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Assessment of Speech Sound Disorders in Children with Cleft Palate &/or VPD

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Disclosures

- Employee at Riley Hospital for Children at IU Health in Indianapolis, IN, as the Speech-Language Pathologist on the Cleft Palate/Craniofacial Team
- Member of the ASHA SIG 5 Speech Science and Orofacial Disorders Education Committee
- Collaborator for the NIH-NICDR funded project, “An Inter-center Comparison of Speech Outcomes for Children with Cleft Palate: The Americleft Project”
What is a cleft lip and/or palate?

- Cleft lips can vary from a small defect to a complete opening that extends to/through the floor of the nose.
- Cleft lips often, but not always, include part or all of the alveolus.
What is a cleft lip and/or palate?

- A cleft palate occurs when the two palatal plates do not fuse together in utero.
- A cleft palate results in an abnormal opening between the oral and nasal cavities.

What is a cleft lip and/or palate?

- A submucous cleft palate occurs when the mucosal lining of the roof of the mouth develops over a cleft of the bony hard palate.
- May be noted by three distinct features:
  - Bifid uvula
  - Midline division of the soft palate musculature
  - Notch at the posterior border of the hard palate.
What is a cleft lip and/or palate?

- Clefts occur in isolation or in combination
- May be unilateral or bilateral, complete or incomplete
- Clefts are among the most common birth defects in North America
- Appear to be due to a combination of genetic and environmental factors

Velopharyngeal (VP) Function

- \( Velo = \text{velum, soft palate} \)
- \( Pharyngeal = \text{pharynx, pharyngeal walls} \)
- \( Velopharyngeal\ Function = \text{referring to the movement of the velum and the pharyngeal walls during speech} \)
Velopharyngeal Function

- **Levator veli palatini muscle**
  - Muscle mass of the velum
  - Primarily responsible for the elevation of the velum
  - Moves the velum superiorly and posteriorly to close against the posterior pharyngeal wall

Velopharyngeal Function

- **Musculus Uvulae**
  - Creates a bulge on the nasal surface of the velum to extend and contact the posterior pharyngeal wall
Velopharyngeal Function

- **Superior Pharyngeal Constrictor**
  - May contribute to the medial movement of the lateral pharyngeal walls and the anterior movement of the posterior pharyngeal wall

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Velopharyngeal Function

- **Palatopharyngeus**
  - Form the posterior faucial pillars
  - Cause adduction of the faucial pillars and narrowing of the VP port
  - Also thought to work against the levator to lower the velum
Velopharyngeal Function

- **Palatoglossus**
  - Act against the levator to depress the velum
  - Responsible for the rapid downward movement of the velum during speech

Normal VP Function for Speech

- Complete closure of VP port necessary for production of oral consonants
  - /p, b, t, d, k, g, s, z, f, v/, “sh,” “zh,” “ch,” “dg,” “th,” and voiced “th”/

- Closure can be variable for vowels

- VP port is consistently open for nasal consonants
  - /m, n/ and “ng”
Velopharyngeal Dysfunction

- Velopharyngeal *Insufficiency* = caused by a tissue insufficiency/abnormal structure

- Velopharyngeal *Incompetency* = tissue/structure is fine, but function/movement is inadequate

- Velopharyngeal *Mislearning* = VPD exists despite sufficient structure and *capable* function
Resonance is the energy created as air travels through the vocal tract.

- Occurs on resonating sounds – vowels and voiced consonants.
- Normal resonance has balance of oral and nasal energy.
- “Normal” is on a continuum.

- *Hyponasality* – too little nasal resonance on nasal sounds.
- *Hypernasality* – too much nasal resonance on oral sounds.
- Mixed = combination of hyper- and hypo-
- Cul de sac = occurs when energy is trapped.
Nasal Air Emission

- Airflow deviation out the nasal cavity
- Occurs during production of oral sounds
- May be audible or inaudible
Goals of Assessment

What is the child doing now?

What is the child capable of doing?

Where do I go from here?

Parts of Assessment

Make appropriate diagnosis and recommendations

Medical History

Language Assessment

Articulation Assessment

Velopharyngeal Function Assessment

Instrumental Assessment (if needed and available)

Oral Mechanism Exam
Medical History

- Leave your assumptions at the door!

- Medical diagnoses (related and unrelated to speech)
- Family history
- Feeding history
- Breathing issues
- History of ear infections
- Motor development
- Surgical history
- Speech therapy history

Language Assessment

- Children with cleft palate are at risk for delayed language development and cognitive delays
- May be due to early hearing issues, hospitalizations/surgeries during years of critical language development, parent-child language stimulation and speech production capabilities
- Can be overlooked when “speech” is the main focus
- Consists of parent report, informal/play based assessment, and standardized assessment
Articulation Assessment

- Conversational speech sample
- Structured speech tasks
  - CV utterances, words, sentences in imitation
  - Rote speech
- Standardized assessment

Developmental Errors
- Those errors that are considered “typical” as part of speech development
- Differentiate between “age appropriate” and a delay
- Ex., /t/ for /k/ substitution or /l/ for “th” substitution

Compensatory Errors
- Learned articulation errors – incorrect placement
- Manner is often maintained, but place is impacted
- Develop secondary to an inability to generate oral pressure for normal articulation
- May continue to be used once velopharyngeal port has been adequately repaired
- Ex., glottal stop substitutions

Obligatory Errors
- Errors that exist due to a present structural cause
- May not be improved until the structural cause is addressed
- Ex., nasalized oral consonants due to VPI
Articulation Assessment

- Note what sounds are correctly produced
  - "Typical" errors
    - Age-appropriate?
    - Delayed?
  - "Atypical" errors
    - Where is the sound coming from?
      - Nasal
      - Palatal
      - Pharyngeal
      - Glottal
    - How is the sound produced?
      - Fricative
      - Stop

Compensatory Articulation Errors

- Glottal stops
  - Stop consonant made at the glottis
- Pharyngeal Stop
  - Lingual base contacts PPW, typically used for /k/ and /g/
- Pharyngeal Fricatives
  - Fricative constriction between the lingual base and the PPW
Articulation Assessment

Compensatory Articulation Errors
- Mid-dorsum palatal stop
  - Stop consonant made in the position of “y”
  - Sounds like a cross between a /t/ and a /k/ or a /d/ and a /g/
- Nasal fricative
  - Typically articulating a nasal phoneme with nasal air emission used in place of a fricative sound

Note any oral distortions present

Weak oral consonants
- High pressure consonants are produced with weak oral pressure

Nasal substitutions
- Substituting a nasal phoneme (ex., /m/) for an oral phoneme (ex., /b/)
Articulation Assessment

- Stimulability Testing
  - What is the child capable of doing?
  - Differentiate compensatory errors from obligatory errors

VP Assessment - Nasal Emission

- Not Present
- Present

  Type
  - Visible
  - Audible

  Pattern
  - Pervasive
  - Intermittent
  - Phoneme Specific
**VP Assessment – Nasal Emission**

- **Look for “visible” nasal air emission**
  - Use a mirror under the nose during production of pressure sounds
  - Look for a nasal grimace

- **Listen for audible nasal air emission**
  - Use a straw or something similar to amplify if necessary
  - Counting from 60-70 (high number of sibilants)
  - Counting from 70-80 (taxing due to nasal-alveolar plosive combo)

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**Sample multiple contexts**

- Imitation, rote speech tasks, conversational speech
- High pressure phonemes or sentences
  - “I poured Paula a pop.” “Billy plays ball.” “I choose cheese.”
- Counting from 60-70 (high number of sibilants)
- Counting from 70-80 (taxing due to nasal-alveolar plosive combo)
Perceptual assessment is still considered gold standard.

Articulation accuracy can affect your judgment of hypernasality – try to separate out resonance from articulation and nasal air emission.
**VP Assessment - Resonance**

- **HYPERnasality**
  - Use of “cul-de-sac” test
  - Sustained vowels
  - Sentences with low pressure consonants
    - “You are here.” “We were away.” “You were away all year.” “Read to Lee.”
  - Sample multiple contexts: imitation tasks, rote speech, conversational speech
  - Note the presence, severity, and pattern/context

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VP Assessment - Resonance

Define scale to increase reliability

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<th>Severity</th>
<th>Descriptor</th>
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| Mild     | Increased nasality on high vowels  
Inconsistent across speech sample  
Considered socially acceptable  
Patient/parents have little concerns |
| Moderate | Hypernasality pervasive/distracting  
Considered socially unacceptable  
Most sounds maintain their identity |
| Severe   | Hypernasality is pervasive and impacts  
understandability  
Socially very unacceptable  
Sounds lose identity (nasalized phonemes, vowel distortions) |


VP Assessment - Resonance

HYPOnasality

- Use phonemes, words, or sentences loaded with nasal phonemes
  - “Make momma come home.”
  - “Anna knew ninety songs.”
- Note if present or absent
Oral Mechanism Assessment

- Generally recommended to complete after your speech assessment
- Face, Nose, Lips
- Tongue
  - Size, ankyloglossia

Oral Mechanism Assessment

- Dentition
  - Class II occlusal deviations
    - Bilabials may become dentalized
    - Sibilants sound distorted
  - Class III occlusal deviations
    - Labiodentals may become distorted
    - Alveolar sounds may become distorted
  - Crossbites, missing/rotated teeth
    - Can contribute to lateral distortions
Oral Mechanism Assessment

- Hard Palate
  - Shape, fistulae
- Soft Palate and Uvula
  - Examine at rest and during phonation
  - Does not necessarily reflect VP function
- Pharyngeal walls
  - Note movement during phonation
- Tonsils
  - Presence, size

Instrumental Assessment

- Instrumental Assessment is dependent upon the child’s speech sample – the child must be old/mature enough to cooperate adequately and must be attempting oral speech production
Instrumental Assessment

Computerized Instrumental Assessment
- Aerodynamic measurements
  - Pressure flow studies estimating the sectional area of the VP space
- Nasometry
  - Measures “nasalance,” a ratio of acoustic energy derived from the speaker's oral and nasal cavities
  - Provides a numeric output

Instrumental Assessment

Imaging Instrumental Assessment
- Allows us to view the structures and functions of the speech mechanism that are not visible during the oral exam
- Natural speech can be observed
- Have seen improved outcomes in surgery for VPD due to imaging
- Most common = Videofluoroscopy or Nasopharyngoscopy
Instrumental Assessment

- Imaging Instrumental Assessment
  - Videofluoroscopy
    - X-ray image of VP function during speech
    - Requires at least 2 views to assess dynamic movements
    - Pros: Easy to tolerate
    - Cons: Exposure to radiation, provides a 2 dimensional pictures
  - Nasopharyngoscopy
    - Uses flexible endoscope inserted into the nostril and passed through to the velopharynx
    - Pros: color picture, 3D, direct view
    - Cons: invasive and can be hard to tolerate

Where do I go from here?...

Speech Therapy

- Phonological Delays
- Language Delays
- Compensatory Misarticulation Errors
  - Speech therapy is necessary for accurate instrumental assessment
- Intermittent Hypernasality and/or Nasal Emission
  - “Trial” speech therapy to see if can improve
Where do I go from here?...

- Pervasive weak oral consonants and/or nasalized oral consonants
- Pervasive compensatory misarticulation errors
  - IF the child is attempting oral speech
  - IF the child is old enough
- Intermittent hypernasality and/or nasal air emission
- Pervasive hypernasality and/or nasal air emission
- Presence of hyponasality or cul-de-sac resonance
  - May be suggestive of possible airway obstruction
- Referral to a cleft palate/craniofacial team

Where do I go from here?

**Treatment Decision Making**

- **Perceptual Speech Assessment**
  - Hyponasality and/or audible nasal emission present, age-appropriate articulation
  - Hyponasality, audible nasal emission, and articulation errors present
  - Phoneme specific nasal air emission only
  - Refer to Cleft Palate Team, consider imaging of VP mechanism during speech
  - Refer to Cleft Palate Team, consider imaging of VP mechanism during speech if at least some oral pressure consonants are accurately produced
  - AND begin speech therapy to target articulation errors
  - Begin speech therapy to target articulation errors; monitor resonance and refer to Cleft Palate Team if continued concerns or lack of progress
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### Auditory Nasal Emission Present

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### Hypersensitivities

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<td>You are here.</td>
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<td>✔️</td>
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<tr>
<td>You were away all year.</td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td>He will come to see.</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Will we leave at three?</td>
<td>✔️</td>
<td>✔️</td>
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### Conversational Speech

- Say: "You are here.
- Say: "You were away all year.
- Say: "He will come to see.
- Say: "Will we leave at three?"
Thank You!

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References


Peterson-Falzone SJ, Hardin-Jones, MA, Karnell MP. *Cleft palate speech* (3rd ed)