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CORRELATION OF ADENOIDS & UPPER AIRWAY WITH VARIOUS SKELETAL MALOCCLUSIONS. A RETROSPECTIVE STUDY.

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ABSTRACT The growth and function of the nasal cavities, the nasopharynx, and the oropharynx are closely associated with the normal growth of the skull. Because of the close relationship, a mutual interaction is expected to occur between the pharyngeal structures and the dentofacial pattern. Lateral cephalograms of 45 subjects were used to measure the upper pharyngeal airway. The subjects were divided into three groups: Skeletal Class I, II & III with 15 subjects per group. Cephalometric evaluation of adenoids and the nasopharyngeal airway was done using the Handelman–Osborne area method. The percentage of airway and adenoid were measured using Autodesk AutoCAD 2020 software. The results showed a greater significance of 0.00 and the airway showed a tendency to decrease from Class III to Class I and Class I to Class II. The mean value of Class I, Class II, Class III airway area is 55.6 %, 33.9 %.,66.5 % respectively. The sagittal skeletal pattern may be a contributory factor in variations in the upper airway dimension. The dimensions of pharyngeal airway passage were decreased from Class III to Class I and Class I to Class II subjects.

KEYWORDS : Lateral cephalometry, Sagittal skeletal pattern, Pharyngeal airway passage.

INTRODUCTION

The growth of maxilla and mandible is under the influence of oropharyngeal functions and airway spaces [1]. The term 'airway' may be defined as the air passage comprising of the nasal cavity, oral cavity, pharynx, larynx, trachea, and large bronchi [2]. Any inhibition in the airways results in mouth breathing and alters the growth of the jaws [3]. It affects the overall growth and development of a child. The major predisposing factors for nasorespiratory obstructions include deviated nasal septum, enlarged turbinates, nasal polyps, enlarged adenoids, tumors, and nasal congestion. Adenoid hypertrophy plays a major role among the various causative factors in severe nasal impairment. Understanding the normal growth of the skull is important to analyze the significance of variations in the growth and function of the nasal cavities and pharynx [4]. Thus, abnormal respiratory modes such as chronic mouth breathing causes dentofacial deformities. Adenoid hypertrophy is a major reason for nasal obstruction and is often related to many symptoms such as mouth breathing. [5]. As a consequence, oral respiratory leads to neuromuscular and soft-tissue deformities, which results in malformation of craniofacial and dental structures [6,7].

Normal airway is one of the major factors for a normal growth of craniofacial structures. The Class II malocclusions are an effect of a backward posture of the tongue, annoying the cervical region and thus the respiratory function is impeded in the region of larynx which causes a faulty deglutition and mouth breathing. Class III malocclusions are a result of a more forwardly positioned tongue [8]. The equilibrium between the tongue and the circumoral muscles is responsible for shape of arch and thus the functional space for tongue is essential for normal development of orofacial system. Skeletal malocclusion is a predisposing factor in airway morphological changes and respiratory problems. Small, retro-positioned mandible, enlarged tongue and soft palate, inferiorly positioned hyoid bone, and retroposed maxilla are also the factors which are responsible for pharyngeal airway obstruction [9]. Evaluation of adenoids and upper airway is done with various tools such as lateral cephalogram, rhinometry, cone beam computerized tomography (CBCT), computed tomography (CT), magnetic resonance imaging (MRI) and nasal endoscopy [10].

AIM AND OBJECTIVE:

- To assess the correlation between the size of adenoids and airway with various skeletal malocclusions.
- To compare the changes in upper airway dimensions among various skeletal malocclusions.

MATERIALS AND METHODS:

Lateral cephalograms of 45 subjects were collected from Department of Orthodontics & Dentofacial Orthopaedics, Best Dental Sciences College & Hospital, Madurai and were used to measure the upper pharyngeal airway. The inclusion criteria were subjects between 11-25 years of age and subjects with no craniofacial anomalies; The exclusion criteria were subjects with history of prior orthodontic treatment, myofunctional therapy, orthognathic surgery, adenoidectomy or tonsillectomy and neuromuscular disorders.

The subjects were divided into three groups based on ANB angle and each group comprises of 15 subjects.

- Skeletal Class I - 2 ± 2° - 15
- Skeletal Class II - >4° - 15
- Skeletal Class III - < 0° -15

Cephalometric evaluation of adenoids and the nasopharyngeal airway was done using the Handelman–Osborne area method. The percentage of adenoid and airway were measured using Autodesk AutoCAD 2020 software.

Radiological Evaluation of Adenoids and Airway Space

- 1 - SpL : sphenoid line
- 2 - PL : palatal line
- 3 - PML : pterygomaxillary line
- 4 - AAL : anterior atlas line

AD – Adenoid area
AR – Airway area
NP (nasopharyngeal area) = AD + AR

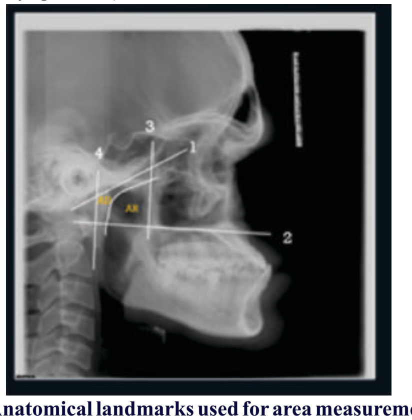

Figure 1: Anatomical landmarks used for area measurement.

Handelman and Osborne area method:

This trapezoid analysis was used for quantifying upper airway dimensions on a lateral cephalogram. The cephalometric reference points and lines used were,

Ba: basion.

SpL: sphenoid line - line drawn tangential to the lower border of sphenoid bone registered on Basion.

PL: Palatal line - On a lateral cephalometric x-ray the palatal plane is represented by a line joining the posterior, and the anterior nasal spines (PNS-ANS). The palatal line may be extended in either direction.

Pm: pterygomaxillare.

PML: pterygomaxillary line - This line passes through the pterygomaxillary fissure and is perpendicular to the palatal plane.

AA. Anterior arch of the atlas - The most anterior point on the anterior arch of the atlas (C1) in the mid sagittal plane.

AAL: anterior atlas line - perpendicular to palatal line registered on anterior arch of atlas.

The nasopharyngeal area (Np area) is described by four lines which joins to form a trapezoid. It is formed by palatal line (PL), sphenoid line (tangent drawn to the lower border of sphenoid registered on Basion), anterior atlas line (AAL), and pterygomaxillary line (PML) drawn perpendicular to the PL (palatal plane) registered on pm (pterygomaxillare). The area of the adenoid tissue in the trapezoid represents the nasopharynx.

It is further divided into adenoid area (AD) which is a part of the nasopharyngeal (NP) area consisting of soft tissue, ie, adenoid and the airway area (AR) which is a part of the Nasopharyngeal (NP) area, ie, airway).

AutoCAD 2010 software was used to measure the volume of upper airway with the digital lateral cephalograms. The nasopharyngeal area (NP) ws measured in mm² dimensions, from which the amount of adenoid area (mm²) and airway area (mm²) were obtained. Then the adenoid area and airway area were converted into percentage occupied in the nasopharyngeal area (NP) .The polyline command is used to draw the borders of adenoid area and airway area. All the lines and drawing were joined to form a closed area. These areas were scaled in millimeter square using area command.

The adenoid area was derived by subtracting the airway area from nasopharyngeal area. Then the percentage of airway area and adenoid wall area were found and then compared.

Statistical Analysis:

Data was analyzed using SPSS software. The mean, standard deviation and p-values were calculated using the one-way analysis of variance (ANOVA). Multiple group comparisons were done using Bonferroni test.

RESULTS:

Table 1 shows the mean amount of adenoid area and airway area among different skeletal malocclusions. The skeletal class II malocclusion shows a greater volume of adenoid area with a mean value of 66 ± 4.1 % and the least volume of adenoid area is seen in skeletal class III malocclusion with a mean value of 33.4 ± 4.3 %. Meanwhile a greater volume of airway area is seen in skeletal class III malocclusion with a mean value of 66.5 ± 4.3 % and the skeletal class II malocclusion shows a least value of airway area with a mean value of 33.9 ± 4.1 %.

Table 1 Shows the mean values (%) of Adenoid area and Airway area among the three skeletal groups.

Descriptives									
		N	Mean (%)	Std. Deviation (%)	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Adenoid area	Class I	15	44.3333	2.37657	.61363	43.0172	45.6494	40.60	48.10
	Cass II	15	66.0933	4.16953	1.07657	63.7843	68.4023	60.30	75.90
	Class III	15	33.4400	4.38207	1.13145	31.0133	35.8667	23.00	38.10
	Total	45	47.9556	14.20892	2.11814	43.6867	52.2244	23.00	75.90
Airway area	Class I	15	55.6667	2.36879	.61162	54.3482	56.9718	51.90	59.40
	Class II	15	33.9067	4.17055	1.07683	31.5838	36.2029	24.10	39.70
	Class III	15	66.5600	4.38207	1.13145	64.1333	68.9867	61.90	77.00
	Total	45	52.0444	14.21383	2.11887	47.7675	56.3081	24.10	77.00

Table 2 Shows the difference of adenoid area and airway area between the groups using ANOVA.

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Adenoid area	Between Groups	8292.012	2	4146.006	294.491	.000
	Within Groups	591.299	42	14.079		
	Total	8883.311	44			
Airway area	Between Groups	8298.544	2	4149.272	294.921	.000
	Within Groups	590.901	42	14.069		
	Total	8889.446	44			

Table 3 Shows the multiple group comparison within adenoid area and airway area using Bonferroni test.

Multiple Comparisons							
Bonferroni							
Dependent Variable	(I) group	(J) group	Mean Difference (I-J) (%)	Std. Error (%)	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
adenoid area	class I	class II	-21.76000*	1.37009	.001	-25.1765	-16.3435
		class III	10.89333*	1.37009	.012	7.4768	19.3099
	class II	class III	32.65333*	1.37009	.000	29.2368	36.0699
airway area	class I	class II	21.76667*	1.36963	.001	18.3513	26.1821
		class III	-10.90000*	1.36963	.012	-14.3154	-3.4846
	class II	class III	-32.66667*	1.36963	.000	-36.0821	-29.2513
*. The mean difference is significant at the 0.05 level.							

Table 2 shows a highly significant difference between the groups of both adenoid area and airway area with a p value of 0.000.

Table 3 shows the multiple comparisons of adenoid and airway area between the skeletal class I, II and III groups. In adenoid area a highly significant difference is present between skeletal class II and III with a p value of 0.000 and the skeletal class I and II shows a significant difference with a p value of 0.001. Similarly the airway area shows a highly significant difference is present between skeletal class II and III with a p value of 0.000 and the skeletal class I and II shows a significant difference with a p value of 0.001.

DISCUSSION:

Class I and Class III subjects had a significantly larger airway volumes when compared with Class II subjects. Class II patients have short or posteriorly placed mandibles which pushes the soft palate back into the upper pharyngeal space, causing airway obstruction. In contrary Class III patients have long or anteriorly placed mandibles which forces the tongue to move anteriorly, causing a wide airway.

Kerr investigated the relationship between the nasopharyngeal and dentofacial structures on the subjects with normal and Class II malocclusions and found that the subjects with Class II malocclusion had a larger nasopharyngeal airway area than the subjects with normal occlusions[11]. Kim et al stated that patients with retrognathic mandible have a smaller airway volume when compared with patients with a normal anteroposterior skeletal relationship [12]. These results coincide with the results of our current study. We have observed that Class I and Class III subjects had significantly larger volumes compared with Class II subjects, which agrees with the findings of Haken et al [13]. He also found that Class I and Class III subjects had significantly larger airway volumes compared with Class II subjects, but they found no significant difference between Class I and Class III groups which is similar in our study.

The use of lateral cephalogram to evaluate the upper airway is limited to a degree as they provide 2-dimensional images of the nasopharynx, which consists of complex 3-dimensional anatomical structures [4]. A high correlation between the results of posterior rhinoscopy and cephalometric radiographs in the evaluation of adenoid size was found by Linder-Aronson [6]. This observation was also made by previous authors who found that lateral cephalometric radiographs gave an good picture of the size of the nasopharyngeal airway in children of all ages [14,15]. All appropriate diagnostic aids must be used to evaluate the functional adequacy of the upper airway. Even though a lateral cephalometric radiograph might not be considered the most appropriate method of examination to detect adenoid hypertrophy, it is still warranted to have its usefulness investigated, since a considerable number of orthodontic patients have nasal obstruction and there is clear evidence of an association between oral breathing and craniofacial alterations [14]. Cephalometry is, however, less expensive, more useful, and and can be easily taken with less radiation exposure, and it also correlates with other investigations such as CT, somnofluoroscopy.

CONCLUSION:

- The sagittal skeletal pattern may be a contributory factor in variations in the upper airway dimension.
- The dimensions of pharyngeal airway passage were decreased from Class III to Class I and Class I to Class II subjects.

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