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Etiology of narrow maxilla creating orthodontic and prosthetic treatment difficulties

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Abstract. – OBJECTIVE: Narrow maxilla occurring due to various congenital or acquired causes creates major orthodontic problems and complicates prosthetic dental rehabilitation. The etiologic factors are mostly related to upper airway pathologies that restrict breathing and cause negative pressure at the base of the nose and nasopharynx. The upper and lower airway is a whole unit. Regional anomalies or acquired problems affect the entire system. This can lead to developmental issues and permanent disorders in childhood, which will last their real life. This study was planned to investigate the incidence of nasopharyngeal obstruction originating from allergic rhinitis, turbinate hypertrophy, septum deviation, and adenoid vegetation in children scheduled for orthodontic treatment due to maxillary stenosis.

PATIENTS AND METHODS: Our study group consists of one hundred children aged 12-16 years who applied to the orthodontist due to dental malalignment and were found to have a narrowing of the maxilla. After the orthodontic evaluation, the patients were referred for an ENT examination to evaluate the etiological factors originating from the upper respiratory tract.

In the study group, nasal congestion and allergic rhinitis were first investigated. All symptoms were evaluated and scored. Then, an ENT physical examination was performed in all cases, and nasal cavities, nasopharynx, and oropharynx were assessed with a fiberoptic endoscope. Regarding etiological factors, allergic rhinitis, turbinate hypertrophy, nasal septum deviation, and adenoid vegetation that would prevent breathing were carefully investigated.

RESULTS: Firstly, deep palate, narrowed maxillary arch, V-shaped arch, adenoid face type, bilateral posterior crossbite, insufficient lip presence, maxillary incisor protrusion (upper forward thrust), skeletal class 2 division 1 malocclusion, and increased lower face height detected in patients primarily diagnoses were grouped according to their pathologies. Allergic rhinitis was found in 43 cases, turbinate hypertrophy in 30 instances, nasal septum deviation in 18 cases, and adenoid vegetation that prevented respiration in 61 patients.

CONCLUSIONS: It is known that increased nasal airway resistance due to allergic rhinitis, septal deviation, turbinate hypertrophy, or adenoid vegetation in the upper respiratory tract may lead to permanent orthodontic disorders in children and adolescents. A multidisciplinary approach, early diagnosis, and treatment should be the first step to prevent this situation. Secondly, it should be planned to correct the anatomical disorders that have occurred with appliances and, if necessary, surgical approaches. Taking precautions before permanent problems arise in childhood is also crucial in prosthetic dentistry.

Key Words:
Dental malalignment, Allergic rhinitis, Turbinate hypertrophy, Nasal septum deviation, Adenoid vegetation.

Introduction

Narrow maxilla occurring due to various congenital or acquired causes creates major orthodontic problems and complicates prosthetic dental rehabilitation. The etiologic factors are mostly related to upper airway pathologies that restrict breathing and cause negative pressure at the base of the nose and nasopharynx. The upper and lower airway is a whole unit. Regional anomalies or acquired problems affect the entire system. This can lead to developmental issues and permanent disorders in childhood, which will last for their whole life[1-3].

With the increase in the quality of life and the importance given to health, the efforts of families to raise their children in the best and healthy way possible have also increased[4]. Today, more children apply to the physician for orthodontic treatment.

The term "pearl-like teeth" often describes what parents hope to see in their children's smiles. In addition, physicians are responsible for the planning and execution of the treatment for this goal. On the other hand, the etiological aspects should

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be given more attention, and the connections to other systems must be investigated more thoroughly. Children who sleep with their mouths open, snore, or have nasal congestion are taken to a pediatrician or an ENT doctor, and these specialists are not concerned with the form of the palate or dental misalignment when treating the airway.

Pathologies of the upper respiratory tract that are frequent in children include allergic rhinitis, turbinate hypertrophy, septum deviation, and adenoid vegetation[3-5]. These disorders will either make it difficult or impossible to breathe through the nose. It has been observed that adenoid hypertrophy may influence orofacial and craniofacial development due to alterations in the dynamics of swallowing and changes in respiratory function. These findings come from three separate studies[3-5]. If the adenoid problem is not resolved before orthodontic treatment, there is a possibility that it will lead to loss or recurrence. This is another factor that should be taken into consideration. In these children, the goal should be to eliminate the cause that raises nasal respiratory resistance while growth continues and to prepare the child for average growth. This can be accomplished by preparing the body for typical development. In this context, working with an orthodontist, an ENT expert, and, if necessary, a pediatric allergy specialist1 will significantly benefit.

This study aimed to assess the incidence of nasopharyngeal obstruction in children who were scheduled for orthodontic treatment because of narrow maxilla and airway obstruction. This obstruction could have been caused by allergic rhinitis, turbinate hypertrophy, septum deviation, or adenoid vegetation.

Patients and Methods

Our study was approved by the ESOGU Non-Interventional Clinical Research Ethics Committee's decision dated 26.7.2022 and numbered 23. The power analysis showed that 100 patients were suitable for statistical evaluation.

Inclusion Criteria

Our study group comprised one hundred children aged 12-16 who applied to the orthodontist (2nd author) due to dentition disorder and upper jaw stenosis. After the orthodontic evaluation, the patients were referred for an ENT examination to evaluate the etiological factors originating from the upper respiratory tract.

Exclusion Criteria

The patients referred for dentition disorder and upper jaw stenosis but who had surgery such as adenoidectomy or tonsillectomy were excluded from the study. Patients with acute infections such as rhinosinusitis and tonsillitis were also excluded from the study,

In the study group, initially, all symptoms were evaluated and scored. Then, an ENT physical examination was performed in all cases, and nasal cavities, nasopharynx, and oropharynx were assessed with a fiberoptic endoscope. Physical and endoscopic ENT examination first investigated nasal passages, congestion, and septum according to the NOSE symptom Scoring System[6,7]. Regarding etiological factors, allergic rhinitis, turbinate hypertrophy, nasal septum deviation, and adenoid vegetation that would prevent breathing were carefully investigated endoscopically.

Concha size was evaluated according to Friedman Concha Evaluation Criteria, and nasal septum was assessed according to Mladina Classification. Adenoid vegetation size was also graded. A statistical comparison was unnecessary as almost all patients had nasal or oropharyngeal pathology.

Results

The patients were initially grouped according to their pathologies. The most frequent pathologies were the deep palate, narrowed maxillary arch, V-shaped arc, adenoid face type, and bilateral posterior crossbite. Insufficient presence of lips, maxillary incisor protrusion (upper thrust), skeletal class 2 divisions 1 malocclusion, and increased lower face height were observed in fewer patients (Table I).

ENT findings of all patients grouped according to orthodontic pathologies were noted. ENT symptoms were evaluated according to NOSE scoring[7], and the symptoms were converted to diagnoses such as allergic rhinitis, turbinate hypertrophy, septum deviation, and adenoid vegetation. Since patients with acute infections such as rhinosinusitis and tonsillitis were excluded from the study, no signs of infection were found in the study group patients. Although we had initially planned a "no-pathology-detected" subgroup, no patients were assigned to that group. The distribution of respiratory tract pathologies detected in the study group is shown in Table II.

Table I. Distribution of orthodontic pathologies detected in patients.

	F (n)	%	M (n)	%	Total (n) %
Deep palate	44	44	56	56	100
Narrowed maxillary arch	37	37	51	51	88
V-shaped arc	34	34	36	36	70
Adenoid face type	30	30	31	31	61
Bilateral posterior crossbite	20	20	18	18	38
Insufficient presence of lips	9	9	11	11	20
Maxillary incisor protrusion (upper thrust)	7	7	9	9	16
Skeletal class 2 divisions 1 malocclusion	6	6	8	8	14
Increased lower face height	7	7	6	6	13

Since more than one pathology is detected in some cases, the columns' total is higher than the number of patients.

Table II. Distribution of respiratory tract pathologies detected in patients.

	F (n)	%	M (n)	%	Total (n) %
Allergic rhinitis	24	24	21	21	43
Turbinate hypertrophy	16	16	14	14	30
Septum deviation	7	7	11	11	18
Adenoid vegetation	30	30	31	31	61
No pathology detected	0	0	0	0	0

Since more than one pathology is detected in some cases, the columns' total is higher than the number of patients.

Discussion

Allergic rhinitis, turbinate hypertrophy, and adenoid and nasal septum deviation are upper respiratory tract pathologies that often coexist or trigger each other. In the presence of these problems, the narrowed nasal passage causes a negative pressure in the nose and causes the palate to be pulled upwards and domed in developing subjects. This doming will cause narrowing of the palate and deterioration of the tooth alignment. Although it is easy to explain this cycle theoretically, it can be challenging to solve the problem together with multidisciplinary studies in practice. In our country, children are first taken to the pediatrician because they sleep with their mouths open. If the pediatrician finds it appropriate, they refer him/her to the ENT doctor. Both physicians focus on breathing and often do not deal with dentition. In cases with dental malalignment, which primarily attracts the family's attention, they take their children to the orthodontist. In this case, treatment is usually applied for dental malalignment, but the underlying respiratory tract pathology is not examined[6-8].

Studies and publications go back a hundred years in Europe and America. Kim et al[5] planned a clinical study, claiming that the relationship between adenoid hypertrophy and dentofacial anomalies has never been investigated in Asia. They examined the tonsillar palatine and adenoid vegetation sizes in children who applied to the sleep disorders department of the pediatric clinic. As a result of this study, it was determined that adenoid and tonsillar hypertrophy are closely related to dentofacial anomalies[5].

The problems that cause nasal congestion can lead to dentofacial structure disorders called adenoid face[8]. It has been reported[8] that mouth breathing will reduce the width of the palate and cause it to become narrow or V-shaped. The stenosis of the jaw may result from the mouth breathing and the tongue positioned below the palatal region. It has been revealed[8] that due to the deterioration of the balance between the tongue and cheek muscles, the alveolar process in the premolar and molar regions is compressed and narrowed from the sides, causing the upper anterior segment to move forward. As a result, the mandible is positioned behind at the same time. These simultaneous movements are called "compressor theory"[8].

In children with prolonged mouth breathing, a markedly long and narrow face, insufficiency of the upper lip, and maxillary changes in the transversal direction leading to crossbite

associated with the palate, maxillary retrusion in the anteroposterior direction, and vertical changes in the palatal plane associated with the skull base, and an increase in lower anterior face height is observed[8].

Loss of lingual and palatal tongue pressure, accompanied by airway obstruction, causes narrowing of the maxilla. The positioning of the tongue also plays a role in mandibular development. A downwardly positioned tongue can lead to a retrognathic mandible, and an in-between tongue can cause anterior occlusal anomalies[8]. It has been reported[8] that narrowing the upper air column is an important etiological cause of malocclusion. Studies[9-11] from 40 years ago stated that an otolaryngologist and orthodontist should work together to treat these patients entirely. We share the same view and hope that this cooperation will increase.

The relationship between adenoid vegetation and orthodontics was explained previously[8]. It is stated[8] that in children with mouth breathing originating from adenoid hypertrophy, muscular activity, especially lip muscles, is affected by this condition. It is stated that extrusion of the maxillary molars and incisors according to the palatal plane and the lower incisors according to the mandibular plane can be expected with increased lip opening. As a result of the change in the tongue's position at rest, the position of the mandible is negatively affected. Maxillary anterior teeth may become protrusive as the tongue begins to be positioned more anteriorly, and the activity of the lip muscles decreases[8-12]. The growing protrusion could bring on malocclusion of the angle class II, division 1. Because the tongue cannot be positioned at the level of the maxillary posterior teeth, the buccal muscles cause the dental arch to shrink in the region of the posterior maxillary teeth. This is because the tongue cannot be positioned at this level. Narrowed upper dental arches emerge as one of the most essential features of adenoid facial types. With the narrowing of the maxillary arch, its dome deepens. Total face height (N-Me), lower face height, palatal plane angle (FH-MP), mandibular plane angle (FH-MP), and gonial angle increase as a result of the openness of the lip posture seen with mouth opening[8-14].

Limitations

The main limitation of this study was that it was performed in a single center. Comparative studies, including various cultures and economic status, should be performed.

Conclusions

It is known that increased nasal airway resistance due to allergic rhinitis, septal deviation, turbinate hypertrophy, or adenoid vegetation in the upper respiratory tract may lead to permanent orthodontic disorders in children and adolescents. A multidisciplinary approach, early diagnosis, and treatment should be the first step to prevent this situation. Secondly, it should be planned to correct the anatomical disorders that have occurred with appliances and, if necessary, surgical approaches. While these results demonstrate structural changes and an evident increase in airway volume, further investigation is needed to determine the impact of this increase on the actual respiratory capacity and patient breathing improvement[13]. Taking precautions before permanent problems arise in childhood is also crucial in prosthetic dentistry.

Conflict of Interest

The authors declared no potential conflicts of interest concerning this article's research, authorship, and/or publication.

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Authors' Contributions

Both authors equally contributed to the conceptualization, methodology, data collection, interpretation, writing the manuscript, and final review of the manuscript.

Informed Consent

The patients were anonymized, and the identity information was not included. Informed consent was obtained from the participants.

Ethics Approval

Our study was approved by the ESOGU Non-Interventional Clinical Research Ethics Committee's decision dated 26.7.2022 and numbered 23, and it was conducted according to the principles expressed in the Helsinki Declaration.

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