Post-Treatment Imaging of Oral and Base of Tongue Cancers: A Comprehensive Review of Locoregional Changes and Complications

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BACKGROUND

Purpose
Oral and base of tongue cancers (TCs) are different diseases. The oral tongue is the most common site of SCC in the oral cavity. Tongue base cancers are associated with HPV, which has a major effect on therapy and prognosis. Treatment may entail surgery with(out) combinations of chemotherapy, radiotherapy, and targeted drug therapy. However, TC has a high rate of locoregional relapse, accounting for treatment failures and poor overall survival. Imaging assessment of residual/recurrent disease after single/multimodal therapies is crucial for clinical planning and prognostic evaluation. We provide a pictorial and educational review of TC post-treatment changes and complications to aid in neuroimaging interpretation and patient management.

Methods
We comprehensively review the roles of CT, MRI, and PET imaging after TC treatment.

Findings
We first review examples of TC cases mainly treated non-surgically, and the types of surgeries and reconstruction options available for TC. After primary treatment, the indications for post-treatment imaging are assessment of response to therapy and tumor control, detection of tumor recurrence, deferment of any planned neck dissection, and differentiating tumor recurrence from chemoradiation changes. CT or MRI can differentiate recurrent TC from mucosal epithelium, lamina propria, and tongue muscles; and PET is sensitive in detecting residual/recurrent nodal disease. New metastases to cervical lymph nodes is a prognostic variable, in addition to size, number, and laterality of these nodes. Imaging is useful to detect other cervico-facial post-treatment changes, including skin invasion, muscle infiltration, dense tethering or fixation to adjacent structures, and any new cranial and other nerve invasion. In addition, recurrent tumors and radiation fibrosis differ in signal intensity patterns. The early phase of radiation changes (high T2) occurs some weeks after treatment; the late phase (low T2) is due to fibrosis. PET/MRI using 18F-FDG has the potential to create a future one-stop examination after TC treatment. We also discuss imaging of: 1) floor of mouth grafts, 2) TC after catheter embolization, 3) complications, e.g. osteoradionecrosis, and 4) post-treatment swallow function using real-time MRI.

Summary
Neuroradiologists should be able to distinguish early post-treatment recurrence from expected treatment-related changes. This presentation will aid in neuroimaging interpretation of the post-treatment tongue to improve patient management.

SIGNIFICANCE

The incidence of oral tongue and tongue base cancer has significantly increased among young white men and women within the same birth cohorts in the US. Approximately 30 to 40% of all patients with tongue cancer still succumb to the disease in five years. Early diagnosis of the disease is of vital importance. As many as 25% of patients with tongue cancer have neck metastases at presentation, which influence the prognosis. The contribution of diagnostic imaging in evaluating the pre- and postoperative status of tongue cancer is essential.

Anatomy

The oral cavity is the most ventral portion of the aerodigestive tract and can be subdivided into the lips, floor of mouth, oral part of the tongue (anterior 2/3), buccal mucosa, gingiva, hard palate, and retromolar trigone. It is separated from the oropharynx by a ring of structures consisting of the circumvallate papillae inferiorly, the soft palate superiorly, and the anterior tonsillar pillars on both sides. Several muscles, fatty tissues, nerves, vessels, and sublingual glands form the floor of the mouth.

The oropharynx is located posterior to the oral cavity and between the nasopharynx and hypopharynx. It contains the base of the tongue (posterior 1/3), palatine tonsils, soft palate, and oropharyngeal mucosa. The circumvallate papillae, anterior tonsillar pillars, and soft palate form the anterior border of the oropharynx. Its posterior border is the posterior pharyngeal wall, and the lateral borders of the oropharynx are the tonsillar regions. The oropharynx is bordered superiorly by the elevated soft palate and inferiorly by the valleculae.

Pre-Treatment Appearance

Tumor demonstrated as an ill-defined mass at the left lateral margin of the tongue involving the floor of the mouth.

Axial contrast enhanced CT

Axial fat suppressed T2

Axial postcontrast T1

Axial ADC

Photomicrograph of histopathological specimen, coronal section (H & E Stain)

Myocutaneous Flap
Initially a mass with soft-tissue attenuation/intensity, representing muscle. Gradually shows denervation atrophy.

Radial Forearm Free Flap

Thin and pliable flap, makes it ideal for reconstructions of the oral cavity, tongue, palate, nose, face, scalp, lip, and pharynx. Can be used to maintain mobility of the tongue after hemiglossectomy.

Myocutaneous Flap

Sharp boundaries exist between the flap and the adjacent normal structures, indicating benignity. Wide spectrum of enhancement, ranging from almost no enhancement to diffuse intense enhancement which does not predict failure of the flap.

Early Radiation Therapy Changes
Thickening of the skin and platysma, reticulation of the subcutaneous fat, edema and fluid in the retropharyngeal space, increased enhancement of the major salivary glands, thickening and increased enhancement of the pharyngeal walls, and thickening of the laryngeal structures.

Flap Recurrence
Most commonly occurs in relation to the recipient flap bed near the anastomotic site between the flap and the tumor resection site. It is important to assess the margins of the flap, where local recurrence most commonly occurs.

Postoperative Granuloma or Vascularized Scar
Typically identified as a moderately enhancing soft tissue mass. Stable over a long period of time on contrast-enhanced CT or MRI.

6 Weeks Postop

Late Radiation Therapy Changes Atrophy of the major salivary glands and thickening of the pharyngeal constrictor muscle, platysma, and skin.

16 months Postop

Axial postcontrast T1

Axial ADC

H & E Histopathologic Slide

Coronal PET showing increased FDG uptake in the right tongue and multiple right cervical lymph nodes.

Coronal T2 showing well circumscribed mass in the right hemitongue.

Coronal fused PET/MR showing increased FDG uptake in the right hemitongue mass.

Coronal fused PET/MR showing increased FDG uptake in a right level 2b node.

The American Joint Committee on Cancer (AJCC) released the 8th edition of the AJCC cancer staging manual in 2017 that includes significant modifications from the 7th edition. These significant changes include incorporation of the depth of invasion and exclusion of extrinsic tongue muscle involvement in the T staging of OCC, the separation of OPC staging based on the high-risk HPV status, and the inclusion of extranodal extension in N staging. 18F-FDG PET/MRI is useful for evaluating cancer stages in OCC and OPC patients based on the new AJCC cancer staging system and has the potential to provide a one stop shop.

Coronal PET demonstrating recurrent SCC adjacent to a myocutaneous reconstruction flap.

Axial fused PET/CT allows precise localization of the tumor adjacent to the flap.

Radiation induced arterial injury produced by high concentration of free radicals damaging all arterial wall layers. The ECA and its major branches are the most frequently identified sources. Images show pseudoaneurysm with extravasation prior to and after coil embolization.

Cine-MRI allows for evaluation of mobility of the structures of the oral cavity and oropharynx and laryngeal elevation.

The elevated position of the velum (arrow) with a low larynx and neutral tongue base position seem to indicate an uncoordinated oropharyngeal phase of swallowing.

Laryngeal elevation (thin arrow) is concomitant with an elevation, instead of a posterior displacement, of the free-flap-reconstructed tongue base (thick arrow).

Flap Necrosis is a rare complication. If the flap is pale or does not blanch with local pressure, the viability of the flap is questionable. When decreased flap perfusion is suspected, re-exploration should be considered without delay.

Flap failure is associated with vascular thrombosis, and the majority of thrombosis is venous in origin, occurring within 3 days after surgery. The detection of thrombus in the artery and vein is important in the evaluation of the viability of the flap.

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