The close interrelationship between the floor of the mouth/sublingual tissue space, tongue, tongue base and adjacent submandibular space structures may offer what appears to be a complex presentation by various congenital, inflammatory, obstructive, benign or neoplastic processes. Having an appreciation of the oral cavity anatomy, adjacent tissue space barriers or weaknesses, more common “disease” processes or mass lesions within the oral cavity/ floor of mouth will be presented using CT/MRI imaging modalities.

A variety of developmental lesions have a strong preponderance for the oral cavity, more particularly the oral tongue, floor of the mouth, sublingual space and root of the tongue. Many of the developmental lesions will be cystic or fluid containing and may be differentiated from each other by subtle differences in their location, shape or content, as well as differentiation from non-developmental lesions of the oral cavity/oropharynx. Other developmental lesions may present as solid tissue masses and a developmental etiology may not be readily considered, particularly if presenting in late adolescence or adulthood.

Developmental Lesions:
Cystic developmental lesions of the oral cavity/oropharynx arise from various etiologies including congenital inclusion cysts (dermoid/epidermoid); incomplete resolution of embryologic migration (thyroglossal duct cyst); fluid filled masses of “vascular lymphatic etiology (lymphatic and venolymphatic malformations); cysts arising from altered salivary flow (sublingual gland retention cysts (ranula), or from obstructed submandibular ducts (sialocele) or congenital retention cysts (eg vallecular cysts).

If the root of tongue is distinguished from adjacent SLS, SMS and oropharyngeal tongue base, these latter areas having a greater frequency of infections and acquired neoplasms, due to their greater exposure to mucosal surfaces and lymphatic tissues compared to root of the tongue with its high percentage of skeletal muscle and lack of significant lymphoid tissue. ¾ of lesions found in the root of the tongue are congenital (non-vascular & vascular) and benign, representing ectopic tissues of thyroidal, epidermal, dermal, foregut, venous and lymphatic origin, with clinical /imaging characteristics that can help suggest the diagnosis. (Skeletal muscle of the root of tongue is relatively resistant to neoplasms compared with other tissues).

By contrast, great majority of SLS lesions are infectious or neoplastic. Masses in root of tongue will bow the GG-GH complexes laterally, while SLS masses will bulge SLS laterally and/or encroach on the lateral aspects of the root of the tongue.

Dermoid and Epidermoid Cysts
The “dermoid” term is often used to refer to all types of dermoid cysts, including epidermoid cysts. Classically these lesions divided into 3 histologic subtypes. 1. Epidermoid cysts lined by
squamous epith. without any dermal appendages. 2. True dermoid cysts (congenital inclusion dermoid cysts) lined by sq. cell epith containing dermal appendages (sebaceous glands, sweat glands, hair follicles in the cyst wall. 3. Teratoid type of dermoid cyst contains derivatives of all 3 germinal layers & lined by different epithelia (eg squamous, respiratory) & may contain bone, muscle or teeth.

Congenital dermoid cysts are derived from fragments of ectodermal tissue entrapped (congenital inclusion) during midline fusion, with sequestration of trapped ectoderm therefore propensity to occur close to midline. Epidermoid cyst acquired from epithelium implanted during trauma, have frequent occurrence away from the midline. 25-33% of H & N dermoid /epidermoid cysts will be in oral cavity with just over half in the sublingual space.

Both dermoid/epidermoid usually appear as well defined hypoattenuating unilocular cysts, often oval shaped, with thin wall that shows some enhancement. Epidermoid has fluid content only (homogeneous low T1 signal/ high T2 signal but occasionally increased T1 due to increased protein content. Dermoid cysts may show internal fatty/liquid mixed density content. In absence of fat globules, dermoid and epidermoid may be indistinguishable. Presence of fat-fluid level or fat globules, better appreciated by MRI, implies dermoid. The “sack of marbles”, multiple discernible low-attenuation nodules or coalescences of fat globules within the fluid matrix, are pathognomonic for a compound dermoid cyst. Dermoid cysts, depending on lipid content, frequently have complex internal signal, with increased T1 signal suggesting the fat content and heterogeneous high T2 signal, intermediate signal from fat, low signal (focal) if calcifications. Oral cavity locations mainly sublingual/ root of tongue need to be differentiated from ranula, LM, TGDC and abscess. Dermoid cyst may be distinguished from lipoma by the dermoid’s sharper margin, that also may enhance, and higher tissue attenuation compared to lipoma since dermoid not purely fat but contains variety of components including fluids and sebum. Age at presentation most often is late teens/early 20’s. Tend to be small and dormant in childhood, enlarge when sebaceous glands activated during adolescence. Usually slow growth. Sudden growth or inflammation may indicate cyst rupture.

**Lymphatic Malformations**

Non-encapsulated lesions that have become sequestered from the normal lymphatic system. May be part of venolymphatic malformation. Classified into macrocystic and microcystic forms

**Macrocystic form** usually unispatial and well-delineated. **Microcystic form** more frequently trans-spatial, does not respect fascial planes, infiltrative with potential for significant functional/cosmetic impairment or airway obstruction. More than 50% present at birth, up to 90% in first 2 yrs of life, commonly affect oral region, including tongue. More common in SMS. Soft, invaginating lesion with relative paucity of mass despite size. Macrocystic LM: well delineated, MR-low T1, increased T2, CT- homogeneous fluid content. Minimal enhancement of thin peripheral wall. Microcystic forms may appear solid and have only moderate T2 hyperintensity. Lesions best seen with T2 FS. Fluid-fluid levels indicating hemorrhage more likely with LM than other oral cavity “cystic” lesions. Phleboliths and/or central enhancement
imply venolymphatic malformation. May have rapid enlargement secondary to intralesional hemorrhage or URI.

**Ranula**

Ranula: a mucous retention cyst that occurs primarily in the small ducts of the sublingual gland. The more common “simple” form in the floor of the mouth arising beneath the mucosa of the floor of the mouth is a true cyst with an epithelial lining. The Plunging ranula is an extravasation pseudocyst or mucocele that develops from the rupture of the wall of a simple ranula. The extravasated irritating saliva induces an inflammatory response that forms a dense connective/granulation tissue wall about the “pseudocyst”. Such pseudocysts usually extend below the mylohyoid muscle. Not all ranula below the mylohyoid are ruptured and may be” simple” in nature but “plunging or deep” by location.

**Simple ranula** - Clinically FOM, off midline, in region of SLG. On CT: homogeneous low central attenuation (10-20 HU) with uniform very thin cyst wall that may not be identified. Lesion centered lateral to genioglossus muscles, superior to mylohyoid m. Occasionally ranula extends anteriorly behind the mandibular symphysis, above the genioglossis muscle attachment to mandible, with a midline isthmus between the bilateral SLS involvement to create a horseshoe-shaped unilocular bilateral SLS cyst. If cyst content is proteinaceous & isodense to cyst wall, ranula may imitate a benign appearing solid mass. If infected, “cyst’ wall enhances, is thicker, less well differentiated from adjacent tissues, and, with central hypoattenuation, may resemble an abscess. D/D lateral dermoid/epidermoid cyst, lipoma, LM, sialocele, salivary gland tumour.

**Plunging Ranula** usually is a painless mass extending into submandibular or submental triangles of neck, with/without mass in FOM. The extravasation pseudocyst that develops from rupture of a simple ranula often infiltrates into the adjacent tissue planes (submandibular/ submental) extending inferolaterally through gaps (boutonniere) in the mylohyoid m. more anteriorly, or beyond the posterior border of the mylohyoid muscle (glosso-mylohyoid gap) into SMS. On MRI, ranula appearance dominated by its high water content therefore may resemble lymphatic malformation, lateral TGDC. If high protein content, ranula may have variable signal, and resemble dermoid, epidermoid or lipoma. Cyst wall best seen on post gad T1FS. On MRI, cysts and solid lesions that have high water content can appear identical without gadolinium. Clue to ranula is presence of a “mouse tail”/ ‘comet” appearance of the collapsed SLS component medial to the mylohyoid muscle directed toward the anterior floor of the mouth, with “mouse body” medial to SMG if posteriorly directed extravasation. If the extravasation is through the mylohyoid muscle more anteriorly, tail appearance will be in the anterior SLS. Plunging ranula can be very large as they extend into the submental or submandibular space. A thick enhancing wall to the ranula may imply granulomatous reaction vs recent infection.

An obstructed submandibular duct near its opening can usually be identified by its elongated narrow dilatation with subtle changes of sialadenitis or early dilatation of the intraglandular ducts. Plunging ranula will displace SMG laterally and lies anterior to the CS structures and may resemble 2nd Branchial cleft cyst .Mean adult age of presentation is late 20’s-early 30’s.
**Thyroglossal duct cysts (TGDC)**

Account for 70-90% of congenital neck anomalies; occur anywhere along the course of the TGD from foramen cecum at tongue base to thyroid gland. Upward movement of these cysts when the tongue is protruded reflects the duct origin at the foramen cecum. 20-25% of TGDC are suprahypoid. In contrast to typical paramedian location of infrahyoid TGDC, the suprahypoid cyst is commonly midline, between bellies of the anterior digastric, frequently embedded within or below the mylohyoid sling in the submental region. Less than 3% of TGDC are intralingual/FOM.

TGDC have variable attenuation/ signal depending on protein content. Septations more often if previous infection or aspiration. D/D of posterior lingual TGDC cyst: dermoid/epidermoid cyst, rare foregut duplication cyst, congenital retention cyst. Approximately 1% of TGDC are associated with malignancy, usually thyroid carcinoma from ectopic rests within the duct/cyst walls, with these malignancies presenting in adult life.

**Solid Developmental Lesions of the Oral Cavity/Oropharynx:**

**Lingual Thyroid**

Ectopic thyroid, resulting from failure of the thyroid gland to descend during embryonic development, can occur anywhere along the thyroglossal duct tract but occurs most commonly (approximately 90%) at the tongue base, mostly midline dorsum, rarely entire tongue.

Ectopic thyroid tissue is typically asymptomatic, especially in younger years. Clinically apparent lingual thyroid 4-8 times more prevalent in females; more frequently presents during puberty, pregnancy or menses. Lingual thyroid size and heterogeneity become more pronounced after puberty into early adulthood. In 70-80% of lingual thyroid patients, no other functioning thyroid tissue is present. I $^{123}$ radionuclide scanning establishes presence or absence of normal functioning tissue in the neck and confirm presence of functioning lingual thyroid tissue. Approximately one-third of patients with lingual thyroid have hypothyroidism. Malignant development within lingual thyroid tissue is rare.

On non-contrast CT, lingual thyroid usually presents as a hyperdense mass within the intrinsic tongue musculature with more homogeneous parenchyma/ enhancement (avidly) in younger patients, prior to goiterous or thyroiditis effects. On MRI, lingual thyroid tissue is iso to hyperintense to muscle on T1, has intermediate to low signal on T2, with variable enhancement.

**Vascular Lesions: Hemangiomas and Vascular Malformations**

There is variation in presentation or appearance of this group of lesions from obvious vascular etiology appearance to the need to consider these etiologies as a possible source for subtle, atypical or trans-spatial lesions within the oral cavity/oropharynx. Some vascular anomalies have limited vascularity/ enhancement and may be difficult to distinguish their vascular nature from adjacent soft tissues or musculature. Congenital vascular anomalies are classified on basis of predominant type of anomalous vessel (capillary, venous, arterial, lymphatic), combination of specific components; presence/ absence of arterial flow and presence/absence of fistulae.
INFECTIONS OF THE ORAL CAVITY AND FLOOR OF MOUTH

Oral region and submandibular space infections most commonly result from dental etiology (infection or procedures), salivary etiologies (calculi or stenosis), or trauma.

Relationship of the apices of mandibular teeth to the mylohyoid ridge, in dental etiology infections, will determine which space, sublingual vs SMS, will be involved. Infection spread inferior to mylohyoid muscle attachment (mylohyoid ridge) will enter the submandibular space, and, if superior to mylohyoid ridge, into the floor of mouth/SLS. Infections of the SMS and SLS are frequently multispatial with communications at the posterior aspect of the SLS through the glosso-mylohyoid gap or through defects (boutonnières) in the mylohyoid muscle more anteriorly where the muscle is thinner.

CT is superior modality for imaging infection/inflammatory processes; to detect small salivary calculi, assess dentition, integrity of the mandibular cortex, or to assess for osteomyelitis. MRI may offer further soft tissue or bone marrow findings.

Inflammatory processes involving the SMG occur most often from obstructed intraductal calculi. Assess for changes of an inflamed gland—enlarged, enhancing, +/- purulent discharge in bacterial infections, obstructed duct with proximal dilatation, sialoadenitis or gland abscess. Duct diameter (intra or extraglandular) greater than 3 mm implies possible obstruction.

Primary abscesses of the tongue are rare. Most lingual abscesses occur secondary to local infections (apical dental infections, infected lingual tonsils or TGDC) or direct invasion by penetrating trauma—adjacent jagged teeth, bite injury, etc. Anaerobic bacterial infections are more frequently seen in older children and adults because of dental and periodontal disease.

Ludwig’s Angina

A rapidly progressive potentially lethal infection, usually polymicrobial mixture of anaerobic and aerobic organisms and normal oral flora, of the soft tissues of the FOM and adjacent neck. Begins as a firmly indurated cellulitis that originates intra-orally and involves the sublingual (supra-mylohyoid) and/or submandibular (infra-mylohyoid) spaces. Partial confinement of the expanding FOM infection by the mylohyoid muscles leads to increased intrinsic mass and posterior displacement of the tongue base, causing airway compromise. If begins in submandibular space, spreads superiorly into sublingual space, causing firm induration of the FOM, (bilateral involvement is typical) elevation and posterior displacement of the tongue, leading to airway compromise. Infection may organize into an abscess or may have necrotizing process along fascial planes, spread posteriorly into PPS/RPS or access the superior mediastinal level. Prior to the antibiotic era, these infections dissected inferiorly along fascial planes into the mediastinum, presenting with angina-like chest pain. Spread of disease is by anatomic continuity rather than by hematogenous or lymphatic spread.
Oral cavity/Oropharynx: Case presentations
Organ Imaging Review
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Edward Kassel
Mount Sinai Hospital/University Health Network
University of Toronto

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Representative Images submitted for the case presentations
30 M CECT

55 M MRI T1 T2 FS
No change in symptoms

T1 gad FS

2 different patients

2 different patients

V VM bilateral