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Lateral Cephalogram for Analysis of Obstructive Airway Using Simple Mathematics

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ABSTRACT:
BACKGROUND: Lateral cephalogram is a 2 Dimensional radiograph taken of the side of the face including all head and neck structures with the soft tissue profile.This particular radiograph gives the extent of pharyngeal airway which can be divided into three parts namely the nasopharynx, oropharynx and laryngopharynx. The nasopharynx however is known to be the most affected in cases of difficulty in breathing caused by its narrowing.
This narrowing maybe caused due to various factors but in this study we center our investigation to cases with malocclusion which will further lead to jaw repositioning and possible obstructive sleep apnea.
AIM: The objective of the study is to help assess obstructed airway using lateral cephalogram which is a 2 Dimensional image, thus leading to jaw repositioning.
METHODOLOGY: The surface area analysis on the lateral cephalogram from 60 patients between the ages of 10 to 20 and 20 to 40 is taken who are going to take orthodontic treatment. Through this compiled data we then compare it to the existing values of surface area of the pharyngeal airway that is normal on a lateral cephalogram hence analytically reinforcing the possible usage of this simple radiograph for assessment of obstructive sleep apnea caused by restricted pharyngeal airway.
RESULT: The result from the statistical analysis gives sufficient proof as there being a significant correlation between area obtained through the analysis of the nasopharyngeal airway space through mathematical formulas.
CONCLUSION: The lateral cephalogram can be used as a efficient tool to determine the airway space and any position reduction in this space through simple mathematics.

I. INTRODUCTION

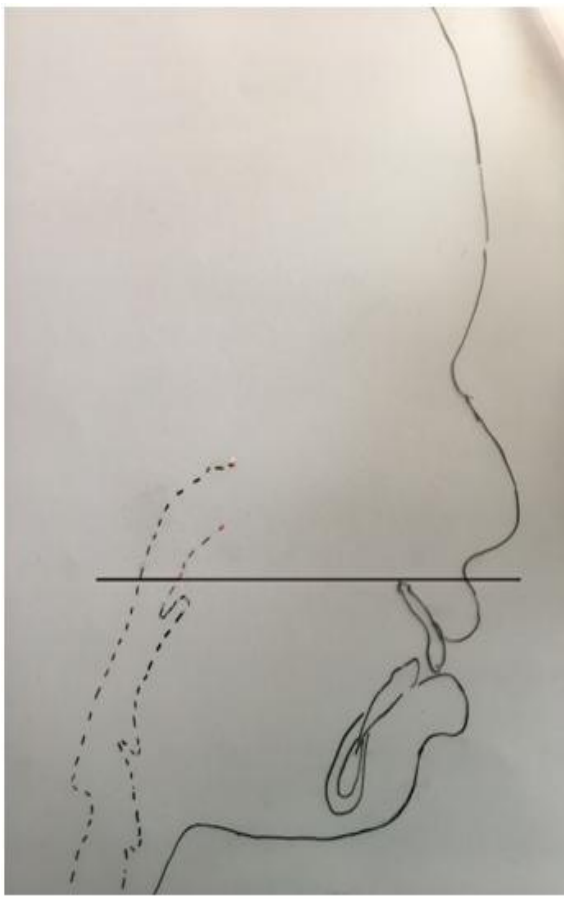
The time tested discussions on a link between craniofacial disturbances and the respiratory disorders has finally been put to rest with the knowledge of definite co-relation with many evidences [1] but to derive this particular relation has been difficult in most cases with serious evidence to backup the topic.However we often stumble upon certain common diagnostic aids which we do not include for such assessment as basic such a lateral cephalograms.[2]

Lateral Cephalogram is a 2 Dimensional Radiograph of the side of the face.It gives precise relations of the jaws -maxilla and mandible ,the profile of the face and also extends upto the neck region giving the relation of the various head and neck structures to one another.It is mainly used in the orthodontic field of dentistry owing to the need of profile correction for many patients.The pharyngeal airway that maybe seen in the lateral cephalogram as a radiolucent area is a structure of the neck region which is affected by the relation of the jaws and the profile of the patient.The pharyngeal airway maybe divided into the nasopharyngeal ,oropharyngeal and laryngopharyngeal areas but the most affected airway space is the nasopharyngeal space as it is the upper part of the airway and is closest to the jaws.A narrowing of this nasopharyngeal airway space can cause further jaw repositioning as a coping mechanism for better breathing which can also cause possible sleep apnea in future.[3]

II. MATERIAL AND METHODOLOGY

In this retrospective study two groups of 30 patients each of 10 to 20 years and 20 to 40 years are chosen. The lateral cephalograms of these patients prior to orthodontic treatment are obtained and the pharyngeal airway along with the soft tissue profile of the patients and the incisor relationships are outlined on tracing papers using lead pencil. These traced papers are then taken individually and four reference points are marked pertaining to the nasopharyngeal area.The first 2 points are marked according to a line drawn along the nasal floor touching the apex of the upper incisor extending backwards upto the nasopharyx where it intersects the tracing these points correspond tothe posterior most point of the soft palate anteriorly and the junction of nasopharynx and oropharynx posteriorly ,the second point and the third points are the points where the tracing of the airway ends in the upper and lower outlines respectively, the accuracy of the tracing

method is most important in this aspect.A thread is used to connect these four points by holding it along the traced outline.The length of the thread thus obtained is measured using a tape and is obtained in centimeters which maybe later converted to millimetres.The reading is then substituted in the formula $C=2\pi r$ and the radius is found which is then substituted in the formula $A=\pi r^2$ to obtain the area of the nasopharynx.The formula was fed into an excel sheet in this format and other variable were included ie,the malocclusions *which was classified according to BRITISH STANDARD CLASSIFICATION OF INCISOR : Class I- The lower incisor edges occlude with or lie immediately below the cingulum plateau of upper central incisors, Class II -The lower incisor edges lie posterior to the ring plateau of the upper incisors - further Division A include patients with increase overset and Division B with normal overjet and Class III -The lower incisor edges lies anterior to the cingulum plateau of the upper incisors., the profile of the patient and their lip competency.*



III. STATISTICAL ANALYSIS

According to the statistical analysis performed it was noted that the 60 subjects chosen on a random basis were mostly of Class I malocclusions , with a convex profile and had incompetent lips owing to which they were seeking Orthodontic correction of profile.However the standard deviation of airway assessment using lateral cephalogram suggested that though there was a reduction of area recorded using lateral cephalogram pertaining to the nasopharyngeal airway space the deviation was not hugely significant to conclude any serious possibility in obstruction of airway,though again it was noted that patients with class II and Class III malocclusion did show lesser readings of airway space.Also the high number of patients with incompetent lip did show that the area assessed on the lateral cephalogram were less which maybe suggestive of correlation in this aspect as to difficulty in breathing but still not enough to be absolutely conclusive.

IV. RESULTS

The use of Lateral Cephalogram for assessing obstruction in airway can be assessed using basic mathematics where simply one can make use of formulas like $C=2\pi r$ which gives the radius and following which the value of 'r' maybe substituted in $A=\pi r^2$.According to spearman's rho analysis correlation between the area calculated and the variable such as malocclusion, profile and lip competency are related in both

groups and significant evidence maybe seen.The descriptive analysis performed on the recording suggest that though one cannot be completely conclusive of the various profiles and malocclusions that may or may not lead to obstruction in airway one can however definitely use a lateral cephalogram to assess the area of the nasopharyngeal airway which will give definite readings to back up a possible obstruction of airway and difficultly to breath.Again according to the student T-test analysis done it can be seen that the two groups of age taken,ie, above 20 years and below 20 years show that there is significant difference in the areas of a growing patient and a patient whose growth spurt has ceased.

Spearman's Rho analysis of 30 patients above 20 years:

			Correlations				
			AREA2	MOCAT2	PROCAT2	LIPCAT2	
Spearman's rho	AREA2	Correlation Coefficient	1	-0.105	-0.141	-0.156	
		Sig. (2-tailed)	.	0.581	0.457	0.41	
		N	30	30	30	30	
	MOCAT2	Correlation Coefficient	-0.105	1	-.476**	.389*	
		Sig. (2-tailed)	0.581	.	0.008	0.034	
		N	30	30	30	30	
	PROCAT2	Correlation Coefficient	-0.141	-.476**	1	-.428*	
		Sig. (2-tailed)	0.457	0.008	.	0.018	
		N	30	30	30	30	
	LIPCAT2	Correlation Coefficient	-0.156	.389*	-.428*	1	
		Sig. (2-tailed)	0.41	0.034	0.018	.	
		N	30	30	30	30	
****. Correlation is significant at the 0.01 level (2-tailed).**							
***. Correlation is significant at the 0.05 level (2-tailed).**							

Spearman's Rho analysis of 30 patients below 20 years:

			Correlations				
			AREA1	MOCAT1	PROCAT1	LIPCAT1	
Spearman's rho	AREA1	Correlation Coefficient	1	0.092	0.008	-0.093	
		Sig. (2-tailed)	.	0.629	0.966	0.624	
		N	30	30	30	30	
	MOCAT1	Correlation Coefficient	0.092	1	.675**	-.420*	
		Sig. (2-tailed)	0.629	.	0	0.021	
		N	30	30	30	30	
	PROCAT1	Correlation Coefficient	0.008	.675**	1	-.527**	
		Sig. (2-tailed)	0.966	0	.	0.003	
		N	30	30	30	30	
	LIPCAT1	Correlation Coefficient	-0.093	-.420*	-.527**	1	
		Sig. (2-tailed)	0.624	0.021	0.003	.	
		N	30	30	30	30	

****. Correlation is significant at the 0.01 level (2-tailed).**							
***. Correlation is significant at the 0.05 level (2-tailed).**							

Descriptive analysis of combined 60 patients according to malocclusion and profile:

				Descriptives					
AREA									
					95% Confidence Interval for Mean				
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum	
CLASS-I	34	818.047	169.387777	29.04976	758.9453	877.14968	509.554	1304.459	
CLASS-II div 1	16	834.36	135.587032	33.89676	762.11084	906.6093	644.904	1146.497	
CLASS-II div 2	3	749.735	156.529722	90.37248	360.89322	1138.57599	575.239	877.787	
CLASS-III	7	773.339	126.173524	47.68911	656.64835	890.03045	644.904	998.726	
Total	60	813.766	153.946495	19.87441	773.99733	853.53452	509.554	1304.459	

				Descriptives					
AREA									
					95% Confidence Interval for Mean				
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum	
CONVEX	37	818.557	159.837258	26.27708	765.26502	871.84981	509.554	1146.497	
STRAIGHT	15	814.666	164.592459	42.49759	723.51734	905.81387	644.904	1304.459	
CONCAVE	8	789.918	115.798463	40.94094	693.10845	886.72833	644.904	998.726	
Total	60	813.766	153.946495	19.87441	773.99733	853.53452	509.554	1304.459	

Correlation of area to the two age groups according to student t-test:

			Group Statistics				
		AGEGR	N	Mean	Std. Deviation	Std. Error Mean	
	AREA	ABOVE 20 YEARS	30	853.628	151.013487	27.571164	
		Below 20 years	30	773.904	148.74023	27.156126	

						Independent Samples Test					
			Levene's Test for Equality of Variances			t-test for Equality of Means					
										95% Confidence Interval of the Difference	
			F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
	AREA	Equal variances assumed	0.077	0.782	2.06	58	0.044	79.723992	38.699151	2.259224	157.188759
		Equal variances not assumed			2.06	57.987	0.044	79.723992	38.699151	2.258844	157.189139

V. DISCUSSION

The statistical data thus obtained gives definitive information on the fact that the area obtained through the method used maybe validated by the facts that it is related to the other parameters such as malocclusion, facial profile and lip competency which maybe consider factors that can lead to narrowing of airway space. Although the study subjects have not shown significant narrowing of airway enough to conclude airway obstruction the data thus obtained does show that subjects with class II and class III malocclusion do show a decrease in area than class I subjects and this is a consistent finding with no exception.It is also seen that patient's lip competency also is related to area suggestive by the data that subjects with incompetent lip seem to have a lesser area of assessed nasopharyngeal airway space on the lateral cephalogram when compared to subjects with competent lips.Thus one can conclude that the lateral cephalogram can be used in the assessment of the airway.

Obstruction in airway is of great significance in recent times owing to the increase in cases patients with sleep apnea.Obstruction in airway leads to jaw repositioning as a compensatory mechanism to increase breathing during sleep,which in case of an already compromised profile and malocclusion can lead to further narrowing of area leading to sleep apnea which decreases ones quality of sleep and leads to various problems like fatigue and other physical -mental weaknesses.[4 5]

VI. CONCLUSION

The study thus conducted is of importance to all general dentists who might come across patients with Obstructive sleep apnea.In such cases the use of lateral cephalogram as an aid to diagnosis through simple chair side evaluation methods by using basic mathematic maybe considered as useful and one can make an equally effective diagnosis through such a method without requiring access to other software or sophisticated equipment which maybe later used in advanced stages of diagnosis.

REFERENCES

[1]. Kim YJ, Hong JS, Hwang YI, Park YH. Three-dimensional analysis of pharyngeal airway in preadolescent children with different anteroposterior skeletal patterns. Am J OrthodDentofacOrthop 2010; 137: 306.e1-11.
[2]. Bronoosh P, Khojastepour L. Analysis of Pharyngeal Airway Using Lateral Cephalogram vs CBCT Images: A Cross-sectional Retrospective Study. The Open Dentistry Journal, 2015, 9, (Suppl 2: M2) 263-266.
[3]. 3.Silva NN, Lacerda RH, Silva AW, Ramos TB.Assessment of upper airways measurements in patients with mandibular skeletal Class II malocclusion.Dental Press J Orthod. 2015 Oct;20(5):86-93.
[4]. Schendel SA, Broujerdi JA, Jacobson RL.Three-dimensional upper-airway changes with maxillomandibular advancement for obstructive sleep apnea treatment.Am J OrthodDentofacialOrthop. 2014 Sep;146(3):385-93.
[5]. 5.Balakrishna R, Reddy M, Kashyap VM, John J.The "Rubber Band" and "Slingshot" Effects of the Posterior Airway Space in Mandibular Orthognathic Surgeries.JMaxillofac Oral Surg. 2014 Dec;13(4):514-8.

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