spectrum of histologic types, ranging from benign neoplasms to aggressive malignancies. Accurate intraoperative diagnosis is crucial to guide the extent of surgical resection and avoid over- or under-treatment [1]. Fine-needle aspiration cytology (FNAC) is frequently used preoperatively, but may yield inconclusive or non-specific results in a significant proportion of cases [2].

Frozen section examination (FS) provides rapid intraoperative histologic evaluation, helping to distinguish benign from malignant tumors and influencing real-time surgical decisions [3]. FS is particularly useful when FNAC is non-diagnostic

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or when the intraoperative findings are discordant with preoperative assessments [4]. Despite its utility, the accuracy of FS can vary depending on tumor subtype and sampling technique [5].

The aim of this study was to evaluate the diagnostic accuracy of frozen section examination in parotid tumors, by comparing intraoperative FS diagnoses with final histopathological results, and to assess its utility in guiding surgical management.

2. Materials and methods

We conducted a retrospective observational study on patients who underwent parotidectomy with intraoperative frozen section examination at the ENT-HNS Department in the Mohammed VI university hospital of Marrakech in Morocco, between January 2018 and December 2023, a six-year period. Patient data were retrieved from the hospital's electronic medical record system. Cases were identified using the search terms "parotid", "parotidectomy", and "frozen section" in the pathology and surgical databases.

Inclusion criteria were: (1) patients who underwent surgery for a parotid mass, (2) intraoperative frozen section performed, and (3) availability of definitive histopathological diagnosis. A total of 74 cases met these criteria and were included in the study.

Frozen section was performed as part of standard institutional practice during all parotid surgeries, regardless of preoperative FNAC results. However, its role was particularly critical in cases where FNAC was inconclusive or suggestive but non-definitive.

For each patient, the following data were extracted: age, sex, preoperative clinical and radiological diagnosis, frozen section diagnosis, and final histological diagnosis.

The diagnostic performance of frozen section was assessed by calculating its sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy for the detection of malignancy, using the final histopathological diagnosis as the gold standard.

3. Results

A total of 74 patients were included in the study. The mean age was 47 years (range: 15–75 years). There were 34 males (46%) and 40 females (54%). The average consultation delay was 36 months (range: 5–72 months). The most common clinical presentation was a parotid swelling, observed in all patients (100%), followed by pain in 25 cases (33.8%) and peripheral facial nerve palsy in 13 patients (17.6%).

Preoperative imaging consisted of contrast-enhanced cervical CT in 50 cases (67.5%) and cervical MRI in 45 cases (60.8%).

Intraoperative frozen section examination was performed in all 74 patients (100%). It suggested a benign neoplasm in 52 cases (70.3%) and a malignant neoplasm in 22 cases (29.7%). All frozen section diagnoses referred to neoplastic lesions; non-neoplastic entities were not included (Figure1).

Superficial parotidectomy was performed in 49 patients (66.2%), whereas total parotidectomy with ipsilateral lymph node dissection was performed in 21 cases (28.3%). Final histopathology confirmed a benign neoplasm in 50 cases (67.6%) and a malignant neoplasm in 24 cases (32.4%) (Figure1).

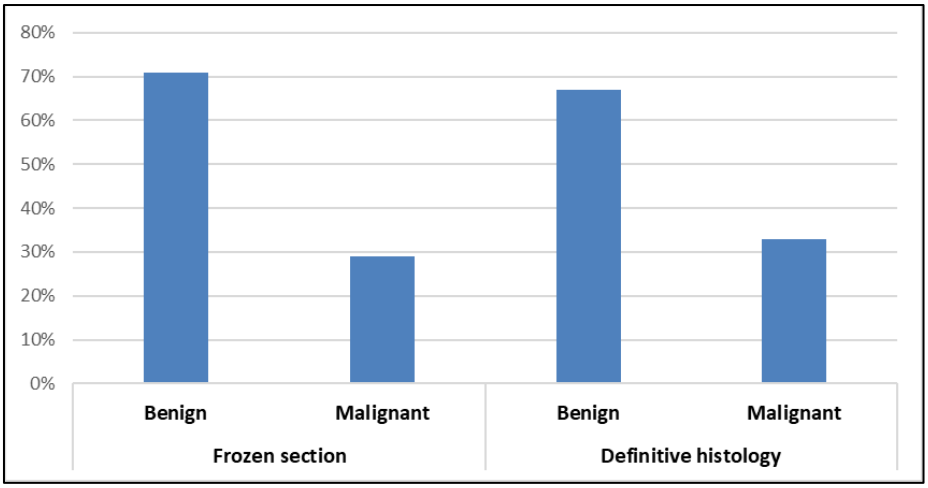

Figure 1 Distribution of Frozen section vs Final Histology diagnosis

The most frequent benign tumor was pleomorphic adenoma in 44 cases (59.4%), followed by Warthin tumour in 9 cases (12.1%) and cystadenoma in 6 cases (8.1%). Among malignant tumors, mucoepidermoid carcinoma was the most common in 9 cases (12.1%), followed by acinic cell carcinoma in 5 cases (6.7%), adenoid cystic carcinoma in 4 cases (5.4%), adenocarcinoma, NOS in 3 cases (4.0%), carcinoma ex pleomorphic adenoma in 2 cases (2.7%), and metastatic squamous cell carcinoma in 2 cases (2.7%). In the three adenocarcinoma, NOS cases, other well-defined salivary gland carcinoma types, particularly salivary duct carcinoma and secretory carcinoma, were excluded in accordance with WHO classification. Both squamous cell carcinomas were confirmed as metastatic. The primary sites were identified as the skin of the temporal region in one case and the oropharynx in the other (Table1)

Discrepancies between frozen section and final histology occurred in **7 cases** (9.5%). This involved misclassification between low-grade carcinomas and benign tumors such as pleomorphic adenoma or Warthin tumour.

A case-by-case comparison was performed, detailing the preoperative clinicoradiological impression, the intraoperative frozen section diagnosis, and the final histopathological diagnosis. These data are summarized in Table 2.

The diagnostic performance of frozen section analysis in detecting malignancy was evaluated using the final histopathological diagnosis as the reference standard. The calculated metrics were as follows: sensitivity 90%, specificity 89%, accuracy 89%, positive predictive value (PPV) 80%, negative predictive value (NPV) 96%, false positive rate 11.3%, false negative rate 9.5%, and critical success index 63%.

These results confirm the reliability of frozen section for distinguishing benign from malignant neoplasms intraoperatively.

Table 1 Histological distribution of benign and malignant parotid neoplasms

Histological type	**Number of cases (n)**	**Percentage (%)**
Benign neoplasms (n = 50)		
Pleomorphic adenoma	44	59.4%
Warthin tumour	9	12.1%
Cystadenoma	6	8.1%
Basal cell adenoma	4	5.4%
Myoepithelioma	2	2.7%
Oncocytoma	1	1.3%
Malignant neoplasms (n = 24)		
Mucoepidermoid carcinoma	9	12.1%

Acinic cell carcinoma	5	6.7%
Adenoid cystic carcinoma	4	5.4%
Carcinoma ex pleomorphic adenoma	2	2.7%
Adenocarcinoma, NOS	3	4.0%
Squamous cell carcinoma (metastatic)	2	2.7%

Table 2 Correlation of Preoperative Clinical-Radiological Diagnosis, Frozen Section Diagnosis, and Final Histopathological Diagnosis for Each Case

Patient No.	Preoperative Diagnosis	Frozen Section Diagnosis	Final Histopathology
1	Benign neoplasm	Benign neoplasm	Cystadenoma
2	Suspicious malignancy	Malignant neoplasm	Mucoepidermoid carcinoma
3	Benign neoplasm	Benign neoplasm	Pleomorphic adenoma
4	Suspicious malignancy	Benign neoplasm	Pleomorphic adenoma
5	Suspicious malignancy	Benign neoplasm	Pleomorphic adenoma
6	Suspicious malignancy	Malignant neoplasm	Mucoepidermoid carcinoma
7	Malignant neoplasm	Benign neoplasm	Warthin tumour
8	Benign neoplasm	Malignant neoplasm	Acinic cell carcinoma
9	Benign neoplasm	Benign neoplasm	Acinic cell carcinoma
10	Suspicious malignancy	Malignant neoplasm	Metastatic squamous cell carcinoma
11	Suspicious malignancy	Malignant neoplasm	Adenocarcinoma, NOS
12	Suspicious malignancy	Malignant neoplasm	Salivary duct carcinoma
13	Malignant neoplasm	Benign neoplasm	Cystadenoma
14	Benign neoplasm	Benign neoplasm	Warthin tumour
15	Benign neoplasm	Benign neoplasm	Pleomorphic adenoma
16	Benign neoplasm	Benign neoplasm	Warthin tumour
17	Benign neoplasm	Benign neoplasm	Warthin tumour
18	Indeterminate	Benign neoplasm	Cystadenoma
19	Benign neoplasm	Malignant neoplasm	Mucoepidermoid carcinoma
20	Benign neoplasm	Malignant neoplasm	Salivary duct carcinoma
21	Suspicious malignancy	Benign neoplasm	Acinic cell carcinoma
22	Malignant neoplasm	Benign neoplasm	Pleomorphic adenoma
23	Benign neoplasm	Benign neoplasm	Pleomorphic adenoma
24	Indeterminate	Malignant neoplasm	Acinic cell carcinoma
25	Suspicious malignancy	Benign neoplasm	Salivary duct carcinoma
26	Benign neoplasm	Benign neoplasm	Pleomorphic adenoma
27	Suspicious malignancy	Benign neoplasm	Cystadenoma
28	Malignant neoplasm	Benign neoplasm	Pleomorphic adenoma

29	Indeterminate	Benign neoplasm	Pleomorphic adenoma
30	Benign neoplasm	Benign neoplasm	Cystadenoma
31	Malignant neoplasm	Benign neoplasm	Pleomorphic adenoma
32	Benign neoplasm	Malignant neoplasm	Adenocarcinoma, NOS
33	Indeterminate	Malignant neoplasm	Mucoepidermoid carcinoma
34	Malignant neoplasm	Benign neoplasm	Cystadenoma
35	Benign neoplasm	Benign neoplasm	Pleomorphic adenoma
36	Benign neoplasm	Benign neoplasm	Salivary duct carcinoma
37	Malignant neoplasm	Benign neoplasm	Warthin tumour
38	Benign neoplasm	Malignant neoplasm	Metastatic squamous cell carcinoma
39	Benign neoplasm	Benign neoplasm	Cystadenoma
40	Benign neoplasm	Malignant neoplasm	Adenocarcinoma, NOS
41	Malignant neoplasm	Benign neoplasm	Pleomorphic adenoma
42	Benign neoplasm	Benign neoplasm	Salivary duct carcinoma
43	Malignant neoplasm	Malignant neoplasm	Acinic cell carcinoma
44	Benign neoplasm	Malignant neoplasm	Warthin tumour
45	Benign neoplasm	Benign neoplasm	Pleomorphic adenoma
46	Malignant neoplasm	Malignant neoplasm	Mucoepidermoid carcinoma
47	Benign neoplasm	Benign neoplasm	Warthin tumour
48	Malignant neoplasm	Benign neoplasm	Pleomorphic adenoma
49	Suspicious malignancy	Malignant neoplasm	Acinic cell carcinoma
50	Benign neoplasm	Malignant neoplasm	Salivary duct carcinoma
51	Benign neoplasm	Benign neoplasm	Pleomorphic adenoma
52	Benign neoplasm	Benign neoplasm	Cystadenoma
53	Benign neoplasm	Benign neoplasm	Pleomorphic adenoma
54	Suspicious malignancy	Benign neoplasm	Adenocarcinoma, NOS
55	Malignant neoplasm	Benign neoplasm	Pleomorphic adenoma
56	Suspicious malignancy	Benign neoplasm	Pleomorphic adenoma
57	Indeterminate	Benign neoplasm	Warthin tumour
58	Malignant neoplasm	Malignant neoplasm	Acinic cell carcinoma
59	Benign neoplasm	Benign neoplasm	Warthin tumour
60	Benign neoplasm	Malignant neoplasm	Salivary duct carcinoma
61	Indeterminate	Benign neoplasm	Warthin tumour
62	Benign neoplasm	Malignant neoplasm	Acinic cell carcinoma
63	Benign neoplasm	Benign neoplasm	Warthin tumour
64	Benign neoplasm	Benign neoplasm	Salivary duct carcinoma
65	Benign neoplasm	Malignant neoplasm	Salivary duct carcinoma
66	Benign neoplasm	Malignant neoplasm	Metastatic squamous cell carcinoma

67	Indeterminate	Malignant neoplasm	Metastatic squamous cell carcinoma
68	Benign neoplasm	Benign neoplasm	Pleomorphic adenoma
69	Benign neoplasm	Benign neoplasm	Warthin tumour
70	Indeterminate	Benign neoplasm	Mucoepidermoid carcinoma
71	Benign neoplasm	Benign neoplasm	Metastatic squamous cell carcinoma
72	Indeterminate	Benign neoplasm	Cystadenoma
73	Benign neoplasm	Benign neoplasm	Metastatic squamous cell carcinoma
74	Suspicious malignancy	Benign neoplasm	Cystadenoma

4. Discussion

Frozen section examination remains a crucial intraoperative diagnostic tool in the management of parotid tumors. Its indications depend primarily on the tumor's location, size, and the need to assess histological nature during surgery, particularly in settings where preoperative cytology is inconclusive or unavailable. In our series, frozen section was performed in all cases as part of the institutional surgical protocol.

Compared to fine-needle aspiration cytology (FNAC) or core needle biopsy, frozen section offers significant intraoperative advantages. While FNAC is minimally invasive and widely used, it may yield non-diagnostic or equivocal results. Frozen section enables real-time pathological assessment, allowing surgeons to tailor the extent of parotidectomy and facial nerve management intraoperatively. In our study, its diagnostic performance in distinguishing benign from malignant lesions was comparable to published series, with sensitivity and specificity in agreement with the literature [6-16].

However, frozen section has limitations. Certain histological subtypes, such as low-grade malignancies and cystic neoplasms, are prone to misinterpretation, leading to false positives or false negatives. Reported false positive rates range from 0% to 12%, and false negative rates from 9% to 24% [17,18], which is consistent with our findings.

In our series, discrepancies between frozen section and final histopathology occurred in 7 cases. These included 5 false negatives (notably low-grade mucoepidermoid carcinoma and acinic cell carcinoma misinterpreted as benign lesions) and 2 false positives (Warthin tumor and oncocytoma misclassified as malignant). These findings highlight the diagnostic pitfalls of intraoperative consultation and the importance of interpreting frozen section results with caution, particularly in borderline or cystic lesions.

Despite its limitations, frozen section remains a valuable adjunct during parotid surgery. When integrated with clinical and radiological findings, it significantly enhances intraoperative decision-making, contributes to adequate surgical margins, and helps avoid overtreatment in benign cases or undertreatment in malignancies.

5. Conclusion

Intraoperative determination of parotid gland tumours has become a real challenge for both ENT physicians and pathologists. In accordance with the results of the literature, our study demonstrated that the frozen section examination is a reliable tool for predicting the nature of the parotid tumour and for guiding the therapeutic decision, thus limiting excessive surgical indications.

Compliance with ethical standards

Disclosure of conflict of interest

The authors have no relevant financial or non-financial interests to disclose.

Statement of ethical approval

The authors affirm that human research participants provided informed consent for publication of the images in all Figures.

Statement of informed consent

Written informed consent was obtained from all subjects (patients) in this study

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Author Contributions

The first draft of the manuscript was written by SS and AR, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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