**DEFINITIONS/TERMINOLOGY**

**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

- **Superior Pharyngeal Constrictor**
  - Responsible for the medial displacement of the lateral pharyngeal walls
  - Narrows the VP port

**Evaluation and Treatment of Velopharyngeal (VP) Function**

- Successful evaluation and treatment requires:
  - A general knowledge of terminology and definitions
  - Familiarity with team care
  - Specifics with regards to evaluating “cleft palate speech”
  - Unique considerations for treatment

**Velopharyngeal Function**

- “Velo” = velum = soft palate
- “Pharyngeal” = pharynx = throat
- The interaction of the muscles of the soft palate and throat to separate the oral and nasal cavity

**Velopharyngeal Function**

- **Musculus Uvulae**
  - Creates a bulge on the nasal surface of the velum to extend and contact the posterior pharyngeal wall

- **Palatopharyngeus**
  - Sphincteric action to pull the lateral pharyngeal walls medially

- **Palatoglossus**
  - Acts against the levator to depress the velum
  - Responsible for the rapid downward movement of the velum during speech

**Velopharyngeal Dysfunction: Practical Suggestions for Assessment and Treatment**

Angela J. Dixon, MA, CCC-SLP
ISHA Convention
April 5, 2013
<table>
<thead>
<tr>
<th>Velopharyngeal Function</th>
<th>Velopharyngeal Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motor Innervation</strong></td>
<td><strong>Velum is at rest and low while breathing</strong></td>
</tr>
<tr>
<td>– Uvular muscles innervated by fibers from the trigeminal nerve and accessory nerve</td>
<td>– Velum is elevated and stretched during speech production of oral sounds</td>
</tr>
<tr>
<td>– Other palate and pharyngeal muscles are innervated by the branches of the glossopharyngeus, vagus, and accessory nerves</td>
<td>– Velum is pulled down during production of nasal sounds</td>
</tr>
<tr>
<td>– Some thoughts that the facial nerve provides “fine tuning” of the palate during speech</td>
<td>– VP function differs for speech and non-speech activities</td>
</tr>
<tr>
<td><strong>Sensory Innervation</strong></td>
<td><strong>Sensory Innervation</strong></td>
</tr>
<tr>
<td>– Vagus nerve provides sensory innervation to the pharynx and soft palate</td>
<td>– Vagus nerve provides sensory innervation to the pharynx and soft palate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Velopharyngeal Function</th>
<th>Velopharyngeal Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Velopharyngeal Dysfunction</strong></td>
<td><strong>Resonance</strong></td>
</tr>
<tr>
<td>– The velopharyngeal valve does not adequately close during speech</td>
<td>– Refers to the acoustic phenomenon that occurs when sound vibrates in the nasal or oral cavity</td>
</tr>
<tr>
<td>– <em>Velopharyngeal Incompetence</em> = adequate structure, but inadequate function</td>
<td>– Judged on a continuum</td>
</tr>
<tr>
<td>– <em>Velopharyngeal Insufficiency</em> = inadequate structure</td>
<td><strong>Hypernasality</strong></td>
</tr>
<tr>
<td>– <em>Velopharyngeal Mislearning</em> = inadequate closure due to faulty learning</td>
<td>– Too much resonance in the nasal cavity, occurs when the oral and nasal cavities are abnormally coupled</td>
</tr>
<tr>
<td></td>
<td>– Noted on voiced sounds</td>
</tr>
<tr>
<td></td>
<td><strong>Hyponasality</strong></td>
</tr>
<tr>
<td></td>
<td>– Too little resonance in the nasal cavity, occurs typically due to a blockage in the nasal cavity</td>
</tr>
<tr>
<td></td>
<td>– Most noted on nasal sounds</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Velopharyngeal Function</th>
<th>Velopharyngeal Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Audible Nasal Air Emission</strong></td>
<td><strong>OVERVIEW OF TEAM CARE</strong></td>
</tr>
<tr>
<td>– The presence of abnormal airflow in the nasal cavity</td>
<td></td>
</tr>
</tbody>
</table>
Team Care

- “the impact of craniofacial birth defects must be viewed in terms of the aggregate effect rather than the impact of any single entity”
- “Management of patients with craniofacial anomalies is best provided by an interdisciplinary team of specialists.”

Parameters of Evaluation and Treatment of Patients with Cleft Lip/Palate or other Craniofacial Anomalies, ACPA, November 2007

Team Care

- Audiologist
- Genetics
- Nursing
- Oral and Maxillofacial Surgeon
- Orthodontist
- Otolaryngologist
- Pediatric Dentist
- Plastic Surgeon
- Psychologist
- Social Worker
- Speech-Language Pathologist

Team Care

- Why refer to a team?
  - Evaluation of the whole child
  - Evaluations completed in fewer visits with less cost
  - Better follow-up
  - Coordinated care/long term plans
  - Research shows that the most important variable in outcomes for individuals with clefts is the volume of patients treated

Team Care

- American Cleft Palate-Craniofacial Association (ACPA)
  - www.acpa-cpf.org
- Cleft Palate Foundation
  - www.cleftline.org
  - 800-24-CLEFT

Assessment

- Leave your assumptions at the door
- Goal is to determine:
  - What is the child doing now?
  - What is the child capable of doing?
  - When should I refer for further investigation?

SPEECH ASSESSMENT
Assessment

- Medical history
- Language Screen
- Articulation Assessment
- Resonance Assessment
- Oral Mechanism Examination
- Instrumental Assessment as needed

Assessment: Medical History

- Medical diagnoses (related and unrelated to speech)
- Feeding history
- Breathing issues
- Presence of ear infections
- Motor development
- Surgical history
- Speech therapy

Assessment: Language Screen

- At risk for problems due to hearing impairments, hospitalizations during years of critical language development, less language stimulation, etc.
- Can be overlooked when “speech” is the main focus
- Children with cleft palate tend to perform less well on tests of cognition

Assessment: Articulation

- Goal is to differentiate between developmental, obligatory, and compensatory errors
- Standardized assessment
- Structured tasks
  - CV utterances, words, sentences in imitation
  - Rote speech
- Conversational speech sample

Assessment: Articulation

- Classify errors as “typical” or “atypical”
- “Typical” errors
  - Are they age-appropriate?
- “Atypical” errors
  - Note placement
  - Note airflow
    - Is it deviant? Where is the deviance?
  - Look for patterns
  - Attempt to determine cause [VP mislearning, VP structure problem, occlusion, etc.]

Assessment: Articulation

- Compensatory Articulation Errors
  - Learned articulations errors
  - Develop secondary to an inability to generate oral pressure for normal articulation
  - May continue to be used once velopharyngeal port has been adequately repaired
Assessment: Articulation

- Compensatory Articulation Errors
  - Glottal stops
    - Stop consonant made at the glottis
  - Pharyngeal Stop
    - Lingual base contacts PPW, typically used for /k/ and /g/
  - Pharyngeal Fricatives
    - Fricative constriction between the lingual base and the PPW

- 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

Assessment: Articulation

- Weak oral consonants
  - High pressure consonants are produced with weak pressure
  - Is the pattern consistent/pervasive?
  - Does nasal occlusion help?
    - “Yes” = suspect a physically based VP problem

Assessment: Articulation

- Abnormal air emission
  - Is it present? Where is it coming from?
  - Oral distortions
    - Look at the teeth
    - 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

Assessment: VP Function

- Nasal air emission
  - Look for inaudible nasal air emission
    - Straw, mirror, nasal grimace
  - Sample multiple contexts
    - Imitation, rote speech tasks, conversational speech
    - High pressure phonemes or sentences
      - “Pick up the puppy,” “Buy baby a bib,” “Do it for dad today.” “Sally has scissors.”
    - Counting from 60-70 (high number of sibilants)
    - Counting from 70-80 (tensing due to nasal-alveolar plosive combo)
  - What is the pattern?
    - “Consistent” = More concerning for a physical based VP problem
    - “Inconsistent”
      - Is it phoneme specific? Does it occur on a certain class of sounds?
      - Most likely a learned error, though a physical problem could be present in some cases
Assessment: VP Function

- Resonance Assessment
  - Hypernasality
  - Hyponasality
  - Cul-de-sac resonance
  - Mixed resonance
- Perceptual assessment is still considered gold standard
- An increase in articulation errors is related to an increase in severity of nasality judgments

Assessment: VP Function

- 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 speech
    - Look for context (assimilation nasality, high vowels)
    - Continuum of acceptability

Assessment: VP Function

- Resonance: HYPOnasality or cul-de-sac
  - Note if either are present or absent
  - “Present” = May suggest presence of obstruction
    - large adenoid, obstructive pharyngeal flap, intranasal airway obstruction, etc.
  - Note the severity

Assessment: Oral Mechanism Exam

- Complete after your speech assessment
  - Face, Nose, Lips
  - Dentition
    - Missing teeth, extra teeth
    - Occlusal status
  - Presence of appliances
- Tongue
  - Size, ankyloglossia

Assessment: Oral Mechanism Exam

- 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
Assessment: Instrumental

• Computerized Instrumental Assessment
  – Aerodynamic measurements
    • Pressure flow studies estimating the sectional area of the VP orifice
  – Nasometry
    • Measures “nasalance,” a ratio of acoustic energy derived from the speaker’s oral and nasal cavities
    • Does not measure hypernasality
    • Provides a numeric output

• 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

Assessment: Instrumental

• 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

Treatment: Medical Intervention

• If VPI impacts speech and is due to a structural cause, medical intervention is typically warranted
• Surgical Intervention
  – Z-plasty, or Pharyngeal wall augmentation
  – Pharyngeal Flap
  – Sphincter pharyngoplasty
• Prosthodontic Intervention
  – Palatal Lift
  – Obturator

TREATMENT

Treatment: Early Intervention

• Early Vocal Development
  – 0-4 months: earliest sounds are typically nasalized vowels and sounds produced in the back of the throat
  – After 4 months: baby is able to produce more typical vowel and consonant sounds, babbling emerges and expands
Treatment: Early Intervention

- Impact of cleft palate on early development
  - Inability to build up intra-oral air pressure
  - May result in nasalized productions
  - Ear infections
  - Babies with clefts tend to produce fewer total consonants, fewer number of consonants, and fewer multi-syllabic productions
  - Babies with clefts can be at a disadvantage for early word learning
  - Babies with clefts may hang on to use of glottal stops
  - VPI can affect speech by the presence of resonance disorders, nasal emission, and articulation errors

- GOALS
  - Provide lots of parent education
  - Increase the consonant inventory
  - Increase vocabulary
  - Increase oral airflow awareness
  - Almost 80% of patients have competent VP function after palate repair

- Parent Education
  - Parents are going to teach speech and language, whether or not they are aware they are doing it
  - Should be educated on normal language developmental milestones and how to provide language stimulation
  - Parents need to understand early that the goal is for normal speech and language, as well as their role in achieving that goal

- Increase Consonant Inventory
  - Before palate repair, work with sounds that are least affected by the cleft (nasals, glides)
  - Teach parents to ignore nasal emission that may occur with stop consonants
  - Ignore and model a more desired vocalization when "growls" or glottal stops are vocalized
  - Compensatory error patterns can sound more appealing and be unknowingly reinforced

- Increase Vocabulary
  - Combine expanding phonemic inventory with vocabulary goals
  - Words should be functional and meet a broad range of communicative purposes
    - Names for toys, people, clothes, food, etc.
    - Attributes, possession, actions, etc.
  - Follow typical models
Treatment: Early Intervention

- Increase Vocabulary
  - In intervention, target simple syllable structure (CV, CVC, CVCV) and consonants in the child's inventory
  - Kids may pick up words quicker if they consist of phonemes already in their inventory, but have been shown to learn a variety of new phonemes by working on novel words
  - Be sure to teach the parents how to continue outside of “therapy”

Treatment: Early Intervention

- Increase Oral Airflow Awareness
  - Use nasal occlusion as necessary
  - Simple blowing activities against light resistance may be beneficial at teaching oral airflow
  - It is important to understand the use for these techniques and to follow up with a sound production activity
  - Toys are not appropriate to “exercise” or strengthen the palate musculature

Treatment: Preschool/School Aged Therapy

- **GOALS**
  - Continue to focus on correct placement for articulation and language skills as needed
  - Reduce/camouflage mild hypernasality
  - Eliminate phoneme-specific nasal emission
  - Eliminate any learned behaviors

Treatment: Preschool/School Aged Therapy

- Reduce/Camouflage mild hypernasality
  - Overarticulate, increasing mouth opening and physical effort
  - Reduce speech rate
  - Increase prosodic variation
  - Improve articulation skills
  - Provide feedback with Nasometer or straws

Treatment: Preschool/School Aged Therapy

- Eliminate learned behaviors or compensatory articulation patterns
  - Educate the child and the parent so they understand the problem
  - Move quickly from nonsense syllable to meaningful open syllables (CV) and monosyllabic words (CVC)
  - Progression = /h/, vowels, /m/, /p/, /b/, tongue tip stops, velar stops, labiodental fricatives, interdental fricatives, lingua-alveolar sibilants, lingua-palatal fricatives, affricates
Treatment: Preschool/School Aged Therapy

- Eliminate learned patterns (continued)
  - Glottal stops
    - Incorporate an /h/ or a whisper
  - Posterior nasal fricatives or Pharyngeal Fricatives
    - Work from a /t/ to an /s/ (/t/ /t/ /tssssss/)
    - Retract tongue from a /th/ to an /s/; retract further for an /sh/; stop and release from an /sh/ to a /ch/

“Care should be coordinated by the team but should be provided at the local level whenever possible:…”

Non-speech Oral Motor Exercises

- Felt to be inappropriate with this population
  - The majority of children with cleft palate do not have an underlying neuromotor problem
- Research dating back to the 1950’s show that
  - Even if increased palate ROM is achieved, it cannot overcome a large opening
  - Any gains in non-speech tasks do not generalize to speech tasks
- Speech therapy was just as effective without exercises
- The bulk of evidence looking at palatal muscle training is negative

Thank you for your time!

Angela J. Dixon, MA, CCC-SLP
adixon2@iuhealth.org
317-944-6698

REFERENCES