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The role of ultrasound in the diagnosis and management of salivary disease

Lisa A. Orloff, MD, Harry S. Hwang, MD, Peter Jecker, MD, PhD

From the Department of Otolaryngology–Head and Neck Surgery, University of California, San Francisco, California.

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The major salivary glands lend themselves well to ultrasound (US) examination, owing to their location and their soft tissue characteristics. With adequate training and experience, clinicians can perform and interpret salivary gland US and frequently obviate the need for MRI or CT imaging. US features of the major inflammatory, neoplastic, and miscellaneous salivary gland disorders are described and demonstrated in this article. US-guided procedures including fine needle biopsy, sclerotherapy, and therapeutic injection have numerous applications to salivary gland pathology, and techniques are discussed. US enhances the diagnosis and management of common salivary gland diseases in the office setting.
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Ultrasonography (US) is underused in most North American sites for imaging of the salivary glands, in contrast to much of Europe and Asia.[1-5] Because of their superficial anatomic position and their fairly homogeneous soft-tissue density, the major salivary glands are well-characterized on US examination. With adequate training and experience, clinicians can perform and interpret salivary gland US and frequently obviate the need for magnetic resonance imaging (MRI) or computed tomography (CT). In certain cases of large or malignant salivary gland lesions, however, cross-sectional imaging is complementary to US and is appropriate for the assessment of tumor margins and infiltration of bone, skull base structures, and the parapharyngeal space, as well as of deep lymph node metastases. US can easily be performed by the clinician at the time of initial evaluation for salivary gland dysfunction or distortion and can enable the streamlining of further workup more selectively. Also, US-guided procedures, including biopsy, sclerotherapy, and therapeutic injection, are quite convenient and highly successful. The physician who is familiar with the diagnosis and management of common salivary gland diseases is ideally situated to use US in the office setting.

Address reprint requests and correspondence: Lisa A. Orloff, MD, Department of Otolaryngology–Head and Neck Surgery, University of California, San Francisco, CA 94115.

E-mail address: lorloff@ohns.ucsf.edu.

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Anatomy

The parotid gland is located within the face and upper neck, anterior to the ear and the sternocleidomastoid muscle (Figure 1). Parts of the normal gland overlie the mandible and the masseter muscle, and the occasional accessory parotid gland can extend anterior to the masseter within the cheek. At the anterior border of the masseter muscle and approximately 1 cm inferior to the zygomatic arch, the main excretory parotid duct (Stenson's duct) crosses the buccinator muscle and enters the mucosa of the cheek opposite the second maxillary molar. The normal nonobstructed Stenson's duct is usually not visible by US.

The parotid gland itself is divided into superficial and deep lobes by the facial nerve and its branches, which cannot be seen by US. Visualization of the trunk of the facial nerve with high-frequency US (>10 MHz) is not expected.[6] In comparison, MRI can attain limited views of the facial nerve trunk, but it is often mistaken for salivary ducts.[7,8] As an alternative, the retromandibular vein, which lies directly in contact with the trunk of the facial nerve or its main branches,[9-11] is used as an US (as well as MRI and CT) landmark for the facial nerve and the division between the superficial and deep parotid lobes (Figure 2).[11] The external carotid artery runs parallel and deep to the retromandibular vein but is usually not seen during parotid US. The deep parotid lobe is only partially visible by US

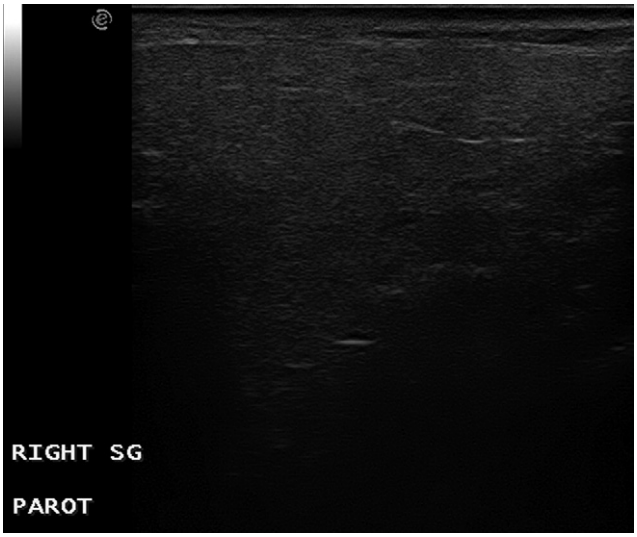

Figure 1 Sagittal US image of normal right parotid gland with medium homogeneous echogenicity.

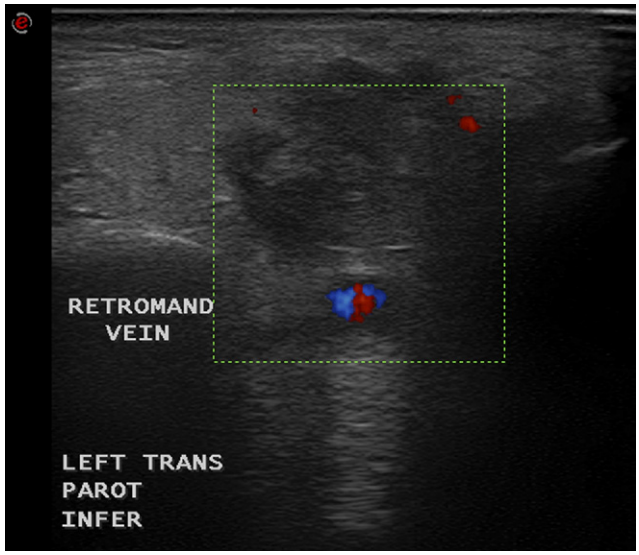

Figure 2 Retromandibular vein (RMV) immediately deep to an invasive malignant tumor of the left parotid gland (squamous cell carcinoma) seen on transverse view. The RMV can serve as a marker for the facial nerve. (Color version of figure is available online.)

because of the intervening position of the mandibular ramus.

The parotid gland contains 20 to 30 lymph nodes,[12] mainly within the superficial lobe, that receive lymphatic drainage from the skin of the face and scalp, as well as the ear. Normal intraparotid lymph nodes are rounded to oval and contain a relatively prominent and hyperechoic hilum. Their short axis in the benign state should not exceed 5 to 6 mm.[5,6]

The submandibular gland lies within the submandibular triangle that is created by the anterior belly of the digastric muscle, the posterior belly of the digastric muscle, and the mandibular body. This region is also defined as level I of the neck, with lymph nodes and connective tissue occupying the space anterior and superior to the submandibular gland. In transverse view, the submandibular gland is usually triangular to teardrop shaped, and may be seen to merge with the parotid or sublingual gland (Figure 3). The deep part of the gland is separated from the palatine tonsil by the mylohyoid, hyoglossus, and digastric muscles. The facial artery takes a tortuous course directly through or next to the submandibular gland, and the lingual artery runs medial to the gland. The facial vein courses along the anterosuperior part of the gland and connects with the retromandibular vein posteriorly. The submandibular duct (Wharton's duct) exits and bends around the gland's border with the mylohyoid muscle, courses along the medial aspect of the sublingual gland, and enters the floor of mouth near the anterior midline. A nondilated duct is generally not visible by US.

The sublingual gland is less commonly affected by disease than the parotid or submandibular glands. It lies deep to the mylohyoid muscle from a submental approach, between the mandible laterally and the muscles of the floor of the mouth (the geniohyoid, intrinsic tongue, and hyoglossus muscles) medially. On transverse US view it is relatively oval and on longitudinal view it is more lens-shaped. The submandibular (Wharton's) duct runs along its medial aspect. The sublingual gland may be difficult to distinguish from the superior portion of the submandibular gland, which extends superomedial to the mylohyoid muscle into the sublingual space.

The normal echotexture of the major salivary glands is relatively homogeneous and varies from very bright and hyperechoic to only slightly hyperechoic in comparison with adjacent muscles. The echogenicity of the parenchyma depends on the amount of intraglandular fat. In patients who have undergone head and neck irradiation, sound penetration and anatomic definition may be poor.

The minor salivary glands are not typically distinguished by US from their harboring structures, such as the pharynx

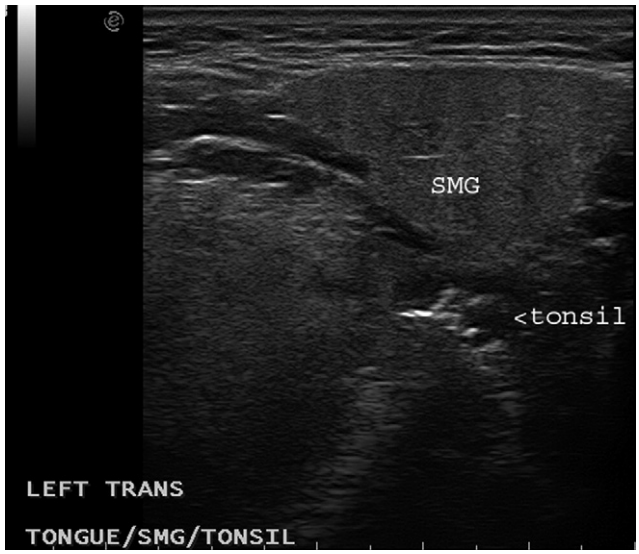

Figure 3 Transverse US image of normal left submandibular gland, with medium echogenicity. Note proximity to the tonsil and tongue.

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