

This is the html version of the

file <http://www.mc.vanderbilt.edu/documents/billwilkerson/files/Speech%20Assessment%20and%20Nasopharyngoscopy%20HO%2011%2007%2011.pdf>.

Google automatically generates html versions of documents as we crawl the web.

Page 1

Speech Assessment of Abnormal Resonance and Velopharyngeal Dysfunction

Ann W. Kummer, PhD
Cincinnati Children's
Hospital Medical Center

Page 2

➤ Effects of Cleft Palate
and VPI
on Speech and Resonance

1. Abnormal resonance (sound)
 2. Nasal air emission (airflow and air pressure)
 3. Dysphonia
-

Page 3

What is resonance for speech?

- Modification of the sound that is generated from the vocal cords
 - Provides the *quality* of perceived sound during speech
-

Page 4

What determines resonance

for speech?

- Size and shape of the **resonating cavities**
 - pharyngeal cavity
 - oral cavity
 - nasal cavity
 - Function of the **velopharyngeal valve**
-

Page 5

Size and Shape of Cavities

Resonance for speech is affected by the following:

- Length and volume of pharynx
 - Size and shape of oral cavity
 - Configuration of nasal cavity
-

Size and Shape of Cavities

- Shorter/smaller cavities: enhance higher formants
 - Longer/larger cavities: enhance lower formants
-

Size and Shape of Cavities

- Differences between
 - children and adults
 - men and women
 - tall people and short people
- Makes voice quality unique to individual

Resonance and Vowels

- Vowels are resonance sounds
 - They are produced by changing the size and shape of the oral (resonating) cavity
-

➤ NORMAL VELOPHARYNGEAL FUNCTION

Structures Active in VP Closure

- Velum (Soft Palate)

- Lateral Pharyngeal Walls (LPWs)
 - Posterior Pharyngeal Wall (PPW)
-

Page 11

Velum: Rest

Page 12

Velum (Soft Palate)

- Moves in a superior and posterior direction
 - Has a type of “knee” action
 - Moves toward the posterior pharyngeal wall
-

Page 13

Velum: During Speech

Physics and Flow

- Water (and air) flow in a forward direction until something stops it
 - An obstructing object will redirect the flow
-

Velopharyngeal Valve and Flow

- Due to the physics of airflow, even a small opening will be symptomatic for speech.
-

Lateral Pharyngeal Walls (LPWs)

- Move medially to close against the velum or in some cases, behind the velum

Page 17

Posterior Pharyngeal Wall (PPW)

- Moves anteriorly toward the velum
- In some speakers, there's a bulge called a Passavant's ridge

Page 18

Passavant's Ridge

Page 19

VP Valve during Speech

- Velopharyngeal valve is closed for oral sounds
 - Most consonants (air pressure sounds)
 - All vowels (resonance sounds)
- Velopharyngeal valve is open for nasal sounds (m, n, ng)

Page 20

Purpose of VP Valve

- Directs transmission of sound energy and air flow in the oral and nasal cavities during speech

Page 21

Normal Velopharyngeal Function

Learning (Articulation)

Physiology (Movement)

Anatomy (Structure)

Page 22

➤ VELOPHARYNGEAL DYSFUNCTION

**Articulation/Speech Learning
(Velopharyngeal Mislearning)**

**Physiology
(Velopharyngeal Incompetence)**

**Anatomy
(Velopharyngeal Insufficiency)**

Page 23

VP Insufficiency

- History of cleft

- Submucous cleft palate (overt or occult)
 - Short velum or deep pharynx (cranial base anomalies)
 - Irregular adenoids
 - Enlarged tonsils
-

VP Insufficiency Following Surgery or Treatment

- Adenoidectomy
 - Maxillary advancement
 - Treatment of nasopharyngeal tumors
-

Causes of VP

Incompetence

- Velopharyngeal hypotonia, paralysis or paresis
- Neurological injury (i.e., TBI) or dysfunction (i.e., neuromuscular disorders)
 - Occurs as a characteristic of **dysarthria**
 - Velopharyngeal incoordination can occur with **apraxia of speech**

Page 26

Velopharyngeal

Mislearning

Causes:

- **Hearing Loss/Deafness**

- **Secondary to VPI:** Learned compensatory productions secondary to VPI
 - **Mislearning:** Misarticulations that cause nasal emission unrelated to a VPI
-

Page 27

➤ Abnormal

Resonance

- Hypernasality
 - Hyponasality (denasality)
 - Cul de sac resonance
 - Mixed resonance
-

Page 28

Hypernasality

- Too much sound resonating in the nasal cavity
 - Usually due to VPI or fistula
 - Most perceptible on vowels
-

Page 29

Hypernasality

- Voiced oral consonants become nasalized (m/b, n/d, etc.)
 - Obligatory distortion
 - Other consonants may be substituted by nasals
 - Compensatory production
-

Page 30

Hyponasality

- Not enough nasal resonance on nasal sounds

(m, n, ng)

- Due to nasal obstruction
- Nasal phonemes sound similar to oral cognates

(b/m, d/n, g/ng)

- Also noticeable on vowels

Page 31

Cul de Sac Resonance

- Sound resonates in a cavity (oral, pharyngeal or nasal), but cannot get out
- Due to blockage in the vocal tract

Page 32

Cul de Sac Resonance

- Voice sounds muffled and low in volume
- Sound is absorbed (like a sponge) in the

Cul de Sac Resonance

Types and Causes

- **Oral** cul de sac resonance
 - **Nasal** cul de sac resonance
 - **Pharyngeal** cul de sac resonance
-

Oral

Cul de Sac Resonance

- Sound stays in the oral cavity
- Due to small oral cavity size or small mouth

opening (microstomia)

- Parents describe speech as “mumbling” (which

is not opening the mouth very much)

- Speech is low in volume and sounds muffled

Nasal

Cul de Sac Resonance

- Sound is mostly in the nasal cavity
 - Due to VPI and nasal obstruction from:
 - a deviated septum
 - stenotic nares
 - maxillary retrusion
 - Common with cleft palate and craniofacial anomalies
-

Pharyngeal Cul de Sac Resonance

- Sound stays in the pharynx
 - Common in patients with very large tonsils
-

Pharyngeal Cul de Sac Resonance

- Has been called “potato-in-the-mouth”
speech

- Enlarged tonsils are the “potatoes”
-

Enlarged Tonsils

- Tonsils block sound transmission to oral cavity

Page 39

Nasal Air Emission

- Occurs with or without hypernasality
- *Air* leaks through the valve
- Occurs on high pressure consonants, particularly *voiceless consonants*

Page 40

Types of Nasal Emission

- Large opening
- Small opening
 - Nasal rustle (turbulence)

Page 41

Nasal Emission with Large Opening

- No impedance to airflow
- Soft, low intensity sound
- Affects articulation and utterance length

Page 42

Nasal Emission with Large Opening

Can also cause:

- Weak or omitted consonants
- Short utterance length
- Occasionally a nasal grimace
- Compensatory articulation productions

Page 43

Compensatory Productions for VPI or Fistula

- Manner of production is maintained
- Placement is in pharynx to take advantage of air pressure
- VP valve will be open, so there will be nasal emission

Page 44

Compensatory Productions for VPI

Plosives (Stops)

- **Pharyngeal plosives**

- **Glottal** stops

Fricatives

- **Pharyngeal** fricatives
- Posterior **nasal** fricatives
- **Glottal** fricative (/h/)
- **Nasal** sniff

Page 45

3. Dysphonia

- Hoarseness
- Breathiness
- Abnormal pitch

Page 46

Dysphonia

- Vocal cord nodules due to strain in the vocal tract with VPI
- Laryngeal anomalies with craniofacial syndromes
- Compensatory strategy

– Breathiness and low volume
mask hypernasality and nasal
emission

Page 47

➤ PERCEPTUAL EVALUATION

Page 48

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

Page 49

When?

Page 50

Evaluation of VP Function

- Child needs:
 - Connected speech
 - Ability to cooperate for stimulability testing
- and instrumental assessment
 - Big enough for a good airway
 - 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

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 to compensate for

abnormal structure

- Glottal stops
- Pharyngeal plosives

- Pharyngeal fricatives

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

Page 57

Nasal Emission

- Characteristics of a large gap versus small gap
-

Page 58

Nasal Emission- Large Gap

- Nasal emission 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 (turbulence) 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)

Page 61

Resonance

Need to determine the type:

- normal resonance
 - right balance of oral and nasal resonance
- hypernasality
- hyponasality
- cul de sac resonance
- mixed resonance

Page 62

Resonance Severity

Rating scales:

- Seven point scale
- Normal, mild, moderate, severe
- Present or absent

Page 63

Phonation

Evaluate for signs of dysphonia:

- Hoarseness
- Breathiness
- Low or high pitch
- Low intensity

Page 64

How?

Page 65

Speech Samples

- Single word articulation test
- NOT good!!!

Page 66

Speech Samples

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

Page 67

Repetition of Single Sounds

- Oral sound to test

hypernasality:

– vowels, particularly /ah/ and /eee/

- Oral sounds to test nasal

emission:

– prolonged /s/

- Nasal sound to test

hyponasality:

– prolonged /m/

Repetition of Syllables

- pa, pa, pa, pa...

pi, pi, pi, pi...

- ta, ta, ta, ta...

ti, ti, ti, ti...

- ka, ka, ka, ka...

ki, ki, ki, ki...

- sa, sa, sa, sa... si, si, si, si...
- sha, sha, sha, sha... shi, shi, shi, shi...

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

Page 69

Repetition of Syllables

- ma, ma, ma, ma... mi, mi, mi, mi...
- na, na, na, na... ni, ni, ni, ni...

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

Page 70

Counting

- Count from 60 to 70

- Repeat 60 or 66 over and over

66 = SIKSTY SIKS

- Good combination of plosives and fricatives in blends

To test nasal emission:

Page 71

Counting

- Count from 90 to 99
- Repeat 99 over and over

To test hyponasality:

Page 72

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?
 - Stimulability is a good prognostic indicator for improvement or correction with therapy
-

For non-compliant children...

Page 75

Either/Or Questions

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?
-

Page 76

Key to Perceptual Assessment

Listen very carefully!!!

Low-Tech/ “No-Tech” Procedures

Use same type of speech samples

»See

»Feel

»Hear

See: Mirror Test

See: Air Paddle

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 oral sounds

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
-

Page 89

Intra-Oral Evaluation

- 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
-

Page 90

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 and posterior sounds

Intra-Oral Evaluation

- Need to see to the tip of the uvula
- Avoid using a tongue blade

Say “aaaah” as in “bat”
and
protrude the tongue

Page 94

Aaaah

Page 95

Submucous Cleft

Page 96

Submucous Cleft

Page 97

Tonsils

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

Page 98

Uvula

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

Page 99

Enlarged Tonsils

- Can extend into pharynx, interfering with LPW and velar movement or preventing a tight VP seal

Page 100

Nasopharyngoscopy of Tonsil

Page 101

Velar Paralysis or Paresis

- Affected side of velum droops, causing a lateral VP gap
- Uvula points to unaffected side

Page 102

➤ INSTRUMENTAL EVALUATION

Page 103

Instrumental Evaluation of VP Function

- Direct Procedures
 - You can see it, but you can't quantify it.
 - Videofluoroscopy and nasopharyngoscopy

- Indirect Procedures
 - You can quantify it, but you can't see it
 - Aerodynamics (pressure-flow) and nasometry
-

Page 104

Direct Measures

- Most important for surgical planning
 - Allow you to determine location
 - You need to find the hole so you can fill it!
 - Can estimate quantity (severity or size), but it's not very important preoperatively
-

Page 105

Indirect Measures

- Indirect measures are important for *objective*

quantification of postoperative results

– Need to do both pre- and postoperatively

- Need objective measures to

determine and

compare surgical outcomes

Page 106

Nasometry (KayPentax)

- Analyzes **acoustic energy** from oral and nasal cavities

- Gives an **objective nasalance score**

Page 107

Basic Equipment

- Headset

- Nasometer box

- Host computer

Page 108

Headset

- Sound separator plate fits on upper lip
- Uses 2 microphones separated by the plate
 - top mic measures nasal acoustic output
 - bottom mic measures oral acoustic output

Page 109

Measured Value called “Nasalance”

- Computes a percentage of nasal acoustic energy in speech

Nasal Acoustic Energy

Total (nasal + oral) Acoustic Energy

Standardized Passages

- Nasalance score can be compared to normative data
- Zoo Passage and Nasal Passage- for adults
- SNAP Test- for kids

The MacKay-Kummer SNAP Test- R Simplified Nasometric Assessment Procedures Revised 2005

Name:

Date:

Age:

Examiner :

Syllable Repetition/Prolonged Sounds Subtest

Instructions: Repeat or prolong until the screen is full.

Oral + /a/ Syllables

Norms

S.D.

Score (Threshold: ≥ 15)

pa, pa, pa...

6

3

ta, ta, ta...

7

4

ka, ka, ka...

7

4

sa, sa, sa...

7

5

fa, fa, fa...

7

4

Oral + /i/ Syllables

Norms

S.D.

Score (Threshold: ≥ 35)

pi, pi, pi...

17

7

ti, ti, ti...

17

7
ki, ki, ki...
18
8
si, si, si...
17
8
fi, fi, fi...
16
8
Nasal+ /a/ Syllables
Norms
S.D.
Score (Threshold: ≤40)
ma, ma, ma...
53
13
na, na, na...
53
11
Nasal+ /i/ Syllables
Norms
S.D.
Score (Threshold: ≤60)
mi, mi, mi...
72
13
ni, ni, ni...
74
11
Prolonged Sounds
Norms
S.D.
Score (Threshold: +/-2 SDs)
Prolonged / a/
6
3
Prolonged / i/
19
9
Prolonged / s/
0
0
Prolonged / m/
93
3

SNAP Test: Sibilants Passage

Normal Speech

SNAP Test: Sibilants Passage

Nasal Rustle

SNAP Test: Suzy Passage

Nasal Rustle

SNAP Test: Velars Passage

Nasal Rustle

SNAP Test: Syllable Repetition

Nasal Emission

SNAP Test: Zoo Passage

Nasal Emission, Hypernasality, Glottal Stops

SNAP Test: Sibilants Passage

Hypernasality and Nasal Emission

Page 119

SNAP Test: Nasal Passage Hyponasality

Page 120

SNAP Test: Nasal Passage Cul de Sac/Hyponasality

Page 121

Nasopharyngoscopy

- Allows direct observation of VP structures and function during speech
 - Important for treatment planning
-

Page 122

Nasopharyngoscopy

- A rose by any other name...
- AKA nasendoscopy or video nasendoscopy
- CPT Code 92511 is
“nasopharyngoscopy”

“Use CPT code 92511 for a diagnostic nasopharyngoscopy with an endoscope,

which views the surface area extending from the posterior edge of the soft palate

to the nasopharyngeal wall, including the Eustachian tube openings.”

From: Coding tip: Learn the difference between nasopharyngoscopy and endoscopy procedures, *Ambulatory Surgery Reimbursement Update*, January 22, 2008.

Nasopharyngoscopy:

To view nasal surface of velum

Can show:

- Evidence of a submucous cleft
- Absent or dysplastic musculus uvulae
- Concavity or notch in velum

Nasal Surface of Velum

Submucous Cleft

Page 125

Nasopharyngoscopy:

To view nasal surface of hard palate

Can show:

- Size and effect of a fistula
-

Page 126

Nasopharyngoscopy:

To view PPW and pharynx

Can show:

- Adenoids or effect of adenoidectomy
- Passavant's ridge
- Medialized internal carotids based on pulsations

- Tonsils in pharynx

Page 127

Passavant's Ridge

Page 128

Irregular Adenoids

Protrusion and Indentation

Page 129

Nasopharyngoscopy of Tonsil

Page 130

Nasopharyngoscopy:

To view vocal folds

Can show:

- Thickening or edema on cords

- Paralysis or paresis of cords
 - Use of ventricular phonation
 - Presence of vocal nodules
 - Other pathologies
-

Page 131

Nasopharyngoscopy:

For surgical planning

Can show:

- Probable cause
 - i.e., irregular adenoids versus a velar defect
- Movement and closure during speech
- Size and shape of the gap
- LOCATION, LOCATION, LOCATION

Page 132

Small Circular Gap in Midline

Page 133

Medium Size Opening in Midline

Page 134

Small Lateral Gap

Page 135

Bowtie Closure

Page 136

Bowtie Closure

Page 137

Narrow Coronal Gap

Coronal Gap with Touch Closure in Midline

Nasopharyngoscopy:

Following surgery
Can show:

- Retropharyngeal implant
 - Pharyngeal flap and lateral ports
 - Sphincter pharyngoplasty
 - Effect of adenoidectomy
-

Pharyngeal Flap and Right Port

Page 141

Preparation before Appointment

- Patient receives coloring book
 - Explains what to expect in pictures and activities
 - Has practice sentences and sounds
- Parents receive information

Page 142

Preparation of the Nasal Cavity

- Child blows his nose to eliminate secretions
 - Avoids need for nasal suction in many cases
-

Preparation of the Nasal Cavity

- Nasal spray (neosynephrine and zylocaine)
 - Two puffs per nostril
 - Patient sniffs
 - Child or parent can help
-

Preparation of the Patient

We ask the child...

- Do you ever pick your nose?

We have a little nose picker.

Page 145

Preparation of the Patient

We are going to be looking for boogers.....

Page 146

Preparation of Patient

- Explain the “tight spot” (where the scope goes through the choana)
 - Demonstrate this with his/her hand
 - May make him/her sneeze
-

Page 147

Preparation: How many hands?

- For older patients (age 5 and up), one person is fine
 - For some (not all) younger patients (ages 3-5):
 1. Lap holder
 2. Head holder at times
 3. Scope holder/operator- “bad guy”
 4. Behavior/speech elicitor- “good guy”
-

Page 148

Position of the Patient

- Put child on parent's lap
- Parent “hugs” the child around arms and holds his hands
- If necessary, parent puts leg over child's legs,

Page 149

Select the Scope

- Consider using a small one (2mm rather than 3 mm)
- “Slime” the end with zylocaine gel
- We call it “donated snot”

Page 150

Nasopharyngoscopy

Procedure

- Put scope in largest nostril (usually non-cleft side)
- Go through the middle meatus
- The scope will go up over turbinate and then down

Page 151

Nasopharyngoscopy

Procedure

- Make sure scope goes down to a vertical position, above port

Page 152

Easy

Hard

If the child cries...

- One person does the talking
 - Need to talk softly and calmly
 - Everybody else in the room needs to be quiet
-

If the child cries...

- Ask the child to open his eyes and look at you.
 - Have pictures for the child to see to cue the speech
 - Bargain on what the child has to say to take it out
-

If the child cries...

- Worst case scenario: Have the child say something like...
 - “Stop it, stop it, stop it.”
 - “Get this stinking scope out of my nose!”

Page 157

Nasopharyngoscopy

- It's not hard for the examiner
- It's not really very hard for the patient...

Page 158

Nasopharyngoscopy vs. Videofluoroscopy

- Done without radiation

- Better tolerated by even young patients (barium is noxious!)
- Much better resolution
- Can see entire port in one view
- No false negatives (head rotation)
- Can see even small gaps

Page 159

Why?

Page 160

Velopharyngeal Insufficiency

(structural abnormality)

- Surgery (speech therapy postoperatively)
- Prosthetics- speech bulb (if surgery is not an option)

- Speech therapy AFTER the structure has been corrected

Note: Speech therapy CANNOT change abnormal structure!

Page 161

Velopharyngeal Incompetence (neurophysiological cause)

- Surgery (speech therapy postoperatively)
- Prosthetics- palatal lift
- Speech therapy

Page 162

Velopharyngeal Mislearning

- Speech therapy only
-

Page 163

Goal of Treatment

- Normal speech and resonance
 - No evidence of “nasality”
 - Merely “acceptable speech” is just not acceptable!
-

Page 164

Thank you for your
attention!