Cross-Sectional Imaging Techniques and Normal Anatomy of the Salivary Glands

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KEYWORDS

• Salivary glands • Salivary gland anatomy • Parotid gland • Submandibular gland • Sublingual gland • Salivary gland imaging

KEY POINTS

- The salivary glands include the 3 paired major salivary glands and 1000 minor salivary glands scattered throughout the aerodigestive tract.
- The goal of imaging is to confirm a lesion as being of salivary gland origin, narrow the list of differential considerations, define the extent of disease, and guide management decisions.
- Inflammatory lesions are often first evaluated with computed tomography; MR sialography may be a useful adjunct in further evaluating duct anatomy in chronic inflammatory conditions.
- MR imaging is the modality of choice for characterizing neoplastic lesions, and should be performed when there is concern for extraglandular or perineural tumor spread of malignancy.
- Diffusion-weighted imaging and advanced MR imaging techniques may be useful adjunct modalities in distinguishing benign and malignant salivary gland tumors.

INTRODUCTION

The salivary glands, which include the paired major salivary glands and as well as numerous minor salivary glands, play several important functions in normal digestion and oral hygiene. Any of these glands can be affected by a variety of pathologies, including benign and malignant neoplasms, inflammatory and infectious processes, congenital lesions, autoimmune disorders, and dysfunction owing to various iatrogenic causes. Although most of these processes are not unique to any of the individual salivary glands, each gland has unique characteristics that may influence the specific diseases which may be more likely to affect it.

Imaging is often warranted in patients with suspected salivary gland disease to help distinguish inflammatory from neoplastic processes and to help confirm the salivary gland as the origin of the process. In certain instances, imaging can be helpful in differentiating benign from malignant neoplasms; however, it is important to keep in mind that conventional imaging features of parotid tumors are often nonspecific. Many low-grade malignancies can be difficult or impossible to differentiate from benign entities by imaging alone, and in these cases imaging is not necessarily done to provide a definitive histologic diagnosis, but rather to narrow the list of diagnostic considerations, define the anatomic extent of abnormality (including possible perineural spread), help guide workup and management, and aid in biopsy and surgical planning.

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Cross-sectional techniques, including computed tomography (CT) and MR imaging are often the first modalities for salivary gland imaging. Regardless of the indication for imaging or the type of imaging performed, providing quality interpretation relies not only on knowing the diseases that may affect the glands, but also on understanding the anatomy of the glands and of the structures that reside within or beside them, because the diseases of a gland can easily spread to involve these structures or vice versa. In addition, one's ability to identify pathology in a gland requires familiarity with the normal appearances of each gland on the different imaging modalities.

This article reviews the function, embryologic development, anatomy, and normal imaging features of the major salivary glands. Additional topics covered include common indications for salivary gland imaging, the general approach to imaging salivary gland pathology, and commonly used cross-sectional techniques used for salivary evaluation—namely CT, MR imaging, and PET/CT scanning—as well as more specialized salivary imaging techniques such as MR sialography and diffusion-weighted imaging (DWI). Newer investigational techniques for characterization of salivary tumors including CT perfusion scanning, dynamic susceptibility contrast perfusion MR imaging, and dynamic contrast-enhanced MR imaging are also briefly discussed.

SALIVARY GLAND FUNCTION

The salivary glands are exocrine glands that are responsible for the production of saliva, a watery substance that contributes to the process of digestion during mastication. There are 3 pairs of major salivary glands that produce most of the saliva in humans: the parotid glands, submandibular glands, and sublingual glands (**Figs. 1** and **2**). In addition to the major salivary glands, there are approximately 1000 minor salivary glands that line and moisten the mucosa of the aerodigestive tract.[1,2]

In normal circumstances, the salivary glands produce approximately 1.0 to 1.5 L of saliva per day. The composition of saliva produced by each gland is slightly different, with the parotid glands producing the most serous fluid, the sublingual glands producing slightly more viscous fluid, and the submandibular glands producing the most viscous and mucinous saliva. Saliva serves several important functions in digestion, including facilitating the tasting of food, moistening food, and initiating the breakdown of fat and starches through the actions of salivary amylase and lipase during mastication.[3–5]

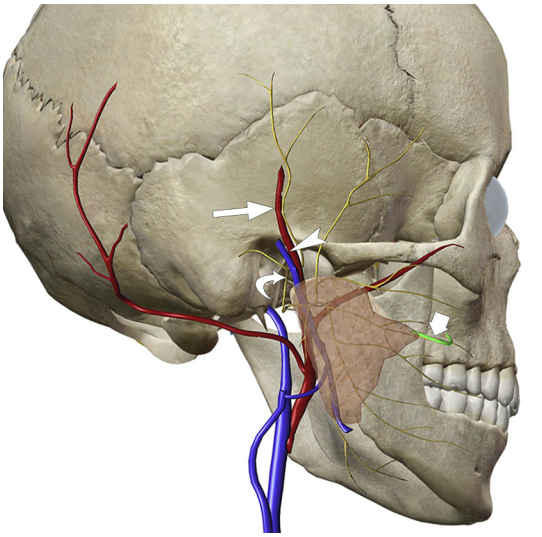

Fig. 1. Normal parotid anatomy. Three-dimensional rendered model demonstrating the anatomic relationships between the parotid gland, parotid duct (*fat arrow*, shaded in *green*), branches of the facial nerve (*curved arrow*, shaded in *yellow*), and neighboring arterial (*red*) and venous (*blue*) structures. The *long arrow* indicates the superficial temporal artery and the *arrowhead* indicates the retromandibular vein.

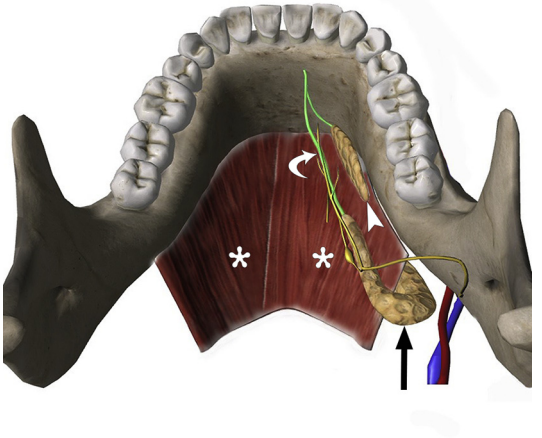

Fig. 2. Normal submandibular and sublingual gland anatomy. (*A*) Three-dimensional rendered model demonstrating the anatomic relationships between the mandible, myelohyoid muscle, submandibular gland (*arrow*), and sublingual gland (*arrowhead*). The myelohyoid muscle (*asterisks*) forms the floor of the sublingual space. The lingual nerve (shaded *yellow*) is shown along the medial margin of the mandible and Wharton's duct (*curved arrow*) courses anteriorly. The anterior facial vein and facial artery (shaded in *blue* and *red*, respectively) can be see along the lateral aspect of the submandibular gland.