### Definition of Primary Tumor

<table>
<thead>
<tr>
<th>T Category</th>
<th>T Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>TX</td>
<td>Primary tumor cannot be assessed</td>
</tr>
<tr>
<td>Tis</td>
<td>Carcinoma in situ</td>
</tr>
<tr>
<td>T1</td>
<td>Tumor ≤ 2 cm, ≤ 5 mm DOI; DOI is not tumor thickness</td>
</tr>
<tr>
<td>T2</td>
<td>Tumor ≤ 2 cm, DOI &gt; 5 mm and ≤ 10 mm; or tumor &gt; 2 cm but ≤ 4 cm, and DOI ≤ 10 mm</td>
</tr>
<tr>
<td>T3</td>
<td>Tumor &gt; 4 cm or tumor ≥ 10 mm DOI, but &lt; 20 mm</td>
</tr>
<tr>
<td>T4</td>
<td>Moderately advanced or very advanced local disease</td>
</tr>
<tr>
<td>T4a</td>
<td>Moderately advanced local disease; T4a is defined as moderately advanced local disease, tumor invading adjacent structures only (e.g., through cortical bone of mandible or maxilla, or involves maxillary sinus or skin of face) or extensive tumor with bilateral tongue involvement &amp;/or DOI larger than 20 mm</td>
</tr>
<tr>
<td>T4b</td>
<td>Very advanced local disease; tumor invades masticator space, pterygoid plates, or skull base &amp;/or encases ICA</td>
</tr>
</tbody>
</table>

DOI = depth of invasion; ICA = internal carotid artery.

### Definition of Regional Lymph Node: Clinical (cN) and Pathological (pN)

<table>
<thead>
<tr>
<th>N Category</th>
<th>N Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical (cN)</td>
<td></td>
</tr>
<tr>
<td>NX</td>
<td>Regional lymph nodes cannot be assessed</td>
</tr>
<tr>
<td>N0</td>
<td>No regional lymph node metastasis</td>
</tr>
<tr>
<td>N1</td>
<td>Metastasis in single ipsilateral node ≤ 3 cm and ENE(-)</td>
</tr>
<tr>
<td>N2</td>
<td>Metastasis in single ipsilateral node larger than 3 cm but not larger than 6 cm in greatest dimension and ENE(-); or metastases in multiple ipsilateral lymph nodes, none larger than 6 cm in greatest dimension and ENE(-); or in bilateral or contralateral lymph nodes, none larger than 6 cm in greatest dimension and ENE(-)</td>
</tr>
<tr>
<td>N2a</td>
<td>Metastasis in single ipsilateral lymph node larger than 3 cm but not larger than 6 cm in greatest dimension, and ENE(-)</td>
</tr>
<tr>
<td>N2b</td>
<td>Metastasis in multiple ipsilateral lymph nodes, none larger than 6 cm in greatest dimension, and ENE(-)</td>
</tr>
<tr>
<td>N2c</td>
<td>Metastasis in bilateral or contralateral lymph nodes, none larger than 6 cm in greatest dimension, and ENE(-)</td>
</tr>
<tr>
<td>N3</td>
<td>Metastasis in lymph node larger than 6 cm in greatest dimension and ENE(-); or metastasis in any node(s) and clinically overt ENE(+)</td>
</tr>
<tr>
<td>N3a</td>
<td>Metastasis in lymph node larger than 6 cm in greatest dimension and ENE(-)</td>
</tr>
<tr>
<td>N3b</td>
<td>Metastasis in any node(s) and clinically overt ENE(+)</td>
</tr>
</tbody>
</table>

Pathological N (pN) | |
| NX         | Regional lymph nodes cannot be assessed |
| N0         | No regional lymph node metastasis |
| N1         | Metastasis in single ipsilateral lymph node, 3 cm or smaller in greatest dimension ENE(-) |
| N2         | Metastasis in single ipsilateral lymph node, 3 cm or smaller in greatest dimension and ENE(+) or metastases in multiple ipsilateral lymph nodes, none larger than 6 cm in greatest dimension and ENE(+) or in bilateral or contralateral lymph nodes, none larger than 6 cm in greatest dimension, and ENE(+) |
| N2a        | Metastasis in single ipsilateral or contralateral lymph node 3 cm or smaller in greatest dimension and ENE(+) or single ipsilateral node larger than 3 cm but not larger than 6 cm in greatest dimension and ENE(+) |
| N2b        | Metastasis in multiple ipsilateral nodes, none larger than 6 cm in greatest dimension and ENE(-) |
| N2c        | Metastasis in bilateral or contralateral lymph nodes, none larger than 6 cm in greatest dimension and ENE(-) |
| N3         | Metastasis in lymph node larger than 6 cm in greatest dimension and ENE(-); or in single ipsilateral node larger than 3 cm in greatest dimension and ENE(+) or multiple ipsilateral, contralateral, or bilateral nodes any with ENE(+) |
| N3a        | Metastasis in lymph node larger than 6 cm in greatest dimension and ENE(-) |
| N3b        | Metastasis in single ipsilateral node larger than 3 cm in greatest dimension and ENE(+); or multiple ipsilateral, contralateral, or bilateral nodes any with ENE(+) |

A designation of “U” or “L” may be used for any N category to indicate metastasis above the lower border of the cricoid (U) or below the lower border of the cricoid (L). Similarly, clinical and pathological ENE should be recorded as ENE(-) and ENE(+).
**M | Definition of Distant Metastasis**

<table>
<thead>
<tr>
<th>M Category</th>
<th>M Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0</td>
<td>No distant metastasis</td>
</tr>
<tr>
<td>M1</td>
<td>Distant metastasis</td>
</tr>
</tbody>
</table>

**AJCC | Prognostic Stage Groups**

<table>
<thead>
<tr>
<th>When T is...</th>
<th>And N is...</th>
<th>And M is...</th>
<th>Then the stage group is...</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>N0</td>
<td>M0</td>
<td>I</td>
</tr>
<tr>
<td>T2</td>
<td>N0</td>
<td>M0</td>
<td>II</td>
</tr>
<tr>
<td>T3</td>
<td>N0</td>
<td>M0</td>
<td>III</td>
</tr>
<tr>
<td>T1, 2, 3</td>
<td>N1</td>
<td>M0</td>
<td>III</td>
</tr>
<tr>
<td>T4a</td>
<td>N0, 1</td>
<td>M0</td>
<td>IVA</td>
</tr>
<tr>
<td>T1, 2, 3, 4a</td>
<td>N2</td>
<td>M0</td>
<td>IVA</td>
</tr>
<tr>
<td>Any T</td>
<td>N3</td>
<td>M0</td>
<td>IVB</td>
</tr>
<tr>
<td>T4b</td>
<td>Any N</td>
<td>M0</td>
<td>IVB</td>
</tr>
<tr>
<td>Any T</td>
<td>Any N</td>
<td>M1</td>
<td>IVC</td>
</tr>
</tbody>
</table>

**G | Histologic Grade**

<table>
<thead>
<tr>
<th>G Category</th>
<th>G Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>GX</td>
<td>Cannot be assessed</td>
</tr>
<tr>
<td>G1</td>
<td>Well differentiated</td>
</tr>
<tr>
<td>G2</td>
<td>Moderately differentiated</td>
</tr>
<tr>
<td>G3</td>
<td>Poorly differentiated</td>
</tr>
</tbody>
</table>


**Summary of Changes**

<table>
<thead>
<tr>
<th>Change</th>
<th>Details of change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Mucosal portion of lip now separated from cutaneous (external) lip</strong></td>
</tr>
<tr>
<td></td>
<td>External portions of lips now considered cutaneous structures for purposes of</td>
</tr>
<tr>
<td></td>
<td>classification and staging</td>
</tr>
<tr>
<td></td>
<td><strong>Extrinsic tongue musculature involvement no longer used for T4</strong></td>
</tr>
<tr>
<td></td>
<td>Clinical and pathological DOI now used to increase T category</td>
</tr>
<tr>
<td></td>
<td><strong>Extranodal extension is added as qualifier for upstaging disease</strong></td>
</tr>
<tr>
<td></td>
<td>ENE defines tumor that has metastasized to lymph node and then progressed within</td>
</tr>
<tr>
<td></td>
<td>node to point at which node capsule is breached, and tumor extends into surrounding</td>
</tr>
<tr>
<td></td>
<td>tissue; ENE carries higher likelihood of local regional recurrence and distant</td>
</tr>
<tr>
<td></td>
<td>metastasis and carries worse prognosis</td>
</tr>
</tbody>
</table>

DOI = depth of invasion; ENE = extranodal tumor extension.
Lip and Oral Cavity Carcinoma

T1

Graphic illustrates T1 disease of the oral tongue and mucosal lip as a tumor that is ≤ 2 cm and depth of invasion (DOI) ≤ 5 mm.

T2

Graphic illustrates clinical T2 disease of the oral tongue and lip as a tumor ≤ 2 cm with DOI > 5 mm and ≤ 10 mm or tumor > 2 cm but ≤ 4 cm, with DOI ≤ 10 mm.

T3

Graphic illustrates T3 disease of the oral tongue and lip as a tumor > 4 cm in greatest dimension or any tumor with DOI > 10 but ≤ 20 mm. Imaging is generally more helpful in patients with larger lesions for evaluating thickness of the lesion and possible invasion of underlying structures.

T4a: Lip

Sagittal graphic illustrates a deeply invasive tumor invading the mandible. Frontal drawing shows the tumor invading the skin of the face. Either finding is sufficient to classify a carcinoma of the lip as T4a.
Axial graphic illustrates moderately advanced local disease with a large oral tongue cancer invading adjacent structures. The tumor extends laterally and invades the mandible. There is also deep invasion with DOI > 20 mm (black line).

Coronal graphic illustrates very advanced local disease with the tumor invading the masticator space, pterygoid plates, and skull base. T4b tumors may also encase the internal carotid artery.

Metastases, Organ Frequency

<table>
<thead>
<tr>
<th>Organ</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung</td>
<td>50%</td>
</tr>
<tr>
<td>Skeleton</td>
<td>25%</td>
</tr>
<tr>
<td>Liver</td>
<td>15%</td>
</tr>
<tr>
<td>Skin</td>
<td>5%</td>
</tr>
</tbody>
</table>
OVERVIEW

General Comments
- American Joint Committee on Cancer (AJCC) staging system is used to stage epithelial and minor salivary gland cancers of oral cavity (OC)
- This classification is not used for other types of malignancies of oral cancer
  - Nonepithelial tumors of lymphoid tissue
  - Nonepithelial tumors of soft tissue, such as sarcoma
  - Nonepithelial tumors of bone/cartilage
  - Mucosal melanoma of OC
  - Cutaneous lip carcinoma
- OC squamous cell carcinoma (SCCa) is closely associated with exposure to tobacco and alcohol
- Imaging in OC carcinomas performed mainly to assess local extension and regional spread
  - Clinical examination is generally better than radiological imaging for screening for mucosal lesions and more accurate for evaluation of mucosal lesion size
  - Majority of carcinomas are imaged after diagnosis has been made
- Treatment is generally aimed at surgical resection of primary lesion ± postoperative adjuvant therapy

Classification
- Vast majority of OC malignancies (90-95%) are SCCa
- Malignant subtypes of OC SCCa tumors
  - Basaloid SCCa
  - Spindle cell carcinoma
  - Adenosquamous carcinoma
  - Carcinoma curiculum
  - Verrucous carcinoma
  - Lymphoepithelial carcinoma
  - Papillary SCCa
  - Acantholytic SCCa
- OC anatomically begins at mucosal-lined portions of lips and extends to oropharynx
  - Posterior margin of OC is defined by junction of hard and soft palate superiority, anterior tonsillar pillars laterally, and circumvallate papillae of tongue inferiorly
  - Anatomic subsites include mucosal-lined portions of lips, alveolar ridges, buccal mucosa, floor of mouth (FOM), oral tongue, hard palate, and retromolar trigone regions

PATHOLOGY

Routes of Spread
- Macroscopic local tumor extension largely dependent on site of origin of tumor
  - Mucosal lip
    - Tumor invades submucosa, adjacent gingival mucosa, skin, and adjacent mandible or maxilla
  - Buccal mucosa
    - Tumor invades submucosa, buccinator muscle, and ultimately, buccal space
    - Tumor can extend laterally into deep subcutaneous fat of cheek
    - Can extend to gingiva and involve maxilla or mandible
    - Large tumors can extend to masticator space
  - Lower alveolar ridge
- Extends submucosally, invades cortex, and then invades marrow space of mandible
- Marrow space involvement can lead to invasion of perineurium of alveolar nerve
  - Upper alveolar ridge
  - Invade maxillary alveolar ridge; can invade hard palate, maxillary sinus
  - Retromolar trigone (or retromolar gingiva)
    - Tumor can spread laterally into buccal space and masticator space
    - Can spread superiorly along pterygomandibular raphe
    - Invades mandibular bone
    - Can involve inferior alveolar nerve and lingual nerve with perineural tumor spread (PNTS)
  - FOM
    - Tumor can spread deep into musculature of tongue, across midline, laterally into mandible, inferiorly to hyoid bone
  - Hard palate
    - Can extend laterally to gingival mucosa, deep through cortical bone of hard palate into inferior nasal cavity or maxillary sinus
    - Perineural extension along palatine nerves to palatine groove
  - Anterior 2/3 of tongue (oral tongue)
    - Tend to invade tongue musculature primarily (intrinsic and then extrinsic)
    - Can extend posteriorly to glossoptonsillar junction and laterally or anteriorly into FOM

Regional lymphatic spread
- Lymph node metastases generally follow predictable and orderly pattern of spread
  - In general, spread goes from upper to middle to lower cervical nodes
  - Cancer of lip (low potential for metastases)
    - Submental (level IA) and submandibular (level IB) nodes
  - Cancer of alveolar ridge or hard palate (low potential for metastases)
    - Submandibular (level IB)
    - Jugular (levels II-IV)
    - Retropharyngeal (less commonly)
  - Primary site closer to midline increases risk of bilateral spread to cervical nodes
  - Anterior superior mediastinal nodes considered regional nodes (level VII); other mediastinal nodes considered distant metastases

Metastatic disease
- Pulmonary metastasis
- Skeletal and hepatic metastases are less common

General Features
- Comments
  - > 90% of cancers in OC are SCCa, most are moderately or well differentiated
  - Most common subsites of OC cancer: Tongue, FOM, and gingiva
- Genetics
  - Oral cancer shows relatively small effect of genetic and familial predisposition
  - Most SCCa of OC have mutations in TP53 gene
Lip and Oral Cavity Carcinoma

- Most OC SCCa are considered genetically unstable
- **Etiology**
  - Tobacco use considered most common etiology
  - Alcohol usage
  - Alcohol and tobacco act synergistically
  - Betel quid chewing
  - Sunlight exposure
  - Human papillomavirus (HPV) infection likely plays role in small percentage of OC cancers
- **Epidemiology cancer**
  - 23,880 estimated new cases in USA in 2010
  - 5,470 estimated deaths in USA in 2010
  - OC SCCa is more common in men
  - OC carcinoma is more prevalent in elderly
    - Mean age at presentation: 60 years
  - Overall decrease in incidence from 1970s in USA
    - Largely attributed to decreases in smoking
  - More prevalent in parts of Asia
    - Due to various forms of tobacco use
      - Consumption of betel-containing substances
- **Associated diseases**
  - There are variety of potentially malignant (premalignant) disorders of OC mucosa, including leukoplakia and erythroplakia
    - Leukoplakia defined clinically as “white patch” or plaque of mucosa that is not otherwise characterized clinically or pathologically as any other disease
    - Erythroplakia is red, “velvety” patch of mucosa that cannot be otherwise characterized clinically or pathologically as being caused by any other condition

**Gross Pathology & Surgical Features**
- Resection of primary tumor allows for pathologic evaluation, including extent of local spread, depth of invasion (DOI), and pT designation
- Lymph node dissection allows for pathologic evaluation of lymph nodes, evaluation for extranodal extension (ENE), and pN classification
  - Surgically resected nodes should be inspected for presence of ENE
  - ENE represents extension of metastatic tumor within lymph nodes through lymph node capsule into adjacent tissue
    - ENE may be microscopic, ≤ 2 mm beyond capsule
    - ENE may be major, > 2 mm or gross ENE
- Pathologic staging, while important, does not supersede clinical staging as primary staging tool
- Classic gross pathology
  - Central mucosal ulceration
  - Tumors tend to be firm and infiltrated with tan or white cut surface
- Tumor can be endophytic, exophytic, or ulcerated

**Microscopic Pathology**
- H&E
  - Most OC SCCa moderately to well differentiated
  - Well-differentiated tumors
    - Exhibit well-differentiated squamous cells, generally polyhedral-shaped with conspicuous intercellular bridges, and appearing in nests, cords, and islands of cells with pink cytoplasm and round nuclei
    - Dykeratotic cells and keratin pearls are prominent
  - Moderately differentiated tumor
    - Composed of cords or islands of neoplastic atypical epithelial cells, oblong or oval-shaped, which infiltrated tumoral stroma
    - Nuclei of neoplastic cells have various shapes and sizes, most hypochromic with large nucleoli
- **Special stains**
  - p16 and HPV
    - Up to 1/3 of OC SCCa p16(+)
    - However, in situ hybridization (more sensitive for high-risk HPV) indicates < 10% are positive for HPV
    - As opposed to oropharynx, studies have shown no definite survival advantage in p16(+) OC SCCa compared to p16(-) OC SCCa
- Other histologic factors to be considered include ENE, DOI, PNTS, and lymphovascular invasion

**IMAGING FINDINGS**

**Detection**
- Clinical assessment usually more accurate than imaging for mucosal lesion (T1-T3)
- Imaging important for deep extent and lymph nodes
- **CT**
  - Apposed mucosal surfaces can limit ability to identify OC lesions
  - Typically, primary lesion will appear as nodular or mass-like area of enhancement involving mucosal surface
    - Enhancing tissue may be predominantly invasive, exophytic (protruding into OC), or combination of both patterns
  - Larger lesions can show areas of necrosis
  - Occasionally, lesions are ulcerated and demonstrate excavation of mucosa with localized tissue loss
  - Appearance of primary tumor will depend on site of origin of tumor, size, and extent of local invasion
    - Locations include lip, buccal mucosa, alveolar ridges, FOM, hard palate, anterior 2/3 tongue (oral tongue), retromolar trigone
  - Coronal and sagittal reformatted images helpful
  - Puffed-cheek technique is often useful for evaluating buccal and buccal-gingival sulcal lesions
- **MR**
  - MR is ideal imaging modality in OC
    - Multiplanar capabilities + better contrast for primary evaluation
    - Dental amalgam artifact less severe than with CT
    - Superior modality in evaluating hard palate tumors
    - Superior illustration of tumor-muscle interface and perineural extension
- **T1WI**
  - Isointense to muscle
    - Low signal intensity of primary tumor
Head & Neck

**PET/CT**
- Most SCCa reliably FDG avid
- Useful in cases of unknown primary to find primary lesion
  - Submucosal tumors may be located via PET/CT when searching for unknown primaries
- Several normal structures in neck may take up FDG physiologically
  - Muscle
  - Brown fat
  - Lymphoid tissues
  - Mucosa

**Limitations**
- MR not always readily accessible in some centers
- Limiting factors include long acquisition time (~ 30 minutes)
- Problems with swallowing, pooling secretions, cough, or airway difficulty may cause significant motion artifact

**Staging**

**T Staging**
- T staging is primarily based on size of primary lesion but is also influenced by DOI
  - DOI can be determined clinically by imaging and by pathologic evaluation of resected specimen
  - To determine DOI on imaging, "horizon" line is drawn through/along site of primary tumor, through expected location of normal basement membrane, correlating with nearest edges intact or normal mucosa
  - Perpendicular line is then drawn from horizon line to deepest margin of infiltrating tumor
  - This 2nd line is measured and designated DOI
  - While DOI is best understood and evaluated in terms of histologic analysis, coronal and sagittal imaging planes are useful in to provide reasonable estimate of DOI
- Tis: Represents carcinoma in situ and is histologic diagnosis, generally below sensitivity for imaging modalities
  - T1: Tumor ≤ 2 cm, DOI ≤ 5 mm
  - T2: Tumor ≤ 2 cm, DOI > 5 mm, and ≤10 mm or tumor >2 cm but ≤ 4 cm, and DOI ≤ 10 mm
  - T3: Tumor > 4 cm or any tumor with DOI > 10 mm but ≤ 20 mm
  - T4a: Moderately advanced or very advanced local disease
    - Involves maxillary sinus
    - Invades skin of face
    - Bilateral tongue involvement
    - DOI > 20 mm
  - T4b: Tumor invades masticator space, pterygoid plates or skull base, or encases internal carotid artery
- Involvement of extrinsic tongue musculature no longer used as staging criteria
- CT is less sensitive than MR in identifying PNTS, but PNTS is occasionally demonstrated as enlarged, enhancing V3 of trigeminal nerve, enlarged inferior alveolar nerve canal, widening of foramen ovale, or as distal facial nerve branch involvement of cheek
- CT with bone windows valuable in evaluating cortical bone invasion
- MR can be useful in evaluation of extent of medullary cavity involvement after violation of mandibular cortex
  - Replaced bone marrow is easier to appreciate on precontrast T1WI

**N Staging**
- CECT is most common modality utilized for initial nodal staging; but MR and PET/CT are useful and are performed as initial modalities in some centers
- When using CECT, multiple features of nodes should be evaluated to determine possibility of metastatic disease, including size, shape, density, necrosis, and possible ENE
  - Malignant lymphadenopathy results in enlarged lymph nodes ± necrosis
- Regional lymph node staging can be categorized clinically (cN) prior to treatment or pathologically (pN) following resection of primary tumor and selected nodal groups
  - Imaging findings support clinical classification
  - Midline nodes are considered ipsilateral
  - Anterior superior mediastinal nodes are considered regional nodes (level VII)
  - 1st-order nodal drainage is to submandibular nodes (level IB), then to jugulodigastric group (level IIA) at top of internal jugular chain
  - Oral tongue SCCa: 70% have malignant nodes at presentation
  - Retropharyngeal nodes should be evaluated, especially if tumor involves posterior wall of oropharynx
- ENE is important discriminator and has been added as prognostic variable for regional lymph node metastases in 8th edition of AJCC Staging Manual
  - Clinical classification of ENE requires unambiguous clinical evidence
    - Invasion of skin, infiltration of musculature or adjacent tissue leading to fixation or objective dysfunction of cranial nerve, brachial plexus, sympathetic trunk or phrenic nerve
  - Current radiologic techniques may suggest presence of ENE and may support clinical findings but is not sufficient alone to designate cENE
  - ENE can be determined by pathologic classification (pENE) based on microscopic identification of metastatic tumor within node extending through node capsule into adjacent tissue
- Clinical nodal staging (cN)
Lip and Oral Cavity Carcinoma

- Clinical N1 (cN1) disease indicates metastasis in single ipsilateral node ≤ 3 cm and ENE(-)
- Clinical N2 (cN2) includes
  - cN2a: Metastasis in single ipsilateral node larger than 3 cm but not larger than 6 cm in greatest dimension and ENE(-)
  - cN2b: Metastasis in multiple ipsilateral nodes, none larger than 6 cm in greatest dimension and ENE(-)
  - cN2c: Metastasis in bilateral or contralateral lymph nodes, none larger than 6 cm in greatest dimension and ENE(-)
- Clinical N3 (cN3) includes
  - cN3a: Metastasis in lymph node larger than 6 cm in greatest dimension and ENE(-)
  - cN3b: Metastasis in any node(s) and clinically overt ENE(+)

M Staging
- Distant metastases are present < 10% of time at presentation: Lung > bone > liver
- CT of chest is commonly performed in addition to CECT of neck to evaluate for pulmonary metastases and also allows for significant osseous coverage of thoracic spine, ribs, sternum, and shoulder girdle
- PET/CT
  - PET scan or PET/CT is best overall evaluation for distant metastases
  - Strong FDG avidity seen in distant metastasis
  - Sensitivity greatest in metastases with diameter > 1 cm
  - PET offers major advantage in detecting 2nd primary tumors
  - Careful attention to artifacts and patterns of physiologic uptake is essential to avoid inaccurate staging

CLINICAL ISSUES

Presentation
- OC SCCa usually occurs after 5th decade of life
- Strongly associated with tobacco and alcohol use; betel quid chewing is primary epidemiological factor in some parts of world
- 50% of patients present with advanced-stage disease
- Symptoms may include
  - Nonhealing ulcers of lip or mouth
  - Loose teeth
  - Odynophagia
  - Weight loss
  - Bleeding of gums or OC lesion
  - Ref erred otalgia
  - Numbness or pain of chin or mouth
  - Trismus
  - Skin fixation or invasion

Cancer Natural History & Prognosis
- Overall 5-year survival is > 60%
- ~ 1/3 of patients will relapse with locoregional recurrence most common failure method
- Most significant influence on outcome is presence of metastatic lymph nodes
- Survival reduced by 50% when compared to those with similar primary tumors without neck metastases
- Initial clinical stage is important predictor of survival
- Risk of 2nd primary malignancy of head and neck is ~ 4-7% per year

Treatment Options
- Alternatives
  - Surgical resection is generally regarded as treatment of choice for OC SCCa
    - Surgical procedures variable depending on location of primary lesion
    - Allows accurate pathologic staging
    - May include cervical node dissection when needed
    - Oral tongue and FOM cancers are more likely to metastasize to neck
    - Rate of microscopic nodal metastases from OC SCCa is ~ 20-30% in cN0 neck
    - Reconstruction techniques important for functional restoration
      - Early-stage tumors can be reconstructed with primary closure or use of skin graft
      - Larger tumors may require microvascular free tissue transfer, such as free radial forearm flap
  - Radiation therapy
    - Modalities include
      - External beam radiation therapy (EBRT)
      - Interstitial implantation
      - These may be used alone or combined
      - Smaller superficial lesions can be treated with
        - Local implantation of various radioactive sources
        - Intraoral cone radiotherapy
        - Electrons
      - Larger lesions typically treated with
        - EBRT
        - Possible supplementation with interstitial radiation sources in order to achieve adequate doses
  - Chemotherapy
    - Typically given concurrently with primary radiotherapy in patients with newly diagnosed unresectable lesions
    - May also be used palliatively

Roadblocks
- Given anatomy involved, treatment of oral cancer, particularly surgery, can have significant effect on patient normal functioning
- Reconstructive and rehabilitative considerations are significant in quality of life
  - Important part of therapeutic decision-making
- Options by stage
  - Wide variability in management based on extent of tumor involvement and primary area of involvement

REPORTING CHECKLIST

T Staging
- Understanding clinical information and possible clinical identification of primary tumor site is useful
- Remember all subsites of OC must be interrogated
- Small T-stage lesions may be difficult to identify with routine imaging parameters
- Primary tumors will have variable morphology, ranging from infiltrative to exophytic to ulcerative
- T staging reflects overall size of tumor as well as DOI
Once primary mucosal tumor is identified, meticulous evaluation of surrounding deep structures, including mandible, maxilla, skin, or masticator space, necessary.

- Report encasement of carotid
  - If > Z70° of carotid artery circumference surrounded by tumor, artery is considered "encased"
    - Typically unresectable in these cases

**N Staging**

- Evaluation of nodes should include size and internal characteristics of node
- 2 node measurements to remember
  - 3 cm and 6 cm, as they are cutoffs for changing N stage
- Report features of metastatic nodal disease that are important in therapeutic decision-making
  - e.g., relationship of metastatic nodes to great vessels of neck, especially carotid artery
    - Helps determine feasibility of surgical resection
- ENE is important factor in terms of prognosis
  - Current radiologic techniques may suggest presence of ENE and may support clinical findings but is not sufficient alone to designate cENE
  - Nodes with irregular or spiculated margins, obliteration of adjacent fat, or suspected invasion into adjacent soft tissues are findings that suggest ENE

**M Staging**

- Careful inspection of visualized lung parenchyma (most common location for metastases outside of neck)
- PET/CT offers most comprehensive look for metastatic disease and 2nd primary tumors

**SELECTED REFERENCES**

Lip and Oral Cavity Carcinoma

Stage I (T1N0M0)

(Left) Axial CECT shows a small, superficial, ulcerated mucosal lesion in the anterior aspect of the tongue just to the left of the midline. (Right) Axial CECT in the same patient shows peripheral enhancement of the lesion with central necrosis. The lesion measured 1.7 cm and DOI was < 5 mm, making this a T1 lesion of the oral tongue.

Stage II (T2N0M0)

(Left) Axial CECT in a 69-year-old female smoker with an anterior tongue lesion demonstrates an enhancing oral tongue lesion on the right measuring 1.8 cm in greatest dimension. (Right) Coronal CECT in the same patient demonstrates an enhancing lesion in the lateral tongue. In this view, the tumor thickness is measured at 9 mm, but DOI was measured at 7.5 mm. A lesion ≤ 2 cm with DOI > 5 mm but ≤ 10 mm is staged as a T2 lesion.

Stage III (T3N0M0)

(Left) Axial CECT in an 82-year-old man with floor of mouth carcinoma demonstrates a moderately enhancing mucosal mass on the right. The lesion measures 2.3 cm in greatest dimension with tumor thickness of 2.0 cm. The DOI was measured at 15 mm, making the lesion a T3 carcinoma. (Right) Coronal CECT in the same patient shows relatively deep invasion of an enhancing tumor. The tumor thickness measured 2.1 cm with DOI determined to be 15 mm. A lesion > 2 cm and ≤ 4 cm with DOI > 10 mm and ≤ 20 mm is a T3 lesion.
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(Left) Axial CECT in an 83-year-old woman presenting with a right submandibular mass is shown. Inspection of oral cavity revealed a mucosal lesion of right floor of mouth. The lesion measured 1.5 cm in greatest dimension with tumor thickness of 1.0 cm. Pathologic depth of invasion was 7 mm. For tumor ≤ 2 cm & DOI > 5 mm and ≤ 10 mm, T stage is T2. (Right) Axial CECT in the same patient shows a 1.3-cm, rounded node consistent with metastasis. Histology showed 3 positive ipsilateral nodes, none > 3 cm or with ENE (N2b).

(Left) Axial CECT in a 79-year-old man with a large anterior tongue lesion shows an enhancing, deeply invasive mass involving much of the oral tongue. The lesion measured 5 cm in greatest dimension. Pathologic depth of invasion was > 20 mm. (Right) Axial CECT at a slightly lower level in same patient shows a large, enhancing mass involving the anterior tongue and left floor of mouth. Depth of invasion was > 20 mm.

(Left) Coronal CECT in the same patient demonstrates the deeply invasive nature of the lesion. The tumor thickness was measured at 3.5 cm, and pathologic DOI was measured at > 20 mm. While the mandible demonstrated no erosion on CT, cortical invasion was demonstrated at pathology. (Right) Axial PET/CT in the same patient demonstrates markedly avid activity in the large mass of the oral tongue. No lymphadenopathy was shown. Both DOI > 20 mm and mandibular invasion make this a T4a lesion.
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**Stage IVA (T4aN1M0)**

(Left) Axial CECT in an 85-year-old smoker who presents with a right cheek mass shows a 3.0-cm right buccal space mass that extends posteriorly to retromolar trigone. A single enlarged lymph node was noted as level IIB (not shown). (Right) Coronal CECT (same patient) shows an enhancing mucosal mass involving upper buccal mucosa. Note normal submucosal fat on left that separates mucosa from buccinator muscle. The submucosal fat is invaded on the affected side as tumor advances to buccinator muscle.

**Stage IVA (T4aN1M0)**

(Left) Axial CECT, slightly higher, in the same patient, shows extension to maxillary tuberosity. (Right) Axial CECT, bone window, at the same level in the same patient confirms cortical erosion of the maxillary alveolar ridge posteriorly, making this lesion at least T4a. After initial imaging and treatment planning, this patient was briefly lost to follow-up.

**Stage IVA (T4aN1M0)**

(Re)Stage IVB (T4bN2bM0)

(Left) Axial CECT in same patient obtained 6 months later with no interval treatment shows the tumor has enlarged and now involves the skin of the right cheek, masticator space, and oropharynx. Multiple new ipsilateral nodes are present. (Right) Axial CECT in same patient demonstrates destruction of the maxilla and pterygoid plates. Masticator space and pterygoid plate involvement make this lesion T4b.
(Left) Axial CECT in a 67-year-old woman shows a heterogeneously enhancing mass of the oral cavity with erosion of the maxillary alveolar ridge. There is extension posteriorly to involve the masticator space (T4b). (Right) Axial CECT in the same patient shows the lesion invading the inferior maxillary sinus with bony destruction and involvement of the pterygoid plates and masticator space.

(Left) Coronal T1 MR in the same patient shows the true extent of the lesion with broad involvement of the maxillary alveolar ridge, hard palate, gingivobuccal sulcus, and superior extension into the maxillary sinus. (Right) Coronal T2 fat-saturated MR similarly shows a hyperintense lesion with involvement of the maxillary alveolar ridge and superior invasion into the maxillary sinus.

(Left) Axial PET/CT in the same patient shows markedly hypermetabolic activity at the level of the maxillary alveolar ridge. (Right) Axial PET/CT at a slightly lower level in the same patient shows hypermetabolic activity within a single level II lymph node (N1).
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(Left) Axial CECT in a 71-year-old man with large floor of mouth squamous cell carcinoma demonstrates a lesion > 5 cm involving the right floor of mouth and invading the mandible and the skin laterally. Tumor extends to the masticator space posteriorly. (Right) Axial CECT slightly lower in the same patient demonstrates a large mass with mandibular destruction.

(Left) Axial CECT, bone window, in the same patient more clearly demonstrates the osseous destruction of the right hemimandible. (Right) Axial CECT through the submental region in the same patient shows a large necrotic midline node. This lesion was fixed clinically indicative of ENE. The irregular margins support the clinical diagnosis of ENE. No other definite adenopathy was demonstrated on CECT.

(Left) Axial CECT slightly lower through the submental region in the same patient again demonstrates a 3.5-cm necrotic submental lymph node in the midline. Midline nodes are considered ipsilateral for the purposes of staging. (Right) Axial CECT in the same patient though the upper lung demonstrates multiple nodules compatible with metastatic disease. Due to comorbid disease, nonoperative palliative treatment was chosen by the patient.