Associations between sleep-disordered breathing symptoms and facial and dental morphometry, assessed with screening examinations

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Introduction: Chronic snoring is considered abnormal in a pediatric population. This disorder is often attributed to enlarged tonsils and adenoids, but multiple anatomic obstructions should also be considered. Facial and dental morphometry associations with various sleep-disordered breathing symptoms were investigated at an orthodontic clinic. **Methods:** Parents or guardians were asked to complete a 4-part questionnaire on behalf of their children (n = 604; <18 years of age), including medical and dental history, bruxism and temporomandibular disorder habits, sleep and daytime behavior, and sleep duration and quality. All subjects underwent a clinical screening assessment by the same orthodontist to identify standard dental, skeletal, functional, and esthetic factors. **Results:** In contrast to sleep-disordered breathing or sleep apnea in adults, which is predominantly associated with obesity, sleep-disordered breathing symptoms in this pediatric cohort were primarily associated with adenotonsillar hypertrophy, morphologic features related to a long and narrow face (dolichofacial, high mandibular plane angle, narrow palate, and severe crowding in the maxilla and the mandible), allergies, frequent colds, and habitual mouth breathing. **Conclusions:** Because of the recognized impact of pediatric snoring on children's health, the determination of these good predictors can help in preventing and managing sleep-disordered breathing. If a health professional notices signs and symptoms of sleep-disordered breathing, the young patient should be referred to a sleep medicine specialist in conjunction with an orthodontist if there are dentoskeletal abnormalities. (Am J Orthod Dentofacial Orthop 2011;140:762-70)

Sleep-disordered breathing forms a severity continuum from primary snoring to obstructive sleep apnea—ie, cessation of breathing. Chronic snoring, albeit common in adulthood, is considered abnormal in a pediatric population.[1] Among children and adolescents, the prevalence of primary snoring has been reported at 3.2% to 12.1%,[2-4] and the prevalence for obstructive sleep apnea is estimated at 0.7% to 10.3%.[3-5] Sleep-disordered breathing in children has been associated with a wide variety of symptoms (Table I).[6-13] Patients often report associated excessive daytime fatigue, morning headaches, loud and abnormal snoring or breathing, restless sleep, impaired intellectual function and attention, mood disturbance, aggressive behavior, and hyperactivity.[4,7,14-16] Sleep-disordered breathing is often underdiagnosed in children and teenagers because the primary complaints reported by parents are more often behavioral symptoms.[17]

Although enlarged tonsils and adenoids contribute greatly to pediatric sleep-disordered breathing, multiple anatomic obstructions should also be considered.[8] Although it is debated, cephalometry in children and adult obstructive sleep apnea patients has shown that decreased mandibular and maxillary lengths, skeletal retrusion, increased mandibular plane angle, and low hyoid position have implications in sleep-disordered breathing.[18-23] In the vertical plane, children with long faces, retropositioned mandibles, and associated lip incompetence have been shown to have increased sleep-disordered breathing and obstructive sleep apnea symptoms.[22,24-26] In the transverse plane, maxillary constriction is a sign of reduced transverse dimension of the upper airways and increased nasal resistance, which results in increased mouth breathing. Transverse

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The authors report no commercial, proprietary, or financial interest in the products or companies described in this article.
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Submitted, July 2010; revised and accepted, March 2011.
0889-5406/$36.00

doi:10.1016/j.ajodo.2011.03.023

maxillary deficiency can be clinically assessed, and a high, narrow palate, and severe crowding of the maxilla and the mandible might also be present.[27] In the anteroposterior plane, a micrognathic or retrognathic mandible will most likely cause the tongue to reduce the pharyngeal airway space and decrease airflow during sleep.

Children and adolescents seeking orthodontic treatment have some form of craniofacial disharmony. Approximately 15% to 22% of children who have not yet received orthodontic treatment have occlusal asymmetry, and nearly 30% have sagittal asymmetry.[28] In addition, nearly 18% of American children (12-17 years of age) have incisor crowding and malalignment.[29] Therefore, the craniofacial disharmony seen in the orthodontic clinic can possibly overlap with those previously identified as risk factors for sleep-disordered breathing or obstructive sleep apnea in children. Many studies have reported a positive relationship between craniofacial morphologic characteristics in children and sleep-disordered breathing symptoms. However, these studies were done on patients who were referred to either sleep clinics or ear, nose, and throat clinics for snoring or obstructive sleep apnea. The objective of our study was to evaluate the prevalence of sleep-disordered breathing symptoms and their associations with facial or dental morphometry in a more general setting, such as a general pediatric orthodontic population, where orthodontists are experienced in evaluating craniofacial morphology and growth.

MATERIAL AND METHODS

A cross-sectional investigation was conducted with 604 subjects from the general orthodontic department of a university clinic (Université de Montréal in Canada). The subjects were under 18 years of age (mean ± SD, 13.01 ± 2.28 years; range, 7-17 years). The study was conducted in accordance with the university's ethical standards.

The parents or guardians present at the clinical examination were asked to complete a 4-part questionnaire on behalf of their children, including medical and dental histories, bruxism and temporomandibular disorder habits, sleep and daytime behavior, and sleep duration and quality.

The sleep and daytime behavior questionnaire was a modified and translated version of the 22-item pediatric sleep questionnaire.[30,31] The questions were translated into French and verified for clarity in 86 children (not included in this cohort). The final portion of the questionnaire was a verified French translation of the Pittsburgh sleep quality index.[32-34]

Table I. Symptoms of sleep-disordered breathing in children and adolescents[6-8,12,13]

Nighttime	*Daytime*
• Abnormal sleeping positions	• Morning tension-type headache
• Chronic, heavy snoring	• Mouth breathing
• Confused arousal	• Excessive morning thirst
• Delayed sleep onset	• Excessive fatigue and sleepiness
• Difficulty breathing during sleep	• Abnormal shyness, withdrawn and depressive presentation
• Difficulty waking up in the morning	• Behavioral problems
• Drooling	• Pattern of attention-deficit/hyperactivity disorder (ADHD)
• Enuresis	• Aggressiveness
• Frequent awakenings	• Irritability
• Insomnia	• Poor concentration
• Mouth breathing	• Learning difficulties
• Nocturnal migraine	• Memory impairment
• Nocturnal sweating	• Poor academic performance
• Periodic limb movement	
• Restless sleep	
• Sleep talking	
• Sleep terror	
• Sleepwalking	
• Witnessed breathing pauses during sleep	

All subjects underwent a clinical screening evaluation by the same orthodontist (A.P.), blinded to the questionnaires, using an orthodontic evaluation form covering various standard dental, skeletal, functional, and esthetic factors. Once the patient was placed in the physiologic natural head position, the general clinical facial evaluation included the following: (1) a profile analysis (convex when a line dropped from the bridge of the nose to the base of the upper lip and the second line extending from that point downward to the chin forms an acute angle, or straight or concave when the angle is obtuse), (2) frontal view for facial thirds analysis (brachyfacial if the lower third was shorter than the average, mesofacial if the lower third was slightly longer than the average, or dolicofacial if the lower third was much larger than the average), and (3) mandibular plane angle visualization with a finger along the border of the mandible (flat, normal, or steep).

Asymmetries of the dental midline to the facial midline were noted to evaluate the relationship of the dentition to the face. The following variables related to oral function were examined by the clinician: (1) respiration (mouth, nasal breathing, or both as reported by the patient), (2) tonsil size according to the Brodsky[35] scale (normal or hypertrophic, when greater than 50% obstruction), (3) tongue size (small without tongue coverage of the posterior mandibular teeth at rest, normal