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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"



Terminology

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

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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

continued

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

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Velopharyngeal (VP) Function

- Velo = velum, soft palate
- Pharyngeal = pharynx, pharyngeal walls
- Velopharyngeal Function = 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

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

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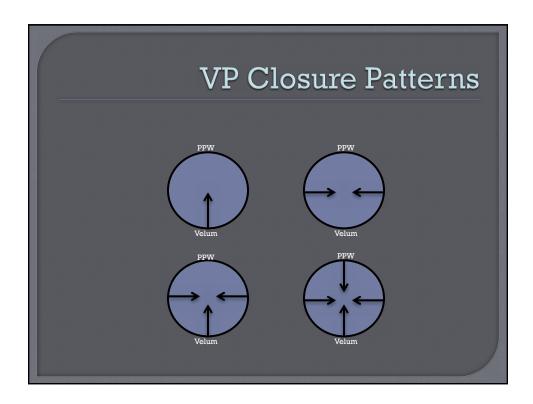
Velopharyngeal Function

- 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

- 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

Resonance

- 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

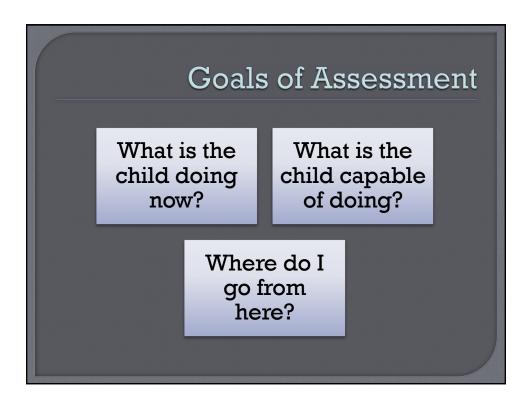


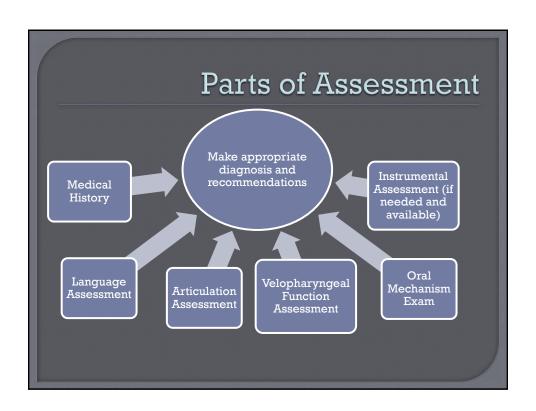
Nasal Air Emission

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

ASSESSMENT



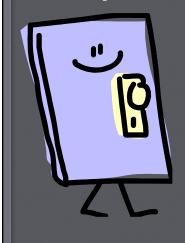






Medical History

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



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

Articulation 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 /f/ for "th" substitution

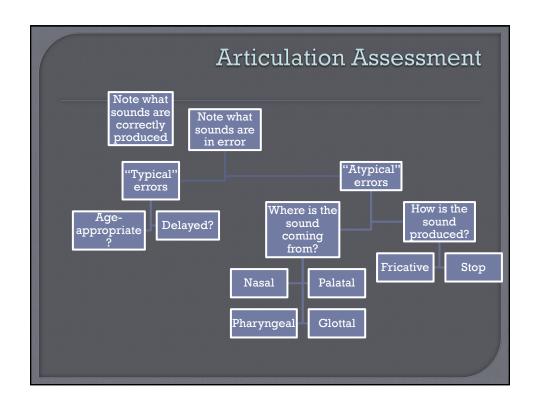
Compensatory Errors

- 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





- Compensatory Articulation Errors
 - Glottal stops
 - · Stop consonant made at the glottis
 - Pharyngeal Stop
 - $^{\circ}$ Lingual base contacts PPW, typically used for /k/ and /g/
 - Pharyngeal Fricatives
 - $\boldsymbol{\cdot}$ Fricative constriction between the lingual base and the PPW



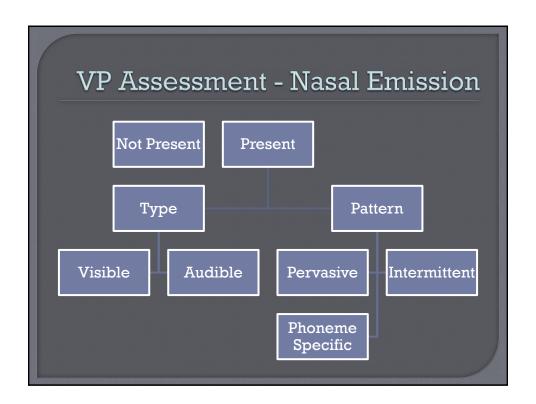
- © Compensatory Articulation Errors
 - Mid-dorsum palatal stop
 - · Stop consonant made in the position of "y"
 - Sounds like a cross between a /t/ and a /k/ or a /d/ and a /g/
 - Nasal fricative
 - Typically articulating a nasal phoneme with nasal air emission used in place of a fricative sound

Articulation Assessment

- 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/)



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





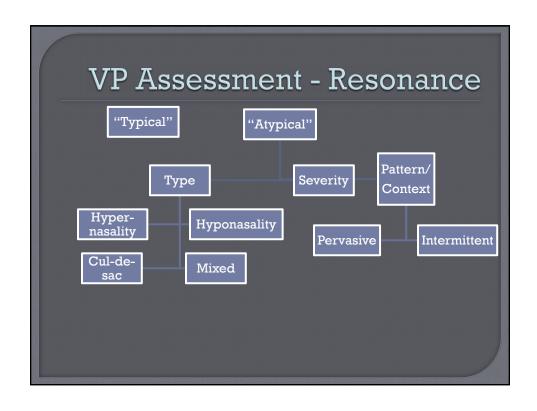
VP Assessment - Nasal Emission

- 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)

VP Assessment - Nasal Emission

- 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 nasalalveolar plosive combo)





VP Assessment - Resonance

- 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 speechNote the presence, severity, and pattern/context



VP Assessment - Resonance

• Define scale to increase reliability

Severity	Descriptor
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)

Based off of Henningsson et al (2008). Universal parameters for reporting speech outcomes in individuals with cleft palate, CPCI

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

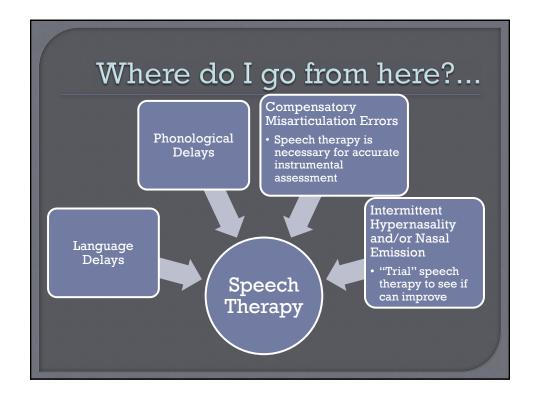
- Imaging Instrumental Assessment
 - Allows us to view the structures and functions of the speech mechanism that are not visible during the oral exam
 - Natural speech can be observed
 - Have seen improved outcomes in surgery for VPD due to imaging
 - Most common = Videofluoroscopy or Nasopharyngoscopy



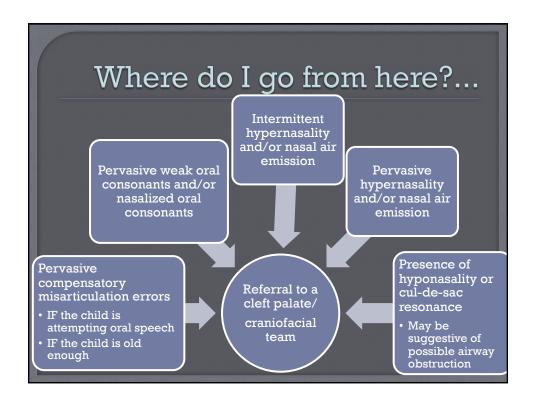
Instrumental Assessment

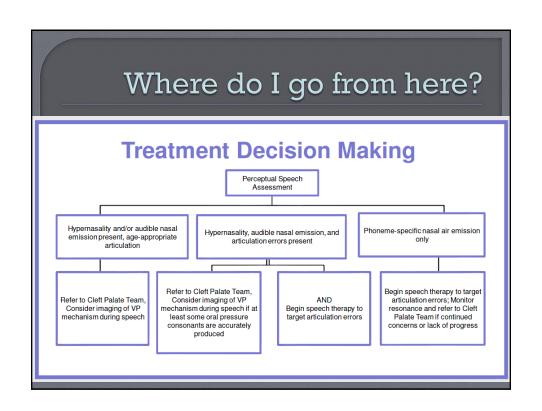
Imaging Instrumental Assessment

- 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











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Hypernasality	Hypernasality Stimuli Trial 1 Trial 2 None Mild Moderate Severe None Mild Moderate Severe You are here.	Stimuli Trial 1 Trial 2 None Mild Moderate Severe None Mild Moderate Severe You are here.	None Mild Moderate Severe None Mild Moderate Severe You are here.		Based off of Ameri 2011. Audible Nasal Emi Stops Affricates/Fricative Hypemasality Stimuli You are here.	ssion Pre	esent:	Incon:	Trial 1	Cons	eloped by	None	k g s z J y	Inconsistent Trial 2	Consistent	
Hypemasality Stimuli Trial 1 Trial 2 Stimuli You are here. You were away all year. You were away all year.	Hypemasality Stimuli Trial 1 Trial 1 Trial 2 None Mild Moderate Severe None Mild Moderate Severe You are here. You were away all year.	Stimuli Trial 1 Trial 2 None Mild Moderate Severe None Mild Moderate Severe You are here. You were away all year.	You are here. You were away all year.		Based off of Ameri 2011. Audible Nasal Emi Stops Affricates/Fricative Hypemasality Stimuli You are here. You were away all	ssion Pre	esent:	Incon:	Trial 1	Cons	eloped by	None	k g s z J y	Inconsistent Trial 2	Consistent	
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Thank You!

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