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Physical Assessment in Pediatric Sleep Hygiene and Airway Health

Kevin L. Boyd

5.1 Introduction

In addition to plaque-mediated dental diseases of childhood, mainly early childhood caries (ECC) and gingivitis, recent evidence suggests that pediatric malocclusion is additionally being recognized as a serious public health dilemma per its frequent comorbid association with sleep and breathing disturbances. Specifically, retrognathic, narrow, excessively vertical, and deficient sagittal skeletal phenotypes in children are often associated with increased risk susceptibility for impaired nasal breathing [1–3].

5.2 Pediatric Sleep Hygiene and Airway Health (p-SAH)

In order to perform a clinically validated appraisal of pediatric sleep and airway hygiene (p-SAH) status in a clinical setting, one must collect accurate descriptive data about physical traits (e.g., malocclusion phenotypes) known to be commonly associated with p-SAH and behavioral traits known to be commonly associated with p-SAH [4], such as sleep-disordered breathing/obstructive sleep apnea (SDB/OSA), parasomnias (e.g., night terrors, bruxism, restless legs, frequent arousals), bedwetting, and diaphoresis. With one exception being morning leg soreness, most p-SAH physical assessment phenotypes are located within the head and neck region, and thus the term craniofacial, an adjective referring to the parts of the head containing the brain and the face, is often used as a general address for where one might locate structural deficiencies that could possibly be associated with negative p-SAH. And while many anatomical structures essential to the proper functioning

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of a child's respiratory apparatus are indeed located within and near to the craniofacial area (e.g., mandible, maxilla, anterior nares, nasal valves, nasal septum, tongue, hard palate, lips), other vital respiratory anatomical components are not located there (e.g., soft palate; posterior naso-, oro-, and laryngo-pharynx; posterior nares (choanae); hyoid bone; cervical spine; pharyngeal dilator muscles). So, in the interest of being more inclusive and scientifically accurate, it seems reasonable to suggest that the term craniofacial-respiratory complex (CFRC) (Fig. 5.1) rather than craniofacial alone would be a more inclusive and useful term for describing precisely where structural deficiencies associated with negative p-SAH might be located.

5.3 Normative Standards

Varieties of malocclusion phenotypes are nearly ubiquitous in industrialized cultures, but seldom seen in cultures that had not yet been exposed to cultural industrialization [5]; similarly, human malocclusion does not appreciably appear in
the human fossil and skeletal records until the middle to late eighteenth-century [6]; nursing and weaning practices associated with cultural industrialization seem to be associated with higher prevalence of pediatric malocclusion in so-called Western-exposed societies [7] (Fig. 5.2). Established normative standards currently in use today for diagnosing morphological discrepancies of the CFRC (i.e., malocclusion) are largely based upon early to mid-twentieth-century subjective measurements that had been derived from very small data sets [8]. Given what is now well understood about the relative scarcity of human malocclusion phenotypes prior to cultural industrialization [9], to utilize a malocclusion classification system and cephalometric normative standards that had been created from postindustrial samples (i.e., late 19th to mid-twentieth-century Caucasians mostly of European origin) cannot now be considered a scientifically defensible practice. For example, in 1899, E.H. Angle published the paper *Classification of Malocclusion* [10] describing a system of three basic malocclusion phenotypes that is still being utilized today as the gold standard for orthodontic diagnosis and treatment. Additionally, in 1953, Cecil Steiner, a former student of E.H. Angle, published *Cephalometrics for You and Me* [11], where he described his ideal numeric values as not actually been derived from any sample, but, as he described, “to express our concept of a normal average American child of average age” and also as being useful to his clinical perceptions of therapeutic goals. And finally, a third contribution to the body of orthodontic literature, commonly purported as being a virtual *trilogy* of established craniofacial normative reference standards, was the publication in 1972 by L. Andrews of *The Six Keys to Normal Occlusion* [12], where he described his concept of the optimal occlusion

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in the permanent dentition as defined by the way certain reference teeth lined up adjacent to and opposed to one another; his data set consisted of 120 study casts from individuals with so-called natural (non-orthodontically treated) ideal occlusions. It is interesting to note that Andrews includes an image of a pre-industrial skull (Fig. 5.3) as a prime example of ideal crown angulation, the third of his six keys.

5.4 Craniofacial-Respiratory Morphology and Pediatric Systemic Health

As mentioned previously, there is ever-accumulating evidence regarding the positive association between maldevelopments of the CFRC in early childhood and risk for susceptibility to negative p-SAH [13]; and while not ethically possible to study prospectively, it seems reasonable to suggest that specific SDB/OSA-associated comorbidities, such as neurological (e.g., ADD/ADHD, cognitive dysfunction) and peripheral (e.g., appetite hormone dysregulation, type 2 diabetes, impaired somatic growth) systemic illness symptoms, might also be improved in conjunction with appropriate orthodontic/dentofacial orthopedic interventions. It might therefore soon become a medically indefensible position to describe as harmless (i.e., unnecessary to treat) certain malocclusion phenotypes that often first become evident in early childhood (i.e., in the primary/early mixed dentition), such as lack of deciduous interdental spacing or moderate/severe dental crowding, excess vertical, anterior-posterior, sagittal and/or transverse discrepancies, and highly vaulted palates. In addition to the aforementioned inadequacies of the currently used normative standards for what might constitute a healthy/unhealthy CFRC phenotype in early childhood, an additional obstacle to provision of appropriately timed and applied,
and often medically indicated, early orthodontic intervention is centered around an orthodontic clinician’s ability, or inability as might be the case, to manage age-appropriate child anxiety and parental concerns, expectations, and anxiety that are often associated with discussing and receiving nontraditional orthodontic treatment (i.e., in the deciduous/early mixed dentition). Specifically, the established curriculum for accredited US postgraduate training programs in orthodontics as is outlined and certified by the American Dental Association’s Committee on Dental Accreditation (CODA) [14] fails to require of their resident trainees the appropriate didactic and/or clinical experience in the areas of child emotional development and anxiety management and behavioral guidance in novel healthcare environments. Furthermore, the American Board of Orthodontics does not require candidates to demonstrate any degree of competence in the area of the aforementioned behavior guidance skills in order to become board certified.

5.5 Future Directions

5.5.1 Technology

Over the past two decades, there have been many scientific efforts aimed at understanding how/why optimal p-SAHI is vital to overall health and wellness. Recent advances in the sophistication of imaging equipment, such as CBCT, intraoral scanners, and 3-D extra-oral cameras, have improved accuracy and simplified record-taking procedures that are essential for correctly diagnosing and appropriately treating young pediatric patients with malocclusion phenotypes associated with increased SDB/OSA risk. Indisputably the gold standard for objectively assessing sleep quantity and quality, is overnight polysomnogram (PSG) sleep studies; however, as PSG testing can be both expensive and physically burdensome to children and their families, aiming to predict OSAS by incorporating data from clinical history and physical examination, various scientifically validated p-SAHI screening assessment tools, like the Pediatric Sleep Questionnaire (PSQ) [4] and the Sleep Clinical Record (SCR) [13], have been shown to correlate closely with PSG metrics and thus might serve as reliable substitutes on occasions where overnight PSG testing within a qualified pediatric sleep lab might not be an option. Screening devices like the PSQ and SCR can now be further strengthened with the additional ability to now gather pertinent objective physiological data, such as p-CO2, HRV, cardiopulmonary coupling, pulse oximetry, and actigraphy, either in-office or at-home when an institutional PSG might not be feasible.

5.6 Cross-Disciplinary Collaboration

According to Stephen Sheldon [16], textbooks in pediatric Sleep Medicine traditionally contain multiple pages describing diseases that children seldom get, but usually contain only a few paragraphs, or at most a few pages, about sleep, which is
something that affects the health and wellness of *all* children. Only over recent years has pediatric Sleep Medicine started to become recognized as a scientific discipline that should be understood by *all* allied health professionals who provide care for children. With this knowledge about the importance of how/why children can benefit from attaining optimal SAH as early in their lives as might be deemed feasible, allied health professionals will be able to more easily collaborate with one another in their individual and collective efforts to improve the growth and development of their mutual young patients; the list of qualified healthcare professionals who might potentially collaborate with dental professionals might include, but are certainly not limited to, pediatric Sleep Medicine physicians, pediatricians, pediatric otolaryngologists, myofunctional therapists, chiropractors, speech and language pathologists, school nurses, and school-based psychologists.

### 5.7 Conclusions

It is problematic that many dental professionals who provide orthodontic services for children are seemingly unable to provide parents/caregivers of young/very young children with incipient malocclusion traits with advice beyond “wait and see” or possibly “save up your money for braces” per the obvious predictability, persistence, and usual worsening of malocclusion beyond the primary dentition. According to orthodontist L.G. Singleton [17], from the vantage point of pediatric dental specialists of his era (circa. 1933), “...the orthodontist who examines the teeth of children from 3 to 5 years of age and presents to the parents a picture of *incipient malocclusion*, is not rendering his full duty to society if he has nothing better to offer than recommendations of delay until the malocclusion becomes objectively apparent when procedures of a mechanical nature may be instituted to correct the defect.”; and Dr. Singleton went on to conclude, “The pretenders in orthodontia should be accorded a rude awakening as imposters upon the ethics of the profession and the innocent child should be protected from this form of charlatanism which has become crude enough to verge upon criminality.”

Most healthcare professionals are/were not prepared by their undergraduate or postgraduate training programs to be concerned about, or even be cognizant of, the numerous scientifically validated behavioral and physical traits that are known to be indicative of existing comorbid disease or predictive of pediatric SDB/OSA risk susceptibility. The primary consequences of this apparent void in pediatric didactic and clinical healthcare education are at least twofold: First, many of the children now being/having been diagnosed with ADD/ADHD primarily based upon their overlapping behavioral symptoms with SDB/OSA risk are often prescribed powerful stimulants like Ritalin and Adderall, which can lead to abuse and possible additional dependence on other drugs [18]. A second consequence of Sleep Medicine educational under-preparedness is centered around the establishment of *standards of care* within various allied healthcare specialty disciplines that are involved in diagnosing and treating disorders known to be associated with unhealthy sleep. For example, even though there is ample published evidence within peer-reviewed
orthodontic and other scientific journals showing that narrow and highly vaulted hard palates, retrusive and vertically developing mandibles, and anterior open-bites are all considered malocclusion phenotypes that can serve as signals for existing or future comorbid airway disease, which in turn can be predictive of increased risk for ADD/ADHD susceptibility, the American Association of Orthodontists (AAO) continues to recommend that children should receive their first orthodontic evaluation not until sometime before the age of 7. Furthermore, the AAO’s most recent brochure [19] states that most orthodontic intervention usually commences not until sometime between the ages of 10 and 13. As mentioned earlier in this chapter, antecedents to narrow, vertical, and retrognathic malocclusion phenotypes are usually first detectable in the primary dentition and usually persist and often become more severe later [20]; it seems inconsistent with a preventive philosophy to ignore a disorder in early childhood [21] that might possibly contribute to negative neurological and/or neurobehavioral health consequences down the road. In light of what is now understood about how certain malocclusion phenotypes can predispose a child to negative health consequences known to be associated restricted craniofacial-respiratory growth, and possibly also somatic and neurological development, the demand for orthodontic services at much younger ages than what is now considered conventional, that is, between the ages of 9 and 14 years [16], will likely continue to grow and exceed the existing supply of qualified orthodontic specialists. A solution to this disparity might be arrived upon when/if orthodontists, pediatric dentists, and general dentists who provide orthodontic and pediatric preventive and restorative services for children better collaborate not only with one another to assure that their young patients receive accurate diagnostic and appropriately timed and applied orthodontic/dentofacial orthopedic interventions but also with other qualified health professional stakeholders. Medical and dental literature from the mid-nineteenth through the middle twentieth [22–27] centuries attest to the importance of habitual nose-breathing and how collaboration between orthodontists and otolaryngologists, then called rhinologists, can lead to positive outcomes for children who suffer from comorbid malocclusion and naso-respiratory incompetence when in the deciduous or early mixed dentition; one might only speculate about precisely why this approach has apparently only recently been rediscovered. As it was obviously an effective collaborative strategy back then, it is reasonable to suggest that it will still be an effective collaborative strategy now.

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16. Personal communication with this author.