Evaluation and Treatment: Resonance Disorders and VP Dysfunction

• Evaluation of VPD
  – Perceptual evaluation
  – Intra-oral evaluation
  – Instrumental evaluation
• Treatment of VPI
  o Surgical procedures
  o Prosthetic devices
• Speech therapy
• Referrals
Perceptual Evaluation

When, What, How, and Why

- **When** the evaluation should be done for the most reliable results and maximum benefit for the patient
- **What** to assess
- **How** to do a perceptual evaluation using simple “low-tech” and “no-tech” procedures
- **Why** the speech evaluation is needed to make appropriate management decisions
When?

Evaluation of VP Function

- Child needs to have...
  - connected speech
  - ability to cooperate for stimulability testing and instrumental assessment
  - adequate airway with no recent airway concerns
- Usually around the age of 3
Caveat: Don’t wait too long!

- Critical period of brain development and speech/language learning
- Consequences of waiting too long
  - Correction will take longer
  - Prognosis is negatively affected
  - Can affect social and emotional development

What?
What to Evaluate

• Speech sound production
• Airflow/air pressure and presence of nasal emission
• Resonance
• Voice (phonation)

Speech Sound Production

• Placement errors
• Phonological (pattern) errors
• Developmental errors
• Obligatory distortions or compensatory errors
Obligatory Distortions
Placement is correct, but structure is abnormal
• Nasalization of oral phonemes (m/b, n/d, ng/g)
• Nasal emission
  – Weak or omitted consonants
  – Short utterance length

Compensatory Errors
Placement is incorrect in response to abnormal structure
• Glottal stops
• Pharyngeal plosives
• Pharyngeal fricatives

Note: These misarticulations can also be due to mislearning in the absence of VPI
Nasal Emission

• Characteristics of a large gap versus small gap

Nasal Emission- Large Gap

• Nasal emission that is barely audible or even inaudible
• Nasal emission causes:
  – Weak or omitted consonants
  – Short utterance length
  – Nasal grimace
Nasal Emission- Small Gap

• Usually in the form of a nasal rustle

Note: Nasal rustle can also be due to a misarticulation which causes phoneme-specific nasal air emission

Nasal Rustle
Can be structural or functional

**Structural Defect**
• Occurs inconsistently, but on all pressure sounds, including /p/, /t/ and /k/

**Functional Error**
• Occurs consistently, but only on certain sibilants (i.e. s/z)
Resonance

Need to determine the type:
• Normal resonance
  – right balance of oral and nasal resonance
• Hypernasality
• Hyponasality
• Cul de sac resonance
• Mixed resonance

Resonance Severity

Types of rating scales:
• Seven point scale
• Normal, mild, moderate, severe
• Present or absent
Resonance Severity

- Severity does not affect treatment plans
- If there is hypernasality due to VPI (mild, moderate or severe)… surgical management is the only way to correct it

Phonation

Evaluate for signs of dysphonia:
- Hoarseness
- Breathiness
- Low or high pitch
- Low intensity
How?

Speech Samples

- Single word articulation test…NOT good!!!
- Kids don’t communicate in single words
- Speech breaks down in connected speech
Speech Samples

- Prolongation of sounds
- Repetition of syllables
- Counting
- Repetition of sentences with pressure-sensitive consonants
- Connected speech

Repetition of Single Sounds

- Oral sound to test hypernasality:
  - vowels, particularly /æ/ (as in “father”) and /i/ (as in “heat”)
- Oral sounds to test nasal emission:
  - prolonged /s/
- Nasal sound to test hyponasality:
  - prolonged /m/
Repetition of Syllables

To test hypernasality or nasal emission, use oral consonants with high and low vowels:

• \( p_α, p_α, p_α, p_α \ldots \) \( pi, pi, pi, pi \ldots \)
• \( t_α, t_α, t_α, t_α \ldots \) \( ti, ti, ti, ti \ldots \)
• \( k_α, k_α, k_α, k_α \ldots \) \( ki, ki, ki, ki \ldots \)
• \( s_α, s_α, s_α, s_α \ldots \) \( si, si, si, si \ldots \)
• \( sh_α, sh_α, sh_α, sh_α \ldots \) \( shi, shi, shi, shi \ldots \)

To test hyponasality, use nasal sounds with high and low vowels:

• \( m_α, m_α, m_α, m_α \ldots \) \( mi, mi, mi, mi \ldots \)
• \( n_α, n_α, n_α, n_α \ldots \) \( ni, ni, ni, ni \ldots \)
Counting

To test nasal emission:

- Count from 60 to 70
- Repeat 60 or 66 over and over

66 = SIKSTY SIKS

- Good combination of plosives and fricatives in blends

Counting

To test hyponasality:

- Count from 90 to 99
- Repeat 99 over and over
Repetition of Sentences

- p/b: Popeye plays baseball.
- t/d: Take Teddy to town. Do it for Daddy.
- k/g: Give Kate the cake. Go get the wagon.
- f/v: Fred has five fish. Drive the van.
- s/z: I see the sun in the sky.
- sh: She went shopping.
- ch: I ride a choo choo train.
- j: John told a joke to Jim.
- l: Look at the lady.
- r: Run down the road. I have a red fire truck.
- th: Thank you for the toothbrush.
- Blends: splash, sprinkle, street

Stimulability and Consistency

- Does change in placement change VP function and eliminate nasality?
- Stimulability is a good prognostic indicator for improvement or correction with therapy
Either/Or Questions for Non Compliant Children

What do you like best?
• Puppy dogs or kitty cats?
• Baby dolls or teddy bears?
• Cup cakes or cookies?
• Baseball or basketball?
• Dancing or singing?

Low-Tech & “No-Tech” Procedures

Use same type of speech samples to:
• see
• feel
• hear
See: See-Scape

Feel: Sides of Nose
Hear: Nose Plugging

- Listen to oral sounds and sentences with nose open and then closed
- If there is a difference, there is an open VP valve
- If there is no difference, the test is inconclusive

Hear: Stethoscope

- Take off the drum
- Put the tip of the tube at the entrance of a nostril
- Listen for air or sound through the scope during production of oral sounds
Straw

• Same as stethoscope
• Straw is always available and it’s disposable!

Hear: Listening Tube
Prediction of Size of Gap based on perceptual features

- Hypernasality, *inaudible* nasal emission, weak consonants, short utterance length, compensatory productions
- Hypernasality, *audible* nasal emission, weak consonants, may have compensatory productions
- Audible nasal emission and possibly mild hypernasality
- Normal resonance, but inconsistent nasal rustle (turbulence)

Intra-Oral Evaluation
Intra-Oral Evaluation

- Can evaluate oral structures and oral function
- *Cannot* evaluate velopharyngeal structure or VP function
- View is well below area of closure

Intra-Oral Evaluation

- Dentition and occlusion
- Oral cavity size
- Position of the tongue tip relative to the alveolar ridge
- Presence of a fistula
Intra-Oral Evaluation (cont.)

- Signs of a submucous cleft
- Position of the uvula during phonation
- Size of the tonsils
- Signs of upper airway obstruction
- Signs of oral-motor dysfunction

Tools for an Intra-Oral Exam

- Gloves
- Light
- Dental mirror
- Tongue blades  
  - (preferably the flavored kind)
- Antimicrobial hand rinse
Dental and Occlusal Exam

Fistula

Effect depends on location and size
Oronasal Fistula vs. VPI

• Occlude the fistula with gum or fruit roll up
  OR
• Compare the degree of nasal air emission for anterior sounds (i.e., /p/, /t/) and posterior sounds (i.e., /k/)

Intra-Oral Evaluation

• Need to see to the tip of the uvula
• Avoid using a tongue blade
Say /æ/ (as in “bat”) and protrude the tongue
Normal Velum

- Color is pinkish and consistent
- White line down the middle (median raphe)
- Velar dimple about 80% back of the entire length of the velum during phonation
- “Uni-uvula”

Tonsils

- Judge the size and symmetry
- May affect position of the uvula
Uvula

• Should be in midline during rest and phonation
• Look for deviation or pointing to one side

Evidence of Upper Airway Obstruction

• Open mouth posture and anterior tongue position
• Suborbital shiners (black eyes)
• Strident breathing
• Snoring and history of restless sleeping
Instrumental Evaluation

Nasometry (KayPentax)

- Analyzes acoustic energy from oral and nasal cavities
- Gives an objective nasalance score (ratio of oral/total energy)
Pressure-Flow Technique

• Aerodynamic instrumentation
• Measures air pressure and airflow during production of a small speech segment
• Gives estimate velopharyngeal orifice size

Catheters:
• One in a nostril and one in mouth
• Connected to a pressure transducer

Flow Tube:
• One in the other nostril
• Connected to a heated pneumotachograph

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Videofluoroscopy

- Multi-view radiographic assessment
  - Lateral view
  - anterior-posterior (AP) view (AKA frontal view)
  - Base view
- Studies are interpreted by both a radiologist and a speech pathologist

Videofluoroscopy: Lateral View

(change the outcome)
Videofluoroscopy: AP View

Videofluoroscopy: Base View
Nasopharyngoscopy

- Allows **direct observation** of structures and function of the VP mechanism
- Can see **location** of the opening

Nasopharyngoscopy vs. Videofluoroscopy

- Done without radiation
- Better tolerated by even young patients (barium for videofluoroscopy is noxious!)
- Much better resolution
- Can see entire port in one view
- No false negatives (head rotation)
- Can see even small gaps
Nasal Spray

• Afrin and Pontocaine thru nasal spray

Nasopharyngoscopy

• Endoscope passed thru middle meatus, thru choanal orifice, to VP port
Happy Camper

Occult Submucous Cleft
Small Circular Gap in Midline

Small Lateral Gap
Bowtie Closure
With Lateral Gaps
Narrow Coronal Gap

Coronal Gap with Touch Closure in Midline
Medium-Size Opening in Midline

Large Opening
Nasopharyngoscopy

• Scope can be passed by either a surgeon or SLP
• Speech sample should be done by SLP
• Interpretation requires expertise of surgeon and SLP

Why?
Treatment of VP Insufficiency

- Surgery
- Speech bulb (if surgery is not an option)
- Speech therapy postoperatively to eliminate compensatory articulation errors

Treatment of VP Incompetence (neurophysiological cause)

- Surgery
- Palatal lift (if surgery is not an option)
- Speech therapy postoperatively to eliminate compensatory articulation errors
VP Mislearning

• Speech therapy only

TREATMENT OF VPI

• Surgery
• Prosthetics
Surgery for 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 or Radiesse (hydroxyl apetit)
- Good for small, localized gaps or irregularities of the posterior pharyngeal wall
Furlow Z Plasty

- Often used as a primary palate repair
- Can be used as a secondary repair to lengthen velum
- Appropriate for narrow, coronal gaps

Pharyngeal Flap

- Best for central openings, big openings, or deep gap
Pharyngeal Flap

- Best for central openings, big openings, or deep gap
Pharyngeal Flap
Patient’s right lateral port

Pharyngeal Flaps
Both are too low
Sphincter Pharyngoplasty

Too narrow and too low

(change the outcome)
Factors in Surgical Procedure Selection

- **Cause:** irregular adenoids versus short velum
- **Size** of the opening
- **Risk** of airway obstruction

▶ **Location, Location, Location!!!**

Need to find the hole and find the right procedure to fill it!

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Surgical Procedure Selection

- Midline gap (most common with cleft palate) or large gap- pharyngeal flap is best
Surgical Procedure Selection

- Lateral gap(s)- sphincter pharyngoplasty (unilateral or bilateral) is best

Prosthetic Devices

- Palatal lift
- Palatal obturator
- Speech bulb
Palatal Lift

- To raise the velum when velar mobility is poor (velopharyngeal incompetence)
- Commonly used with dysarthria

Palatal Obturator

- To close or occlude an open cleft, palatal defect or fistula
Speech Bulb (Speech Aid)

- To occlude nasopharynx when the velum is short (velopharyngeal insufficiency)
- Can be combined with an obturator
Palatal Obturator with Bulb

Limitations of Prosthetic Devices

• Require insertion and removal
• Have to redo periodically due to growth
• Can be lost or damaged
• May be very uncomfortable
• Compliance is often poor
• Don’t permanently correct the problem

Most centers use only if surgery is not possible
Speech Therapy

Speech Therapy With Structural Anomalies

• Speech therapy CANNOT…
  – change abnormal structure, and therefore cannot…
  – correct “nasality” due to VPI
• Speech therapy CAN:
  – correct compensatory placement errors secondary to VPI or malocclusion, and…
  – correct placement errors that cause nasal emission or hypernasality
Speech Therapy or Not

Red: Stop! Obligatory distortions will not respond to speech therapy

Green: Go! Compensatory errors will require speech therapy after correction of the structure

Obligatory Distortions

Because articulation placement is normal and the distortion is due solely to abnormal structure, obligatory distortions...
- CANNOT be corrected with speech therapy
- Require physical management (surgery, prosthetic appliance, orthodontics, etc.)
Compensatory Errors

Because articulation placement is abnormal, compensatory errors...

- CAN be corrected with speech therapy
- It’s best to do therapy after correction of the structure

Effects of VPI (or fistula) on Speech and Resonance

1. **Hypernasality**: Affects sound; therefore, vowels and voiced consonants

2. **Nasal air emission**: Affects air pressure; therefore, pressure-sensitive consonants (plosives, fricatives and affricates). Causes...
   - weak or omitted consonants
   - short utterance length (due to need to replenish breath)
   - nasal grimace
   - compensatory articulation productions
Speech Therapy Techniques

Speech Therapy with Uncorrected VPI

- Done while waiting for surgery or a prosthesis
- Use nose plugging technique
  - Gives the child increased oral pressure to work on articulation
  - Child should wear nose plug at home as much as possible
Speech Therapy after VPI Surgery

- *Changing structure does not change function*
- There may be remaining hypernasality or nasal emission due to lack of use of structures
- There may be compensatory errors which result in nasal emission

Speech Therapy for **Post-Op**
Hypernasality or Nasal Emission

- Need auditory feedback to learn to make use of the corrected structures
  - Auditory stimulation and imitation is the “natural” way
- Tubes work best
- “Exercises” do not work!!!
Disadvantage of Listening Tube

- SLP or parent can’t hear what child hears
- Half of the sound is going through the tube to the child’s ear

Auditory Feedback: Oral & Nasal Listener (ONL)*

- Allows the SLP or parent to hear the sound and therefore, help in giving feedback

* Super Duper Publications- 2007
Therapy for Placement Errors
Compensatory or Mislearning

- Glottal stops
- Nasalized plosives, vowels or ng/l
- Nasalized (or misarticulated) /r/
- Pharyngeal plosives (or abnormal /k/ or /g/)
- Pharyngeal or posterior nasal fricatives
- Palatal-dorsal production (or lateral lisp)

Start with Awareness

- Give as many clues as possible using the following senses:
  - Visual
  - Tactile
  - Auditory
Therapy for Glottal stops

- Make the child aware of the wrong sound and the target
  - Watch neck in mirror during production
  - Feel the neck during production
  - Hear the difference by contrasting the glottal stop with voice onset with single vowels and with nasal syllables (i.e., ma)
  - Hear the difference between the target sound and the glottal stop

Therapy for Glottal stops

- Produce an isolated voiceless plosive (i.e., /p/)
- Produce the voiceless plosive and then the vowel preceded by an /h/ (i.e., /p... ha/
- Produce the voiced plosive cognate with a whisper and add an /h/ before the vowel (i.e., /b...ha/)
Therapy for nasalized plosives, vowels or ng/l

- Begin with a big yawn to raise the velum and bring down the back of the tongue
- Make the child aware of the open stretch in the back of the mouth
- Co-articulate the /l/, plosive or vowel with a big yawn and then gradually decrease
- For auditory feedback, use the ONL or listening tube

Therapy for /ə/ 

- With a tongue blade, stimulate both sides of the back of the tongue and then the upper gum ridge behind the molars
Therapy for /ɔ/: 

- Show the child how the shape of the tongue forms a “boat”
- Show where the back of tongue touches gums behind or just under upper molars
- Ask the child to make a wide smile while “backing up the boat”

Therapy for /ɜ/: 

- Push up against the base of the chin with your finger to push up the back of the tongue
- Make sure it feels loose so you can push
Therapy for /ɜ:/

- Assist placement by squeezing the cheeks with your thumb and forefinger to get lip rounding
- Use your middle finger to push up the back of the tongue

Therapy for /ɜ:/

- Once final /ɜ:/ is achieved, work on initial /r/ by showing the forward movement of the tongue with your hand
- If the child goes to a /w/, have him hold his hands on his face and tell him not to allow the face to move while going from /ɜ:/ to /r/
Therapy for pharyngeal plosives (or abnormal k/g)

- Start with an /ng/ placement
- Have the child hold /ng/ to feel placement
- If the child can’t produce an /ng/...
  - Put a tongue blade on the middle of the tongue and push down and back OR
  - Firmly press your thumb under the base of the child’s chin to push the back of the tongue up
- Work on the up and down movement by achieving position and then dropping the tongue

Therapy for pharyngeal plosives (or abnormal k/g)

- Have child take a breath, place his tongue in an /ng/ position, and drop the tongue to produce a /g/
- If necessary, pinch his nose closed and then have him drop the tongue
- Have the child whisper this sound to achieve the /k/
Therapy for pharyngeal or posterior nasal fricatives

- Have the child produce a loud /t/ sound
- Have him produce the /t/ with the teeth closed
- Have the child prolong the production until it becomes /tssss/

Palatal-dorsal productions causing lateral distortion

- Causes lateral distortion on lingual-alveolars and a lateral lisp on sibilants
- To determine flow of air, put a straw in front of the teeth and to the sides during the production of the /s/
  - If normal, air through straw will be heard when it is in front of the central incisors
  - If lateral, air through straw will be heard when it is on the side of the dental arch
Therapy for palatal-dorsal productions/lateral lisp

- Essentially same technique as with pharyngeal/posterior nasal fricatives
  - Have the child produce /t/ and push the airstream into the straw
  - Move to /tssss/ and prolong the /s/ with air going through the straw
  - Transition to the syllable by inserting an /h/ between the /s/ and vowel

Establishment of “Carry-Over”

- Speech requires motor movement that is *fast, complex, automatic* and *effortless*
- This is accomplished by *motor learning* and *motor memory*
Motor Learning

- **Motor learning** is dependent on **feedback**
- Results in the development, change or refinement of a motor program (i.e., change in production of a speech sound)
- This is what is done in speech therapy

Motor Memory

- **Motor memory** is dependent on **practice**
- Develops the automaticity of the movement
- This is what should be done at home
Practice

- Result in brain reorganization due to neural plasticity
- Necessary for learning to perform all complicated motor movements and sequences without conscious thought
  
  Examples:
  - Playing an instrument: piano
  - Ballroom dancing: salsa
  - Sports: shooting a basketball
  - Speech

Therapy is like Piano Lessons

- If you just go for the lesson but don’t practice at home, you don’t learn to play the piano
Practice Amount

• A large number of practice trials is most beneficial for learning
  – The number of correct responses elicited (in therapy and at home) is directly related to the rate of progress.
  – Drill work is most effective

Practice Distribution

• Distributed facilitates both short-term performance and long-term learning
  – Frequent short practice sessions throughout the day and week are better than a few long sessions
Weekly Practice Log

| Child’s Name: __________________ Practice Log Start Date: ____________ |
| Practice between sessions will greatly increase your child’s success in speech therapy. It is better to practice several times each a day, than to practice a long time once a day. A practice session can be as short as 30 seconds. |

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What NOT to do for VPI...

- Do NOT use blowing or sucking exercises
- Do NOT use velar exercises
- Do NOT use oral-motor exercises
- Do NOT pinch the nose to improve VP function
  - This inhibits velar movement against positive pressure
- None of these techniques have evidence of efficacy and they just don’t work!!!
Goal of Treatment

- Normal speech and resonance
- Merely “acceptable speech” is not acceptable!
- If there is little progress, refer to a craniofacial team for assessment of VP function!

Referrals
Referrals

Check Around...

- This is a specialty area for all disciplines (ENT, surgery and speech path)
- **Refer to a craniofacial team**
- Check with American Cleft Palate-Craniofacial Association (ACPA) for professionals with experience in this area (http://www.acpa-cpf.org/)

Resources

- Kummer, AW. (2011). Disorders of resonance and airflow secondary to cleft palate and/or velopharyngeal dysfunction. *Seminars in Speech and Language*, 32(2), 141-149.
Thanks for your interest!