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Diagnostic Accuracy of Fine-Needle Aspiration Cytology and MRI in Parotid Tumors: Correlation with Histopathology

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Abstract

Introduction: Parotid gland tumors represent the majority of salivary gland tumors and pose a diagnostic challenge due to their wide histological diversity. Reliable preoperative assessment is essential to guide surgical management.

Objective: To evaluate the degree of concordance between parotid fine-needle aspiration cytology (FNAC), imaging findings (MRI ± CT), and the definitive histological results of parotidectomy specimens.

Materials and Methods: A retrospective descriptive study was conducted in the Department of Otolaryngology and Head and Neck Surgery at Mohammed VI University Hospital of Marrakech, including 90 patients operated on for parotid tumors over a five-year period (2021–2025). All patients underwent FNAC and parotid imaging, followed by parotidectomy with histopathological examination.

Results: The mean age was 45 years (range: 18–75 years), with a female predominance. Benign tumors accounted for the majority of cases, mainly pleomorphic adenoma. FNAC showed a sensitivity of 75% and a specificity of 84.8% for the diagnosis of malignancy. MRI showed a sensitivity of 83.3% and specificity of 87.9%, while the combined FNAC–MRI approach improved diagnostic accuracy to 91.1%.

Conclusion: FNAC is a useful diagnostic tool for guiding the management of parotid tumors, with excellent specificity. MRI remains the reference imaging modality for preoperative characterization and should be performed prior to FNAC whenever possible.

Keywords: Parotid Tumor; Fine-Needle Aspiration Cytology; MRI; Histology; Diagnostic Correlation

1. Introduction

Salivary gland tumors constitute a rare and heterogeneous group of neoplasms, accounting for approximately 2–3% of all head and neck tumors. The parotid gland is the most frequently involved site, representing nearly 70–85% of salivary gland tumors, the majority of which are benign [1].

The histological diversity of parotid tumors is considerable. Benign lesions are mainly dominated by pleomorphic adenoma and Warthin tumor, whereas malignant forms are primarily represented by mucoepidermoid carcinoma, adenoid cystic carcinoma, and adenocarcinoma [1,2]. This histological heterogeneity makes preoperative diagnosis complex but essential, as it determines the surgical strategy, the extent of parotidectomy, and facial nerve preservation [2].

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Clinical examination alone is insufficient to reliably distinguish benign from malignant tumors, justifying the use of complementary investigations. Fine-needle aspiration cytology (FNAC) is a simple, minimally invasive technique widely used in the preoperative evaluation of parotid masses [3]. Although FNAC demonstrates good diagnostic specificity, its sensitivity remains variable across studies, due to histological diversity and occasionally insufficient or non-contributory samples [4].

Imaging also plays a central role in the evaluation of parotid tumors. Magnetic resonance imaging (MRI), particularly through morphological and diffusion-weighted sequences, is currently considered the reference imaging modality, allowing better lesion characterization, assessment of local extension, and more reliable diagnostic orientation toward malignancy [5].

In this context, combined analysis of clinical, cytological, and radiological data appears essential to improve preoperative diagnostic accuracy and optimize the therapeutic management of parotid tumors.

2. Materials and Methods

2.1. Study Design and Period

This was a retrospective descriptive study conducted in the Department of Otolaryngology and Head and Neck Surgery at Mohammed VI University Hospital of Marrakech. The study was carried out over a five-year period, from January 2021 to December 2025.

2.2. Study Population

The study population consisted of 90 patients managed for parotid gland tumors.

2.3. Inclusion Criteria

Patients presenting with parotid swelling who underwent:

- preoperative parotid fine-needle aspiration cytology (FNAC),
- parotid imaging (MRI with or without computed tomography),
- parotidectomy with definitive histological examination of the surgical specimen,
- were included in the study.

2.4. Exclusion Criteria

Patients without a complete preoperative workup, those with incomplete medical records, and those who did not undergo postoperative histological examination were excluded from the study.

2.5. Data Collection

Data were collected from medical records and included:

- Epidemiological data (age, sex);
- Clinical data (functional and physical signs, tumor consistency, mobility, status of the stensen duct orifice, presence of cervical lymphadenopathy);
- Radiological data from ultrasound, computed tomography, and mainly magnetic resonance imaging (tumor location, margins, t1- and t2-weighted signal characteristics, diffusion-weighted sequences, contrast enhancement, and locoregional extension);
- Cytological data from fnac, classified according to the milan system for reporting salivary gland cytopathology;
- Definitive histological data from parotidectomy specimens.

2.6. Analysis Method

FNAC and imaging results were compared with definitive histological findings, considered as the diagnostic reference. The diagnostic performance of FNAC was evaluated in terms of sensitivity and specificity for the diagnosis of malignancy.

Definitive histological examination was considered the diagnostic gold standard.

2.7. Statistical Analysis

Statistical analysis was performed using SPSS software (version 26.0, IBM Corp., Armonk, NY, USA). Qualitative variables were expressed as frequencies and percentages, while quantitative variables were expressed as means and ranges.

Diagnostic performance of FNAC and MRI was evaluated by constructing 2×2 contingency tables comparing preoperative results with definitive histopathological diagnosis, considered the gold standard.

The following parameters were calculated:

- Sensitivity
- Specificity
- Positive predictive value (PPV)
- Negative predictive value (NPV)
- Overall diagnostic accuracy

Confidence intervals were estimated at 95% when applicable.

For statistical analysis, cytological categories classified as “suspicious for malignancy” and “malignant” according to the Milan System were considered positive for malignancy. Non-diagnostic, non-neoplastic, benign neoplasms, and SUMP categories were considered negative for malignancy in the primary analysis.

2.8. Ethical Considerations

This study was conducted in accordance with the Declaration of Helsinki. As this was a retrospective study based on anonymized medical records and involved no direct patient intervention, formal ethical approval was not required. Patient confidentiality was strictly maintained throughout the study.

3. Results

3.1. Epidemiological Characteristics

A total of 90 patients were included in the study. The mean age was 45 years, with a range from 18 to 75 years. A female predominance was observed, with 66 women (73.3%) and 24 men (26.7%), corresponding to a male-to-female ratio of 0.36.

3.2. Clinical Data

- Parotid region swelling was the main reason for consultation and was present in all patients (100%).
- Peripheral facial nerve palsy was observed in 18 patients (20%), while parotid pain and lateral cervical swelling were each noted in 6 patients (6.7%).
- Local inflammatory signs were observed in 12 patients (13.3%).
- On physical examination, the parotid mass was firm in 66 cases (73.3%) and hard in 24 cases (26.7%). It was mobile in 66 cases (73.3%) and fixed in 24 cases (26.7%).
- Examination of the Stensen duct orifice was normal in 72 patients (80%), while discharge of blood or pus was observed in 18 patients (20%).
- Associated cervical lymphadenopathy was present in 18 patients (20%).

3.3. Ultrasound and Computed Tomography

Cervical ultrasound was performed in all 90 patients (100%) and represented the first-line imaging examination. Based on morphological criteria, it suggested a benign nature in approximately 68 cases (75.6%) and raised suspicion of malignancy in 22 cases (24.4%).

Cervicofacial computed tomography was performed in 64 patients (71.1%). Among these, radiological features favored benignity in 52 cases (81.3%), whereas findings suggestive of malignancy were observed in 12 cases (18.7%), particularly irregular margins and infiltration of adjacent structures.

3.4. Magnetic Resonance Imaging

Parotid MRI was performed in all 90 patients. Lesions were located in the superficial lobe in 72 cases (80%), in the deep lobe in 12 cases (13.3%), and involved both lobes in 6 cases (6.7%).

Regular margins were observed in 62 cases (68.9%), while irregular margins were found in 28 cases (31.1%). Extension to adjacent tissues was noted in 20 cases (22.2%), and associated cervical lymphadenopathy was present in 18 cases (20%).

On T1-weighted images, lesions showed hypointense signal in 58 cases (64.4%) and iso- or heterogeneous signal in 32 cases (35.6%). On T2-weighted images, hyperintense signal was observed in 66 cases (73.3%), mainly in benign lesions, whereas heterogeneous signal was found in 24 cases (26.7%).

Diffusion-weighted imaging demonstrated low apparent diffusion coefficient (ADC) values in 26 cases (28.9%) and high ADC values in 64 cases (71.1%).

After contrast agent injection, early and intense enhancement was observed in 28 cases (31.1%), while progressive or delayed enhancement was noted in 62 cases (68.9%).

Based on MRI morphological and functional criteria, imaging suggested a malignant tumor in 28 cases (31.1%) and a benign tumor in 62 cases (68.9%).

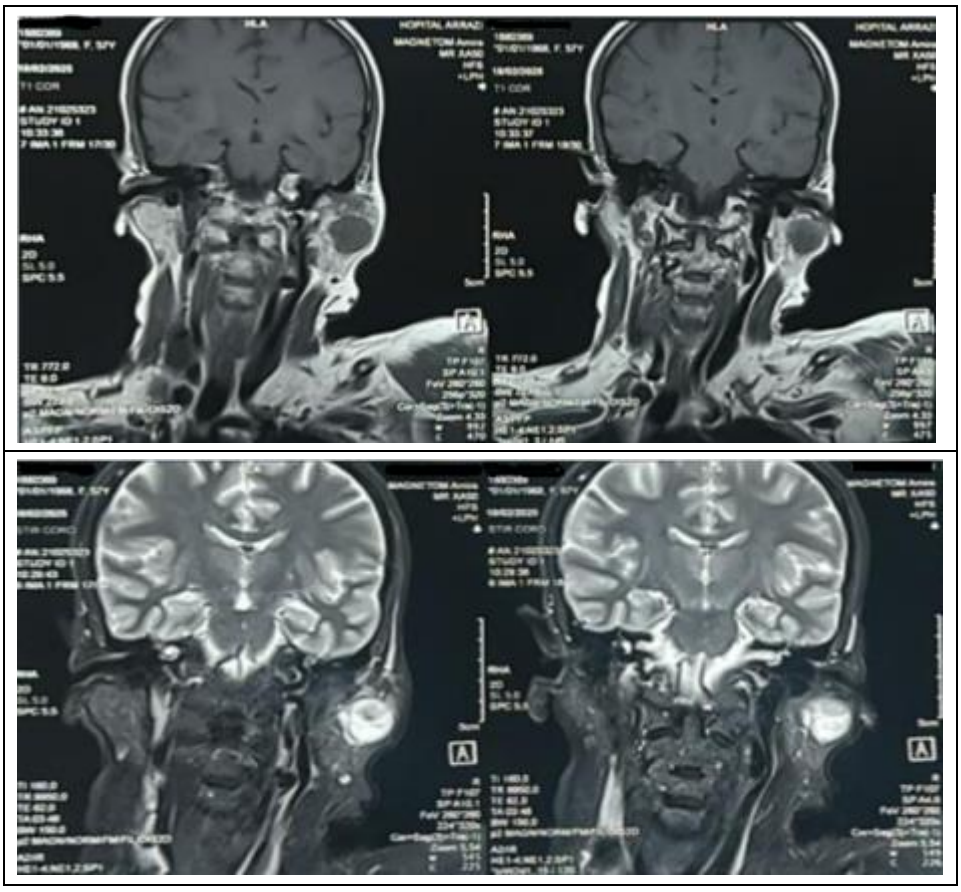

Figure 1 Preoperative multiparametric MRI demonstrating a left parotid pleomorphic adenoma

3.5. Cytological and Histological Data

3.5.1. FNAC Results

Parotid fine-needle aspiration cytology was performed in all 90 patients. Cytological samples were analyzed and classified according to the Milan System for Reporting Salivary Gland Cytopathology.

The distribution of cytological results was as follows:

Table 1 Distribution of FNAC results according to the Milan System for Reporting Salivary Gland Cytopathology

FNAC results	Number of cases	percentage
I . non-diagnostic or insufficient samples	8	8.9 %
II . non-neoplastic lesions	12	13.3%
III . atypia of undetermined significance (AUS)	8	8.9%
IVa . benign neoplasms	44	48.9%
IVb . neoplasms of uncertain malignant potential	12	13.3%
V . suspicious for malignancy	4	4.5%
VI . malignant lesions	2	2.2%

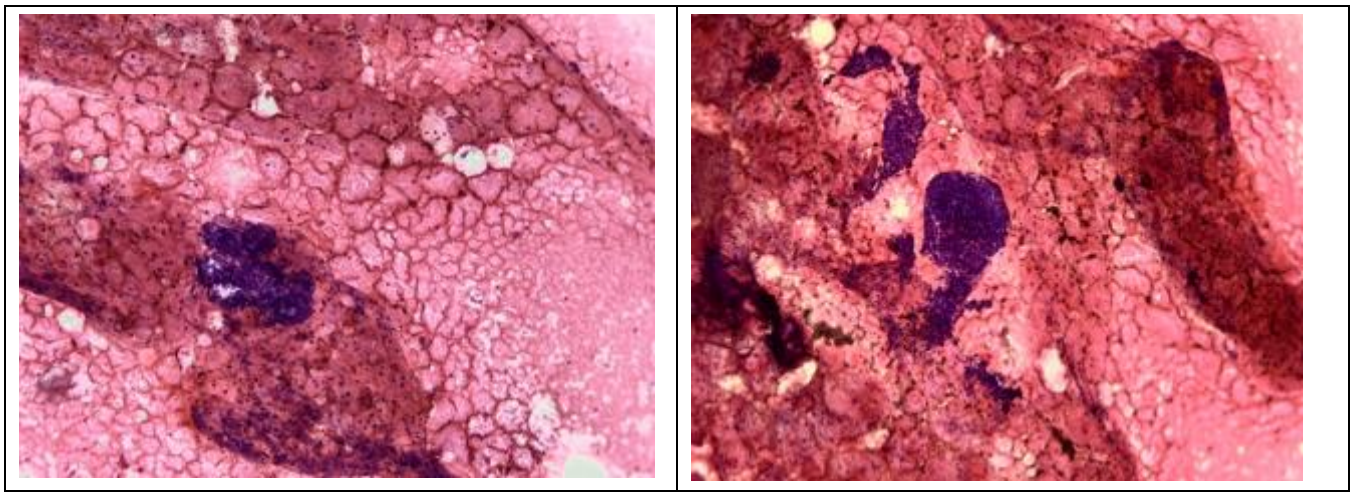

Figure 2 Parotid gland FNAC showing a salivary gland neoplasm of uncertain malignant potential

3.5.2. Histological Results

Table 2 Histological distribution of parotid gland tumors

Tumor type	Number of cases	percentage
Benign tumors	66	73.3%
Pleomorphic adenoma	44	48.9%
Warthin tumor	12	13.3%
Lymphoepithelial cysts	10	11.1%
Malignant tumors	24	26.7%
Adenocarcinomas	10	11.1%
Squamous cell carcinomas	8	8.9%
Lymphomas	6	6.7%

3.6. MRI–Histology Correlation

Among 24 histologically confirmed malignant tumors:

- 20 were correctly identified by MRI (true positives),
- 4 were falsely classified as benign (false negatives).

Among 66 histologically confirmed benign tumors:

- 58 were correctly classified as benign (true negatives),
- 8 were falsely classified as malignant (false positives).

Based on these data:

- Sensitivity: 83.3%
- Specificity: 87.9%
- Positive predictive value: 71.4%
- Negative predictive value: 93.5%
- Overall diagnostic accuracy: 86.7%

MRI demonstrated good diagnostic performance, with particularly strong negative predictive value.

3.7. FNAC–Histology Correlation

Comparison of FNAC results with definitive histology allowed construction of a diagnostic contingency table.

Among 24 histologically confirmed malignant tumors:

- 18 were correctly identified by FNAC (true positives),
- 6 were falsely classified as non-malignant (false negatives).

Among 66 histologically confirmed benign tumors:

- 56 were correctly classified as benign (true negatives),
- 10 were incorrectly classified as malignant or suspicious (false positives).

Table 3 Correlation between FNAC (Milan classification) and final histopathological diagnosis

Milan Category	**Number (n)**	**Percentage (%)**	**Corresponding histology (n)**
I. non-diagnostic	8	8.9	4 benign, 4 malignant
II. non-neoplastic	12	13.3	12 benign
III. Atypia of undetermined significance (AUS)	8	8.9	6 benign, 2 malignant
IVa. Benign neoplasm	44	48.9	42 benign, 2 malignant
IVb. Neoplasm of uncertain malignant potential (SUMP)	12	13.3	8 benign, 4 malignant
V. Suspicious for malignancy	4	4.4	0 benign, 4 malignant
VI. Malignant	2	2.2	0 benign, 2 malignant
Total	90	**100**	**66 benign, 24 malignant**

Based on these data

- Sensitivity: 75%
- Specificity: 84.8%
- Positive predictive value: 64.3%
- Negative predictive value: 90.3%
- Overall diagnostic accuracy: 82.2%

These findings indicate that FNAC has high specificity and strong negative predictive value, making it particularly reliable for excluding malignancy.

3.8. Diagnostic performance of FNAC and MRI for detecting malignancy in parotid tumors

Table 4 Diagnostic performance of FNAC, MRI, and combined FNAC–MRI in detecting malignant parotid tumors

Parameter	FNAC (%, 95% CI)	MRI (%, 95% CI)	Combined FNAC + MRI (%, 95% CI)
Sensitivity	75.0% (42.8–94.5)	83.3% (51.6–97.9)	91.7% (61.5–99.8)
Specificity	84.8% (68.1–94.9)	87.9% (71.8–96.6)	93.9% (79.8–99.3)
Positive Predictive Value (PPV)	64.3% (40.5–82.8)	71.4% (45.9–88.3)	78.6% (52.4–92.4)
Negative Predictive Value (NPV)	90.3% (76.6–96.5)	93.5% (80.2–98.2)	96.9% (83.8–99.5)
Accuracy	82.2% (68.0–92.0)	86.7% (73.2–95.0)	91.1% (78.8–97.5)

4. Discussion

Parotid gland tumors constitute a heterogeneous group of lesions whose management relies on accurate preoperative evaluation aimed at distinguishing benign from malignant forms. This distinction determines the surgical indication, the extent of parotidectomy, and the facial nerve preservation strategy [1,2]. In this context, fine-needle aspiration cytology (FNAC) and imaging, particularly magnetic resonance imaging (MRI), play a central role in the diagnostic workup.

From an epidemiological standpoint, our findings are consistent with those reported in the literature, showing a female predominance and a mean age around the fifth decade of life [1,2]. Similarly, the high proportion of benign tumors observed in our series (73.3%) is comparable to that described in large international series, with a clear predominance of pleomorphic adenoma, followed by Warthin tumor [1].

4.1. Diagnostic Contribution of Fine-Needle Aspiration Cytology

In our study, parotid FNAC demonstrated a sensitivity of 75% and a high specificity of 84.8% for the diagnosis of malignancy. These results are in agreement with published data, in which FNAC is recognized for its excellent specificity, often exceeding 90%, but with variable sensitivity, generally ranging from 60% to 80% across series [3,6,7].

This variability can be explained by several factors, including the histological diversity of parotid tumors, the presence of cystic or necrotic lesions, and the dependence of the technique on the experience of both the operator and the cytopathologist [3,6]. In our series, false-negative results mainly involved malignant tumors with cystic components or heterogeneous cytological architecture, limiting sample representativeness. These limitations are well described in the Milan System, which highlights the risk of diagnostic underestimation in certain cytological categories, particularly atypical lesions or those of undetermined significance [4,9,10].

Nevertheless, the very high specificity observed in our study confirms that FNAC remains a reliable tool for establishing the benign nature of a lesion, thereby helping to guide therapeutic strategy and improve patient counseling [3,4].

4.2. Contribution of Magnetic Resonance Imaging

Parotid MRI showed good correlation with histology in our series, with an estimated sensitivity of 83.3% and a specificity of 87.9% for the detection of malignant tumors. These performances are comparable to those reported in the literature, where MRI sensitivity ranges between 75% and 95%, depending on the criteria used [5,11–13].

The MRI features most suggestive of malignancy identified in our study were irregular margins, extension to adjacent tissues, diffusion restriction with low ADC values, and early, intense contrast enhancement. These features have been widely reported as predictors of malignancy in several studies using multiparametric MRI and diffusion-weighted imaging [5,11,12,14,15].

However, as reported by several authors, MRI tends to overestimate malignancy in certain benign lesions, particularly remodeled or inflammatory pleomorphic adenomas, explaining the presence of false-positive cases in our series

[5,12,15]. Conversely, some small malignant tumors or those with homogeneous architecture may exhibit nonspecific radiological features, leading to false-negative results [13,15].

4.3. Complementarity of FNAC and Imaging and Clinical Implications

Our results confirm that neither FNAC nor MRI alone can establish a definitive preoperative diagnosis, as widely emphasized in the literature [3,5,13]. However, their combined use significantly improves the preoperative characterization of parotid tumors.

FNAC provides reliable cytological orientation with excellent specificity, while MRI offers essential information regarding tumor location, locoregional extension, and anatomical relationships—elements that are crucial for surgical planning and for preventing complications, particularly facial nerve palsy [1,15–17]. This multimodal approach is currently considered the most relevant strategy for optimizing the management of parotid tumors [13,16,17].

Although diagnostic performance parameters were calculated, the relatively small sample size may limit the precision of sensitivity and specificity estimates. Confidence intervals should therefore be interpreted cautiously, and larger prospective studies are required to validate these findings.

4.4. Comparison of diagnostic performances with published series

Table 5 Comparison of diagnostic performance of FNAC and MRI with published studies

Study	Year	n	FNAC Sens (%)	FNAC Spec (%)	MRI Sens (%)	MRI Spec (%)
Present study	2025	90	75.0	84.8	83.3	87.9
Schmidt et al. [3]	2015	Meta-analysis	66-80	95-98	-	-
Christe et al. [5]	2011	52	-	-	82	89
Yabuuchi et al. [12]	2008	51	-	-	85	91
Ikeda et al. [15]	2009	67	-	-	79	88

5. Conclusion

Parotid gland tumors represent a diagnostic challenge due to their wide histological diversity and the major therapeutic implications related to distinguishing between benign and malignant lesions.

Our study highlights the value of a multimodal approach combining fine-needle aspiration cytology (FNAC) and imaging, particularly magnetic resonance imaging (MRI), in the preoperative evaluation of parotid tumors. FNAC proved to be a reliable diagnostic tool with excellent specificity, allowing confirmation of the benign nature of lesions, although its sensitivity for detecting malignant tumors remains moderate.

MRI, through its morphological and functional sequences, particularly diffusion-weighted imaging, showed good correlation with histology, providing essential information on tumor location, locoregional extension, and anatomical relationships. It therefore constitutes the reference imaging modality for the preoperative characterization of parotid masses.

The combination of FNAC and MRI optimizes therapeutic management, improves surgical planning, and enhances patient counseling. However, larger prospective studies are required to strengthen these findings and further refine the diagnostic performance of this combined approach.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

Statement of ethical approval

This retrospective study was conducted in accordance with the principles of the Declaration of Helsinki. As the study was based exclusively on the review of anonymized medical records and involved no direct patient intervention, formal ethical approval was not required.

Statement of informed consent

Due to the retrospective nature of the study and the use of anonymized patient data, the requirement for informed consent was waived.

Research Involving Human Participants and/or Animals

All procedures performed in this study involving human participants were conducted in accordance with the ethical principles of the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. No animals were involved in this study. As this was a retrospective study based on anonymized medical records and involved no direct patient intervention, formal ethical approval was not required, and the requirement for informed consent was waived.

References

[1] Carlson ER, Ord RA. Salivary gland neoplasms. Oral Maxillofac Surg Clin North Am. 2019;31(1):125–144.

[2] Bradley PJ, McGurk M. Incidence of salivary gland neoplasms and management strategies. Curr Opin Otolaryngol Head Neck Surg. 2013;21(2):113–118.

[3] Schmidt RL, Hall BJ, Layfield LJ. Fine-needle aspiration cytology of salivary gland lesions: a systematic review and meta-analysis. Head Neck Pathol. 2015;9(3):388–400.

[4] Rossi ED, Faquin WC, Baloch Z, et al. The Milan System for Reporting Salivary Gland Cytopathology. Cancer Cytopathol. 2018;126(12):925–935.

[5] Christe A, Waldherr C, Hallett R, Zbaeren P, Thoeny HC. MR imaging of parotid tumors: typical lesion characteristics in MR imaging improve discrimination between benign and malignant disease. Radiographics. 2011;31(2):363–378.

[6] Batsakis JG. Fine-needle aspiration of salivary glands: its utility and tissue effects. Ann Otol Rhinol Laryngol. 1992;101(2):185–188.

[7] Ali NS, Akhtar S, Junaid M, Awan S, Aftab K. Diagnostic accuracy of fine needle aspiration cytology in parotid lesions. ISRN Surg. 2011;2011:721525.

[8] Seethala RR, Barnes EL, Hunt JL. Epithelial-myoepithelial carcinoma: diagnostic pitfalls in salivary gland cytology. Diagn Cytopathol. 2007;35(7):418–422.

[9] Faquin WC, Rossi ED. The Milan System for Reporting Salivary Gland Cytopathology: an overview. Acta Cytol. 2018;62(5–6):325–330.

[10] Rossi ED, Wong LQ, Bizzarro T, et al. The impact of the Milan System on reporting salivary gland cytopathology: an international multi-institutional study. Diagn Cytopathol. 2020;48(8):671–678.

[11] Thoeny HC, De Keyzer F. Diffusion-weighted MR imaging of head and neck. Radiology. 2007;245(3):786–801.

[12] Yabuuchi H, Matsuo Y, Kamitani T, et al. Parotid gland tumors: differentiation of benign and malignant lesions with diffusion-weighted MR imaging. Radiology. 2008;249(3):909–918.

[13] Razek AAKA, Mukherji SK. State-of-the-art imaging of salivary gland tumors. Neuroimaging Clin N Am. 2018;28(2):303–317.

[14] Eida S, Sumi M, Sakihama N, et al. Apparent diffusion coefficient mapping of salivary gland tumors: differentiation of benign and malignant lesions. AJNR Am J Neuroradiol. 2007;28(6):1163–1168.

[15] Ikeda M, Motoori K, Hanazawa T, et al. The usefulness of MRI in diagnosing malignant parotid tumors. AJNR Am J Neuroradiol. 2009;30(6):1140–1146.

[16] Som PM, Curtin HD. Head and Neck Imaging. 5th ed. St. Louis: Mosby; 2011.

[17] Quer M, Vander Poorten V, Takes RP, et al. Surgical options in benign and malignant parotid tumors: current perspectives. Head Neck. 2017;39(1):132–146.