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A comparative analysis of upper airway space with lateral cephalogram and cone beam computed tomography in north Gujarat population

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***Abstract*---**Objective: The Aim and objective of this study is to evaluate the accuracy of upper airway measurement using with lateral cephalogram, CBCT lateral reconstruction and CBCT axial planes as well as to correlates these finding with area measurements acquired with the latter imaging methods. Methods: In this study, 44 subject (22 males & 22 females) included from north Gujarat adults. Landmark were defined for measurement of naso and Oropharynx, for different planes, using linear antero-posterior measurement and the corresponding area. Result: Analysis of variance shows linear measurement in nasopharynx and oropharynx area wise distribution

and Inter Group Wise Distribution in Nasopharynx, all three group have significant different value. In inter Group Wise Distribution in Oropharynx, there is statistically no significant difference between Lateral Reconstruction Group and Lateral Cephalogram Manual Tracing Group. Statistically, no significant difference between Lateral Reconstruction Group and Axial Slice Group & also Statistically, no significant difference between Lateral Cephalogram Manual Tracing Group and Axial Slice Group. Conclusion: The linear measurements of the airway space obtained using the different techniques correlated positively with the respective area measurements, which demonstrate the reliability of the investigated techniques.

Keywords---upper airway, CBCT, lateral cephalogram, orthodontics.

Introduction

Evaluation and Assessment of Upper airway and its interaction with craniofacial development and growth has been the subject of interest in several medical field such as otolaryngology, speech pathology, paediatrics, Orthodontics and general dentistry .[1] The upper airway is a complex structure which involves bone, cartilage, and soft tissues adapted to functions related to respiration, deglutition, and phonation.[2] Individual variations in airway morphology are commonly found because of its inheritance and functional disorders.[1] Airway obstruction often alters normal breathing , which has a significant impact on the development of craniofacial structures .The impact of the mode of breathing and head posture on the facial growth pattern was described in the 'soft-tissue stretching hypothesis' by Solow and Kreiborg [3] who claimed that a change in jaw posture caused by mouth breathing could lead to stretching of the lips, cheeks, and musculature resulting in upright incisors and narrower dental arches, as observed in patients with long face and open bite growth pattern.[2]Alteration in upper airway are occasionally found at the beginning of orthodontic treatment, after cephalometric evaluation.[1] Faruk Izzet Ucar and Tancan Uysal did study on airway dimension of upper airway in class I malocclusion with different growth pattern. And They conclude there is significant different were identified in most of craniofacial measurements among Class I subjects with three different vertical growth patterns.[4]

There are many cause to obstruct airway i.e Nasal polyp , viral or bacterial infection , backwardly placed lower jaw etc. So any airway disorder must be identified, diagnosed, and, if possible, treated. There are several methods have been proposed in order to assess the airway, including cephalometry, rhinoendoscopy, and tomography. Cephalometric Images are the two-dimensional representation of three-dimensional structures so it provides limited diagnostic information.Cone- beam computed tomography (CBCT) was developed with the purpose of providing a 3D superior imaging modality in dentomaxillofacial diagnosis.van Vlijmen et al.[5], in their systematic review, concluded that the use of CBCT represents a more valuable diagnostic tool in studying upper airway when compared to conventional plane radiography. The purpose of this study was to evaluate the accuracy of airway measurements from lateral cephalograms, CBCT

lateral reconstructions, and CBCT axial planes, as well as to correlate these findings with area measurements acquired with thelatter imaging method.

Material and Method

For this study, 44 patients (22 males and 22 females) obtained from North Gujarat Adults , that included both a conventional cephalogram and a CBCT scan acquired using the same protocol, were analysed. All patients signed an informed consent and the research project had previously been approved by the Sankalchand patel Univercity, Visnagar Gujarat.

Cone-beam computed tomography analysis

CBCT scans will be performed using i-CAT 3D Digital imagine system (Oroscan , Ahmedabad) with an FOV(Field of view) 13x16cm, 20 Seconds, 0.25 voxel, 120 KVA, 13.7 mAs. For Analysis, data will be transferred in i-CAT 3D Imaging software .This study is designed to compare accuracy of CBCT amd Lateral cephalogram of upper airway space in North Gujarat population according to McNamara upper airway space analysis. For this purpose, 44 (22 males & 22 females) lateral cephalograms and conebeam computed tomography images will be collected from North Gujarat Adults and upper airway space (nasopharynx and oropharynx) will be calculated. The following pre-established airway measurements will be marked on the sagittal plane:

- Nasopharynx : The most posterior point at the height of the posterior nasal spine , from which a line was traced parallel to the floor extending to the posterior wall of the pharynx.
- Oropharynx : A point at which the tongue image crossed the lower border of the mandible , from which a line parallel to the floor extended to the posterior wall of pharynx.

Cephalometric analysis

44 (22 males & 22 females) lateral cephalograms are taken and manual tracing will be done of upper airway according to McNamara analysis. Table 1. Adopted criteria for sample selection

Exclusion criteria

- A Past history of orthodontic treatment, orthognathic surgery, and prosthetic
- treatment of more than 3-unit bridges.
- Subjects with more than two missing teeth will be also exclude.
- Patient having class-2 and class-3 malocclusion.

Statistical Analysis

The results were tabulated in Microsoft excel.The Level of Significant was ≤ 0.05 .
Test Used: One Way ANOVA, Post Hoc Tukey,
Pearson CorrelationSPSS Version 20.0

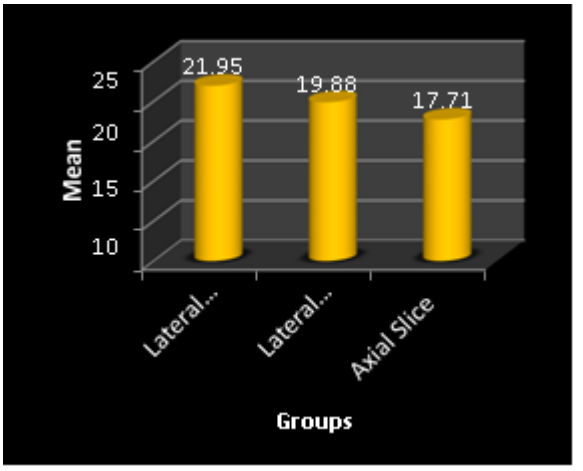
Result

Table II
Nasopharynx Wise Distribution

Groups	Mean	SD	P Value
Lateral Reconstruction	21.95	3.47	≤ 0.05 *
Lateral Cephalogram Manual Tracing	19.88	3.28	
Axial Slice	17.71	3.31	

Level of Significance P ≤ 0.05, * Significant Result
** Non Significant Result

Mean value was high in Lateral Reconstruction Group (21.95 ± 3.47) followed by Lateral Cephalogram Manual Tracing Group (19.88 ± 3.28) and Axial Slice Group (17.71 ± 3.31) respectively. Statistically, significant difference was observed among all the groups in nasopharynx.



Graph 1. Nasopharynx Wise Distribution

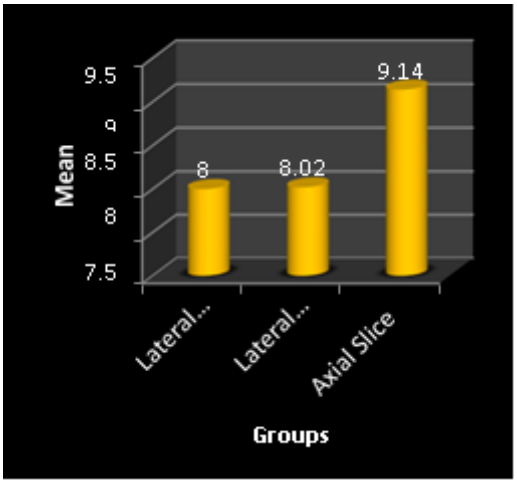
Table III
Inter Group Wise Distribution in Nasopharynx

Groups		P Value
Lateral Reconstruction	Lateral Cephalogram Manual Tracing	≤ 0.05*
	Axial Slice	≤ 0.05 *
Lateral		

Cephalogram Manual Tracing	Axial Slice	≤ 0.05 *

Level of Significance P ≤ 0.05, * Significant Result,
** Non Significant Result

- Statistically, significant difference was observed between Lateral Reconstruction Group and Lateral Cephalogram Manual Tracing Group.
- Statistically, significant difference was observed between Lateral Reconstruction Group and Axial Slice Group.
- Statistically, significant difference was observed between Lateral Cephalogram Manual Tracing Group and Axial Slice Group.



Graph 2. Oropharynx Wise Distribution

Table IV
Pearson Correlation wise Distribution in Nasopharynx

Groups		Correlation Value	P-Value
Lateral Reconstruction	Lateral Cephalogram Manual Tracing	0.903	≤ 0.05 *
	Axial Slice	0.638	≤ 0.05 *
Lateral Cephalogram Manual Tracing	Axial Slice	0.611	≤ 0.05 *

Level of Significance P ≤ 0.05, * Significant Result,

** Non Significant Result

- Statistically, significant positive correlation was present between Lateral Reconstruction Group and Lateral Cephalogram Manual Tracing Group.
- Statistically, significant positive correlation was present between Lateral Reconstruction Group and Axial Slice Group.
- Statistically, significant positive correlation was present between Lateral
- Cephalogram Manual Tracing Group and Axial Slice Group.

Table V
Oropharynx Wise Distribution

Groups	Mean	SD	P Value
Lateral Reconstruction	8.00	2.69	≤ 0.05 *
Lateral Cephalogram Manual Tracing	8.02	2.06	
Axial Slice	9.14	3.76	

Level of Significance P ≤ 0.05, * Significant Result,
** Non Significant Result

Mean value was high in Axial Slice Group (9.14 ± 3.76) followed by Lateral Cephalogram Manual Tracing Group (8.02 ± 2.06) and Lateral Reconstruction Group (8.00 ± 2.69) respectively. Statistically, significant difference was observed among all the groups in Oropharynx.

Table VI
Inter Group Wise Distribution in Oropharynx

Groups		P Value
Lateral Reconstruction	Lateral Cephalogram Manual Tracing	> 0.05 **
	Axial Slice	> 0.05 **
Lateral Cephalogram Manual Tracing	Axial Slice	> 0.05 **

Level of Significance P ≤ 0.05, * Significant Result,
** Non Significant Result

- Statistically, no significant difference was observed between Lateral Reconstruction Group and Lateral Cephalogram Manual Tracing Group.

- Statistically, no significant difference was observed between Lateral Reconstruction Group and Axial Slice Group.
- Statistically, no significant difference was observed between Lateral Cephalogram Manual Tracing Group and Axial Slice Group.

Pearson Correlation wise Distribution in Oropharynx

Groups		Correlation Value	P-Value
Lateral Reconstruction	Lateral Cephalogram Manual Tracing	0.841	≤ 0.05 *
	Axial Slice	0.390	≤ 0.05 *
Lateral Cephalogram Manual Tracing	Axial Slice	0.460	≤ 0.05 *

Level of Significance P ≤ 0.05, * Significant Result,
** Non Significant Result

- Statistically, significant positive correlation was present between Lateral Reconstruction Group and Lateral Cephalogram Manual Tracing Group.
- Statistically, significant positive correlation was present between Lateral Reconstruction Group and Axial Slice Group.
- Statistically, significant positive correlation was present between Lateral Cephalogram Manual Tracing Group and Axial Slice Group.

Discussion

The initial purpose of the study was to evaluate the accuracy of upper airway measurement using with lateral cephalogram , CBCT lateral reconstruction and CBCT axial planes CBCT axial images allow obtainment of these measurements without the interference of neighbouring soft tissues. On the other hand, with sagittal plane images, both CBCT reconstructions and lateral cephalograms, interference might result due to superimposition of the structures, particularly on the nasopharynx, where hypertrophic tissues are commonly observed. The results showed that the linear measurement in nasopharynx (Table No II)and oropharynx (Table no V) area wise distribution and Inter Group Wise Distribution in Nasopharynx (Table no III) , all three group have significant different value. In inter Group Wise Distribution in Oropharynx, (Table No VI) there is statistically no significant difference between Lateral Reconstruction Group and Lateral Cephalogram Manual Tracing Group. Statistically, no significant difference between Lateral Reconstruction Group and Axial Slice Group & also Statistically,

no significant difference between Lateral Cephalogram Manual Tracing Group and Axial Slice Group.

Moshiri et al. (2007)[6] assessed the accuracy of a number of cephalometric measurements using dry human skulls, comparing different CBCT. The main objective of this research was to compare airway space on different orientation planes and the performance of conventional radiographs (a classic imaging method chosen by orthodontists for cephalometric analysis) with CBCT, which provide a three-dimensional visualization. Several studies have proposed an array of measuring methods concerning airway assessment in different groups of patients (Filho et al., 2001;[6] ; Lagravere and Major, 2005 [7]; Moshiri et al., 2007 [9]; Ogawa et al., 2007 [10], Vizzotto et al 2011 [1]). However, landmark identification and measurement execution is still affected by considerable subjectivity.

In this Present study, the reference points used to trace linear measurements were the palatal plane extension to the nasopharynx and the lower border of the mandibular intersection with the posterior border of the tongue extending to the oropharynx, both with the palatal plane parallel to the floor. These measurements were chosen so that standardization of easily identifiable points on planes could be achieved, allowing reproducibility of measurements. reconstructions with lateral cephalograms. Their conclusions suggest that measurements of twodimensional reconstructions are nearly the actual values. For radiographs, though, those that diverged had a magnification range of 4.6–9.1 per cent. Kumar et al. (2008)[11] compared cephalometric angles and linear measurements of conventional and magnified CBCT images with radiographic images and concluded that linear measurements were not significantly different.

As regards the evaluation of the antero-posterior linear measurement and its respective area, it was possible to establish a positive correlation for all radiographic types of examination of both the naso- and oropharynx. This revealed that increases or decreases in linear measurements indicate an airway alteration at the corresponding area. Filho et al. (2001), in a study of two auxiliary diagnostic methods of nasopharynx airway obstruction, endoscopy and radiography, found a high sensitivity and a low specificity of the radiographic diagnosis when compared with endoscopic diagnosis. Ogawa et al. (2007)[10] used CBCT volumetric images in order to evaluate patients diagnosed with obstructive apnoea, compared with control subjects. Airway measurements on axial slices showed a significantly decreased airway volume, area, and distances in subjects with apnoea.

The conclusions reached by those authors indicate the importance of CBCT in the diagnosis of this condition. Since clinicians generally consider lateral radiographs as a reliable instrument for cephalometric analysis and upper airway evaluation, this study was designed to estimate the possibility that airway constrictions occasionally represented on sagittal images of laterally positioned hypertrophic tissues are not correlated in axial visualizations. Nevertheless, in spite of the difference found between the radiographs and the corresponding axial cut in the oropharynx, the results demonstrate a correlation between linear and area measurements, independent of the type of method used. This reliability of cephalometric analysis in terms of upper airway evaluation, both with

radiographic and CBCT images, may serve as a guide during the different stages of orthodontic treatment, and when appropriate may promote patient referral to the appropriate medical specialist.

Conclusion

In this study , we did comparison of three group. lateral cephalogram by manual method (2) lateral Cephalogram reconstruction (CBCT) (3) axial slice (CBCT) Linear measure was done in nasopharynx and oropharynx area. The results shows that linear measurement in nasopharynx and oropharynx area wise distribution and Inter Group Wise Distribution in Nasopharynx , all three group have significant different value so that we cannot rely on particular method but there is positive correlation. In inter Group Wise Distribution in Oropharynx, there is statistically no significant difference between Lateral Reconstruction Group and Lateral Cephalogram Manual Tracing Group. Statistically, no significant difference between Lateral Reconstruction Group and Axial Slice Group & also Statistically, no significant difference between Lateral Cephalogram Manual Tracing Group and Axial Slice Group so we can rely any one method for airway measurement.

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