

Velopharyngeal Dysfunction: A Review of Identification Techniques, Evaluation Protocols and Treatment Strategies

Cara Werner, MA, CCC-SLP
cara.werner@cchmc.org



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Conflict of Interest

- Financial: Employed within the Division of Speech-Language Pathology at Cincinnati Children's
- Nonfinancial: Nothing to disclose



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Learner Outcomes

1. To identify types of velopharyngeal dysfunction and treatment recommendations for each.
2. To explain simple ways to screen for resonance and nasal emission.
3. To name recommended next steps when working with a child who has resonance/VPD concerns.
4. To describe treatment techniques to successfully target cleft speech characteristics.



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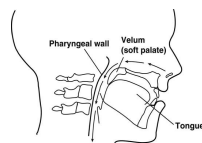
Velopharyngeal Dysfunction (VPD)



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Normal Velopharyngeal Function

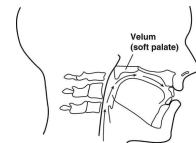
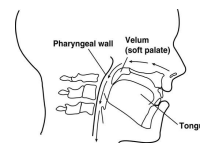
- Structures involved in velopharyngeal closure include:
 - Velum (soft palate)
 - Posterior pharyngeal wall
 - Lateral pharyngeal walls



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Normal Velopharyngeal Function

- Velum at rest
- Velum during speech



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Types of VPD

Velopharyngeal Insufficiency (VPI)	Velopharyngeal Incompetence	Velopharyngeal Mislearning (Phoneme-Specific Nasal Emission)
<i>Cause:</i> abnormal anatomy	<i>Cause:</i> abnormal physiology	<i>Cause:</i> incorrect articulation with no abnormal anatomy or physiology
<i>Patient population:</i> cleft palate, craniofacial conditions, 22q11.2 deletion syndrome, VPI following adenoidectomy	<i>Patient population:</i> cerebral palsy, TBI, stroke, dysarthria etc.	<i>Patient population:</i> anyone, patients with apraxia, or patients who have a history of VPI that has been corrected with surgery
<i>Treatment:</i> surgery	<i>Treatment:</i> surgery or prosthetic device	<i>Treatment:</i> speech therapy



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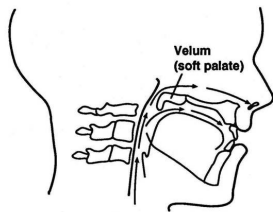
Velopharyngeal Insufficiency (VPI)

- The soft palate is unable to close against the posterior pharyngeal wall when speaking due to being too short or scarring



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Velopharyngeal Insufficiency (VPI)



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Velopharyngeal Insufficiency (VPI)

- VPI can cause the following cleft speech characteristics:
 - *Hypernasality:* nasal speech quality
 - *Nasal emission:* air escaping through the nose during speech
 - *Nasal rustle:* a form of nasal emission caused by air escaping through a very small opening
 - Speech sounds may be quiet, low in intensity and pressure or weak
 - Abnormal speech sound production skills



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Velopharyngeal Insufficiency (VPI)

- Velopharyngeal insufficiency **does not** cause:
 - Limited verbal output or limited vocalizations



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VPI Causes

- Cleft palate
 - The palate is too short, there may be poor movement due to muscle positioning, scarring or a combination
- 22q11.2 deletion syndrome (Velocardiofacial syndrome)
 - With or without cleft palate, abnormal structures and positioning, size/distance relationship, and differences with velar thickness are typically appreciated
- VPI following adenoidectomy



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22q11.2 Deletion Syndrome

- Majority of children present with receptive and expressive language delays
 - Most do still develop as verbal communicators
 - Cognitive delays, social and behavioral needs can often be present
- Decreased speech sound production skills with more significant articulation disorder compared to isolated cleft palate
 - Apraxia, dysarthria, VPD, and/or articulation substitutions can all be present



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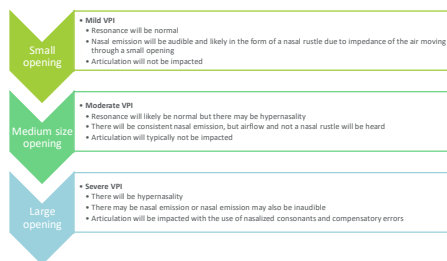
22q11.2 Deletion Syndrome

- 22q11.2 deletion syndrome is the most common genetic cause of VPD
 - VPD should be assumed in these patients until we are able to rule it out
- The velum is thinner and the pharynx is deeper in those with 22q compared to nonsyndromic children without cleft palate
- The levator muscle is thinner and shorter



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Velopharyngeal Opening



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Screening for VPI



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Speech Sample

- A lot of information can be obtained by eliciting and analyzing a speech sample
 - Formal testing is not needed to screen for VPI
 - Having the child imitate sentences is best, but syllable repetition can also be valuable
- Tools required include a flashlight for an oral examination and a straw
- Steps include: 1. oral examination 2. elicit a speech sample 3. assess for resonance and nasal emission



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Oral Examination

- Pay attention to dentition and bite pattern
- Look at integrity of the palate and assess for fistulae or evidence of a submucous cleft palate
- A high arched palate typically does not cause any functional deficits



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Dentition



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Oral Examination



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Speech Sample

American English Sentence Sample

/m/ Mom and Amy are home	/k/ A cookie or a cake
/p/ Puppy will pull a rope	/g/ Give Aggie a hug
/b/ Buy a baby a bib	/h/ Hurry ahead Harry
/f/ A fly fell off a leaf	/blends/ I spy a starry sky
/v/ I love every view	/r/ Ray will arrive early
/th/ Thirty-two teeth	/w/ We were away
/th/ The other feather	
/n/ Anna knew no one	
/t/ Your turtle ate a hat	
/d/ Do it today for Dad	
/l/ Laura will yell	
/s/ Sissy saw Sally race	
/z/ Zoey has roses	
/sh/ She washed a dish	
/ch/ Watch a choo-choo	
/j/ George saw Gigi	
/ing/ We are hanging on	

Cordero et al., 2024



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What to Evaluate

- Are you hearing nasalized consonants?
 - Primarily use of /m/ and /n/ in place of oral consonants with same placement
- Are you hearing increased nasal resonance?
 - Hypernasality
- Does the child sound like they are congested or “stopped up”?
 - Hyponasality
- Do you hear air escaping through the nose when speaking?
 - Nasal emission
 - Is the nasal emission present on all sounds or only certain sounds?



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How to Evaluate



Voiceless Plosive Syllable Repetition

/p/ pa, pee, puppy
 /t/ ta, tee, teddy
 /k/ ka, kee, cookie
 /s/ sa, see, sixty
 /m/ ma, mee, money

- No air on /p/, /t/, /k/ and /s/ indicates *normal velopharyngeal function*
- Air on /p/, /t/, /k/, and /s/ indicates *velopharyngeal dysfunction*
- Air on /s/ with no air on /p/, /t/, or /k/ could suggest *velopharyngeal mislearning* (phoneme-specific nasal emission)
- No sound for /m/ could suggest *hyponasality*
- Hearing sound suggests *hypernasality*

Kummer, 2020



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Next Steps

- If you are the first one identifying concerns, the child needs to be referred to a VPI Clinic or Craniofacial Center at a pediatric hospital
 - Only craniofacial plastic surgeons or ENTs with specialized training are equipped to treat VPI
 - Pediatricians or general practice ENTs have little to no training in velopharyngeal dysfunction
- An American Cleft Palate Craniofacial Association approved team is best practice



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Diagnosing VPI

- VPI is diagnosed by a trained SLP who then confirms the need for surgical correction
- Most SLPs trained in VPI also are affiliated with a pediatric hospital and craniofacial team
- The role of SLPs without this specialty training include
 - Knowing the red flags
 - Knowing when to refer on
 - Knowing what cannot be corrected and should not be targeted in treatment



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Diagnosing VPI

- To diagnosis VPI, a child needs to be able to:
 - Follow a variety of directions
 - Be combining words into phrases and sentences spontaneously
 - Imitate regularly on command



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Management for VPI



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Treatment

- Treatment for velopharyngeal incompetence may include surgery or often includes a prosthetic device
- We will focus on treatment for velopharyngeal insufficiency, which always includes surgery



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Treatment

- VPI along with associated characteristics (hypernasality and nasal emission) can **never** be corrected with speech therapy
- Nonspeech oral motor exercises for purposes of improving velopharyngeal function should **always be avoided**, just like they should be avoided for articulation errors



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Surgical Intervention Options

- Surgical recommendations are dependent on resonance evaluation findings and imaging through nasopharyngoscopy
- Options utilized at CCHMC include:
 - Injection pharyngoplasty
 - Furlow palatoplasty
 - Bilateral myomucosal buccal flaps
 - Pharyngeal flap

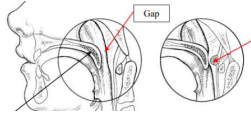


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Injection Pharyngoplasty

Small opening

- Mild VPI
- Resonance will be normal
- Nasal emission will be audible and likely in the form of a nasal rustle due to impedance of the air moving through a small opening
- Articulation will not be impacted as a result of the VPI

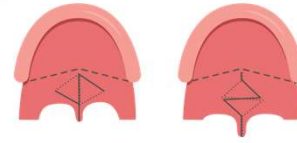


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Furlow Palatoplasty

Small opening

- Mild VPI
- Resonance will be normal
- Nasal emission will be audible and likely in the form of a nasal rustle due to impedance of the air moving through a small opening
- Articulation will not be impacted as a result of the VPI

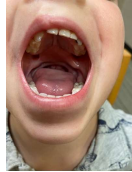


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Bilateral Myomucosal Buccal Flaps

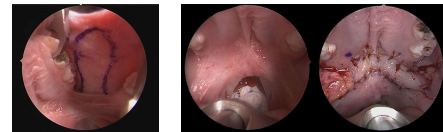
Medium size opening

- Moderate VPI
- Resonance will likely be normal but there may be hypernasality
- There will be consistent nasal emission, but only airflow and not a nasal rustle will be heard
- Articulation may be impacted as a result of the VPI



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Bilateral Myomucosal Buccal Flaps

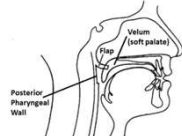
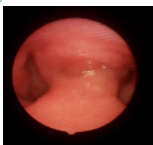


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Pharyngeal Flap

Large opening

- Severe VPI
- There will be hypernasality
- There may be nasal emission or nasal emission may also be inaudible
- Articulation will usually be impacted by the VPI with use of nasalized consonants and active, compensatory errors



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Treatment Strategies and Techniques



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Relationship to Development

- Cleft palate history puts kids at risk for delayed speech and language skills
 - Language acquisition can be impacted if the cleft is accompanied by additional diagnoses
 - If hearing is impacted by poor Eustachian tube function, early language learning can also be impacted
 - Reduced consonant inventory, limited oral placement for phonemes or increased errors can be seen



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Relationship to Speech and Language Development

- A meta-analysis published in 2019 found that young children (birth to age 8) with nonsyndromic CL/P perform significantly below peers in:
 - Consonant inventory
 - Speech accuracy
 - Expressive and receptive language acquisition
- Discrepancy between CL/P individuals and peers decreases as age increases
- Several limitations including evaluation tool variety and varying chronological ages for matched peers



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Relationship to Speech and Language Development

- Reduced consonant inventory is a risk prior to and after initial palate repair
- In looking specifically at stop consonants, children impacted by CL/P may take longer to acquire stop consonants, specifically after surgery
 - 21% producing oral stops 3 months post-op, 95% producing stops 9 months post-op
- Voiced stops emerge before voiceless stops for both cleft and noncleft cohorts
- Early identification and early intervention is key to support success



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Early Language Learners/Late Talkers

- Be familiar with history and red flags to watch for
 - Limited consonant inventory
 - Deficient placement for speech sounds
- Don't feel pressured to rush towards targeting articulation
- Focus should continue to be quantity over quality until receptive and expressive language increase
- Incorporate stimulation for early developing phonemes into language targets and vocabulary teaching



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Early Language Learners/Late Talkers

- Phonemes to emphasize and model: /m/, /n/, /w/, /y/, /h/, /p/, /b/, /t/, /d/, and any fricative!
 - /m/ and /n/ are nasals so correct placement can always be expected regardless of palate function
- We want to elicit correct placement and use of articulators
 - At this point, ignore if consonants are nasalized or you appreciated nasal emission, just honor attempts and use of articulators
- Think of words that include low pressure phonemes, visual phonemes and phonemes that include a lot of auditory feedback!



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Possible Vocabulary Targets

- | | | |
|---------|------------|----------|
| • Oh-no | • On | • Start |
| • Wee | • Push | • Stop |
| • Woah | • Pull | • Shhh |
| • Wow | • Please | • Wash |
| • Want | • Open | • Fun |
| • One | • Up | • Finish |
| • Yay | • Big | • Find |
| • Yes | • Bye | • Hi |
| • You | • Boo | • Here |
| • No | • Two | • Hooray |
| • Not | • Turn | |
| • In | • Out | |
| • More | • All done | |
| • Mine | • Down | |
| • Me | • See | |

Targets listed generally avoid use of velars or ability to substitute with glottal stops to avoid reinforcing any potential active errors.

Environmental sounds and animal sounds are also great to stimulate phonemes while prioritizing language acquisition.

This isn't a comprehensive list!



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Indications for Speech Therapy

- What can be targeted *before* surgery includes:
 - Improved placement for phonemes
 - Bilabials
 - Lingual-alveolars
 - Sometimes, attempts at oral airflow for fricatives
- What cannot be targeted *before* surgery
 - Eliminating nasalized consonants
 - Eliminating nasal emission



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Indications for Speech Therapy

- What can be targeted *after* surgery
 - Eliminating the use of active, compensatory errors
 - Nasalized consonants
 - Nasal and pharyngeal fricatives
 - Glottal stops
- What cannot be targeted *after* surgery
 - Eliminating hypernasality
 - Eliminating residual nasal emission



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Speech Therapy Follow VPI Intervention

- It is typical to see limited change in speech immediately after surgery
- This does not mean that surgery was not successful if these errors remain
 - Surgery addresses structure
 - Therapy then teaches function and how to utilize new structures



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Speech Therapy Follow VPI Intervention

- Begin by working on discrimination skills to ensure child can hear and identify difference between error and preferred target
- Use basic language
 - “nose sound” vs “mouth sound” vs “throat sound”



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Speech Therapy Follow VPI Intervention

- Once child is accurately discriminating, begin by selecting targets
- Think out of the box and select targets based on stimulability rather than typical hierarchy
- Always check for stimulability in various positions of words to determine starting position
- Avoid targeting velars as first target unless highly stimutable
 - We want to improve bringing placement anteriorly rather than reinforcing posterior placements



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Speech Therapy Follow VPI Intervention

- Be mindful of dentition
- Accept what may appear to be a frontal distortion if the child has a crossbite or maxillary hypoplasia
- Accept reverse labio-dentals or bilabial fricatives for /f/ and /v/ if the child has a crossbite or maxillary hypoplasia



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Techniques

Bilabial stops /p/ and /b/

- Start from /m/ and occlude nose to elicit /b/
- Begin 'popping lips' and then include tissue for visual feedback for air release
- Use /h/ to avoid glottal stop substitution
- Consider starting in final position
- Prompts for a 'whisper' as needed

Alveolar stops /t/ and /d/

- Start from /n/ and occlude nose to elicit /d/
- Elevate tongue tip to teeth and then move tongue back as dentition allows
- Shaping from /l/, /s/ or /th/
- Use /h/ to avoid glottal stop substitution
- Consider starting in final position
- Prompts for a 'whisper' as needed

Kotlarek & Krueger, 2023  Cincinnati Children's
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Techniques

Fricatives and affricates

- Probe for stimulability to find starting point (different phonemes, different word positions etc.)
- Shape from /t/ using 'long /t/' technique
- Consider shaping from /f/ or /th/ if patient is stimulable
- Use straw in front of teeth for auditory feedback

Velars /k/ and /g/

- Unless these are the only stimulable sounds, avoid targeting as initial focus
 - Remember focus being to acquire new, *anterior, oral* sounds for many of these kids
- Pair with high vowels
- Attempt in final position

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Velopharyngeal Mislearning (Phoneme-Specific Nasal Emission)

- Incorrect articulation placement with manner maintained in the setting of typical anatomy
- Can impact one phoneme or a variety of phonemes
 - Most often /s/ and/or /z/, but also can include /f/, /sh/, /ch/, /j/ and/or /th/

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Velopharyngeal Mislearning (Phoneme-Specific Nasal Emission)

- Begin by reinforcing desired placement for sounds
 - "mouth sounds" instead of "nose sounds"
- Increase awareness by pointing out sounds that are being produced correctly in the mouth
- Explore to see if any sounds in error are correct in any positions of words
- Start in isolation, shaping from like phonemes as able
 - /t/ to /s/, /th/ to /s/, /f/ to /s/ etc.
- Don't feel pressured to work on multiple sounds at a time

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Takeaways for Treatment

- Try not to be too concerned about VPI too early
 - Prioritize language expansion and incorporate speech stimulation techniques
- When there is VPI, placement can still be targeted in treatment before surgery
- After surgery, ignore typical developmental hierarchies for sound acquisition and choose targets based on stimulability
- Use shaping from other phonemes as needed
- Provided explicit feedback using anatomical terms
- Great articulation progress can be made even if VPI cannot be fully eliminated
- Don't be afraid to ask for help!

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Resources

- ACPA
 - <https://acpares.org/>
 - Find an ACPA approved Cleft and Craniofacial Team: <https://acpares.org/team-care/>
- ASHA
 - <https://www.asha.org/practice-portal/resources/comprehensive-assessment-for-cleft-lip-and-palate-and-resonance/>
- Informed SLP
 - Speech Therapy for Cleft Palate Part One: <https://www.theinformedslp.com/review/speech-therapy-for-cleft-palate-part-one-assessment-and-referrals>
 - Speech Therapy for Cleft Palate Part Two: <https://www.theinformedslp.com/review/speech-therapy-for-cleft-palate-part-two-treatment>
- Leaders Project
 - <https://www.leadersproject.org/ceu-courses-2/english-cleft-palate-speech-therapy-evaluation-and-treatment-asha-0-5-ceu-self-study-course/>
- Allison Fors
 - <https://allisonfors.com/cleft-lip-and-palate/>

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