

Cleft Palate Speech and Resonance

An Audio and Video Resource

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Linda D. Vallino, PhD

*Head, Craniofacial Outcomes Research Laboratory/Senior Speech Scientist
Center for Pediatric Auditory and Speech Sciences
Nemours/Alfred I. duPont Hospital for Children
Clinical Professor of Pediatrics
Sidney Kimmel Medical College, Thomas Jefferson University
Adjunct Associate Professor, University of Delaware
Wilmington, Delaware*

Dennis M. Ruscello, PhD

*Professor of Communication Sciences and Disorders
Department of Communication Sciences and Disorders
College of Education and Human Services
Adjunct Professor of Otolaryngology
West Virginia University
Morgantown, West Virginia*

David J. Zajac, PhD

*Professor, Department of Dental Ecology
Adjunct Associate Professor, Division of Speech and Hearing Sciences
Department of Allied Health Sciences
University of North Carolina at Chapel Hill
Chapel Hill, North Carolina*





5521 Ruffin Road
San Diego, CA 92123

e-mail: info@pluralpublishing.com
website: <http://www.pluralpublishing.com>

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■ Preface

Cleft Palate Speech and Resonance: An Audio and Video Resource was developed to be a companion to the textbook, *Evaluation and Management of Cleft Lip and Palate: A Developmental Perspective* (Zajac & Vallino, 2017). It can also serve as a standalone text to facilitate learning about speech disorders associated with cleft palate (CP) and other problems of resonance in speakers without a cleft condition.

The original intent was to edit a series of digital audio and video samples for speech-language pathologists (SLPs) to use in becoming familiar with the speech, resonance, and phonatory characteristics of individuals with CP. That is, we wanted to create a clinical tool that would assist students and SLPs in developing their auditory perceptual identification skills. However, our discussions and literature searches over the past 2 years altered our thinking. The most pressing issue was that patients¹ with CP constitute a low-incidence population, and many clinicians have limited academic exposure and/or clinical training in this area, a shortcoming that many recognize. The result is that their knowledge base and clinical skills are limited. Grames (2008) provides an excellent discussion of the history of care of the individual with cleft palate in the United States, and she also identifies current issues that limit academic and clinical opportunities for students. Survey data collected by the American Speech-Language-Hearing Association (2012) and corroborated by others indicate that one of the significant challenges facing SLPs in the schools is the lack of education and training in low-incidence populations such as cleft palate (Bedwinek, 2007; Vallino, Lass, Bunnell, & Pannbacker, 2008).

The paradigm shift in our thinking resulted in the preparation of this *Resource*. The issues that currently prevail led us to alter our thinking in terms of developing a useful educational product for students and

¹In this *Resource*, we use the word patient rather than client to refer to the speakers in the audio and video samples as they have all been managed by our respective hospital-based interdisciplinary teams. We acknowledge that community-based SLPs and those working in academic settings use the term client to refer to those individuals to whom they provide speech and language services.

clinicians. Rather than present a series of audio and video recordings that would only address a skill area, we decided to develop a publication that would address both knowledge and skill areas. While there are several excellent publications in the management of cleft lip and palate, we reasoned that both students and SLPs would benefit from a publication that focuses on cleft-related speech disorders with the opportunity to hear, see, and assess these disorders as well. The goals of this publication are to improve the knowledge base and clinical skills of students and SLPs by presenting current and evidence-based information and a range of auditory-perceptual experiences that will help them to identify the different speech, resonance, and phonatory problems associated in speakers with CP. It will also enable them to apply these concepts to care for the individual with cleft palate and interact with caregivers and cleft palate teams. Students and SLPs need easy access to information and materials, which explicitly deal with the particular communication disorder and are state of the art (Kuster, 2010). This is very important in cleft care, since assessment and treatment concepts have changed significantly over the past 25 years.

This *Resource* offers material for those who need such information and features a series of audio- and video-recorded speech samples and case studies that the student and practicing clinician can use to develop perceptual identification skills to assess patients with cleft palate and resonance disorders and also those with noncleft-related velopharyngeal dysfunction. The audio and video samples can be accessed on the PluralPlus companion website. For instructors, it can provide much-needed teaching materials that are necessary in the classroom, particularly where access to this population is limited. Practicing SLPs can also use it to retool their skills. Last, it can also be a great resource for dental and medical students, and residents who are learning about cleft palate.

The first chapter provides an overview of the velopharyngeal mechanism, followed by descriptions of resonance, articulation, and phonatory characteristics of speakers who have cleft palate. Hearing and other potential coexisting communication problems are also discussed. Chapter 2 focuses on a systematic assessment of communication problems associated with cleft palate. Chapter 3 provides an array of audio- and video-recorded speech samples and case examples illustrating a variety of speech problems associated with cleft palate, some of which may seem to be straightforward and others more complex. Here, the SLP will have an opportunity for independent practice in listening and analyzing these speech samples and to make recommendations for treatment, and

to compare their analyses with ours provided in Appendices A and B. Because there are a variety of cases in which speech therapy is recommended, Chapter 4 describes treatment strategies to correct speech errors that are amenable to therapy. Chapter 5 offers a guide for referring a patient to a cleft palate team. Each chapter begins with a list of key terms relevant to the material presented.

Linda D. Vallino
Dennis M. Ruscello
David J. Zajac

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Last, I am able to do what I truly enjoy because of the love and support of my family. Nicholas, Caroline, John, and Eleanor are four extraordinary children who have grown up to be four extraordinary adults. Then there is my adoring husband, Joe, who is always at the heart of my adventures. You're awesome!

Linda D. Vallino
Wilmington,
Delaware

■ Reviewers

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Anne Bedwinek, PhD, CCC-SLP
Adjunct Associate Professor
Department of Communication
Science & Disorders
The University of Missouri
Columbia, Missouri

Kate Bunton, PhD, CCC-SLP
Associate Professor
Speech, Language, and Hearing
Sciences
University of Arizona
Tucson, Arizona

Dana R. Collins, PhD, CCC-SLP
Associate Professor
Department of Communication
Sciences and Disorders
University of Minnesota Duluth
Duluth, Minnesota

John Wm. Folkins, PhD
Professor
Department of Communication
Sciences and Disorders
Bowling Green State University
Bowling Green, Ohio

Nancy Gauvin, EdD, CCC-SLP
Clinical Assistant Professor

Department of Communication
Sciences and Disorders
University of Vermont
Burlington, Vermont

**Jennifer M. Glassman, PhD,
CCC-SLP, CHES**
Assistant Professor
Speech-Language Pathology
University of Toledo
Toledo, Ohio

Carol L. Koch, EdD, CCC-SLP
Associate Professor
Communication Sciences and
Disorders
Samford University
Birmingham, Alabama

Brenda Louw, DPhil, SLP
Professor and Chair
Department Audiology and Speech-
Language Pathology
East Tennessee State University
Johnson City, Tennessee

Jayanti Ray, PhD, CCC-SLP
Professor
Communication Disorders
Southeast Missouri State University
Cape Girardeau, Missouri

Gale B. Rice, PhD, CCC-SLP
Dean, College of Education and
Allied Health Professions
Fontbonne University
Speech-Language Pathologist,
Craniofacial Anomalies Team
The University of Missouri
Columbia, Missouri

Jeff Searl, PhD, CCC-SLP
Associate Professor

Department of Communicative
Sciences and Disorders
Michigan State University
East Lansing, Michigan

**Natalie R. Wombacher, MS,
CCC-SLP**
Speech-Language Pathologist
Craniofacial Anomalies Program
University of Michigan
Ann Arbor, Michigan

■ List of Abbreviations

ACPA	American Cleft Palate-Craniofacial Association
ANE	Audible nasal emission
ANF	Anterior nasal fricative
ASHA	American Speech-Language-Hearing Association
CLP	Cleft lip and palate
EMT	Enhanced Milieu Training
EMT/PE	Enhanced Milieu Training with Phonological Emphasis
ENT	Ear, Nose, and Throat
HIPAA	Health Insurance Portability Accountability Act
KR	Knowledge of Results
MADO	Maxillary advancement using distraction osteogenesis
NA	None apparent
NE	Nasal emission
NF1	Neurofibromatosis, type 1
NSOME	Nonspeech oral motor exercises
NT	Nasal turbulence
OME	Otitis media with effusion
OSA	Obstructive sleep apnea
PE	Pressure-equalization
PNF	Posterior nasal fricative
PSNE	Phoneme-specific nasal emission
SLP	Speech-language pathologist
SNHL	Sensorineural hearing loss

T&A	Tonsillectomy & adenoidectomy
VP	Velopharyngeal
VPD	Velopharyngeal dysfunction
VPI	Velopharyngeal inadequacy
WFL	Within functional limits
WNL	Within normal limits

Legend to Audio and Video Samples

Chapter 3

Section 1

Speech Features Commonly Associated With Cleft Palate and Velopharyngeal Dysfunction

Resonance

- Audio 3.1.1 Normal nasal resonance
- Audio 3.1.2 Slight hypernasality but within functional limits
- Audio 3.1.3 Mild hypernasality
- Audio 3.1.4 Mild-moderate hypernasality
- Audio 3.1.5 Moderate hypernasality
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- Audio 3.1.10 Mixed hyper-hyponasality

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- Audio 3.1.11 Audible nasal air emission (ANE)
- Audio 3.1.12 ANE on /s/ and /z/ segments
- Audio 3.1.13 ANE
- Audio 3.1.14 ANE
- Audio 3.1.15 Nasal turbulence

Articulation Errors Within the Oral Cavity

Obligatory (Adaptive) Oral Distortions

- Audio 3.1.16 Anterior sibilant and affricate distortions
- Audio 3.1.17 Interdental /s/
- Audio 3.1.18 Interdental /s/
- Audio 3.1.19 Fronting on fricatives and affricates
- Audio 3.1.20 Dentalized /s/
- Audio 3.1.21 Lateral /s/ distortions
- Audio 3.1.22 Palatalized stop during production of /t/ (Note: We acknowledge that others have considered this as a compensatory misarticulation, and as discussed in the text it is best characterized in some cases as an obligatory oral distortion.)
- Audio 3.1.23 Dentalized alveolar and palatal sounds

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- Audio 3.1.25 Glottal stops
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- Audio 3.2.6 9-year old female with hypernasality following tonsillectomy and adenoidectomy
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- Audio 3.2.8 7-year-old female with repaired left unilateral cleft lip and bifid uvula and posterior nasal turbulence
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- Audio 3.2.10 9-year-old boy with right hemifacial macrosomia with posterior nasal fricatives
- Audio 3.2.11 8-year-old female with submucous cleft palate with mild hypernasality, audible nasal air emission, interdentalized sibilants, an unusual gr/w substitution.
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- Audio 3.2.16 6-year-old male with repaired right unilateral cleft lip and palate with moderate hypernasality, audible nasal air emission, and reduced loudness. He also produced /s/ on inspiration.
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- Audio 3.2.18 6-year-old male with a complete cleft palate with moderate hypernasality and compensatory articulation errors
- Audio 3.2.19 3.5-year-old male with repaired left unilateral cleft lip and palate with mild hypernasality, audible nasal air emission, high pitch, and developmental errors
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Section 3

Audio Case Studies: Independent Practice

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- Audio 3.3.14 7-year-old male with repaired bilateral cleft lip and palate with moderate hypernasality and lateralization of sibilants
- Audio 3.3.15 7-year-old female with neurofibromatosis with severe hypernasality, imprecise articulation, and pitch variations

- Audio 3.3.16 Almost 4-year-old male with repaired left unilateral cleft lip and palate with moderate hypernasality, nasal fricatives, glottal stops, sound deletions, and severe hoarseness
- Audio 3.3.17 6-year-old female with submucous cleft palate with moderate hypernasality, nasal fricative, /r/ distortion, and mild hoarseness
- Audio 3.3.18 3-year-old male with repaired right unilateral cleft lip and palate with moderate hypernasality, audible nasal air emission, compensatory articulation errors, and developmental speech errors
- Audio 3.3.19 9-year-old male with repaired right unilateral cleft lip and palate with moderate hypernasality, compensatory articulation errors including glottal stops, pharyngeal fricatives, and pharyngeal affricates
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- Video 3.4.2 6-year-old male with isolated cleft palate with essentially normal resonance albeit a slight hint of hyponasality on nasal consonants, and developmental articulation errors unrelated to cleft palate.
- Video 3.4.3 14-year-old female with left unilateral cleft lip and palate with resonance that is within functional limits during citation but demonstrates an increase in hypernasality during conversational speech. Her videonasoscopy assessment is also shown.
- Video 3.4.4 6-year-old male with right unilateral cleft lip and palate with mild hypernasality, facial grimace, and oral distortions.
- Video 3.4.5 11-year-old male with bilateral cleft lip and palate with mild hypernasal speech, audible nasal air emission, nasal grimace, obligatory oral distortions, and hoarse voice quality.
- Video 3.4.6 18-year-old female with left unilateral cleft lip and palate with moderate hypernasal speech, audible nasal air emission, and nasal grimace. She is shown again after surgery to improve speech and resonance.
- Video 3.4.7 11-year-old male without cleft palate with mild-moderate hypernasality, and nasal turbulence.

- Video 3.4.8 Almost 15-year-old male with Crouzon syndrome with mild hypernasality and oral distortions.
- Video 3.4.9 6-year-old female with neurofibromatosis type 1 (NF1) presenting with a motor speech disorder including severe hypernasality, imprecise articulation, and abnormal pitch variations. Her videonasoscopy assessment is also shown. Note left carotid artery pulsation.
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- Video 3.4.11 8-year-old female with submucous cleft palate and nasal fricatives. Her videonasoscopy assessment is also shown.
- Video 3.4.12 Almost 8-year-old-male with bilateral cleft lip and palate with moderate hypernasality, mild nasal grimace, palatalized sibilants, and tip alveolar stop consonants.
- Video 3.4.13 Almost 7-year-old male with repaired submucous cleft palate with mild hypernasality, pharyngeal fricatives, and glottal stops.
- Video 3.4.14 3-year-old male with repaired right unilateral cleft lip and palate with mild hypernasality, audible nasal air emission, and hoarse voice quality.
- Video 3.4.15 5-year-old male with left unilateral cleft lip and palate with moderate hypernasality, audible nasal air emission, and developmental and obligatory articulation errors. His videonasoscopy assessment is also shown.
- Video 3.4.16 3.5-year-old male with left unilateral cleft lip and palate with coexisting articulation errors, nasal grimace, and moderate-severe hoarse voice quality. He is shown again at 14 years of age, presenting with normal resonance and slight /r/ and oral distortions.
- Video 3.4.17 10-year-old female with Pierre Robin sequence and cleft palate before and after insertion of a speech appliance to improve resonance.
- Video 3.4.18 8-year-old male with a cleft of the secondary palate before and after surgery to correct velopharyngeal dysfunction. His videonasoscopy assessment is also shown.
- Video 3.4.19 8-year-old female with ectodermal dysplasia as part of Bartsocas Papas syndrome and bilateral cleft palate before and after surgery to correct velopharyngeal dysfunction

Chapter 4

- Video 4.1 Example of a child with pharyngeal fricatives and affricates who acquired correct production of /s/ and /tʃ/ in treatment.

We dedicate this publication to our families who have always supported us in our academic and clinical endeavors. In addition, we acknowledge and dedicate this work to Drs. Betty Jane McWilliams, Betty Jane Philips, and Ralph Shelton, who are pioneers in cleft care and whose work inspired us to embark upon this project. Finally, this is dedicated to all of those who were born with a cleft condition and benefited from the services of cleft palate–craniofacial teams and different community care specialists.

1

Resonance and Speech Problems

Key Terms

- Backed Alveolar Consonants
- Clicks
- Compensatory (Maladaptive) Articulation Errors
- Conductive Hearing Loss
- Cul-de-sac Resonance
- Fricatives on Inspiration
- Glottal Stops
- Hypernasality
- Hyponasality
- Malocclusion
 - Dental Malocclusion
 - Skeletal Malocclusion
 - Open Bite
 - Crossbite
- Mixed Hyper-Hyponasality
- Nasal Air Emission
 - Visible
 - Audible
 - Turbulent
- Nasal Fricatives
 - Anterior
 - Posterior
- Nasal Grimace

- Nasal Substitutions
- Nasalized Plosives
- Obligatory (Adaptive) Oral Distortions
- Otitis Media With Effusion (OME)
- Palatalized Tongue-Tip Stops/Fricatives (Mid-Dorsum Palatal)
- Pharyngeal Affricates
- Pharyngeal Fricatives
- Pharyngeal Stops
- Phoneme-Specific Nasal Emission (PSNE)
- Resonance
- Velarized Nasals/Liquids
- Velopharyngeal Dysfunction (VPD)
- Velopharyngeal Inadequacy (VPI)
- Velopharyngeal Incompetency
- Velopharyngeal Insufficiency
- Weak Pressure Consonants

■ Introduction

There are three ways that the speech-language pathologist (SLP) studies speech production, and these are physiologic, acoustic, and perceptual (see Chapter 2). Each study method is important in understanding normal and disordered speech production, because of the different information that each provides. However, the decisive test for a person with a communication disorder(s) is the perceptual impact of the problem. What is the impression of a person with a communication disorder that other speakers form when engaging with them in verbal communication? This is particularly important for speakers with cleft palate because they may present with problems that affect different speech production subsystems. Thus, the ear is the most important clinical tool for the SLP who must develop a perceptual frame of reference for the different speech disorders that may be present in a speaker with cleft palate. That is, one must listen and be able to iden-

tify the feature(s) of the communication disorder in a reliable manner and formulate appropriate diagnostic and treatment plans. We must note, however, that some speech characteristics associated with cleft palate are difficult to reliably identify with the ear alone. Palatalized stops (or mid-dorsum palatal stops), for example, are quite difficult even for experienced SLPs to identify (Santelmann, Sussman, & Chapman, 1999). Likewise, although most can easily recognize the distinctive sound of a learned nasal fricative, a similar or even identical sound can occur as an obligatory consequence of velopharyngeal dysfunction (VPD). In these cases, the use of objective instrumentation is essential to make appropriate diagnostic and management plans. We provide examples in Chapter 3 to illustrate the use of acoustic analysis to confirm perceptual identification of nasal fricatives.

We begin this chapter with an overview of the velopharyngeal valving mechanism for speech. This is followed by a description of the types of speech problems associated with cleft palate and other problems of VPD, including resonance, nasal air emission, articulation, and phonation. Other important considerations, including hearing problems and other potential coexisting speech problems unrelated to the cleft, will be discussed.

■ A Note on Terminology

In describing problems of velopharyngeal closure, there is often confusion about terminology usage. Throughout this *Resource*, the term *velopharyngeal dysfunction* (VPD) is used to refer to a problem of velopharyngeal closure. *Velopharyngeal inadequacy* (VPI) is a synonymous term that also denotes abnormal velopharyngeal function (Folkins, 1988). It is important to emphasize that both terms are generic and that neither one specifies a cause of the problem.

There are, however, terms used to describe impaired velopharyngeal function based on anatomical or physiologic referents. *Velopharyngeal insufficiency* (anatomic) is used to denote impaired velopharyngeal function that occurs as

a result of insufficient tissue to accomplish velopharyngeal closure. *Velopharyngeal incompetence* (physiologic) denotes a neurologic etiology that results in impaired motor control of the velopharyngeal mechanism.

Because we are relying on perceptual judgments about the adequacy of speech and not using instrumentation to identify the structural or neurological processes causing impaired velopharyngeal function (Folkins, 1988), the term *VPD* used in this text to refer to problems of velopharyngeal closure is appropriate.

■ Overview of the Velopharyngeal Mechanism

The complexity of the velopharyngeal (VP) mechanism is well recognized and appreciated, the details of which are beyond the scope of this *Resource*. The aim of this section is to provide the SLP with an overview of the of the VP mechanism during the production of speech. For the interested reader, comprehensive descriptions of VP anatomy and function can be found in texts such as Zemlin (1998); Peterson-Falzone, Hardin-Jones, and Karnell (2010); and Zajac and Vallino (2017).

Anatomy

The palate is made up of the hard palate anteriorly and the soft palate posteriorly (Figure 1–1). The hard palate is the bony structure that forms the roof of the mouth and floor of the nasal cavity. The soft palate or velum extends beyond the hard palate and is continuous with the uvula, the pedunculated structure at the end of the velum.

The velopharyngeal mechanism is composed of the velum, lateral pharyngeal walls, and the posterior pharyngeal wall (back wall of the throat). The space surrounded by these structures is referred to as the velopharyngeal port (Figure 1–2).

There are five muscle pairs of the velum and pharynx that are involved in velopharyngeal movement. They are the

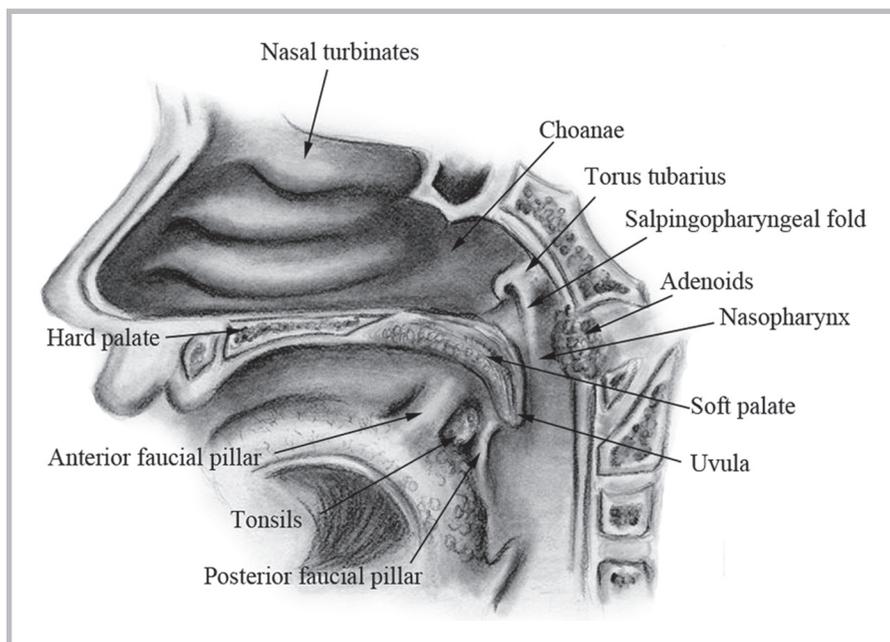


Figure 1-1. Lateral view of the oral and nasal cavities and nasopharynx. Source: Reprinted with permission from Zajac, D. J., and Vallino, L. D. (2017). *Evaluation and management of cleft lip and palate*. San Diego, CA: Plural Publishing.

levator veli palatini, palatoglossus, musculus uvulus, palatopharyngeus, and tensor veli palatini (Figure 1-3).

The *levator veli palatini* is the primary muscle responsible for elevating and retracting the velum. The *palatoglossus* muscle is antagonistic to the levator muscle, and when contracted, it lowers the velum during speech and also acts to elevate the tongue during bolus preparation and transport. The *musculus uvulus* adds bulk to the velum and may stiffen to provide firm contact to the posterior pharyngeal wall. The horizontal fibers of the *palatopharyngeus* muscle provide sphincter action to orient the lateral pharyngeal walls medially, and its vertical fibers may lower the velum and elevate the pharynx/larynx during deglutition. The muscle responsible for medial displacement of the lateral pharyngeal walls is the

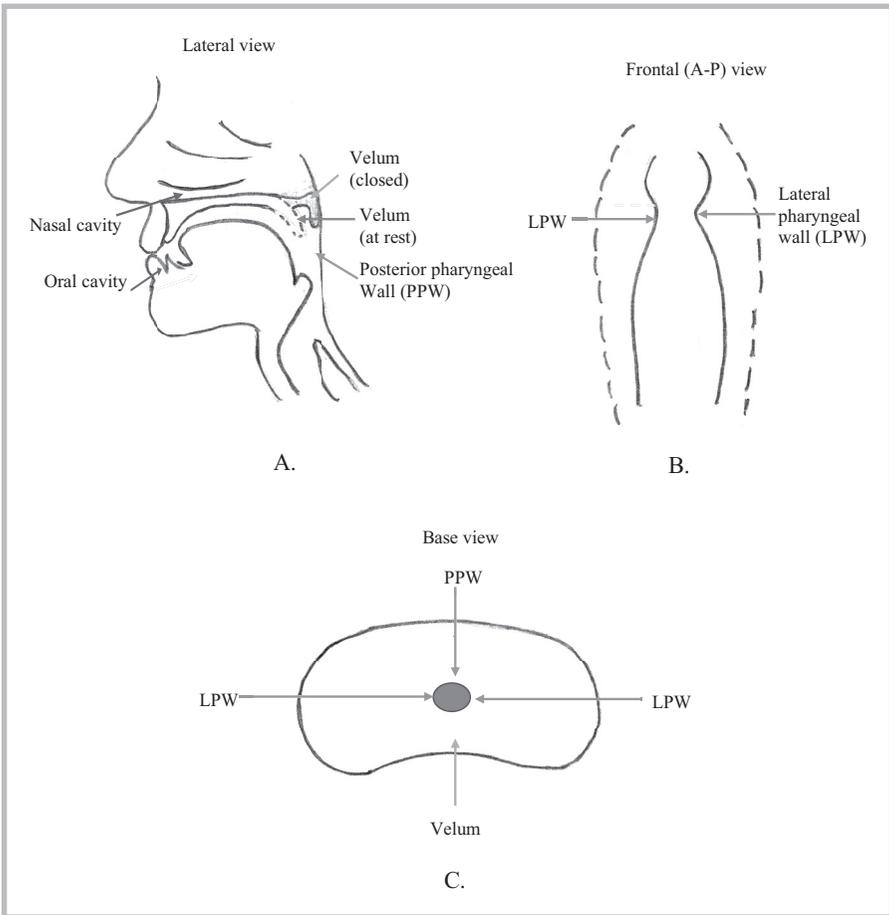


Figure 1-2. The velopharyngeal portal. **A.** Lateral view showing the velum and posterior pharyngeal wall. **B.** Frontal or anteroposterior (A-P) view showing the lateral pharyngeal walls. **C.** Base view showing the entire velopharyngeal portal. The circle is illustrative of the velopharyngeal portal.

superior constrictor. The *tensor veli palatini* muscle is also often included as a muscle involved in velopharyngeal movement. However, the primary purpose of this muscle is to open or dilate the eustachian tubes (Dickson & Maue-Dickson, 1982; Rood & Doyle, 1978).