Neurology of Sleep Disordered Breathing

The connection between sleep apnea, neurotransmitter deficiency, and a dysfunctional swallow is discussed in some depth by Andrisani et al., who explore how orofacial muscle dysfunction, particularly involving the swallowing mechanism, can impact neurological regulation of the upper airway.

Here's a breakdown of the concept based on their work:

1. Swallowing and Brainstem Reflexes

Swallowing is a highly coordinated neuromuscular activity controlled by brainstem centers that also regulate breathing. Andrisani et al. emphasize that a dysfunctional swallow—often caused by poor tongue posture, weak or poorly coordinated orofacial muscles, or abnormal swallowing patterns (e.g., tongue thrust)—disrupts normal sensorimotor feedback to the brainstem. (more information about swallowing on pages 2-3)

2. Neurotransmitter Signaling

Proper swallowing stimulates neurotransmitter release—especially acetylcholine, dopamine, and other modulators involved in motor control and autonomic function. These neurotransmitters help regulate tone in the upper airway dilator muscles, such as the genioglossus, during sleep.

When the swallowing mechanism is dysfunctional, it leads to:

- Reduced stimulation of brainstem nuclei
- Impaired neurotransmitter production or signaling
- Loss of excitatory tone to airway muscles

3. Upper Airway Collapse and Sleep Apnea

During sleep, especially REM, muscle tone naturally decreases. If neurotransmitter activity is already diminished due to lack of proper oropharyngeal stimulation, this can exacerbate upper airway collapse, leading to obstructive sleep apnea (OSA).

Andrisani et al. propose that this cycle originates early in life, possibly due to:

- Improper oral habits (e.g., bottle feeding, pacifier use)
- Poor oral posture
- Myofunctional disorders

These interfere with normal neuromuscular development and swallow reflexes, setting the stage for long-term breathing and sleep disorders.

Here is a link to the article: https://doi.org/10.1007/s11325-023-02783-7

💪 Mature Swallow (Somatic Swallow) - Definition: The adult swallow pattern that typically develops around age 2–4, characterized by correct tongue posture and minimal accessory muscle use.

Muscles Recruited:

1. Tongue Muscles
- Intrinsic tongue muscles: shape the tongue
- Genioglossus: moves the tongue forward
- Styloglossus & Hyoglossus: retract and depress the tongue after the swallow
- Palatoglossus: elevates the posterior tongue

2. Suprahyoid Group
- Mylohyoid: elevates the floor of the mouth and tongue
- Geniohyoid: pulls the hyoid bone forward and up
- Digastric (anterior belly): assists in lowering the mandible and elevating the hyoid
- Stylohyoid: elevates the hyoid bone

3. Pharyngeal Muscles
- Superior, middle, and inferior pharyngeal constrictors: propel the bolus into the esophagus
- Palatopharyngeal and stylopharyngeus: aid in soft palate and pharyngeal elevation

4. Minimal Facial Muscle Involvement
- Orbicularis Oris and mentalis should be relatively passive
- Lips stay closed without active contraction
- No cheek or neck strain is evident

✅ Characteristics:
- Tongue tip presses against the alveolar ridge
- Lips remain closed with no pursing
- Mandible remains still
- No visible effort from chin, cheeks, or neck
- Swallow is silent and efficient

🍼 Immature Swallow (Visceral or Infantile Swallow) - Definition: A primitive pattern seen in infants and often retained in children or adults with orofacial myofunctional disorders.

Muscles Recruited:

1. Facial Muscles
- Orbicularis Oris: purses lips to stabilize the swallow
- Mentalis: activates to help seal the lips (dimpling seen on chin)
- Buccinator: contracts to aid in cheek compression and compensate for poor tongue posture

2. Neck and Accessory Muscles
- Platysma: can contract during exaggerated swallows
- Sternocleidomastoid: may activate to stabilize the head and neck

3. Tongue Muscles (Abnormally Positioned)
- Tongue often protrudes forward or between teeth (tongue thrust)
- Tongue is low in the mouth, with tip often between or against anterior teeth

❌ Characteristics:

- Lips purse or tighten with each swallow
- Chin dimples and cheeks tighten
- Tongue is not sealed to the palate—may move forward
- Head may tip or neck muscles engage
- Noisy, effortful swallow often seen
- Often associated with open bite, mouth breathing, or thumb sucking

🧠 Why a Mature Swallow Supports Airway Muscle Health

A mature swallow promotes healthy tone and coordination in the muscles that stabilize the tongue, jaw, and pharynx—all of which play a crucial role in maintaining a patent (open) airway. The tongue acts like a natural "scaffolding" that keeps the oral cavity and upper airway properly shaped and supported.

When the swallow is mature:

- The tongue presses against the palate, stimulating growth and maintaining tone
- Suprahyoid muscles elevate the hyoid bone and support the base of the tongue
- Palatal and pharyngeal muscles are rhythmically engaged, which helps tone the soft palate and upper airway

These repeated, functional patterns (we swallow ~600–1,000 times a day!) exercise and reinforce the airway-supporting musculature.

🍼 What Happens with an Immature Swallow

If a person retains an immature (infantile) swallow, the tongue sits low in the mouth, doesn't elevate properly, and may thrust forward. This has multiple downstream effects:

1. Disuse Atrophy of Airway Muscles

- Palatoglossus and palatopharyngeal muscles are underused → soft palate becomes flaccid
- Weak pharyngeal constrictors can contribute to airway collapse during sleep (linked to sleep-disordered breathing)
- Poor engagement of the suprahyoid muscles results in reduced hyoid elevation → impaired airway protection and swallowing safety

2. Loss of Proper Tongue-Tone Coordination

- Without consistent palatal stimulation, the tongue loses tone
- The back of the tongue may fall backward during sleep, increasing the risk for snoring or obstructive sleep apnea

3. Nasal Airway Impairment

- A low tongue posture from immature swallowing leads to narrowing of the palate, reducing nasal volume
- The body compensates with mouth breathing, which further weakens nasal and oropharyngeal tone