Craniofacial Signs, Symptoms and Orthodontic Objectivs of Paediatric Obstructive Sleep Apnoea

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Introduction

The study of craniofacial growth and development has a long history in the disciplines of Paediatric Dentistry and Orthodontics. Unbalanced facial growth is known to be causative for dental misalignment and malocclusion. However, historically little emphasis has been placed on the possible link to Obstructive Sleep Apnoea. Through greater understanding from contemporary studies and reflections from past research we now are bringing to light the interrelationships of all proximal structures in the many chronic issues that ail our children.

When studied with the context to link the maxillomandibular complex with pharyngeal patency and Sleep Breathing Disorders, many signs and symptoms are present. When care is taken to evaluate the facial structures of the growing child, clear indicators of development issues and their connection with airway dysfunction are observable.

Clues from definitive corrective treatments for Obstructive Sleep Apnoea may give us reason to consider changes in orthodontic operative standards. Treatment objectives accounting for the orthodontic impact on the airway will hopefully expand future markers for success to encompass improving balance for the whole craniofacial complex.

Orthodontic Context for Obstructive Sleep Apnoea

Obstructive Sleep Apnoea (OSA) is a dysfunction during sleep characterized by recurrent, episodic cessation of breath due to complete or partial blockage of the upper airway. It is a high order part of a spectrum of upper airway dysfunctions within the Sleep Disorder Breathing Syndromes (SDBS).

Although all the related disorders within the spectrum of SDBS are diagnosed and managed by medical practitioners, Kaditis (2015) as part of the European Respiratory Society Task Force now recommends adjunctive Orthognathics and Orthodontics be included in stepwise care for SDBS.

Orthodontic observations provide vital clues to airway performance. Misaligned teeth and distorted jaws are but hard tissue evidence of craniofacial aberrations of the structures associated with upper airway obstructions. Huang (2013) overviewed this and reflected many decades of linking disorders of oral-facial growth and OSA in children.

To understand the association of malocclusion and OSA it is useful to review how malocclusion develops. Specifically, Dibbets (1996) indicated the maxilla set too far down, back or too small in form is the genesis of malocclusion. Bjork (1968) measured ideal maxillary growth at a mean of 51 degrees and later Ruf (2001) mandibular growth at 54 degrees. Both noted good overall alignment with these growth directions but considerable variations of increased vertical growth associated with malocclusions. McNamara (1981) highlighted that even in Angle's Class II malocclusions most commonly the maxilla was retrusive and excess height of the lower face the most common finding.

Platou (1983) then confirmed patients with more horizontal growth tendencies of "prognathia" (forward jaws) had straighter teeth, and better balance in facial form than vertical growing "retrognathia" (retruded jaws). The most typical orthodontic cluster of findings in SBDS was illuminated by Linder-Aronson (1979) many decades previously.

"The results have shown that children who had difficulties in nasal breathing were characterized by increases in both the lower and total facial heights, the sagittal depth of the bony nasopharynx was less, the tongue had a lower position, the upper arch was narrow, the upper and lower incisors were retroclined, the palatal vault was of normal height, there was a cross-bite or tendency towards cross-bite, a tendency towards open bite and normal antero-posterior relationship between upper and lower jaws. Disturbed nasal respiration can affect both facial morphology and the dentition."

Hultcrantz (2009) and Kim (2011) reconfirmed these findings in recent studies. Craniofacial aberrations and distortions cannot but impact the function of its organs and efficiency of the body's actions. Less than optimal form and imbalances in structures of the soft and hard

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tissues of the face reduce all it's potential. Developmental distress can present as dysfunction of mastication, communication and of course breathing.There are two aperture areas with two segments in the upper respiratory pathways; two nostrils and the mouth lead respectively to the nasopharynx and the oropharynx.
Any reductions in maxilla size, distortions in its shape and or incorrect location of its positioning can reduce nasopharyngeal airflow efficiency. Increase in soft tissue mass of the turbinates, the adenoids and the tonsils are also obstructive, however Migueis (2016) concluded nasal and nasopharyngeal level issues, important in SBDS, play only a minor role in the more extreme disorder of OSA. Venekamp (2015) confirms this by also discarding the relevance of obstructions at or above the oropharyngeal level, voiding the relevance of the usual suspect set of adenoids and tonsils when dealing with OSA.

Of highest significance then, are the hyoid level obstructions. Any loss of tone, over crowding of the intraoral space, dysfunction in the glossus muscles (tongue) and the mandible elevator muscles results in the hanging of the mandible and resting with the mouth open. This postural weakness has the potential in the supine sleep position for further flexion of the head/neck that can collapse all the soft tissues interlinked with the hyoid bone and the posterior pharyngeal wall.

An open mouth posture must be one of the key indicators to assess for as it is commonly intertwined with mouth breathing tendencies, which by default, is already a laboured means of respiration. The genesis of this incorrect oral posture is likely from nasal and nasopharyngeal congestions and obstructions, though De Felicio (2016) suggests weakness and poor functional muscular coordination.

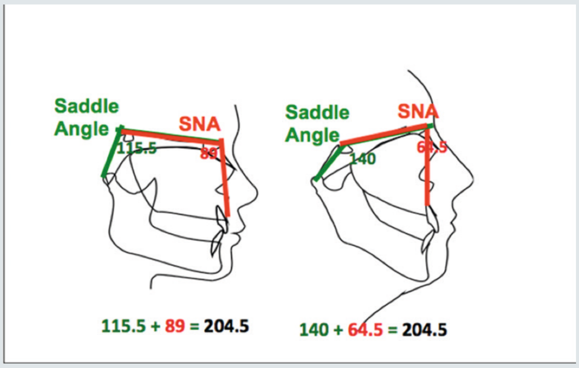
Surprisingly, though the signs and symptoms of poor oral posture are obvious to the eye, they are largely ignored. Glatz-Noll (1991) discovered normal (the clinical control subjects) industrialized 4 year olds on average leave their mouths open for 80% of the time, yet few even today appear to place any significance to these findings. Trotman (1997) however, elucidated a very powerful interrelationship with the soft and hard tissues of the maxillomandibular complex.

"A more open lip posture was associated with a downward and backward rotation of the maxilla and mandible a more obtuse gonial angle, a retruded mandible with retroclined incisors, extruded maxillary molars and maxillary and mandibular incisors, and an elongated total face height caused mainly by a larger anterior face height."

To truly understand the dental/facial/head/neck relationship to airway flow, the equilibrium balance of space management in the body organ relationship needs recognition. Each structure of the body requires a minimum volume with correct spatial placement to work effectively. Luzi (1982) showed a consistency in biological form that adapted the base of skull saddle Ba S N angle and maxilla/mandible ANB angle relative relationships to very precise arrangements (figure 1). Less than 2.5 degrees was found within the group of 160 Class I subjects measured indicating very tight volumetric requirements for the head and face

The growing structures adapt to environmental change but must maintain overall spatial requirements for function. To some degree, form can change but not overall volume. In children who maintain an open mouth posture, when the unsupported maxilla "drops" the mandible must change rotational position to maintain the excess freeway space adopted. This has an unwanted consequence of shifting the tongue at the hyoid level to close pharyngeal space. In order to protect the airway, the mandible in the growing child, in time must change its form too.

Fig. 1



Luzi (1982) showed a consistency in biological form that adapted the base of skull saddle Ba S N angle and maxilla/mandible ANB angle relative relationships to very precise arrangements.

Remodelling occurs in the vertical ramus forward and a reduction in the horizontal ramus coincides to rebalance the angles necessary for the best equilibrium of the balance of all the structures (Figure 2). In the growing child as enormous changes occur over short periods of time, the adaptations of bony structures to soft tissue induced poor posture can be disproportionally large. Trenouth (1999) measured 20-degree difference in saddle angles between well-balanced faces with good dental alignment and distorted faces with dental misalignment.

In children with high saddle angle growth, in addition to the maxilla and mandible being down and back, the arch lengths are shorter and teeth crowded. As Bernabe (2005) confirmed arch length to be the deciding factor in dental crowding, it is clear the anterior posterior dimensions are also critical for optimal placement of the tongue in the intraoral cavity.

Marcotte (1981) and Vig (1989) observed a further postural compensation occurs when the mouth is left open at rest. The cervical vertebra curves forward to allow the extension of the cranium on the atlas, so the weight of the head balances and the eyes level to the horizon. In compensation the head is tipped up for ease in breathing with the neck and shoulders rolled forward to allow the eyes to level for ambulatory balance.

In the airway-compromised, the head is routinely rotated to keep nasion forehead/nose juncture above pogonian of the lower jaw chin.

Fig. 2

Remodelling occurs in the vertical ramus forward and a reduction in the horizontal ramus coincides to rebalance the angles necessary for the best equilibrium of the balance of all the structures.

The Facial Clues

With these considerations, there are many signs and symptoms revealing of structural and functional problems in the growing child's face and mouth. Mew (2013) outlines oral and head postural problems that highlight childhood development issues. A sloping forehead can foretell of imbalances, as likely head tilt compensation is present (figure 3). Typically in compromised postures the forehead is tilted back or down, both placing the head in a forward position. A forehead when in the upright stance should be roughly perpendicular to level ground and in line with the chest. When the head is reset to this level, a truer relative position of the facial jaws in their horizontal and vertical growth direction can be shown (figure 4).

A correctly placed maxilla in an up and forward position tends to carry the nose tip up in line with the stably positioned nasal bones. Straight noses have good nasal and maxilla bone support. Correctly placed and sized maxilla offers significant support in the soft tissue structures around the eyes and strongly defines the cheekbones. In good balanced faces the cheek line runs parallel with the nasal bones (figure 5).

Fig. 3

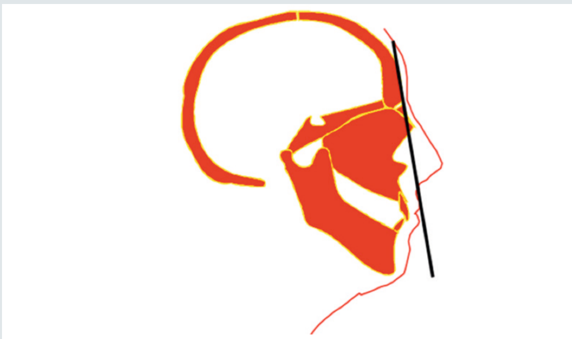


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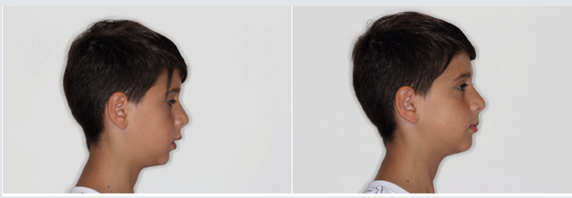
Fig. 4



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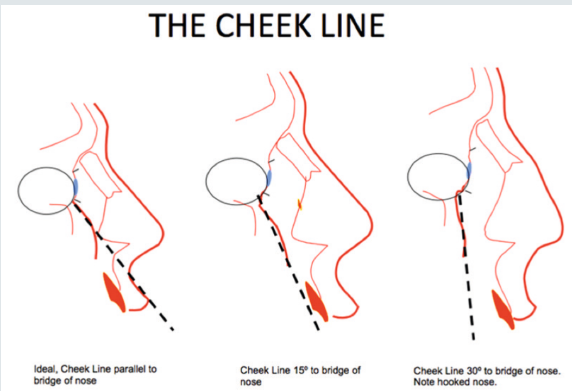
A break in the nose line can be very revealing of much deeper changes in the facial bone complex. Facial bone development that is in a back and downward direction results in flattening of the zygomatic cheekbone lines and drop away from the line of the nasal bones. Cheekbones present as soft and flat and the soft tissue form of the face including the tip of the nose is drawn down away from the line of the nasal bones. A hooknose or angle change from the nasal bone inclination to nose tip tells of less forward and more vertical growth (figure 6).

Even the eyelid levels are impacted by the growth trend direction of the maxilla (figure 7). Well-positioned maxillae offer good support of the soft tissues overlaying them, so they uplift the eyelids and no whites under the iris should show. When white sclera is noticeably visible under the irises and downward turn of the canthus (outer corner) of eyelid appears as a sleepy droop then underlying cheekbone fullness is lacking and there is good indication of the lack of forward projection of the maxilla in growth. Further down the face more soft tissue markers tell of muscle tone weakness or dysfunction. Cheek muscle bulge or hollowness is very revealing of levels of muscle tone. Ongoing overuse of the buccinators muscles indicates lack of maturity in the swallow pattern. Incorrect muscle function influences growth in the immature bones of young children as it impacts both functional action and resting posture. Facial muscles (buccinator, oblicularis oris, mentalis) and the tongue driving forward are used in the infant for suckling. This is normally scheduled to shift to a predominance of the mandible elevator muscles (temporalis, masseter) for chewing and the tongue gently uplifting for swallowing in the 2nd year of life. This should coincide with eruption of the primary molar teeth and the time of anatomical readiness for speech.

In correct development, suckling changes fully to swallowing but Matsuo (2008) and Van Den Engel-Hoek (2015) note various disturbances to the natural cycle of neuromuscular co ordination as being commonplace today. Unlike the quiet nature of the mature swallow this compensatory hybrid type "suck-swallow" is excessively busy because much like the infant suckle, all the muscles of the mouth and face appear to fire simultaneously. Machodo (2012) and Almiro (2013) revealed radiologically how these parafunctions are detrimental to airway patency in the dentate child. Visually this presents as over retention of "baby cheeks" and excessive lower lip activity and chin "dimpling" due to disruptions of the learning process needed to quieten the face in adult deglutition (figure 8).

Fig. 5



In good balanced faces the cheek line runs parallel with the nasal bones.

Fig. 6

A hooknose or angle change from the nasal bone inclination to nose tip tells of less forward and more vertical growth.

Fig. 7

Even the eyelid levels are impacted by the growth trend direction of the maxilla

Fig. 8

Visually this presents as over retention of "baby cheeks"

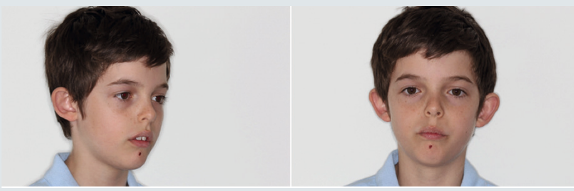
Brace (1986) hypothesised one possible culprit for this phenomenon; spoon-feeding infants who are only capable of suckling liquids, before their time for neurobiological development of lip seal swallow for solids. Correct lip form is dual symmetric, even in tone in both upper and lower jaw and without eversion past the dry/wet line of the inner oral surfaces (figure 9). Lip unevenness with tight thinner upper lip, everted, flaccid, overly full lower lip and downturned corner commissures signify improper muscle tone and control. Good habitual lip together resting from toned temporalis and masseter elevator muscles presents a natural tendency to leave the lips softly together in the resting posture. In poor function lip seal is only fleetingly present, often without touching during in speech and when in contact, “purse forced” under tension (figure 10).

It is important also to be observant for facial (and general body) signs of obesity, which Mathew (2013) note has a 50% association with childhood apnea. Being overweight is neither a normal nor healthy characteristic. Narang (2012) states in children with OSA “obesity may independently or synergistically magnify the underlying cardiovascular and metabolic burden.” Incidentally but equally pertinent, parallel signs of excessive decay are commonly found in these children. Unsurprisingly, Ruanpeng (2017) recognises the culprit for much of their problems as the age-old dental nemesis, excess sugar consumption.

Fig. 9

Correct lip form is dual symmetric, even in tone in both upper and lower jaw and without eversion past the dry/wet line of the inner oral surfaces.

Fig. 10



In poor function lip seal is only fleetingly present, often without touching during in speech and when in contact, “purse forced” under tension

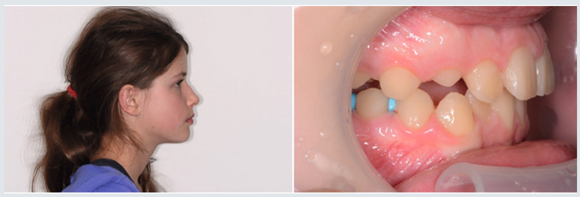
Orthodontic Clues

Skeletal and dental assessments standard to orthodontic evaluations for malocclusion can be very useful when searching for insights into compromised airways. Flores-Mir (2013) points out key associations with retrusive chin, steep mandibular plane, vertical direction of growth and a tendency towards Class II malocclusion and OSA. Reviewing the child in for routine orthodontic evaluations with an airway centric mindset can be advantageous for the health-compromised child. Normally malocclusion misalignment of the jaws and teeth are categorised by their vertical and horizontal relationships using the Angle’s Classification of Malocclusion.

Class I Crowding: Upper and lower jaws in even balance. Crowding or spacing misalignments limited to teeth. Good muscle tone in general. There will still be some reduction in tongue space as growth forward is still reduced from ideal if there is insufficient arch length for all 32 permanent teeth. Posturally, lip seal is good at rest but teeth are left slightly apart and tongue is off the palate in the posterior 1/3 and likely resting between the molars (figure 11).

Class II Division 1: Lower jaw behind upper. Size and form distortions notable with weakened muscle tone. Both jaws are back with the lower weaker of the two. Crowding of the teeth is minimal but the upper incisors are proclined forward. Tongue is completely off the palate at rest and at hyoid level further back in pharyngeal

Fig. 11



Class I crowding

Fig. 12

Class II Division 1

throat space. The mouth is open at rest with jaw swung back with a large freeway space, as overall tone is poor (figure 12).

Class II Division 2: Both jaws set back with lower cupped up within upper. Jaw length is shortened and crowding of teeth found both at front and back of arch. Distortions are found in shape and form from strong but uncontrolled muscle tone. Upper front teeth are retroclined. Joints are often compressed back and tongue space tight with spreading out broadly between molar teeth so dental misalignments usually noticeable. Lips are tightly sealed at rest but teeth are always apart (figure 13).

Class III Low Angle: Lower jaw ahead of upper jaw, with upper smaller by a degree. Space is tight for upper teeth but good alignment is found in the lower arch though in both arches the incisors are retroclined. Tongue space is good in the lower arch but insufficient in the upper so the maxilla is unsupported and growth has a hidden vertical tendency. Lowered tongue posture is kept in mouth often due to obstructions further back from enlarged tonsils or just a habit of resting low. Good muscle tone but mouth open and lower jaw held forward at rest (figure 14).

Class III High Angle: Lower jaw ahead of upper with divergent growth directions. Tongue space is rarely adequate in either arch. Nasal and throat obstructions from adenoids and tonsils are common. Sleep breathing disorder symptoms are common. Mouth is open at rest and tongue held down firmly (figure 15).

Excess Vertical Growth: Jaws divergent with long face presentation with both jaws down and back. Significant distortions in form and crowding are common. Intraoral tongue space is deficient and airways compromised in multiple levels along the pharyngeal space. SBD symptoms abound. Weak muscle tone. Mouth open and jaw down and back (figure 16).

Openbite: Teeth not meeting at the front are characteristic of incomplete bites where the tongue rests forward and the mouth is kept open. Tongue space is compromised in throat and mouth and appears proportionately large and very strong. Mouth always open with tongue held forward past teeth (figure 17).

The soft tissue organs and boundaries of the mouth are important to consider when gauging airway patency. Looking into the open mouth can be most revealing. Mallampati (figure 18) scoring is a diagnostic tool used by Anaesthetists to reveal the level of "congestion"

Fig. 13

Class II Division 2

Fig. 14

Class III Low Angle

Fig. 15

Class III High Angle

Fig. 16

Excess Vertical Growth

Fig. 17

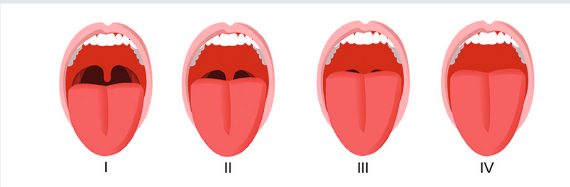
Openbite

within the mouth blocking their access to the throat space. When reviewing for potential airway issues, the tongue to available intraoral space relationship in the mouth is the most easily observable of the many signs. Without sufficient intraoral space in the closed bite resting position for the tongue, the tongue will either have to back off into the throat or come forward out past the lips. Ubiquitous to this forward tongue resting children is nasal congestion and mouth breathing tendency. (figure 19)

The glossus muscle is the central organ of the mouth. It occupies an enormous percentage of the oral cavity and it is concurrently the front boundary of the pharyngeal throat space. A tongue tight for intraoral space or just habitually resting back will impact throat space volume in the oropharynx and the pharynx at the hyoid bone level.

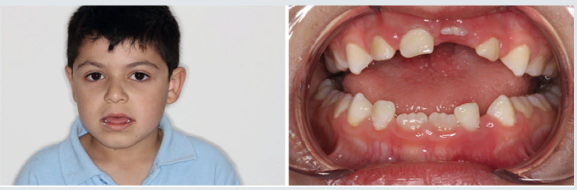
Outside of the obviousness of excessive tongue size, Guilleminault (2016) links untreated short lingual frenulum (figure 20) with obstructive sleep breathing syndrome at later age.

Fig. 18



Mallampati scoring

Fig. 19



Ubiquitous to this forward tongue resting children is nasal congestion and mouth breathing tendency.

Fig. 20

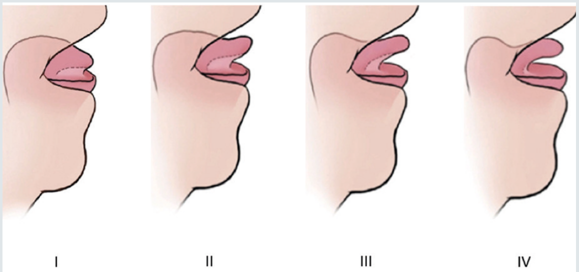
Untreated short lingual frenulum

Ankyloglossia tongue-ties range from complete to mild depending on the proximity of the tether to the tip (figure 21). The tether to the floor of mouth normally should more than 16mm from the tip of the tongue but many infants and children show reduced range of tongue mobility from being over bound to the mouth floor.

Further back, Ear/Nose/Throat surgeons grade tonsil size for the purpose of evaluating their inflammation levels and potential for obstruction (figure 22) These tools all can be recruited for orthodontic use to check issues of the oropharyngeal plane.

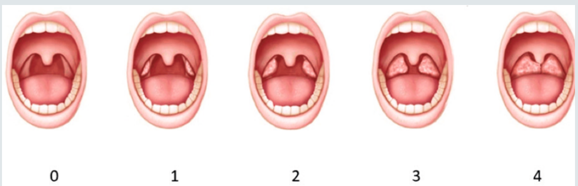
Low draped soft palate, flaccid, enlarged uvula, hypertrophic and inflamed tonsils take up valuable pharyngeal real estate (figure 23). It is unclear if mouth breathing and lowered tongue postures are the cause or the effect of the enlarged tonsils but they should non-the less, be included in routine examinations.

Fig. 21



Ankyloglossia tongue-ties range from complete to mild depending on the proximity of the tether to the tip.

Fig. 22



Grading tonsils

Fig. 23

Low draped soft palate, flaccid, enlarged uvula, hypertrophic and inflamed tonsils take up valuable pharyngeal real estate.

Dental arch form provides much information when viewed with the airway in mind (figure 24). High and narrow palate with prominent rugae will usually indicate tongue in lower, retruded and disruptive position as rest. Tongues that are tight for space in the mouth rest either back, down, laterally or forward off the palate, often creating much disruption of the teeth alignment as well. Crossbites are often found in children with OSA (figure 25). When the lower jaw or teeth archform is broader or longer than in the upper, the lower crosses past the upper when biting. In all situations the tongue is displaced more posteriorly mouth and takes up valuable pharyngeal space.

Mew (2013) charts an in-depth relationship between the resting tongue and the intraoral arch dimensions at the palatal gingival margins of the upper 1st molars. (figure 26). There is cause to believe the narrower the upper arch; the lower the tongue sits in the mouth.

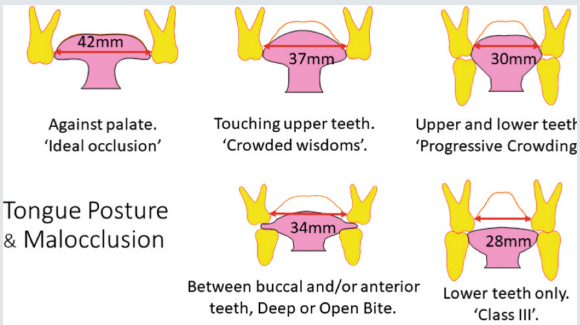
Fig. 24

Dental arch form provides much information when viewed with the airway in mind.

Fig. 25

Crossbites are often found in children with OSA.

Fig. 26



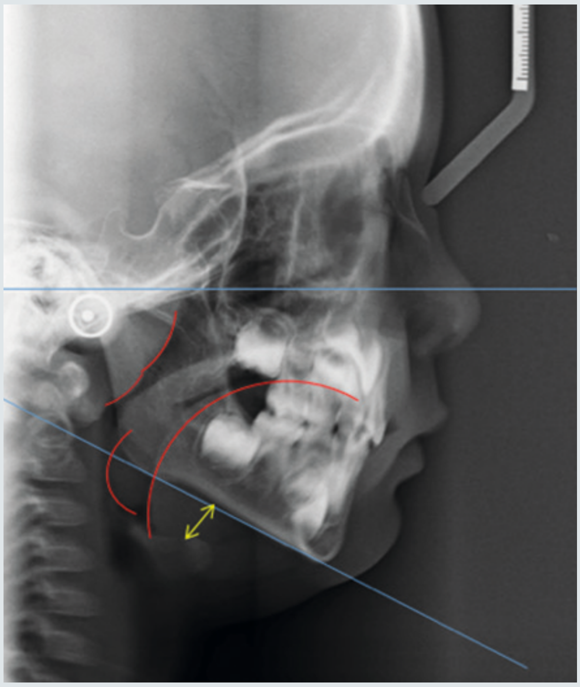
Mew (2013) charts an in-depth relationship between the resting tongue and the intraoral arch dimensions at the palatal gingival margins of the upper 1st molars.

Any widespread disease states found in the dentition can also be valuable clues. Enamel erosion and generalised decay may be symptomatic of gastroesophageal reflux common to OSA. Noronha (2009) and Ranjitkar (2012) record correlation and rising incidence in childhood OSA with dental damage caused by acid regurgitation. Often the Orthodontist will not see the eroded occlusal surfaces with “dished out” dentine exposure but instead the initial presentation will be full coverage restorations of the teeth throughout the mouth (figure 27). As the Paediatric Dentist will have already been primary carer for these children, affected teeth will be either already restored with composite fillings, stainless steel crowns or extracted early.Standard Xray used for all diagnostics in orthodontic care can also be used to show upper airway obstructions (figure 28).

Fig. 27

Affected teeth will be either already restored with composite fillings, stainless steel crowns or extracted early.

Fig. 28



Standard Cephalometric X-Ray

Major (2006) concluded soft tissue obstructions in the nasopharynx, the oropharynx is easily traceable and reasonably reliable for screening purposes. In addition Vieira (2011) correlated increased vertical facial height and anterior and inferior position of the hyoid bone to be predictive for obstructive sleep apnoea in children.

Malformation Syndromes

Unfortunately Kaditis (2015) reports OSA to be all too common a finding in syndromic malformations. Normally these syndromes are organised in 4 general categories of relevance for their medico dental management teams. Mandibular deficiency. E.g. Pierre Robin, Stickler, Treacher Collins. Mandibular prognathism. E.g. Marfan, Downs, Crouzon. Facial height problems. E.g. Amelogenesis Imperfect. Facial asymmetry. E.g. Hemifacial Microsomia.

Unquestionably, extreme distortions of the maxilla and mandible impact vital function from birth. Cleft lip and palate present as the most common issue with the maxilla (figure 29). In the micrognathic extreme under sized mandible, there is always a threat to airway function. E.g. Pierre Robin Syndrome (figure 30) and Stickler Syndrome (figure 31).

Fig. 29

Cleft lip and palate present as the most common issue with the maxilla.

Fig. 30

Pierre Robin Syndrome

Fig. 31

E.g. Stickler Syndrome

Orthodontic Ideals

For the tongue to clear adequate oral pharyngeal space, it must sit forward and high into the mouth, resting fully on the palate. Well-formed palates are a mirror image of the dorsum of the tongue as they fully receive the resting tongue (figure 33). Correctly placed and sized jaws allow the tongue to be housed fully in the closed mouth, the ideal position at rest for optimal pharyngeal airway.

Optimally in a well-functioning maxillomandibular complex there will be light wear of teeth with adequate spacing between all teeth in the primary dentition and evenness of alignment in the permanent dentition (figure 34). Ideally every organ should be in its place with its own space with even matching of the upper and lower jaw and teeth.

Fig. 33

Well-formed palates are a mirror image of the dorsum of the tongue as they fully receive the resting tongue.

Fig. 34

Evenness of alignment in the permanent dentition

There should be even show off upper and lower teeth with a small gingival display and no dark corridors to the sides in the smile. It is expected there is sufficient room and correct balance in placement for 20 primary teeth and then later for 32 adult teeth (figure 35).

Treatment Objectives in Obstructive Sleep Apnoea

Breik (2016) revealed complete corrections for obstructive sleep apnoea in children with deficient mandibles are possible through distraction ostegenesis. In a similar vein Hsieh (2013) and Zaghi (2016) concluded maxillomandibular advancement to be definitively corrective in adults suffering from obstructive sleep apnoea.
Hsieh (2014) observed the anterior movements of the maxilla, soft palate and hyoid in dual jaw surgical advancement cases. The parallel findings of Schendel (2014) and Butterfield (2015) concluded the resultant creation of increase in pharyngeal airspace was why the mandibular maxillary advancement surgery corrects obstructive sleep apnoea.
Iwasaki (2013) likely pieced together the explanation of the causal correction from these surgical therapies: linking tongue posture improvement and pharyngeal airway enlargement.

Fig. 35

Sufficient room and correct balance in placement for 20 primary teeth and then later for 32 adult teeth.

Given this understanding of how facial and dental structures impact airway patency, treatment objects should be aimed to prioritizing development of forward facial growth. Concurrent guarding against retractive interventions must also be allowed for as recommended by Knudsen (2015). For the growing child, in order to safeguard against obstructive sleep apnoea, “counter clockwise rotation” upward and forward maxillomandibular development is paramount.
Although the orthodontic profession persist with its view malocclusion is a genetically driven developmental deviation, it is important to consider this does not necessarily follow the findings of anthropological and genetic studies. Corruccini (1984, 1990), Evensen (2007), Jerome (2009) and Pinhasi (2015) all suggest the role of environmental factors as being significant. Certainly Mossey (1999) suggests there is reason to question a purely genetic based aetiology and both Uyeda (2011) and Cole (2016) place the time line of malocclusion outside the parameters of evolutionary change.
Although it is easy to dismiss the impact of the orthodontic therapy at the basal level, Lundstrom (1980) demonstrated this has never been true and significant shifts in growth trends are possible over large numbers of the population undergoing routine treatment. Bork (1983) also revealed this applies even to the mandible and over an extensive timeframe from birth right through to adulthood.
Currently Carvalho (2016) supports the use of oral appliance or functional orthopaedic appliance when craniofacial anomalies are present. Villa (2011) and Camacho (2017) recommend maxillary expansion as effective in improving OSA marker Apnoea Hypopnoea Index in

Abb. 36

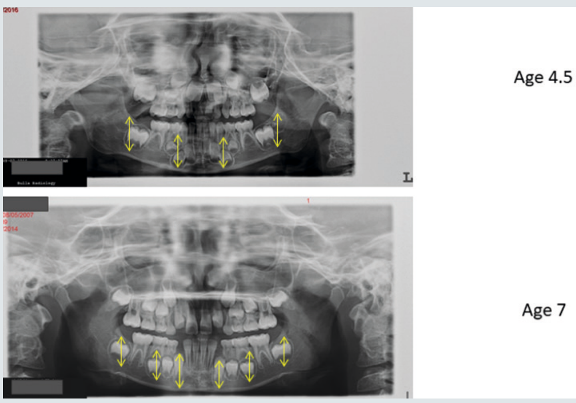
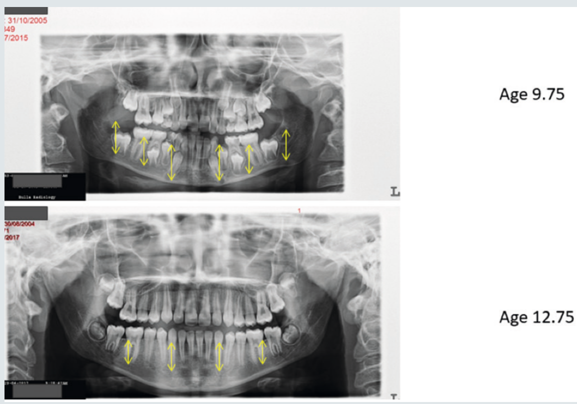


Abb. 37



the ratio of dentolalveolar to basal bone proportion is not fixed but rather is highest in the early years, will give correct justification for interceptive therapies in the first decade of life.

both the short and long term. Both Camacho (2015) and Chuang (2017) advocate myofunctional therapy on children with OSA. There fore, the common practices to wait until puberty before orthodontic treatment is undertaken can work against the correction of vertical facial growth trends. It is important not to forget the practice of orthodontics accepts dentoalveolar changes are always possible. Remembering the ratio of dentolalveolar to basal bone proportion is not fixed but rather is highest in the early years, will give correct justification for interceptive therapies in the first decade of life (figure 36 and 37).

Other Tools of Observation

Xray comparative of pre and post operatively skeletal and dental forms have always been a defining measurement of orthodontic success. Broadening the field of vision to include the soft tissues of the pharyngeal space can be of great service for the management of SBDS. As Neelapu (2017) and Momany (2016) imply, a greater emphasis on pharyngeal space measurements will redirect focus when diagnosing and revaluating for finishing (figures 38-40). For modern day orthodontics to truly thrive in healthcare, vital function must also be considered for when marking for overall success.

Chen (2016) suggests an airway centric approach with the use of cone beam computer tomography, will allow an even greater view for the interpretation of measurements captured in the films (figure 41 and 42).

Interdisciplinary cross referral is paramount in the total care of the obstructive sleep apnoeic child. Although it is not within the licensure of the dental professional to diagnose any SBDSs, the Paediatric Dentist or Orthodontist may be amongst the first to recognise signs and symptoms that give suspicion for SDBS and OSA. Chervin (2007) developed the Paediatric Sleep Questionnaire to be a simple but effective instrument of prediction for general practice medical screening. Ideally the dental profession can also consider incorporating this history taking form into their routine examination practice and in so doing extend it's scope a little further beyond the teeth borders.

Ultimately of course redirecting vertical facial growth to a more horizontal trend, irrespective of race, gender or genetics, can be easily seen, as it's own measure of aesthetic success (figures 43-52).

Abb. 38

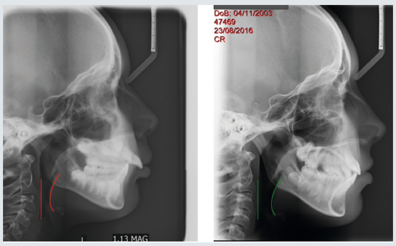


Abb. 39

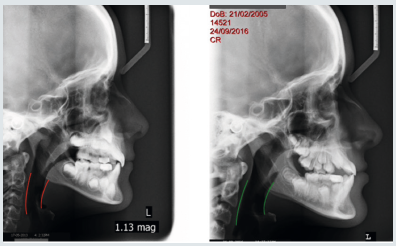
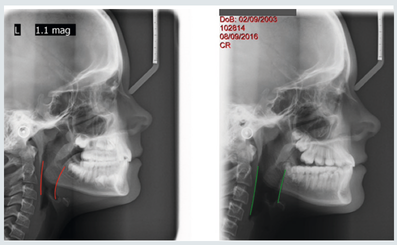
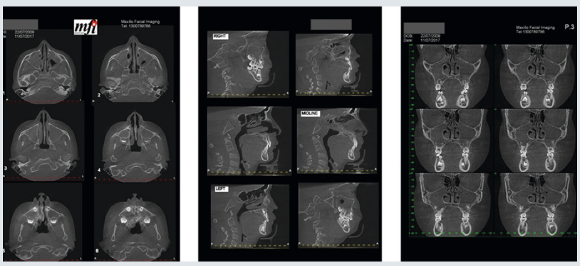


Abb. 40



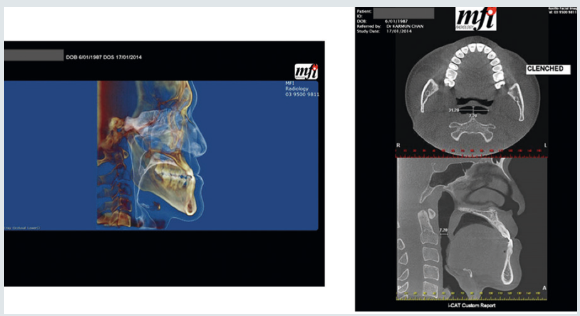
Pre and post-operative cephalometric X-rays with pharyngeal airway markings

Abb. 41



CBCT (Cone beam CT) airway evaluation

Abb. 42



CBCT (Cone beam CT) airway evaluation

Conclusion

Obstructive sleep breathing disorders by definition relate to functional changes in airway patency. The contemporary view draws together deviations with craniofacial growth and development with functional and postural disturbances of the maxillomandibular structures. Readily observable traits in head neck and jaw posture, facial form characteristics of nose shape, eye surrounds, cheek fullness, lip competency/tone, tongue size and tethering as well as breathing and swallow patterns are revealing for deeper disruptions of the upper airways function.

As routine orthodontic evaluations are regularly carried out on children growing with jaw imbalances, opportunities abound to deepen the assessment criteria and search for clues for the airway compromised. The 3 dimensional skeletal and dental pictures developed using Angles and facial height classifications and xray evaluations can be broadened further to account for obstructions in the airway. Even observation of commonly seen dental presentations such as narrow palates, cross bites and dental erosion or excessive decay when viewed in the context of sleep breathing disorders, are very revealing.

Abb. 43

Abb. 44

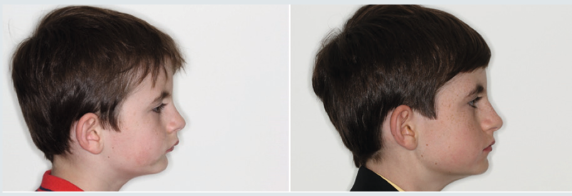


Abb. 45

Abb. 46

Abb. 47

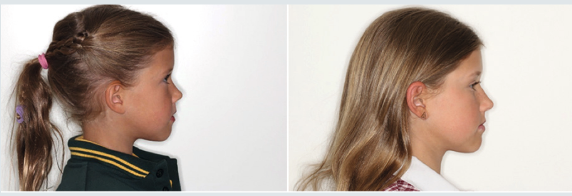


Abb. 48

Abb. 49

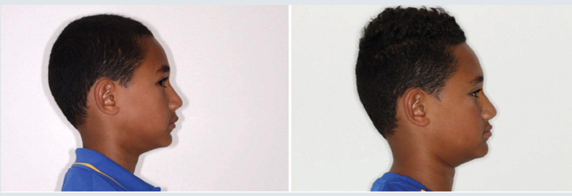


Abb. 50

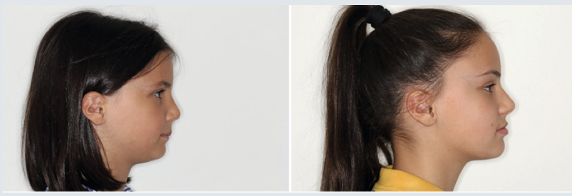


Abb. 51

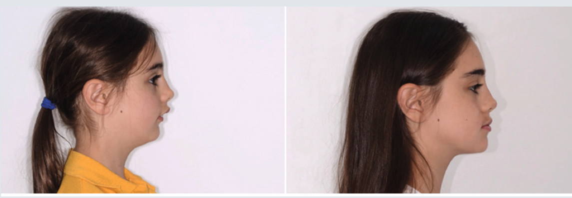
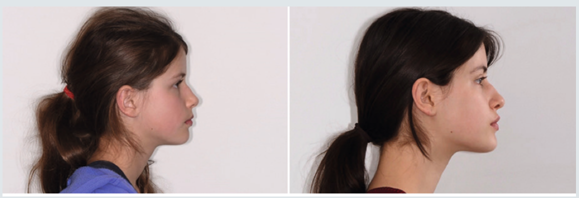


Abb. 52



Before and after profile images showing redirecting vertical growth to a more horizontal trend

Syndrome malformations present distortions in the extreme of the maxillomandibular complex. These cases readily give acknowledgement; normal breath function requires craniofacial structures to lie within defined boundary ranges.

Awareness of disorders that increasingly plague our children gains true value when management aims to be curative. Surgical corrections to advance the facial complex have been shown to be corrective for obstructive sleep apnoea. It is imperative therefore, these objectives and goals in craniofacial rebalancing becomes definitive standard of care for all the health professions.

Coupling this understanding with our deeper knowledge in genetics and the relationships between hard and soft body tissue, orthodontic care planning will be expected to expand its impact beyond the aesthetic improvements of the smile. Only by dealing with developmental issues earlier in the timeline will we be able to intervene to prevent craniofacial growth anomalies, reduce the severity of sleep breathing disorders and improve overall vital function for all our children.

Literatur beim Verfasser

Abb. Autor: Dr. Simon Wong BDSc FICCDE DipLSFO is a graduate from the University of Melbourne and a practicing General Dentist clinician since 1991. He is the current Head Fellow's Mentor and Examiner at the London School of Facial Orthotropics and Profesor Visitante co director of the Orthotropics Module at the University Of Valencia, Department of Orthodontics. The past 9 years of his career have been focused on correction of early childhood craniofacial development issues and as the principle of the clinic Natural Smiles Centre; a devoted practitioner for the early correction of malocclusion. It has been Dr Wong's good fortune to have guidance and mentoring from both Prof. John Mew from London and Dr. Bill Hang from Los Angeles. Based the Mew Tropic Premise postural growth theories, he developed a surprisingly effective exercise programme and so authored the book "Good Oral Posture exercises". Currently Dr Wong is working on publishing research and developing projects at the University Of Valencia, Department of Orthodontics. His hope is by helping children learn correct oral posture there may be some address for the multiple chronic health problems endemic in modern society.