Tongue Anatomy and Glossectomy: 101

LEO MARTINEZ, M.D.
UNIVERSITY OF TEXAS MEDICAL BRANCH (UTMB HEALTH)
DEPARTMENT OF OTOLARYNGOLOGY
GRAND ROUNDS PRESENTATION
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Outline

- Relevant anatomy
- History of glossectomy
- Disease overview of the tongue
- Glossectomy procedures
- Reconstruction options
- Conclusion and coding
Embryology

- The tongue appears in the fourth week of life.
- It develops with the turberculum impar, which is a mesenchyme swelling in the floor of the primitive pharynx, cranially to the foremen cecum.
- The anterior two thirds form from the first pharyngeal arches, lateral to the turberculum impar.
- They fuse to form the medial sulcus of the tongue.
Embryology

- lingual swelling
- 1st arch
- 2nd arch
- 3rd arch
- 4th arch
- tuberculum impar
- hypobranchial eminence
- epiglottal swelling
- artery
- 1st cleft
- cartilage
Embryology

- The posterior 1/3 of the tongue arises from hypobrachial eminence overgrowth from the copula
- Hypobrachial eminence is from the third and fourth pouch
- Cupola is from the second pharyngeal arch.
Embryology

Development of the Tongue (part 1)

lingual swellings
lateral
median
foramen caecum
cupola

Pharyngeal Arches

Hypopharyngeal eminence component (arch 3 & 4)
Embryology
Embryology

Development of the Tongue (part 3)

- median sulcus
- terminal sulcus
- circumvillate papilla
- pharyngeal
- epiglottis
The tongue is used for:

- Speech
- Sense of taste
- Swallowing
- Manipulation and positioning of food
- Cleansing of the oral cavity
The tongue is lined by stratified squamous epithelium. The degree of epithelial keratinization is determined by the amount of physical force placed on it.
Sense of Taste

- Papillae
- Taste buds
- Sensory nerve fiber
- Connective tissue
- Taste cell
- Taste pore
- Supporting cell
- Taste hair
- Epithelium of tongue

Areas of the tongue:
- Bitter
- Sour
- Salty
- Sweet

No compartment for bitter taste.
Anatomy

The sulcus terminalis divided the anterior and posterior tongue.

Tongue base ends at the vallecula.

Foramen cecum - area where the thyroid descends.
There are 8 muscles of the tongue. They are classified as **intrinsic** and **extrinsic** muscles.
There are four paired intrinsic muscles of the tongue:

**Superior Longitudinal** muscle, which runs the length of the superior surface of the tongue.

**Inferior longitudinal** muscle, lines the sides of the tongue.

**Verticalis** - Middle of the tongue, goes up and down, joined to the longitudinal muscles.

**Transversus muscle** - which divides the tongue at midline by going across the tongue.
Anatomy

Inferior and superior longitudinal muscles - Move tip up and down

Transverse muscle - Narrows and lengthens the tongue

Vertical Muscle - Flattens and depresses the tongue
The four extrinsic muscles are

1) Genioglossus - from the mandible
2) Hyoglossus - from the hyoid bone
3) Styloglossus - from the styloid process
4) Palatoglossus - from the palatine aponeurosis
Function of the extrinsic muscles

Genioglossus- protrusion of tongue apex from the mouth

Hyoglossus- depression of the tongue

Styloglossus- elevates and retracts the tongue

Palatoglossus- elevates and retracts the tongue

All tongue muscles are innervated by the hypoglossal nerve except the palatoglossus- innervated by vagus
The main artery of the tongue is the lingual branch of the external carotid artery.

Other contributors include the ascending palatine and tonsillar branch of the facial artery.

There is an extensive submucosal plexus which is responsible for the vast blood supply of the tongue.
**Sensory nerves**

Lingual branch of V2 - General sensation for the anterior two thirds of tongue

Chorda tympani of CN VII - taste for anterior 2/3

Lingual branch of CN IX - General sensation and taste for posterior 1/3

Superior laryngeal CN X - root of tongue and lingual base sensation.
The earliest description of tongue lesions came from the Egyptian Papyrus Ebers, originally thought around 1550 BC. The Egyptians tried milk gargles and various chewed concoction to treat tongue lesions. Other treatments over the years included sclerosing agents, leeches, surgical interventions.
History

- 600-300 BC Sushruta produced surgical text describing macroglossia and procedure of rupturing the cyst of the tongue
- Dark ages had Albucasis (1013-1106), which described different oral and tongue conditions, but the only surgical procedure described draining of ranula by forcing the fluid out.
History

- Early surgical interventions included bleeding of the tongue, to surgically mauling of the tongue to cause scaring and contraction.

- Case reports
  - 1600- Sweden patient with macroglossia underwent surgical resection of part of tongue that protruded from mouth, without cautery. Patient survived despite severe hemorrhage
  - 1865- Ligation of external carotid on one side, and when that did not help, tied off common carotid on the other side. Tongue shrunk in size, and patient survived, although not sure quality of life.
  - 1900- French used an écraseur which was like a snare, but instead of wire, had chain links, with a handle to tighten the chain
Fig 4. Chassaignac’s écraseur. This device was essentially a chain that could be tightened about the tongue by means of the screw-handle. This instrument is almost exclusively used for tongue excision. (Reprinted 22)
Glossectomy

• Definition of Glossectomy
  • Partial glossectomy 1/3 or less of tongue
  • Hemiglossectomy 1/3 to ½ of tongue
  • Near total glossectomy ½ to ¾ of tongue
  • Total glossectomy ¾ or greater of tongue
Glossectomy

- Treatment planning in patients with cancer of the tongue depends on involvement of the floor of mouth, mandible and other surrounding landmarks, the size of the cancer, and the presence of lymph node disease.
- Oral Cancer may be treated with radiation or surgery, but surgery still remained the favored treatment of primary choice.
Glossectomy

- For T1/T2 lesion, a transoral partial glossectomy provided adequate margins of resection.
- This maintains articulation and swallowing function.
- However, even early stage cancer may be associated with rates of nodal metastasis of 30%.
- Also, an increase in loco-regional and disease free survival after elective neck dissections for clinically tumor negative necks mandates aggressive treatment.
Glossectomy

- For T3/T4 cancers, a hemiglossectomy or total glossectomy is usually necessary.
- This is because they usually involve adjacent structures such as the floor of the mouth, tonsillar pillar, and or mandible
A comprehensive treatment strategy has been developed by O’Brien and associates which includes:

- Initial surgery for primary cancer
- Preservation of mandible whenever possible
- Selective neck dissection for level 1-4 negative neck, and modified radical (or radical) neck dissection for clinically positive neck
- Tracheostomy for advance cancer
Glossectomy

- Speech therapy after treatment
- Postoperative radiation therapy for:
  - T3/T4 primary cancer
  - Positive surgical margins (however ideally treated with resection)
  - Poor differentiation
  - Perineural invasion
  - Involvement of multiple nodes
  - Extracapsular spread of nodal disease

This applies to carcinoma of the tongue, but also can be used with other primary cancers of the oral cavity.
Glossectomy

Plan on use of partial glossectomy with primary closure or skin graft.

- Selective neck dissection with N0/N1 and modified with N2 or greater neck disease
- History of alcohol consumption is critical for prevention of delirium tremens in the postoperative period. Also concern over malnutrition.
Glossectomy

- Patients should be examined for tongue motility and otalgia
- Otalgia suggests perineural or deep invasion
- Deviation of tongue suggests deep infiltration of muscul arity of the tongue.
- Exam should include evaluation of endophytic vs exophytic lesions
Upper – Ulcerative endophytic lesion. These lesions tend to metastasis more due to deeper more infiltrating nature

Lower – Exophytic lesions
Glossectomy

- Sparana et al (2004) has suggested that tumor thickness is a factor in regional recurrence and survivorship.
- Tumor of ≥ 4mm in thickness have been shown to have 59% chance of neck metastasis.
- Tumors of ≥ 3-4mm have shown to have worse regional recurrence and survivorship.
Glossectomy

- Therefore, bimanual palpation of tumor size is essential.
- A surface measurement should also be performed to properly stage the disease.
- As always, a complete examination of the oral cavity with indirect laryngoscopy should be performed.
Glossectomy

- Complete dental evaluation is necessary.
- Periodontal disease needs a dental consultation.
- Full mouth extractions are needed prior to radiation treatment to prevent osteoradionecrosis.
- Also, extraction of poor dentition will help with wound healing, as increased bacterial count is associated with periodontal disease.
Glossectomy

- Patients should have complete neck examination and a CT scan of the neck with contrast to evaluate for neck disease.

- Sometimes, an MRI may help with depth determination and extend of involvement of the muscle fibers of the tongue. This information can be especially helpful with reconstruction planning.
Table 1
American Joint Committee on Cancer (AJCC)
TNM Staging Classification for the Lip and Oral Cavity
(7th ed., 2010)
(None epithelial tumors, such as those of lymphoid tissue, soft tissue, bone, and cartilage are not included)

<table>
<thead>
<tr>
<th>Primary Tumor (T)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TX</strong> Primary tumor cannot be assessed</td>
</tr>
<tr>
<td><strong>T0</strong> No evidence of primary tumor</td>
</tr>
<tr>
<td><strong>Tis</strong> Carcinoma in situ</td>
</tr>
<tr>
<td><strong>T1</strong> Tumor 2 cm or less in greatest dimension</td>
</tr>
<tr>
<td><strong>T2</strong> Tumor more than 2 cm but not more than 4 cm in greatest dimension</td>
</tr>
<tr>
<td><strong>T3</strong> Tumor more than 4 cm in greatest dimension</td>
</tr>
<tr>
<td><strong>T4a</strong> Moderately advanced local disease* (lip) Tumor invades through cortical bone, inferior alveolar nerve, floor of mouth, or skin of face, that is, chin or nose (oral cavity) Tumor invades adjacent structures (eg, through cortical bone [mandible or maxilla] into deep [extrinsic] muscle of tongue [genioglossus, hyoglossus, palatoglossus, and styloglossus], maxillary sinus, skin of face)</td>
</tr>
<tr>
<td><strong>T4b</strong> Very advanced local disease Tumor invades masticator space, pterygoid plates, or skull base and/or encases internal carotid artery</td>
</tr>
</tbody>
</table>

*Note: Superficial erosion alone of bone/tooth socket by gingival primary is not sufficient to classify a tumor as T4.

<table>
<thead>
<tr>
<th>Regional Lymph Nodes (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NX</strong> Regional lymph nodes cannot be assessed</td>
</tr>
<tr>
<td><strong>N0</strong> No regional lymph node metastasis</td>
</tr>
<tr>
<td><strong>N1</strong> Metastasis in a single ipsilateral lymph node, 3 cm or less in greatest dimension</td>
</tr>
<tr>
<td><strong>N2</strong> Metastasis in a single ipsilateral lymph node, more than 3 cm but not more than 6 cm in greatest dimension; or in multiple ipsilateral lymph nodes, none more than 6 cm in greatest dimension; or in bilateral or contralateral lymph nodes, none more than 6 cm in greatest dimension</td>
</tr>
<tr>
<td><strong>N2a</strong> Metastasis in single ipsilateral lymph node more than 3 cm but not more than 6 cm in greatest dimension</td>
</tr>
<tr>
<td><strong>N2b</strong> Metastasis in multiple ipsilateral lymph nodes, none more than 6 cm in greatest dimension</td>
</tr>
<tr>
<td><strong>N2c</strong> Metastasis in bilateral or contralateral lymph nodes, none more than 6 cm in greatest dimension</td>
</tr>
<tr>
<td><strong>N3</strong> Metastasis in a lymph node more than 6 cm in greatest dimension</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Distant Metastasis (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M0</strong> No distant metastasis</td>
</tr>
<tr>
<td><strong>M1</strong> Distant metastasis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Histologic Grade (G)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GX</strong> Grade cannot be assessed</td>
</tr>
<tr>
<td><strong>G1</strong> Well differentiated</td>
</tr>
<tr>
<td><strong>G2</strong> Moderately differentiated</td>
</tr>
<tr>
<td><strong>G3</strong> Poorly differentiated</td>
</tr>
<tr>
<td><strong>G4</strong> Undifferentiated</td>
</tr>
</tbody>
</table>
**Glossectomy**

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<table>
<thead>
<tr>
<th>CLINICAL STAGING</th>
<th>TREATMENT OF PRIMARY AND NECK</th>
<th>ADJUVANT TREATMENT</th>
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</thead>
<tbody>
<tr>
<td><strong>Buccal mucosa, floor of mouth, anterior tongue, alveolar ridge, retromolar trigone, hard palate</strong></td>
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<td></td>
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<tr>
<td>T1–2, N0 or</td>
<td></td>
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- **Excision of primary (preferred) ± ipsilateral or bilateral neck dissection (guided by tumor thickness)**
  - No adverse features
    - One positive node without adverse features
      - RT optional (category 2B)
  - One positive node with adverse features
    - Extracapsular spread and/or positive margin
      - Chemo/RT (preferred) (category 1) or Re-excision or RT
    - Other risk features
      - RT or Consider chemo/RT
  - External-beam RT ± brachytherapy
    - No residual disease
      - Salve surgery
    - Residual disease
      - Salvage surgery
With T1/T2 lesions that are not biopsied previously, but show characteristic of carcinoma, an excisional biopsy as the partial glossectomy may be performed in the OR with a frozen section performed. This can done instead of subjecting the patient to outpatient biopsies. A neck dissection can then performed after the frozen biopsy confirms the disease.
Surgical Technique

- Patients should be placed under nasal tracheal intubation if no tracheostomy is planned. This will provide better exposure.
- A tracheostomy should be performed with patients with extensive disease or patients who will require a skin graft with bolus.
- Before any surgical intervention, a direct laryngoscopy and esophagoscopy should be performed.
Surgical technique-Partial glossectomy

- A mouth gag or bite block should be placed.
- A silk suture is placed 1 cm behind the tip in the avascular midline and used to extract the tongue out.
- At least a 1 cm margin of normal tissue is usually taken.
- The specimen is then marked with sutures and ink margins.
- Appropriate frozen section margins are taken as well
Surgical Technique

- The hemiglossectomy is carried out the same way, except the incision is started at the midline raphe and carried down. The posterior and lateral cuts are then made to complete the resection, with appropriate margins.
- This more extensive resection may not be able to closed primarily or if closed primarily, would cause significant restriction of the tongue.
- Therefore a split thickness skin graft may be performed.
Surgical Technique

- Skin graft size of 0.016-0.018 are appropriate
- Use of interrupted or quilting suture technique
- Every other suture should be left long to provide adequate suture for the bolus.
NCCN Guidelines™ Version 2.2011
Cancer of the Oral Cavity

Buccal mucosa, floor of mouth, anterior tongue, alveolar ridge, retromolar trigone, hard palate

CLINICAL STAGING

TREATMENT OF PRIMARY AND NECK

ADJUVANT TREATMENT

- **N0, N1, N2a-b, N3**
  - Excision of primary, ipsilateral or bilateral neck dissection (guided by tumor thickness, extent of disease)

- **T3, N0; T4a, Any N; T1-3, N1-3** → Surgery
  - **N2c (bilateral)** → Excision of primary and bilateral neck dissection

- No adverse features
  - RT (optional)

- Extracapsular spread and/or positive margin
  - Chemo/RT (preferred), RT (category 1) or Re-excision → RT

- Adverse features
  - Other risk features
  - RT or Consider chemo/RT
Surgical Technique

- With lesions that are T3/T4, management is more complex.
- These may infiltrate the floor, more posteriorly, and involve the mandible.
- Also, tongue base lesions may be more difficult to manage.
- They tend to be more infiltrated and poorly differentiated.
- Usually a laryngectomy is needed if the lesion extends inferiorly to the hyoid.
- However, a larynx preserving procedure may be used if adequate margins is made posteriorly.
Surgical technique

- Successful rehabilitation after total glossectomy without laryngectomy is possible
- Care should incorporate speech pathology, dietitian, and social workers
Surgical technique

- When evaluating a patient with an extensive lesion, again CT scan is choice of radiograph.
- Soft tissue replacement becomes more of a concern.
- The surgical approach depends on the following:
  - Size
  - Location
  - Invasions of mandible
  - Need for neck dissection
Surgical technique

- The main types of approaches to the primary tumor
  - Transoral
  - Midline mandibulectomy/Mandibulotomy
  - Neck approaches
Surgical technique

- Use of transoral approach is ideal for small lesions
- Best for $\leq 1.5$ cm
- Combination with other approaches
- Has very limited exposure
- But is the simplest approach
Surgical technique

- Mandibular lingual release is typically used with midline mandibulectomy
Surgical technique

- Lip incision in the midline
- Curve incision around chin pad
Surgical technique

- An incision is made in the floor of the mouth and undermining of the mandibular periosteum is done.
- The tongue is released with an incision across the vallecula.
Surgical technique

- Median labio-mandibular glossectomy
- Lip split mandibulotom with incision of the midline tongue
- Better access to poster midline lesions
Surgical technique

- Suprahyoid pharyngotomy approach
- Pull through technique
- Useful for tongue base, total glossectomy
Surgical technique

- Use of apron flap
- Identification of hyoid bone
- Divide the suprahyoid muscles
Surgical technique

- Lateral Pharyngotomy approach
- Used with neck dissections
- Hyoid bone resected at greater cornu, and retraction of superior laryngeal nerve, hypoglossal nerve and lingual nerve can be achieved
Surgical technique
Surgical technique
Reconstruction

As stated before, small defects can be closed primarily.

Defect size of 1/3 the volume can be closed. Resection of ½ the tongue results in loss of tongue bulk and scar contracture if limited reconstruction option are pursued.

The decrease in lingual contact with the palate, lip, and teeth can result in impaired articulation and propulsion of food bolus.
Reconstruction

- Therefore larger than 1/3 defects required some form of reconstruction

- Local flap vs regional flap can be used for this purpose

- Goal is to achieve mastication, speech, and acceptable aesthetic results
Reconstruction

- Local flaps
  - Limited amount of tissue
  - Inferior functional results
  - Not useful for tongue defects - can cause limited tongue motions

  - Tongue flap – divide tongue anteriorly and rotate posteriorly
Reconstruction

- Regional flaps are well vascularized
- Need single state reconstruction
- Harvest not too difficult

- However, they have limited reach,
- Can be bulky
- Necrosis at distal end
Reconstruction

- Pectoralis major
- Latissimus dorsi
- Trapezius
- Sternocleidomastoid
Reconstruction

- Microvascular flaps can overcome the limitations of regional flaps
- Forearm
- Lateral arm
- Lateral thigh
- Latissimus dorsi
- Rectus abdominus
- Iliac crease
Reconstruction

- The preferred method of reconstruction of hemiglossectomy to near total is free tissue flaps.
- Able to select donor site to match requirements of defect
- Also, donor site may provide tissue that is no subject to locoregion therapy such as radiation.
Reconstruction
Reconstruction
Reconstruction
Reconstruction

- Complications from flap failure reach 0-15%
- Rate of G-tube dependence is 3-17%
- A 5% aspiration event rate is noted with free flaps, however 3% aspiration rate is noted for primary closures
Regardless of treatment of tongue SCCA, surveillance is needed:

1st year: 1-3 months interval
2nd year: 2-4 months intervals
3rd year: 3-6 month intervals
4th and 5th year: 4-6 month intervals
Yearly intervals after that
Reconstruction

- Survival rates have been reported for five year as 82% with stage I or II disease, and 49% for stage III/IV.
- However, with recurrence, despite the type of salvage therapy offered, survival of five years is 15-35%.
• CHANGE IN KEY INDICATOR PROCEDURES
• The Review Committee for Otolaryngology has made a change to one of the Key Indicator Procedures.
• The **Laryngectomy** key indicator procedure category will be replaced with **Glossectomy [Oral Cavity Resection]**. This change will be incorporated into the summary data provided for the upcoming 2011–2012 otolaryngology residency graduates.
Coding

- **Glossectomy Procedures**
  - When a significant portion of the tongue is removed, the procedure should be reported as a glossectomy codes. These codes vary according to
  - 1) the amount of tongue that is removed,
  - 2) whether a neck dissection was performed,
  - 3) whether a resection of the floor of the mouth was also performed and
  - 4) whether the mandible was resected.
Glossectomy; less than one-half tongue: 41120
Glossectomy; hemiglossectomy: 41130
Glossectomy; partial, with unilateral radical neck dissection: 41135
Glossectomy; complete or total, with or without tracheostomy, without radical neck dissection: 41140
Glossectomy; complete or total, with or without tracheostomy, with unilateral radical neck dissection: 41145
Excision of lesion of tongue with closure; posterior one-third: 41113\nExcision of lesion of tongue with closure; with local tongue flap: 41114
Excision of malignant tumor of mandible: 21044
Excision of malignant tumor of mandible; radical resection: 21045
Excision of benign tumor or cyst of mandible; requiring extra-oral osteotomy and partial mandibulectomy (e.g., locally aggressive or destructive lesion(s)): 21047
Glossectomy; composite procedure with resection floor of mouth and mandibular resection, without radical neck dissection: 41150 Glossectomy; composite procedure with resection floor of mouth, with suprahyoid neck dissection: 41153
Glossectomy; composite procedure with resection floor of mouth, mandibular resection, and radical neck dissection (Commando type): 4115
Not included:

- **41100** biopsy of tongue; anterior two-thirds
- **41105** ... posterior one-third.
- **41110** excision of lesion of tongue without closure
- **41112** excision of lesion of tongue with closure; anterior two-thirds (BUT POSTERIOR 1/3 IS CODABLE)
- **41115** excision of lingual frenum (frenectomy).
Conclusion

- Tongue anatomy and embryology provide useful information for surgical treatment
- Varying degrees of surgical treatment options are available, depending on size of lesion
- Careful and extensive workup is key before any surgical intervention
- Reconstruction is challenging for tongue defects
Questions?
References