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Cleft Palate – What do I hear? What do I do?

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How do we determine status of VP function?

- **History**
- **Single word articulation** transcription:
 - Stops, fricatives, affricates: place, pressure buildup, oral release of pressure buildup
 - Resonance of vowels, liquids, glides
 - Resonance of nasal consonants
- **Spontaneous speech** sampling for above
- **Stimulability testing for any misarticulations**
- **Intraoral exam**
- **Instrumentation**

Instrumentation for Velopharyngeal Function

- **Indirect assessment:** Pressure/flow, nasometry
- **Direct assessment:** Nasopharyngoscopy, multi-view videofluoroscopy

Do not elicit compensatory articulations during instrumental assessment of vp function, as these articulations either eliminate the need for velopharyngeal closure or require velopharyngeal opening. One of the reasons to work on articulation therapy when VPI is present is to establish attempt at oral articulations.

Physical Management of VPI

- **Surgery:**
 - Secondary Furlow Z-plasty
 - Pharyngeal flap
 - Sphincter pharyngoplasty
 - Injection to the posterior pharyngeal wall
- **Prosthetics**
 - Pharyngeal extension bulb appliance
 - Pharyngeal extension lift appliance

What does **normal** VP function sound like?

- Normal resonance balance: Resonance relates to how we hear voiced energy produced at the larynx, and then enhanced by a cavity (oral vs nasal).
 - Voiced energy of vowels, liquids, and glides should be perceived to have energy enhancement by the oral cavity.
 - Voiced energy of /m/, /n/, /ŋ/ should be perceived to have energy enhancement by the nasal cavity.
- Normal airflow control: High pressure oral consonants are produced with good oral pressure buildup and no nasal emission

/p/, /b/, /t/, /d/, /k/, /g/, /f/, /v/, /θ/,
 /ð/, /s/, /z/, /ʃ/, /ʒ/, /tʃ/, /dʒ/

What does **overclosure** of VP function sound like?

- Nasal consonants /m/, /n/, /ŋ/ have reduced nasal energy enhancement = hyponasality, or denasal resonance
- Vowels, liquids, glides are perceived to resonate orally, as they should.
- High intraoral pressure consonants (the stops, fricatives, affricates) have good oral power, as they should.
- Causes(?): Obstruction, such as enlarged adenoid, or secondary velopharyngeal structure

What does *insufficient* VP function sound like?

- Vowels, liquids & glides have (undesirable) nasal energy enhancement. Nasal consonants /m/, /n/, /ŋ/ continue to have (desirable) nasal energy enhancement.
- High intraoral pressure consonants
 - have reduced oral power +/- nasal air emission if correct oral place features are used,
 - OR
 - are substituted by learned compensatory articulations

Possible Types of Speech Errors Produced by Children with Cleft Palate

1. **Related to learning of high pressure consonants in the context of velopharyngeal dysfunction; i.e., compensatory articulations: “sacrifice place, maintain manner”**
2. Related to development, age appropriate or inappropriate, for age
3. Related to malocclusion
4. Other category, such as 2nd language learning

Abnormal Airflow Control with Insufficient Velopharyngeal Function

High intraoral pressure consonants

- Stops: / p /, / b /, / t /, / d /, / k /, / g /,
- Fricatives: / f /, / v /, / θ /, / ð /, / s /, / z /, / ʃ /, / ʒ /
- Affricates: / tʃ /, / dʒ /

These consonants are produced

- with use of an appropriate oral place feature,
- with reduced oral pressure buildup at that place feature,
- but nasal leak of airflow (audible or inaudible)

OR-



The child “chooses” to use compensatory articulations as substitutions for the high intraoral pressure consonants (stops, fricatives, affricates.)

Why use compensatory articulations?

Problem: Children with velopharyngeal dysfunction often have difficulty producing consonants with oral place features with high intraoral pressure buildup.

Solutions:

- 1) “Choose” pharyngeal or glottal articulations as substitutions for high intraoral pressure consonants **to eliminate the need for velopharyngeal closure.**
- 2) Use the **opening of the velopharyngeal port for intentional airflow into the nasal cavity** as a fricative release.
- 3) **Back place within the oral cavity** to avoid fistula in hard palate/alveolus.

- When these compensatory articulations are produced, no perceptual judgment can be made regarding volitional “oral” vs. “nasal” airflow control, as these articulations eliminate the need for velopharyngeal closure.
- Do not elicit compensatory articulations from the child during instrumental assessment of velopharyngeal function.

Compensatory Articulations...

- are learned
- become habituated
- can persist long after the velopharyngeal mechanism has been made sufficient, if not appropriately targeted with therapy

These compensatory articulations can be divided into 3 categories:

- Those that occur behind the VP port;
- Those that occur at the VP port, using the VP port opening as part of the articulation;
- Those that occur in front of the VP port but are backed within the oral cavity, with tongue tip down.

Category 1: **Backing of Place** Features,
behind the VP Port

- Glottal stop
/ʔ/ for /p/, /b/, /t/, /d/, /k/, /g/
- Glottal fricative
[h] for /f/, /v/, /θ/, /ð/, /s/, /z/, /ʃ/, /ʒ/
& sometimes /tʃ/, /dʒ/

Glottal Stop Co-Productions

- Glottal stops can be produced simultaneously with oral stop consonant place features

ʔ ʔ ʔ ʔ
[p], [b], [t], [d]

- Visually, the articulation may appear to be “normal” but the glottal place becomes the effective place of impounded pressure, not the oral place feature.

- Pharyngeal stops

/ ʕ /, / ʕ̥ / for / k /, / g /




- Pharyngeal fricatives

/ ʕ /, / ʕ̥ / for / f /, / v /, / θ /, / ð /, / s /, / z /
/ ɣ /, / ɣ̥ / & sometimes / tʃ /, / dʒ /

- Pharyngeal affricates

[ʕʕ̥], [ʕʕ̥̥] for / tʃ /, / dʒ /

Category 2: **Backing of place** features,
plus **intentional opening of vp port**
required for nasal airflow release

- Voiceless bilabial nasal fricative /  /
- Voiceless tip-alveolar nasal fricative /  /
- Voiceless back-velar nasal fricative /  /

These are all possible substitutions for

/f/, /v/, /θ/, /ð/, /s/, /z/, /ʃ/, /ʒ/
& sometimes /tʃ/, /dʒ/

Category #3: Those articulations that have **place features in front of the velopharyngeal port, with intraoral pressure buildup and oral release, but with backed place features for the speech target**

- Back-velar stops /k/, /g/
- Mid-dorsum stops /t/, /d/
- Mid-dorsum fricatives /s/, /z/
- Mid-dorsum affricates /tʃ/, /dʒ/

Intraoral Exam

- What you can see is important, but not as important as what you still cannot see at the level of the nasopharynx. **You cannot judge velopharyngeal closure by looking in the mouth.**
- Note structural differences, but always focus on function; i.e., how does speech *sound*? We look in the mouth to determine if existing structural differences **could** impact speech production. Structural differences do not **have to** impact function for speech.
- Does what you see relate to or support what you heard? i.e., A child who is backing has a large anterior fistula—probably related

Some Anatomical Variations to Note

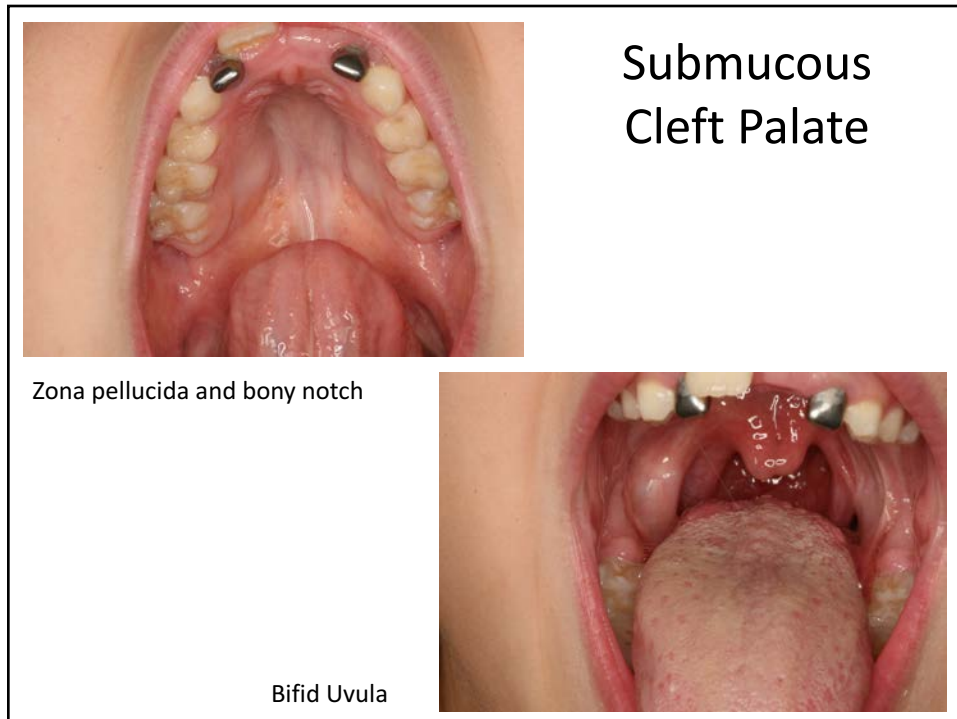
- Fistula or non-reconstructed cleft site
- Large tonsils
- Small mandible in Pierre Robin Sequence, Class II appearance
- Maxillary constriction, Class III appearance
- Zona pellucida
- Bifid uvula, post-surgical vs. congenital
- Malocclusion: types
- Cross bite, open bite, deep bite
- Short upper lip, protrusive premaxilla

Before & After
Simultaneous Lip & Palatal Repair



Dehiscence of Soft Palate Repair





Bilateral Alveolar Cleft Sites



Reconstructed with bone grafts

Fistula

Before and after surgical repair



Fistula at Junction of Hard & Soft Palatal Area



Patent Areas to the Nasal Cavity

- Patent fistulas or unreconstructed alveolar sites can cause nasal airflow upon production of high intraoral pressure consonants whose oral place features **occur at, or anterior to**, the patent area.

Example: Patent fistula of anterior hard palate can cause problem for airflow control for /p/, /b/, /t/, /d/, /s/, /z/

Patent Areas to the Nasal Cavity May:

- Require temporary obturation to make accurate assessment of velopharyngeal function.
- Require construction of removable obturator, or surgery, to close the area.
- Require tolerance of nasal airflow in therapy (temporarily) but therapy should be maintained, reinforcing the use of oral place features, acknowledging that nasal airflow occurs. Nasal occlusion is a valid therapy technique to perceive use of appropriate place feature.

Sphincter Pharyngoplasty Structure, not a Fistula



Protrusive Premaxilla



Maxillary Deficiency; Class III Malocclusion



Class II Malocclusion with Deep Bite



What to do in therapy for speech production in children with compensatory articulations

What can babies with unrepaired cleft palate easily produce?

- Babies can easily produce vowels, liquids, glides, and nasals with an unrepaired palate in babbling.
- But- most babies with unrepaired cleft palate primarily produce only rough “laryngealizations” and bilabial nasal [m].
- Expand the consonant repertoire to include [w], [n], [j] to encourage use of bilabial and lingual place features, without the need for intraoral pressure buildup.

Pre-palatal Repair: What do I hear?

- Babbling experimentation in presence of unrepaired cleft palate can lead to preference for glottal and pharyngeal place features for pressure buildup in babbling & first words
- So listen for the “precursors” of compensatory articulations, with preferences for pharyngeal and glottal place features, including laryngealizations. **Teach families how not to reinforce use of these aberrant place features.**

What to “Listen for” after Palatal Repair

- The big question- Did the palate repair work?
 - Resonance- listen to vowels, liquids, glides
 - Airflow control - listen for consonants with some oral power. **Are early pressure consonants produced in sound play and first word attempts with oral place features and some degree of oral pressure buildup?**
 - **Backing** preference for laryngeal & glottal places may persist
 - **Backing** [k], [g] for /t/, /d/ may emerge

Other areas: Education about possible feeding issues, development, need for hearing/ENT checks

Phonological Learning in Presence of Velopharyngeal Insufficiency

Which strategy will the baby/toddler/child use?

- Tolerate reduced oral power of pressure consonants with oral place features with nasal air emission?
OR
- Eliminate the need for velopharyngeal closure by choosing place features posterior to, or at, the VP port? Eliminate nasal air emission through a patent fistula/unrepaired palate by backing place behind it?

Case review: G

Complete & bilateral cleft lip & palate

G's bilateral cleft lip repaired at age 3 months
and palatal repair at 13 months

But G's hard palate repair does not remain intact:
One month post-palatoplasty, there is a fistula.



G undergoes Fistula Repair

- G left hospital with intact hard palate but one month later, now 18 months of age, fistula is again evident.
- Articulation therapy continues to show lack of progress in production of high pressure consonants. Glottal stops are used as substitutions for the earliest high pressure consonants, the stops /p/, /b/, /t/, /d/, /k/, /g/.

G's speech with maxillary obturator, now 2 years of age

Moderate hypernasality of vowels, glides

Glottal stops continue to predominate as substitution for all high pressure consonants; pharyngeal stops are emerging in the word final position

Consonantal repertoire includes nasals [m], [n]

Vowels are not well differentiated

Intelligibility is low with even with known context



G's Therapy Goals after Pharyngeal Flap & Fistula Closure

- High pressure [k] and [g] emerge quickly, and occur as substitutions for anterior pressure consonants /p/, /b/, /t/, /d/ as well
- Goal: Target anterior high pressure consonants /p/, /b/, /t/, /d/, with use of correct place features, oral pressure buildup and oral release of that pressure buildup

Backing to [k], [g]

- In children with cleft palate, use of back-velar [k], [g] is not developmental in nature.
- This represents backing of the place feature, often as a substitution for anterior high intraoral pressure consonants /p/, /b/, /t/, /d/.
- Often this pattern emerges when there is, or has been, an area of the hard palate that has been patent to the nasal cavity during early learning.
- The pattern requires therapy intervention as early as possible.

G's Goals after Pharyngeal Flap & Successful Fistula Closure of Hard Palate

- More successful with voiceless [p] than voiced [b] for pressure buildup; resorts to [m] for [b], so use nasal occlusion, as she has the correct place feature, but not the concept for oral pressure buildup and oral release of pressure buildup for [b]
- Reinforce appropriate use of [k], [g].
- Establish [t] or [d], avoiding debilitating contexts [k], [g]; use [n] for place feature and occlude nares to establish oral pressure buildup and oral release of pressure buildup.

Therapy Bits

Video 1

Therapy Techniques

- Reinforce use of correct oral place feature, with oral pressure buildup & oral release of pressure buildup for stops, fricatives, affricates, using a hierarchy.
- Nasal occlusion is used intermittently to teach oral path of airflow release.
- Use auditory & verbal cues to describe place, path & oral release.
- Consider: What are facilitating & debilitating contexts in eliciting correct oral place, oral pressure, oral path of release?
- Listen for co-productions (simultaneous use of backed place feature & anterior place feature) to avoid reinforcing maintenance of the backed articulations.

Nonspeech Oral Motor Exercises are Not Indicated for Children with Clefts

These children have normal range, rate and strength of the articulators.

- G. has habituated “backing,” first at the larynx with glottal stops, then at the back-velar place after pharyngeal flap construction.
- G. needs to learn use of anterior place features, with oral pressure & oral release of pressure.

Therapy Principles: School aged Children

- Target oral place features, with pressure buildup and oral release of pressure buildup for the high intraoral pressure consonants, the stops, fricatives, affricates.
- If nasal fricatives produced, vowels contiguous to the nasal fricatives will be perceived to be hypernasal. As the articulation is targeted, and oral release of pressure buildup is established, the vowels contiguous to the learned oral articulation will improve in perceived resonance, because the VP port is not being intentionally opened.

“PSNE” or Nasal Fricatives

- PSNE occurs in both cleft palate and non-cleft individuals.
- Can occur as a substitution for any of the fricatives and/or affricates, but very often for just /s/, /z/
- Is often misperceived as nasal air emission, an airflow leak & surgery can be inappropriately recommended.
- Nasal fricative production may “inflate” the perception of hypernasal resonance for vowels contiguous to these due to the need to open the VP port for nasal fricative release.

“PSNE” or Nasal Fricatives

- This is a learned **misarticulation** that requires **therapy** for establishment of
 - 1) oral place feature,
 - 2) oral pressure buildup at that place feature &
 - 3) oral release of that pressure buildup for any of the fricatives & affricates that are affected.
- [t], [d] are often facilitating contexts, as the child usually produces oral place & path for those phones

Case Review: J

- 7 years of age
- Referred to VPI Clinic with suspicion of submucous cleft palate and need for surgical intervention to improve velopharyngeal function for speech
- Received speech therapy services for 4 years after aging out of early intervention services

Case Review: J

Reported for his spontaneous speech:

- Bilingual English & Spanish
- Reduced intelligibility for both Spanish & English productions
- Perception of hypernasality and nasal air emission

Case Review: J

In reality:

- Articulation testing revealed use of back-velar nasal fricative substitutions for /s/, /z/
- Use of normal oral place features, oral pressure buildup and oral release of that pressure buildup for all other high intraoral pressure consonants
 - Stops: /p/, /b/, /t/, /d/, /k/, /g/
 - Fricatives: /f/, /v/, / θ /, / ð /, / ʃ /, / ʒ /
 - Affricates: / tʃ /, / dʒ /

Case Review: J

- Other developmental type phonological processes and dialectal variations include:
 - Affrication of / tʃ /, / dʒ /
 - [f] for θ /
 - Stopping [d] for voiced / ð /
 - Cluster reduction
 - Derhoticization of /r/ and 'er'

Case Review: J

- Intraoral exam failed to reveal bifid uvula but...
- Perhaps zona pellucida?
- Odd looking posterior hard palate
- Odd midline demarcation of the soft palate
- But given the speech findings, even if this is a microform of cleft palate, no surgery is indicated!
- **Not all microforms of cleft palate require surgical intervention, and adenoidectomy is contraindicated to preserve vp function for speech.**

Intraoral Exam: J



Speech Sample without /s/, /z/
targets, followed by speech targets
that elicit /s/, /z/

Video 2

What is perceived when the nasal
fricatives are **not** elicited in the speech
sample??

- When correctly articulated high pressure consonants are produced **without the presence of /s/, /z/ targets**, oral resonance is perceived, with energy enhancement by the **oral** cavity, not the nasal cavity.

When /s/, /z/ targets are included in the speech sample....

- Opening of the velopharyngeal port for production of the nasal fricative snort allows the vp port to be open long enough to create nasal energy enhancement of contiguous vowels, giving the perception of hypernasal resonance.

This is an Articulation Disorder that needs Articulation Therapy

- Using model of [t], sustaining it, **J is stimuable for production of oral place feature, oral pressure buildup & oral release of pressure buildup for [s]** production in isolation, unblended and blended syllables; [t] is the facilitating context with correct oral place feature, oral pressure buildup & oral release
- But thus far, [s] has been elicited as a phonetic event, not a phonemic event, referring to “long t” not ‘s’
- Introduction of real word targets could elicit the back-velar nasal fricative substitution again

Therapy for Nasal Fricatives

Phonetic practice of the long 't' precedes production as phonemic 's', 'z' targets,

but correct 's', 'z' can often be elicited in words within the very first session.

Therapy for Nasal Fricatives

- With older children, you can clearly describe how [t] and [s] are alike: both have the same place, both have air buildup in the front of the mouth, and both have that air come out of the mouth, not the nose.
- If you have difficulty teaching oral airflow release, try nasal occlusion, trapping the nasal fricative in the nasal cavity, forcing the airflow back into the oral cavity, and then the production would likely be perceived as a [k]; at least you can reinforce "It came out of your mouth."

Therapy for Nasal Fricatives

- Working on the phonetic place features for oral place feature, oral pressure buildup and oral release of the pressure buildup for /s/, /z/ **will have a secondary benefit of improving speech resonance of vowels.**
- **Surgery to the soft palate is not indicated.**
- **Oral motor exercises are not indicated; this is not a muscular weakness.**
- Articulation therapy is indicated, to teach correct oral place feature, oral pressure buildup & oral release of that pressure buildup for /s/, /z/.

Case review: I

- Now 5 years old,
bilateral cleft lip &
cleft palate
- Bilateral cleft lip
repaired in China
- Cleft palate repaired at
age 2 ½ years with
Furlow z-plasty repair
of the soft palate

Case review: I

- Just had secondary surgical management with sphincter pharyngoplasty at nearly 5 years of age
- In the video, watch her throat with high pressure consonant targets; contraction of the pharyngeal musculature is visually obvious as she produces the pharyngeal fricatives.

I's Speech Production

Video 3

Variability, but all pressure consonants produced with glottal or pharyngeal place features

- Glottal stops simultaneously co-articulated with oral place feature for targets: /p/, /b/, /s/, /z/, /ʃ /, /k/, /g/
- Singleton glottal stops for inter- & postvocalic /s/
- Pharyngeal fricatives for inter- & postvocalic /s/, /z/
- Pharyngeal stop for postvocalic /g/

With these compensatory articulations,

- the effective place of pressure buildup is in the pharynx or at the glottis, even when oral place features can be visualized as in the case of “co-productions.” Be careful not to reinforce the co-production.
- Therapy for pharyngeal fricative substitution for sibilants should establish correct oral place feature and oral pressure buildup, with oral release of the pressure buildup.

Therapy Suggestions

- There are currently no articulations which show use of oral place feature, with attempt to build up and release airflow orally. Therapy needs to establish consonant production that has oral place, with attempt to build up pressure at that oral place, and attempt to release that airflow orally, without co-productions.

Therapy Techniques

- Be specific about use of place features: a “mouth sound” vs. a “throat sound”
- Practice any successful oral place features, using hierarchy of production: sound in isolation, unblended syllable, blended syllable, “nonsense” monosyllabic words, true monosyllabic words, predictable two word utterances, less predictable two word utterances, etc.
- Educate family members: how compensatory articulations are made, sound, etc.

Pay attention to phonetic features to improve articulation for child with compensatory articulations

- Start with highly visual oral place, voiceless [p] or [t]?
- Use nasal occlusion with [m] to create a [b]?
- Use nasal occlusion with [n] to elicit a [d]?
- Use voiceless consonant targets to eliminate glottal stop co-productions?
- Avoid increasing vocal intensity as you model oral pressure, as this may elicit glottal stop production

Last but not least: Mid-dorsums

Video 4

Therapy for Mid-Dorsums

- “Front” vs. “back” phonemic boundaries are lost, as the middle of the tongue makes contact with the middle of the hard palate.
- The tongue tip is not elevated.
- Makes it difficult to distinguish
/t/ vs. /k/ & /d/ vs. /g/

Mid-dorsums

- Do not disappear “when orthodontic treatment is done.” These are learned and habituated.
- Require therapy intervention to teach appropriate anterior place and tongue tip elevation for /t/, /d/, “front” vs. “back” place feature differentiation.
- The longer we wait to treat, the greater is the habit strength, and the more difficult it is to change the speech articulation.

Consult with cleft teams for expert speech and velopharyngeal assessment,
rather than referring to individual practitioners, when you suspect a velopharyngeal problem.

Call 1-800-24-cleft or go to www.acpa-cpf.org to find a cleft team with the appropriate professionals in your area.

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