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Association between snoring and deciduous dental development and soft tissue profile in 3-year-old children

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Introduction: The aim was to study the association between snoring and development of occlusion, maxillary dental arch, and soft tissue profile in children with newly completed deciduous dentition. **Methods:** Thirty-two (18 female, 14 male) parent-reported snorers (snoring ≥3 nights/week) and 19 (14 female, 6 male) nonsnorers were recruited. Breathing preference (nose or mouth) was assessed at the mean age of 27 months by otorhinolaryngologist. At the mean age of 33 months, an orthodontic examination was performed, including sagittal relationship of second deciduous molars, overjet, overbite, and occurrence of crowding and lateral crossbite. Bite index was obtained to measure maxillary dental arch dimensions (intercanine and intermolar width, arch length). A profile photograph was obtained to measure facial convexity. **Results:** No significant differences were found between nonsnorers and snorers in any of the studied occlusal characteristics or in measurements of maxillary dental arch dimensions. Snorers were found to have a more convex profile than nonsnorers. Occurrence of mouth breathing was more common among snorers. **Conclusions:** Parent-reported snoring (≥3 nights/week) does not seem to be associated with an adverse effect on the early development of deciduous dentition, but snoring children seem to have more convex profile than nonsnorers. Snoring is a mild sign of sleep-disordered breathing, and in the present study its short time lapse may not have had adequate functional impact on occlusion. (Am J Orthod Dentofacial Orthop 2019;156:840-5)

Sleep-disordered breathing (SDB) describes a spectrum of conditions with increasing upper airway resistance. In its mildest form, patients exhibit a snoring habit without daytime symptoms. With the increase in airway resistance, this may gradually lead to a more severe disorder, ie, obstructive sleep apnea.[1] Snoring prevalence in the pediatric population has been found to vary greatly depending on the criteria used to judge snoring. In a Finnish study of 1- to 6-year-old children, the prevalence of snoring "always" or "often" was 6.3% and of snoring "sometimes", 12.4%.[2] In a systematic review and meta-analysis by Lumeng and Chervin,[3] the prevalence of parental reports that their child snored "always" was in the range of 1.5%-6.2%. But if including children who snored "often," the range was much greater: 3.2%-14.8%. Since occasional snoring is common in children, snoring during 3 nights per week or more frequently is generally considered a sign of SDB.[4]

Snoring is caused by obstruction in airways, which in small children is commonly due to increased adenoids and/or palatine tonsils, allergic rhinitis, respiratory infections, and parental snoring and smoking.[2] Furthermore, an association has been reported between body mass index and the severity of SDB in children.[5] Interestingly, breastfeeding has been found to be a protective factor in pediatric snoring.[6] Due to the increasing obstruction, the mode of breathing may change from normal nose breathing to partial or total mouth breathing. Since unrestricted breathing, particularly during sleep, is considered important for normal craniofacial

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and occlusal development,[7-10] snoring and mouth breathing may lead to a deviation from normal growth pattern. Maxillary transversal growth can be adversely affected, and mandibular forward displacement directed predominantly downwards, leading to increased lower facial height.[11-17] Most of the studies have, however, included subjects with significant variation in age, which also means significant variation in occlusal status.

The aim of the present study was to evaluate the association between snoring and the development of an occlusion, maxillary dental arch, and soft tissue profile in 3-year-old children with newly completed deciduous dentition. It was hypothesized that nonsnoring children would have more optimal development of deciduous dentition and a less convex soft tissue profile than snoring children.

MATERIAL AND METHODS

The present study is part of the Child-Sleep Birth Cohort research project, which is a longitudinal birth cohort study consisting of 1,673 children born between April 2011 and February 2013 at Tampere University Hospital. The inclusion criteria were a Finnish–speaking family and residing in the Pirkanmaa Hospital District. The families were recruited to take part of the project prenatally at the 32nd week of pregnancy in local maternity clinics. Questionnaires which concentrate on sleep, behavior, temperament, somatic and mental health, and family relations, were filled out prenatally at week 32, at the birth of the child, and at 3, 8, 18, and 24 months following birth. The study protocol was approved by the Ethics Committee of the Pirkanmaa Hospital District and the City of Tampere in March 2011.

Questions based on the Sleep Disturbance Scale for Children questionnaire[18] were used to assess snoring frequency. The question was "Does the child snore?" and the answer options were "always (daily)," "often (3-5 times per week)," "sometimes (once or twice per week)," "occasionally (once or twice per month or less)," and "never." This study focuses on children whose parents have reported their child to snore minimum of 3 nights per week at the age of 8 or 24 months. A child was excluded if snoring was detected only during respiratory infections. Controls were recruited among nonsnoring children. Patients' and controls' families were personally asked to participate in this substudy and were interviewed by phone to verify the occurrence of snoring. Duration of exclusive breastfeeding was also questioned at 24-months questionnaire. Written informed consent was obtained from the parents.

Based on the 8-months questionnaire, 22 snoring and 13 nonsnoring children were recruited to participate in the study. Seven snorers and 9 nonsnorers dropped out before the age of 24 months. Based on the 24-months questionnaire, 17 new snorers and 16 new nonsnorers were recruited, making a total of 32 (18 female, 14 male) snorers and 20 (14 female, 6 male) nonsnorers. At the mean age of 27 months (range 23-34 months), an otorhinolaryngological examination was performed, in all cases by the same researcher (S.M.). As a part of the examination, the child's breathing preference was assessed. A child was labeled to be a mouth or nose breather according to the principal breathing preference noticed by close observation during the examination.

One nonsnorer dropped out of the study before dental examinations. At the mean age of 33 months (range 28-42 months), when deciduous dentition is typically fully formed, orthodontic examination was performed. Examination included sagittal relationship of second deciduous molars (mesial step, distal step, or flush), overjet (increased $\geq$3 mm), overbite (open bite $\leq$0 mm, deep bite $\geq$3 mm), crowding (yes or no), and lateral crossbite (yes or no). In addition, occlusal bite index (Yellow Bite Wax Sheets, 0.18-0.22 cm thick, Modern Materials) was obtained to measure the maxillary dental arch dimensions. Measurements were made with a digital sliding caliper (Somet PM 160 digi s hl.d 1.6 Typ:14016458KS) and included intercanine width measured between maxillary deciduous canine cups tips (dd. 53–63), intermolar width measured between mesiopalatal cups of maxillary second deciduous molars (dd. 55–65), and arch length measured from the labial surfaces of the first deciduous incisors perpendicular to the line connecting the distal surfaces of the right and left maxillary second deciduous molars (Fig 1).

A profile photograph of the face was taken with a digital camera (Canon EOS 60D, DS126281 Canon Inc). Children were standing at rest and asked to bite their teeth together at the moment of taking the photo. The photographs were printed, and soft tissue landmarks-Glabella (G), subnasale, and Pogonion (Pg) were identified to measure facial convexity (Fig 2).

The maxillary dental arch and soft tissue profile angle measurements were made twice by one operator (PN) and mean values used in the statistical analysis. Statistical analysis was performed using IBM SPSS Statistics (version 22 or newer). Crosstabulation was used to compare occlusal characteristics between the groups and the strength of the association was evaluated with Fisher exact test. Differences in arch dimensions and soft tissue profile measurements between the groups were tested with Mann-Whitney U test. P value < 0.05 was considered statistically significant.

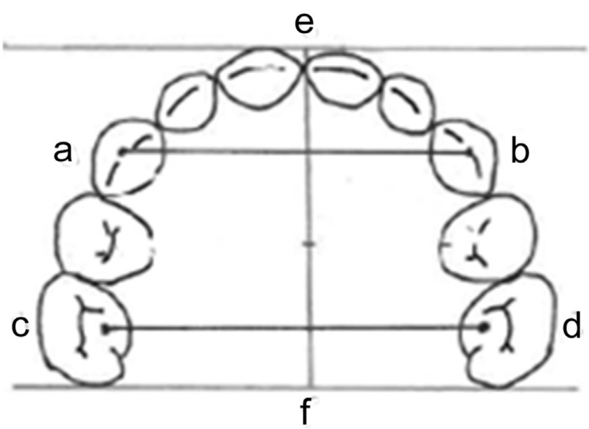

Fig 1. Deciduous dental arch measurements: a-b intercanine width (dd.53–63), c-d intermolar width (dd.55–65) and e-f arch length.

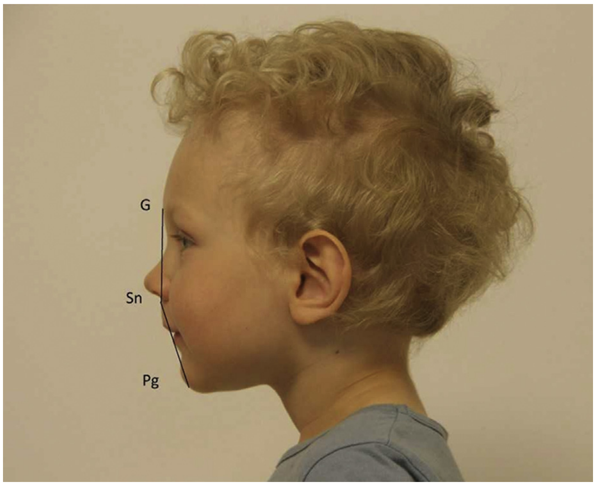

Fig 2. Soft tissue landmarks on lateral facial photographs. Soft tissue Glabella (G), Sn, and soft tissue Pogonion (Pg).

RESULTS

At the time of the otorhinolaryngological examination, all control children were still nonsnoring. Snoring status of the snoring children varied: 56% (n = 18) still snored minimum of 3 nights per week. A statistically significant difference was found between the groups in soft tissue profile in that, snorers had a more convex profile than nonsnorers ($167° \pm 4.5°$ vs $170° \pm 4.8°$, $P = 0.044$, Mann-Whitney U test). Occurrence of mouth breathing was also statistically more common among snorers (10/31.3% vs 1/5.0%, $P = 0.035$, Fisher exact test, Table I).

Statistical analysis did not reveal significant differences between nonsnorers and snorers in any of the studied occlusal characteristics ($P > 0.05$, Fisher exact test, Table II). No statistically significant differences were found between the groups in the measurements of maxillary dental arch dimensions. Intercanine width (dd. 53–63) was 27.8 mm and 28.1 mm, intermolar width (dd. 55–65) 32.9 mm and 33.8 mm, and arch length 28.8 mm and 28.6 mm in snorers and nonsnorers, respectively ($P > 0.05$, Mann-Whitney U test). Duration of exclusive breastfeeding was 3.8 and 3.9 months in the snoring and nonsnoring groups, respectively, ie, no statistically significant difference.

The same parameters were compared between the children whose parents reported them to snore minimum of 3 nights per week at the age of 24 months (n = 18) and the controls (n = 19). Snoring children were found to have mouth breathing preference statistically more frequently than the controls ($P = 0.04$). No other statistically significant differences were found ($P > 0.05$, Fisher exact test, data not shown). The same parameters were also compared inside the snorer group (n = 32) to distinguish differences between mainly mouth breathing snoring children (n = 10) and mainly nose breathing snoring children (n = 22). No statistically significant differences were found ($P > 0.05$, Fisher exact test, data not shown).

DISCUSSION

The strength of the present study is that, the children were studied at a younger age than in earlier studies and thus formed a homogenous group in terms of occlusal development. The examination time point was planned in children who had just completed deciduous dentition, which normally occurs by 30 months.[19] In 6 subjects, maxillary and/or mandibular second deciduous molars had not yet erupted, while all others had fully formed deciduous dentition. The age range of those without fully erupted dentition was 32-42 months. Gender difference has been found in dental arch measurements in that, boys tend to have larger values.[20] In the present study, however, no meaningful difference in the gender breakdown is noticed between the groups. Facial profile photographs, instead of radiological imaging (lateral radiographs), were used. This is an evident but ethically acceptable limitation and prevents direct comparison to most previous studies. Young age was also a challenge, and because of inadequate cooperation, not all planned information and measurements could be collected.

Habitual snoring status has been demonstrated to fluctuate naturally in the early childhood years.[21] In the current study, all controls were still nonsnoring and 56% of the snoring children were snoring minimum of 3 nights per week at the time of examination. The

Table I. Soft tissue profile measurements (mean, in degrees), occurrence of mouth breathing (n/%), and missing values in snorer and nonsnorer groups

	Snorers (n = 32)	*Snorer missing values*	*Nonsnorers (n = 19)*	*Nonsnorer missing values*	P *value*
Soft tissue profile (degrees)	167 ± 4.5	4	170 ± 4.8	7	0.044
Mouth breathing	10/31.3%	-	1/5.3%	-	0.035

Table II. Frequencies of occlusal morphological characteristics (n/%), and missing values in snorer and nonsnorer groups

	Snorer (n = 32)	*Snorer missing values*	*Nonsnorer (n = 19)*	*Nonsnorer missing values*	P *value*
Overjet ≥ 3 mm	14/46.7%	2	7/38.9%	1	0.77
Open bite ≤ 0 mm	4/12.5%	-	1/5.6%	1	0.77
Normal	15/46.9%		10/55.6%		
Deep bite ≥ 3 mm	13/40.6%		7/38.9%		
Crowding	8/25.0%	-	2/11.1%	1	0.30
Crossbite, lateral	2/6.3%	-	2/10.5%	-	0.62
Molar relationship					
mesial step	21/65.6%	-	9/50.0%	1	0.36
flush	5/15.6%		6/33.3%		
distal step	6/18.8%		3/16.7%		

groups can be interpreted to represent never snoring children (control group) and children who have had remarkable snoring between ages 8-24 months (snorer group).

Snoring children were found to have a more convex profile than nonsnorers, a finding that is in line with previous studies.[17,22] Systematic review and meta-analysis by Katyal et al[17] concluded that children with primary snoring have a statistically significantly increased ANB angle compared with nonsnorers, a difference that is mainly due to a more retrognathic mandible in snorers (1.4° decrease in SNB angle). The age range of the children included in the systematic review was however large: from 0 to 18 years. In a study of 6- to 8-year-old children by Ikävalko et al[22] a comparable profile photography method was used as in the present study. In SDB children, facial convexity was more remarkable than in healthy children. Unfortunately, as the authors indicated, use of facial convexity assessment is clinically challenging, since facial convexity is a normal characteristic of every healthy child. Minor difference, ie, 2°-3° is probably of marginal clinical significance. The tendency for increased facial height and a vertical growth pattern of the mandible have also been found in 4- to 8-year-old snoring children, using lateral cephalometry.[17,23,24] The current study methodology precluded assessment of these facial characteristics.

The present findings seem to contradict previous studies on dental arch measurements and occlusal characteristics. Löfstrand-Tideström et al[12] studied 4-year-old children and found that the maxillary dental arch width was smaller and lateral crossbite more frequent in snoring children than in nonsnorers. Pirilä-Parkkinen et al[15] reported that snoring children (mean age 7.2 years, range 3.8-10.8 years) had a larger overjet and narrower maxillary dental arch than the control children. They furthermore reported an increase in malocclusion prevalence with increased severity of the breathing disorder, from snoring to obstructive sleep apnea.[15] In the current study, no statistically significant differences were found in dental arch measurements or in any occlusal characteristics. Mouth breathing, as found in 30% of the snoring children, has been considered to have an impact on the muscular balance between the tongue and cheek muscles, and when long-lasting, on the occlusal relationships.[25] In the present study, this adverse effect may have not yet been at work sufficiently long to have an adverse effect on the maxillary dental arch or the occurrence of malocclusion, since no statistically significant difference was found between nose vs mouth breathing children in the snoring group. Souki et al[26] studied the association between mouth breathing and occlusal characteristics at different developmental stages (primary, mixed, and permanent dentition) and concluded that older children with mouth breathing tended to have increasing prevalence of malocclusions with great individual variation. They even stated that "using a young sample may explain the lack of association between the tested variables" as evidenced in our study. On the other hand, in our previous study, occlusal and dentoalveolar dimensions and features of snoring 5-year-old children did not differ compared with nonsnorers. In this study, the dichotomous question (yes or no snoring) may not have differentiated the groups adequately.[27]

The impact of breathing function on occlusal and craniofacial growth has been a controversial issue among orthodontists for longer than a century.[28] In many studies, the age range of the included subjects has been wide, meaning variable duration of the functional factor on the studied parameter(s). This has probably led to substantial variation in the response and unfounded conclusions on the association. During the first months after birth, feeding pattern seems to be an important factor: exclusive breastfeeding up to 3 months has been reported to be associated with lower SDB probability in later life. In our study this factor could not be properly studied, since duration of exclusive breastfeeding was equal in both groups. Carlson[29] has pointed out another probable confounding factor: normal variation in the individual genome, which means a different response to the same environmental factor; in this case, breathing function.

CONCLUSIONS

Within the limitation of the present small sample size, it can be concluded that parent-reported snoring (≥3 nights/week) does not seem to be associated with an adverse effect on the early development of deciduous dentition at the age of 2-3 years. Therefore, the hypothesis of the study has to be refuted concerning occlusion, but it cautiously supports the facial profile assumption. Snoring as the first and mild sign of SDB may not have adequate functional and environmental impact on the occlusion. Another explanation for the lack of association could lie in the short time lapse between completion of deciduous dentition and the snoring and mouth breathing. An ongoing, long-term study with the same study population will hopefully shed light on this issue.

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