Upper and lower airway difference in class I and class II patients- A radiographic study

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Abstract:

Aim: This retrospective study aimed to evaluate the upper airway difference in individuals with class I and class II malocclusion.

Materials and method: 100 lateral cephalogram of class I (50 patients) and class II (50 patients) will be selected form the department in saveetha dental college and airway differences will be noted.

Results: The airway difference in class I patients which was found to be normal with upper, airway difference in class II patients which has been found to be with in the normal limit . For upper airway it was 1.5 cm and 1.1 cm, and there was no major significant difference in the normal limit but comparatively there was a mild difference in between class I and class II Patients.

Conclusions: Patients with Class I and Class II malocclusions have significantly normal airway. But when compared to pharyngeal airways among Class I and Class II malocclusions there was mild difference between upper and lower airways among the group of study population.

Keywords: upper airway, lower airway, class I patients, class II patients

Introduction:

Cephalometry is the study and measurement of the head, usually the human head, especially by medical imaging such as radiography. Craniometry, the measurement of the cranium (skull), is a large subset of cephalometry. Cephalometry also has a history in Phrenology, which is the study of personality and character as well as Physiognomy, which is the study of facial features. Cephalometry as applied in a comparative anatomy context informs biological anthropology.

The lateral cephalogram is a profile x-ray of the skull and soft tissues and is used to assess the relation of the teeth in the jaws, the relation of the jaws to the skull and the relation of the soft tissues to the teeth and jaws. In children, growth predictions can be made and we can also determine the changes that have occurred with treatment. In adults, treatment can be predicted with varying degrees of accuracy and results quantified.

The growth of each compartment of the craniofacial skeleton is integrated with the others, and coordinated growth is required for normal development to occur. Growth and function of the nasal cavities, the nasopharynx and the oropharynx are closely associated with the normal growth of the skull. Obstructions of the nasal passage cause a functional imbalance that would result in an oral breathing pattern.[1]

Lateral cephalometric films have severe limitations, such as distortion, difficulties in landmark identification, differences in magnification, and the superimposition of bilateral craniofacial structures. Computed tomography (CT) has the advantage of providing a better accuracy in identifying the boundaries of soft tissues and empty spaces and, therefore, helps in better airway visualization.[2]

Nasal obstruction secondary to hypertrophied inferior turbinates, adenoidal pad hypertrophy, and hypertrophy of the faucial tonsils can cause chronic mouth breathing, loud snoring, obstructive sleep apnea, excessive daytime sleepiness, and even corpulmonale. In this situation, a number of postural changes, such as open mandible posture, downward and forward positioning of the tongue, and extension of the head, can take place. If secondary postural changes continue for a long period, especially during the active growth stage, dentofacial disorders at different levels of severity can be seen, together with the inadequate lip structure, long face syndrome, and adenoidal facies.[3,4]

Skeletal Class II malocclusion is a dentofacial deformity caused by a growth disorder of the bones frequently associated with mandibular retrusion relative to upper facial structures.1 This deformity is also associated with functional disorders, mainly affecting upper airways and the temporomandibular joint.[5]

Associations of Class II malocclusions and vertical growth pattern with obstruction of the upper and lower pharyngeal airways and mouth breathing have been suggested. This implies that these malocclusion characteristics have a predisposing anatomical factor for these problems. Therefore, the purpose of this study was to compare upper and lower pharyngeal widths in patients with untreated Class I and Class II malocclusions and normal and vertical growth patterns.[6]

There is a significant association between the nasopharngeal airway space size and the morphology of the face, which also involves the mandible, because reduction of the nasopharyngeal airway space causes difficulties in nasal breathing, sometimes even making it impossible, and necessitates mouth breathing. Chronic mouth breathing restores the normal balance in the oral and paraoral structures; however, alteration of both structures is expected.[7,8,9]
Asper Balters' philosophy, Class II malocclusions are a consequence of the backward position of the tongue, which disturbs the cervical region. As a result of this positioning, the respiratory function is impeded in the region of larynx, as well as faulty deglutition and mouth breathing. [10]

The cause of Class III malocclusions is the more forward position of the tongue, in addition to the cervical overdevelopment. Some authors associated mouth breathing and Class II malocclusions, and others reported associations of vertical growth patterns with obstruction of the upper and lower pharyngeal airways concurrently with mouth breathing. If this relations actually exists, Class II malocclusions and vertical growth patterns must have natural anatomical predisposing factors.[11]

Obstructive sleep apnea, excessive daytime sleepiness, cor pulmonale, chronic mouth breathing and loud snoring are triggered by nasal obstruction secondary to hypertrophied inferior turbinate's, adenoidal pad hypertrophy, including hypertrophy of the facial tonsils. Consequently, there occur several changes in posture, including the posture of the open mandible, downward and forward positioning of the tongue and extension of the head. However, if these secondary postural changes prolong for long periods, notablyin the course of their active growth, on the basis of the level of severity, varying dentofacial disorders are reported, which are accompanied with inadequate lip structure, long face syndrome and adenoidal facies.[12,13,14]

Obstructive sleep apnea(OSA) is a common respiratory sleep disorder characterized by snoring and episodes of breathing cessation during sleep despite respiratory effort, which is rarely observed in young subjects. OSA involves an occlusion of the upper airway, which typically lies at the level of the oropharynx and less often at the nasopharynx orhypopharynx. A reduction in pharyngeal spaceis a clinical observation commonly reported in OSA patients; however, until now, the precise mechanism of upper airway occlusion remains sunder debate. Previous studies of OSA from different samples have shown an association between craniofacial skeletal morphology and upper airway dimensions in OSA patients. It has been reported that Class II malocclusions and vertical growth patterns are anatomic predisposing factors for the obstruction of the pharyngeal airways.[15,16,17] Further more, when compared to healthy patients with normal occlusions and growth patterns, or ClassI malocclusions, healthy patients with ClassII malocclusions and vertical growth patterns might have narrower airway passages.

Significant relationships between the pharyngeal structures and both dento-facial and craniofacial structures have been reported. Craniofacial anomalies such as mandibular or maxillary retrognathism, short mandibular body, and backward and downward rotation of the mandible might lead to reduction of the pharyngeal airway space. [18]

In addition, different anatomic features of the maxilla and mandible could change the position of the hyoid and soft palate and lead to decreased dimension of posterior airway space. Although a number of studies were performed to investigate the relationship between sagittal skeletal patterns and pharyngeal airway, the relationship between vertical growth patterns and pharyngeal airway using lateral cephalometric films an association between pharyngeal airway dimensions and both sagittal and vertical skeletal patterns was demonstrated.[19]

Patients with skeletal Class II malocclusion who have this deformity due to deficiency in mandibular growth present with a retrognathic mandible either because of growth vector or by deficient mandibular length.

According to Muto et al, craniofacial abnormalities, including mandibular retrognathism, short mandibular body length and backward/downward rotation, can lead to decreased pharyngeal airway. These findings indicate that nasopharyngeal obstruction may be related to changes in mandibular morphology.

The study of upper airways and their relationship with mandibular position and size is extremely important in orthodontic diagnosis because of their association with obstructive respiratory disorders, especially sleep apnea. This knowledge is definitive to the indication of mandibular advancement, whether orthopaedic or surgical, for treatment of these disorders.

There are various predisposing factors reported in the literature for obstruction of pharyngeal airways such as allergies, environmental irritants and infections. According to the Balters philosophy, 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. Alveset al. refuted a significant relationship between airway obstruction and frequency of malocclusion. Other reported association of vertical growth patterns with obstruction pharyngeal airways concomitantly with mouth breathing. However, several authors found that there is natural predisposition of narrower airway passages. As there is close association between pharynx and dentofacial structures, a mutual interaction is expected to occur between pharyngeal structures and the various dentofacial patterns, thus justifying orthodontic treatment.[20]

The aim of this study was to compare upper and lower pharyngeal widths in subject with skeletal class-I and classII malocclusion with different craniofacial pattern.

Materials and method:

This cross-sectional analytical study was conducted using data from pre-treatment lateral cephalographs of patients which were above the age group of 18 years from saveetha Dental College and Data was collected using non probability purposive sampling technique.

The sample comprised 100 subjects divided into 2 groups: 50 Class I and 50 Class II. The upper and lower pharyngeal airways were assessed according to McNamara's airways analysis.

McNamara’s analysis:

The McNamara analysis relates several variables: teeth to teeth; teeth to jaws; each jaw to the other; and jaws to the cranial base. The analysis is a combination of elements of the Ricketts and Harvold approaches, using original measurements to create a more precise definition of jaw and tooth positions. According to this method, the anatomic Frankfort plane as well as the basion-nasion line are used as reference planes.

There are three main advantages of the McNamara analysis. Firstly it depends largely on linear measurements rather than angles. It analyzes the interarch relationship in the vertical plane as well as sagittal making them into one single integrated unit. Lastly, it helps to diagnose external conditions in the airway.

The upper pharyngeal width is the smallest distance from the posterior pharyngeal wall to anterior half of the small plate outline. The normal for an adult is 17 +/- 4. The measurement marked with a decrease is only used as an indicator for possible upper airway impairment. For a more accurate diagnosis you’ll have to see a clinical otorhinolaryngologist for a clinical exam.

The lower pharyngeal width is measured on the mandibular plane from the posterior tongue to posterior pharyngeal wall. The norm for an adult women is 11.3 +/- 4, while the norm for an adult male is 13.5 +/- 4. Values that are less than 15 millimetres suggest that the anterior positioning of the tongue is either postural or there’s an enlargement of the tonsils. [5,6]

Results:

Chart 1: upper and lower airway difference in class 1 patients

It reveals the airway difference in class I patients which was found to be normal with upper airway 1.7 cm and lower airway 1.3 cm.

Chart 2: upper and lower airway difference in class II patients

It reveals the airway difference in class II patients which has been found to be with in the normal limit . For upper airway it was 1.5 cm and 1.1 cm.

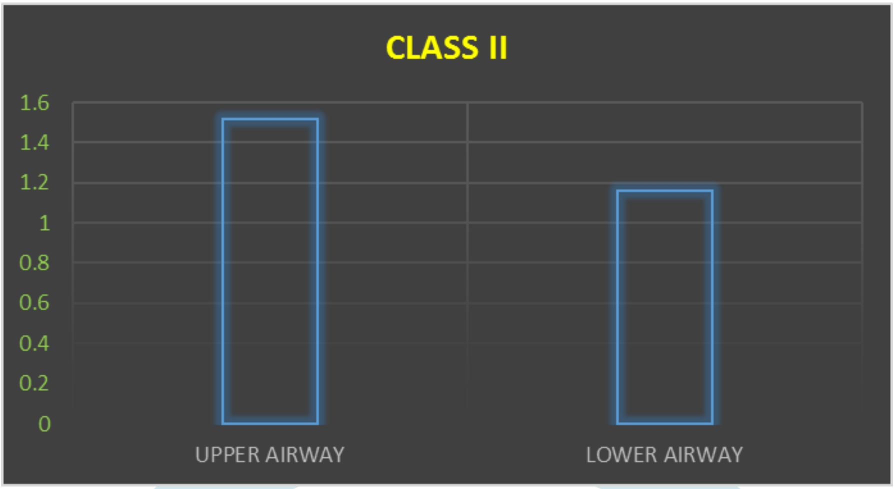
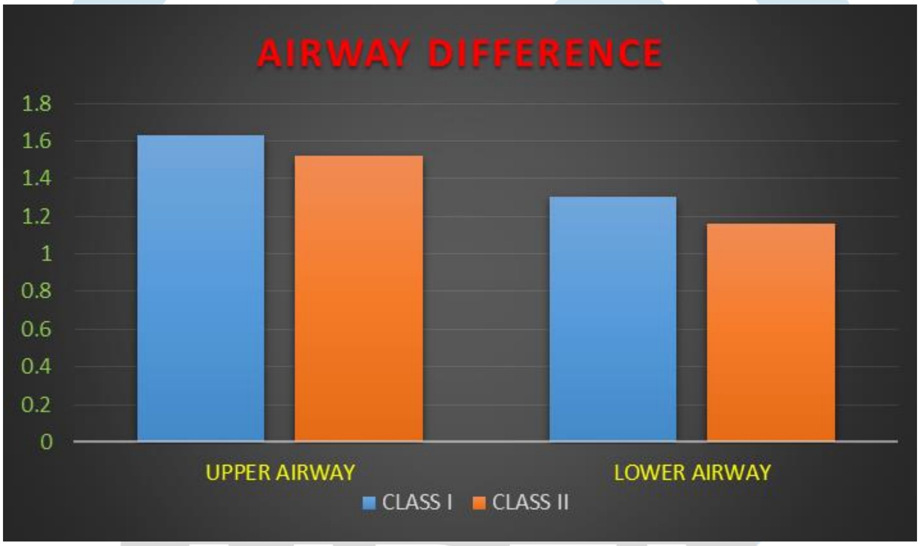


Chart 3: comparison between class I and class II patients

It reveals there was no major significant difference in the normal limit but comparatively there was a mild difference in between class I and class II Patients.



Discussion:

Abnormal development of the upper airway is related to airway constriction, and the relationship relevance between reduced respiratory function and craniofacial growth has long been of interest to orthodontists. A number of researchers during last 50 years used variety of radiographs to study the association between the obstruction of upper and lower pharyngeal airways with mouth breathing. The present study used lateral head cephalometric films for pharyngeal airway width measurement, according to the findings of Cameron et al.[1,2,3,4,5]

They concluded that the subjects with upper airway obstruction displayed excessive vertical dentofacial development, leading to a long face appearance. They suggested that this condition needs to be prevented by early recognition and treatment of the causative factor. Batool et al. compared the widths of the upper and lower pharyngeal airways in Class II malocclusion patients with low and high vertical growth patterns.[6,7,8]

Analyzing these results, we can infer that upper airway width is influenced by the craniofacial growth pattern, as previously suggested. However, some studies found weak relationships between growth pattern, facial morphology, and nasopharyngeal airway.[9]

There is a significant association between the nasopharngeal airway space size and the morphology of the face, which also involves the mandible, because reduction of the nasopharyngeal airway space causes difficulties in nasal breathing, sometimes even making it impossible, and necessitates mouth breathing. Chronic mouth breathing restores the normal balance in the oral and paraoral structures however, alteration of both structures is expected.[10,11,12]

The relationship between airway patency and craniofacial development is highly controversial not only having academic implications but also having considerable clinical consequences. It can influence the orthodontist's decision on diagnosis and treatment planning.[13]

Our study was carried out considering that several others have assessed the association between facial growth pattern and upper airways measurements. When comparing Class I and Class II groups, FMA and facial axis indicated an increased vertical trend among Class II individuals as well as a shorter mandibular ramus. According to Jarabak, this finding refers to mandibular morphology with a clockwise growth pattern. This same feature was reported in the study by Joseph et al who used a sample of individuals with Class II malocclusion. This information does not allow us to claim that all mandibular Class II individuals will have a vertical growth trend, although such feature was found in the sample. However, there seem to be an association between vertical pattern and reduced airways measurements, which has already been reported by several studies.[14]

No statistically significant difference in lower pharyngeal airways between groups was found, showing no association of lower pharyngeal airway space with craniofacial growth pattern and malocclusion type. This corroborates previous studies.

Comparison between class I and class II patients it reveals there was no major significant difference in the normal limit but comparatively there was a mild difference in between class I and class II Patients.
When there is high degree of difference in the airway noted then it can be corrected according to the age of the patient. When the growth phase has not yet completed can be corrected through fixed appliance therapy and when patient has completed the growth phase it can be corrected through surgical corrections and later followed by fixed appliance therapy.

Conclusions:

Patients with Class I and Class II malocclusions have significantly normal airway.

But when compared to pharyngeal airways among Class I and Class II malocclusions there was mild difference between upper and lower airways among the group of study population.

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