Postural Interplay Between the Torso, Throat, Tongue and Teeth

A Novel Model of Interdisciplinary Integration

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Postural Restoration Institute®
celebrating 20 years

Opening Remarks

The human's ability to regulate tension, strength, oral pharyngeal pressure, and motion of the oral cavity is dependent on the position the chest and chin are directed, by lateralized effort to remain balanced when upright.

Two groups of muscle that assist in 'centering' over the right leg, that is used for postural support, and that assist the left leg and right arm can provide stabilization guidance, are the muscles that attach to the mandible and hyoid.

Of the two hyoid slings, the suprahyoid sling is the most vibrant, eccentric, active and elastic.

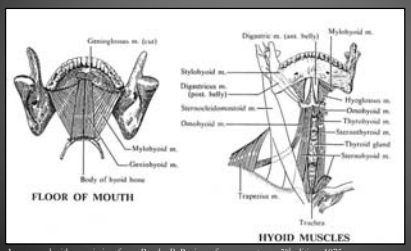
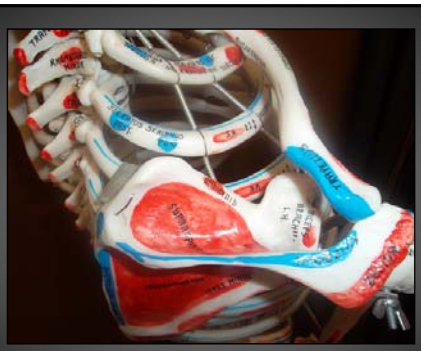


Image used with permission from: Pansky B. Review of gross anatomy, 3rd edition. 1975. MacMillan Publishing Co, Inc. New York, New York.

Neurologic information, respiratory airflow, digestive bolus and gas, and physiologic fluid (blood, interstitial fluid and lymph) have to move up and down through the anterior neck and chest, using these two groups (bones) of muscle.

This information, airflow, bolus, gas and fluid movement depends on the position and alignment of the suprahyoid and infrahyoid anatomy.

Our oral-pharyngeal and thoracic inlets and outlets depend on this position and alignment.



Our cervical lordosis and cervical retention of appropriate throat and tongue tension,

Image from: https://functionalanatomyblog.com/2010/08/26/effective-manipulation-for-the-cervical-thoracic-junction/

is maintained by suprahyoid and infrahyoid recurrent lateralized movement from side to side.

Otherwise, we become dependent on lateralized intra-oral and extra-oral muscle tension and tightness for egocentric awareness and function.

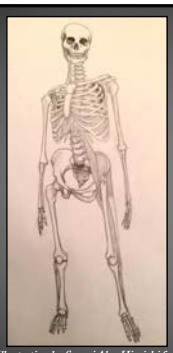
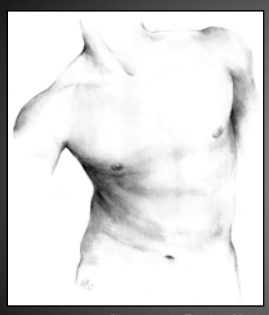
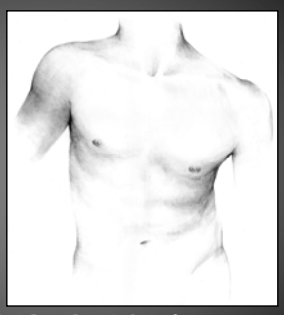


Illustration by Sayuri Abe-Hiraishi for the Postural Restoration Institute®





Illustrations by Elizabeth Noble for the Postural Restoration Institute®

This lateralization more than likely will have an impact on mandibular condylar growth,

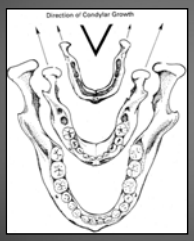
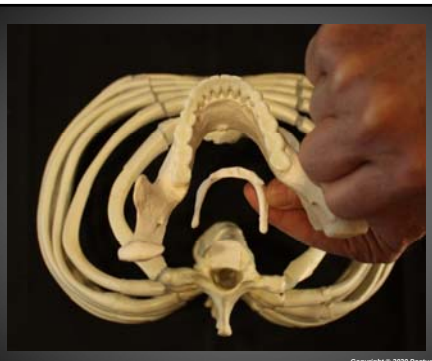


Figure from Dr. Michael Hoef's presentation, "The Airway: Management of the nasal and pharyngeal airways from the dental perspective", 2012 Interdisciplinary Integration Symposium.

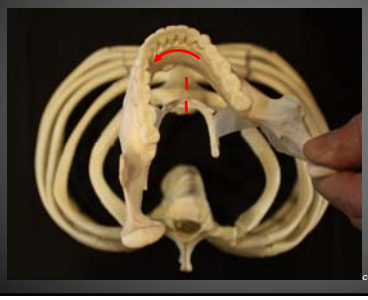
and on thoracic-cervical inlet and outlet alignment effort and limitation as well as the management of the mandibular, hyoid and clavicle/first rib "slings" of muscle, which are one in the same.

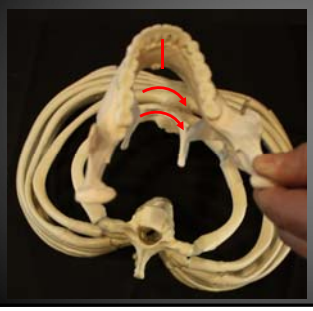


When we lose the ability to re-lateralize ourselves, we become malaligned and often we are not mindful or aware of it.

Malalignment management is challenged by normal asymmetrical growth and development, and patterned airflow directed by teeth malocclusion and oral myologic compensatory effort.

Mandibular sling to the left without torso movement.

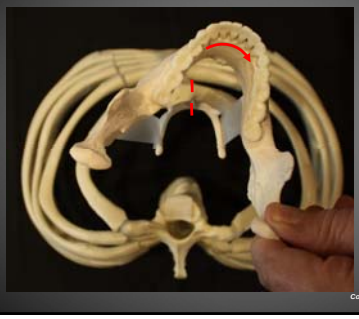




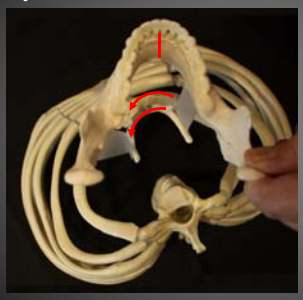
Hyoid and Clavicle/1st rib sling to the right with torso orientation to the right, secondary to compensatory weakness of muscles that move the mandible to the right.

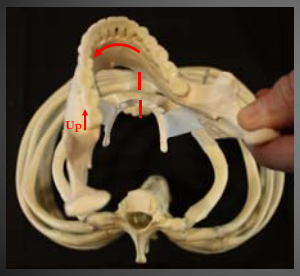
This previous slide also could reflect asymmetry associated with forward locomotion while on the right leg.

Mandibular sling to the right



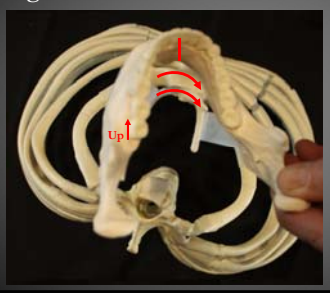
Hyoid and Clavicle/1st rib sling to the left





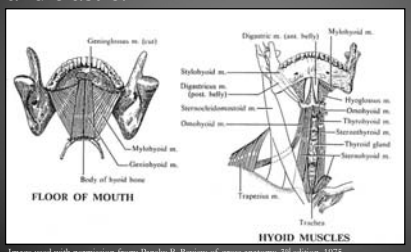
Mandible sling to the left (which is commonly seen in humans who have their center of mass lateralized to the right).

Clavicle/1st rib sling often stays to the right in vertical and horizontal positions.



This asymmetry between the torso and throat places muscles between the throat and tongue and the throat and mandible (teeth) in malaligned and imbalanced positions.

Of the two hyoid slings, the suprahyoid sling is the most vibrant, eccentric, active and elastic.



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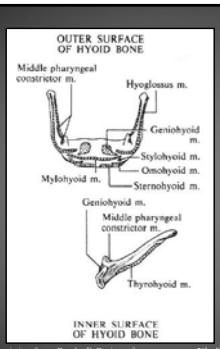

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The four muscles of the suprahyoid sling are the digastric, stylohyoid, geniohyoid, and mylohyoid. They are considered pharyngeal muscles with the exception of the geniohyoid muscle.

They all:

- assist in elevating the hyoid
- widen the esophagus during swallowing

However, for them to effectively work, they require counter or antagonistic balance from the infrahyoid muscle.

The infrahyoid sling muscle positions the hyoid bone from the thorax. They play an active role in swallowing and larynx movement, as well as with depression of the hyoid.

Maintaining symmetry of the hyoid and balance of the anterior neck, reduces tension of the suprahyoid muscle and dropping (down and back) of the hyoid.

- Gonzalez HE, Manus A. Forward head posture: Its structure and functional influence on the stomatognathic system, a conceptual study. Journal of Craniomandibular Practice. 1996, 14:71-80.

An insecure and imbalanced hyoid poorly elevates the larynx during swallowing, and epiglottis and pharynx regulation activity behind it.

Our hyoid, infrahyoid and suprahyoid position depends on depends on our mandibular and thoracic independent unrestricted movement. Restriction of the mandible or upper chest results in hyoid backward, downward and lateral displacement with respect to the forward depressed head and anterior elevated chest.

However, the most influential muscle of cervical and oral myology is the omohyoid, since it is the muscle responsible for hyoid depression and pharyngeal collapse.

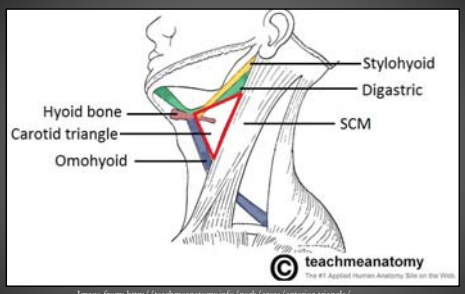
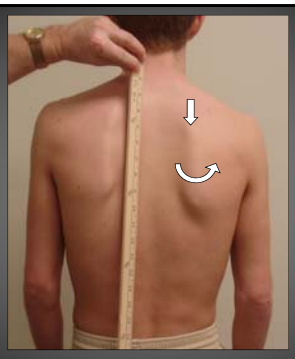


Image from: http://teachmeanatomy.info/neck/areas/anterior-triangle/

When the right scapula is positioned in an upwardly rotated, internally rotated, and anteriorly protracted/posteriorly retracted state, the accompanying hyoid retraction and depression influences airflow, circulation to the brain and our baroreceptors.



Since the omohyoid attaches to the carotid sheath, pulling on the sheath maintains a low pressure in the internal jugular vein, and therefore, increases the blood return from the head to the superior vena cava.

Free flowing alternating, reciprocal arm swing enhances the tension and re-tension of hyoid slings, because of this infrahyoid pendular action provided by the scapulae, and assists with the re-alignment of the larynx and vocal cords for pulmonary air pressure regulation.

A rigid and stiff thorax and scapula is possibly related to an overly contracted omohyoid that pulls the laryngeal structure down, challenging modulation of sound pitch.

A rigid and stiff thorax, neck and mandible, is possibly related to an overly contracted geniohyoid and mylohyoid (usually on the right) and a relaxed omohyoid that makes larynx depression difficult and interoceptive low frequency recognition and production difficult.

How we produce, what we produce and when we produce a product (i.e. voice, sound, noise, appendicular or axial movement, muscle contraction, etc.) is always influenced by the pattern we are in or use to produce.

The result of the process, the product, is reinforced by repetition of the pattern that produced it or by the product's influence on the pattern. In the latter situation, the pattern becomes the priority, not the product.

"Correct patterns of breathing must be established before much improvement can be made on phonation. Likewise, correct phonation patterns must be established before much improvements can be made on articulation."

Titze I. Principles of voice production. National Center for Voice and Speech, 2000.

"Rotation of the torso, can result in laryngeal asymmetry and its related problems. It is accepted that asymmetry of the larynx in adults may have a number of contributing factors, such as twisted posture during other activities and sports."

Chapman J. Singing and teaching singing, 3rd edition. Plural Publishing, 2017.

Using Janice Chapman's guidelines in defining the three basic types of 'valving' the vocal cords or voice in classical style singing, I realize that I talk with patients to 'hear' their voice 'valving'.

Myologic Patterns are Related to:

1. Upper trapezius "tightness"
2. Limited intercisal opening and mandibular lateral Trusive movement secondary to forward head position
3. Overactive mylohyoid, geniohyoid (lingual frenulum)
4. Compensatory pterygoid, anterior temporalis and masseter function

Voice Patterns Related to Myologic Patterns

1. Breathy

- Incomplete closure of the vocal fold edges with air escaping through the glottis. This can be a glottal chink, where the posterior one third of the folds remain open during phonation.

- General laxity of tonus in the vocal fold musculature (hypovalving), because of mal-aligned throat.
- Asymmetrical SCM size and orientation.

- 'Uneven' projection of voice. Short, whispy sentences – often incomplete, insecure phonation, quick 'sniff' through nose or moth after talking followed by a 'sigh'.
- Limited arm movement and chest wall expansion.
- Forward upper chest and head.

2. *Imbalanced*

- Vocal fold closure and subglottal air pressure needs to be balanced to create full closure with appropriate valving for the vocal tasks.

'Balanced' Vocal Cord Indicators:

- Chest wall expression/expansion reflects unrestricted arm language/movement.
- Flexible neck and face during phonation.
- Variable tonation (pitch and intensity).
- Interactive "vibration" between non-phonation 'rest' periods.
- 'Neutral' at rest (non-restricted sphenoid, sternum, sacrum upon PRI testing).

3. *Hyperadducted*

- Described as "pressed phonation" (vocal folds are pressed too tightly together [adducted] to allow easy phonation).
- Often caused by insufficient subglottal airflow and resulting muscle tension on the neck and articulatory system.

- Sound quality is "pressed" tight and small in tone,. Often the pitch of voice is higher than lower.
- Singers and speakers using this type of quality often experience hoarseness, vocal fatigue, and possible vocal pathologies.

- Can be caused by power lifters who "close" their glottis (Valsalva maneuver) to produce maximal abdominal, thoracic and pelvis force for squatting, deadlifting and bench pressing.
  (Orlikoff RF, Voice production during a weightlifting and support task. Folia Phoniatrica et Logopaedica. May 2008;60:188-194.)
- Also, according to Orlikoff, there is a significant amount of research on vocal cord dysfunction (hyperadduction) associated with cheerleaders and aerobic instructors.

Side note: Optimal breathing patterns for producing maximal optimal trunk stabilization requires inhalation through the nose and phonation during elevation of the body or non-body mass. The Valsalva maneuver will commonly be done either against a closed glottis, or against an external pressure measuring device, thus eliminating or minimizing the pressure on the Eustachian tubes. Straining or blowing against resistance as in blowing up balloons has a Valsalva effect and the fall in blood pressure can result in dizziness, light headedness and fainting.

- Elevated chest walls and forward head.
- Excessive head on neck rotation.
- Elongated, narrow facial features.
- Extended mid-thoracic spines.

Production Effort

The position our 'voice box' and 'breath box' are placed, reflects production effort. Jo Estill in her Voicecraft system highlights the effort levels within the various components of voicing. Chapman believes a balance of effort or energy between the 'voice' and the body is required to discriminate vocal tract production and body function.

Vibrato is intrinsic to the singing (speaker) instrument and should feel natural to the producer (singer/speaker).

Once breathing (glottis and tongue), abdominal support and postural alignment (neutrality) are well established, vibrato will appear as s natural phenomenon. – *J. Chapman*

Laryngeal Vibration

Vocal folds compress (adduct), decompress (abduct), compress (adduct), etc.

This build up, release, build up, etc. is referred to as glottal flow, glottal cycling, or vibration.

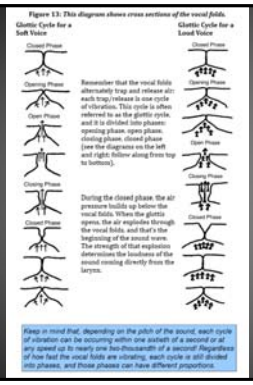


Figure from:
www.lionsvoiceclinic.umn.edu/page2.htm
#vfpitch

Once the vocal folds are allowed to vibrate, airflow resumes resulting in enhanced vocal quality and control for a longer vocal line on a single breath, if desired.

Over adduction or hyperadduction of the vocal cords (cervical tension from accessory respiratory function, 'lifting', or the autonomic nervous system) severely impedes normal modes of vocal cord vibration.

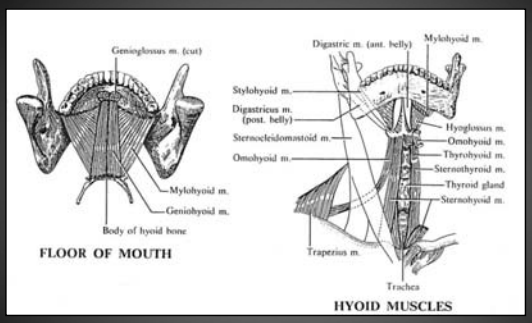
Titze I. Principles of voice production. National Center for Voice and Speech, 2000.

When laryngeal vibration is affected, so is chest (sternothyroid muscle) vibration, and vice versa, when chest vibration is affected, so is laryngeal vibration.

C3-C6 (larynx position) separates chest vibration from head vibration.

Position of the Larynx in the Neck

- Ideal laryngeal position is a low one.
- The only true depressors of the larynx are the sternothyroid, the sternohyoid and the omohyoid.



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- Register transitions are not smooth due to increased muscular tension.
- The low position of the tongue base limits articulatory clarity (i.e. the vowels tend to sound homogeneous and some consonants, weak).
- The palate is pulled down by the activity of the palatoglossus muscle.
- Wobble can develop as the tongue root and jaw move in sympathy with the vibrato.

Chapman J. Singing and teaching singing, 3rd edition. Plural Publishing, 2017.

- Vibrato can become unstable in both pitch and speed because of the pressure from the muscle tension.
- Acoustic energy will be dampened affecting vocal carrying power.
- The singer's own pitch perception can be distorted resulting in "flattening" (which the singer cannot detect).
- Vocal stamina is compromised.

Chapman J. Singing and teaching singing, 3rd edition. Plural Publishing, 2017.

It takes an excessive amount of air pressure to get the vocal folds to separate, as well as for the tongue to flatten in the oro-pharyngeal cavity.

Vibratory or oscillatory movement also needs to take place between the thyrohyoid muscles that elevates the thyroid cartilage and narrows the thyrohyoid space, and the sternothyroid and sternohyoid muscles that lower the larynx.

The cricothyroid muscle is the key muscle in laryngeal tensioning and cricothyroid vibration. If the neck moves forward, or the anterior chest wall becomes depressed (concave) or asymmetrical, the suprahyoid muscle shortens and the resting position of the larynx becomes elevated in the neck. The new shape of the vocal tract alters and challenges resonance, timbre, vocal musculature, fascial tension and the vibratory oscillatory function of the cricothyroid joint.

Rubin J et al. Musculoskeletal patterns in patients with voice disorders. Journal of Voice. 2007; 21(4).

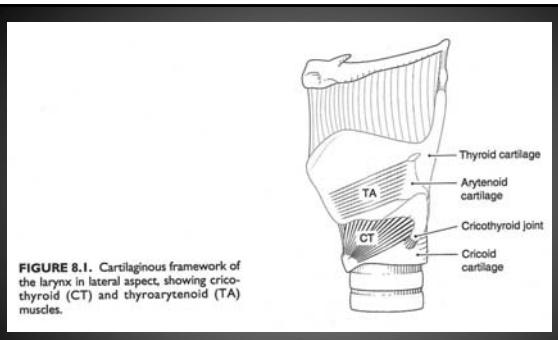


FIGURE 8.1. Cartilaginous framework of the larynx in lateral aspect, showing cricothyroid (CT) and thyroarytenoid (TA) muscles.

Figure from: Titze I. Principles of voice production. National Center for Voice and Speech, 2000.

The action of the cricothyroid (CT) musculature is opposed by the action of the thyroarytenoid (TA) muscle. This agonistic-antagonistic relationship allows the cricothyroid joint to rotate and translate.

The CT muscle pulls the joint together, which elongates the vocal folds. Contraction of TA muscle shortens the vocal folds.

Length change, vocal cord torque and vibration, as small as these changes in length tension and amplitude are, have significant impact on our head, neck, and chest position.

Laryngeal Control of Airway and Lung Resistance

During quiet breathing, movement of the vocal folds is used as a choke, or carburetor for fine control of airway, lung and reflexive resistance.

On inspiration, phasic activity of the posterior cricoarytenoid muscles, acting by rotating the arytenoid cartilages, abducts the vocal cords to minimize overall resistance.

Brancatisano TP et al. Respiratory activity of posterior cricoarytenoid muscle and vocal cords in humans. J Appl Physiol Respir Environ Exerc Physiol. 1984 Oct;57(4):1143-1149.

A greater effort occurs during expiration, when phasic electrical activity in the thyroarytenoid muscles indicates adduction of the vocal cords, and therefore an increase in resistance, which helps prevent collapse of the lower airway, including the lungs.

Kuna ST et al. Thyroarytenoid muscle activity durin wakefulness and sleep in normal adults. J Appl Physiol. 1988 Sep;65(3):1332-1339.

Vocal fold 'oscillation' or 'flow-induced' oscillation enhances symmetrical oral and neck function in general.

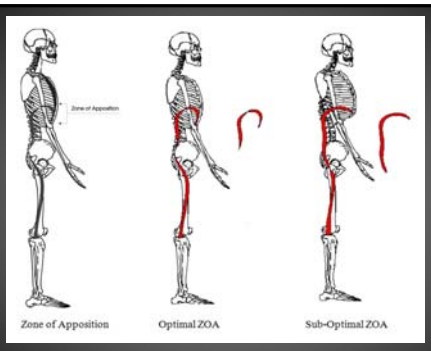
The fact that a stead stream of air flowing past a wall can set the wall into vibration has kept the interest of scientists for many years. It is related to the swaying of trees in the wind, the rattling of air ducts in a forced-air heating system, and the vibration of an airplane wing in flight."

Resonance is often used to get maximum response from an oscillating system with a minimum stimulus. Glottal air flow positive and negative air pressure momentum in the vocal tract is fueled by chest wall flexibility and self-sustained scapula thoracic oscillatory movement from the swing of the upper extremities and the sway of the spine from side to side.

Self-sustained vocal fold oscillation is tied to self-sustained scapular thoracic oscillation through omohyoid swing. The laryngeal and hyoid pumping provided by the swinging arms keeps the larynx cartilage free to move, the vocal cords flexible, and the flow of air vibrational.

Larynx elevation and 'false larynx depression' can be associated with:

1. A forward upper extended neck and head.
2. An elevated asymmetrical anterior chest.
3. A hyperinflated chest wall.
4. Poor diaphragmatic unilateral or bilateral zones of appositions (ZOA's).
5. A rigid and stiff thorax accompanied by over-secured shoulder blades.



A rigid and stiff thorax and scapula is possibly related to an overly contracted omohyoid that pulls the laryngeal structure down, challenging modulation of sound pitch.

("Omohyoid Influence on Larynx", presented by Ron Hruska at the 2018 Interdisciplinary Integration Symposium)

A rigid and stiff thorax, neck and mandible, is possibly related to an overly contracted geniohyoid and mylohyoid (usually on the right) and a relaxed omohyoid that makes larynx depression difficult and interoceptive low frequency recognition and production difficult.

("Omohyoid Influence on Larynx", presented by Ron Hruska at the 2018 Interdisciplinary Integration Symposium)

Therefore, vocal cord vibrational (oscillation) flow and bronchial vibrational (oscillation) flow depends on pendular hemi-thoracic translational energy provided by upper extremity rotational energy.

Kinetic energy is:

Translational energy, or energy related to the linear velocity of the arm, and rotational energy, or energy from rotational velocity of an arm in space.

Potential energy is:

The quantity of mass (scapular and larynx) raised against gravity, multiplied by the height to which the arm is raised.

Potential energy transforms into kinetic energy (vibration) so we can freely use our vocal cords for translational energy, and our laryngeal cartilage for rotational energy during phonation.

Larynx neutral-depressed position, offered by the omohyoid and sternothyroid muscle, amplifies resonance, or sympathetic vibration, in the bones of the skull, chest wall and neck.

Other resonators for the voice are:

- Chest
- Trachea
- Larynx
- Pharynx
- Oral Cavity
- Nasal Cavity
- Sinuses

McKinney C. The diagnosis and correction of vocal faults. Nashville, TN: Broadman Press, 1987.

Excess raising of the larynx impedes 'free' vibrations coming from the larynx.

This larynx height pushes up on the tongue and extrinsic muscles of the larynx.

The vocal tract becomes shorter, the neck becomes 'tied down' and the tongue is in a 'swallow' mode.

The position of the shoulder blades directly affects the position of the larynx.

Rigid and stiff scapula's and thoraxes contribute to the omohyoid being tight and contracted, which will pull the laryngeal and hyoid down "into" the throat.

Conversely, if the scapula's are upwardly rotated, protracted and internally rotated, so often seen in 'habitual rounding of the shoulders', the omohyoid muscles go on slack.

They become less effective in depressing the larynx downward in an appropriate position for voice production.

Therefore, swinging, reaching, extending, and rhythmically moving the arms will increase vocal quality and decrease vocal fatigue.

PRI Non-Manual Technique Application for Symmetrical Oral Position

'Arms Forward/Arms Up' Examples

Supine Hooklying Bar Reach

The main difference between upright and supine resting tidal breathing is that the abdomen is not active in the supine position. Gravity replaces the abdomen (abdominals) from working in the manner they would work when upright. Gravity, in this position, mechanically "tunes" the diaphragm by 'expiring' the abdomen. Because the abdomen is passive, it is highly compliant and easily moved by contraction of the diaphragm's costal fibers.

Hoit JD. *Influence of body position on breathing and its implications for the evaluation and treatment of speech and voice disorders.* J Voice. 1995 Dec; 9(4):341-347.

Supine Hooklying T8 Extension

To help expand a rib cage for classical singing, public speaking or walking without holding your breath for "push", effort, or force to propel, an activity like this is suggested.

The demands for rapid and precise pressure control can be achieved by speaking or singing during the exhalation phase.

Supine Hooklying Stabilization #1

During supine speech breathing, the motions of the abdomen are a consequence of the actions of the diaphragm (during inspiration) and rib cage (during speaking and with this technique supplemented with scapula-omohyoid alternation – laryngeal manipulation).

Supine Hooklying Stabilization #2

Supine Weighted Scapular Protraction

Good technique for speakers, singers, and media personnel (i.e. radio announcers) in that it assists in increasing inward displacements of the abdomen to elevate the rib cage to a higher position during performance without hyperventilating or over-using accessory anterior neck muscles.

Supine Hooklying Supported Left Hamstring with Overhead Support

Teaching someone how to vocalize while pushing hands/arms up into a wall and using a tripod state in a supine position.

This position facilitates emergence of what is sometimes referred to as the most "natural" breathing pattern. This pattern is said to be characterized by relatively large abdominal motion and little or no rib cage motion.

Supine Hooklying Supported Left Hamstring with Overhead Support

The patient is asked to attend to the rise and fall of the abdomen while breathing quietly and then to practice vocalizing using the same large abdomen motion. Next, the patient is brought to an upright seated or standing position and instructed to maintain the same breathing pattern. The goal is that the patient eventually will carry over the so-called "natural breathing pattern" from the supine body position to everyday speaking activities performed in the upright body position. *(J Hoit, 1995)*

'Arms Forward/Arms Down' Examples

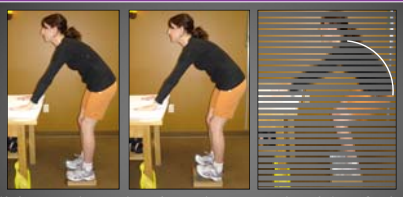
Squatting Bar Reverse Reach

After achieving resting tidal breathing in the supine body position, and speech breathing in the supine body position, one should consider speech breathing in this upright breathing body position as the arms reach forward in the last photo.

Reversed Standing Resisted Reach

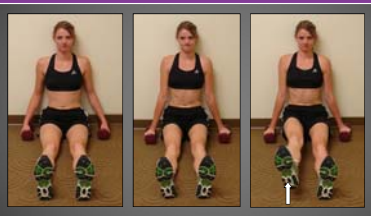
Wonderful way to lengthen suprahyoid fascia and muscle.

Standing Supported Bilateral IO/TA



In addition to lengthening the suprahyoid soft tissue, with phonation, laryngeal lowering is more than likely going to occur because of the desirable abdomen position and ideal zone of apposition position.

Long Seated Supported Press Down with Right Iliacus and Psoas



Lower trapezius and triceps help lower the larynx/hyoid through omohyoid "pull".

Long Seated Supported Press Down with Abdominals

Suprahyoid lengthening, laryngeal lowering and elongation of laryngeal/hyoid soft tissue for 'vibratory freedom' when finished.

'Alternating Appendage' Examples

Long Seated Alternating Crossovers

Best technique for oscillatory resonance and resonance frequency.

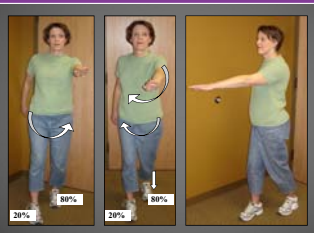
Seated Resisted Serratus Punch with Left Hamstrings

Great technique for unilateral scalene, sibson's fascia, omohyoid, sternothyroid, thyrohyoid and sternohyoid soft tissue.

Latissimus Hang Stretch

Reduces demands on supraglottal need for increased tension, thus improving infraglottal frequency, vibration and resonance.

Left Stance in Right AF IR Position from the Right AIC Pattern



Enhances scapular oscillation and laryngeal/hyoid "pumping".

Forward Alternating Reciprocal Resisted Respiratory Reach

Simply reduces vocal fatigue and improves voice quality if phonation occurs during exhalation.

Single Leg Kneeling

When done in alternating sequence, strain on neck is reduced and base of tongue relaxes as the larynx 'push up' is reduced because of shift of extrinsic postural muscle shifts to pelvis, abdomen and thorax, provided breathing or phonation is not held.

Thank you for keeping me company.

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Postural Restoration Institute®
celebrating 20 years