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Original article

Oral breathing: new early treatment protocol

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Abstract

Oral breathing is a respiratory dysfunction that affects approximately 10-15% of child population. It is responsable of local effects and systemic effects, both immediate and long-term. They affect the growth of the subject and his physical health in many ways: pediatric, psycho-behavioral and cognitive. The etiology is multifactorial. It's important the establishment of a vicious circle involving more areas and it is essential to stop it as soon as possible. In order to correct this anomaly, the pediatric dentist must be able to make a correct diagnosis to treat early the disfunction and to avoid the onset of cascade mechanisms. Who plays a central role is the pediatrician who first and frequently come into contact with little patients. He can identify the anomalies, and therefore collaborate with other specialists, including the dentist. The key aspect that guides us in the diagnosis, and allows us to identify the oral respirator, is the "adenoid facies". The purpose of the study is to highlight the importance and benefits of an early and multidisciplinary intervention (pediatric, orthopedic-orthodontic-functional). A sample of 20 patients was selected with the following inclusion criteria: mouth breathing, transverse discrepancy > 4 mm, early mixed dentition, central and lateral permenent incisors, overjet increased, lip and nasal incompetence, snoring and/or sleep apnea episodes. The protocol of intervention includes the use of the following devices and procedures: a maxillary rapid expander (to correct the transverse discrepancy, to increase the amplitude of the upper respiratory airway and to reduce nasal resistances tract) in association with myo-functional devices (nasal stimulator and oral obturator). They allow the reconstruction of a physiological balance between the perioral musculature and tongue, the acquisition of nasal and lips competence and the reduction of overjet. This protocol speeds up and stabilizes the results. The control of the muscles during the growth phase is important: muscular forces influence the direction of facial growth.

Keywords

Oral breathing, systemic effects, "tools" for pediatric interception, rapid palatal expansion, neuromuscular re-education.

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Introduction

Oral breathing, in children, is a very common problem. This dysfunction affects approximately 10-15% of child population. It results in a wide spectrum of consequences both immediately and at long-term. These consequences involve different districts of the body (mouth, craniofacial development, upper and lower airway) [1]. They influence the growth of the subject and his physical health in many ways, pediatric, orthodontic, orthopedic, behavioral, metabolic, cardiovascular, psycho-behavioral, cognitive and phonatory [2-5]. Oral breathing, in fact, can be considered as the most obvious manifestation of a syndromic pattern that has an impact not only on the physical sphere, but also on a social and psycho-cognitive level [3, 6].

The pathogenesis is complex and multifactorial. Causes can be both local and systemic, related to malformations, bad habits, airway disease, etc. [7, 8]. However, what must be emphasized, is that these problems intersect each other forming a vicious circle that keep itself [2, 9]. An early diagnosis (**Tab. 1**), in collaboration with the pediatrician, and the interceptive treatment, which interrupts the circuit as soon as possible, are important steps. In this way is possible to avoid several conditions: frequent infections, pathological masticatory pattern, the development of a malocclusion, incorrect deglutition and phonation, abnormalities of body posture (**Fig. 1A**). Short attention span, decreased memory, poor school performance, changes in sleep-wake cycle, day irritability and then a negative influence on psycho-social life of the subject are all aspects related to a poor oxygenation [2-5]. A multidisciplinary intervention is needed to solve the problem where the specialist that has a key role is the pediatrician. Since there is a close correlation between oral breathing and dento-facial inharmonies, the pediatrician should involve the pediatric dentist after an early identification of an oral breathing in a child.

Table 1. Anamnesis and physical examination [10, 11].

Family anamnesis	Physical examination
Tiredness	Dark Circles
Epistaxis	Nasal Septum
Difficult sleeping	Verbal articulation
Snoring	Posture
Apnea	Breathing
Swallowing saliva wets the pillow	Deglutition
Difficult chewing	Adenoids
Keep open mouth	Tonsils
	Encoding nasal
	Lingual frenulum
	Lips
	Skeletal analysis

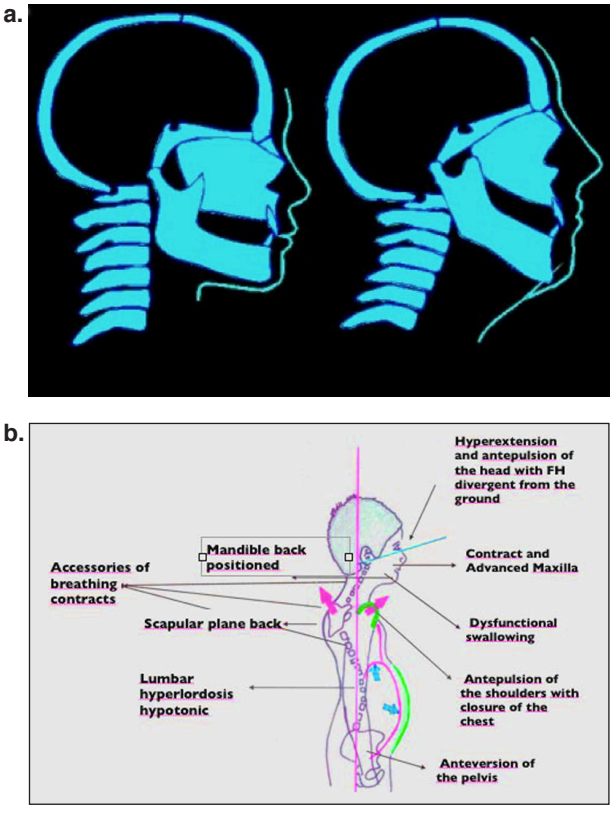

Figure 1A. Postural characteristics of patients affected by oral breathing: Cephalic Posture (**a**), Body Posture (**b**).

There are numerous studies that confirm the influence of a wrong respiratory pattern on the dento-facial development [12-15]. Oral breather develops some specific characteristics [16]. The easiest aspect to identify is the "adenoid facies" (**Fig. 1B**), characterized by long face, dark circles marked, postural attitude with open mouth, flattened cheekbones, short and incompetent upper lip (**Tab. 2**), nostrils small and hypotonic, low-lingual posture, posterior mandible rotated, open bite tendency, hyperextension of the head [5], extrusion of the posterior teeth, transverse discrepancy, crossbite, "V"shape maxilla [25], arched palate, lingual version in the posterior elements [26]. There is a diagnostic scheme (**Tab. 2**) which allows a first evaluation of the patient and the classification of certain functions (type of breathing, the presence of bad habits, the presence of problems of phonation, etc.) to adapt the treatment to the severity of the dysfunction of the patient.

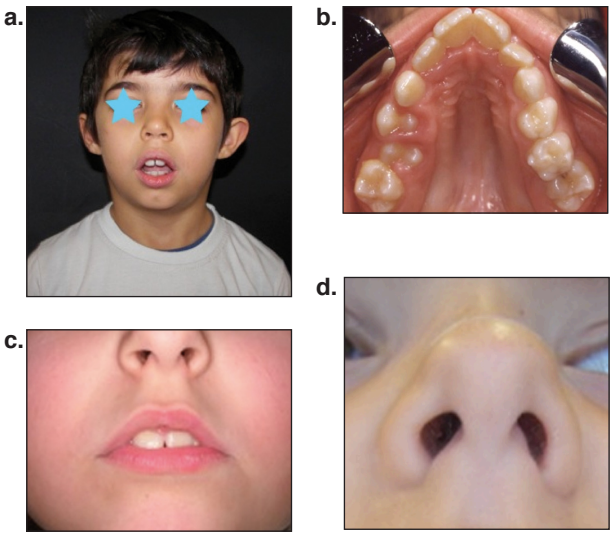

Figure 1B. Clinical characteristics of an oral breather: adenoid facies (**a**); V-shape *Maxilla* (**b**); lip incompetence (**c**); nasal incompetence (**d**) [3-6, 9, 16-24].

Table 2. The different effects of oral breathing.

Lips: Lip incompetence; short upper lip; chapped lips, bulky or flabby.	**Oral-facial muscles:** Facial muscles hypotonia; lingual posture low; atypical swallowing.	**Tongue:** low lingual posture; possible short lingual frenulum.
Maxilla: hypoplasia of transverse and sagittal planes; arched palate, high palate; vertical soft palate; rotation of the bispinale plane[a]; flattened and/or absent cheekbones.	**Mandible:** increase in lower facial height; growth in posterolateral rotation; distal position or antero position (skeletal Class II or III)[b].	**Posture:** extension of the head; inversion of cervical lordosis; low posture of the mandible; lowering of the hyoid bone; scapular winging.
Nose and sinuses: adeno-tonsillar hypertrophy; underdevelopment of the nasal cavity and paranasal sinuses; nose broad-based and small; nostrils facing the high.	**Dentature:** buccal version of maxillary incisors; back inclination of the mandibular incisors; dento-alveolar crowding; unilateral or bilateral crossbite; anterior open bite; modification of the bacterial flora and increased susceptibility to caries.	**Other:** fonesi and timbre of the voice are altered (especially the issuance of certain phonemes such as M, N, NG), since the nasal cavity does not carry out its functions as a sounding board; may tend to obesity or extreme thinness.

[a]Bispinale the plane is the plane passing through the anterior nasal spine and posterior nasal spine.
[b]If the jaw is more shifted forward with respect to the maxilla it's class III. If the jaw is positioned back than the norm it's class II.

Aim of the study

The aim of the study is to highlight the benefits of early treatment and combined orthodontic-orthopedic-functional.

Materials and methods

It was selected a sample of 20 patients aged between 6 and 10 years (9 M, 11 F) who had the following inclusion criteria: deciduous dentition, or at least a first mixed dentition (with the eruption of central and lateral permanent incisors and first permanent molars), mouth breathing, transverse discrepancy greater than 4 mm, with or without crossbite, increased overjet (OVJ, i.e. the distance between the margins of the upper and lower incisors in the horizontal plane), nose incompetence, lip incompetence, snoring and/or sleep apnea. We have adopted the following exclusion criteria: previously orthodontic treatment, patients with muscle diseases that could affect the neuromuscular re-education,

patients with cleft or other malformations. The protocol "Early treatment" includes a rapid palatal expander (screw A.621 Leone® Italy) bonded on the decidous molars [26-28] (**Fig. 2a**), in association with the use of silicone myofunctional devices such as the nasal stimulator (**Fig. 2b**) and the oral obturator (**Fig. 2c**), that speeds and increases the effectiveness and stability of treatment [11]. These appliances also allow the reconstitution of a physiological balance between the perioral musculature and tongue, the improvement of the overjet and the acquisition of lips and nose competences [11]. It's fundamental the control of the muscles during the growth phase: muscular forces influence the direction of facial growth as they form the functional matrix of the jaw bones [2, 6, 9].

Different parameters were evaluated for all 20 patients at time T1 (before treatment) and at the end of early interceptive treatment that lasts an average of one year (T2). The parameters that we examined were: overjet (measured in millimeters), transverse discrepancy between the arches (detected through measurement in millimeters with a digital caliber of the diameters between the central of the first upper molars and the cusps of distobuccal first lower molars), labial and nose competence (measured with the use of clinical parameters present in **Tab. 3A** and **Tab. 3B**).

The protocol involves the use, in succession, of an oral obturator permeable, semi-permeable, and impermeable (for a period of about 4 months, each), so we can lead gradually the patient to a nasal breathing, also facilitated by the association with a nasal device [11]. After 6 months from the beginning of myofunctional therapy, a rapid palatal expander bonded on decidous molars is positioned. The active phase of the palatal expander is in the range 15-21 days. It depends on the extent of the discrepancy. The stabilization phase of the suture is about 6 months. The used expander is the one the new micro-screw A-0621 Leone® Italy. It has an orthopedic action with the minimum space in the mouth of children that are very small. So the discomfort of the child is avoided and the collaboration is improved [21, 22, 28]. Two activations per day during the first week, and a daily activation from the second week, if the suture is opened, should be performed. The most obvious clinical sign of the disjunction of the palatal suture is the opening of the interincisal diastema and 4-6 month to stabilise the expansion of maxillary sutures are needed.

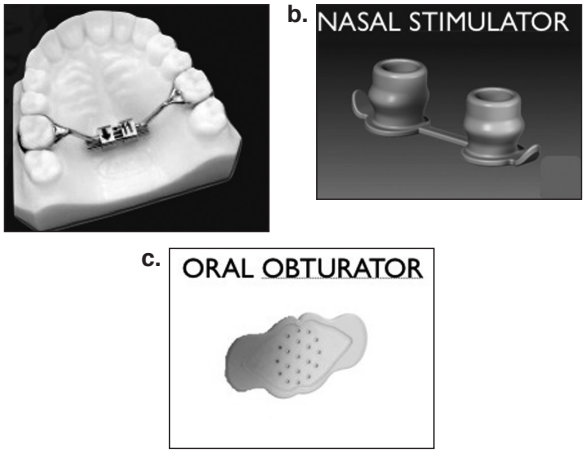

Figure 2. Rapid maxillary expansor screw A-621 Leone® (**a**); nasal stimulator (**b**); oral obturator (**c**).

Table 3. Parameters used to evaluate the nasal and lip competences [11].

A.

Relationship between the lips

A normal relationship of the upper lip is ranged from 1/3 to 2/3 more forward than the lower lip.
We also consider:
• upper lip incompetent at rest (not touching the lower lip);
• dry or chapped lips.
For its codification we will give a grade 0 to the normal relationship of the lips, a degree 1 with respect to the upper incompetent lips at rest, a grade 2 for dry or chapped lips.

B.

Codification of the nostrils

Degree of collapse nasal codified by dr. Duran. It encodes 5 degrees (plus a degree 0 of total absence of the problem) in function of the motility of the nostrils during forced inspiration:
0 = bilateral dilation of the nostrils during inspiration;
1 = no dilatation nor collapse of the nostrils during inspiration;
2 = partial unilateral collapse;
3 = partial bilateral (3-a) or total unilateral (3-b) collapse;
4 = total one-sided and partial collapse of the opposite side;
5 = total bilateral collapse.

Results

The use of nasal device allows the stimulation of the insertions of perinasal muscles, and the remodeling of cartilage. Thus, the patient acquired the perception of his nose (in patients with alteration of 4th and 5th grade the use of the device was prolonged). The oral obturator exercised and strengthened the perioral musculature, allowed the patient to acquire lips competence and a gradual transition from oral to nasal breathing. This device has also the advantage of improving and sometimes solving the OVJ as can be noted in **Fig. 3**. Other results are presented in **Fig. 4** and **Fig. 5**. An example of Cone Beam Computed Tomography (CBCT) is presented in **Fig. 6**.

Conclusions

The correlation between oral breathing and dento-facial inharmonies was confirmed in numerous contributions in the literature [13, 29, 30].

The rapid palatal expander is a valid appliance to solve malocclusion and oral breathing. It improves the morphology and function of the masticatory system and the upper part of the airway. Thanks to the connections between oral cavity, nasopharynx and auditory tube, the expander can also improve ear disease and/or dysfunction of the acoustic type [12, 13, 30, 31]. The maxilla constitutes the upper wall of the oral cavity and the floor of the nasal cavity [19].

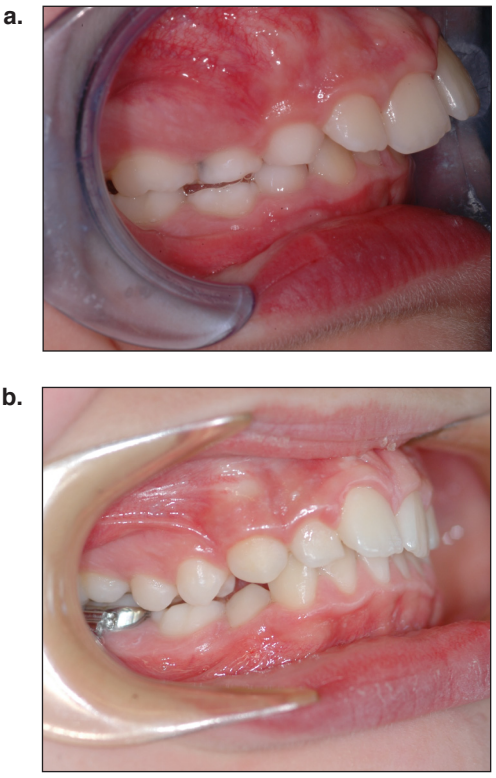

Figure 3. Overjet before (**a**) and after (**b**) treatment with Maxillofacial Surgery (MFS) oral obturator.

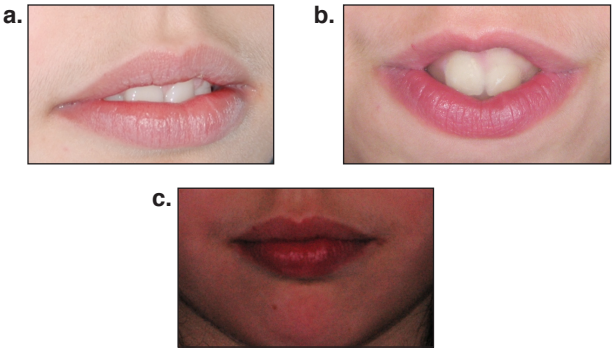

Figure 4. Lip incompetence before treatment (**a**), lips stimulation during treament (**b**), lip competence after treament (**c**).

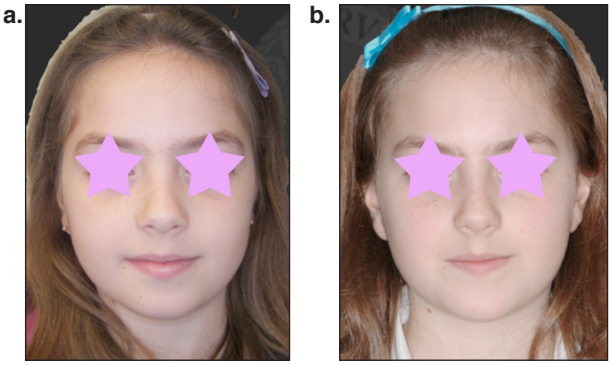

Figure 5. Adenoid facies before treatment (**a**), after treatment (**b**). The expansion, however, allows the correction of the discrepancy of transverse crossbite, the improvement of the palate morphology and the increase of airway patency by expanding the nasal cavity (such result has anatomical bases; in fact, the maxilla constitutes the roof of the oral cavity and the floor of the nasal cavity).

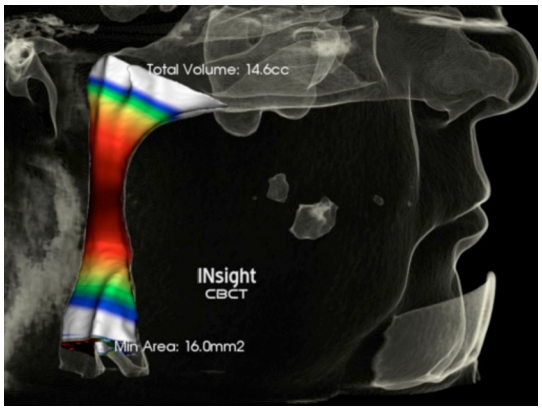

Figure 6. The airflow in the upper airways in Cone Beam Computed Tomography (CBCT).

Table 4A. Values obtained at T1.

Patient	Overjet (OVJ) (mm)	Discrepancy transversal (mm)	Lip competence	Nasal competence	Snoring and/or sleep apnea
1	3.5	1	Grade 0	Grade 2	no
2	4	0	Grade 1	Grade 0	no
3	3.2	3	Grade 0	Grade 0	no
4	2.9	2	Grade 0	Grade 2	no
5	3.5	1	Grade 1	Grade 3	yes
6	3	0	Grade 0	Grade 0	no
7	3.7	1	Grade 0	Grade 0	no
8	4.1	4	Grado 0	Grade 3	no
9	2.7	2	Grade 1	Grade 1	no
10	4.8	0	Grade 0	Grade 1	yes
11	4.3	-1	Grade 1	Grade 1	no
12	2.0	0	Grade 0	Grade 0	no
13	3	1	Grade 1	Grade 2	no
14	5.5	-1	Grade 1	Grade 1	no
15	3.3	-2	Grade 0	Grade 0	no
16	3.8	0	Grade 0	Grade 0	no
17	3.5	0	Grade 0	Grade 1	no
18	2.5	1	Grade 0	Grade 0	no
19	3.5	-1	Grade 0	Grade 1	no
20	2	1	Grade 0	Grade 1	yes

Table 4B. Values obtained at T2.

Patient	Overjet (OVJ) (mm)	Discrepancy transversal (mm)	Lip competence	Nasal competence	Snoring and/or sleep apnea
1	5	7	Grade 2	Grade 3	yes
2	6	4	Grade 2	Grade 2	no
3	4.7	6	Grade 1	Grade 1	no
4	3.4	8	Grade 2	Grade 4	yes
5	3.7	7	Grade 1	Grade 4	yes
6	3	5	Grade 0	Grade 1	no
7	4.8	4	Grade 1	Grade 3	no
8	6	10	Grade 1	Grade 5	yes
9	4.1	9	Grade 1	Grade 2	no
10	5.3	6	Grade 2	Grade 3	yes
11	5.5	5	Grade 1	Grade 4	no
12	2.9	7	Grade 0	Grade 3	no
13	3	5	Grade 2	Grade 3	yes
14	6.4	6	Grade 2	Grade 2	no
15	4.4	5	Grade 0	Grade 2	no
16	5.1	6	Grade 1	Grade 1	yes
17	3.5	7	Grade 1	Grade 1	no
18	3.9	8	Grade 0	Grade 2	yes
19	4.5	4	Grade 1	Grade 3	no
20	5	5	Grade 1	Grade 4	yes

A general conclusion that may be drawn from the results is that an early and interceptive treatment of functional alterations corrects bad habits, unphysiological growth directions and posture. In this way we can avoid drastic future choices such as dental extractions and orthodontic-surgical solutions to the end of growth, but, more generally, we can reduce systemic future problems. Based on the analysis of several clinical parameters and medical anamnesis (such as improvement of adenoid facies, lips and nose competence acquisition, reduction of overjet, correction of crossbite, improved palatal morphology, improvement in attention span and concentration, improvement in school performance, etc.), we can conclude that the use of the new multidisciplinary (orthopedic-orthodontic-functional) protocol "early treatment" is effective in the resolution of oral breathing with stable and long-lasting results.

Declaration of interest

The Authors declare that there is no conflict of interest.

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