Oropharyngeal Anomalies: Effects on Speech and Resonance
How what’s in the mouth affects what comes out of it!

Ann W. Kummer, PhD, CCC-SLP
Cincinnati Children’s Hospital Medical Center
Outline

1. Speech Errors due To Structural Anomalies
2. Oropharyngeal Anomalies
3. Velopharyngeal Dysfunction
4. Treatment Of Velopharyngeal Dysfunction
1. Speech Errors due to Structural Anomalies
Types of Speech Errors due to Structural Abnormalities

- **Obligatory Errors:** Errors of distortion where function (articulation) is *normal*, but structure is abnormal

- **Compensatory Errors:** Errors of distortion where function (articulation) is *changed* in response to abnormal structure
Importance of Differential Diagnosis

- **Obligatory Errors:** Treatment is correction of structure (i.e., surgery, orthodontics)
- **Compensatory Errors:** Treatment is correction of function (i.e., speech therapy), but preferably after correction of structure
2. OROPHARYNGEAL ANOMALIES

A. Lips and mouth
B. Nose and nasal cavity
C. Dentition and occlusion
D. Hard palate
E. Tongue
F. Tonsils and adenoids
G. Eustachian tube
H. Velum/velopharyngeal valve
A. Lips and Mouth
Short Upper Lip

• Due to dysmorphology and/or cleft lip repair
• Scarring causes lip to shorten
Short Upper Lip

- Relative shortening due to protruding premaxilla
Short Upper Lip

- Can cause difficulty with bilabial competence at rest
- Can affect bilabial competence during speech for production of bilabial sounds (p, b, m)
- Labio-dental placement may be used as a substitute
Macrostomia

- Associated with facial clefts and syndromes, especially hemifacial microsomia
- One corner of the mouth extends into cheek, making mouth opening very large
- Doesn’t usually affect speech
Microstomia

- Can have minimal affect on articulation
- May cause cul-de-sac resonance and low volume
- Sounds like “mumbling”
B. Nose and Nasal Cavity
Nose and Nasal Cavity

- Stenotic naris
  - common after cleft lip repair
- Deviated septum
  - common with unilateral clefts
- Nasal polyps
- Nasal congestion
Nasal Cavity Size with Maxillary Retrusion

- Maxillary retrusion can compromise nasal cavity size and nasopharynx
- Common with bilateral clefts
Nasal Airway Obstruction

- Can cause hyponasality or cul de sac resonance
- Nasal sounds (m, n, ng) are particularly affected
C. Dentition and Occlusion
Normal Dentition and Occlusion

Important for:

• Aesthetics
• Chewing
• Speech
Basic Facts

- Tongue rests in mandible
- Tongue tip needs to:
  - be under the alveolar ridge
  - to move up and down during speech
  - be free of obstructing forces
- Sibilants or “teeth sounds” (s, z, sh, zh, ch, j) are not really produced by the teeth
Basic Facts

• Most consonants are produced in the anterior part of the oral cavity (near teeth)
• Abnormalities of the anterior dental arch can interfere with movement of the tongue tip and lips
• Narrow maxillary arch can cause oral cavity crowding and distorted speech and resonance
Dental/Occlusal Abnormalities

Speech errors may be:

• Obligatory
  – Labial or lingual position is correct, but the structural abnormality interferes

• Compensatory
  – Labial or lingual position is altered due to structural abnormality
Dental Abnormalities

- Ectopic tooth
- Supernumerary teeth
- Missing teeth and open bite
Ectopic Tooth
(note tongue flap)
Supernumerary or Misplaced Teeth
Missing Teeth or Open Bite

Effect depends on:

• Size of oral cavity/presence of oral cavity crowding
  – Maxillary retrusion
  – Low, flat or narrow palatal arch
  – Macroglossia

• If there is crowding, tongue will seek opening (an existing one or one due to opening the teeth)
Missing Teeth
Missing Teeth due to Early Extractions

• Usually does not negatively affect speech
• Teeth are really not necessary for early speech development
• Reminder: “Teeth sounds” are not produced by the teeth
Open Bite with Maxillary Retrusion
Open Bite
due to thumb sucking or tongue thrust
Effect of Crossbites

• Anterior crossbite
  - Can interfere with tongue tip movement
  - Can cause crowding in the oral cavity
  - Small oral cavity size can affect quality of resonance

• Lateral crossbite(s)
  - Can cause crowding in the oral cavity
  - Small oral cavity size can affect quality of resonance
Anterior Crossbite
Lateral and Anterior Crossbite
Class II Malocclusion

- Only affects speech if alveolar ridge is so far forward that tongue tip cannot connect
Class III Malocclusion with Anterior Crossbite

• Has most detrimental effect on speech because it can affect ALL anterior speech sounds
Compensatory Production: Palatal Dorsal Placement

Usually causes:

• a lateral lisp on sibilants (s, z, sh, ch, j)
• distortion of lingual-alveolars (t, d, n)
Dental/Occlusal Abnormalities

- Particularly affect articulation of **sibilants** (s, z, sh, ch, j)
- Can affect labio-dentals (f, v)
- Can affect lingual-alveolars (t, d, n, l)
- Can affect bilabials (p, b, m)
Treatment - Dental

• Orthodontics
• Surgery-usually after facial growth is complete
• Speech therapy to correct compensatory errors
D. Hard Palate
Abnormal Palatal Arch

- High arch is not a problem
- Low, flat arch can cause lingual crowding and abnormal resonance due to small cavity size
- Position of alveolar ridge relative to tongue is most important
Palatal Fistula

• Hole or opening in the palate after cleft palate repair
• Can be due to breakdown of surgical repair
• Can open after maxillary expansion or growth
• Effect on speech depends on location and size
Fistula

Effect depends on

• Size- larger the more symptomatic
• Location- under the tongue tip will be most symptomatic
Size of the Fistula
Location: Physics and Flow

- Water (and air) flow in a forward direction until something stops it.
- An obstructing object will redirect the flow.
Location of the Fistula

- Tongue articulation may cause nasal emission by upward movement
- Tongue may prevent nasal emission by occluding the fistula
Location of the Fistula

- Labio-alveolar “intentional” fistula
- Not repaired so doesn’t interfere with maxillary growth
- Bone graft done before eruption of permanent dentition
E. Tongue
Macroglossia

• Tongue is large relative to the oral cavity size
• Associated with Down’s syndrome, Beckwith-Wiedemann syndrome
Macroglossia
Macroglossia

- Is not the same as a “long” tongue
Macroglossia

Large tongue causes:
- lingual protrusion
- open mouth posture
- anterior open bite
- occasional drooling
- airway obstruction!!!
Macroglossia

Effects on speech:

• Interferes with all tongue tip sounds (lingual-alveolars, lingual-dentals and sibilants)
• Palatal-dorsal production is common
• Causes frontal or lateral distortion
Microglossia

- Tongue is small in size, especially relative to oral cavity size
- Rarely causes speech problems unless the tongue tip cannot articulate against the alveolar ridge
Lobulated Tongue

- Seen in some syndromes, such as Oral-Facial Digital syndrome (OFD)
- Usually has no significant effect on speech
Tongue Thrust: Characteristics

- **Swallowing**: Forward tongue thrust against or between incisors
- **Speech**: Frontal lisp on sibilants (s, z, sh, ch, j)
- **Dentition**: Open bite or overjet
Tongue Thrust: Causes

- Prolonged thumb/finger sucking or extended pacifier use
- Upper airway obstruction
- Genetics ???
Tongue Thrust: Treatment

- Myofunctional therapy
- Speech therapy
- Orthodontics
Ankyloglossia ("Tongue Tie")

- Congenital anomaly
- Lingual frenulum is too short or has an anterior attachment near the tongue tip
Functional Characteristics

• With mouth open, patient can’t touch roof of mouth with tongue tip
Functional Characteristics

- Patient can’t protrude tongue past incisal edge of the lower gingiva
Functional Characteristics

• Limits normal lingual movements
• With protrusion attempts, tongue becomes heart-shaped or shows a “notch” in midline
Ankyloglossia Incidence

Figures vary:

- .02%
- 4.8%
- 97% in newborns with a decline to 25-35% in 9 year olds
Changes with Growth

- Oral cavity changes in first 4-5 years
- Alveolar ridge grows in height and the teeth begin to erupt
- Tip of tongue grows
- Initial restrictions of movement may improve as the child gets older
Ankyloglossia: Functional Effects

- Feeding
- Dental
- Speech
- Cosmetics and social function
Feeding

• Newborns:
  – About 25% will have some trouble latching to nipple and sucking; most do fine

• Older children:
  – May have difficulty with movement of a bolus in the oral cavity; clearing of food from sulci and molars
Dental

• Frenulum can be attached high on gingival ridge behind lower teeth
• Can pull gingiva away from teeth.
• Usually not a problem until 8-10 years old
Speech: Common Belief

• Tongue tip cannot move well
• Therefore, this will affect speech
Speech

No empirical evidence in the literature that ankyloglossia *causes* speech defects
Affects on Speech???

Common sense approach:

- Need for elevation: /l/
- Need for protrusion: /th/
- These sounds can usually be produced, even with significant tongue tip restriction
- Spanish /r/ may be affected, however
Indications for Frenulectomy

- Rarely needed for correction of articulation
- May help if there are indications of oral-motor dysfunction
- Can improved feeding abilities
- Can be done for cosmetic purposes
Frenulectomy

• May be needed for French kissing…
F. Tonsils and Adenoids
Tonsils and Adenoids

• (Palatine) Tonsils- Located in the oral cavity, between the anterior and posterior faucial pillars
  – Lingual tonsils are at the base of the tongue
• Adenoids- Located on the posterior pharyngeal wall in the nasopharynx
Hypertrophic Adenoids

- Open mouth posture and mouth breathing
- Respiratory stridor
- “Adenoid facies”
- Snoring, and sleep apnea
- Chronic ME effusion
- Anterior tongue position
- Dental malocclusion
Hypertrophic Adenoids: Effects on Speech

- Hyponasality if there is airway obstruction
- Fronting of phonemes due to anterior tongue position to open airway
Adenoidectomy
Adenoidectomy

• May improve speech and resonance
  OR
• May cause velopharyngeal insufficiency
  – If lasts more than 6 weeks, this would require surgical intervention, not speech therapy
Hypertrophic Tonsils

• Can cause an anterior tongue placement resulting in fronting of sibilants and lingual-alveolars

• Can cause hyponasality or cul de sac resonance
Enlarged Tonsils
Enlarged Tonsils

• Block sound transmission to oral cavity
Cul de Sac Resonance

- Called “potato-in-the-mouth speech” by many professionals!
- Tonsils are the “potatoes”
Tonsillectomy

• May improve speech and resonance
  AND

• Almost never has a negative effect on speech or resonance
G. Eustachian Tube Dysfunction
Normal Function

- At rest, tube is closed
- During swallowing:
  - tensor veli palatini muscle opens Eustachian tube
  - releases negative pressure
  - allows fluids to drain
- Young children have horizontal tubes
Eustachian Tube Function

- If tensor veli palatini muscle is abnormal due to a cleft palate, tube doesn’t open
- Negative pressure builds
- Fluids can’t drain out
- Causes conductive) hearing loss
- Can affect speech/language development in the short term
H. Velum/Velopharyngeal Valve

Velum (soft palate)
3. Velopharyngeal Dysfunction
Structures Active in VP Closure

- Velum (Soft Palate)
- Lateral Pharyngeal Walls (LPWs)
- Posterior Pharyngeal Wall (PPW)
Velum (Soft Palate)

- Moves in a superior and posterior direction
- Has a type of “knee” action
- Moves toward the posterior pharyngeal wall
Velum at Rest and during Speech

- Pharyngeal wall
- Velum (soft palate)
- Tongue
Velopharyngeal Valve and Flow

- Due to the physics of airflow, even a small opening will be symptomatic for speech.
Lateral Pharyngeal Walls (LPWs)

- Move medially
- Usually close against the velum
- Sometimes close in midline behind the velum
Lateral Pharyngeal Walls

Frontal View A

Lateral View B

LPW

PPW

Velum
Posterior Pharyngeal Wall (PPW)

• Moves anteriorly toward the velum
• In some speakers, there’s a bulge called a Passavant’s ridge
Passavant’s Ridge
VP Valve during Speech

- Velopharyngeal valve is closed for oral sounds
  - Particularly important for “pressure-sensitive” consonants and all vowels
- Velopharyngeal valve is open for nasal sounds (m, n, ng)
Purpose of VP Valve

- Directs transmission of sound energy and air flow in the oral and nasal cavities during speech.
Muscles of VP Closure

- Levator veli palatini (velar “sling”)
- Superior constrictor (pharyngeal ring)
- Palatopharyngeus (post faucial pillar)
- Palatoglossus (ant faucial pillar)
- Musculus uvulae (bulge on nasal surface)
Muscles of VP Closure
Motor Nerves of VP Function

- Glossopharyngeal (IX)
- Vagus (X)
- Accessory (XI)
- Trigeminal (V)
- Facial (VII)
Sensory Nerves of Velum

- Vagus (X)
- Glossopharyngeal (IX)
Normal VP Closure
(Nasopharyngoscopy)
Patterns of VP Closure among Normal Speakers

- Coronal Pattern - velum and PPW
- Sagittal Pattern - LPWs
- Circular Pattern - all structures
  - sometimes includes Passavant’s ridge
Patterns of Closure

Lateral View of VP Closure

Patterns of VP closure as viewed through Nasopharyngoscopy

Coronal

Sagittal

Circular
Variations in VP Closure

• Non-Pneumatic:
  – gagging, vomiting, swallowing

• Pneumatic:
  – blowing, whistling, speech (+ pressure)
  – sucking, kissing (- pressure)
Normal Velopharyngeal Function

Learning (Articulation)

Anatomy (Structure)  Physiology (Movement)
Velopharyngeal Dysfunction

Articulation/Speech Learning
(Velopharyngeal Mislearning)

Anatomy
(Velopharyngeal Insufficiency)

Physiology
(Velopharyngeal Incompetence)
Velopharyngeal Insufficiency (VPI)
VP Insufficiency
(Structural Causes)

• History of cleft
• Submucous cleft palate (overt or occult)
• Short velum or deep pharynx (cranial base anomalies)
• Irregular adenoids
• Enlarged tonsils
History of Cleft Palate

• Velum may be too short following repair
• Velum may have a notch on posterior nasal surface
Overt Submucous Cleft

Characteristics (any or all)

- Bifid or hypoplastic uvula
- Zona pellucida (blue zone)
- Abnormal insertion of the levator muscle
- Notch in posterior border of hard palate
Submucous Cleft
Submucous Cleft
Occult (Hidden) Submucous Cleft

- Can only be seen on the nasal surface of the velum through nasopharyngoscopy
Submucous Cleft
Nasal Surface
Deep Pharynx

- Due to cranial base or cervical spine anomalies
  - Klippel-Feil syndrome, craniosynostosis
- Velum is short relative to position of posterior pharyngeal wall
Deep Pharynx
Adenoids

- Positioned in usual site of VP contact
- Kids have velo-adenoidal closure
Irregular Adenoids

• Normal VP closure requires a tight seal
• Adenoid irregularity (marked indentation or protrusion) prevents a tight seal
• Can cause small gap and nasal emission
Irregular Adenoids
Enlarged Tonsils

- Can extend into pharynx
- May interfere with LPW movement
- May intrude between the velum and PPW, preventing a tight VP seal
Hypertrophic Left Tonsil
Nasopharyngoscopy of Tonsil
VP Insufficiency
Following Surgery or Treatment

• Adenoidectomy
• UPPP or UP3 (Uvulopalatopharyngoplasty)?
• Maxillary advancement
• Treatment of nasopharyngeal tumors
Adenoidectomy

• Can cause VPI due to sudden increase in the nasopharyngeal dimension
• Often temporary and resolves within 6 weeks
• Permanent VPI is a risk, especially with history of cleft or submucous cleft
VPI Post Adenoidectomy

• Caused by a change in the structure
• Speech therapy CANNOT change structure
• Surgical correction is indicated
Maxillary Advancement

• Done surgically or through distraction
• Corrects Class III malocclusion and midface retrusion
• Improves aesthetics and articulation (obligatory errors)
• Often done for patients with history of cleft
Le Fort I Maxillary Advancement
Pre Maxillary Advancement
Post Maxillary Advancement
Post Maxillary Advancement

- Moving maxilla forward also moves velum forward
- Velum may stretch and lengthen; LPW movement may increase
- VPI is a risk, especially in patients with history of cleft or submucous cleft
Treatment for Nasopharyngeal Tumors

• Radiation therapy shrinks tissue
• Ablative surgery removes tissue
• Both increase nasopharyngeal space, making closure more difficult
Velopharyngeal Incompetence (VPI) (Neurogenic Causes)

- Poor muscle function
- Hypotonia
- Velar paralysis or paresis
- Neuromuscular disorders
- Dysarthria
- Apraxia
Hypotonia

- Can cause poor velar and pharyngeal movement
- Pharyngeal hypotonia—common in patients with velocardiofacial syndrome
Velar Paralysis or Paresis

- Due to brain stem or cranial nerve damage
- Common with hemifacial microsomia
- Affected side of velum droops, causing a lateral VP gap
- Uvula points to unaffected side
Neuromuscular Disorders

- Myasthenia gravis, muscular dystrophy
- Can affect oculofacial and VP muscles
- Weakness increases with activity and fatigue
- Gradual onset of hypernasality often the first symptom
Dysarthria

- Neuromuscular disorder due to neurological insult, injury, or disease
- Affects all subsystems of speech:
  - Respiration
  - Phonation
  - Articulation
  - Velopharyngeal function
Apraxia of Speech

- Motor speech disorder causing difficulty combining and sequencing motor movements
- Affects coordination of speech subsystems:
  - Phonation
  - Articulation
  - Velopharyngeal function
Velopharyngeal Mislearning
Velopharyngeal Mislearning

- Hearing loss
- Abnormal posterior or nasal articulation
Hearing Loss

- No tactile-kinesthetic feedback of VP movement
- Lack of auditory feedback affects VP function and speech learning
- Can have a mixture of hyper- and hyponasality
Effects of VPD on Speech and Resonance

- Hypernasality
- Nasal emission
  - Weak or omitted consonants
  - Short utterances
  - Compensatory articulation productions
- Dysphonia
Hypernasality

- Speech sounds “nasal”
- Too much sound resonating in the nasal cavity
- Most perceptible on vowels
- Can also affect voiced oral consonants
Nasal Emission

• Not hypernasality, but often associated with hypernasality
• Audible on consonants, not vowels
• Occurs on pressure-sensitive consonants
Compensatory Articulation Productions

- **Velar** fricatives
- **Pharyngeal** plosives
- **Pharyngeal** fricatives
- **Pharyngeal** affricates
- Posterior **nasal** fricatives
- **Glottal** stops
Predicting VP Gap Size

Can we predict VP gap size by perceptual characteristics?
Size of Opening and “Nasality”

→ Hypernasality

→ Hypernasality, nasal emission

→ Nasal emission

→ Nasal rustle
Intra-Oral Evaluation

• Need to see to the tip of the uvula
• Avoid using a tongue blade
Say “aaaah” and Protrude Tongue
Aaaah
Treatment for Velopharyngeal Dysfunction
Surgery vs. Speech Therapy
Surgical Intervention of VPI

- Pharyngeal augmentation
- Furlow Z plasty
- Pharyngeal flap
- Sphincter pharyngoplasty

Note: These do not always work the first time. May need revision or even re-do.
Pharyngeal Augmentation

• Injection of a substance in the posterior pharyngeal wall
• Can use fat, collagen (Demalogen, Simetra) or Radiesse (hydroxyl apetit)
• Good for small, localized gaps or irregularities of the posterior pharyngeal wall
Pharyngeal Flap
Pharyngeal Flap
(view from nasopharyngoscopy)

Pharynx prior to Pharyngeal Flap

Pharynx with a Pharyngeal flap
Sphincter Pharyngoplasty
Speech Therapy
Speech Therapy
With Structural Anomalies

- Speech therapy CANNOT change abnormal structure
- Speech therapy CANNOT correct VPI
Speech Therapy
With Structural Anomalies

• Speech therapy CAN change abnormal function
  – Compensatory errors secondary to abnormal structure (i.e., malocclusion or VPI)
  – Misarticulation causing nasal emission
  – Oral-motor dysfunction (apraxia)
Auditory Feedback:
Oral & Nasal Listener*

* Super Duper Publications- 2007
Therapy for VP Mislearning

- Glottal stops
- Nasalized plosives, vowels or ng/l
- Nasalized /r/
- Pharyngeal plosives
- Palatal-dorsal production (lateral lisp)
- Pharyngeal fricatives/ posterior nasal fricatives
General Principles

• Use general articulation procedures to establish appropriate placement.

• Speech therapy is like piano lessons— if you don’t practice at home, you don’t make progress.
Summary

• Structure, function and physics all have an effect on the quality of speech and resonance

• Speech can be affected in a positive way by dental and orthodontic treatment

• Speech therapy is never indicated for obligatory distortion due to abnormal structure