Submitted: 07 December, 2024 Accepted: 21 March, 2025 Published: 03 May, 2025 DOI:10.22514/jocpd.2025.064

Journal of Clinical Pediatric Dentistry

ORIGINAL RESEARCH

Adenoid hypertrophy and oral respiration: effects on maxillofacial growth and early orthodontic treatment

Lili Xie[1,*], Yanan Ma[2]

[1]Departmen of Stomatology, Hebei General Hospital, 050057 Shijiazhuang, Hebei, China
[2]Chengde Nursing Vocational College, 067000 Chengde, Hebei, China

***Correspondence**
90030165@hebmu.edu.cn
(Lili Xie)

Abstract

Background: The purpose of this study was to investigate the oral and maxillofacial developmental characteristics and early corrective effects of physiological adenoid hypertrophy in children with oral respiration. Physiological adenoid hypertrophy refers to a ratio of adenoid thickness to nasopharyngeal width (A/N) between 60% and 70%. **Methods**: Firstly, forty-two children with physiological adenoid hypertrophy, accompanied by Class II malocclusion were selected from Hebei General Hospital and divided into oral respiration group (O) (n = 21) and nasal respiration group (N) (n = 21) according to their breathing patterns. Measurement and statistical analysis of two groups of cephalometric were conducted by specific experts. Secondly, 10 children with oral respiratory and physiological gonadal hypertrophy suitable for early functional treatment were selected, with an average treatment time of 7 months. A comparative analysis was conducted on the cephalometric before and after treatment. Each cephalometric measurement was tested three times and the average was taken to reduce errors. **Results**: The comparison between O and N groups showed statistically significant differences in the position of maxilla and mandible relative to skull (SNA, SNB), the angle of upper incisors (U1-SN, U1-NA), lower incisors FMIA), and the angle of soft tissue facial protrusion (N'-SN Mg'). These indicated that maxillary protrusion and upper incisor forward inclination were the main features of the oral breathing group. In the second part, the functional treatment showed statistically significant differences in the A/N, SNB, angle of the mandible relative to the maxilla (ANB), nasopharyngeal (PNS-R, PNS-UPW) and laryngopharyngeal (V-LPW) airways ($p < 0.05$), which indicating that orthodontic treatment can widen the nasopharyngeal and laryngopharyngeal airways and may promote mandibular growth. **Conclusions**: Children with Class II malocclusion and physiological adenoid hypertrophy, accompanied by oral respiration, can lead to abnormal facial development. Early orthodontic treatment can alleviate oral respiratory symptoms and improve maxillofacial abnormalities in children with Class II malocclusion.

Keywords

Oral respiration; Physiological adenoid hypertrophy; Cephalometric measurement; Maxillofacial development; Early orthodontic treatment; Functional appliance

1. Introduction

Normal human respiration involves exchanging air through the nasal passages, which keeps the airways moist and free from infection, reducing the risk of respiratory infections. In contrast, oral respiration occurs when primary airflow occurs through the oral cavity, which is triggered by nasal congestion, enlarged tonsils, adenoid hyperplasia, and other upper respiratory tract obstructions or as a result of detrimental oral habits [1–3]. Children with adenoid hypertrophy are more likely to suffer from oral and respiratory diseases. Understanding the correlation between adenoid hypertrophy and oral respiration is crucial for developing effective treatment strategies and improving the quality of life for affected individuals. Physiological adenoid hypertrophy refers to an adenoid to nasopharyngeal ratio (A/N ratio) between 60% and 70% in lateral cephalometric radiographs. It is an intermediate state between normal adenoids and pathological hypertrophy. When accompanied by symptoms such as oral breathing and sleep disorders, it is necessary to determine whether to treat it based on clinical evaluation. Pathological adenoid hypertrophy refers to an A/N ratio exceeding 70%. Research has shown that pathological adenoid hypertrophy is a possible trigger for oral breathing. However, there is insufficient attention and research on the correlation between physiological adenoid hypertrophy and oral respiration. Therefore, the symptoms of these children are often overlooked, leading to serious oral and maxillofacial developmental abnormalities or respiratory diseases. Oral respiration, as noted by Thomson and Gao, can elevate the risk of obstructive sleep apnea in children, impairing their respiratory function [4]. Early detection and management of physiological adenoid hypertrophy can effectively prevent developmental abnormalities in the maxillofacial region and respiratory complications.

Children's oral respiration has a wide range of effects on craniofacial development, mental and physical health. Besides causing maxillary protrusion [5], an elevated palatal arch [6], mandibular retrusion [7] and dental crowding with associated malocclusions [8], it may also negatively affect their psychological well-being and social interactions [9]. As some scholars have studied, oral respiration significantly affects craniofacial growth patterns, highlighting the importance of early intervention [10]. Grassia uses mixed palatal expansion (MPE) for maxillary arch expansion treatment in children during their growth and development period [11]. This study aims to explore the impact of physiological adenoid hypertrophy and oral respiration on children's maxillofacial development and the efficacy of early orthodontic treatment, providing a theoretical basis for clinical correction of oral respiration in children.

2. Materials and methods

42 children came from the Orthodontics Department of Hebei General Hospital. Children with Class II malocclusion accompanied by physiological adenoid hypertrophy were selected, and the A/N ratio was found to be between 60% and 70% on cephalometric. Evaluate the breathing patterns of these children and divide them into O group (oral breathing) and N group (nasal breathing) based on 5 clinical test results. Thus oral group consisted of 21 children with oral respiration, and nasal group consisted of 21 children with nasal respiration. Perform statistical analysis on the measurement indicators of two groups. A second part of the study compared and analyzed the changes before and after early orthodontic treatment in 10 children with oral breathing. Data was presented as mean $\pm$ standard deviation, and $p < 0.05$ indicates statistically significant differences.

In this study, the cephalometric of the children were recorded at the Orthodontic Department of Hebei General Hospital.

2.1 Selection of study cases

Children with physiological adenoid hypertrophy were included in this study. The inclusion criteria were as follows:

• Children and adolescents aged 6 to 14 years;

• Clear and complete lateral cephalometric radiograph;

• A/N ratio is between 0.6 and 0.7 on the cephalometric;

• A history or symptoms of mouth breathing lasting at least 6 months.

The exclusion criteria include:

• History of orthodontic treatment;

• Bad oral habits such as thumb sucking, lip biting or tongue thrusting;

• Family history of dental and maxillofacial deformities;

• History of trauma or surgery to the face, neck or throat;

• History of an adenoidectomy or tonsillectomy;

• Cleft lip and palate;

• With a micrognathia condition due to various causes;

• Cervical vertebral bone age assessment is at the end of Stage IV development.

In this study, cephalometric of 42 children with adenoid hypertrophy were collected from October 2021 to December 2023, and divided into two groups based on whether they had oral breathing or not.

Additionally, 10 patients with oral breathing accompanied by physiological adenoid hypertrophy and suitable for early functional treatment were selected for treatment and comparative analysis.

2.2 Study design

2.2.1 Oral respiration diagnosis

All subjects were first examined by the same researcher for their medical history, including whether children breathed through their mouths during rest or sleep and the duration. Further, researchers diagnosed mouth breathing through clinical examinations, including a cotton swab test, water content test, double-sided mirror test and pulmonary function meter test.

2.2.2 Comparison study between the oral breathing group (O) and the nasal breathing group (N)

Children in the oral (O) and nasal (N) groups had cephalometrics taken to compare craniofacial features.

2.2.3 Early functional treatment

Children were treated with Twin Block functional orthodontic appliances for oral breathing. The average treatment time is 7 months. The orthodontic appliance is designed with a new occlusal position neutral to the molars, while ensuring a harmonious and aesthetically pleasing profile for the patient.

2.2.4 Measurement subjects

Children in the O group and in the N group were photographed and analyzed for cephalometric measurements (Fig. 1). 20 measurement items were selected, including the sagittal and vertical directions of the maxillofacial region, as well as airway indicators (Figs. 2,3). All definitions of maxillofacial, dental (Table 1), and airway measurement items (Table 2) were clearly indicated and explained. The cephalometric analysis was conducted by a 25-year clinical expert, who tested each slide three times and took the average to reduce errors.

2.3 Statistical analysis

Data analysis was performed using SPSS 23.0 (IBM SPSS Statistics 23.0, Armonk, NY, USA). Comparisons between both groups (O and N) were made using independent samples t-tests. Comparisons before and after early functional treatment were made using paired t-tests. Data was presented as mean $\pm$ standard deviation, and $p < 0.05$ indicates statistically significant differences.

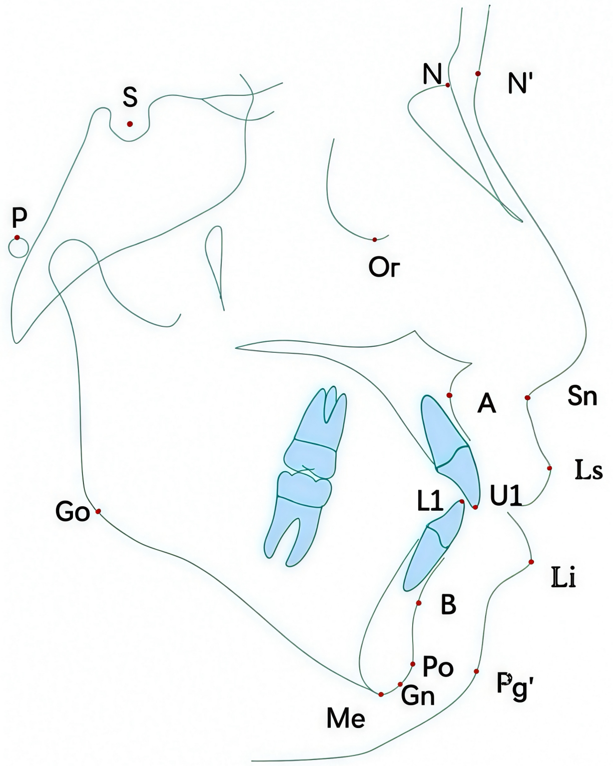

FIGURE 1. Analysis of cephalometric measurements. S: sella; N: nasion; P: porion; Or: orbitale; A: subspinale; Go: gonion; B: supramental; Po: pogonion; Me: menton; Gn: gnathion; Sn: subnasale; N': nasion of soft tissue; L1: Lower incisor; U1: upper Incisor; Ls: upper labrale; Li: lower labrale; Pg': pogonion of soft tissue.

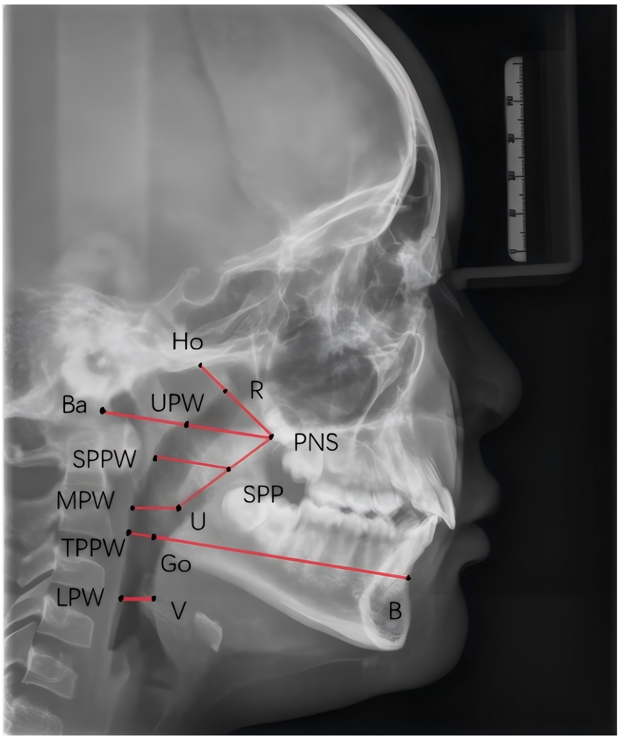

FIGURE 2. Airway marker points of cephalometric measurements. U: uvula apex; V: epiglottis valley; Ho: sella turcica; R: pharyngeal vertex; PNS: posterior nasal spine; Ba: basion; B: supramental; Go: gonion; UPW: upper pharyngeal wall; SPP: Intersection point between parallel line of Go-B passing through the midpoint of PNS-U and posterior pharyngeal wall; SPPW: Intersection point between parallel line of Go-B passing through the midpoint of PNS-U and soft palate; MPW: Middle pharyngeal wall; TPPW: Intersection point of extension line of Go-B and posterior pharyngeal wall; LPW: Lower pharyngeal wall.

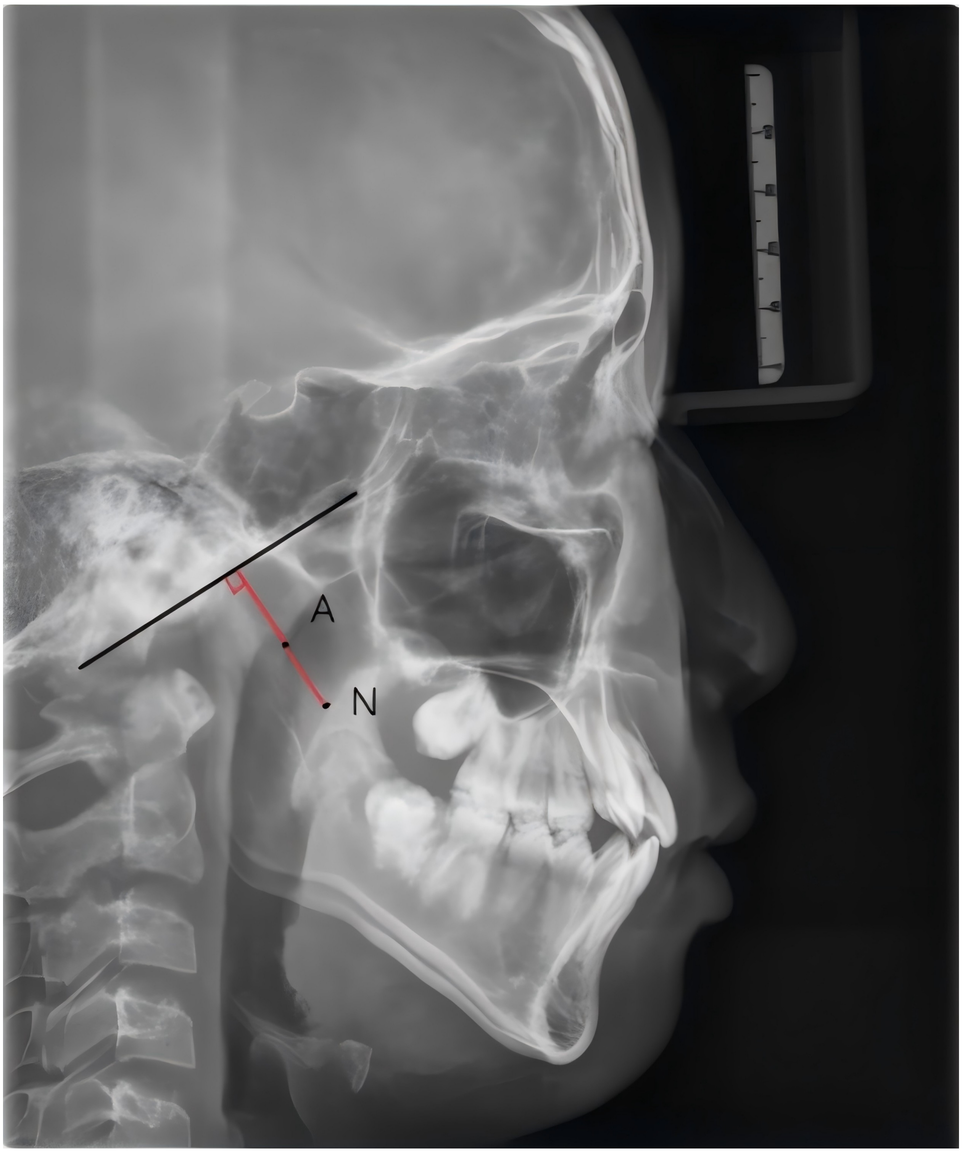

FIGURE 3. The A/N ratio. A: thickness of the adenoids; N: width of the nasopharynx.

3. Results

3.1 There was no statistically significant difference in the age of the O group and N group ($p > 0.05$)

The age comparison between children in the oral breathing group (O) and those in the normal nasal breathing group (N) showed no difference, indicating that the age composition of the two sample groups was balanced (Table 3).

3.2 There were statistically significant differences ($p < 0.05$) in SNA, SNB, FH-NPo, U1-SN, U1-NA, FMIA and N'-Sn-Pg' between the oral respiration group (O) and the nasal respiration group (N)

SNA, SNB, U1-SN, U1-NA, FMIA showed higher values in the oral group than in the nasal group, and N'-Sn-Pg' showed smaller in the oral breathing group, indicating a protrusion of the upper jaw and forward inclination of the upper anterior teeth are the main characteristics. However, the lower incisors incline towards the lingual side (Table 4).

3.3 After 7 months of orthodontic treatment, early functional treatment group showed statistically significant differences in the A/N ratio, SNB, ANB, PNS-R (mm), PNS-UPW (mm) and V-LPW (mm) ($p < 0.05$)

The post-treatment mean values for PNS-R (mm), PNS-UPW (mm) and V-LPW (mm) increased, indicating that orthodontic treatment can widen the nasopharyngeal and laryngopharyngeal airways. The A/N ratio significantly decreased, while the airway widened, indicating the significance of early functional treatment for improving respiratory function. SNB increased and ANB decreased after treatment ($p < 0.05$), suggesting that functional treatment may promote mandibular growth (Tables 5,6).

TABLE 1. Definition of measurement items.

Variable	Definition
SNA (°)	The angle between the line connecting nasion to subspinale and anterior cranial base plane.
SNB (°)	The angle between the line connecting nasion to supramental and anterior cranial base plane.
ANB (°)	The angle between the line connecting nasion to subspinale and the line connecting nasion to supramental.
FH-NPo (°)	Angle between Frankfort plane and facial plane.
NA-APo (°)	Intersection angle between NA plane and PA extension line.
SN-MP (°)	Angle between anterior cranial base plane and mandibular plane.
Y-Axis (SGn-FH) (°)	Facial growth and development direction.
U1-SN (°)	Angle between anterior cranial base plane and maxillary incisor axis.
U1-NA (°)	Intersection angle between the long axis of the upper incisor and the NA line.
U1-NA (mm)	The vertical distance from the upper incisor edge to the NA line.
L1-NB (°)	Intersection angle between the long axis of the lower incisor and the NB line.
L1-NB (mm)	The vertical distance from the lower incisor edge to the NB line.
U1-L1 (°)	Angle between the long axis of the upper and lower incisors.
FMIA (L1-FH) (°)	Angle between Frankfort plane and lower incisor axis.
IMPA (L1-MP) (°)	Angle between lower incisor axis and mandibular plane.
FMA (FH-MP) (°)	Angle between Frankfort plane and mandibular plane.
N'-Sn-Pg' (°)	Nasion'–Subnasale–Pogonion' Angle.

SNA: Sella-Nasion-A point Angle; SNB: Sella-Nasion-B point Angle; ANB: A point-Nasion-B point Angle; FH-NPo: Facial Angle; NA-APo: Angle of Convexity; SN-MP: Sella-Nasion Plane to Mandibular Plane Angel; Y-Axis (SGn-FH): Y Axis Angle; U1-SN: Angle of upper incisors; U1-NA (°): Angle of upper Incisor to Nasion-A Point Line; U1-NA (mm): Distance of upper Incisor to Nasion-A Point Line; L1-NB (°): Angle of lower Incisor to Nasion-B Point Line; L1-NB (mm): Distance of lower Incisor to Nasion-B Point Line U1-L1: Inter-incisal Angle; FMIA (L1-FH): Angle of lower incisors-Frankfort plane; IMPA (L1-MP): Angle of lower incisors-Mandibular Plane; FMA (FH-MP): Mandibular Plane Angle; N'-Sn-Pg': Full soft tissue convexity; NA: Nasion-A point plane; AP: A point-Pogonion plane; NB: Nasion-B point plane.

TABLE 2. Airway measurement marker points.

Variable	Definition
UPW	Intersection point of the line connecting PNS and Ba with the posterior pharyngeal wall
SPP	Intersection point of the line parallel to Go-B line through the midpoint of PNS-U line with soft palate
SPPW	Intersection point of the line parallel to Go-B line through the midpoint of PNS-U line with the posterior pharyngeal wall
MPW	Foot of the perpendicular from the U point to the posterior pharyngeal wall
TPPW	Intersection point of the extension line of the Go-B line with the posterior pharyngeal wall
LPW	Foot of the perpendicular from the V point to the posterior pharyngeal wall

PNS: Posterior Nasal Spine; Ba: Basion; V: Epiglottis Valley; UPW: Upper pharyngeal wall; SPP: Intersection point between parallel line of Go-B passing through the midpoint of PNS-U and posterior pharyngeal wall; SPPW: Intersection point between parallel line of Go-B passing through the midpoint of PNS-U and soft palate; MPW: Middle pharyngeal wall; TPPW: Intersection point of extension line of Go-B and posterior pharyngeal wall; LPW: Lower pharyngeal wall; Go-B: Gonion-B point line; PNS-U: Posterior nasal spine-Nvula apex line.

TABLE 3. Age distribution of oral and nasal respiration groups (mean ± SE).

	Group		*t*	*p*
	N (n = 21)	O (n = 21)		
Age	9.10 ± 1.76	9.52 ± 1.72	−0.798	0.429

N: nasal respiration; O: oral respiration.

TABLE 4. Comparison of oral and nasal respiration groups (mean ± SE).

Measurements	N (n = 21)	O (n = 21)	*t*	*p*
SNA (°)	79.94 ± 2.70	81.73 ± 2.27	−2.32	0.03
SNB (°)	74.89 ± 2.58	77.62 ± 2.67	−3.38	<0.001
ANB (°)	4.91 ± 1.71	4.07 ± 2.32	1.35	0.19
FH-NPo (°)	83.89 ± 2.62	85.93 ± 3.07	−2.31	0.03
NA-Apo (convexity) (°)	11.33 ± 3.69	8.76 ± 4.84	1.94	0.06
SN-MP (°)	39.22 ± 5.15	37.18 ± 6.42	1.14	0.26
Y-Axis (SGn-FH) (°)	64.14 ± 2.73	62.36 ± 3.00	2.02	0.05
U1-SN (°)	102.85 ± 4.12	107.60 ± 3.71	−3.93	<0.001
U1-NA (°)	22.87 ± 4.43	25.92 ± 4.47	−2.22	0.03
U1-NA (mm)	3.73 ± 1.92	4.64 ± 2.20	−1.43	0.16
L1-NB (°)	31.51 ± 4.54	29.72 ± 4.59	1.27	0.21
L1-NB (mm)	6.82 ± 1.76	6.24 ± 2.24	0.94	0.36
U1-L1 (°)	115.59 ± 24.90	120.29 ± 7.89	−0.82	0.42
FMIA (L1-FH) (°)	51.28 ± 7.41	56.30 ± 5.74	−2.45	0.02
IMPA (L1-MP) (°)	97.38 ± 4.83	94.92 ± 4.35	1.73	0.09
FMA (FH-MP) (°)	29.92 ± 5.25	28.78 ± 5.92	0.66	0.51
N'-Sn-Pg' (°)	167.76 ± 2.29	162.35 ± 3.12	−6.40	<0.001

SNA: Sella-Nasion-A point Angle; SNB: Sella-Nasion-B point Angle; ANB: A point-Nasion-B point Angle; FH-NPo: Facial Angle; NA-APo: Angle of Convexity; SN-MP: Sella-Nasion Plane to Mandibular Plane Angel; Y-Axis (SGn-FH): Y Axis Angle; U1-SN: Angle of upper incisors; U1-NA (°): Angle of upper Incisor to Nasion-A Point Line; U1-NA (mm): Distance of upper Incisor to Nasion-A Point Line; L1-NB (°): Angle of lower Incisor to Nasion-B Point Line; L1-NB (mm): Distance of lower Incisor to Nasion-B Point Line; U1-L1: Inter-incisal Angle; FMIA (L1-FH): Angle of lower incisors-Frankfort plane; IMPA (L1-MP): Angle of lower incisors-Mandibular Plane; FMA (FH-MP): Mandibular Plane Angle; N'-Sn-Pg': Full soft tissue convexity.

4. Discussion

Children suffering from adenoid hypertrophy demonstrate the largest decreases in happiness in the following areas: behaviour, general perception of health and mental health [12]. Children's oral respiration incidence ranges from 12% to 55% [13]. Meanwhile, oral respiration influences maxillofacial development controversially [14]. In terms of dental malocclusion, most children with oral respiration exhibit Class II malocclusion [15]. This study selected 42 children with Class II malocclusion, accompanied by physiological adenoid hypertrophy, and divided them into oral and nasal breathing according to their breathing patterns. In previous studies [16, 17] adenoid hypertrophy was typically studied only in severe cases, however physiological adenoid hypertrophy has already affected children's growth and development. In this study, we found that the characteristics of the oral respiratory group mainly led to maxillary protrusion and upper lip inclination, while the lower incisors incline towards the lingual side. Unlike this, some studies suggest that children with adenoid hypertrophy and mouth breathing are more likely to have craniofacial malformations when A/N >0.6. In terms of development, the skeletal type II facial type is most common, which manifests as the retraction of the mandible, the increasing of the mandibular angle, and the lack of development of the length of the mandible [18]. But the research sample is a mixture of moderate and severe adenoid hypertrophy, which is the reason for the different conclusions. In summary, children with moderate adenoid hypertrophy and mouth breathing require timely and comprehensive treatment to address the multifaceted nature of their condition. A multidisciplinary approach is essential to manage airway obstruction, correct breathing patterns and prevent craniofacial and dental complications. By addressing these issues early, healthcare providers can significantly improve the quality of life and developmental outcomes for affected children.

This research result poses new challenges for orthodontists, pediatricians, dentists, otolaryngologists and pediatricians. More attention should be paid to physiological adenoid hypertrophy and active treatment should be given improve oral respiration. However, due to being in the early growth and development of child, the harm is not as obvious, and coupled with a lack of awareness of the hazards of mouth breathing, many parents cannot accept early orthodontic treatment. But this is also the significance of our research on adenoid hypertrophy and oral respiration in children. Therefore, in this study, we additionally selected 10 children with oral breathing suitable for functional correction for early functional therapy. Functional appliances such as the Twin Block (TB) and Activator are widely used to treat Class II malocclusion, particularly to improve the appearance of a retruded mandible [19–21]. However, limited research has been conducted on their ef-

TABLE 5. Comparison before and after functional treatment (mean ± SE).

Measurements	(mean ± SE)		Δ*d* (Before–After)	*t*	*p*
	Before	After			
SNA (°)	80.98 ± 2.77	81.63 ± 2.12	−0.65	−1.77	0.11
SNB (°)	75.40 ± 3.51	76.96 ± 3.50	−1.56	−5.76	<0.001
ANB (°)	5.57 ± 1.90	4.67 ± 2.33	0.90	2.64	0.03
FH-NPo (°)	84.43 ± 3.19	85.55 ± 3.24	−1.12	−1.20	0.26
NA-Apo (°)	12.06 ± 5.47	10.87 ± 5.43	1.19	1.44	0.18
SN-MP (°)	37.30 ± 8.26	37.96 ± 8.78	−0.66	−1.02	0.33
Y-Axis (SGn-FH) (°)	62.53 ± 2.51	62.29 ± 3.39	0.24	0.32	0.76
U1-SN (°)	108.42 ± 11.18	104.87 ± 7.92	3.55	1.13	0.29
U1-NA (°)	27.09 ± 11.53	22.89 ± 6.85	4.20	1.37	0.21
U1-NA (mm)	5.90 ± 2.40	4.39 ± 2.89	1.51	1.79	0.11
L1-NB (°)	29.87 ± 8.24	33.19 ± 11.36	−3.32	−1.55	0.16
L1-NB (mm)	6.89 ± 3.21	7.21 ± 3.57	−0.32	−0.62	0.55
U1-L1 (°)	117.14 ± 18.07	118.56 ± 16.98	−1.42	−0.42	0.68
FMIA (L1-FH) (°)	54.13 ± 8.55	52.05 ± 11.68	2.08	1.32	0.22
IMPA (L1-MP) (°)	97.18 ± 5.09	98.63 ± 8.73	−1.45	−0.78	0.46
FMA (FH-MP) (°)	28.71 ± 6.58	29.31 ± 7.19	−0.60	−0.71	0.50
N'-Sn-Pg' (°)	163.67 ± 5.37	164.30 ± 5.80	−0.63	−0.65	0.53

SNA: Sella-Nasion-A point Angle; SNB: Sella-Nasion-B point Angle; ANB: A point-Nasion-B point Angle; FH-NPo: Facial Angle; NA-APo: Angle of Convexity; SN-MP: Sella-Nasion Plane to Mandibular Plane Angel; Y-Axis (SGn-FH): Y Axis Angle; U1-SN: Angle of upper incisors; U1-NA (°): Angle of upper Incisor to Nasion-A Point Line; U1-NA (mm): Distance of upper Incisor to Nasion-A Point Line; L1-NB (°): Angle of lower Incisor to Nasion-B Point Line; L1-NB (mm): Distance of lower Incisor to Nasion-B Point Line; U1-L1: Inter-incisal Angle; FMIA (L1-FH): Angle of lower incisors-Frankfort plane; IMPA (L1-MP): Angle of lower incisors-Mandibular Plane; FMA (FH-MP): Mandibular Plane Angle; N'-Sn-Pg': Full soft tissue convexity.

TABLE 6. Comparison of airway before and after functional treatment.

Measurements	(Mean ± SE)		Δ*d* (Before-After)	*t*	*p*
	Before	After			
A/N	0.64 ± 0.03	0.51 ± 0.04	0.13	8.16	<0.001
PAS (TB-TPPW) (mm)	9.36 ± 3.23	10.47 ± 3.49	−1.11	−1.48	0.17
PNS-UPW (mm)	19.45 ± 3.82	22.00 ± 2.96	−2.55	−2.68	0.03
V-LPW (mm)	9.97 ± 2.96	12.68 ± 3.25	−2.71	−3.12	0.01
PNS-R (mm)	16.51 ± 2.52	18.88 ± 2.99	−2.37	−4.41	<0.001
SPP-SPPW (mm)	10.21 ± 2.20	13.30 ± 5.52	−3.09	−1.80	0.11
U-MPW (mm)	8.51 ± 2.05	9.94 ± 3.95	−1.43	−1.15	0.28

A/N: adenoid to nasopharyngeal; PAS (TB-TPPW): Upper airway glossopharyngeal segment; PNS-UPW: Nasopharyngeal segment of upper airway; V-LPW: Upper airway pharyngeal segment; PNS-R: Nasopharyngeal segment of upper airway; SPP-SPPW: Upper airway palatopharyngeal segment; U-MPW: Upper airway palatopharyngeal segment; SE: Standard error.

fectiveness when treating physiological adenoid hypertrophy. Twin-block appliances combined with maxillary expansion can expand the anteroposterior depth of the oropharynx in children with Class II mandibular retrusion. This results in increased maxillary width, a more normal tongue position, and contributes to improved airway patency, thereby alleviating oral respiration symptoms [22]. Grassia uses mixed palatal expansion (MPE) for maxillary arch expansion treatment in children during their growth and development period [11]. Previous studies on mandibular retraction and palatal expansion were mostly based on improvements in craniofacial morphology, with less attention paid to oral breathing. This study demonstrated significant improvements in oral respiration symptoms, primarily by advancing the mandible and increasing the width of the nasopharynx and laryngopharynx, thereby reducing the A/N ratio. When A/N decreases significantly, airway width increases and adenoid hypertrophy symptoms disappear, children's physical and mental health improves, craniofacial development improves and orthodontic effects are stabilized. This may be due to the forward movement of the jaw, which reduces the overjet of the upper and lower anterior teeth, allowing better lip closure. When lip closure is improved, the strength of the muscles can alleviate the upper jaw protrusion trend. Additionally, the upper lip bow of TB appliance can also relieve the labial inclination of the upper teeth. This not only treats oral respiration but also addresses the retruded mandible associated with Class II malocclusion. Also, the mandibular's leading force causes the lower incisors to tilt labially, which improves lingual tilting of the lower incisors caused by oral breathing.

Therefore, orthodontic functional appliances can have significant effects on children with oral respiration and physiological adenoid hypertrophy in the early stages of growth and development. This study, however, has a limited sample size and a short follow-up period. The clinical data will be improved through follow-up studies. We recommend timely early orthodontic treatment for children with physiological adenoid hypertrophy and oral respiration.

5. Conclusions

Children with Class II malocclusion and physiological adenoid hypertrophy, accompanied by oral respiration, can lead to abnormal facial development, characterized by maxillary protrusion and forward inclination of the upper incisors.Early orthodontic treatment can decreased A/N ratio and promote mandibular growth, thereby alleviating oral respiratory symptoms and improving maxillofacial abnormalities in children with Class II malocclusion.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

LLX—designed the research study. LLX and YNM—performed research work; analyzed the data; and wrote the manuscript. Both authors contributed to the editorial changes in manuscript. Both authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The patients' parents or guardians have signed a written informed consent to use their data including photos and images. The research plan was approved by the Ethics Committee of Hebei General Hospital after due examination and authorization (Approval No. 2024-LW-008).

ACKNOWLEDGMENT

Not applicable.

FUNDING

This research received no external funding.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] Lan Y, Chen J, Chen S, He Y, Huang F. Influences of adenoid hypertrophy on children's maxillofacial development. Healthcare. 2023; 11: 2812.

[2] Wang H, Qiao X, Qi S, Zhang X, Li S. Effect of adenoid hypertrophy on the upper airway and craniomaxillofacial region. Translational Pediatrics. 2021; 10: 2563–2572.

[3] Li YY, Liu YH. Multidisciplinary sequential diagnosis and treatment for mouth breathing in children. Stomatology. 2024; 44: 565–569.

[4] Thomson M, Gao, W. The effect of mouth breathing on pharyngeal airway size in children with obstructive sleep apnea. Sleep and Breathing. 2014; 18: 629–635.

[5] Cheng B, Li HF, Wang GL, Wu ZX, Zou L, Wang F. A study of three-dimensional facial morphology for mouth breathing children. Oral Biomedicine. 2024; 15: 38–42. (In Chinese)

[6] Schlenker WL, Jennings BD, Jeiroudi MT, Caruso JM. The effects of chronic absence of active nasal respiration on the growth of the skull: a pilot study. American Journal of Orthodontics and Dentofacial Orthopedics. 2000; 117: 706–713.

[7] Al Ali A, Richmond S, Popat H, Playle R, Pickles T, Zhurov AI, *et al*. The influence of snoring, mouth breathing and apnoea on facial morphology in late childhood: a three-dimensional study. BMJ Open. 2015; 5: e009027.

[8] Wang HW, Li HN, Guo QZ, Ma HF, Zhao YM, Wang XX, *et al*. Three-dimensional analysis of pharyngeal and dentofacial morphology in children with mouth-breathing. Journal of Clinical and Pathological Research. 2023; 43: 920–927. (In Chinese)

[9] Gao XM, Yang K, Zeng XL. The relationship between children's breathing patterns and the growth and development of the maxillofacial region. National Medical Journal of China. 2005; 44: 3105–3106.

[10] Habumugisha J, Mohamed AS, Cheng B, Liu L, Zou R, Wang F. Analysis of maxillary arch morphology and its relationship with upper airway in mouth breathing subjects with different sagittal growth patterns. Journal of Stomatology Oral and Maxillofacial Surgery. 2023; 124: 101386.

[11] Grassia V, D'Apuzzo F, Ferrulli VE, Matarese G, Femiano F, Perillo L. Dento-skeletal effects of mixed palatal expansion evaluated by postero-anterior cephalometric analysis. European Journal of Paediatric Dentistry. 2014; 15: 59–62.

[12] Niedzielski A, Chmielik LP, Kasprzyk A, Stankiewicz T, Mielnik-Niedzielska G. Health-related quality of life assessed in children with adenoid hypertrophy. International Journal of Environmental Research and Public Health. 2021; 18: 8935.

[13] Zhao Z, Zheng L, Huang X, Li C, Liu J, Hu Y. Effects of mouth breathing on facial skeletal development in children: a systematic review and meta-analysis. BMC Oral Health. 2021; 21: 108.

[14] Festa P, Mansi N, Varricchio AM, Savoia F, Calì C, Marraudino C, *et al*. Association between upper airway obstruction and malocclusion in mouth-breathing children. ACTA Otorhinolaryngologica Italica. 2021; 41: 436–442.

[15] Franco LP, Souki BQ, Cheib PL, Abrão M, Pereira TB, Becker HM, *et al*. Are distinct etiologies of upper airway obstruction in mouth-breathing children associated with different cephalometric patterns? International Journal of Pediatric Otorhinolaryngology. 2015; 79: 223–228.

[16] Yoon A, Abdelwahab M, Bockow R, Vakili A, Lovell K, Chang I, *et al*. Impact of rapid palatal expansion on the size of adenoids and tonsils in children. Sleep Medicine. 2022; 92: 96–102.

[17] Niedzielski A, Chmielik LP, Mielnik-Niedzielska G, Kasprzyk A, Bogusławska J. Adenoid hypertrophy in children: a narrative review of pathogenesis and clinical relevance. BMJ Paediatrics Open. 2023; 7: e001710.
[18] Chen JZ. The effect of adenoid hypertrophy with mouth breathing on dentofacial and craniofacial development [master’s thesis]. Dalian Medical University. 2021.
[19] Ma XQ, Lu W, Ye M, Xing YB, Qian WH, Zhang L. Effect of Twin-block in adolescents with mandibular retrusion and normal anterior overjet. Shanghai Journal of Stomatology. 2023; 32: 422–427.
[20] Li Y, Xu J, Jiang X, Chen S. Meta-analysis of condylar changes produced by a twin-block appliance in class II malocclusion. West China Journal of Stomatology. 2023; 41: 463–470.
[21] Xie LL, Zuo YP, Dong FS. The effect to occlusion with different methods for the early treatment of angle class II division 1 malocclusion. Journal of Modern Stomatology. 2006; 367–369.
[22] Wang M, Tao LM, Hu YN. Changes in tongue position and three-dimensional changes in upper airway before and after treatment with Twin-block combined with maxillary expansion appliance in children with mandibular retrusion. Shanghai Journal of Stomatology. 2023; 32: 635–639.

How to cite this article: Lili Xie, Yanan Ma. Adenoid hypertrophy and oral respiration: effects on maxillofacial growth and early orthodontic treatment. Journal of Clinical Pediatric Dentistry. 2025; 49(3): 173-181. doi: 10.22514/jocpd.2025.064.