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How to recognize skeletal craniofacial and dental types: warning signs in child snorers and risk factors for OSAS

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ABSTRACT

In children, obstructive sleep apnea syndrome (OSAS) is common but screening is poor. The orthodontist is strategically placed within the multidisciplinary team to detect respiratory disorder and suspected OSAS.

The objective of this article is to consider indications for medical management of young patients. Parents do not always report their child's snoring, and it is up to the orthodontist to raise the question.

The orthodontist's awareness of radiological anatomy and masticatory system physiology and experience in observing the various functions in clinical examination of young patients can alert parents, guide referral to ENT or sleep medicine and allow early treatment.

KEY WORDS

Obstructive sleep apnea syndrome, children, screening, craniofacial skeletal and dental typology

INTRODUCTION

In specialized consultations for obstructive sleep disorder, ENT physicians and pneumologists are attentive to the pharyngeal anatomy and physiology implicated in snoring and apnea. Such consultations have for several years now been multidisciplinary, and orthodontists have a central role to play in screening.

ENT, pneumology and orthodontics specialists each contribute their specific diagnostic and therapeutic attitudes.

Obstructive sleep apnea syndrome (OSAS) affects children, with peak incidence between the ages of 3 and 5 years[5,6].

Childhood OSAS may affect neonates as well as adolescents, and shows specific pathophysiology that differs from that found in adults and proves difficult to screen for.

Diagnosis is classically founded on polysomnography (PSG), but few children undergo this as sleep laboratory access is limited.

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The symptoms of OSAS are not sufficiently well known, are variable, and depend on growth stage and maturation.

Without suitable treatment, children may develop pulmonary dysfunction, neurocognitive impairment with learning difficulties, mood disorder (anger, aggression), attention disorder and hyperactivity.

Daytime somnolence is not systematically reported.

Breaks in the growth curve are late warning signs.

ENT PROBLEMS

Full name:
Date of birth:

Does your child have:	difficulty breathing	yes/no
	frequent head-colds	yes/no
	frequent ear infection	yes/no
	pharyngitis	yes/no
	rhinopharyngitis	yes/no
Has your child had the tonsils removed		yes/no
	adenoids removed	yes/no
Does your child have the following signs:		
	mouth open during the day	yes/no
	sucking thumb, fingers, comforter	yes/no
	sucking lower lip	yes/no
	sleeping mouth open	yes/no
	snoring	yes/no
	rings under the eyes	yes/no
	night sweats	yes/no
	difficulty waking in the morning	yes/no
	urinating at night	yes/no
	bed wetting	yes/no
	chapped lips	yes/no
	frequent nightmares	yes/no
	sleep-walking	yes/no
	sleep-talking	yes/no
	saliva stains on pillow	yes/no
	frequent awakening at night	yes/no
	sleep apnea	yes/no
Does your child push the tongue forward to speak or swallow?		yes/no
Is your child hyperactive?		yes/no
Does your child have difficulty concentrating at school?		yes/no

Figure 1
Medical questionnaire.

Interaction between obstructive respiratory disorder and craniofacial development and morphology is an important dimension of OSAS research. Certain skeletal types such as mandibular retrognathia or maxillary contraction are also found in the healthy population.

The orthodontist is thus an important link in the multidisciplinary chain, with a key role to play in screening for respiratory pathology in young children and adolescents who snore[7].

CLINICAL WORK-UP FOR OSAS

Orthodontic consultation

In orthodontic consultation, the importance of certain signs needs highlighting during the interview with the patient and family.

A dedicated medical questionnaire (fig. 1) establishes the patient's medical, and notably ENT, history and screens for OSAS warning signs:

– severe snoring[9], apnea;
– daytime somnolence;
– daytime fatigue;
– impaired concentration;
– hyperactivity.

Overweight and obesity should be screened for.

So should allergy and asthma.

Extra-oral, intra-oral and functional examination provide preliminary information on skeletal and dental type and associated risk of onset of breathing disorder.

This clinical work-up is completed by a prescription for radiologic assessment, to be studied and interpreted by the orthodontist.

Taken together, these elements may found suspicion of OSAS.

Suspected OSAS

In case of suspected OSAS, the orthodontist refers the patient to pneumology, sleep medicine or ENT.

Clinical and radiological assessment is completed by PSG, to highlight obstructive respiratory events and rule out other sleep disorder.

Treatment associates pneumology, ENT and orthodontics.

WHAT DOES THE LITERATURE SAY?

Predisposing facial phenotype

A predisposing facial phenotype, involving mandibular retrusion or maxillary contraction, is found in the general population. Children presenting with obstructive respiratory disorder show significant morphological specificities at the skull base, maxilla and mandibular divergence.

– Guilleminault et al. described a facial phenotype found in 34% of children with sleep-disordered breathing[8,9].
– Rees et al. identified a particular phenotype associating micrognathia and retrognathia[14].

– Zucconi et al. confirmed this phenotype associating maxillary micrognathia, mandibular retrognathia and facial hyperdivergence[18].

Craniofacial typology

Other authors reported particularities in various skeletal structures.

Skull base

– Short anterior skull base (SN distance), according to Bacon[1,2] and Battagel[3];
– Closed skull-base angle (Ba-SN), according to Tangugsorn[17] and Jamieson[11].

Maxilla

– Retromaxillism, according to Lowe[12], Pracharktam[13], DeBerry[4] and Tangugsorn[17].
– Endomaxillism, according to Pracharktam[13].

Mandible

– Retromandibulism associated with OSAS, first report by Riley[15] in 1983: association found in 66% of cases.
– Retromandibulism and short mandibular body, according to Riley[15], Jamieson[11], Lowe[12], Zucconi[18], Tsuchiya and Hochban[10].
– Facial hyperdivergence, according to Lowe[12], Bacon[1] and Jamieson[11].
– Increased vertical facial dimension, according to Lowe[12], Bacon[1], Jamieson[11] and Tangugsorn[17].

Hyoid bone

– Lowered and caudal position, according to Riley[15], Lowe[12], Zucconi[18], Hochban[10] and Battagel[3].

Screening factors in child and adolescent snorers

– Hypoplasia or micromaxilla.
– Maxillary contraction or endoalveolism.
– Maxillary retrognathia.
– Mandibular retrognathia.
– Short mandibular body and ramus.
– Facial hyperdivergence.
– Short skull base – Closed skull-base angle.
– Low caudally positioned hyoid bone.

HOW TO ASSESS CRANIOFACIAL AND DENTAL TYPES?

The skeletal types described in the literature are frequently encountered in orthodontic patients presenting with snoring or disordered breathing.

There are interactions between obstructive respiratory disorders, development and craniofacial type.

The orthodontist plays a major role, as clinical examination screens for certain craniofacial and functional risk factors for obstructive respiratory pathology and may allow early treatment[16].

What are the important points to note in the various extra-oral, intra-oral and functional examinations, completed by photographic and cephalometric analysis?

Extra-oral and photographic study

AP and lateral study of the face begins with clinical examination, with the patient seated in the chair, and is continued by photographic study.


Figures 2 and 3
AP and lateral photographs. Anaïs B.

Guilleminault[8] described a specific predisposing phenotype, found in 34% of young OSAS patients: the "adenoid facies":
– dental and skeletal class II;
– mandibular retrognathia;
– narrow, pointed chin;
– mandibular hyperdivergence ;
– long face;
– ogival hard palate;
– long soft palate.

Tracing the various planes on AP (fig. 2) and lateral photographs (fig. 3) highlights several elements.

On the AP photograph (fig. 2), we look out for:
– rings under the eyes, a sign of oral breathing;
– short, narrow nose: narrow, sometimes asymmetric nostrils, and possible septal deviation;
– thick, lateralized, chapped lips or short superior lip;
– labial non-occlusion at rest;
– relatively pronounced lip-chin groove;
– relatively well contoured chin;
– symmetry, asymmetry and height of facial levels;
– increased lower-level height, long face.

On the lateral photograph (fig. 3), to complete facial examination, we look for:
– type of profile: cisfrontal, orthofrontal or transfrontal according to the position of the upper lip and chin (cutaneous pogonion) relative to the Simon and Izard planes;
– position of the nose;
– naso-labial angle (♀: 100° – ♂: 110°);
– position of chin, laterally;
– chin-neck distance;
– goniac angle;
– Merrifield esthetic Z line (tangent to cutaneous pogonion and most anterior point of the more protrusive lip);
– mandibular hyperdivergence;
– retromandibulism.

Intra-oral examination

Maxillary arcade (fig. 4)

– Deep, narrow ogival palate.
– V-shaped arcade.
– Crowding.
– Vestibular version of maxillary incisors.

Mandibular arcade (fig. 5)

The mandibular arcade is very often non-congruent with the maxillary arcade, and is usually U-shaped.

Adjacent tissue

It is important to examine:
– soft palate;

Figure 4
Maxillary arcade.

Figure 5
Non-congruence of arcades.

– palatine tonsils, which may be hypertrophic;
– volume and position of the tongue.

Various patterns of soft-tissue/skeletal or skeletal/soft-tissue relations may be found: excessive soft tissue volume or insufficient skeletal framework. It is also important to assess muscle tonus. Hypotony may be associated with soft-tissue/skeletal dysharmony.

Functional examination:

"Preventive or pre-therapeutic action on dento-maxillo-facial dysmorphia should always include screening for oral breathing." Jean Delaire.
– Position and volume of the tongue.
– Swallowing.
– Parafunctions.
– Respiration.

Dysfunction is never isolated and can induce morphologic and anatomic modifications liable to disturb or prevent various functions.

Occlusion relations

Occlusion relations are examined in 3 dimensions.

Anteroposterior (fig. 6)

Yong patients who snore and/or present with OSAS very often have Angle class II division 1 or 2. Anterior overhang or corono-palatine incisor version may be observed.

All patterns are, however possible, including class I or III.

Vertical

Vertically, infra-occlusion or anterior supra-occlusion may be observed.
– Anterior gap (fig. 7).
– Incisor supra-occlusion (fig. 8).

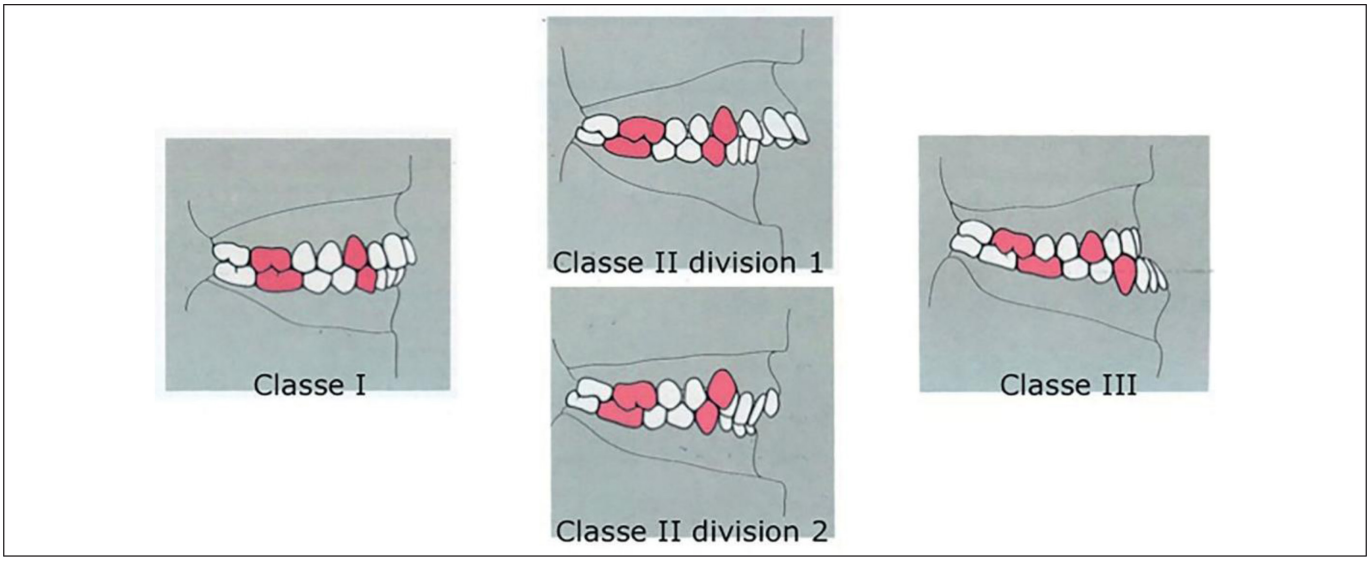
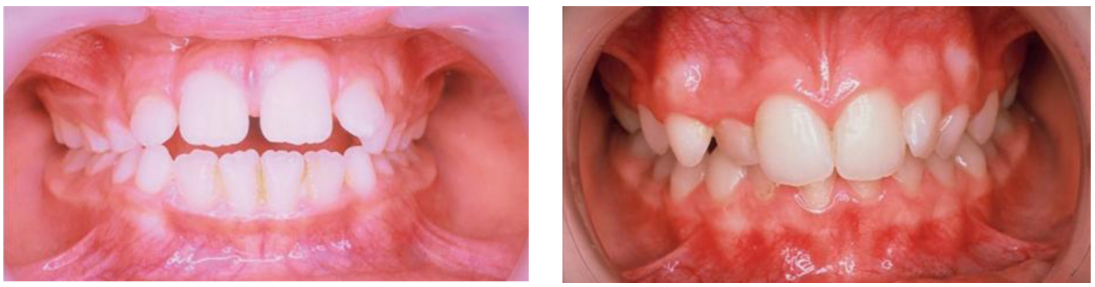


Figure 6
Anteroposterior direction.



Figures 7 and 8
Vertical direction.

Figure 9
Transverse direction.

Transverse direction (fig. 9)

Transversally, it is important:

– to detect any deviation of the incisor center;
– to determine differential diagnosis between endoalveolism and maxillary contraction.

Radiology and cephalometry

The radiology file comprises:

– panoramic X-ray;

– teleradiograph in occlusion;
– AP (if necessary);
– lateral;
– other views (if contributive).

Before performing cephalometry, it is important to "read" the lateral teleradiograph to screen for certain elements found in oral breathers:

– double nasal and oral entry in the oropharyngeal lumen;
– reduced oropharyngeal diameter;
– palatine tonsil and adenoid hypertrophy;
– lowered ala convexity/anterior nasal spine;
– reduced symphyseal cortex;
– mouth open, lips not together, high cutaneous/osseous pogonion;
– low tongue position;
– lowered hyoid bone/C3-C4;
– reduced frontal, maxillary and sphenoid sinus volumes;
– bone narrowing in the naso-maxillary and tubercle regions.

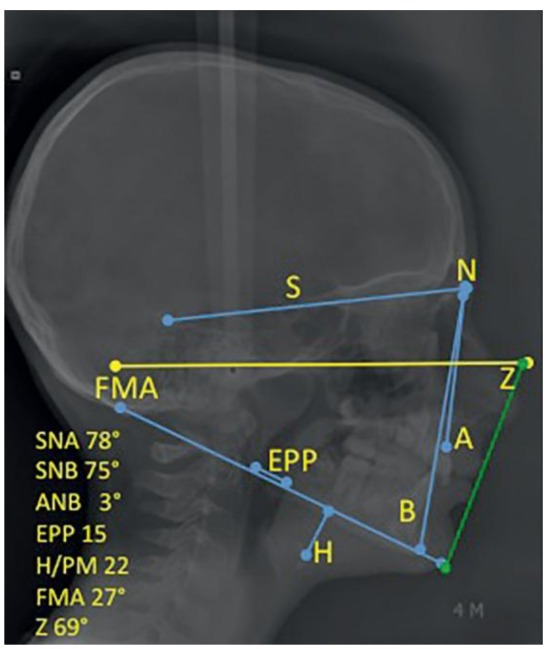


Figure 10
Tweed's cephalometric analysis, modified by Riley.

Tweed's structural analysis (fig. 10), used here as reference, assesses skeletal anteroposterior and vertical relations.

• Anteroposterior
– Position of maxilla and mandible in the facial configuration.
– Measurement of bone base shift–Skeletal typology (Ballard classification).

Anteroposterior study focuses on the SNA, SNB and ANB angles.

Riley introduced specific measurements for OSAS:

– posterior pharyngeal space (PPE) measured in the goniac angle region;
– distance between hyoid bone and Downs' mandibular plane (HMP).

• Vertical
– Maxillary base divergence:
– normal divergence ;
– hypodivergence;
– hyperdivergence.
– Height and proportions of facial levels.

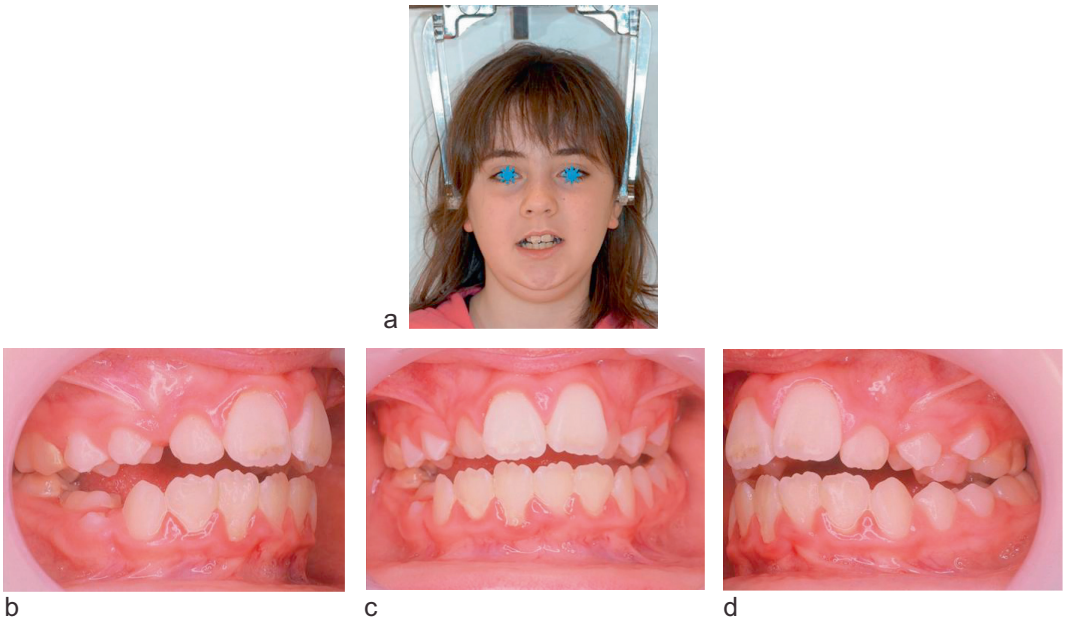
Vertical study focuses on the Frankfort mandibular plane angle (FMA), anterior and posterior height, and facial height index (FHI).

While it is true that a majority of apnea patients show an increased vertical dimension, hyperdivergent skeletal pattern and oral breathing, this is not systematic, and cases of vertical insufficiency with considerable overlap and hypodivergence may be found.

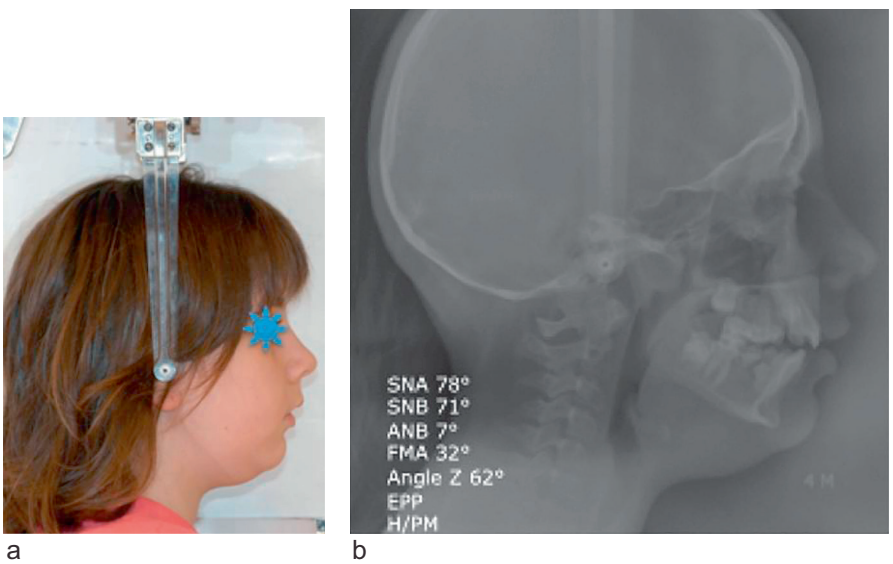
Dentally, assessment focuses on:

– incisor position on lateral view (maxillary and mandibular incisor axes/Frankfort plane);
– inter-incisor angle.

Clinical example (fig. 11a, b, c, d) (fig. 12a, b)



Figures 11 a, b, c, d
Anaïs B. AP and right, frontal and left intra-oral photographs. Dental class II - anterior gap - central deviation - endomaxillism - labial non-occlusion - long face.



Figures 12 a, b
Anaïs B. Lateral photograph and teleradiograph. Dental class II - anterior gap - labial non-occlusion - oral breathing - long face - biretrognathia – skeletal class II - facial hyperdivergence.

Esthetic analysis situates the lips and chin with respect to Merrifield's Z line and measures the Z angle (Z line/ Frankfort plane).

CONCLUSION

Sleep is indispensable for everyone, but especially for children, being essential for growth and the development of the brain.

Before 4 years of age, 8 out of 10 children are estimated to encounter occasional sleep-related problems.

More than half under-4 year-olds snore.

There is nothing negligible about snoring, which can impact health in childhood and adolescence.

Snoring is caused by obstructed air passage, which normally runs through a series of conduits comprising nose, pharynx, larynx and trachea before reaching the lungs.

When there is an obstacle in the nose or pharynx, the child's breathing becomes abnormal and very noisy, which often worries the parents. It may cause sleep apnea.

Childhood snoring should not be taken lightly. It may reveal a serious pathology: obstructive sleep apnea syndrome.

Craniofacial skeletal architecture influences the etiopathogenesis of OSAS.

Management of OSAS has to be multidisciplinary, and the role of the orthodontist in screening and possible early treatment of maxillary contraction and retromandibulism in children is essential.

Conflict of interest: The author declares no conflict of interest.

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