International Journal of Current Research and Review
DOI: https://doi.org/10.31782/IJCRR.2021.13436

Scopus

Research Article

IJCRR
Section: Healthcare
ISI Impact Factor (2019-20): 1.628
IC Value (2019): 90.81
SJIF (2020) = 7.893

Cephalometric Relation of Mandibular Body to the Surface Area of the 2 Paranasal Sinusesfor Mandibular Growth Prediction in Different Skeletal Malocclusions – A Lateral Cephalometric Retrospective Study Using 2D Dolphin Software

Karthick D Shetty[1], Veera Sawant[2], Pranita Jadhav[3], Keval Shroff[4], Aarti Sethia[5], Akil Shetty[6]

[1]Professor, Department of Orthodontics and Dentofacial Orthopedics, Dr D Y Patil University School of Dentistry, Nerul, Navi Mumbai, Maharashtra, India; [2,3,5]Assistant Professor, Department of Orthodontics and Dentofacial Orthopedics, Dr D Y Patil University School of Dentistry, Nerul, Navi Mumbai, Maharashtra, India; [4]Post Graduate Student, Department of Orthodontics and Dentofacial Orthopedics, Dr D Y Patil University School of Dentistry, Nerul, Navi Mumbai, Maharashtra, India; [6]Professor, Department of Orthodontics and Dentofacial Orthopedics, AB Shetty Memorial Institute of Dental Sciences, NITTE University, Mangalore, Karnataka, India.

ABSTRACT

Introduction: The largest sinus is the maxillary sinus. The growth and development commence during fetal development (3rd Month) by the infundibulum present on ethmoid bone. Post birth, it expands in the lateral direction during the growth spurt period (Birth - 3 years and 7 - 12 years).

Aim/Objectives: The aim was to determine the relation of mandibular body length with the area dimensions of the maxillary and frontal sinus using digital lateral cephalogram.

Materials and Methods: 60 Digital lateral cephalograms were equally divided to form 3 groups of Class I, Class II, Class III patients comprising 20 each with equal inclusion of male and female patients. The Dolphin 2017 software was used to calculate the area dimensions and individual variables of both the paranasal sinuses, mandible size and both the cranial bases with their growth pattern.

Results: Class III malocclusion showed greater dimensions and surface area compared to those in other groups. Mandibular body length showcased a positive correlation to the sinus dimensions. Results obtained showed that the mean value of frontal sinus area for Class I was 335.59 mm^2, Class II was 257.64 mm^2 and Class III was 393.82 mm^2. The mean value of maxillary sinus area for Class I was 973.70 mm^2, Class II was 690.48 mm^2 and Class III was 1078.75 mm^2. Males showed greater values than the female group.

Conclusion: Class III malocclusion showed higher values for dimensions and surface areacompared to the other sample groups. Values calculated had a positive relation with both the cranial bases and mandibular body size.

Key Words: Para Nasal Sinus, Mandibular Body Length, Dolphin Software, Malocclusion, Dimensions and Surface Area, Growth

INTRODUCTION

Cavities surrounding the nasal region are known as the paranasal sinuses. Frontal sinus is situated within the frontal bone. Its shape and size are influenced by primary and secondary factors. The sinus is tiny or negligible at birth. Growth in the vertical dimension of the sinus starts at 24 months and it is evident on radiographs around 8 years of age. Growth spurt within frontal sinus occurs approximately one year post the bodies growth peak.[1,2]

The largest sinus is the maxillary sinus. The growth and development commence during fetal development (3rd Month) by the infundibulum present on ethmoid bone. Post birth, it expands in the lateral direction during the growth spurt period (Birth - 3 years and 7 - 12 years).[3]

Corresponding Author:
Dr. Karthick D. Shettya, Professor, Department of Orthodontics and Dentofacial Orthopedics, Dr D Y Patil University School of Dentistry, Nerul, Navi Mumbai, Maharashtra, India; Email: karthick.shetty@dypatil.edu

ISSN: 2231-2196 (Print) **ISSN:** 0975-5241 (Online)

Received: 08.08.2020 **Revised:** 15.10.2020 **Accepted:** 22.11.2020 **Published:** 16.02.2021

Final dimensions of mandibular growth occur around the age of 18 years in females /20 years in males. Normal growth of mandible can cause failure of treatment in Class III patients, estimation of final jaw size is important. Therefore, ideal-treatment timing in Class II/III malocclusions of skeletal origin significantly alters orthodontic treatment success. [4]

Area dimensions of both the sinuses would be utilised to estimate the remaining growthfor mandible knowing that positive relation exists between both of them.

AIM/OBJECTIVES

The aim was to determine the relation of mandibular body length with the area dimensions of the maxillary and frontal sinus using digital lateral cephalogram.

MATERIALS AND METHODS

In this retrospective study, 60 Digital lateral cephalograms were equally divided to form 3 groups of Class I, Class II, Class III patients comprising 20 each with equal inclusion of male and female patients. The area dimensions of frontal and maxillary sinuses, size of mandible and both the cranial bases with growth direction were calculated. Dolphin 2D 2017 software was used in which the sinus and other parameters were outlined by an experienced operator.

FRONTAL SINUS

Width/Height/Ratio/FSSA

MAXILLARY SINUS

Length/Height/MSSA

Dolphin software was also used to calculate the following values:

1. Mandibular Body Length
2. Cranial Base Length: Anterior and Posterior
3. Growth Pattern

Same operator was used for the digitisation of every lateral cephalogram. After one week the same operator repeated the procedure to ensure intra-examiner reliability after which the mean of each index was used.

Values were entered into Microsoft Excel for continuation of the study.

Inclusion criteria:

- Age group of patients was between 8-18 years.
- No history of orthodontic treatment.
- No pathologies involving the sinuses
- Facial asymmetry or CLCP absent
- Clear visibility of paranasal sinuses as well as the hard tissue landmarks on the lateral cephalograms.
- No prosthesis

Exclusion criteria:

- History of previous orthodontic therapy.
- Missing teeth (3rd Molars excluded).
- Permanent teeth impaction
- Poorly defined margins of the sinus.

Index	Definition
SN	Anterior cranial base length
AR-S	Posterior cranial base length
Mandibular body length	Distance from Go to Gn
SN-GoGn angle	Angle between anterior cranial base and GoGn
Jarabak index	Posterior facial height (S-Go) to anterior facial height (N-Me) ratio (%)
Sum of posterior angles	Sum of saddle, articular, and gonial angles
Gonial angle	Intersection of the lines tangent to the posterior border of the ramus and the lower border of mandible
ANB	Anteroposterior relationship between A-point and B-point with respect to nasion
Wits	Distance between the points of contact of the perpendicular lines on the occlusal plane (AO: A point to occlusal plane and BO: B point to occlusal plane)
Occlusal plane	Line drawn through the overlap of the mesiobuccal cusps of the first molars and the buccal cusps of the first premolars

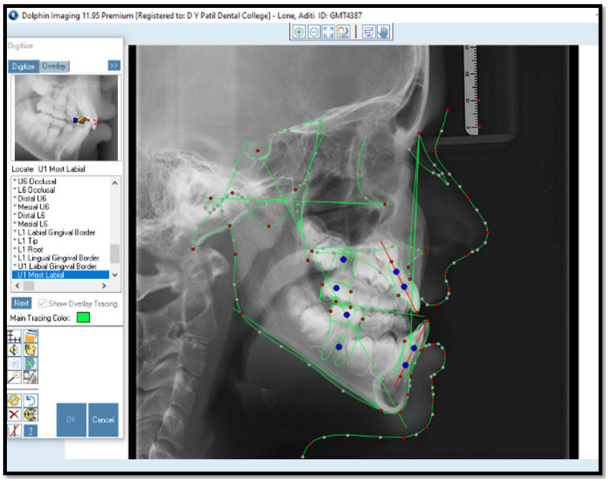

Figure 1A: Dolphin Imaging.

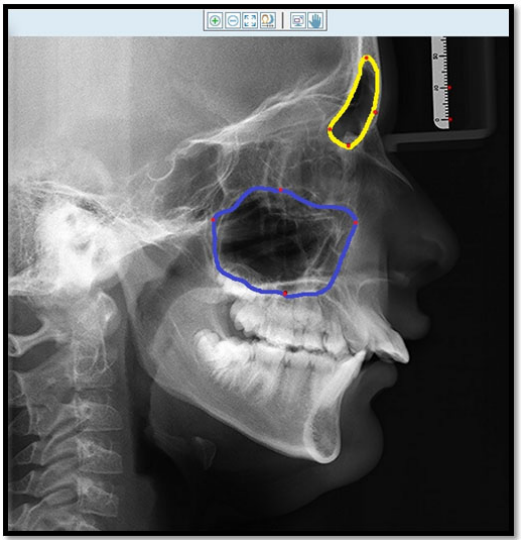

Figure 1B: Dolphin Imaging.

STATISTICAL ANALYSIS

Descriptive statistics were expressed as means and standard deviations for each group. Comparison of the study variables between the three groups was done using One Way ANOVA test followed by post hoc Bonferoni test. Comparison of dimensions of the sinus between both the sexes were done using Student t test. The correlation ofdimensions of the sinus and cephalometric variables was done using Pearson's correlation coefficient. "P" value beneath or somewhat equal to 0.05 ($P \leq 0.05$) was taken to be significant statistically. "Statistical Package for Social Sciences" software V.20 performed every single test analysis.

RESULTS

This study was emphasized to correlate the area of FS and MS in various skeletal malocclusions relying on values obtained from cephalogram. 60 individuals fulfilling the inclusion criteria were undertaken. The study included an equal ratio of female and male in each class. Each group of skeletal discrepancy was divided into 3 from the total sample size based on the Wits Appraisal, ANB Angle and Schwarz Analysis.

FSH

Class 3 subjects showed the largest FSH dimension with an average of 26.59 mm followed by Class 1 with an average of 24.88mm and the least was in Class 2 Subjects with an average of 22.1 mm.

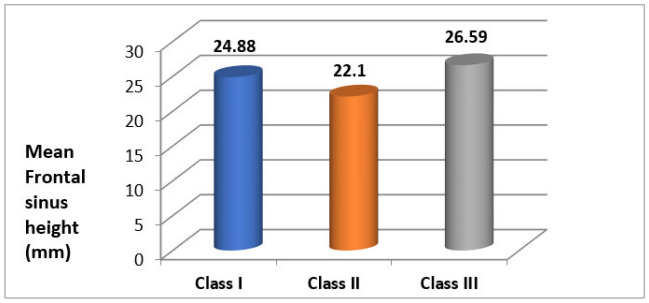

Figure 2: FSH Dimension.

FSW:

Class 3 subjects showed the largest FSW dimension with an average of 14.67 mm followed by Class 1 with an average of 13.34 mm and the least was in Class 2 Subjects with an average of 11.59 mm.

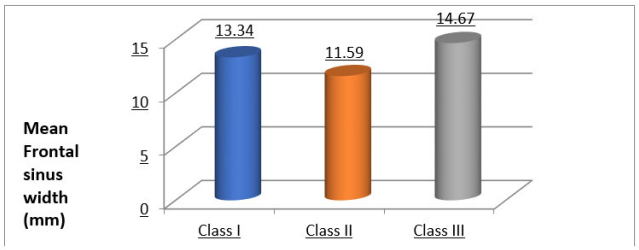

Figure 3: FSW Dimension.

FSSA:

Class 3 subjects showed the largest FSSA with a mean average of 393.82 mm^2 followed by Class 1 with a mean average of 335.59 mm^2 and the least was in Class 2 Subjects with an average of 257.64 mm^2.

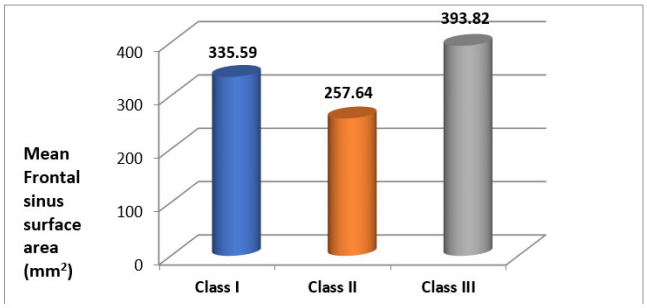

Figure 4: FSSA Dimension.

FSR (H/W):

Class 2 subjects showed the largest ratio with an average of 1.92% followed by Class 1 with an average of 1.88% and the least was in Class 3 Subjects with an average of 1.83%.

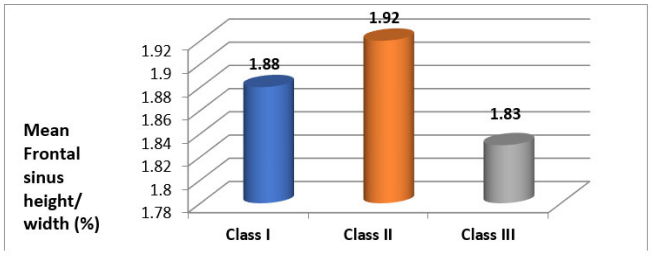

Figure 5: Frontal Sinus Ratio (H/W).

MSH:

Class 3 subjects showed the largest MSH dimension with an average of 29.67 mm followed by Class 1 with an average of 28.41 mm and the least was in Class 2 Subjects with an average of 21.9 mm.

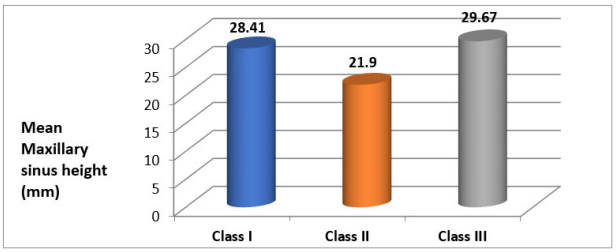

Figure 6: MSH.

MSW:

Class 3 subjects showed the largest MSW dimension with an average of 36.23 mm followed by Class 1 with an average of 34.15 mm and the least was in Class 2 subjects with an average of 31.49 mm.

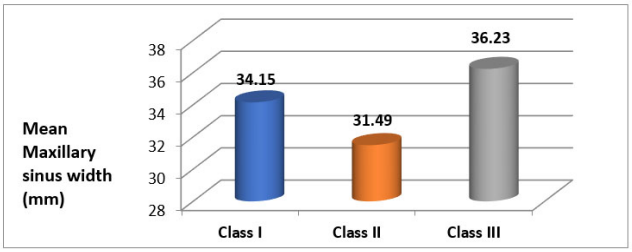

Figure 7: MSW Dimension.

MSSA:

Class 3 subjects showed the largest MSSA dimension with an average of 1078.75 mm^2 followed by Class 1 with an average of 973.7 mm^2 and the least was in Class 2 subjects with an average of 690.48 mm^2.

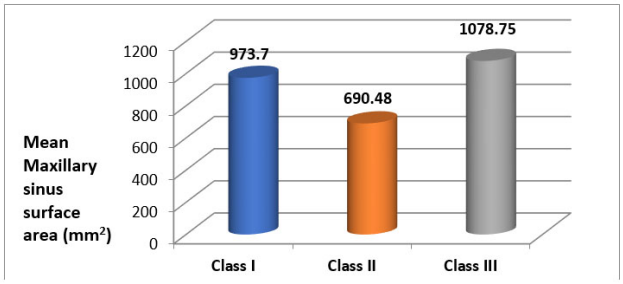

Figure 8: MSSA.

Table 1: Comparison table between M vs F (Male Vs Female)

	MSH	MSW	MSSA
M	26.82 ± 4.29	34.49 ± 3.47	934.73 ± 217.36
F	26.49 ± 4.10	33.42 ± 3.31	893.88 ± 209.18
P value (Student t test)	0.764	0.224	0.461

Table 2: Frontal sinus with different cephalometric variables:

	FS							
	H		W		SA		H/W	
	R	P value	R	P value	R	P value	R	P value
Sella-Nasion	0.079	0.546	0.181	0.167	0.145	0.270	-0.072	0.583
AR-S	0.084	0.522	0.072	0.582	0.088	0.505	0.014	0.915
GO-GN	0.414	**0.001***	0.712	**<0.001***	0.610	**<0.001***	-0.292	**0.023***
Sn-Go-Gn angle	0.079	0.550	0.006	0.964	0.083	0.527	0.037	0.779
Jarabaks Ratio	-0.077	0.558	-0.068	0.607	-0.107	0.416	0.026	0.843
Posterior angle sum	0.068	0.607	-0.002	0.989	0.072	0.586	0.039	0.768
Gonial angle	0.133	0.312	0.034	0.798	0.110	0.401	0.087	0.511

Table 3: Maxillary sinus with different cephalometric variables

	Maxillary Sinus					
	H		W		SA	
	R	P value	R	P value	R	P value
Sella - Nasion	-0.181	0.166	-0.010	0.939	-0.130	0.321
AR-S	-0.253	0.051	-0.134	0.306	-0.232	0.075
GO-GN	0.471	**<0.001***	0.369	**0.004***	0.460	**<0.001***
Sn-Go-Gn angle	0.173	0.185	0.124	0.345	0.167	0.202
Jarabaks Ratio	-0.186	0.155	-0.200	0.126	-0.204	0.119
Posterior angles sum	0.183	0.163	0.127	0.332	0.174	0.185
Gonial angle	0.195	0.136	0.116	0.378	0.176	0.179

Table 4: Body Length of Mandible to the Frontal/ Maxillary Sinus Index:

Independent variables	R	P value
Constant	10.717	0.766
FSH	0.345	0.635
FSW	2.623	0.056
FSSA	-0.036	0.494
MSH	1.682	0.199
MSW	1.253	0.246
MSSA	-0.044	0.251

DISCUSSION

Radiographs are important requirements for diagnosis and treatment planning. Final length of mandible is really important factor which affects the treatment result. Primarily important in Class III malocclusionpatients. Limited researches have been done to relate the size of the sinus in skeletal discrepancies. This study was used to assess both the paranasal sinus parameters to the mandible size.[10]

Dolphin software was used to assess both the paranasal sinuses. Digital radiographs have the advantages of better quality; therefore, the errors would be at minimal.

Dolphin is a very commonly utilised software which consists of programs for 2D and 3D use. Dolphin 2017 was used in this study, which guided us for the digitization of every radiograph.

The current results showed that the mean height, width, and surface area of the frontal sinus in Class III skeletal malocclusion were significantly greater than those in Class I and II malocclusions. Furthermore, the dimensions and surface area of the frontal sinus had a significant correlation with the mandibular body length and gonial angle. [10]

Genes as well as growth direction of the facial structures are 2crucial factors which affect dimensions of asinus. Result proved the average height and area of frontal sinus to have a positive relation with linear distances of Sella-Nasion and Ar-S. [7]

The results of this study showed that the dimensions of the maxillary sinus in skeletal Class III malocclusion were much greater than those in the Class I and Class II malocclusion group.[10]

According to our results, Maxillary sinus dimensions were much greater in male than female due to the cranial base in themweregreater than that in female population. The result followed the same conclusion for the frontal sinus area dimensions as well.

Results also showed that individual dimensions and surface area of the maxillary sinus showed positive correlation with the mandibular body length. Therefore, proves that increase in dimensions of the maxillary sinus is associated with an increase in the mandibular body length.

Dimensions of the maxillary sinuses was lesser in patients with a hyperdivergent growth pattern.

Various analysis was undertaken to show the relation of Mandibular size with the 2 paranasal sinuses and showed that changes in the mandibular size can be estimated using an equation with roughly 52% probability.

Body Length of Mandible = 10.717+ 0.345 (FSH) + 2.623 (FSW) - 0.036 (FSSA) + 1.682 (MSH) + 1.253 (MSW) - 0.044 (MSSA).

The equation helps to predict final mandibular body dimension in CL III samples. So, with values of both the paranasal sinuseswe would be able to use it for determination of the patient needing orthodontic camouflage treatment or orthognathic surgery treatment after puberty.[10]

To improve the efficacy of this study, the suggestion in the upcoming studies is to study the dimensions, surface area, and volume of the sinuses of the malocclusions by CBCT.

CONCLUSION

Results of mystudy stated that:

1. Class III skeletal malocclusion showed the greatest area dimensions of both the involved paranasal sinuses compared to other group samples.
2. Mandible size and both the cranial bases had a positive relation with the area dimensions of the 2 paranasal sinuses.
3. Males showed greater dimension and surface area than those in females.

ACKNOWLEDGEMENT

Authors acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript. The authors are also grateful to authors / editors / publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

Source of funding: Self

Conflict of Interest: None

Authors' Contribution: All authors contributed equally towards the data collection, data analysis & compilations

REFERENCES

1. Atchison K, Luke L, White SC. Pretreatment radiograph contribution to orthodontist decision making. Oral Surg Oral Med Oral Pathol. 1991; 71:238-45
2. Nijkamp PG, Habets Luc LMH, Aartman IHA, Zentner A.The influence of cephalometrics on orthodontic treatment planning. Eur J Orthod. 2008; 30(6):630-5.
3. Devereux L, Moles D, Cunningham SJ, McKnight M.How important are lateral cephalometric radiographs in orthodontic treatment planning? Am J Orthod Dentofacial Orthop. 2011; 139(2): e175-81.
4. Albarakati SF, Kula KS, Ghoneima AA.The reliability and reproducibility of cephalometric measurements: A comparison between conventional vs digital methods. Dentomaxillofac Radiol.2012; 41(1):11-7.
5. Durao AR, Pittayapat P, Rockenbach MIB. Validity of 2D lateral cephalometry in orthodontics: A systematic review. Prog. Ortoda. 2013, 14, 31
6. Oktay H. The study of the maxillary sinus areas in different orthodontic malocclusions. Am J Orthod Dentofacial Orthop 1992; 102:143-5
7. Kwak HH, Park HD, Yoon HR, Kang MK, Koh KS, Kim HJ. Topographic anatomy of the inferior wall of the maxillary sinus in Koreans. Int J Oral Maxillofac Surg 2004; 33:382-8.
8. Tanner JM. Growth at Adolescence. 2nd ed. Oxford: Blackwell Scientific Publications; 1962. p. 3.
9. Graney DO, Rice DH. Anatomy. In: Cummings CW, Fredrickson JM, Harker LA, Krause CJ, Schuller DE, editors. Otolaryngology: head and neck surgery. 2nd ed. St Louis: Mosby Year Book; 1993. p. 901-6. 3.
10. Rossouw PE, Lombard CJ, Harris AM.The fontal sinus and mandibular growth prediction. Am J Orthod Dentofacial Orthop. 1991; 100(6):542-6.