Original Article

Association between Tongue Posture, Upper Airway and Maxillary Dent alveolar Morphology in Adults with Skeletal Class II Malocclusion: A Case Control Study

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ABSTRACT

Keywords: Tongue posture, upper airway, dentoalveolar morphology, skeletal class II malocclusion.

Purpose: The present study aims to assess the environmental effects that tongue posture, upper airway and maxillary dentoalveolar morphology have with respect to their association in skeletal Class II malocclusion cases.

Materials and methods: Pre treatment lateral cephalograms and study models of 32 adult skeletal Class II malocclusion orthodontic patients were selected randomly. Tongue posture measured as tongue to palate distance along 7 different lines and 3 linear upper airway parameters were determined cephalometrically. For maxillary dentoalveolar morphology, Inter canine width (ICW) and Intermolar width (IMW) was determined on study models. Pre treatment lateral cephalogram and study models of equal number of age matched skeletally Class I malocclusion patients were included as controls in this study.

Results: The mean measurement for tongue posture along 5 of the 7 reference lines are significantly higher in controls compared to the cases (P-value<0.01). The mean upper airway parameters are significantly higher in controls compared to the cases (P-value<0.05). The distribution of maxillary dentoalveolar morphology did not differ significantly between cases and controls (P-value>0.05 for both).

Conclusion: A definitive pre treatment, mid treatment and post treatment assessment of tongue posture and upper airway on a lateral cephaogram and dentoalveolar morphology on study models is important in management of adult skeletal Class II malocclusion cases.

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INTRODUCTION

Literature Influence on the growth and development of maxilla and mandible is either by genetic and/or environmental factors. Currently accepted hypothesis are that genes and gene products regulate craniofacial morphogenesis. These gene products provide factors that may affect the receptivity and responsiveness of cells to intrinsic and extrinsic stimuli1. Certain craniofacial features are known to have increased predilection for airway collapsibility some of which include mandibular retrognathism, long face syndrome, high arch palate, transverse maxillary deficiency and superiorly & posteriorly postured tongue2. Although it has been shown that a close form and function relationship exists, the degree of interplay is still a matter of debate. Mandible is considered as one of the primary craniofacial bone structure that helps in determination of the size of airway3. However, relationship between sagittal mandibular position, tongue posture, upper airway and dentoalveolar morphology is yet to be understood completely.

AIM

The present study aims to assess the environmental effects that tongue posture, upper airway and maxillary dentoalveolar morphology have with respect to their association in skeletal Class II malocclusion cases.

OBJECTIVES

The specific objectives of present study were to evaluate the association of tongue posture (measured as the tongue-to-palate distance), and upper airway parameters (measured as Velopharyngeal Airway Space (VAS), Posterior Airway Space (PAS) and Hypopharyngeal Airway Space (HAS)) with the maxillary dental morphology (measured by inter canine and inter molar widths) in a group of skeletal Class II malocclusion subjects in comparison to a group of Class I malocclusion (normal) subjects.

MATERIALS AND METHODS

From the archival records of our dental centre, pre treatment lateral cephalograms and study models of 32 adult orthodontic patients who fulfilled the inclusion criteria were randomly selected. In addition to having a skeletal Class II malocclusion as depicted by ANB angle of more than or equal to 40 and Wits measurement of more than or equal to +3mm, cases were also required to be skeletally mature which was determined by CVMI stage VI. Study models with complete permanent dentition and no missing or supernumerary teeth were included. A control group of same size was randomly selected among the age matched skeletal Class I malocclusion cases as determined by ANB angle of 20 and Wits measurement of +1 + 1mm from the same pool of records. Skeletally mature subjects as evaluated by the CVMI method (those in stage VI) were only included in the study so that the growth in these subjects had been attained in all the three planes of space.

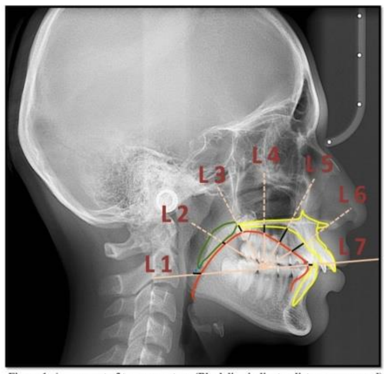

Figure 1: Assessment of tongue posture (Black line indicates distance measured)

Tongue Posture	Cases [Class II Malocclusion]		Controls [Class I Malocclusion]		P-value
Length of Line (measured in mm)	**Mean**	**SD**	**Mean**	**SD**	
L1	3.75	1.77	5.44	2.66	0.037*
L2	4.13	2.16	6.31	2.53	0.008**
L3	5.25	2.59	7.25	2.65	0.018*
L4	4.13	2.98	7.38	2.53	0.001***
L5	4.06	2.72	6.81	2.64	0.007**
L6	4.38	1.75	4.88	2.31	0.495^{NS}
L7	2.63	1.99	2.69	1.49	0.921^{NS}

Table 1: Inter-group comparison of Tongue Posture parameters studied as Length of Lines L1 to L7 as measured in mm (n = 32).

Assessment of Tongue Posture : Pre-treatment lateral cephalograms of all subjects were obtained using the same X-ray machine. Cephalograms were recorded in NHP at end expiration using a standard protocol of our center. Tongue posture was assessed on the lateral cephalograms using the method described by Rakosi4 wherein inferior border of hard palate and entire soft palate outline was traced, followed by tracing of outline of dorsum of tongue. A template with an inscribed millimeter scale was used to assess the tongue position relative to the palate. The template was superimposed on the lateral cephalogram with its horizontal line through the incisal edge of the lower central incisor, the cervical distal third of the last erupted molar, and the most inferior point of the soft palate or its projection on the reference line between the lower incisor and the distal point of the molar. Contours of dorsum of the tongue and bony palate were marked and distances from point zero were measured at six different angles (300, 600, 900, 1200, 1500 & 1800). Distance between dorsum of tongue and soft/ hard palate on respective lines was determined. Seven distances for each subject were recorded (L1 to L7) (Fig.1).

Figure 1 : Assessment of tongue posture (Black lines indicate distances measured)

Assessment of upper airway parameters: Linear distance in mm was measured across upper airway positions on the lateral cephalogram as per the method described by Yao5. The three positions where linear distances measured were: a. VAS: A horizontal distance from the tip of the soft palate to pharyngeal wall, b. PAS : Horizontal distance from the posterior margin of the tongue to pharyngeal wall measured on the Gonion to Point B line & c. HAS : Horizontal distance in the hypopharyngeal area, measured from vallecula to posterior pharyngeal wall (Fig.2).

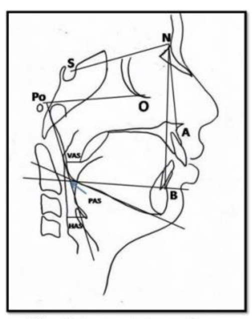

Figure 2: Assessment of upper airway

Figure 2 : Assessment of upper airway

Maxillary dentoalveolar morphology: Transverse maxillary width across the anterior and posterior regions was measured as intercanine with (ICW) & intermolar width (IMW) and was determined using a digital Vernier caliper (0-150mm, Dentaurum, Germany).

RESULTS

Data was statistically analysed using Statistical Package for Social Sciences (SPSS ver 21; IBM Corp; Armonk NY) for MS Windows. As the study involved statistical determination of association between various tongue postures, upper airway and dentoalveolar morphological parameters in relation to either cases or controls hence independent't' test was done across all the sub groups. All the hypotheses were formulated using two tailed alternatives against each null hypothesis (hypothesis of no difference) to either establish or rule out any association between various parameters amongst cases and controls. P-values less than 0.05 were considered to be statistically significant.

Values are Mean and standard deviation (SD). P-value by independent sample t test. P-value <0.05 is considered to be statistically significant. *P-value<0.05, **P-value<0.01, ***P-value<0.001, NS: Statistically Non-Significant.

The mean VAS and PAS is significantly higher in controls compared to the cases (P-value<0.05 for both). However, distribution of mean HAS did not differ significantly between cases and controls (P-value>0.05 for all). This depicts a narrower upper airway in Class II malocclusion cases.

Values are Mean and standard deviation (SD). P-value by independent sample t test. P-value <0.05 is considered to be statistically significant. *P-value<0.05, **P-value<0.01, ***P-value<0.001, NS: Statistically Non-Significant.

Airway Parameters	Cases [Class II Malocclusion]		Controls [Class I Malocclusion]		P-value (Cases v Controls)
(measured in mm)	Mean	SD	Mean	SD	
VAS	8.06	0.99	9.13	1.45	0.022*
PAS	9.25	1.34	11.19	2.00	0.003**
HAS	14.75	2.38	15.25	3.07	0.610NS

Table 2: The inter-group comparison of Airway parameters studied (n = 32).

Dental Morphology Parameters	Cases [Class II Malocclusion] (n=16)		Controls [Class I Malocclusion] (n=16)		P-value (Cases v Controls)
(measured in mm)	Mean	SD	Mean	SD	
Inter Canine Width	28.25	3.53	27.81	4.04	0.746NS
Inter Molar Width	37.50	3.59	38.19	4.05	0.616NS

Table 3: The inter-group comparison of dentoalveolar morphology studied (n = 32).

The distribution of mean inter canine width and inter molar width did not differ significantly between Cases and Controls (P-value>0.05 for both) thus lack of association between them and Skeletal pattern of either Class I or Class II malocclusion.

DISCUSSION

Tongue is the most adaptable organ in the body. It is a mobile part consisting of various muscle spindles which culminate into a free end. On account of its location in the oral cavity, various entities surrounding it such as teeth, soft and hard palate, upper airway and floor of the mouth come into a continuous interplay with the tongue. Orthodontists have long known that in growth and development of the craniofacial region, there exists a relationship between tongue, upper airway and dentoalveolar morphology. Associations between various dental malocclusions and tongue position have also been described in abundance in the literature. Previous studies report contrasting associations between tongue size6-9 or posture10,11 and the characteristics of the maxillary and mandibular dental arches. These studies have measured the transverse and linear measurements, mainly between the teeth. It is noteworthy that most of these studies have focused on the sagittal dental relationship (Angle's Classification) for classification of malocclusion. But, it is also very important to identify the skeletal jaw relationships that lie underneath dental malocclusion relationship which could themselves be a cause of this malocclusion. Hence, present study was conducted to specifically evaluate the association of tongue posture, upper airway and maxillary dentoalveolar morphology with respect to adults with skeletal Class II malocclusion.

A significant finding of the present study was that posteriorly and mid segmentally superior tongue posture was seen in the Class II cases as compared to the Class I controls. According to the method described by Rakosi and used herein, most of the differences in terms of tongue-to-palate distance were seen at the posterior region (measurement along lines 1–5), while no significant differences were seen at the anterior region (measurement along lines 6 and 7). This can be attributed to the reduced space available for adaptation of tongue due to retrognathic mandible which further leads to accentuation of curvature of dorsum of tongue. These results are also in consonance with the study of Moss12 who also mentions the necessity of equilibrium in tongue and other surrounding soft tissues to achieve a harmonious growth and development of hard tissues of dental arches.

The upper airway parameters are also significantly reduced in case of Class II subjects as compared to the controls. To quantify the changes more precisely, upper airway has been evaluated in three positions (VAS, PAS & HAS). On further subdividing upper airway into upper 2/3rd and lower 1/3rd, it becomes apparent that significant reduction in upper 2/3rd of entire upper airway is seen in Class II malocclusion, however there no difference in lower1/3rd portion of upper airway. These findings are in correlation with the previous studies on the subject13, 14. Kirjavainen M15 and coworkers found out narrower upper dimensions exist even in cases where dental Class II malocclusion exists even without mandibular retrognathism. In light of the fact that upper airway is assuming importance in present day orthodontics, the finding of present study may be utilized as a guideline for easy assessment of upper airway on a lateral cephalogram and considering the association of reduction in upper airway parameters and skeletal Class II malocclusion as lateral cephalogram still forms a part of pre requisite for any orthodontic pre treatment records.

Meta analysis16 on intra arch widths does not show any remarkable associations between maxillary inter canine and inter molar widths with respect to dental Class I or Class II malocclusion. With regards to the present study also the transverse width of dental arches depicting dentoalveolar morphology in anterior and posterior maxillary arch does not appear to be influenced in skeletal Class II subjects. In his landmark article, J A McNamara17 has suggested mandibular skeletal retrusion rather than maxillary skeletal protrusion as being the single most common characteristic feature associated with Class II malocclusion. Observed similarities between two classes of skeletal malocclusion that were seen for maxillary dentoalveolar morphology are thus possible due to the probability that more number of Class II subjects with a retrognathic mandible rather than a prognathic maxilla were included in the present study. However, the lack of difference in the maxillary ICW and IMW could also be a consequence of dental compensation in both dental arches that occurs as a result of skeletal discrepancy. Therefore, dental compensation for skeletal disharmonies in Class II subjects need to be further evaluated separately for better understanding.

Therefore, as a clinical implication, not only is the assessment of tongue posture and upper airway important on pre treatment lateral cephalograms but also their monitoring during mid treatment and post treatment stages, particularly in skeletal Class II malocclusion patients is of utmost importance. Also, comprehensive treatment for Class II skeletal malocclusion should include the correction of improper tongue posture if required order to enhance upper airway and thereby increase the treatment efficiency.

CONCLUSIONS

The present study has shown that: 1. Tongue posture is significantly higher in adults with skeletal Class II malocclusion as compared to Class I patients and the difference is mainly present in the posterior and mid segmental regions, 2. Tongue posture is associated with the upper airway parameters and these parameters are reduced in cases adult skeletal Class II malocclusion, 3. There is no correlation between maxillary dentoalveolar morphology and adults with Skeletal Class II malocclusion, which could be mainly due to the dental compensations that take place to compensate for underlying skeletal discrepancies.

A definitive pre treatment, mid treatment and post treatment assessment of tongue posture and upper airway on a lateral cephaogram and dentoalveolar morphology on study models assumes paramount importance in management of adult skeletal Class II malocclusion cases.

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