State-of-the-Art Imaging of Salivary Gland Tumors

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KEYWORDS

• Parotid • Salivary • Benign • Malignant • Spread • Staging

KEY POINTS

- MR imaging is the state-of-the-art imaging modality of choice in the evaluation of salivary gland tumors.
- Routine postcontrast MR imaging is important for accurate localization, locoregional extension of salivary gland tumors.
- Contrast MR imaging is excellent for detection of perineural spread of salivary malignancy, which is commonly reported in patients in adenoid cystic carcinoma.
- Multiparametric imaging of advanced MR imaging, such as diffusion-weighted MR imaging and dynamic contrast-enhanced (DCE) MR imaging, may help in characterization of some salivary gland tumors.
- Diffusion-weighted MR imaging can be used to differentiate recurrence from post-treatment changes and monitor patients with malignant salivary gland tumors after therapy.

INTRODUCTION

Epidemiology

Salivary gland tumors are rare, accounting for about 2% to 6.5% of all head and neck tumors and about 0.5% of all malignancies.[1,2] The most common location of salivary tumors is the parotid gland (70%), followed by the submandibular gland, the minor salivary glands, and the sublingual gland in descending order. Most tumors are benign pleomorphic adenomas (65% of parotid tumors), followed by Warthin tumor (15%–20% of parotid tumors). The most common malignant tumor is mucoepidermoid carcinoma, which forms 10% of salivary tumors and 30% of malignancies; approximately half of these occur in the parotid glands.[3–5] Salivary gland tumors are classified according to the World Health Organization histologic classification into 20 malignant epithelial salivary gland tumors and 11 benign epithelial salivary gland tumors.[6]

Methods of Examination

MR imaging is the modality of choice in patients with salivary gland tumors. Routine precontrast and postcontrast MR imaging is commonly used for assessment of salivary gland tumors.[7–15] Multiparametric imaging of diffusion-weighted MR imaging and dynamic contrast-enhanced (DCE) MR imaging are incorporated into routine imaging in evaluation of salivary gland tumors in our center.[16–20] Other recent sequences of MR imaging, such as diffusion tensor imaging, intravoxel incoherent motion diffusion MR imaging, proton MR spectroscopy, and dynamic susceptibility contrast MR imaging have recently been used to characterize salivary gland tumors but they are not validated and need further studies for their clinical application.[21–24] Routine postcontrast computed tomography (CT) scan may be used to better evaluate cortical invasion of the skull base.[25,26] Advanced CT techniques, such

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as CT perfusion and dual-energy CT, have limited role in evaluation of salivary gland tumors and need further studies.[27–32] PET-CT is helpful for detection of distant metastasis from salivary gland cancer.[33] The details and protocols of these techniques are discussed in Christopher Atkinson and colleagues' article, "Cross-Sectional Imaging Techniques and Normal Anatomy of the Salivary Glands," in this issue.

ROLE OF IMAGING IN SALIVARY GLAND TUMORS

Imaging provides information about accurate localization of salivary gland tumors either in superficial or deep lobe, identification of the intraparotid course of facial nerve, differentiation of malignancy from benignity, characterization of some benign and malignant salivary gland tumors, and staging of salivary cancer. In addition, imaging helps in differentiating between recurrent malignant salivary gland tumors from post-treatment changes, monitoring patients after therapy, and may help in differentiation of salivary gland tumors from simulating lesions.[7–15]

Localization of Salivary Gland Tumors

It is important to identify whether a mass arises from the deep lobe or superficial lobe of the parotid gland, because the surgical approach for these tumors differs. A mass that arises from the deep lobe of the parotid is centered lateral to the parapharyngeal space and invades the parapharyngeal space from the lateral to medial direction (**Fig. 1**). The mass also widens the interval between the styloid process and the mandible known as the stylomandibular tunnel.[8,11,34]

Identification of Intraparotid Course of Facial Nerve

Differentiation of deep and superficial lobe parotid tumors hinges on the identification of the intraparotid course of the facial nerve. When evaluating most parotid tumors, it is usually sufficient to map the expected course of the nerve using anatomic landmarks (eg, stylomastoid foramen, retromandibular vein, and posterior belly of digastric and the mandibular ramus) (see **Fig. 1**). Three-dimensional FIESTA sequence was described in Christopher Atkinson and colleagues' article, "Cross-Sectional Imaging Techniques and Normal Anatomy of the Salivary Glands," in this issue and can help demonstrate the facial nerve. This T2-weighted sequence has the advantage of distinguishing duct (high signal) from the low-signal-intensity nerve.[2–10]

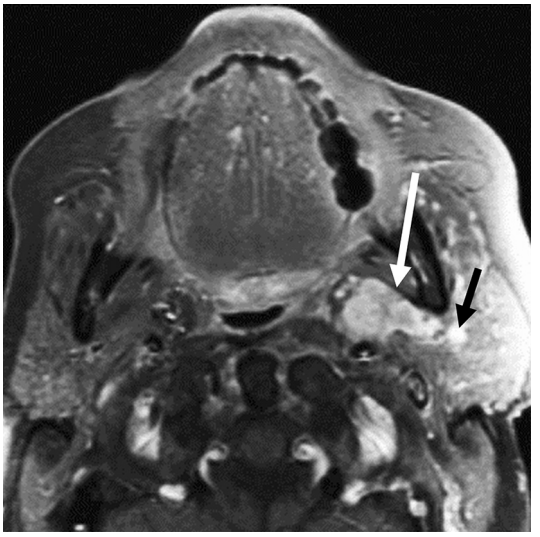

Fig. 1. Localization of salivary gland deep lobe of pleomorphic adenoma. Axial contrast-enhanced T1W image with fat-suppression shows an enhancing mass (*white arrow*) located in the left parotid gland. The mass is deep to the retromandibular vein (*black arrow*). Because the facial nerve is located lateral to the retromandibular vein, the mass is localized to the deep lobe of the parotid gland.

Malignancy Versus Benignity

Presence of certain MR imaging findings at routine postcontrast MR imaging may help distinguish between malignant and benign salivary tumors. However, the imaging findings are often nonspecific.[7–15] Multiparametric MR imaging of diffusion-weighted MR and dynamic contrast MR imaging has a role in differentiation of malignant salivary gland tumors from benign tumors.[10–17] Recently, advanced MR imaging sequences were used for characterization of salivary gland tumors, but they need further study for clinical applications.[21–24]

Routine MR imaging

Benign salivary gland tumors typically have smooth and well-defined borders, hyperintense signal on T2-weighted images, and are often superficially located. The MR imaging findings suggestive of high-grade malignant salivary gland tumors are ill-defined borders, invasion into adjacent tissues, low T2 signal, heterogeneous enhancement, cystic changes, and central necrosis.[7,9,35] Cystic components are seen in 50% of benign and 78% of malignant tumors. Eccentric location of the cystic areas is seen in 90% of benign tumors and 50% of malignant salivary tumors and central cystic areas are seen only in malignant tumors.[36] Rim enhancement is present in