

# Magnetic Resonance Imaging versus Fine Needle Aspiration Biopsy in the Differential Diagnosis of Neoplastic Parotid Gland Lesions

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## Abstract

**Objective:** This research aims to compare fine needle aspiration biopsy (FNAB) with magnetic resonance imaging (MRI) in differentiating between neoplasms found within the parotid gland.

**Methods:** Using a retrospective methodology, records were reviewed from 74 cases who had surgery for a parotid neoplastic lesion between January 2013 and November 2018. 41 cases were men and 33 women, with a mean age of 51.3±12.8 years. In each instance, comparison was made between the eventual histopathological diagnosis and the results of evaluation by FNAB or MRI prior to surgery. The comparison looked at how the two methods influenced surgical choice, their ability to distinguish between malignant and benign lesions and power to predict histopathological subtype.

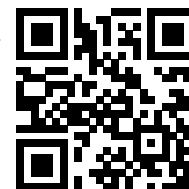
**Results:** 57 cases (out of 74) represented benign lesions (77%), whilst 17 were malignant (23%). Superficial parotidectomy was carried out on 54, and total parotidectomy on 20 individuals. FNAB had a sensitivity in the detection of malignancy of 73.3% with a specificity of 100%. The accuracy was 93.4%. MRI, on the other hand, had a sensitivity in the detection of malignancy of 81.2% with a specificity of 90.5%. The accuracy was 88.4%. Amongst benign lesions found, the most frequently occurring were pleomorphic adenoma and Warthin's tumour. MRI could accurately identify the histopathological type in 90% of such cases, whilst FNAB identified 89.1%.

**Conclusion:** In distinguishing between benign and malignant neoplastic lesions of the parotid gland, FNAB and MRI have similar abilities. Although MRI is unable to adequately predict the histopathological subtype in malignant lesions, unlike FNAB, its role in surgical planning and tumour staging remains highly significant.

**Key Words:** Magnetic Resonance Imaging, Fine Needle Aspiration Biopsy, Parotid Gland.

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## Introduction

Neoplasms of the salivary glands represent 3-5% of the total neoplasms found in the head and neck region. Amongst salivary gland neoplasms, 80% arise within the parotid gland. Benign neoplasms account for 80% of parotid neoplasms [1]. Pleomorphic adenomas are the most frequently occurring of benign parotid neoplasms, whilst mucoepidermoid carcinoma is the most frequently encountered parotid malignancy [2]. The key indications in favour of surgical intervention are anatomical location and expectation of malignant character. In malignant lesions, particularly, the histopathological subtype greatly influences what surgical measures are advised [3]. FNAB (fine needle aspiration biopsy) is the usual method employed to inform the probable diagnosis prior to operative intervention. FNAB has several key points to recommend its use: it is straightforward, allows swift interpretation and rarely results in complications. Another significant advantage of the technique is that it can identify those lesions (infective, calculus-related or lymphoma producing a mass effect) where surgery is not recommended [4,5]. There are, however, a number of limitations inherent in the FNAB technique, including adequacy of the material sent for cytology and the experience of the pathologist in examining such samples, and these limitations entail the possibility of a false negative result [3,6]. Thus, FNAB is not a technique offering a guarantee of reliability to the surgeon. Correspondingly, imaging modalities, especially MRI (magnetic resonance imaging) have been assuming a greater role in informing the preoperative diagnosis within the last several years. MRI assists in localising the lesion, indicating its likely character as benign or malignant, and may even allow for accurate prediction of the histopathological subtype [7,8]. MRI also vitally assists in identifying the anatomical relations of the tumour, any vascular or neural infiltration and clarifying whether there is any cervical lymph node involvement [8].

This research aims to compare fine needle aspiration biopsy (FNAB) with magnetic resonance imaging (MRI) in ability to differentiate between benign and malignant neoplasms found within the parotid gland, indicate a histopathological subtype and guide surgical planning.

## Materials and methods

The study sample consisted of 74 patients who underwent parotid surgery between January 2013 and November 2018. 41 (55.4%) cases were men and 33 (44.6%) were women, with a mean age in years of  $51.3 \pm 12.8$  (range:

9-76). 54 individuals underwent superficial parotidectomy whilst 20 individuals had a total parotidectomy. 7 patients additionally underwent neck dissection.

The following technique was employed to obtain FNAB: the sample material was aspirated using a 22-gauge needle tip and sprayed onto a microscope glass slide. A thin layer of cells was achieved by using a second glass slide to smear the sample, after which alcohol and other fixatives were used to dry and preserve the sample for cytological assessment. FNAB results included both an assessment of likely benign or malignant character and a provisional diagnosis of likely histopathological subtype.

The MRI appearances were re-evaluated for the study by a single experienced radiologist, who was requested to make a benign-malignant distinction and, if possible, specify a histological pre-diagnosis. Contrast agents were used in all imaging. Irregularities in the mass wall, surrounding tissue invasion, the existence of necrotic areas within the tumour mass and any suspicion of regional lymphadenopathy were signs deemed to point towards a likely malignant diagnosis.

In this research, surgical planning was based on the outcome of FNAB. For lesions reported as benign, either total or superficial parotidectomy was performed. Total parotidectomy was indicated by a tumour originating within the deep lobe, whilst superficial parotidectomy was performed if the origin was superficial. For suspected malignant lesions, total parotidectomy was performed in every case.

The results from FNAB and MRI were compared both in terms of how they distinguished benign from malignant lesions and for how accurately they produced a pre-histological diagnosis.

Statistical analysis of the results was carried out by means of the SPSS 21.0 version statistical software application (SPSS Inc., Chicago, IL, USA). Correlation was examined using the Pearson correlation test. The chi-square test was used to assess how successfully FNAB and cross-sectional radiological examinations, separately and together, informed the differential diagnosis. The sensitivity and specificity of each technique was calculated.

## Results

All the cases enrolled in the study had previously been admitted to the clinic with a presenting complaint of swelling in the anterior and lateral cheeks. No facial paralysis was observable in any of these cases. Four individuals had facial pain in addition to the complaint of swelling in front of

the ear. The average time elapsed between formation of the mass and admission to hospital was 24 months (range 1-144 months). 74 patients were included in the study. In 33 patients (44.6%), a mass was observed in the parotid gland on the right side and in 41 patients (55.4%) on the left.

According to the final histopathological diagnosis, 57 cases represented benign (77%) and 17 (23%) malignant neoplastic lesions. The distribution according to histopathological diagnosis is presented in Table 1.

74 cases were included in the study, of which 72 underwent FNAB. FNAB was found to possess 73.3% sensitivity to diagnose malignancy, with a specificity of 100% and diagnostic accuracy of 93.4%. The positive predictive rate was 100%. The corresponding negative rate was 92% (Table 2).

69 individuals out of the 74 enrolled in the study underwent MRI. MRI was found to possess 81.2% sensitivity to diagnose malignancy, with a specificity of 90.5% and diagnostic accuracy of 88.4%. The positive predictive rate was 72.2%. The corresponding negative rate was 94.1% (Table 2).

FNAB predicted the eventual histopathological diagnosis correctly 92.7% of the time for benign neoplasms. MRI achieved a success rate of 90.5% by the same criteria. The benign neoplasms which were most frequently diagnosed were pleomorphic adenoma and Warthin's tumour. Of the 45 cases with an eventual diagnosis of either pleomorphic adenoma or Warthin's tumour, FNAB lead to a correct in-

Table 2: Diagnostic values of fine needle aspiration biopsy (FNAB) and magnetic resonance imaging (MRI) for the detection of malignancy in parotid gland neoplasms.

	FNAB (n=72)	MRI (n=69)
Sensitivity	73,33%	81,25%
Specificity	100%	90,57%
Accuracy	93,44%	88,41%
Positive predictive value	100%	72,22%
Negative predictive value	92%	94,12%

itial diagnosis 90% of the time. 5 other cases also underwent FNAB, of which two were reported to be benign on cytology, although further characterisation was impossible. The 3 remaining cases were misclassified as benign (6%), tissue diagnosis eventually confirming a malignancy. MRI imaging resulted in 41 of 46 cases (89.1%) being correctly classified as either a pleomorphic adenoma or Warthin's tumour. Of the remaining 5 scans, 4 were correctly classified as benign but not otherwise specified. 1 case (2.1%) was reported as benign on MRI appearances, but found to be malignant on histopathology.

FNAB result and definitive histopathological diagnosis were also compared. In 67 of 72 cases (93%) for which FNAB was performed, an appropriate surgical intervention was indicated, i.e. neither incomplete nor excessive. In 3 cases, FNAB led to an incomplete surgical intervention (although total parotidectomy would have been the appropriate option, superficial parotidectomy was in fact per-

Table 1: Distribution of neoplasms according to postoperative histological diagnosis.

Benign	(n=17)	%	Malign	(n=17)	%
Pleomorphic adenoma	25	43,8	Mucoepidermoid Ca	5	29,4
Warthin's tumor	20	35,1	Adenoid cystic Ca	3	17,6
Adenoma	7	12,2	Adenocarcinoma	2	11,7
Myoepithelioma	2	3,5	Salivary ductal carcinoma	2	11,7
Oncocytoma	1	1,75	Squamous cell cancer	2	11,7
Cystadenoma	1	1,75	Epithelial-myoepithelial Ca	2	11,7
Sialolipoma	1	1,75	Acinic cell carcinoma	1	5,8

formed), whilst in 2 cases an excessive surgical intervention (total parotidectomy instead of superficial parotidectomy) was undertaken.

## Discussion

Mass lesions within the parotid are typically divided into two categories: neoplastic or non-neoplastic. Neoplastic lesions are further classified as benign or malignant<sup>[1]</sup>. Prevention of unwarranted, inadequate or excessive surgical responses critically depends on being able to differentiate between these categories of lesion.

Amongst benign neoplasms, the most frequently encountered type is the pleomorphic adenoma, whilst the most frequent malignant neoplasm is a mucoepidermoid carcinoma<sup>[2]</sup>. Parotid gland neoplasms frequently arise in the superficial lobes, and benign lesions confined to these lobes may be adequately excised by superficial parotidectomy. However, benign neoplasms arising in a deep lobe necessitate total parotidectomy<sup>[9]</sup>. For malignant neoplasms, whether located in a deep or superficial lobe, total parotidectomy is the usual treatment, with or without additional measures, including neck dissection and postsurgical radiotherapy<sup>[10]</sup>. This research applied surgical protocols that are in line with the medical literature on the topic.

FNAB is a diagnostic technique in highly widespread use for the evaluation of salivary gland neoplastic lesions. There have been concerns about possible risks associated with FNAB, including bleeding, haematoma, injury to cranial nerve VII, production of fistulae, tumour seeding and infective consequences. It was also thought to have a poor diagnostic yield<sup>[11]</sup>. However, overall the literature favours FNAB as a technique with reasonable safety, ease of performance and rare side effects<sup>[2,12]</sup>. Currently, FNAB is the most popular procedure chosen to assist surgical planning, in the vast majority of cases, as is reflected in this study<sup>[13]</sup>. FNAB performs a vital function in helping to avoid unwarranted, insufficient or excessive operative interventions<sup>[14]</sup>.

In the literature, FNAB has a reported sensitivity in the detection of malignancy in salivary glands of between 57 and 96% with a specificity of between 86 and 100%. The accuracy was between 92 and 94%<sup>[15,16]</sup>. Thus, our results are in line with those already reported. FNAB has been demonstrated to possess lower accuracy in diagnosing head and neck neoplasms originating from the parotid<sup>[17]</sup>. This fact may be attributable to the high frequency of occurrence of parotid-gland associated neoplasms and the cor-

respondingly numerous potential histopathological types that these neoplasms fall into. The scheme of classification of head and neck tumours proposed by the World Health Organisation (WHO) does, in fact, list 31 distinct types of tumour that can arise from the epithelium of the salivary glands<sup>[18]</sup>.

In spite of the complexity of histopathological typing, the diagnosis may be of less overt significance than might be expected, given that virtually all parotid gland mass lesions may be treated by excision.

Nonetheless, there exists potential to harm the patient and increase morbidity through insufficient or excessive operative interventions if the diagnosis is inexact. Revision surgery following on from inadequate excision or unwarranted total (since the tumour is superficially confined) parotidectomy can elevate the risk of traumatic injury to cranial nerve VII<sup>[19]</sup>. Our study participants achieved a rate of appropriate management guided by FNAB in 93% of cases. Inadequate operative intervention was found in 3 cases and excessive surgical intervention occurred twice (involving total parotidectomy). Taking MRI imaging into account, of this group of 5 cases, 4 would have received a pre-diagnosis leading to appropriate management. In one case, there was no MRI available for comparison. Given that surgical interventions were in fact guided solely by FNAB, the imaging played no role in the surgical planning. Had operative planning weighed MRI evidence, the surgical management would have achieved similar rates of adequacy to those which actually occurred. FNAB failed to improve on surgical planning. Other researchers have already observed that FNAB has no impact on the choice of operation<sup>[7,20]</sup>. A certain body of research states that FNAB has value in guiding judgements of the benign or malignant nature of lesions prior to the operation, an aspect where imaging modalities are inadequate<sup>[21]</sup>.

From the literature, MRI had a sensitivity in the detection of malignancy in salivary gland tumours of between 81 and 88% with a specificity of between 77 and 100%. The accuracy lay between 83 and 96%. Thus, our findings are in line with those already reported elsewhere. Whilst some previous research points towards the inadequacy of MRI in distinguishing benign from malignant lesions in the salivary gland<sup>[21]</sup>, our results suggest MRI has a comparable ability to FNAB to achieve this distinction. We found that MRI can predict the eventual histopathological type of the most frequently occurring benign lesions, pleomorphic adenoma and Warthin's tumour, with highly comparable

efficiency to FNAB. Such an outcome would support the notion that FNAB has little to offer in cases where MRI has already identified a pleomorphic adenoma or Warthin's tumour and hence planning an operation based on MRI alone is a defensible option. In contrast, MRI did possess some deficiency compared to FNAB in being able to predict accurately the subtype of malignant lesions. In addition, MRI does have an essential and obligatory role in allowing the staging of malignancy and advising on tumour anatomical relations, particularly on cranial nerve VII involvement and the tumour's relation to blood vessels [21].

In every case, MRI was contrast-enhanced. In a few cases, diffusion-weighted and/or dynamic contrast-enhanced MRI was employed. However, the low numbers involved did not allow for meaningful comparisons and the results are accordingly not reported here. Within the literature, there exist reports suggesting a high diagnostic value for diffusion-weighted MRI in the assessment of parotid neoplasms [23]. A study conducted by Yerli H *et al.* concluded

that diffusion-weighted MRI and FNAB possess similar efficacy in differentiating between benign and malignant lesions [8]. In some reports, dynamic MRI has been shown to have a higher rate of accurate diagnosis in parotid neoplasms than conventional MRI [24].

## Conclusion

In conclusion, FNAB and MRI possess comparable abilities to differentiate parotid neoplasms. Use of FNAB did not lead to a significant change in planning for surgical intervention. After MRI identifying a pleomorphic adenoma or Warthin's tumor, FNAB is unnecessary; indeed, the accuracy of MRI in predicting the histological type for these tumours has been found to be very similar to FNAB. Although MRI has been shown to be insufficient as compared to FNAB to define the probable histological subtype of malignant salivary neoplasms of the parotid, it still has a vital role to play, especially in surgical planning and tumour staging in this group of patients.

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