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## Respiratory disorders in paediatric age: orthodontic diagnosis and treatment in dysmetabolic obese children and allergic slim children

### ABSTRACT

**Aim** Obesity and allergic susceptibility are worsening problems in the most industrialised countries. With different mechanisms, they both lead to a deterioration of children's life quality because they affect the respiratory system, leading to asthma and respiratory disorders such as mouth breathing and obstructive sleep apnoea. The latter are related to specific types of malocclusions that require an early diagnosis and specific multidisciplinary treatment. The purpose of this work is to show the characteristic signs and symptoms of these disorders in children of the two phenotypes (allergic and slim, obese and dysmetabolic). Intercepting such issues allows both pediatricians and paediatric dentists to refer the child to a multidisciplinary team of specialists able to deal, in a holistic way, with both the physical and behavioural causes, and also with the consequences on systemic and craniofacial development in particular.

**Materials and methods** The literature available

on this topic in the years between 1997 and 2011 was reviewed, paying special attention to prevention, paediatric visits, diagnostic tools and treatment options for each of the two conditions.

**Conclusion** Dysmetabolic obese children and allergic slim children have specific respiratory problems during rest and exercise. Mouth breathing and obstructive sleep apnoea are due to an abnormal craniofacial development and can cause serious systemic problems in adulthood. Intercepting early signs of pathognomonic symptoms of sleep apnoea and mouth breathing permits to treat children with an early multidisciplinary approach, and allows for proper physical and psychological development of the child.

**Keywords** Obesity; Oral breathing; OSAS; Respiratory disorders.

### Introduction

Obesity and allergic susceptibility are worsening problems in the most industrialised countries [World Health Organization, 1997]. Both are called "welfare diseases" as they are related to a sedentary lifestyle and to unhealthy diet. These children have both respiratory disorders such as diurnal and nocturnal mouth breathing and obstructive sleep apnoea [Favero et al., 2010]. In a developing child the short-term consequences can affect the craniofacial structures, teeth and posture of the whole body [Weider et al., 2003]. Long-term altered cerebral oxygenation during sleep could lead to frequent awakenings during the night, resulting in attention deficit and hyperactivity, until the onset of cardiovascular problems, which will increase the risk of hypertension, stroke, and myocardial infarction in adulthood [Zino-Cohen et al., 2004].

Given the important consequences that daily and nocturnal breathing problems have on the obese dysmetabolic and on the slim allergic child, the aim of this work is to illustrate the characteristic signs and symptoms of respiratory disorders in the two child phenotypes. Intercepting such issues allows the pediatrician and pedodontist to refer children to a multidisciplinary team of specialists able to deal, in a holistic way, with both the physical and behavioural causes of the problem, and with the consequence on the craniofacial and systemic development of children.

### Breathing disorders

The paediatrician is the specialist who visits a child on a regular basis since the early days of his life,

MOUTH BREATHING SIGNS AND SYMPTOMS	
Skeletal	Skeletal Class II Narrow palate Hyperdivergent skeletal pattern
Dental	Posterior cross bite Anterior open bite Deep overjet
Facial	Long face Incompetent lips Hyper-extended head Narrow nostrils

TABLE 1 Signs and symptoms of mouth breathing.

and therefore is in a privileged position to diagnose respiratory disorders in children. Starting from the school age, the general dentist, the orthodontist and the paediatric dentist can perform large scale screenings, and it is not uncommon for one of these professionals to identify children at risk for OSAS and mouth breathing, and address them to a specialist for further studies. This is possible due to the detection of pathognomonic signs and symptoms, specific of the child phenotypes.

It has been performed a review of the literature available on this topic in the years between 1990 and 2011, with particular emphasis on prevention, paediatric visits, diagnostic tools and the treatment options for each of the two conditions.

### Mouth breathing

Mouth breathing is a stable and pathological alteration of the normal breathing pattern, which is triggered when there is an obstacle on the upper airway that increases the nasal resistances.

The allergic, asthmatic or adenoid child is very often a chronic mouth breather. Enlarged tonsils and adenoids, hypertrophied turbinates, deviated nasal septum, chronic rhinitis and bronchospasm obstruct nasal breathing [Rahbar, 2004]. The lip seal failure secondary to such conditions and the consequent abnormal posture of the tongue lead to the development of characteristic types of malocclusions [Trotman et al., 1997]. The patient will develop a characteristic functional class II malocclusion: long face, posterior cross-bite and anterior open bite, often accompanied with tooth crowding (Fig. 1).

### OSAS (Obstructive Sleep Apnoea Syndrome)

We define as "sleep-disordered breathing" a set of pathological changes of the airflow that occur when the patient is asleep, and include snoring, obstructive hypoventilation, hypopnoea and apnoea.

Apnoea is the complete cessation of ventilatory flow, the minimum duration of 10 seconds, with reduction of blood oxygen saturation, hypercapnia, and abnormal



FIG. 1 Example of mouth breathing child.

EEG waves [Givan, 2003].

Obstructive apnoea is caused by the presence of a mechanical obstacle in the airway lumen, which can be caused by the following.

- › Collapse of the pharyngeal wall in patients with upper airway hypotonus, as in obese subjects [Mallory et al., 1989].
- › Fall back of the tongue in patients who sleep in supine position [Cozza et al., 2002].
- › Recurrence of severe forms of hypertrophic tonsils [Contencin et al., 2003].

Obesity, tonsillar hypertrophy and chronic mouth breathing are predisposing factors for obstructive apnoeas.

OSAS (Obstructive Sleep Apnoea Syndrome) is a disorder which entails at least 5 apnoeas per hour of sleep associated with daytime symptoms such as chronic fatigue, attention deficit and hyperactivity disorder. In the case of more than 30 episodes per hour, the brain's hyperoxygenation is so severe that creates a risk for the child's development, with consequences ranging from alterations in the growth hormone release to the development of hypertension in adulthood, heart failure and myocardial infarction [Schechter, 2002].

## Slim allergic children with breathing disorders

### Characteristic signs and symptoms

The allergic-adenoid-mouth breathing children tend to be slim and slender. The face looks stretched, lips are frequently incompetent with hypotonic upper lip and everted lower lip, nostrils are small and the Gudin's reflex is absent or poorly represented. The open mouth posture means that the lips are often dry and cracked. The tongue has a low posture, the palate shows a transverse deficit with crowding and the oral hygiene

SDB SIGNS AND SYMPTOMS
Snoring
Apnoea episodes
Mouth breathing
Dry mouth upon awakening
Bruxism
Restless sleep, nightmares, sweating and sleepwalking episodes
Bed wetting atypical for the age
Tiredness, listlessness, difficulty getting up in the morning
Headache, nausea and vomiting
Little attention in school, continuous stirring, hyperactivity, irritability and aggression

TABLE 2 Signs and symptoms of sleep-disordered breathing.

is often poor due to the malocclusion and dry mouth. (Table 1). Hypertrophic tonsils can be easily identified by direct inspection. Parents often report that children have frequent colds, chronic nasal obstructions, asthma under stress and burning eyes.

The suspect of chronic nasal obstruction can be confirmed by means of clinical tests (examination of the Glatzel mirror, retaining a tongue stick with the

lips) or instrumental examinations.

The orthodontist is able to assess the patency of the pharyngeal lumen through cephalometry of the upper airways, which relates the position of the tongue, adenoids, and throat diameter. If this two-dimensional estimate is not enough, the latest volumetric CT processing softwares can accurately measure the airways, and detect any barriers to the passage of the airflow [Aboudara et al., 2009].

The otolaryngologist by means of rhinomanometry can accurately quantify air resistance, and the point of obstruction [Caprioglio et al., 1999].

The diagnosis of respiratory allergy and allergic asthma requires the intervention of an allergist or pulmonologist, who will perform the patch and stress tests in a controlled environment [Mansfield et al., 2004].

### Therapy

Once the cause of respiratory obstruction is found, the specialist is in charge to identify for each case the pharmacological or surgical method for reduction or removal of the obstruction.

Allergic patients should avoid environmental allergens, take corticosteroids and use antihistamines and nasal decongestants [Mansfield et al., 2004].

Aerobic sports in a controlled environment, such as swimming, are excellent for raising the threshold of

	OBESE DYSMETABOLIC CHILDREN	SLIM ALLERGIC CHILDREN
<b>SIGNS</b>	Short neck Micrognathia Skeletal II class Eyeholes	Mouth breathing Palatal deficit Lip seal failure Long face
<b>SYMPTOMS</b>	Snoring Apnoea episodes Tiredness Headache Hyperactivity irritability	Allergic rhinitis Enlarged tonsils Bronchospasm
<b>DIAGNOSTIC TESTS</b>	Upper airway cephalometry Polysomnography	Glatzel mirror test Tongue stick test Rhinomanometry Patch test 3D upper airway cephalometry
<b>CAUSAL THERAPY</b>	Weight loss Physical activity Functional class II devices	Adenotonsillectomy Allergic desensibilisation Rapid palatal expansion Myotherapy
<b>SYMPTOMATIC THERAPY</b>	cPAP Mandibular protruders	Environmental prevention Antihistamines and nasal decongestants
<b>SPECIALISTS INVOLVED</b>	Paediatrician Paedodontist Orthodontist Nutritionist Sport doctor	Paediatrician Paedodontist Orthodontist Pneumologist ENT specialist Surgeon Allergist Speech therapist

TABLE 3 Multidisciplinary and orthodontic diagnosis and treatment of obese dysmetabolic children and slim allergic children.

bronchospasm and tone the body muscles [Ram et al., 2000].

Adenotonsillectomy is controversial. Tonsils removal is therefore indicated only in the presence of repeated episodes of infection during the year and if they involve significant grade of OSAS [Guilleminault et al., 2004].

Orthodontists are able to significantly reduce respiratory resistance by increasing the volume of the nasal cavities through the rapid expansion of the maxilla [Ceroni Compadretti et al., 2006]. The palate is the floor of the nasal cavity, which has approximately a triangular shape. This means that even small increases of the skeletal intercanine and intermolar diameter result in a significant decrease in nasal resistance [Doruck et al., 2004]. A normalised palate is then a more stable position for the tongue, which has the possibility to stay in a physiological posture, no longer interposed between the arches. This often results in a repositioning of the mandible, with reduction of the functional class II and the anterior open bite. However if such correction can not be obtained spontaneously, functional appliances such the Bionator, Fränkel II, Kinator, associated with myotherapy exercises for the recovery of the labial competence and tongue posture, are able to facilitate the craniofacial development during the whole growth period [Schievano D. et al., 1999].

## Dysmetabolic obese children with breathing disorders

### Signs and symptoms

Childhood obesity is a widespread problem in Italy. It is estimated that 20-25% of children under 10 years are overweight.

Obesity is not a disease in itself, but a risk factor for the so-called metabolic syndrome: insulin resistance, type II diabetes, dyslipidemia, hyperuricemia and hypertension [Dehgham et al., 2005]. It is also a risk factor for OSAS, because pharyngeal wall with fatty infiltration has a low muscle tone [Mallory et al., 1989] (Fig. 2).

A routine question that should be asked to parents is the presence of snoring, which is often associated with OSAS. Signs and symptoms of suspected OSAS are listed in Table 2.

The gold standard diagnostic test for OSAS is polysomnography [Schechter, 2002]. It consists in a continuous recording, during sleep, of parameters such electrocardiogram, electroencephalogram, electromyogram, electrooculogram, pulse oximetry, measurement of ventilatory flow and movements of the rib cage. It is done in specialized centers under the supervision of a Sleep Doctor and Pulmonologists. It is a very precise examination, but it is an expensive test and must be reserved to symptomatic patients with signs of daily and nightly OSAS.



FIG. 2 Example of overweight child suffering from OSAS.

### Therapy

The treatment of mild OSAS is of behavioural type: weight loss through a balanced diet and adequate physical activity, regular sleep schedule, sleeping in lateral and supine positions [Steinbeck, 2001].

In severe cases, especially in adulthood, but sometimes even in childhood, Continuous Positive Airway Pressure (CPAP) is used [Palombini et al., 2004]. This is a device that dispenses a constant flow of air through a mask, thus preventing collapse of the airway during sleep. It is effective but uncomfortable for the patient, because it can be quite noisy and the air introduced, by positive pressure, causes dryness of the mucous membranes and rhinorrhea.

In cases of mild to moderate OSAS associated with skeletal second class, the orthodontist can intervene through a nighttime mandibular propulsor, which forces the mandible in a forward position during sleep [Favero et al., 2004]. The advancement of the base of the tongue involves a reflex that causes the muscle to stretch and the upper airway to open. Mandibular propulsors are well-known appliances, widely used for OSAS in adults. During child development, this device has the advantage of reducing episodes of apnoea, and also serves as a functional unit supporting mandibular growth in selected patients [Shoaf, 2006]. However, further studies are needed to understand the effects of mandibular growth in developing patients.

## Conclusion

Mouth breathing and OSAS are respiratory disorders that affect, with different mechanisms, allergic slim and dysmetabolic obese children. These disorders lead to signs and symptoms, which must be identified by both the paediatric dentists and orthodontists. These diseases are potentially serious for the child's psychological

and physical development. Their treatment requires a multidisciplinary coordinated approach, involving paediatrician, orthodontist, ENT (ear, nose and throat) specialist, allergist, pulmonologist, nutritionist and speech therapist.

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