Reconstruction of Tongue Base Defects

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Outline

- Introduction
- Tongue base carcinoma
- Surgical Anatomy
- Surgical Resection
- Reconstruction Options
- Conclusion
Introduction

- The oropharynx plays a key role in speech, swallowing, and host defenses.
- Squamous cell cancers in this region can cause significant morbidity, and affects quality of life.
- Reconstruction of these defects attempts to improve function and quality of life.
Epidemiology

- Oropharyngeal carcinoma has an incidence of 11.9/100,000
- 30,000 new cases annually in the United States.
- The tongue base is the number one site for oropharyngeal tumors, accounting for approximately half.
Epidemiology

- 2.5-3:1 male to female predominance
- African American males account for most new cases
Etiology

- Alcohol use
- Cigarrette use
- Betel nut use
Tongue base SCCa

- Present at advanced stage
- Base of tongue drains to levels II and III.
- High incidence of nodal disease on presentation (60%)
- Good locoregional control with multidisciplinary approach
- TNM staging
- WHO classification
Symptoms

- Sore throat
- Otalgia
- Dysphagia
- Weight loss
- Neck mass
Oropharynx

- Oropharyngeal embryology
  - 4th week of life, the pharyngeal arches, clefts, and pouches develop.
  - Anterior tongue develops from 1st arch, while the posterior tongue develops from 3rd arch.
  - The epiglottis is formed from the hypopharyngeal eminence, a condensation of the 3rd and 4th arch.
  - Palatine tonsils and tonsillar fossa are formed from the 2nd pharyngeal pouch
  - Secondary palate is formed around the ninth week by the fusion of the intermaxillary process, and the lateral maxillary processes.
Embryology
Oropharynx

- Superior boundary
  - Superior border of soft palate
- Inferior boundary
  - Superior surface of hyoid bone
- Anterior boundary
  - V-shaped circumvallate papillae
  - Anterior border of soft palate/uvula
  - Palatoglossal arch (anterior tonsillar pillar)
- Posterior boundary (pharyngeal wall)
Surgical anatomy

- The oropharynx consists of four distinct sites
  - Soft palate
  - Tonsillar fossa/palatine tonsil
  - Posterior pharyngeal wall
  - Base of tongue
Oropharynx
Oropharyngeal musculature
Base of tongue landmarks

- The sulcus terminalis (V-shaped furrow on dorsal surface of tongue) divides anterior/posterior tongue
- Foramen cecum – area where thyroid descends.
- Taste papillae, mucus glands
- Lingual tonsils
Base of tongue – blood supply

- Lingual arteries supply the tongue
- Enter the tongue base medial to the hyoglossal muscle
- Septum linguae – near bloodless plain in the midline of tongue
- Submandibular arteries provide important anastomosis to contralateral tongue
Musculature

- Intrinsic muscles
- Extrinsic muscles
  - Genioglossus
  - Hyoglossus
  - Styloglossus
  - Chondroglossus
Innervation

- Base of tongue motor innervation by hypoglossal nerve
- Damage to this nerve causes
  - deviation to ipsilateral side
  - Fasiculations
  - atrophy
- Taste from glossopharyngeal nerve
Oral Cavity

- Oral cavity begins at the lips, and ends at the circumvillate papillae.
  - It consists of the lips, alveolar ridge, anterior tongue, retromolar trigone, floor of mouth, buccal mucosa, and hard palate.

- Many tumors of the oropharynx extend into the oral cavity.

- Approaches to the oropharynx require dissection through the oral cavity.
Oropharynx and adjacent structures
Vallecula and Epiglottis

- The epiglottis is a cartilaginous structure that protects the airway during eating.
- The vallecula is the area between the tongue base and epiglottis.
- Hyoepiglottic ligament – an important landmark for surgery.
  - Attaches hyoid to anterior surface of epiglottis
  - Important barrier preventing invasion of cancer
Vallecula/Epiglottis
Surgery of the tongue base

- Intubation may be difficult.
- Need wide exposure to ensure clear margins and to reconstruct defects.
- Close proximity of mandible, vascular structures, nerves, and narrow introitus make resection challenging.
Surgical approaches

- The base of tongue can be approached via the oral cavity or the neck.

- Approaches through the oral cavity give wide exposure of the tongue base, but have significant morbidity associated with them.

- Approaches through the neck have decreased morbidity, but limited access.
Oral approaches

- Are differentiated by whether the mandible is involved
- Transoral - can be used for small lesions.
- Mandibular-lingual release
- Trotter’s procedure (anterior midline labio-mandibuloglossotomy.
- Mandibular swing (midline, paramedian, or lateral mandibulotomy)
- Commando procedure
Transoral approach

- Small lesions $\leq 1.5$cm
- Can be combined with other approaches
- Advantages: simple, mandible intact, flexible
- Disadvantage: limited exposure
Transoral Approach

- retractor
- soft palate elevation (suture vs. catheters)
- avoid beveling
- cautery or laser
Mandibular lingual release
Mandibulotomy

- Lip incision in midline (vs. visor flap)
  - Mark vermilion border
  - Usually curve around chin pad

- Incision of vestibular mucosa with minimal elevation of periosteum (no more lateral than mental n.)

- Shape plate and drill holes before osteotomy

- Midline vs. paramedian vs. lateral osteotomy
  - Thin blade saw vs. Gigli saw
  - Stairstep vs. notched vs. straight
Lip-split mandibulotomy

- Can divide pterygoids if need more exposure
- Reapproximate divided structures
Median labio-mandibulo glossotomoy

- Lip-split mandibulotomy
- Tongue incised in midline
Mandibulectomy

- “Composite Resection”
- Used for tumors invading mandible.
- Lip-split vs. visor incision
- Cheek flap
- Subperiosteal dissection from mental n. to ascending ramus. Mucosa incised
Neck approaches

- Anterior pharyngototomy
  - Suprahyoid
  - Subhyoid
  - transhyoid

- Laryngectomy
  - Supraglottic
  - Partial
  - Total
Suprahyoid Pharyngotomy

- Apron flap—hyoid identified
- Divide suprahyoid mm.
- Identify hyoepiglottic ligament
- Pharyngotomy
Pharyngotomy
Supra/Subhyoid supraglottic laryngotomotomy/ectomy

- Used to excise tongue-base lesions which are adjacent to or invade the vallecula. The more extensive the tumor, the farther inferior the approach.

- Approach is similar to suprahyoid pharyngotomy except:
  - Hyoepiglottic ligament is divided at its origin
  - Dissection in underlying preepiglottic fat reveals lateral border of epiglottis
  - Laryngotomy performed between epiglottis and false cords

- At least one sup. Laryngeal neurovascular bundle is preserved.

- Closure includes suspension of the hyoid/thyroid cartilage and partial closure of larynx, if indicated
Transthyroid supraglottic laryngotomy/ectomy

- Oropharyngeal lesions which deeply invade the supraglottic larynx, but do not involve the true vocal cords or lower paraglottic space.
- Can be combined with pull-through approach
- Approach similar to supraglottic laryngectomy with transthyroid cartilage laryngotomy
- Total laryngectomy is performed for patients with oropharyngeal lesions which involve the larynx. It should also be considered for patients with poor pulmonary reserve.
Reconstruction of defects

■ Goals of reconstruction are
  – Maintenance of airway
  – Physiologic swallowing function
  – Maintenance of intelligible speech
    ▪ Tongue base not involved with articulation, but if a significant portion of the tongue is removed, then articulation will be affected.
Base of tongue function

- Tongue base is the most important structure of the oropharynx
- Responsible for pharyngeal closure during the oral phase
- Driving for force for the bolus in the pharyngeal phase
- Need at least one hypoglossal and one lingual artery for mobility and survival of remaining tongue
Base of tongue

- Reconstruction must
  - restore bulk
  - Recreate glossopharyngeal fold
  - ensure continued mobility of tongue
Reconstruction

- Ideal reconstruction prevents aspiration
- Sensate tissue
  - More physiologic swallowing
  - Dynamic capability needed for articulation
Reconstructive Options

- Follows the reconstructive ladder
- Use simplest option that will achieve desirable outcome
  - No closure
  - Primary closure
  - Skin grafting
  - Local pedicled flaps
  - Regional flaps
  - Microvascular flaps
Small defects

- Defects up to 1/3 volume of the tongue base
- **Closed primarily**
- Split-thickness skin graft
- **Granulation**
- Minimal functional defect
Large defects

- Larger than 1/3 volume of base of tongue
- Require reconstruction
- Primary closure/skin grafting causes functional deficit
  - Tongue tethering
  - Pharyngeal stenosis
Local flaps

- Have fallen out of favor
- Limited amount of tissue
- Inferior functional results
- Not very useful for tongue defects
  - Tongue flaps, divide tongue anteriorly and rotate posteriorly
  - Limited tongue motion
Regional flaps

- Advantages
  - Abundant, well-vascularized tissue
  - Single stage reconstruction
  - Easy to harvest

- Disadvantages
  - Limited superior reach
  - Bulk
  - Tip necrosis
Regional flaps

- Pectoralis major
- Latissimus dorsi
- Trapezius
- Platysma
- Sternocleidomastoid
Microvascular flaps

- Overcome the deficiencies of regional flaps
- Ability to provide sensory or motor innervation
Microvascular flaps

- Fasciocutaneous
  - Forearm
  - Lateral thigh
  - Lateral arm
- Latissimus dorsi
- Rectus abdominis
Radial Forearm

- Workhorse flap
- Lateral antebrachial cutaneous nerve can be used for sensation
Neurovascular pedicle

- Up to 20 cm long
- Vessel caliber 2 – 2.5 mm
- Radial artery
- Venae comitantes / cephalic vein
- Lateral antebrachial cutaneous nerve (sensory)
  - Anastomose to lingual nerve
  - Increased two point discrimination after inset
Technical considerations

- Tourniquet

- Flap designed with skin paddle centered over the radial artery

- Dissection in subfascial level as the pedicle is approached.

- Pedicle identified b/w medial head of the brachioradialis, and the flexor carpi radialis

- Radial artery is dissected to its origin
  - Divided distal to the radial recurrent artery

- External skin monitor can be incorporated into the flap (proximal segment)

- A-plasty - reduces the potential for stricture
Radial Forearm Flap

- Morbidity
  - Hand ischemia
  - Fistula rates - 42% to 67% in early series
    - Subsequent series - 15% and 38%.
    - Creation of a controlled fistula or use of a salivary bypass stent can protect the suture line from salivary soilage and decrease the potential for fistulization.
  - Stricture formation - 9% to 50%.
  - Radial nerve injury
  - Variable anesthesia over dorsum of hand.
Radial Forearm Flap

- **Preoperative considerations**
  - Allen test
    - Tests viability of palmar arch system
  - No IVs / blood draws in donor arm.
  - Skin graft (must preserve paratenon layer)
  - Should not be used if defect extends below the thoracic inlet

- **Postoperative management**
  - Forearm and wrist immobilization w/volar splint
  - 7-10 days
  - Oral intake can generally begin within 7 to 10 days
    - 2 weeks is best if the patient has been previously irradiated.
Lateral Arm Flap

- Described by Song in 1982
- Moderately thin fasciocutaneous flap
- Donor site skin 6-8 cm (1/3 circumference of arm)
- Thick skin from the upper arm
  - Tongue base
Neurovascular pedicle

- Terminal branch of profunda brachii artery and posterior radial collateral artery
- Venae comitantes
- Travel with radial nerve in spiral groove of humerus
  - Travels in the lateral intermuscular septum
    - Posterior - Triceps
    - Anterior - Brachialis and Brachioradialis
- Artery caliber 1.55 mm diameter (1.25 to 1.75 mm) @ deltoid insertion
- Skin blood supply – 4 to 5 septocutaneous perforaters
- Sensory nerves (from proximal radial nerve)
  - Posterior cutaneous nerve of the arm (lower lateral brachial cutaneous nerve)
  - Posterior cutaneous nerve of the forearm (post antebrachial cut nerve)
Technical considerations

- No tourniquet.
- Central axis of flap design based on intermuscular septum
  - Lateral intermuscular septum - 1 cm posterior to line drawn from insertion of deltoid and lateral epicondyle
  - Can be extended distally over the upper forearm
- Radial nerve identified along the anterior aspect of the pedicle
- Radial nerve and pedicle are followed into the spiral groove
- Must identify and preserve muscular branches from radial nerve
- Osteocutaneous flap
  - Humerus segment
    - 10 cm in length
    - 20% of the circumference
Lateral Arm Flap

Morbidity

- Radial nerve damage
  - Palsy 2/2 constrictive dressings or tight wound closure.
- Primary closure if less than 1/3 of arm
  - Use STSG if closure under too much tension.
Lateral Arm Flap

- Preoperative Considerations
  - Easy scar camouflage
  - Male patients may have less hair in this region when compared to forearm
    - Consider for intraoral reconstruction
  - Flap becomes thinner more distally
Lateral Thigh Flap

- Described by Baek in 1983
- Large surface area
- Expendable tissue
- Flap size up to 25 x 14 cm
- Fasciocutaneous flap – thin to moderately thick
- Intraoral and pharyngeal reconstruction
- Reinnervated via lateral femoral cutaneous nerve
Neurovascular pedicle

- Third perforator of profunda femoris
- Travels w/in intermuscular septum
- Pedicle 8 – 12 cm
- Vessel caliber 2 – 4 mm
- Lateral femoral cutaneous nerve of the thigh
  - Anterosuperior entry into flap
  - Does not travel with vascular pedicle

- Terminal cutaneous branch of second or fourth perforators are the dominant arterial supply (rare)
  - 4th perforator usually included in dissection to account for variations
  - When 2nd perforator dominant – pedicle length limited by muscular branch vessels to preserve femoral blood supply.
Lateral Thigh Flap
Lateral Thigh Flap
Technical considerations

- Centered over lateral intermuscular septum
  - Separates vastus lateralis and iliotibial tract (fascia lata) anteriorly from the biceps femoris posteriorly

- Septum located by line b/w greater trochanter and lateral epicondyle of femur

- 3rd perforator at midpoint of line
  - Terminates in the intermuscular septum between the long head of the biceps femoris and the vastus lateralis

- Lateral femoral cutaneous nerve provides sensation to the skin of the lateral thigh and may be incorporated into the flap

- Dominant perforator identified in subcutaneous plane and then traced through the biceps femoris to the main pedicle

- Release of the adductor magnus from the linea aspera facilitates dissection of the main pedicle
Lateral Thigh Flap

- **Morbidity**
  - Atherosclerosis of profunda femoris and its branches
  - Avoid in pts with h/o peripheral vascular disease
  - Sciatic nerve injury
Lateral Thigh Flap

- **Preoperative Considerations**
  - Assess for PVD (palpate peripheral pulses)
  - Not advised for use in obese individuals or in those with previous surgery or trauma to the thigh

- **Postoperative management**
  - Primary closure of donor site
  - Early walking
Rectus abdominis

- Easy to harvest
- Long pedicle
- Skin from abdomen and lower chest
- Myocutaneous flap or muscle only flap
- Not used for functional motor reconstruction
- Total glossectomy defects
Neurovascular pedicle

- Two dominant pedicles
  - Deep superior epigastric artery/vein
  - Deep inferior epigastric artery and vein
- Based on inferior epigastrics when used for h/n recon because of larger pedicle size
- Inferior epigastric diameter – 3 to 4 mm
- Reinnervated with any of the lower six intercostal nerves.
- Pedicle may travel along lateral aspect of muscle before taking intramuscular route
Technical considerations

- Cutaneous blood supply
  - Harvest anterior rectus sheath in paraumbilical region (dominant perforators located here)
  - Skin paddle designed with epicenter above the umbilicus

- Primary closure
- Hernia prevention depends on restoring abdominal wall.

- Arcuate line (level of ASIS)
  - Superior – posterior sheath with transversalis fascia, internal oblique and transversus abdominis
    - Closure of posterior sheath prevents herniation
  - Inferior – only transversalis fascia posterior to muscle
    - Must close anterior sheath to prevent herniation
Technical considerations

1. Dissect superiorly first
2. Dissect down to underlying muscle
3. Split fascia to the costal margin
4. Lateral and inferior portions of skin paddle incised next
5. Small cuff of anterior rectus fascia preserved medially and laterally, to preserve cutaneous perforators
6. Split fascia vertically down to the public region
7. Divide rectus superiorly and free from posterior rectus sheath
8. Dissection below the arcuate line
9. Vascular pedicle identified below arcuate line along the lateral deep aspect of the muscle.
10. Divide rectus inferiorly
11. Pedicle dissected inferiorly to origin off the external iliac system
Rectus abdominis

- Morbidity
  - Abdominal weakness
  - Hernia
Rectus abdominis

- **Preoperative Considerations**
  - Prior abdominal surgery
  - Prior inguinal herniorrhaphy may compromise pedicle dissection 2/2 scarring
  - Hernia
  - Diastasis recti

- **Postoperative management**
  - Ileus
  - Avoid abdominal strain for 6 weeks.
Latissimus dorsi

- Pedicle or free flap
- Free flaps
  - Better flap positioning
  - Cutaneous portion can be centered over pedicle
  - Less risk of pedicle kinking
- Musculocutaneous
  - Large volume defects of large cutaneous neck defects
- STSG for final resurfacing
- Non-sensate
- Motor reconstruction possible
- Useful after total glossectomy
Neurovascular pedicle

- Thoracodorsal artery
- Arise from subscapular vessels off of third portion of axillary artery and vein
- Vessel diameter at origin – 2.7 mm (1.5 to 4.0)
- Vein diameter – 3.4 mm (1.5 to 4.5)
- Pedicle length 9.3 cm (6 to 16.5)
  - Can be lengthened by sacrificing branch to serratus anterior
- Numerous variations
  - Most common: independent origin of thoracodorsal vein/artery
Technical considerations

- **Lateral decubitis position**
  - If at 15 degrees, flap may be harvested simultaneously with primary lesion resection
  - Anterior muscle border along line b/w midpoint of axilla and point midway b/w ASIS and PSIS
- **Vessels enter undersurface of muscle 8 to 10 cm below midpoint of axilla**
- **Serratus vessels ligated during harvest**
- **Can design two paddle flap based on medial and lateral branches of thoracodorsal vessels**

- **Total glossectomy insetting.**
  - Muscle inset as a sling on undersurface of mandible
  - Sutured to pterygoid, masseter, or superior constrictor...
  - Thoracodorsal nerve anastomosed to a hypoglossal nerve
    - Gives reconstructed tongue the ability to elevate superiorly toward the palate
Latissimus dorsi

- Morbidity
  - Marginal flap necrosis
  - Pedicled flaps pass b/w pec major and minor
    - Changes in arm position may occlude pedicle
    - Should immobilize arm in flexed position
Latissimus dorsi

- **Preoperative Considerations**
  - Relative contraindications - prior axillary LN dissection
  - Preop angiography advocated to assess vessel patency

- **Postoperative management**
  - Suction drains
  - High incidence of seroma
Algorithm for reconstruction of tongue base defects

Tongue base defects

Post CO₂ laser resection

<30%

Secondary intention

Consider primary closure

Isolated base of tongue

>30%

Subtotal/total glossectomy

Larynx intact

Not candidate for free flap

Platysma pectoralis major latissimus

Innervated fasciocutaneous free flap

Forearm Lat. arm Lat. thigh

Free flap

Rectus Latissimus

Prefer musculocutaneous free flaps

May consider regional flap

Laryngectomy

Prefer musculocutaneous

Free flaps

Rectus Latissimus

Pec. Lat.
Conclusion

- The tongue base is a very important structure found in the oropharynx.
- Over half of all oropharyngeal SCCa involve the base of the tongue.
- Resection of these cancers leave anatomic as well as functional defects.
- Reconstruction of these defects tries to restore airway protection, swallowing, and speech functions.
Bibliography