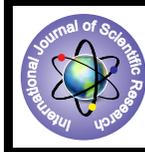


Cephalometric Evaluation of Pharyngeal Airway Dimension in Different Maxillomandibular Sagittal Relationship – A Cephalometric Study



Medical Science

KEYWORDS : pharyngeal airway, maxillomandibular relation, cephalometry

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ABSTRACT

Aim of the study: To evaluate the association between the maxillomandibular sagittal relationships on the dimensions of pharyngeal airway passage.

Materials and methods: Lateral cephalograms of 105 subjects were used to measure the upper pharyngeal airway. Based on the sagittal skeletal pattern i.e. ANB Angle, Beta Angle, App- Bpp Angle, all the subjects were divided equally into three groups; skeletal class I (ANB 1- 2, β angle 27 – 35, APP-BPP 2 – 8 mm), skeletal class II (ANB > 2, β angle < 27, APP-BPP > 8), skeletal class III (ANB < 1, β angle > 35, APP-BPP < 8). All lateral cephalograms were traced manually.

Results: The results showed a significant reduction in the upper airway at the level of nasopharynx and oropharynx and the airway showed a tendency to decrease from Class III to Class I and Class I to Class II.

Conclusion: Sagittal skeletal pattern may be a contributory factor in variations in the upper airway dimension and the dimensions of the pharyngeal airway passage decrease markedly from Class III to Class I to Class II subjects.

Introduction

After a period of time during which it was generally believed that heredity immutably determines craniofacial form, there has in recent years been a renewed interest in the little understood interaction, which at least some workers believe exists, between form and function in the craniofacial region. Among the craniofacial interactions studied, the topic of predominant respiratory mode and the associated craniofacial growth has received particular attention. The possible relationship that exists between respiration and facial form could be used to illustrate a basic belief that in most things animal, function plays an important role when it comes to the determination of form. If the proposed interactions do indeed exist, they are of great practical interest to pediatricians, otorhinolaryngologists, allergists, speech physiologists, and in particular orthodontists who, by training, are uniquely qualified to diagnose and monitor aberrant as well as normal facial growth.¹⁻³

The pharynx is a tubeshaped passage¹ structure that extends superoinferiorly from the cranial base to the level of the inferior surface of the sixth cervical vertebra. It is divided into three parts: Nasopharynx, oropharynx and laryngopharynx. Narrowing of the pharyngeal airway passage (PAP) is common feature in patients with breathing problems.²⁻⁵ There are significant relationships between the pharyngeal dimensions and craniofacial abnormalities. Craniofacial abnormalities, such as mandibular deficiency, bimaxillary retrusion, steep occlusal plane, increased mandibular plane angle, and a more caudally positioned hyoid bone result in narrowing of the pharyngeal airway passage.^{1,6-8} It is accepted that maxillofacial growth and development in children is affected by both genetic and environmental factors.⁹ Familial aggregation and genetic background have been shown to contribute to prognathism^{10,11} and other facial and occlusal growth patterns.^{11,12} On the other hand, normal respiratory activity influences the growth of maxillofacial structures, favoring

their harmonious growth and development.^{13,14,15}

It has been demonstrated that there are statistically significant relationships between the pharyngeal structures and both dentofacial and craniofacial structures at varying degrees.¹⁶⁻²⁰ According to the Balter's philosophy⁴ skeletal Class II or Class III malocclusions are a consequence of difference in the position of the tongue, disturbing the pharyngeal structures. Thus, it might be considered to be useful that the assessment of the pharyngeal structures be included with the orthodontic diagnosis and treatment planning, as the functional, positional and structural assessments of the dentofacial pattern.^{4,21,22}

According to Sorensen et al²³ airway adequacy was related to the size and position of the mandible rather than maxillary variables where as Sosa et al²⁰ has shown that Craniofacial anomalies, including mandibular or maxillary retrognathism, short mandibular body, and backward and downward rotation of the mandible, may lead to reduction of the pharyngeal airway passage. Ceylan and Oktay⁴ reported that the pharyngeal structures were not affected by changes in the ANB angle.

In recent years, studies^{4, 20, 23} have been done concluding that variations in skeletal pattern could predispose to upper airway obstruction but different studies have shown variable results.

So, this study was conducted to evaluate the association between the maxillomandibular sagittal relationships on the dimensions of pharyngeal airway passage using larger parameters than was used in previous studies.

MATERIALS AND METHODS

The study was carried out on visiting patients and the records of previous patients in the Department of Orthodontics and Dentofacial Orthopedics. A total of 105 subjects were selected and the selected subjects met the following inclusion criteria:

- To breathe comfortably through the nose
- No previous history of orthodontic treatment
- To have normal vertical occlusal relationship
- No wound, burn and scar tissue in the neck region

However, subjects with cleft lip and palate, history of chronic mouth breathing, snoring and tonsillectomy or adenoidectomy were excluded from the study.

Based on the sagittal skeletal pattern i.e. ANB Angle, Beta Angle, App- Bpp Angle, all the subjects were divided equally into three groups containing 35 subjects each;

Group 1 - Class I skeletal group

- Having ANB - 1 - 2
- Having β angle - 27 - 35
- Having APP-BPP - 2 - 8 mm

Group 2 - Class II skeletal group

- Having ANB - more than 2
- Having β angle - less than 27
- Having APP-BPP - more than 8

Group 3 - Class III skeletal group

- Having ANB - less than 1
- Having β angle - more than 27
- Having APP-BPP - less than 8

Various cephalometric landmarks, linear and angular parameters used for the measurement of pharyngeal airway passage and soft palate dimensions are –

Landmarks:

Nasion (Na): The frontonasal suture at its most superior point on the curve at the bridge of the nose

Subspinale (A point): The most posterior point on the curve between ANS and PR. "A" point is usually found 2mm anterior to the apices of the maxillary central incisor.

Supramentale (B point): The most posterior point of the bony curvature of the mandible below infradentale and above Pogonion. "B" point is usually found near the apical third of the roots of the mandibular incisors and may be obscured during the eruption of these teeth. When the profile of the chin is not concave, "B" point cannot be determined.

Sella(S): The center of the hypophyseal fossa (sella tursica).

Anterior Nasal Spine (ANS): Most anterior point on the bony hard palate in sagittal plane

Posterior Nasal Spine (PNS): The most posterior point on the bony hard plate in the sagittal plane: usually the meeting point of the inferior and superior surfaces of the hard plate.

S-N Line: The S-N line represents the anterior cranial base. It is constructed by connecting the points Sella Turcica and the Nasion.

Palatal Plane: The palatal plane is drawn by extending a line from the anterior nasal spine (ANS) to posterior nasal spine (PNS).

Basion (Ba): lowermost point on anterior margin of foramen magnum;

Ad1: point of intersection of posterior pharyngeal wall and line Ptm-Ba;

SPPW: point of intersection of line from soft palate and center perpendicular to posterior pharyngeal wall and posterior pharyngeal wall;

SPP: point of intersection of line from soft palate center perpendicular to posterior pharyngeal wall and posterior margin of soft palate

U: the tip of the uvula;

MPW: foot point of perpendicular line from point U to posterior pharyngeal wall;

TPPW: point of intersection of posterior pharyngeal wall and extension of line B-Go;

TB: point of intersection of base of the tongue and extension of line B-Go;

V: the most posterior inferior point on the base of the tongue;

LPW: foot point of perpendicular line from point V to posterior pharyngeal wall.

Variables:

PNS-Ba: distance between PNS and Ba;

PNS-R: distance between PNS and R;

PNSAd1: distance between PNS and Ad1;

SPP-SPPW: distance between SPP and SPPW;

U-MPW: distance between U and MPW;

TB-TPPW: distance between TB and TPPW;

V-LPW: distance between V and LPW;

Soft palate thickness: maximum thickness of soft palate and

Soft palate length: linear distance between U and PNS

Hypopharynx (eb-peb): The distance from vallecula of epiglottis (eb) to horizontal counterpoint on the posterior pharyngeal wall (peb)

STATISTICAL ANALYSIS:

All the analysis was done using SPSS version 14. A p-value of <0.05 was considered statistically significant. Comparison of mean among class 1, 2 and 3 was done with ANOVA with post-hoc Tukey's test.

RESULTS

The significant differences were found between Class II and Class III at the level of SPP-SPPW (palatopharynx), U-MPW and TPP-TPPW (oropharynx)

DISCUSSION

The relationship between craniofacial morphology and respiratory function has been studied extensively since the beginning of 20th century²⁴. Ricketts, 1968; Linder-Aronson, 1970 and Moore, 1972²⁵ claim that patients with deficient respiratory functions present with lip incompetency, increased anterior face height, maxillary constriction, protruded maxillary incisors with Class II molar relationship, open bite, and narrow external nares, so called 'adenoid facies'.

The upper airway is a structure responsible for one of the main vital functions in the human organism is breathing. The interest in studying the upper airway has always been present in orthodontics, and main objective is to clarify the relationship between pharynx structures and craniofacial complex growth and development.²⁶

The present study was conducted on patients visiting the Department of Orthodontics and Dentofacial Orthopedics. The samples were divided into skeletal Class I, skeletal Class II, and skeletal Class III patterns according to the ANB angle, Beta an-

gle .app- bpp distance .

Riedel²⁷ introduced the ANB angle as a skeletal sagittal discrepancy indicator, which has become the most commonly used parameter in orthodontics.

Nanda and Merrill²⁸ recommended the palatal plane as a reference plane for the assessment of sagittal jaw relationships. The major advantages of the palatal plane were seen as the independence from nasion and in its relative stability during growth. In addition, the use of a linear measurement was preferred to an angular measurement due to the fundamental fact that a linear measurement is affected by fewer variables than an angular one, which involves at least three points with six degrees of freedom as said by Moyers and Bookstein, 1979.²⁹

The configuration of the Beta angle gives it the advantage to remain relatively stable even when the jaws are rotated.⁴

Cephalometric radiographs enable analysis of dental and skeletal anomalies as well as soft tissue structures and form. Many studies have assessed the anatomic conformation of the upper airway with more sophisticated and expensive techniques, including cine-computed tomography, fluoroscopy, acoustic reflection, fiberoptic pharyngoscopy and magnetic resonance imaging. Cephalometry is, however, less expensive, more useful, easily achieved with reduced radiation, and correlates with other investigations such as computed tomography (CT) or somnofluoroscopies carried out during wakefulness or sleep.⁵⁻⁹

When the airway dimensions were compared, the significant differences were found between Class II and Class III at the level of SPP-SPPW (palatopharynx), U-MPW and

TPP-TPPW (oropharynx) and the results of the study seemed to suggest that the dimension of the oropharynx decreased markedly from Class III to Class I to Class II subgroups. The

Difference in SPP-SPPW can be explained by: 'Balter's philosophy'⁴ according to which, Class II malocclusions are a consequence of a backward position of the tongue, disturbing

the cervical region. The respiratory function is impeded in the region of larynx and there is thus a faulty deglutition and mouth breathing. Class III malocclusions are due to a more forward position of the tongue and to cervical overdevelopment.¹² Ceylan and Oktay⁴ found that pharyngeal structures were not affected by the ANB angle, although they found a significant difference in the oropharyngeal area between Class I and Class III, as well as between Class II and III. Akcam et Al²¹ also reported a decrease in the upper airway dimensions of subjects who had posterior mandibular rotation.

The difference at the level of U-MPW and TPP-TPPW (oropharynx) can be because of the decreased size and posterior position of the mandible that leads to palatopharyngeal and

hypopharyngeal obstruction. This is in accordance with the study conducted by Zhe Zhong Et Al¹³ Lam Et Al¹⁴ Claudino et al³⁰ in which Class II subjects have smaller minimum and mean areas in the lower pharyngeal portion, and the velopharynx and oropharynx segments than do Class III subjects.

Kerr¹⁸ reported that Class II malocclusion subjects showed narrow nasopharyngeal airway space compared with Class I and normal occlusion subjects.

In a study on Pharyngeal airway in children with prognathism and normal occlusion by

Yoshihiko Takemoto et al⁹ concluded that more anterior positioning of the mandible of 7 and 8 year old children resulted in a wider lower pharyngeal airway.

Kirjavainen And Kirjavainen³¹ studied the upper airway of 40 patients with Class II division 1 malocclusion and compared them to 80 children with a Class I molar relationship. They concluded that the children with Class II malocclusion had a wider or similar nasopharynx than the controls but narrower oropharyngeal and hypopharyngeal areas. Martin et al³² also found that the lower pharyngeal dimensions were increased in Class III subjects. Similar findings were noted in the studies of Trotman Et Al³³ and Athanasiou Et Al.²⁴

Hakan El And Juan Martin Palomo²⁴ on their study on airway of different maxillary and mandibular sagittal positions found that the posterior airway space, area of the most constricted region at the base of the tongue, and Oral Passage volume were significantly higher for the CLASS III group, whereas CLASS II subjects had the lowest values. The only significant difference for the Nasal Passage volume was between CLASS III and Class II groups where a smaller volume for the CLASS II group was observed.

CONCLUSION

There is a positive association between sagittal maxillomandibular relationship and the dimensions of pharyngeal structures. The following conclusions were drawn from the present study:

The sagittal skeletal pattern may be a contributory factor in variations in the upper airway dimension.

Dimensions of the pharyngeal airway passage were decreased markedly from Class III to Class I to Class II subjects.

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