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Muscle Balance, Tongue Posture, and Dentofacial Development: A Review of Foundational Concepts

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Abstract

The human face is one of the most complex anatomical and functional regions of the body, integrating sensory, muscular, and skeletal components that influence dentofacial development. Malocclusions often reflect a combination of structural and functional deviations, including altered muscle balance, tongue posture, and orofacial habits. Early assessment and intervention are critical to facilitate harmonious growth and stable orthodontic outcomes. This review examines the interplay between muscular forces, tongue posture, and craniofacial development, emphasizing a holistic understanding of the stomatognathic system. The importance of awareness training, mechanical unlocking, and individualized treatment planning is highlighted, along with the role of cranial posture and nasopharyngeal function in guiding orthodontic therapy. Understanding these foundational concepts allows clinicians to optimize functional and aesthetic outcomes in growing patients.

Keywords: Muscle balance, Tongue posture, Dentofacial development, Orthodontics, Malocclusion, Functional matrix, Awareness training, Cranial posture, Orofacial dysfunction, Orthodontic stability

Introduction

Orthodontists must appreciate that the human face integrates anatomical and functional complexities, with fine nuances of expression made possible by delicate movements of facial muscles. Sensory input, including vision, hearing, smell, and taste, is intricately linked to oral proprioception and pressure sensing, all of which can influence dental function, appearance, and stability. Dysfunction in the orofacial region may result from muscular imbalances, abnormal tongue posture, cranial misalignment, or pernicious oral habits, and can manifest as malocclusions if not addressed early[1–3].

Treatment approaches have varied historically, focusing on occlusal corrections, temporomandibular joint therapy, or psychological interventions. A holistic approach that integrates these perspectives, considering both physiological and behavioral components, is most effective[4–6]. Psychophysiology, addressing both behavior and physiology, underpins the management of patients with malocclusions requiring “unlocking” of the dentition[7–9]. Early intervention is critical, as prolonged dysfunctions complicate achieving a neutral zone for stable dentofacial development.

Discussion

Functional Four-Dimensional Model

A functional four-dimensional model encompassing the anteroposterior, transverse, vertical planes, and the temporal dimension (growth and duration of dysfunctions) is crucial for planning orthodontic treatment. Long-standing orofacial dysfunctions hinder placement of the dentition in a neutral zone, making stable correction more challenging[10–12].

The question may be asked: "How certain can an orthodontist be that his or her early intervention that eliminated an orofacial dysfunction has prevented a malocclusion from occurring?" For the moment, the answer may lie in the fact that clinicians have associated certain dental malocclusions with particular orofacial dysfunctions for decades. As an example of such an association, features of a malocclusion (Figs 1, 2A, and B), that were observed in a patient with longstanding respiratory problems are shown. In this patient, the dental arches constricted, the mandibular molars moved 5 mm mesially, while there were a number of soft tissue changes associated with a 7 ° clockwise rotation of the mandible.

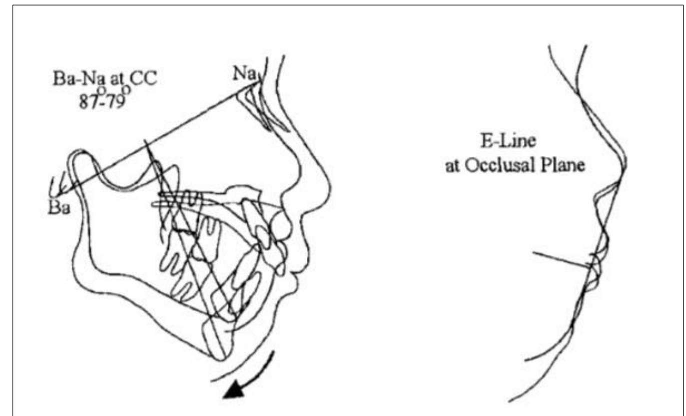

Figure 1: The cephalometric change noted in a patient with chronic nasal obstruction. The facial axis moved in a clockwise direction while the soft tissue profile became more convex with time

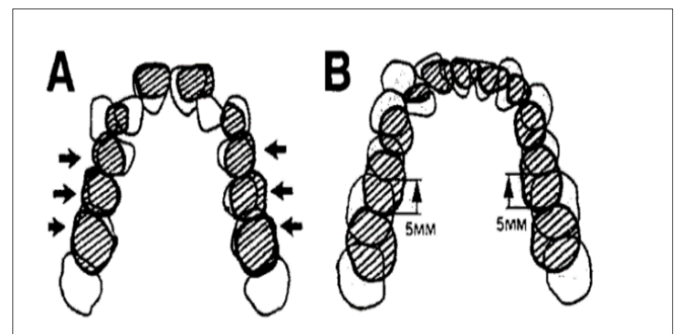

Figure 2: the maxiallry dental changes that took place a patient with a chronic nasal obstruction. The shaded teeth represent the original arch that became narrower with time (A). The mandibular arch changes that took place in a patient with chronic nasal obstruction. The shaded teeth represent the original arch that drifted mesially with time (B).

Muscle Balance and Tongue Posture

Tongue posture and volume significantly influence dentofacial development. Macroglossia, microglossia, or tongue-tie can compromise equilibrium between lingual and buccal muscles, affecting occlusion and stability[13–15]. Surgical intervention may be required for tongue-tie to restore functional movement[16]. At rest, the tongue typically postures against the posterior hard palate, guiding palatal growth and determining the neutral zone

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for teeth. Buccinator and orbicularis oris muscle balance also shapes dental arch form and influences gingival and cortical plate morphology[17–19].

The presence of pernicious oral habits should be disclosed during the process of orthodontic diagnosis. Although not in itself a habit, an anatomically abnormal tongue may predispose to functional abnormalities that could in turn affect the dentition. The tongue should have a normal range of movements and should not be "tied" to the floor of the mouth. In some patients, minor surgery (Fig 3A and B) may be required to release a tied tongue.

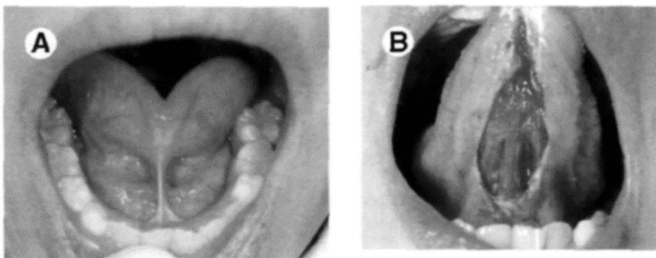

Figure 3: A typical tongue “tie” before surgical release (A). The underside of a tongue release of a tongue “tie” (B).

Cranial and Head Posture

An evaluation of a patient's habitual cranial position (Fig 4) should be part of the orthodontic diagnostic process. It is likely that the natural head posture for any individual represents a range of cranial positions that will include periods of cranial extension and flexion that will affect the individual's mean head position, sometimes called the orthostatic head position. Habitual cranial postures that appear to be abnormally flexed or extended have been associated with a variety of facial abnormalities. A forward head position that is extended at the atlantooccipital joints has been noted in patients who are predominantly mouth breathers due to a complete or partial obstruction of the nasal passages[14, 15, 20].

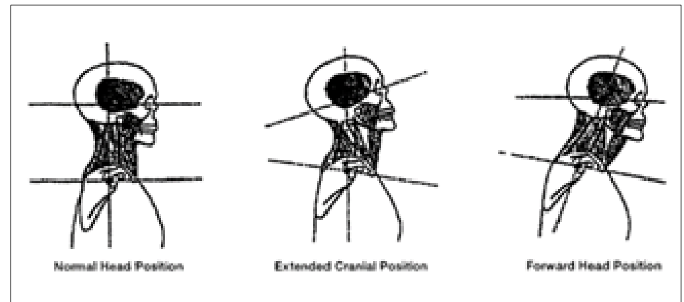

Figure 4: Three examples of head position. Every individual has a range of head positions that contribute to the average head position of that individual.

Depending on factors such as the need to maintain adequate vision, a forward position of the head can be associated with either an extension or flexion at the atlanto-occipitaljoints. In keeping with the concept that form deter- mines function, it is likely that prolonged alterations in cranial position will lead to functional changes that will in turn lead to morphological adaptations or signs and symptoms of dysfunctions.

Awareness Training and Mechanical Unlocking

1. **Diaphragmatic Breathing and Swallowing Coordination**

- Patients are trained to breathe diaphragmatically while coordinating swallowing.
- Exercises are performed in a relaxed upright position: arms at sides, lips sealed.
- Breathing sequence: inhale for 10 counts → hold briefly → exhale for 10 counts → short pause.
- For patients with reduced respiratory capacity: stretch arms upward while standing on toes with back against vertical support.

2. **Perioral Muscle Development**

- Patients practice lip pursing to achieve a proper lip seal using variations of an oral screen.
- In lip-incompetent patients, a string may be added to the oral screen for resistance.
- Breathing exercises continue during perioral training.
- Additional exercises address harmful oral habits.

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3. Mechanical Unlocking of Dentition

Goal: Restore full mandibular mobility and free movement in all planes.

- **Transverse Plane**:
  - Correct molar derotation, maxillary expansion in growing patients, alveolar remodeling in adults.
  - Maxillary expansion often accompanied by mandibular transverse adaptation (~5:3 ratio).
  - Frontal cephalometry helps ensure neutral tooth positioning relative to facial musculature.
  - Adequate transverse development enhances functional occlusion and smile aesthetics.
- **Vertical Plane**:
  - Intrusion arches (e.g., utility arch) used to align, torque, and intrude incisors.
  - Control secondary effects on molars during vertical corrections.
- **Anteroposterior Plane**:
  - Correct malocclusion and establish orofacial environment free from dysfunction.
  - Initial minimal bracket placement allows condyles to assume centric position, promoting jaw harmony and treatment stability.

4. Integration and Clinical Importance:

- Awareness training + mechanical unlocking ensures functional occlusion and aesthetic results.
- Forms the basis of the “Zero Base” orthodontic philosophy: addressing dysfunctions before mechanics.
- Emphasizes individualized diagnosis and functional correction alongside traditional treatment mechanics.

Conclusions

Malocclusions are often the manifestation of underlying functional imbalances, including muscle dysfunction, abnormal tongue posture, and altered cranial position. Early assessment and intervention, combining awareness training and mechanical unlocking, are essential for achieving stable, functional, and aesthetic outcomes. Understanding the interplay between form and function enables clinicians to design individualized treatment protocols that address both physiological and behavioral components, maximizing the success of orthodontic therapy.

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