Airway Orthodontics, the New Approach

6

Barry D. Raphael

This purpose of this chapter is to discuss the therapeutic or behavioral interventions that can be a part of a preventive approach to sleep-disordered breathing.

6.1 Introduction

No one would deny that many of the factors that lead up to a coronary blockage can be addressed by either therapeutic or behavioral interventions and that, certainly, prevention is a far better choice. But there has been an absence of such discussion regarding occlusion of the airway. The purpose of this chapter is to stimulate such a discussion and to paint a picture of what a preventive approach to sleep-disordered breathing would look like.

6.2 The Etiology and Predisposition to Breathing Disorders During Sleep

It was once thought that obstructive sleep apnea was a disease of old, fat men. We have since learned that thin, athletic women can also fall victim to this problem as well as children. We have learned that while weight and age add to the susceptibility to obstructive sleep disorders, they are not the root causes. Difficulty breathing at night comes from resistance to airflow, and there are many circumstances that can make breathing difficult. Efforts at pinpointing the source of resistance are important to determining proper remediation.

B. D. Raphael (✉)
Raphael Center for Integrative Orthodontics, Clifton, NJ, USA
e-mail: drbarry@alignmine.com

© Springer Nature Switzerland AG 2019
E. Liem (ed.), *Sleep Disorders in Pediatric Dentistry*,
https://doi.org/10.1007/978-3-030-13269-9_6

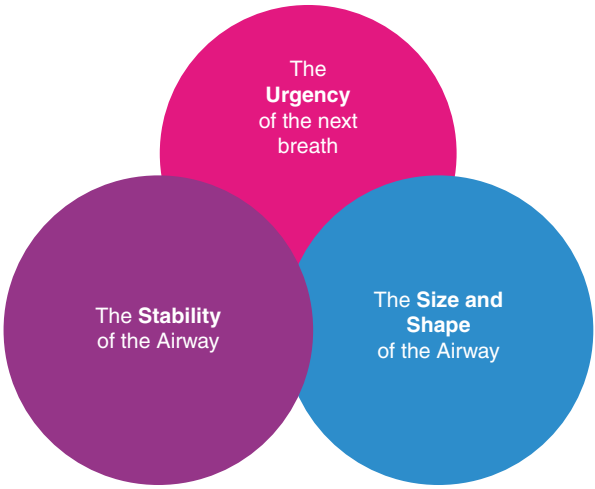


Fig. 6.1 The causes of airway turbulence

We have learned from flow physics and airway physiology that there are three main determinants of airway resistance:

1. The size and shape of the airway (Anatomy)
2. The stability of the airway (Physiology)
3. The velocity and turbulence of the airflow (Behavior)

Delving into the physics of each is not the point of the chapter. Instead, the way that each of these factors can be addressed well before the first apnea ever occurs with either therapeutic or behavioral interventions will be the goal. By defining opportunities to mitigate predisposing risk factors to airway resistance, we can begin to build a new paradigm in airway and sleep management. As such, the focus will be on prevention so that, just as we might prevent the heart attack, the end-stage disease of obstructive sleep apnea might never occur. From this discussion, a new field of Airway Dentistry and Orthodontics will emerge that can define a possible future for the way orthodontics is practiced (Fig. 6.1).

6.3 Anatomy: The Size and Shape of the Airway

Yes, losing weight and reducing fat deposits in the neck or removing tonsils are widely regarded as important, but we also know that *craniofacial morphology* is a primary risk factor for breathing problems as well [1–4]. Orthodontics has long been concerned with the growth and development of the face with regard to facial profile and the correction of skeletal and dental malocclusion but has only recently considered its relevance to the formation of the naso-oropharyngeal airway [5]. Anatomically, the maxilla (and the soft palate that hangs off the back of it) and the mandible (with the tongue attached to it) create the anterior boundaries of the pharyngeal airway. Studies have shown how retroposition of these bones relative to the face narrow the airway and create the risk for obstruction [2, 6]. This is true in

both adults and children. Orthopedic treatments in children are now being explored to help enlarge or at least prevent further restriction of the airway in a more natural and permanent way [7].

Most of the focus in orthopedic research has been on palatal expansion, with the purpose of widening the nasal aperture and palate, with equivocal results [8, 9]. Additionally, studies show that bringing either or both jaws forward with advancement appliances or orthognathic surgery can be effective in opening the airway in the adult [10]. We also know helping either jaw grow forward in the child may also be helpful [11]. More recent work shows that changing maxillary growth in all three planes of space, including advancement, provides even more promising results [7].

Playing off findings in the anthropology literature, the shape of the maxilla has changed dramatically in the modern human. This transformation is associated with a rapid change in the following environmental challenges, all of which have become rampant in today's world: [12]

- Dietary (high sugar and refined carbohydrate content)
- Metabolic (autonomic and digestive stressors)
- Cultural (early feeding and weaning habits)
- Breathing (open mouth and low tongue postures)
- Postural (forward head and slumped shoulders; portable electronics)
- Sleep (artificial light and altered sleep cycles)
- Inflammatory (a changing gut biome)

Given the rapidity of the environmental change, purely genetic variations must be ruled out.

Epigenetic variations of the bone's shape, however, indicate that it is changing in width, yes, but also slumping downward and failing to fill out sagittally as well, a condition being called craniofacial dystrophy [12]. This nearly universal midface deficiency (no matter the Angle classification of the teeth) has formed a bone with a collapsing palate with insufficient room for the teeth, and that often restricts the forward growth of the mandible hampering proper positioning of the tongue all of which limit the eventual size of the airway.

Helping the jaws grow *forward*, not just wider, is the goal. Reversal of midface collapse presents numerous challenges to current orthodontic paradigms that often look to retract teeth and jaws distally (=caudally), but it also empowers us as well. There has been a thread of thought throughout the historical orthodontic literature supporting the idea that a palate is not just congenitally narrow, but *becomes narrow as a result of what we DO*.

Altering these habits can begin to heal the dystrophy.

If the modern lifestyle can create these changes to the modern face so rapidly (in the past 300–400 years), then human ingenuity can reverse them as well. Originally independently formulated by forward thinking clinicians like George Crozat [13], Edward Angle, John Mew, and Chris Farrel, protocols such as Crozat, Advanced Lightwire Functionals, Postural Orthodontics, Biobloc Orthotropics, Cranial Osteopathy, and Myofunctional Orthodontics, all seek to reverse the conditions that lead to midface collapse. All these approaches have a common goal of reestablishing

postural support of the growing maxilla by maintaining the resting tongue on the palate as a scaffold for the growing (and non-growing) bone.

The protocols that encourage forward growth of the jaws have all found some measure of success in reducing sleep-disordered breathing [7, 13, 14]. Furthermore, treatments that restrict forward growth or reduce the size of space for the tongue have been shown to reduce airway size and, for purposes of breathing, should be avoided [15].

More research in this area is needed, but common sense says that any technique that enlarges the airway space will be helpful in combating breathing problems.

6.4 Physiology: The Stability of the Airway

Even a fairly substantial airway can be closed off if the walls cannot withstand the turbulence created by the airflow within it. There are several points along the way from the nose to the trachea where soft tissue is apt to give way to the negative pressure (see Fig. 6.2). And there are several conditions that can decrease the stability and increase the collapsibility of these tissues, all of which are reversible to some extent.

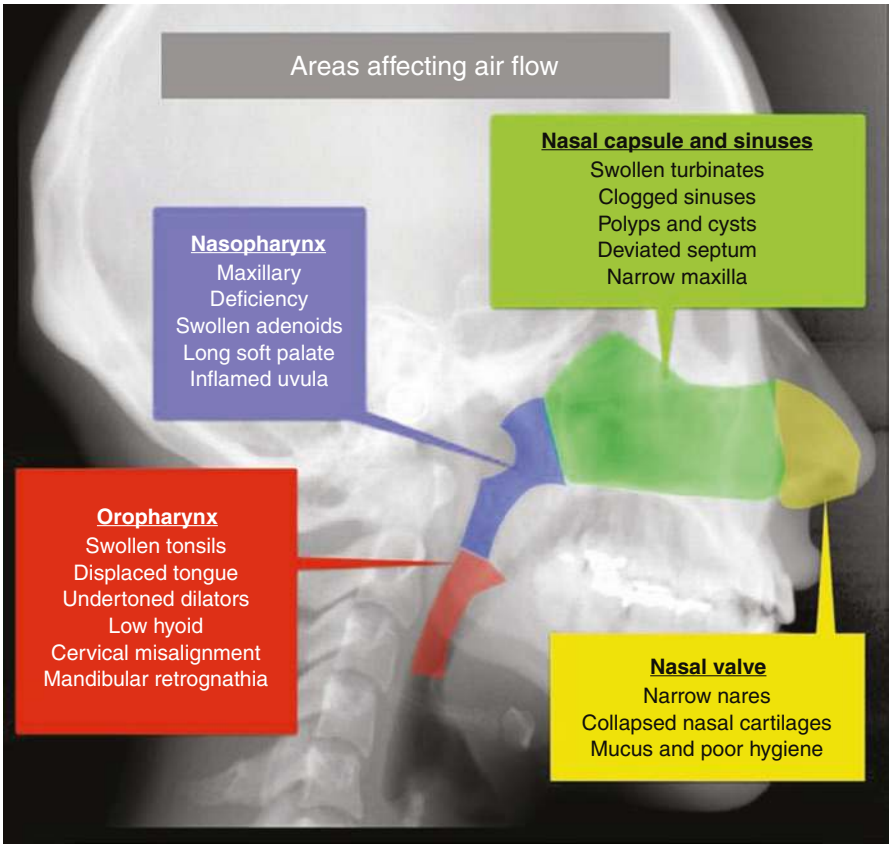


Fig. 6.2 Areas of flow limitation

1. Swelling of lymphoid tissue is perhaps the most commonly recognized problem [16]. Tonsils and adenoids are currently thought of as the predominant risk factor for sleep-disordered breathing in children. The American Academy of Pediatrics has recently stated that surgical removal of lymphoid tissue can be considered a first line of treatment in obstructive sleep apnea [17]. But one question that is rarely asked is, **why** do lymphoid tissues get so swollen as to block the airway in the first place? While they are known to be more reactive in a young growing child, their enlargement, like the collapse of the palate, is not a congenital given. Efforts to reduce the swelling can sometimes dramatically open the airway and may reduce the need for surgery.

   Some of the methods used to reduce lymphoid swelling include:

   (a) A transition from mouth breathing, which allows unfiltered air to irritate the tonsils, to nasal breathing, which filters and conditions the air before it gets to the lymph tissue, can reduce swelling within weeks.
   (b) Improvements in body posture and muscular movement, as with regular exercise, can also help lymph tissue drain adequately.
   (c) A transition from accessory muscle use to proper use of the diaphragm for breathing also helps lymphatic circulation.
   (d) Nasal lavage to keep sinuses open and airway walls clean can help.
   (e) Massage and bodywork can help lymphatic circulation.
   (f) Acupuncture and homeopathic remedies that encourage drainage of lymph tissue throughout the body.
   (g) The use of ozone and ozonated water injected into the swollen tissue has been shown to reduce lymph swelling.
   (h) Short-term use of nasal steroids and decongestions as a good head-start are helpful.

   Certainly, it's better to try to shrink swollen lymph tissues as a preliminary approach. The frequent recurrences seen after surgical removal are probably linked to a failure to incorporate some of the above conservative measures postsurgically, especially continued oral breathing. This makes a conservative approach even more important not only as a first line of defense but also when the tissues are removed.
2. Poor muscle tone is also associated with blockage of the airway. Certainly, the tongue falling back into the oral cavity at night is well recognized as a risk factor for sleep-disordered breathing. But well-toned extrinsic and intrinsic glossal muscles resist backward displacement. The use of myofunctional therapy, with specific exercises for creating better muscular balance of the pharyngeal musculature, has been shown to be helpful in reducing airway collapse at night and deserves more attention in this field [18]. Even learning to play the Australian didgeridoo has been shown to be helpful in reducing pharyngeal collapse at night [19].
3. Chronic inflammation of pharyngeal tissues makes them less able to resist negative pressure due to loss of elasticity. The constant trauma to the tissues of the flapping of snoring only serves to irritate, elongate, and soften pharyngeal tissues and the soft palate. Chronic assault by stomach acid from gastric or laryngeal reflux is another source of inflammation that needs to be addressed. The cause of

reflux itself can be addressed by changes in breathing mode (i.e., nasal breathing) and posture, too, thereby reducing reliance on protein pump inhibitors that have their own side effects. Finally, honing in on foods—some natural, some not—that instigate inflammation or disturb the natural flora in the gut and supplanting them with healthier choices can change the condition of the airway as well as the rest of the body.

6.5 Behavior: Velocity and Turbulence of the Airflow

Though the way air flows through the breathing space has been tested and studied and recognition of air pressure changes within the pharynx and within the thoracic cavity has been given due consideration, little attention has been paid to the behaviors that actually create these negative pressure conditions. In fact, some theorize that it is not the nighttime breathing that creates the biggest problem but the daytime habits of breathing that set up the circumstances for airway collapse at night [20]. These conditions include habitual over-breathing in response to the many chronic stressors that we encounter each day.

Chronic stress has a person adopting certain compensatory behaviors simply because *the urgency to take the next breath* is the most important thing we do moment to moment. The autonomic nervous system is frequently activated without adequate chance for recuperation, setting in motion a cascade of events that result in, among many other things, rapid shallow breathing with tidal volumes nearly three times what is necessary for efficient oxygenation—in other words: chronic hyperventilation.

It is said that over-breathing is just as dangerous to health as overeating. Chronic hyperventilation, especially with the large portal of an open mouth, shifts the balance between oxygen and carbon dioxide in the lungs and in the blood. Chronic hypocapnia (low native stores of carbon dioxide) is a common condition in mouth breathers and can result in reduced oxygenation of tissues (the Bohr effect) and increased smooth muscle spasm (think: vessels and organs). The symptoms from these two phenomena alone are quite diverse, affecting the vasculature (hypertension, venous pooling); organs (enuresis, digestive issues); tubes (asthma, reflux, xerostomia); and tissue perfusion (intermittent hypoxia to the brain, neurocognitive deficits such as attention, memory and learning, anxiety, and muscle fatigue and spasm). And, oh yes, apnea.

Heavy breathing at night pulls air through the pharynx rapidly, creating increased turbulence and negative pressure. This can compromise an otherwise healthy system (e.g., snoring only when you get intoxicated). Combine that with small airway size and you get the perfect internal storm—a hurricane in a box, if you will.

Some think that central sleep apnea is nothing more than the body's respiratory mechanism taking a pause to restore proper carbon dioxide levels and maintain homeostasis. While this thinking seems to be in direct opposition to the commonly held view that sleep-disordered breathing is a problem of hypoventilation and hypercapnia, a change in daytime breathing mode—again, from oral to light nasal breathing—can reduce nighttime distress almost immediately in some patients [21]. In fact, the relationship between daytime breathing habits and nighttime distress is so strong the syndrome should be called breathing-disordered sleep instead of

sleep-disordered breathing. Adopting new changes in daytime breathing behaviors should be the first line of defense in the treatment of breathing-disordered sleep.

Simple breathing training includes:

1. Adopt nasal breathing primarily, even during activity, as much as possible.
2. Reduction of tidal volume by reducing breathing rate and depth.
3. Use of the diaphragm for powering inspiration.

Biofeedback techniques are especially helpful in retraining daytime breathing. Once the body can accommodate to this new breathing mode, there is often no longer such a struggle at night. And at very least, modalities like PAP (positive airway pressure) and MADs (mandibular advancement device) can become more tolerable.

6.6 Airway-Related Craniofacial Dysfunctions: A Change in Paradigm

Besides sleep apnea, there are a host of refractory conditions that dentistry has been struggling with that are now being looked upon as airway-related craniofacial dysfunctions (ACDs).

They include:

1. Chronic naso-pharyngeal obstruction (physical or functional) [22]
2. Tethered oral tissues (lip-tie and tongue-tie) [23]
3. Open mouth rest posture (with the tongue off the palate) [24]
4. Myofunctional disorders (swallowing, chewing, etc.) [25]
5. Chronic hyperventilation and hypocapnia [26]
6. Breathing-disordered sleep (OSA, UARS, snoring) [27]
7. Bruxism, parafunctions, and dental deterioration [21]
8. TMD and facial pain components [28]
9. Cranial and postural issues [29]
10. Craniofacial dystrophy with malocclusion [30]

Each topic deserves its own discussion, but putting them under the umbrella of airway dysfunctions seems to have answered a lot of challenging questions for practitioners in all disciplines. In fact, once you see the relationship, it's hard to see how we ever thought otherwise.

6.7 Conclusions and the Future of Orthodontics

The current gold-standard treatment, if gold is the appropriate color, for obstructive sleep apnea is to artificially pry open the airway at night with air, plastic, or scalpel. Perhaps someday we'll have Swarovski-studded tracheostomy plugs for a more perfect (read: fashionable and quick) solution.

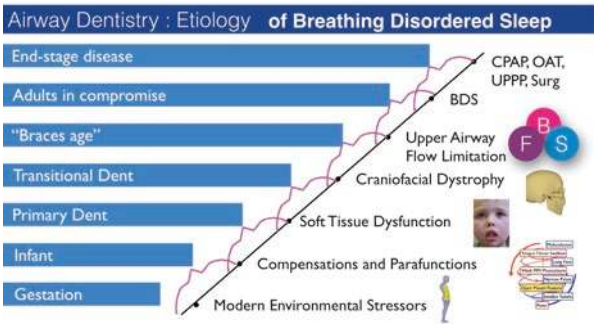


Fig. 6.3 Timeline

But if you look at the progression of events leading up to obstruction (Fig. 6.3), there are many, many opportunities to intervene, to change the trajectory of the disease and to increase the quality of life. By helping the airway to grow larger (size and shape), keeping the airway physically fit (stability), and optimizing the airway's use (flow), the problem can be, at worst, delayed and, at best, avoided [31].

In recent years, the orthodontic profession has been arguing about the relative benefits of early orthodontic treatment asking, "Is the benefit worth the burden?" [32, 33] One could ask the same question about the effort needed to prevent heart disease. Yet, today, fitness centers and whole foods establishments are becoming mainstream in our society answering that question by popular demand. Perhaps in days soon to come, there will be similar outcry looking for orthodontists and dentists to help adults and children have better sleep and breathing as well. Our job will be to first make the airway easier to breathe through and then to teach children how to breathe easier.

"...craniofacial morphology
is a primary risk factor for
breathing problems..."

"...over-breathing is
just as dangerous to
health as is overeating."

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