

1 • VOICE PRODUCTION: ANATOMY AND PHYSIOLOGY

Voice production is comprised of three main components: *respiration* as the driving power or generator for vocal sound, *phonation* as the sound source, and *resonance* to shape or filter the sound. The delicate balance of these parameters determines the overall quality of the voice and will be revisited throughout this book.

This chapter provides a brief overview of voice production from an anatomical and physiological perspective. It is a reference to help you understand structural landmarks, neural intervention, basic laryngeal functions, and vocal physiology. It is important to understand how a change in structure (anatomy) and/or function (physiology) may impact the voice. This knowledge aids in both the accurate diagnosis and generation of appropriate treatment plans for patients with voice disorders.

Overview of Laryngeal Anatomy (See Figures 1-4, page 7.)

LARYNGEAL CARTILAGES

The larynx is made up of nine cartilages and the hyoid bone. There are three larger cartilages (thyroid, cricoid, epiglottis) and three paired, smaller cartilages (arytenoids, corniculates, cuneiforms). The larynx is bordered by the hyoid bone superiorly and the cricoid cartilage inferiorly. The hyoid bone provides stability and assists in positioning of the larynx during phonation and swallowing.

Thyroid

- largest of the laryngeal cartilages
- two laminae joined in midline (approximately 90° angle in males, 120° angle in females)
- superior landmark is the thyroid notch (“Adam’s apple”)
- protects the internal structures of the larynx
- houses the superior-most cartilage of the laryngotracheal airway

Cricoid

- shaped like a signet ring
- superior most tracheal cartilage
- articulates with the thyroid cartilage (cricothyroid joint)

Epiglottis

- leaf-shaped
- attached to the inner surface of the thyroid cartilage at the petiole
- aids in airway protection during swallowing

Arytenoids (2)

- shaped like pyramids
- mobile joints (sinovial) that articulate with the cricoid cartilage (cricoarytenoid joints)
- serve as posterior attachments for the vocal ligaments
- serve as attachments for the lateral and posterior cricoarytenoid muscles (LCA/PCA)
- serve as attachments for the aryepiglottic folds
 - Corniculates (2)—sit on the apex of the arytenoids
 - Cuneiforms (2)—embedded within the aryepiglottic folds

MTD type 3: partial anterior-posterior (AP) constriction of the supraglottis

MTD type 4: complete supraglottic “squeeze” of the larynx (FVF and AP tension)

Presentation

During phonation, there is hyperfunctional adduction/squeezing of the false vocal folds (FVF) and/or supraglottis.

Etiology

Laryngeal structures may be normal or there may be an underlying pathology inhibiting vibration of the true vocal folds (TVFs) and/or creating “stiffness.” (Presbylarynx or a medial glottal gap may also promote use of the FVFs to aid in medial closure.)

Vocal characteristics

The voice most often presents with a reduced/low pitch and a strained vocal quality (may vary from mildly to severely strained).

Treatment

Voice therapy is targeted at laryngeal relaxation during phonation.

Note: MTD type 4 may also be called *ventricular phonation* (page 56) and therefore benefits from similar therapy techniques.

Therapy tasks

Focus on laryngeal relaxation through the use of easy phonatory tasks and the establishment of increased oral and nasal resonance (i.e., focus the voice away from the larynx) as highlighted in the following therapy tasks:

- cervical exercises (pages 97-100)
- diaphragmatic breathing (page 104)
- laryngeal massage techniques (page 91)—Use with MTD types 3 and 4.
- tactile vibration (page 125)
- humming—Have the patient produce a steady hum at a comfortable pitch and loudness.
- humming with pitch glides—Have the patient produce a low-pitched and then high-pitched hum. Use pitch scales to go from low to higher pitches.
- resonance focus (nasal) (page 126)
- /m/ words, phrases, and sentences (pages 126-131)
- resonance focus (oral) (page 130)
- /h/ words, phrases, and sentences (pages 109-111)
- /f/ and /s/ sentences (pages 112-113)
- easy onset of vowels (pages 119-120)
- tense vowels in words and phrases (page 131)

Carryover tasks

Use longer passages and paragraphs to maintain relaxed voicing during tasks like the following:

- vowel intense paragraph (page 121)
- functional reading (e.g., magazine, newspaper) to promote use of relaxed voice in less structured tasks

Respiration Exercises

Target: respiration/airflow

Goal: to facilitate voice production

Background: The technique of diaphragmatic breathing is the basis for easy voice production.

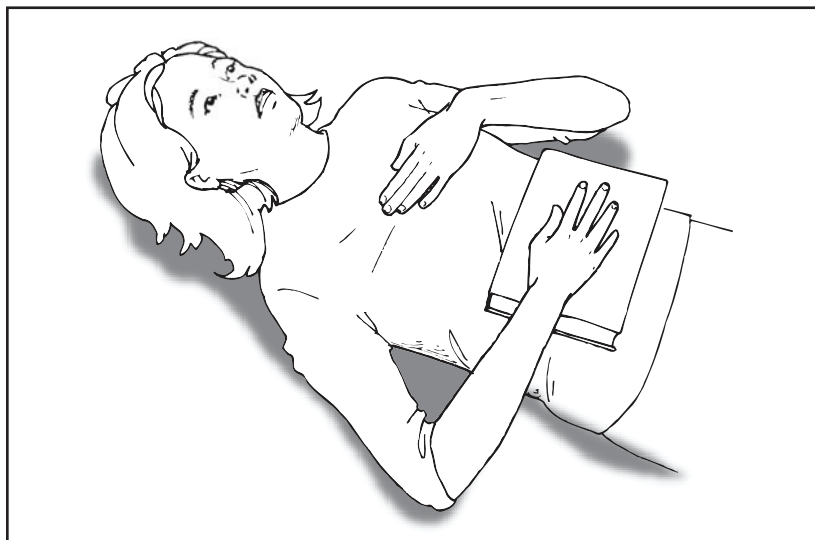
The diaphragm is the dome-shaped muscle that separates your lungs from your visceral organs (stomach, liver, intestines, kidneys). It is located at the bottom of your rib cage (See Figure 10, page 13, Chapter 1).

It is important to breathe using your diaphragm for many reasons:

- You are able to reach higher total lung volumes (more space) and inhale more air.
- It does not involve active chest or clavicular movement (doesn't involve external laryngeal muscles) and improves relaxation of the laryngeal posture.
- Support and control of air by the diaphragm reduces the need for laryngeal control of airflow.

Diaphragmatic Breathing Practice

1. Lie on your back.
2. Place a book on your diaphragm.
3. Place one hand on the book and one hand on your chest.
4. Raise the book as you breathe IN without raising your chest.



Clinical Note: Make sure that the patient is not contracting abdominal muscles to move the book but is using air to expand her lungs. Cue air exchange through the use of audible inhale/exhale (e.g., Have the patient purse her lips as she blows in and out to “hear” the movement of air).

to produce supraglottic voicing and use of effortful/pushed phonation. You can address swallowing by using supraglottic swallow techniques. (See Logemann 1998.)

Evaluation and Counseling

A large part of your pre-operative and post-operative evaluation involves counseling and provision of information to the patient and caregivers. This counseling is to provide support needed to deal with the physical changes, as well as encouragement for developing effective alaryngeal communication.

PRE-OPERATIVE EVALUATION AND COUNSELING

The following is a general outline to help you obtain information that will assist in post-operative treatment for return to functional communication.

Evaluation

Assess patient's communication needs.

- Living situation—What is the patient's need for communication within his home environment?
- Occupation—What is the patient's need for communication within his work environment? Does the patient intend to return to work?
- Social requirements—What are other social communication needs (e.g., worship, travel)?
- Hobbies—Does the patient have a hobby that requires use of his voice?

Screen/evaluate baseline communication skills in the following areas:

- Cognitive status—ability to understand and participate in rehabilitation process
- Articulation—intelligibility
- Language—receptive and expressive language skills
- Voice—volume and respiratory parameters
- Rate—rate of speech
- Fluency—presence of/severity of dysfluency
- Reading/writing skills—Are they functional for communication?
- Hearing—presence of a hearing loss

Obtain the following information from the referring physician:

- What type of surgical excision is to be performed?
- Has the patient had radiation? Will the patient be undergoing radiation post-operatively?

Counseling

A pre-operative counseling session should incorporate the following information:

- First review what the patient has already been told by his physician.
- Find out what treatments the patient has already undergone.
- Address any misunderstandings or concerns.
- Provide new information (written when possible).
- Discuss post-operative course of treatment and what to expect.