AMERICAN SPEECH-LANGUAGE-HEARING ASSOCIATION

SPECIAL INTEREST GROUP 5
Craniofacial and Velopharyngeal Disorders

EVALUATION OF SPEECH DISORDERS ASSOCIATED WITH CLEFT PALATE AND VELOPHARYNGEAL DYSFUNCTION

Handout to Accompany Poster
Developed by Special Interest Group 5 (2017)

Professional Development Committee:
Jamie Perry - Chair
Kazlin Mason, Kristen DeLuca, Sara Kinter,
Alison Scheer-Cohen, Lynn Marty Grames

Coordinating Committee:
Judith Trost-Cardamone - Chair
Scott Dailey, Anne Bedwinek, Kristina Wilson,
Ann-Mari Pierotti, Adriane Baylis

WHAT IS VELOPHARYNGEAL FUNCTION & DYSFUNCTION:

The velopharyngeal mechanism is a muscular valve that is made up of the soft palate (velum) and the lateral and posterior pharyngeal walls. Contraction of the muscles within these structures provide velopharyngeal closure that is needed for speech and swallowing. At rest the velum is maintained in a lowered position (Figure 1). When a speaker produces oral pressure consonants (e.g., /p, t, s/etc.), the velum elevates to create a tight seal to close off the nasal cavity above, thus directing airflow out of the mouth (Figure 2).

Velopharyngeal dysfunction (VPD) is failure of the velopharyngeal mechanism to achieve consistent and complete closure during oral speech tasks. If the velum does NOT elevate properly, hypernasality and/or nasal air emission can occur.

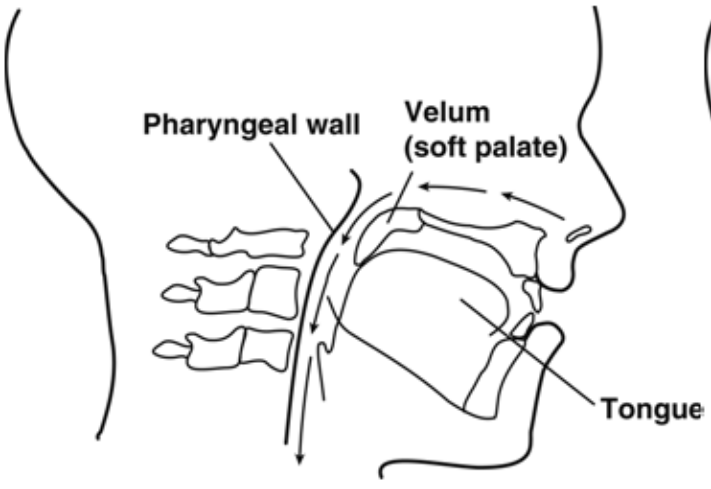


Figure 1. VP mechanism at rest and during breathing (nasal inhalation depicted in figure)

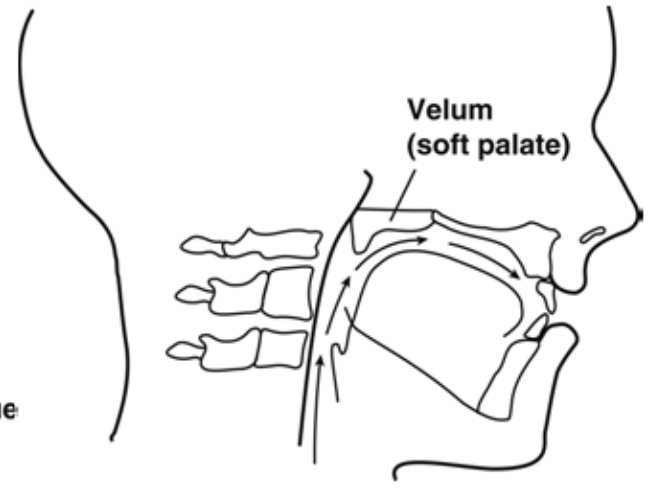
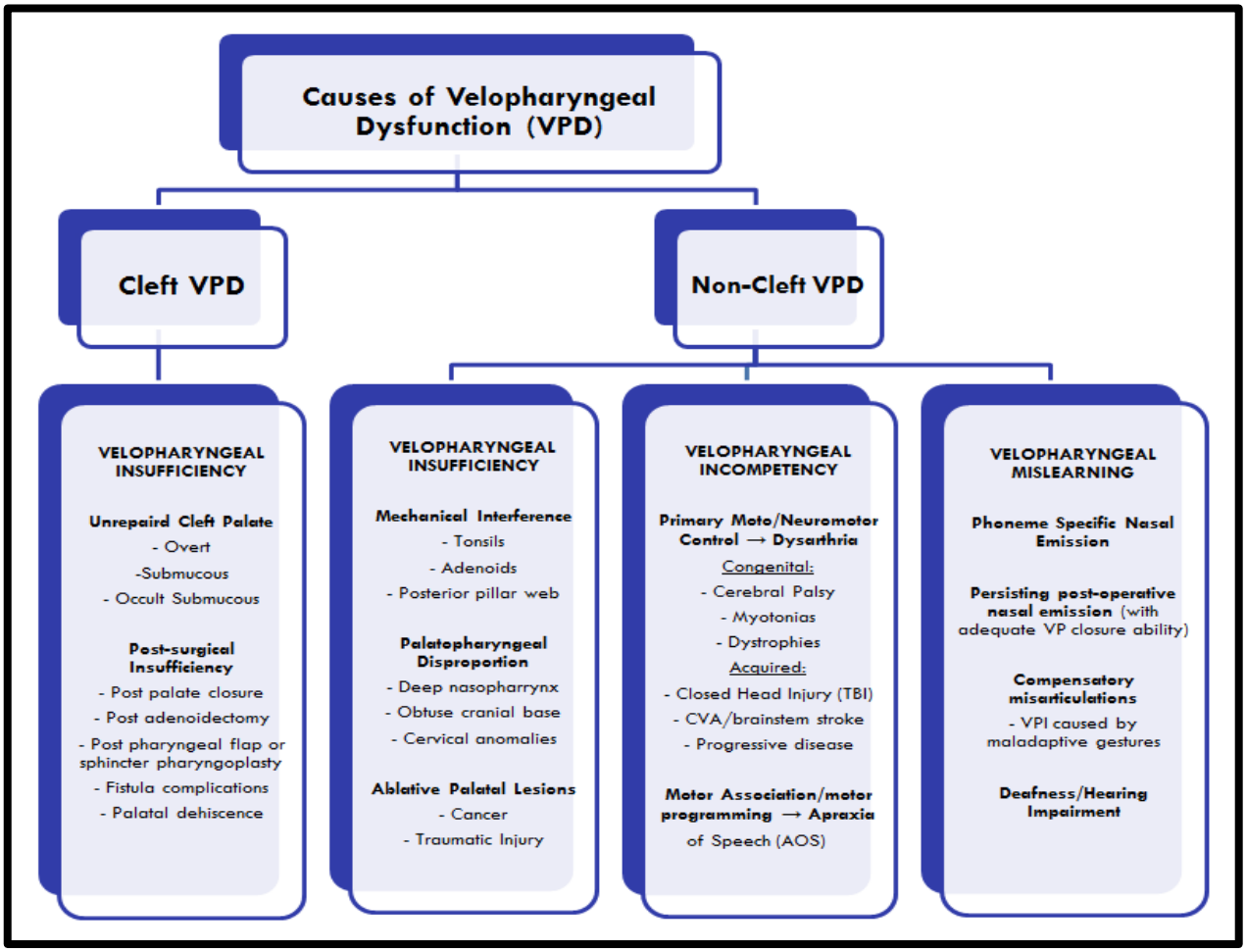


Figure 2. VP mechanism during normal oral speech production. (Kummer, 2008)

CATEGORIES AND CAUSES OF VELOPHARYNGEAL DYSFUNCTION:

1. **VP Insufficiency**: The palate is too short after palate repair surgery (insufficient tissue or due to scarring); congenitally short soft palate; submucous cleft palate; anterior orientation of the levator veli palatini muscle; deep pharynx; palate cannot reach posterior pharyngeal wall after maxillary advancement surgery; or, occasionally, or status post-adenoidectomy.
2. **VP Incompetency**: The VP mechanism does not function properly during speech due to paralysis, weakness, incoordination, or some type of neuromuscular disorder. Can co-occur with motor speech disorder (like Apraxia) which can impact other speech subsystems.
3. **VP Mislearning**: Phoneme-specific nasal air emission (e.g., nasal emission only on /s, z/) or other compensatory articulation errors negatively impact VP closure attempts. This type of VPD will only improve with speech therapy.



Flowchart from Peterson-Falzone et al., 2006

RESONANCE CHARACTERISTICS ASSOCIATED WITH VPD

Normal resonance is based on having an appropriate balance of sound in the oral and nasal cavities during speech. When there is an imbalance in resonance, this results in a **resonance disorder**. The following are features associated with resonance disorders. These features of a resonance disorders are obligatory and WILL NOT respond to therapeutic intervention. They most often require medical management.

Types of Resonance Qualities:

- **Hypernasality**: Excessive nasal resonance on vowels and voiced sounds; associated with VPD.
- **Hyponasality**: Too little nasal resonance on /m/, /n/, and /ŋ /. The patient may sound "stuffy."
- **Cul-De-Sac resonance**: A muffled quality resulting from blockage anterior to the VP mechanism.
- **Mixed resonance**: A combination of hyper- and hyponasality.

Obligatory Features

- **Audible or Inaudible nasal air emission**: Abnormal escape of airflow through the nose during speech, which can be secondary to an oronasal fistula or VPD.
- **Weak pressure consonants**: High pressure consonants have reduced intraoral pressure and intensity.

Compensatory Articulation Errors:

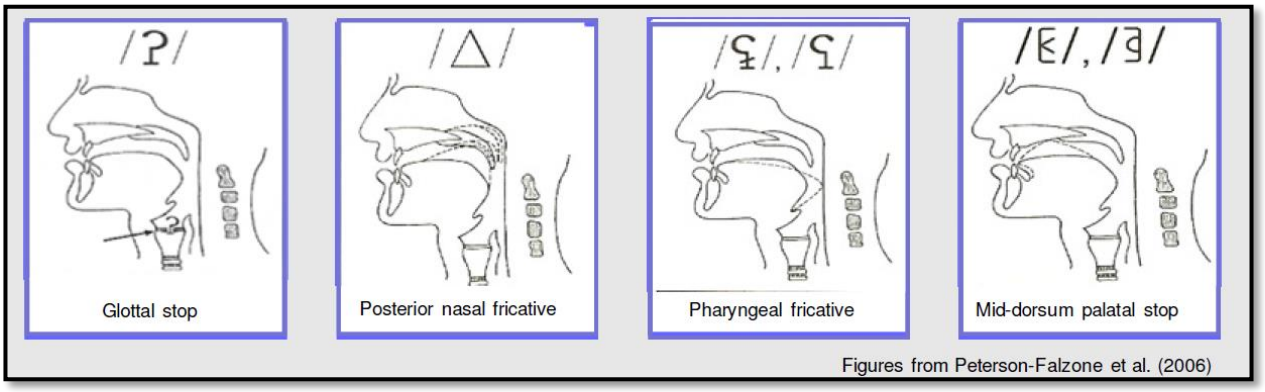
In general, compensatory errors involve moving the placement of articulation to a level along the vocal tract where pressure build-up can be accomplished. These are attempts by the speaker to create pressure consonants despite the loss of air pressure from velopharyngeal dysfunction. They are **learned placement errors** and can persist after surgery. These require **intensive speech therapy** for correction.

Other types of articulation or phonological errors may also be present, as well as distortions secondary to any malocclusion. Co-articulations or simultaneous production of a compensatory error and correct place of production can also occur; for example, a glottal stop plus bilabial placement simultaneously produced for a /b/.

Commonly Used Compensatory Maladaptive Articulation Errors:

1. **Glottal stops** /ʔ/ are generally substituted for oral stop consonants /p/, /b/, /t/, /d/, /k/, /ɡ/ and sometimes /h/ but also can replace fricatives and affricates. The place of articulation is the glottis, using vocal fold valving. Glottal stops can be co-produced with any oral placement, meaning the child postures the tongue or lips so that it looks like s/he is producing the consonant accurately, but simultaneously is producing (co-producing) the glottal stop. Listen closely and be careful not to reinforce co-productions because these contribute to decreased speech intelligibility and can slow therapy progress.
2. **Pharyngeal stops** are usually substituted for velar stops /k/ and /ɡ/. The place of articulation is the base of the tongue against the posterior pharyngeal wall.
3. **Pharyngeal fricatives** can be substituted for oral fricatives or affricates /f/, /s/, /ʃ, /ʧ, /ʤ/ and less often for stop/plosive consonants. The place of articulation is in the pharynx, with the base of tongue approximating the posterior pharyngeal wall.
4. **Mid-dorsum palatal stops** are substituted for tip-alveolar and back-velar stops. The sound is produced by the mid-dorsum of the tongue contacting the middle of the hard palate in the approximate place of /j/.
5. **Mid-dorsum palatal fricatives** are commonly substituted for blade alveolar fricatives /s/ and /z/ and may also replace /ʃ/. The tongue tip is dropped, tongue grooving is reduced and the mid-dorsum of the tongue approximates the mid-portion of the hard palate.
6. **Nasal fricatives** are commonly substituted for sibilant fricatives and fricatives or affricates /s/, /z/, /ʃ/, /ʧ/, /ʤ/ but may also replace other high pressure consonants such as /f/ and /p/. The nasal fricative is a voiceless nasal articulated with simultaneous exclusive audible nasal air emission. The VP port is open and airflow is intentionally sent into and through the nasal cavity. It can be articulated in any of the three oral placements for nasals: bilabial, alveolar or velar. So there is the bilabial nasal fricative, alveolar nasal fricative and velar nasal fricative. Nasal fricatives can also be produced with labio-dental placement (like /f/ or /v/). Any of these can be made with co-produced turbulence (snorting sound). Turbulent nasal fricatives are the result of a small velopharyngeal opening such that the VP port is the source of the turbulence. Non- turbulent nasal fricatives are made with a more widely open VP port.

Examples of articulatory placement and transcription symbols for common compensatory errors:



COMPONENTS OF THE EVALUATION

1. **Perceptual Judgments**: Uses perceptual scales to rate hypernasality, nasal emission, oral pressure, intelligibility, etc.
2. **Clinical Assessment of VP Function**: Uses low-tech tools to assess air escape and velopharyngeal closure (See-Scape, a straw, or Nasal Listener)
3. **Articulation Evaluation**: Uses spontaneous connected speech and a structured speech sample to identify & transcribe compensatory errors.
4. **Oral Exam**: Identify symmetry of palate elevation, placement of velar dimple, structure of palate and velum (check for presence of fistula, bifid uvula, submucous cleft, etc. and describe posterior nasal spine). Assess cranial nerves and dentition.
5. **Instrumentation**: Uses the Nasometer to quantify % of hyper or hypo nasality/nasalance. Pressure-flow assessment using the PERCI-SARS can also be completed.
6. **Imaging**: Uses nasendoscopy, cephalometric radiographs, fluoroscopy, and/or MRI to quantify and visualize velopharyngeal closure, size of velopharyngeal opening/nasopharynx, pattern of closure, consistency of velopharyngeal closure, and adenoid tissue.

Bottom Line:
No single measure provides all necessary information. Instrumentation and imaging selection should be problem driven. Refer to a craniofacial team for full evaluation of velopharyngeal function.

LOW-TECH/NO-TECH CLINICAL TOOLS

Below are common low-tech and no-tech tools that can assist in screening for nasal air escape which can be indicative of deficits in velopharyngeal closure. These are excellent tools to use for detection of inaudible nasal air escape. When using these tools, note if the nasal air escape is consistent or inconsistent.

1. **The See-Scape**
2. **Nasal Mirror**
3. **Straw/Tubing**
4. **Nasal/Oral Listener**

SPECIFIC EVALUATION TECHNIQUES

How to Assess Hyper- and Hypo Nasality

1. Assess vowels and voiced consonants at the word level and in connected speech.
2. To test hypernasality, use oral loaded sentences (no nasals; "Pick up a puppy;" "Buy baby a bib;" "Take teddy a toy;" etc). Compare nasality on high vowel (/i/) and low vowels (/ɑ /).
3. To test hyponasality, use nasal loaded sentences ("Mama made lemonade;" counting 90-99, etc).
4. The nasal pinching test can identify resonance imbalances. Plug and unplug the nose while the child sustains /i/. If a difference is noted on this sound, when the nose is plugged and unplugged, hypernasality may be present.
5. Use the Nasometer to quantify a nasalance percentage.

How to Assess Nasal Air Emission (Audible & Inaudible)

1. To test nasal air emission, use oral consonants (especially pressure consonants)
2. Prolongation of /s/
3. Nasal grimacing, if present, is indicative of nasal air emission.
4. The Nasal Mirror Fogging test can display nasal air emission.
5. See-Scape can be used to demonstrate inaudible nasal air emission.
6. Straw or tubing can also be utilized to amplify any nasal air escape.

Differentiating between Hard Palate Fistula or VPD as a cause of nasal air escape and/or hypernasality

1. Assess using the following loaded speech samples: "Take teddy a toy" and "Go get the egg."
2. If the fistula is symptomatic (depends on location) and there is VPD, both speech samples will demonstrate nasal air escape and/or hypernasality.
3. If a fistula is present in the hard palate and is the cause of nasal air escape/hypernasality (normal valving) the speech sample "Take teddy a toy" will have nasal air emission. The sample, "Go get the egg" may sound normal because valving for this phrase occurs behind the fistula. If a fistula is present anterior to the uvula, audible nasal air emission may be present on "Go get the egg."

Components of the Perceptual Assessment:

- ✓ Phonetic transcription of articulation errors
- ✓ Rating scales to quantify features such as hypernasality, audible nasal air emission and/or nasal turbulence, and intelligibility
- ✓ Qualitative descriptions
- ✓ Low-tech tools such as the See-Scape or a straw to identify inaudible nasal air escape

<u>Evaluate Resonance in:</u>

- ✓ Connected speech (spontaneous or reading)
- ✓ Use prolonged vowels
- ✓ Listen for Nasal Emission, Weak Consonants, Compensatory Errors

<u>Need to determine:</u>

- ✓ Type of resonance (normal oral resonance, hypernasality, hyponasality, cul-de-sac resonance or mixed resonance).
- ✓ Severity (mild, moderate or severe)
- ✓ Presence and type of nasal emission (unobstructed or obstructed)

- ✓ Consistency of nasal emission and whether it is phoneme-specific
- ✓ Effect on pressure consonants and utterance length

The following speech samples can be used:

- ✓ Articulation test or screening of consonants
- ✓ Repetition of pressure-sensitive phonemes (pa, pa, pa, etc.)
- ✓ Repetition of sentences loaded with pressure-sensitive phonemes
- ✓ Counting from 60-70; pa, pa, pa; baby (assesses hypernasality)
- ✓ Counting from 90-100; mom made lemon jam (assesses hyponasality)

Crucial Components of the Oral Exam

- **Lips**: Assess if movement sufficient for speech production (i—oo).
- **Eyes:** Look for symmetry, hypo/hypertelorism, epicanthal folds, ptosis, etc.
- **Ears**: Note if any microtia, anotia, atresia, or asymmetry.
- **Nose/Airway**: Assess for patency of each nostril. Have the child occlude one nostril at a time and hum and sniff. This will indicate if nostrils are not patent. If not patent, then this could confound perceptual resonance findings. If congestion present, consider decongestions of nostrils prior to instrumental assessment.
- **Maxilla/Mandible:** Assess micro/macrognathia, micro/macrostomia, and symmetry of the jaws, ramus, and overall profile.
- **Dentition:** Assess any missing teeth, define occlusal pattern and note if any crossbite is present.
- **Hard Palate:** Assess if it is intact, cleft, or dehisced, check for any fistula.
- **Velum/Uvula:** Assess palatal elevation and symmetry on phonation, note any bifid uvula, and describe length of velum and mobility of velum on "ahhh."
- **Assess Cranial Nerve Function**

Judgments that **CANNOT** be made from an oral exam are the amount of velopharyngeal closure, depth of the nasopharynx, and pattern of closure. These require instrumental evaluation.

Instrumentation to Quantify Resonance:

- Objective information regarding velopharyngeal structure and function may be obtained through instrumental procedures (e.g., nasometry, aerodynamics, videofluoroscopy, and/or nasopharyngoscopy). This information may supplement perceptual observations from the evaluation of resonance.

SPECIAL CONSIDERATIONS FOR ASSESSING RESONANCE

Positive Findings from Perceptual Evaluation:

- ✓ Age-appropriate place of articulation
- ✓ Any oral pressure sounds
- ✓ Oral pressure with nasal occlusion

Negative Findings from Perceptual Evaluation:

- ✓ Compensatory articulation
- ✓ No improvement in oral pressure with nasal occlusion

Diagnostic Considerations:

- ✓ Nasal congestion can mask VPD
- ✓ Hoarseness can mask hypernasality
- ✓ Behavioral hypernasality (such as whining) may also be present

REMEMBER: You do not need high tech equipment to determine if there is velopharyngeal closure. Listen for pressure consonant production, use a straw or See-Scape to detect if any nasal air emission, and most importantly, **USE YOUR EAR**. Identifying if there is or isn't velopharyngeal closure is the first step in developing the correct management route for the patient.

MANAGEMENT ROUTES: SURGICAL, PROSTHETIC, AND THERAPEUTIC

Considerations for Physical Management of Velopharyngeal Dysfunction:

1. Manage VPD as soon as it is diagnosed and a treatment plan is developed.
2. Management may involve physical and/or behavioral treatments.
3. The best gains in behavioral management typically come after physical management. HOWEVER, initiation of behavioral management should not be dependent on completing physical management.

Surgical Management:

Pharyngeal Flap: Requires medial movement of the lateral pharyngeal walls.

Sphincter Pharyngoplasty: Requires velar elevation, typically seen in a circular or coronal closure pattern and tissue should be placed at the height of maximal velar elevation.

Palatal re-repair: several different types of re-repair may be used to lengthen the palate and re-orient the levator muscles in a child with a repaired cleft.

Posterior wall fat grafting: Autologous fat grafting to the posterior pharynx can, at times, reduce hypernasality in patients with cleft palate and very mild velopharyngeal insufficiency.

Prosthetic Management:

Speech Bulb/Obturator: Makes up for tissue deficiency

Palatal Lift: Makes up for palatal movement deficiency

Therapeutic Management:

- Corrects inappropriate or inefficient place of articulation.
- Is both diagnostic and therapeutic.
- Establishes oral articulation prior to management of VPD (Nasality can sometimes improve with improved place of articulation).
- Goals of speech therapy in this population are to **normalize articulatory placement**.
- Therapy tasks using non-speech oral motor exercises (NSOMEs) are inappropriate and ineffective. HOWEVER, blowing may be diagnostic of velopharyngeal closure (via oral airflow) and may be used to interest or facilitate certain speech tasks such as production of fricative sounds.

Refer to a Craniofacial Team

If you suspect **ANY** hypernasality (even without any evidence of a cleft palate), **refer the patient to a local cleft or craniofacial team!** Delayed identification and delayed management results in poor outcomes.

Use of this Handout, or information it contains, should be cited as follows:

ASHA Special Interest Group 5. Evaluation and management techniques for speech sound disorders associated with cleft palate and velopharyngeal dysfunction. Handout to accompany Poster. Developed in 2017.

RESOURCES:

1. American Cleft Palate Craniofacial Association (ACPA) and Cleft Palate Foundation (2019). Retrieved from www.acpa-cpf.org Free downloads available at https://acpa-cpf.org/team-care/
2. Golding-Kushner, K. J. (2001). *Therapy Techniques for Cleft Palate Speech and Related Disorders.* Clifton Park, NY: Delmar Cengage Learning.
3. Henningsson, G., Kuehn, D. P., Sell, D., Sweeney, T., Trost-Cardamone, J. E., & Whitehill, T. L. (2008). Universal parameters for reporting speech outcomes in individuals with cleft palate. *Cleft Palate-Craniofacial Journal*, *45*(1), 1–17. doi:10.1597/06-086.1
4. Kummer, A. W. (2013). *Cleft Palate and Craniofacial Anomalies, Effects on Speech and Resonance* (3rd ed.). Clifton Park, NY: Delmar Cengage Learning.
5. Morley, M. E. (1970). *Cleft Palate and Speech* (7th ed.). London, UK: Williams & Wilkins.
6. Peterson-Falzone, S. J., Trost-Cardamone, J. E., Karnell, M. P., & Hardin, M. A. (2017). *The Clinician's Guide to Treating Cleft Palate Speech* (2nd ed.). St. Louis, MO: Mosby.
7. Riski, J. E. (2013). Speech, language, and velopharyngeal dysfunction: Management throughout the life of an individual with cleft palate. In *Cleft Lip and Palate: Diagnosis and Management* (pp. 803–820). Springer-Verlag Berlin Heidelberg. https://doi.org/10.1007/978-3-642-30770-6_38
8. Trost-Cardamone, J. E. (2013). *Cleft palate speech: A comprehensive 2-part set.* Rockville, MD: American Speech-Language-Hearing Association. http://www.asha.org/eweb/OLSDynamicPage.aspx?Webcode=olsdetails&title=Cleft+Palate+Speech%3a+A+Comprehensive+2-Part+Set