

Difficulties achieving orthodontic stability? - The answer may be blowing in the wind.

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The majority of children today exhibit some degree of malocclusion^{1, 2} and it has been well documented that this is related to soft tissue dysfunction^{3, 4}. In fact, it is now well accepted that the muscles of the tongue, lips and cheeks play a major role in tooth position and jaw development.^{5, 6} Furthermore, there are contemporary pre-orthodontic clinics, around the world, using a myofunctional philosophy to treat children between 5 and 15-years-old (Myobrace Pre-Orthodontic Center®).

Despite these evolutionary myofunctional treatment systems achieving outstanding results, there remain a small percentage of cases that prove difficult to treat. This raises questions regarding what might be causing these stubborn cases, as well as how best to treat them when all obvious poor myofunctional habits, such as digit sucking, tongue postural issues, and dysfunctional swallowing patterns, have all been addressed in the myofunctional sense. It appears answers may be uncovered by examining the child's airway and breathing patterns.

¹ **Prevalence of malocclusion and orthodontic treatment need in children and adolescents in bogota, Columbia.** Birgit Thilander, Lucia Pena, Clementina Infante, Sara Stella Parada, Clara de Mayorga. *European Journal of Orthodontics*.

² **Prevalence and distribution by gender of occlusal characteristics in a sample of Italian secondary school students: a cross-sectional study.** Fabio Ciuffolo, Lamberta Manzoli, Michele D'Attilo, Simona Tecco, Filippo Muratore, Felice Festa, Ferdinando Romano. *European Journal of Orthodontics*.

³ **Soft Tissue Dysfunction: a missing clue when treating malocclusions.** German O. Ramirez-Yanez, Chris Farrell. *International Journal of Functional Orthopedics* (2005).

⁴ **Muscling in on the truth.** Rohan Wijey. *Australasian Dental Practice*.

⁵ **Insights into Orthodontic Treatment.** German O. Ramirez-Yanez. *Dental Asia* (July/August 2006).

⁶ **The Trainer System in the context of treating malocclusions.** German O. Ramirez-Yanez. *Ortho Tribune* (August / September 2009).

Relevant literature explains how mouth breathing is a significant factor in the aetiology of malocclusion^{7, 8, 9, 10, 11, 12}. In short, when mouth breathing occurs, the tongue moves down in the mouth to allow the passage of air above it. Furthermore, an open mouth posture can affect the direction of growth as the muscles pulling on the jaws are affected. However, the real details of why children habitually mouth breathe are not so well documented.

Factors Involved in Patients with Breathing Dysfunction

Factor 1: Tongue and Head Posture

Breathing through the mouth causes the tongue to sit lower as well as alter the head and neck posture. This low tongue posture then leads to reduced maxillary growth^{13, 14} and increases in vertical growth.

⁷ **Mouth breathing in allergic children: Its relationship to dentofacial development.** Dante Bresolin, D.D.S., M.S.D., Peter A. Sharpiro, D.D.S., M.S.D., Gail G. Shapiro, G.M.D., Chapko, M.K. Ph. D., and Dassel, S. M.D. Brasilia, D.F., Brazil, and Seattle, Wash. *American Journal of Orthodontics and Dentofacial Orthopedics* 1983.

⁸ **Prevalence of malocclusion among mouth breathing children: do expectations meet reality?** Souki BQ, Pimenta GB, Souki MQ, Franco LP, Becker HM, Pinto JA, Federal University of Minas Gerais, Outpatient Clinic for Mouth-Breathers, Belo Horizonte, Brazil. *Int J Pediatr Otorhinolaryngol.* 2009 May; 73(5): p.767-773.

⁹ **Etiology, clinical manifestations and concurrent findings in mouth-breathing children.** Abreu RR, Rocha RL, Lamounier JA, Guerra AF. *J Pediatr (Rio J).* 2008 Nov-Dec; 84(6): p.529-535.

¹⁰ **Radiological evaluation of facial types in mouth breathing children: a retrospective study.** Costa JR, Pereira SR, Weckx LL, Pignatari SN, Uema SF. *Int J Orthod Milwaukee.* 2008 Winter; 19(4): p. 13-16.

¹¹ **The negative effect of mouth breathing on the body and development of the child.** Flutter J. *Int J Orthod Milwaukee.* 2006 Summer; 17(2): p. 31-37.

¹² **Nasal Obstruction and Facial Growth: The Strength of Evidence for Clinical Assumptions.** Katherine W. L. Vig, BDS, MS, FDS, DOrth. *Dentofacial Orthol* 1998; 113:663-11.

¹³ **Insights into Orthodontic Treatment.** German O. Ramirez-Yanez. *Dental Asia (July/August 2006).*

¹⁴ **The Trainer System in the context of treating malocclusions.** German O. Ramirez-Yanez. *Ortho Tribune (August / September 2009).*



Picture 1:

Mouth Breathing and low tongue posture causes a crowded and narrow upper arch.

Factor 2: The Bohr effect and Cellular Hypoxia

It is important to be mindful that “breathing dysfunction” includes more than just mouth breathing. It also includes habitual hyperventilation, which means the patient will be consistently breathing an excess of air (high minute volume). This will then cause reduced default ETCO_2 , resulting in the bond between haemoglobin and oxygen to be strengthened (Bohr Effect) and while blood oxygen saturation can be normal, oxygenation at a cellular level may be reduced due to poor oxygen release from haemoglobin. As a result cells become stressed and this cellular hypoxia can lead to dysfunction at a cellular level.

My observations as a breathing educator and dentist practicing myofunctional orthodontics are the following:

In addition to exhibiting malocclusions, patients with poor breathing patterns also tend to suffer from sinus congestion, asthma, hay-fever, enlarged adenoids or tonsils as well as ADD, Aspergers and other syndromes on the autism spectrum. It appears that there may be more health issues in children with malocclusion, compared to those without, and this may be related to mouth breathing in my opinion. Further research is needed to conclusively show this link.

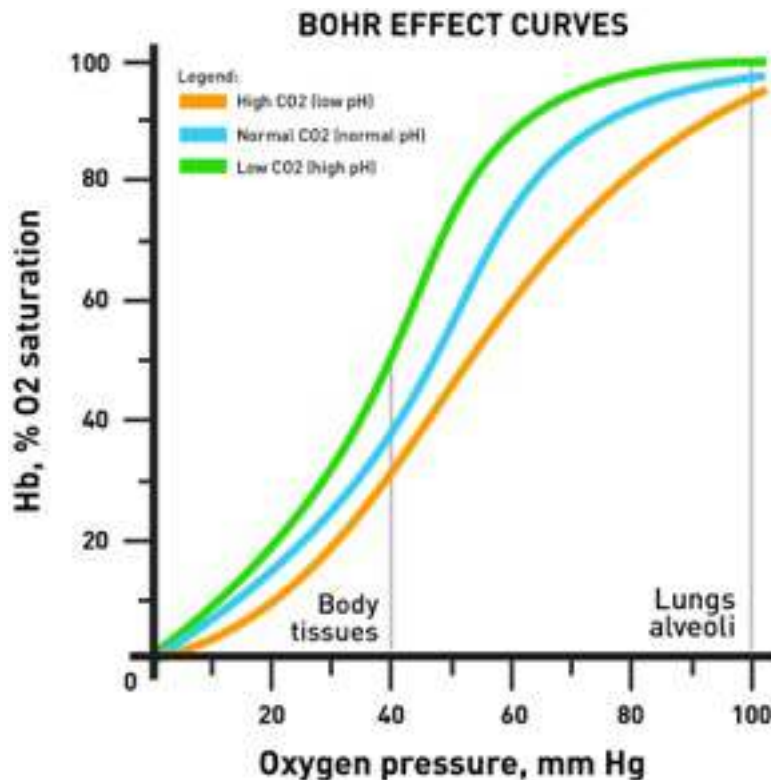


Figure 1: The central proposition of the Bohr Effect states oxygen affinity to hemoglobin depends on absolute CO₂ concentrations and reduced CO₂ values decrease oxygen delivery to body cells. Habitual hyperventilation leads to reduced arterial CO₂ and therefore, less oxygen released to cells.

Factor 3: Becoming Locked into a Cycle of Habitual Hyperventilation

Patients who habitually hyperventilate become accustomed to breathing greater than normal volumes of air at rest (> 4-5L). It is hypothesised that habitual hyperventilation causes the trigger point at which the brain (capnoreceptors) detects a level of CO₂ sufficient to prompt the breathing reflex to become too low. Thus, patients become too sensitive to healthy (higher) CO₂ levels, causing them to breathe an excess of air. They are in effect, locked into this cycle of habitual hyperventilation, and breaking the mouth breathing habit may be difficult for these patients and they may require extra help to learn to tolerate normal CO₂ levels so they may breathe normally.

What can be done to help these patients?

An increasing number of dental professionals are focusing on innovative techniques to help these patients break their cycle of habitual hyperventilation. These techniques involve a combination of breathing and awareness exercises designed to assist the patient become accustomed to breathing smaller, healthier volumes of air. As a result these patients learn to breathe less (retain more CO₂) and so more O₂ is released to their cells and tissues. Additionally, airways stay clearer, patients often become healthier, and tongue posture improves when the mouth remains closed. These techniques are used by Myobrace® Pre-Orthodontic Centers to treat the difficult 5% of cases when the patient does not adapt to a better breathing habit using Myobrace appliances along with myofunctional and breathing activities alone.

To predict which patients may require help correcting their airway dysfunction, they can be divided into three groups during treatment planning (*see below*). It is important to note the groups remain flexible.

Group 1: Unlikely to require assistance – 5% of patients.

- No asthma
- No Hx of ENT
- No medications
- No regular illness

Group 2: May require assistance – 95% of patients.

- Previous asthma
- Previous ENT
- Medications
- Regular illness

Group 3: Likely to require assistance – 5% percent of patients.

- Current asthma
- Current ENT
- Multiple / several medications
- Constant illness

Patients classified into Groups 1 and 2 are likely to change their airway dysfunction during treatment with the *Myobrace System*[™], which encourages correct breathing by developing a closed mouth posture. However, patients classified into Group 3 are likely to require additional assistance.

How can a habitual hyperventilator be identified?

Generally, they will show:

- Mouth breathing, lips apart at rest.
- Shoulder / upper chest breathing at rest
- Audible breathing at rest
- Medical history of enlarged tonsils and/or adenoids, asthma, hay-fever, recurrent respiratory infections, snoring, tooth grinding or sleep apnea.
- Narrow upper arch form.
- Forwards head / shoulder posture.
- Venous pooling (see description below).

A note on venous pooling: Typically mouth breathers will exhibit venous pooling, which occurs as a result of the inferior orbital vein becoming constricted due to low levels of CO₂, which usually has a vasodilatory effect. Additionally, mouth breathing causes a reduction in N₂O¹⁵ (found in the paranasal sinuses), which is also vasodilatory and mixes with air when nasal breathing predominates. Furthermore, patients with narrow maxillae can be expected to have a smaller than average pterygomaxillary fissure. As a result of these two factors there is less venous drainage from the inferior orbital vein, which has to pass through the narrowed ptergomaxillary fissure. Deoxygenated or venous blood then pools beneath the eyes. When a patient habitually breathes through their mouth and has narrow maxilla they are likely to show symptoms of venous pooling.

¹⁵ **High nitric oxide production in human paranasal sinuses.** Lundberg JO, Farkas-Szallasi T, Weitzberg E, Rinder J, Lidholm J, Anggaard A, Hokfelt T, Lundberg JM, Alving K. *Nat Med* 1995 April; 1 (4): 370-3.

Summary of factors associated with venous pooling:

- Low blood CO₂ caused by habitual hyperventilation.
- Low N₂O caused by a lack of nasal breathing.
- Reduced vasodilation caused by low CO₂ and N₂O.
- Small pterygomaxillary fissure as a result of constricted maxilla.
- Low tongue posture.

Conclusions

It is clear that a correctly functioning tongue acts as a natural retainer but when a patient habitually breathes through their mouth the tongue is prevented from functioning in this way. In contrast, when the mouth remains closed and the tongue sits correctly and increased orthodontic stability can be expected. Furthermore, when a patient maintains a closed mouth posture and high tongue posture, treatment time can be expected to lessen as forces exerted on the teeth and jaws will work favourably. Finally, it has been well documented that mouth breathing is not in the best interests of health, growth and correct development^{16, 17}. Therefore, it is reasonable to assume that encouraging correct functional breathing patterns will have a more far-reaching effect than just correcting crooked teeth and jaws. Simply fixing the teeth and jaws with braces alone, is potentially missing a huge piece of the puzzle at the expense of possible health gains and future orthodontic stability.

¹⁶ **The negative effect of mouth breathing on the body and development of the child.** Flutter J. *Int J Orthod Milwaukee*. 2006 Summer; 17(2): p. 31-37.

¹⁷ **Nasal Obstruction and Facial Growth: The Strength of Evidence for Clinical Assumptions.** Katherine W. L. Vig, BDS, MS, FDS, DOrth. *Dentofacial Orthol* 1998; 113:663-11.