Malposition of Airway Axial Alignment and Stomatognathic Common Compensatory Conflict

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AAPMD Collaboration Cures
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The four major postural contributions underlying most human compensations for airway physiologic regulation and physical management are:

1. Forward pelvis inclination
2. Forward xiphoid inclination
3. Forward shoulder inclination
4. Forward head inclination

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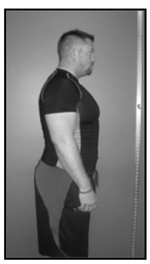
As the resting lumbar lordosis increases, the head is advanced forward for vestibular postural balance and cervical ocular comfort.



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Forward inclination of the pelvis, xiphoid, shoulder(s) or cranium has a direct impact on the need to advance the other three sites forward for innate balance.

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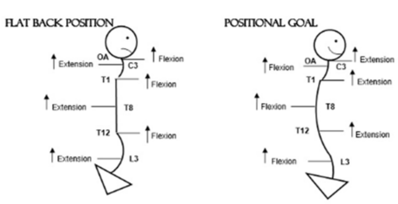
The posterior upper thoracic retrusion enhances mid thoracic flatness, and curvature, through rotary compressive forces.



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When the resting cervical lordosis of 30 degrees is lost, activity of the sternocleidomastoid, genioglossus, hyoglossus and lateral pterygoid muscle increases.

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'Neutral' OA and cervical spine (30-35°)

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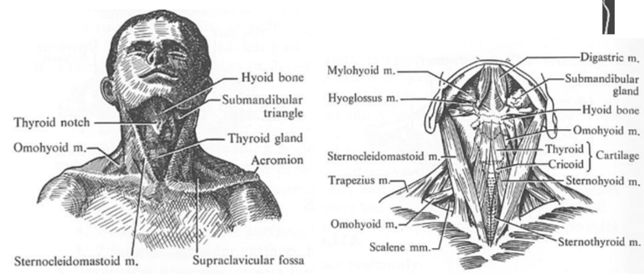

Figures from: Pansky B, House E.L. Review of gross anatomy. 3rd Edition.

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Any of the above "forward inclination scenarios" can and do, influence the other three, through accompanying patterned cortical, functional respiratory compensation.

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For instance, someone who overuses the accessory respiratory muscles for nasal inhalation will need to "pull" their anterior chest wall up with their pec minors in the front, and their latissimus dorsum muscle in the back.

Both promote forward shoulder inclination.

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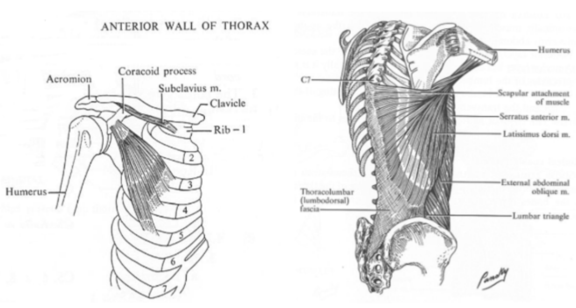

Figures from: Pansky B, House E.L. Review of gross anatomy. 3rd Edition.

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Therefore, inhibiting compensation associated with the above three "forward" scenarios, can be very instrumental in reducing airway or pharyngeal limitation, airway obstruction or restriction and torsional rigidity of the soft tissue immediately around the airway.

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Human Respiratory Compensatory Conflict Considerations

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To inhibit respiratory compensatory conflict, an appreciation for the human common pattern of neuromuscular asymmetrical behavior would help outline the methodology needed for facilitating diaphragmatic effectiveness on expanding the velopharynx, the oropharynx and the laryngopharynx.

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Restoring pelvis, shoulder and head resting or neutral orientation reinforces the physiologic experience that comes with good air flow, and therefore reinforces postural positioning that inhibits the compensatory effort associated with forward inclination.

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It is also important to recognize that when nasal breathing is restricted, by either anatomical or inflammatory factors, there will be a physiological and physical change of pelvis, shoulder and head position to compensate for nasal respiratory challenge.

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Restriction in normal nasal breathing would facilitate a physiological shift to oral breathing and use of the genioglossus muscle to open the airway.

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This shift to oral breathing lowers the mandible, decreasing the muscle tension of the suprahyoid muscle.

The pharyngeal air passage, concomitantly, is compromised as the hyoid bone moves posteriorly, and the upper cervical spine (C3) moves forward, or anteriorly.

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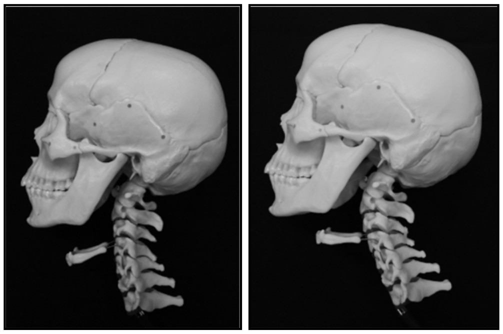

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As the longitudinal axis of the airway shifts on itself, there is a cervical osseous rotary component that also shifts cranial passages, foramens, orbits, conchae, turbinates and canals, via the atlas occipital joint arthrokinetic adaptation, to visual, vestibular, and gravitational cortical referencing.

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This reduction in cervical-cranial flow, space and movement, in general, necessitates cortical processing of sense, associated with this malposition, to assume a more extended position at the base of the head, the mid thorax and the mid lumbar spine so that the hyoid bone can move anteriorly and superiorly, without using suprahyoid muscles to restore airway space as much as possible.

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Forward Head Inclined Asymmetry

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As the head advances forward, the head itself usually remains in an extended and compressed, compromised state, with cranial rotation often to the left on an atlas that is oriented laterally and transversely to the right.

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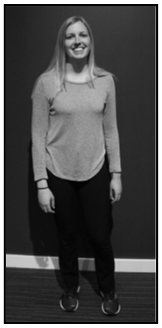

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This unilateral thoracic/hyoid shift of orientation to the right followed by compensatory mandibular compensatory rotation to the left (right genioglossus and right lateral pterygoid) for attempted temporal re-direction of cranium to the left, more than likely contributes to the collapse of the posterior pharyngeal wall.

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Mandibular sling to the left

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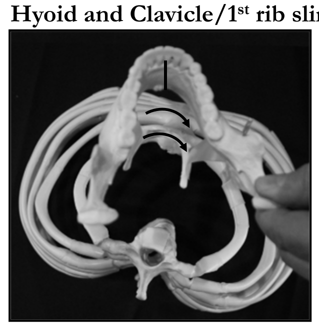
Hyoid and Clavicle/1st rib sling to the right



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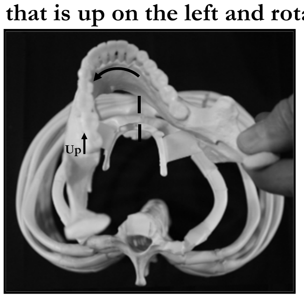
Left Sidebend Cranial Mandibular sling that is up on the left and rotated to the left



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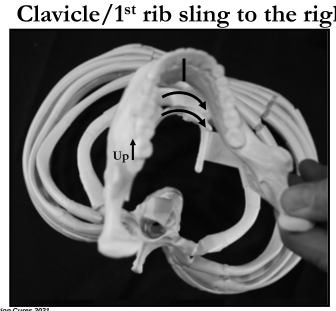
Left Sidebend Cranial Hyoid and Clavicle/1st rib sling to the right



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Correcting alignment of the cervical spine during inspiration allows the lateralized mandibular and hyoid 'sling' musculature to align with their counterparts for appropriate genioglossus muscle opposition to the negative thoracic pressure produced during diaphragmatic inspiration.

[Tingey EM, et al. Mandibular rest position: a reliable position influenced by head support and body posture. Am J. of Orthodontics and Dentofacial Orthopedics. 2001; 120(6):614-622.]

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The genioglossus muscle acts as a dilator of the pharynx and the mandibular position influences the genioglossus activity, further strengthening the anatomical and biological association between stomatognathic/occlusal functional guidance and airway patency.

[Lee NR, et al. Genioglossus muscle advancement techniques for obstructive sleep apnea. Atlas of the Oral and Maxillofacial Surgery Clinics of North America. 2007; 15(2):179-192.]

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The stomatognathic system compensation increases when neutral head rest is compromised, secondary to forward unilateral head inclination. Acoustic resonance, laryngeal aerodynamics and subglottal pressure all are directly influenced by airway constriction or anterior cervical soft tissue torsion.

[Massery M, et al. Effect of airway control by glottal structures on postural stability. J Appl Physiol. 2013; 115:483-490.; Rubin JS, et al. Posture and Voice. J of Singing. 2004; 60(3):271-275.; Vorperian HK, et al. Effect of body position on vocal tract acoustics: Acoustic pharyngometry and vowel formants. J Acoust. Soc. Am. 2015; 138(2).]

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Hypertonicity of the thoracic, asymmetric tone between hemidiaphragms, large lung volume (hyperinflation) or weakness of anterolateral abdominal muscles, would result in "decreased descent of the diaphragmatic dome" upon contraction.

[Hruska, RJ. Influences of dysfunctional respiratory mechanics on orofacial pain. Dental Clinics of North America. 1997;41(2): 211-227.]

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This places greater demand on accessory respiratory muscles such as the SCM, especially on the right side, and anterior cervical musculature to lift the ribcage, leading to postural compensations as a result of the faulty breathing patterns: increased lumbar lordosis, decreased thoracic kyphosis, posterior cranial rotation, and thus forward head position.

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Overactive ipsilateral SCM muscular function has been shown to cause postural deviations in facial and head posture, and spinal axial rotation.

[Chate, RAC. Facial scoliosis due to sternocleidomastoid torticollis: a cephalometric analysis. International J. of Oral and Maxillofacial Surgery. 2004;33(4):338-3434.]

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Cervical Axial Alignment Influence on Airway Alignment

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In the later part of 1977, I read this from Aelred C. Fonder, DDS in his book titled *'The Dental Physician'*:

"When mandibular-neuromuscular tension is removed, the mandible assumes a relaxed posture, the hyoid bone and cervical vertebrae assume a physiologic relationship, and as a result, the muscles of the upper torso, which establish the posture of the head, neck and shoulder frame begin to normalize."

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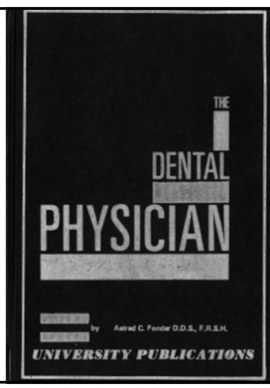

My life has centered around asymmetrical axial alignment ever since.

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There are numerous references in our multidisciplinary literature that have shown how altered occlusion or malocclusion influences cervical axial alignment or laryngeal inlet diameter.

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There probably is no greater amount of literary reference, on compensatory mechanisms of the human body, than there is on the presence of compensation that follows temporal mandibular dysfunction secondary to malocclusion or occlusal alteration of those with limited cervical symmetrical function.

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Compensation usually leads to or follows pathology, and cervical pathology and cervical ocular reflex pathology usually coexist with most stomatognathic conflicts. "Airway obstruction regulates postural compensation, and postural compensation regulates airway obstruction."

[Hruska RJ. Cervical Revolution: An Integrated Approach to the Treatment of Patterned Cervical Pathomechanics. Postural Restoration Institute.]

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However, there probably is no one in the health care industry that visualizes the orientation of airway through the stomatognathic system more than the anesthesiologist.

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Direct laryngoscopy and tracheal intubation, are two of the basic and the most important skills in anesthetic practice.

It requires proper positioning of the head and neck to adequately visualize the glottis and easily negotiated the tracheal tube through the glottic opening.

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The position traditionally recommended and taught to all learners of airway management is the "sniffing position".

This involves supine neck flexion (head elevation) by putting a pillow under the head and then extending the head at the atlanto-occipital joint.

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This position allows the line of vision to fall straight on the laryngeal inlet by aligning oral, pharyngeal, and laryngeal axes. This three-axes alignment theory (TAAT) describes alignment of pharyngeal and laryngeal axes by flexion of the neck and alignment of the oral axis with the other two axes by extension of the head.

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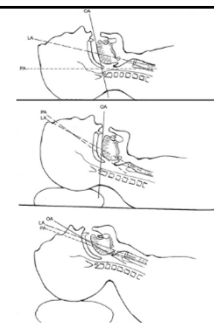

Figure 1: The three axes alignment theory. Upper: position of the 3 axes with the head in the neutral position. Middle: head elevation (neck flexion) aligns the pharyngeal axis (PA) and the laryngeal axis (LA). Lower: extension of the elevated head achieves alignment of the oral axis (OA) with the other axes.

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Figure 1 from: El-Orbany, Mohammad MD, et al. Head and Neck Position for Direct Laryngoscopy, Anesthesia & Analgesia: July 2011 - Volume 113 - Issue 1 - p 103-109 doi: 10.1213/ANE.0b013e31821c7e9c

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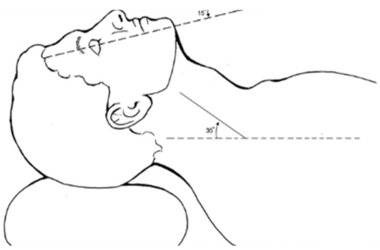

Figure 2: The head in the sniffing position. The neck should be flexed 35° on the torso and the head extended at the atlantooccipital joint to produce a 15° angle between the facial plane and the horizontal. These angles should be used to define the proper sniffing position.

Figure 2 from: El-Orbany, Mohammad MD, et al. Head and Neck Position for Direct Laryngoscopy, Anesthesia & Analgesia: July 2011 - Volume 113 - Issue 1 - p 103-109 doi: 10.1213/ANE.0b013e31821c7e9c

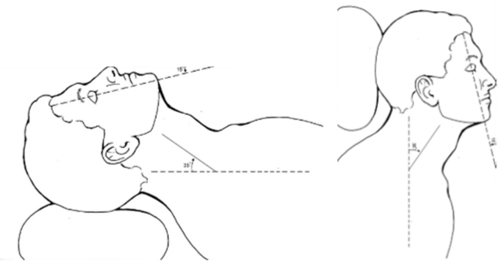

Figure 2 from: El-Orbany, Mohammad MD, et al. Head and Neck Position for Direct Laryngoscopy, Anesthesia & Analgesia: July 2011 - Volume 113 - Issue 1 - p 103-109 doi: 10.1213/ANE.0b013e31821c7e9c

Historical Overview of the Three Axes Alignment Theory and Its Comparison to the Present Precedence of Inclined Posture

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In 1852, Horace Green positioned a patient in he sitting position, with the head pushed forward and next to a window. With his back to the window Green was able to use daylight alone to view the patient's vocal cords and excise a polyp.

[Greenland KB, et al. The origins of the sniffing position and the Three Axes Alignment Theory for direct laryngoscopy. Anaesth Intensive Care. 2008; 36(1).]

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In 1855, Manuel Garcia used a mirrored laryngoscopy to obtain diagnoses and treat upper airway obstruction.

[Garcia M. Observation on the human voice. Pro Roy Soc, London. 1855; 7:397-410.]

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In 1897, Kirstein introduced the term "autoscopy" to describe direct visualization of the glottis. He also advocated having patients seated with their head and neck positioned in what closely resembles the sniffing position.

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In 1913, Chevalier Jackson wrote ‘Peroral endoscopy and laryngeal surgery’, a landmark textbook on upper airway endoscopy from a surgical perspective. He described a number of different positions for direct laryngoscopy dependent on the indication for the procedure.

The base of the occiput to C3 joints are hyperextended in each “sniffing position” procedure.

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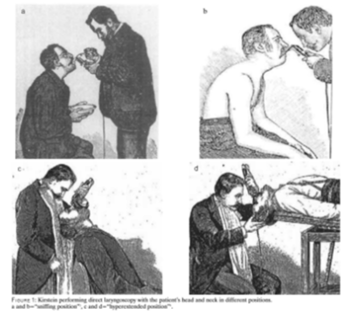

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Figure 1 from: Greenland KB, Eley V, et al. The origins of the sniffing position and the three axes alignment theory for direct laryngoscopy. Anaesth Intensive Care. 2008; 36(Supp 1):23-27.

In 1936, Sir Ivan Magill recommended placing a pillow under the occiput to raise the head and then to extend it to achieve the best laryngeal exposure.

He was the first to describe the optimal head position for direct laryngoscopy as the position the head assumes when one wishes to ‘sniff’ the air.

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The sniffing position enlarges both retroglossal and retropalatal airways.

The size of the pharyngeal airway is determined by a precise interaction between neural regulation of the activity of the pharyngeal dilator genioglossus muscle and anatomical structures of the pharyngeal airway.

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Many individuals with limited nasal flow and resonance quality, limited abdominal strength, limited hamstring usage, limited centric occlusion or limited visuo-spatial integration will bring their head and upper neck forward, by raising their distal sternum (xiphoid) up and forward along with the attached ribs to acquire an upright “sniffing positional” state for pharyngeal dilatation and sub-optimal zone of apposition (ZOA).

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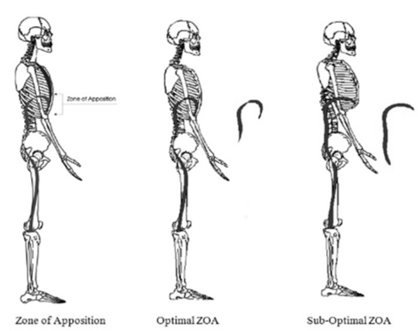

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Pharyngeal Collapsibility

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Pharyngeal collapsibility, which is an important factor that dictates whether the pharyngeal airway remains patent, is influenced by hyperinflation of the lungs, obesity, as well as craniofacial structural abnormalities.

[Watanabe T, et al. Contribution of body habitus and craniofacial characteristics to segmental closing pressures of the passive pharynx in patients with sleep disordered breathing. Am J Cri Care Med. 2002; 165:260-5.]

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Pharyngeal collapsibility is reduced, bony enclosure size is enhanced, and pharyngeal airway size increases upon forward head projection, regardless of the elevation of the chest wall secondary to poor diaphragm apposition, i.e. abdominal resting tension/strength.

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Forward head projection or over extension of the cranium on an over-flexed mid cervical spine (sniffing position) also enables the mechanical load relief of the tongue soft tissue from the soft palate, which may be a probable explanation for the retropalatal airway patency improvement.

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Individuals who maintain the sniffing position for reduction of pharyngeal collapsibility acquire paradoxical inspiratory retraction of the rib cage and lower intercostal interspaces, which has been attributed to direct traction of the lateral rib cage margins by flattening the diaphragm.

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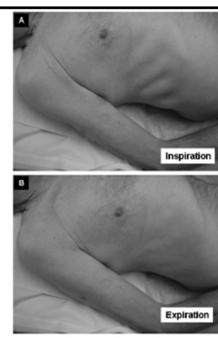

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Figure 1 from: Johnston CR III, et al. The Hoover's sign of pulmonary disease: molecular basis and clinical relevance. Clinical and Molecular Allergy. 2008;6:8.

In the 1920s, Hoover described a sign that could be considered a marker of severe airway obstruction, especially noted in patients diagnosed with chronic obstructive pulmonary disease.

[Johnston CR III, et al. The Hoover's sign of pulmonary disease: molecular basis and clinical relevance. Clinical and Molecular Allergy. 2008; 6:8]

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The Hoover's sign position, in standing, sitting or supine, is the same "sniffing" position anesthesiologists, past and present, place their patients in to examine an "open" airway.

Axial alignment of the pharynx is improved in these positions, albeit temporarily.

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True connate pharyngeal patency, or reduced pharyngeal collapsibility can only be maintained when stomatognathic balance of lateral pterygoid, genioglossus, and hyoglossus function is restored, after bilateral zone of apposition is achieved.

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Orientation of these primary stomatognathic muscles are important in the regulation of phonation, deglutition, mastication, and respiration.

Asymmetrical cranial mandibular orientation and operative function are all a reflection of cervical axial innate patterning to maintain upright postural balance and equilibrium.

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Unilateral, or bilateral loss of thoracic zones of apposition (forward inclined and elevated anterior rib cage) has a significant impact on cranio-cervical- mandibular kinesthetics and related cortical function. The most common anatomical feature associated with the forward pelvis, xiphoid, shoulder, and head is an elevated anterior rib cage.

[Hodges P, et al. Contractions of specific abdominal muscles in postural tasks are affected by respiratory maneuvers. J Appl Physio. 1997; 83:3.; Mead J. Functional significance of the area of apposition of diaphragm to rib cage. Am Rev Respir Dis. 1970; 11:31.; Hruska RJ. Management of pelvic-thoracic influences on temporomandibular dysfunction. Ortho Phys Ther Clin North Am. 2002; 11:2.)

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Overall the important consideration here, is that pharyngeal collapsibility is reduced when the pelvis, xiphoid, shoulder and head go forward when the zone of apposition, on one or both sides of the thorax is lost.

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However, pharyngeal collapsibility is also reduced when the pelvis, mid thorax, shoulder and head move back, as the thoracic zones of apposition are maintained. This is an important consideration when addressing airway management. It is a multidisciplinary issue and requires a good understanding of chest wall dynamics and position influence on the stomatognathic system, and vice versa.

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In other words, if the human can maintain downward eccentric and concentric "pull" on the anterior rib cage, the need to "pull" the head, shoulders, and xiphoid forward and toward each other, to open an airway, is reduced.

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Natural, organic airway management depends on non-compensatory conflict at the stomatognathic system, by establishing resonating co-activation of thoraco-abdominal orientation to a neutral, aligned cervical axis.

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This relationship between head and neck compensation, and thoraco-abdominal orientation can easily be assessed by considering the patency of the airway.

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Instead of preparing to perform laryngoscopy in the "sniffing position", to achieve "three axis alignment" of the pharyngeal axis, the laryngeal axis, and the oral axis, theoretically one might assess the need, to reduce the compensation manifestations placed on the stomatognathic system, first.

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This can be done through manual assessing the cervical axis orientation.

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Cervical Axial Orientation

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Airway axial alignment or pharyngeal orientation reflects upright cervical axial orientation, occipital atlas kinetics, and stomatognathic muscle patterns of compensation.

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C1 through C3 (C2) aligned stability is required for temporomandibular fossa side to side shifting (lateral pterygoid). Therefore, C2 serves as an automatic shifting fulcrum or balance point for the mandible and our airway. As the mouth opens, the mandible can maintain its balanced relationship to C2.

[Upledger JE. Craniosacral Therapy. Eastland Press.]

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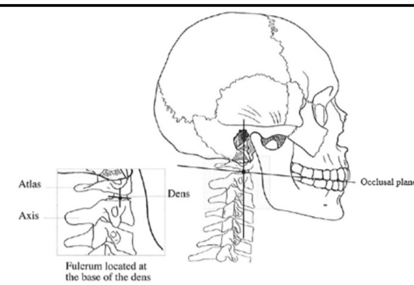

12.3 The fulcrum for mandibular motion

From Craniosacral Biodynamics, Volume II: The Primal Midline and the Organization of the Body by Franklyn Sills, published by North Atlantic Books, copyright © 2004 by Franklyn Sills. Used with permission of publisher.

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This range of resting lordosis of the cervical spine reflects the occipital atlanto and cervical thoracic arthro- and osteo-kinetics, as well as accompanying airway opening. Airway patency is reduced when the lordosis is reduced, and in some situations, heightened, secondary to the thoracic orientation of the upper cervical spine, forward or to the right.

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Regardless if the cervical spine is oriented forward, to the right or both, C3 moves forward, as C7/T1 moves back.

Forward positioned T8 (loss of zone of apposition), more than likely is the leading implication behind these osteokinematic movement patterns.

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When T8 moves forward, the occiput, on one or both sides, would need to over-extend to "open" the airway. (Sniffing position).

This overextension at the base of the cranium or head, enhances compensatory conflict between lateral pterygoid, genioglossus and hyoglossus muscles.

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Over time, this compensatory conflict between these outlined muscles, challenge sustainability of airway patency and viability of lateral pterygoid function, as a regulator of the palatopharyngeus, palatoglossus, and pharyngopalatine arches.

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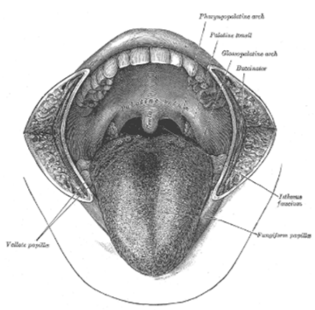

From: Henry Gray (1918) Anatomy of the Human Body. Public domain on Wikipedia Commons. https://en.wikipedia.org/wiki/Palatoglossal_arch

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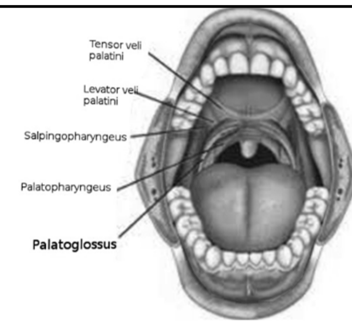

From: Rathee M, Jain P. Anatomy, Head and Neck, Palatoglossus Muscle (Glossopalatinus, Palatoglossal) [Updated 2021 Jun 18]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021 Jan. Available at https://www.ncbi.nlm.nih.gov/books/NBK549823/ & distributed under the terms of the Creative Commons Attribution 4.0 International License.

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Over-extension of the occiput on the atlas, or the C1-C3 segment on occiput, usually requires shifting of the entire stomatognathic system, usually to the right and forward.

Normal alternating function of the mandible, tongue, hyoid and sternum becomes increasingly limited as this occurs.

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The tongue, lateral pterygoid and sternocleidomastoid, become overactive as unilateral rotators and stabilizers of the head, neck and chest, reinforced by the need to find a way to move the cranium forward for respiration.

[Hruska RJ. Cervical Revolution: An Integrated Approach to the Treatment of Patterned Cervical Pathomechanics. Postural Restoration Institute.]

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Cervical Axial Rotation Test

Patient lies in supine with knees flexed to flatten the lumbar spine. Place both hands around each side of the patient's neck, with little fingers placed on distal transverse processes of C2, middle fingers placed on transverse processes of C7 and index fingers placed on spinous process of T1. Place thumbs directly under and parallel to SCM's. Passively rotate the cervical spine as a unit to the left by rotating the neck with right thumb, 3rd, 4th, and 5th fingers while right index finger stabilizes T1. Compare soft tissue limitations or rotational limits or differences secondary to thoracic spine position by rotating neck from neutral to the left and from neutral to the right, through C7 and T1 and surrounding soft tissue.

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Cervical Axial Rotation

A positive test is indicated by limitation in one direction when compared to the other, or when inequality of range of motion exists.

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Cervical/Airway Axial Repositioning Recommended Techniques

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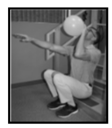
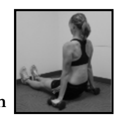
Stair Short Seated Balloon



Stair Short Seated Balloon Anterior Neck Inhibition

Long Sitting

Long Seated Supported Press Down with Abdominals



Long Seated Press Down

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Thank you!

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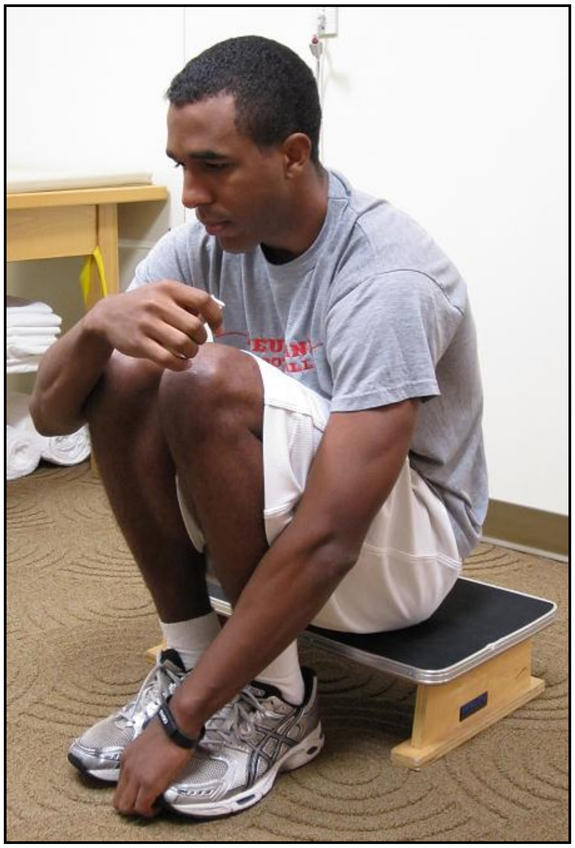
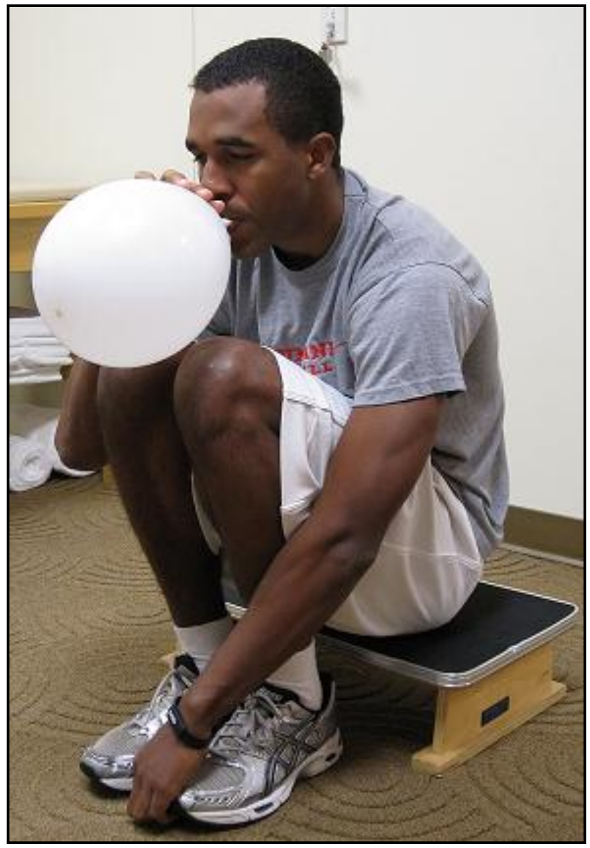
Stair Short Seated Balloon





1. Sit on a 6-inch step with your feet together, knees bent and knees together.
2. Round out your back and roll your pelvis back, feeling your “sit bones.”
3. Inhale through your nose and slowly blow out into the balloon.
4. Pause three seconds with your tongue on the roof of your mouth to prevent airflow out of the balloon.
5. Without pinching the neck of the balloon and keeping your tongue on the roof of your mouth, take another breath in through your nose.
6. Slowly blow out again as you stabilize the balloon with your hand.
7. Do not strain your neck or cheeks as you blow.
8. After the fourth breath in, pinch the balloon neck and remove it from your mouth. Let the air out of the balloon.
9. Relax and repeat the sequence 4 more times.

Reference Center(s): Left abdominals, Left sit bone, Left heel, Right arch

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Stair Short Seated Balloon Anterior Neck Inhibition

1. Sit on a 6 to 8-inch step and place a small ball between your knees. Keep your weight evenly distributed through your sit bones.
2. Once you have achieved this short seated position, reach forward with your right arm and place a balloon in your mouth with your left hand. (1^{st} photo)
3. Inhale deeply through your nose while maintaining this right arm forward reach position.
4. Slowly blow out into the balloon as you maintain your right arm forward reach position. (2^{nd} photo)
5. Pause three seconds with your tongue on the roof of your mouth to prevent airflow out of the balloon.
6. Without pinching the neck of the balloon and keeping your tongue on the roof of your mouth, take another breath in through your nose while maintaining this right arm forward reach position.
7. Slowly blow out into the balloon as you raise your right arm to head level, and as your head begins to face upward. (3^{rd} photo)
8. Pause three seconds with your tongue on the roof of your mouth to prevent airflow out of the balloon.
9. Without pinching the neck of the balloon and keeping your tongue on the roof of your mouth, take another breath in through your nose while maintaining this right arm forward position.
10. Slowly blow out into the balloon as you maintain the right arm position and rotate your head backward. Your right arm should continue to reach forward as your head moves back. You should feel a stretch in your anterior neck. (4^{th} photo)
11. Relax and repeat the sequence 4 more times.

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Long Sitting

1. Sit on the floor with your legs straight out in front of you.

2. Sit upright and place your hands on your knees. You should feel your "sit bones."
   *Your back should be straight, not slouched or arched backwards.

3. Maintaining the above position, turn both legs in so that your toes are pointing straight towards the ceiling.

4. Hold this position while you take 4-5 deep breaths in through your nose and out through you mouth. You should feel the muscles on the back of your thighs.

   *As you inhale, do not let your anterior ribs pull up or your back arch backwards.

Reference Center(s): Left abdominals, Left sit bone

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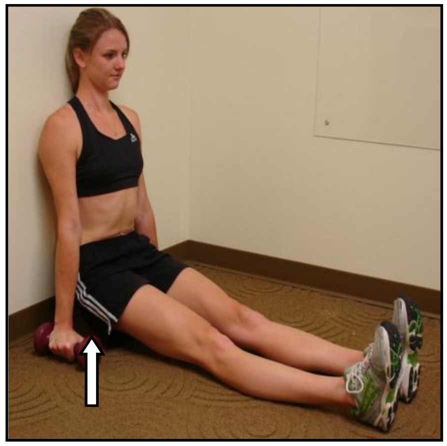
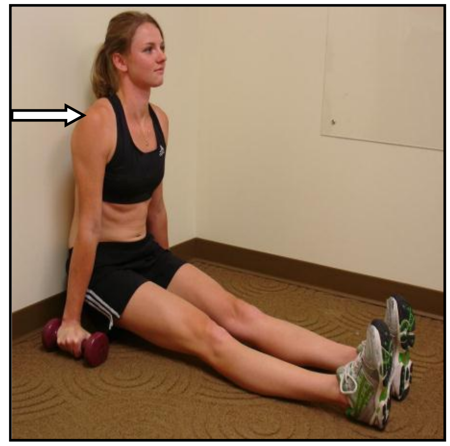
Long Seated Supported Press Down with Abdominals





1. Sit on the floor with your back against the wall and your legs straight.
2. Place hand weights that are large enough so you can grasp the handles without your fingers touching the floor.
3. Pull your shoulder blades down and together.
4. Keeping your shoulder blades pulled together, slowly raise your bottom off the floor by straightening your elbows. You should feel the muscles on the back of your shoulder blades engage.
5. Maintaining the above position, bring your upper trunk forward, leading with your sternum, not your neck. Keep a slight pelvic tilt so that your bottom is tucked under you. You should feel your abdominal muscles engage along with the back of your thighs.
6. Hold this position as you take 4-5 deep breaths, in through your nose and out through your mouth.
7. Relax and repeat 4 more times.

Reference Center(s): Left abdominals, Left heel

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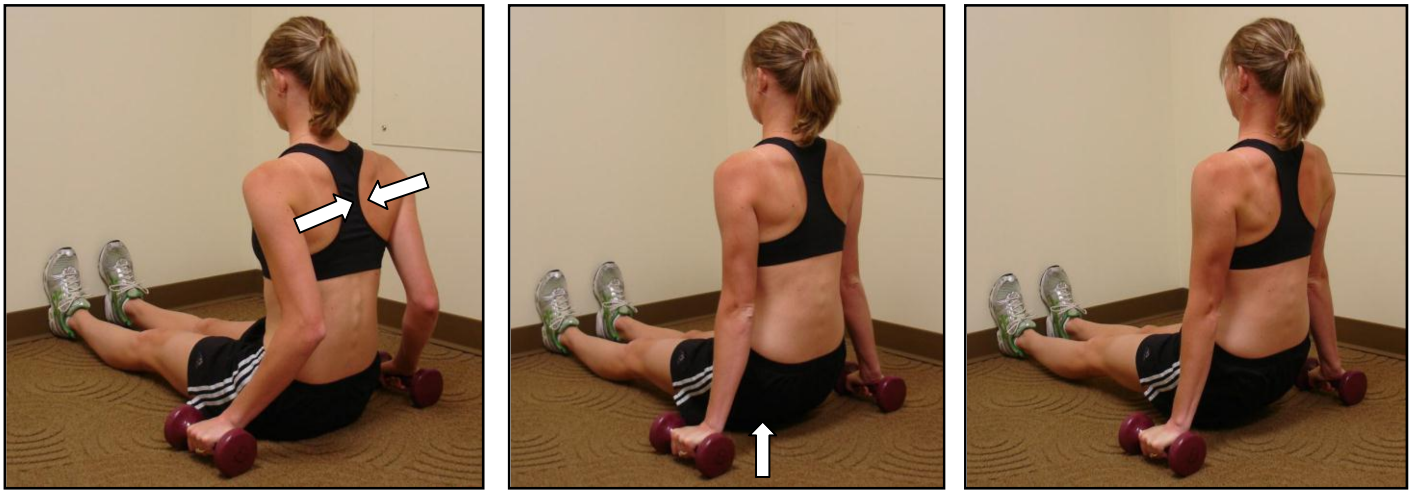
Long Seated Press Down



1. Sit with your legs straight and your feet pressed into a wall.
2. Place hand weights at your sides that are large enough to grasp the handles without your fingers touching the floor.
3. Pull your shoulder blades down and together.
4. Keeping your shoulder blades pulled together, push your body up by straightening your elbows. You should feel the muscles on the back of your arms engage.
5. Bring your upper body further up and lean your trunk slightly forward, keeping your pelvis tucked under you. You should feel the muscles on the back of your thighs and the back of your shoulder blades engage.
6. Hold this position while you take 4-5 deep breaths, in through your nose and out through your mouth.
7. Relax and repeat 4 more times.

Reference Center(s): Left abdominals, Left heel

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