RELATIONSHIP BETWEEN FRONTAL SINUS WIDTH AND SKELETAL JAW PATTERN: A LATERAL CEPHALOMETRIC STUDY

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ABSTRACT

Objective: *To determine the association between frontal sinus width and skeletal jaw pattern.*

Materials and Methods: *Study sample include lateral cephalometric radiographs of 42 patients, 48% were male and 52% were female. Recorded measurements were as follow: maximum width of the frontal sinus, maxilla relationship to anterior cranial base (SNA), mandible relationship to anterior cranial base (SNB), anteroposterior maxillary and mandibular relationship (ANB), maxillary and mandibular base length. SPSS version 22 was used for analyzing the data.*

Results: *Frontal sinus width was greater in class I subjects (9.29 mm) as compare to class II (8.50 mm) and class III (9.14 mm) subjects. Mean difference in frontal sinus width between the three skeletal classes was found to be insignificant (p=0.596). The correlation between frontal sinus width and length of maxillary base (r=0.23) and length of mandibular base (r=0.24) was positive. Frontal sinus width in male was greater i.e. (9.60±2.64 mm) than females which was (8.41±1.37 mm).*

Conclusion: *Frontal sinus as visualized on cephalometric radiograph cannot be utilized as an aid for diagnosing skeletal jaw discrepancy. Further studies need to be done assessing a three dimensional CBCT scan of frontal sinus dimension.*

Keywords: *Frontal sinus, skeletal jaw pattern, lateral cephalometric radiograph, maxillary base length, mandibular base length*

INTRODUCTION

Broadbent in 1931 introduce cephalometric radiograph which became a common source for assessment of orthodontic cases and treatment planning with a characteristic feature of high re-producibility[1,2,3]. Cephalometric radiograph can be traced conventionally on acetate sheet and the linear and angular measurements can then be analyzed[4]. It consist of multiple anatomical landmarks which are use for identification of various malocclusion and planning treatment accordingly[5,6]. It can also be used to study and predict growth[7].

Paranasal sinus is the landmark which is used in this study as it is a non duplicate structure so will provide accurate information[8]. Paranasal sinuses are pneumatized areas surrounding the nasal cavity. They are four in number the ethmoidal, frontal, sphenoidal and maxillary sinus. Due to easy identification of frontal sinus in the lateral cephalogram of majority of population[9], it is used in this study. Pnuematization of frontal bone leads to formation of frontal sinus[10]. They are not present at birth, at 2 years of age the frontal bone is invaded by anterior ethmoidal cells

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and later in life by the age of 15 years it is fully matured[11]. They are two in number and are parted by intersinus septum[12]. Frontal sinus varies greatly in morphology in different individuals[13]. Evidence shows that frontal sinus plays a significant role in prediction of skeletal jaw patterns[14,15]. Rossouw et al[16] conducted a study to find a correlation between excess growth of the mandible and a large size of frontal sinus concluded that frontal sinus serves an indicator for predicting the growth pattern of mandible. Prashar et al[17] investigated the frontal sinus size in different craniofacial skeletal patterns and found that on average the size of frontal sinus was greater in class III skeletal malocclusion (310.50±68.07) than Class I (203.33±66.02) and Class II (219.07±62.83) skeletal malocclusion. The objective of study was to determine correlation between the width of frontal sinus and skeletal pattern of jaw, to detect if frontal sinus can serve as an additional diagnostic indicator which will serve as a reference enabling orthodontist to make more accurate prediction and diagnosis for skeletal jaw growth pattern.

MATERIALS AND METHODS

This chart review was carried out at orthodontics department Khyber college of dentistry Peshawar. After taking approval from ethical committee of institute the study was carried out on records of 42 patients. The calculation of sample size was done using openepi by taking class I F.S width mean 8.17±1.81 mm and class II of F.S width mean of 10±2.36 mm to detect difference of -1.83 by keeping 80% power of the test and 95% confidence interval having sample size ratio of group 2/1 of 1. Same operator have taken all the radiographs using planmeca promax 3D mid machine with film size of 8x10¨. Patients between ages of 15-25 years, Patients with complete records, including radiographs of high quality were included while patients with orthognathic surgery, trauma to craniofacial region, syndromes, and pathology or infection of sinus were excluded. All measurements were made by single operator. On the lateral cephalogram, frontal sinus analysis was performed. Each radiograph was manually traced on standard tracing paper over a standard illuminated view box. The cephalogram was oriented with the sella-nasion line horizontally. Frontal sinus peripheral border as seen on lateral cephalogram was traced. Marking of two points of sinus extension the highest (Sh) and the lowest (Sl) were done. Maximum height was obtained by connecting these points. Maximum sinus width was measured perpendicular to this interconnecting line as shown in figure 1. The landmarks that were studied are defined in table 1 shown in Figure 2. Angular and linear variables in the cephalogram that were assessed are defined in Table 2 and shown in Fig 2. The sample subjects have been ranked into three skeletal classes according to measurements of ANB angle which are as follows Skeletal "class I ($0° \leq ANB < 4°$), Class II ($ANB \geq 4°$), and Class III ($ANB < 0°$)"[18].

For data analysis Statistical Package for Social Sciences (SPSS) version 22 was used. The following statistical tests were applied Pearson correlation test was used to determine correlations between width of frontal sinus and the mandibular and maxillary base lengths in all three skeletal classes. ANOVA test was applied to find mean variability in frontal sinus width between three skeletal classes and independent sample T test was use to find out mean width of frontal sinus in females and males.

RESULTS

Out of total 42 the mean age of the sample studied was 19.10 ± 22.61 years, of which 20(48%) were male and 22(52%) were female patients. They were divided into three skeletal classes I (n=14), II (n=14), III (n=14) as shown in table 3.

Descriptive statistics of the width of frontal sinus for skeletal class I, skeletal class II, and skeletal class III subjects are shown in table 4. Highest mean value was found in skeletal class I subjects (9.29 mm), while class II subjects demonstrated the lowest mean value (8.50 mm). The frontal sinus width mean value of skeletal class III subjects was close to that of skeletal class I subjects (9.14 mm).

ANOVA test that was applied in order to verify the mean difference in frontal sinus width between the three skeletal classes represented in table 5 shows the difference to be insignificant (p=0.59).

Pearson correlations was applied to find the correlation of width of frontal sinus with the length of maxillary and mandibular base, the correlation between frontal sinus width and length of maxillary base (r=0.23) and length of mandibular base (r=0.24) was positive as shown in table 6.

T test shows that the mean frontal sinus width in male was greater (9.60±2.64 mm) than females

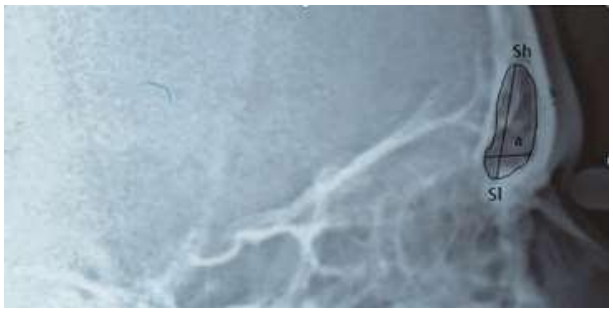

Fig 1: Maximum width of frontal sinus "a" assessed perpendicular to line connecting Sh to Sl

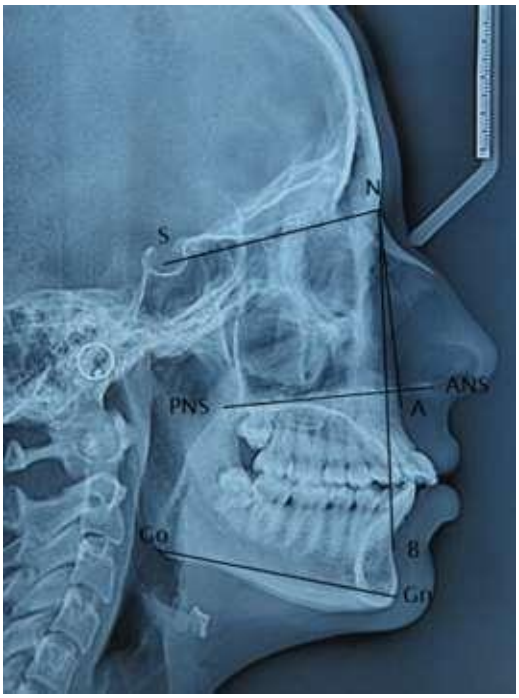

Fig 2: Landmarks and angular and linear measurements that are assessed

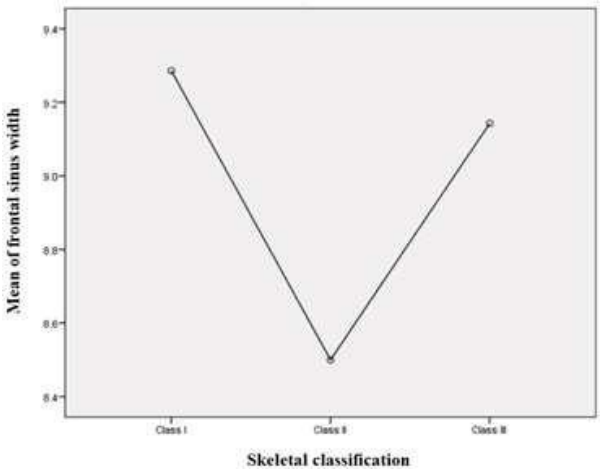

Fig 3: Mean of frontal sinus width between three skeletal classes

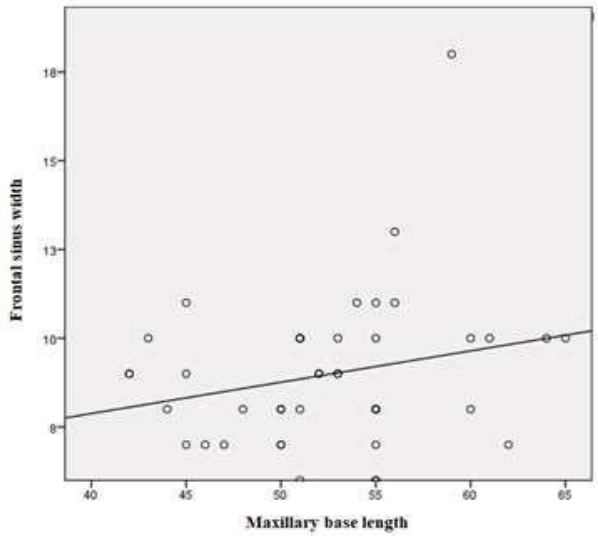

Fig 4: Relationship between frontal sinus width and maxillary base length

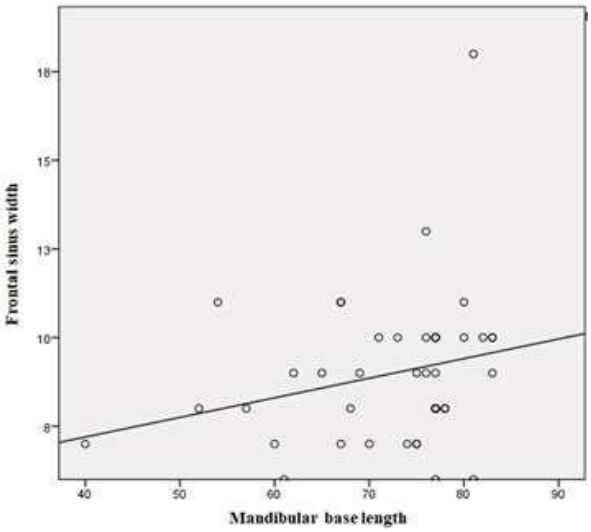

Fig 5: Relationship between frontal sinus width and mandibular base length

which was (8.41±1.37 mm) as shown in table 7.

DISCUSSION

This research was undertaken to find out if frontal sinus width have any relationship with skeletal jaw patterns in a sample of Peshawar population. The results shows an increase in frontal sinus width in skeletal class I subjects as compare to skeletal class III and II subjects, however the mean difference in frontal sinus width between the three skeletal classes was found to be insignificant.

In this study frontal sinus width was measured

Table 1: Cephalometric landmarks definition use in this study

Nasion (N)	Frontonasal suture anterior most point
Sella (S)	Sella middle point
Point A	Point of deepest concavity on maxillary alveolus anteriorly
Point B	Deepest anterior point on concavity of mandibular symphysis
Gnathion (Gn)	On the bony chin, the most inferior anterior point
Gonion (Go)	On the mandibular angle, the most posterior lower point
Anterior nasal spine (ANS)	The most anterior middle point of maxilla's anterior nasal spine
Posterior nasal spine (PNS)	Palatine bone most posterior middle point
Maximum sinus width (a)	Measured perpendicular to the line connecting highest (Sh) and the lowest (Sl) points of sinus extension.

Table 2: Linear and angular cephalometric variables assessed

Maxillary base length	Distance in millimeter from AP Max (a point determined by drawing a line perpendicular from palatal plane to point A) to PNS (posterior nasal spine)
Mandibular base length	Distance in millimeter from Gnathion (Gn) to Gonion (Go)
SNA	The angle from sella to nasion to point A
SNB	The angle from sella to nasion to point B
ANB	Difference between SNA and SNB

Table 3: Frequency distribution of categorical variable

Gender	**Male**		**Female**
	20(48%)		22(52%)
Skeletal classes	Class I	Class II	Class III
	14(33.3%)	14(33.3%)	14(33.3%)

Table 4: Descriptive statistics of the frontal sinus width measurements (in mm) for the three skeletal classes.

Class	**No. of subjects**	**F.S width Mean**	**S.D.**	**Minimum**	**Maximum**
I	14	9.29	1.73	7	13
II	14	8.50	1.69	6	11
III	14	9.14	2.85	6	18

Table 5: ANOVA test between the three skeletal classes for the frontal Sinus width

	Sum of squares	**d.f.**	**Mean square**	**F**	**P-value**
Between Groups	4.91	2	2.45	0.53	0.59
Within Groups	182.1	39	4.66		
Total	186.9	41			

Table 6: Pearson correlation between width of frontal sinus and the length of maxillary and mandibular base

Total N:42	**Pearson correlation**	**P value**
Correlation between width of frontal sinus and length of maxillary base	0.23	0.12
Correlation between width of frontal sinus and length of mandibular base	0.24	0.12

Table 7: *T test shows mean frontal sinus width among female and male

	Gender	N	Mean	Std. Deviation	P value
F.S. width	Male	20	9.60	2.64	0.07
	Female	22	8.41	1.37	0.08

*Independent sample T Test

on the lateral cephalogram. The similar methodology had been used in previous study by Prashar et al[17] on the the relation between frontal sinus width and skeletal Class I II III jaw patterns.

In our study males were n= 20(48%) and females were n= 22(52%). More percentage of females than males may be due to more aesthetic awareness among females than males[19].The angular variable used for the classification of patients into class I ,II and III was ANB the same anteroposterior variable was use in study done by Azita et al[20].

In this study frontal sinus width was greatest in Class I subjects, compare to Class III and class II subjects which was not in agreement to findings of study done by Rossouw et al[16] in which frontal sinus width was smallest in class I subjects and greatest in class III subjects it might be due to the use of additional radiograph to lateral cephalometric radiograph i.e posteroanterior radiograph in addition to this the radiographs were digitized while in our study manual tracing of radiograph was done. In current study the frontal sinus width was smallest for class II subjects which were in accordance with the study done by Alka et al[15].

The mean difference between frontal sinus width for three skeletal classes was insignificant which was in agreement with the study done by Kapasiawala et al[9]. However the study conducted by Prashar et al[17] and Rossouw et al[16] observed significant difference between width of frontal sinus and different skeletal patterns, a possible explanation might be small sample size use in our study.

In current study there was a positive correlation between length of maxillary base and mandibular base and width of frontal sinus which means that there was increase in frontal sinus width with increase in mandibular and maxillary base length which was in agreement to the study done by Al bustani et al[14]. An explanation to this would be that during pubertal growth spurt there is increase in the overall body growth so it could be suggested that the frontal sinus, maxilla and mandible are under the same hormonal and genetic influence that leads to growth during puberty.

In our study the width of frontal sinus was greater in males as compare to females which was consistent with the findings obtain from studies done by Belaldavar et al[21], Soman et al[22] and Buyuk et al[23] so it led to the conclusion that the size of the frontal sinus is gender dependent.

LIMITATIONS

This study have two limitations one is small size of the sample due to which the results could not be generalized and other one is the 2 dimensional measurement of the three dimensional structure this could be overcome by a CBCT scan showing the dimensions of frontal sinus which would warrant more precise assessment of the sinus dimension in all three planes of space.

CONCLUSION

As an insignificant correlation was found between width of frontal sinus and different skeletal patterns of the jaw we can state that frontal sinus does not serve as a reliable indicator in determining skeletal jaw pattern.

Width of frontal sinus was more in males as compare to females.

RECOMMENDATION

Further investigations in different centers with larger sample size and three dimensional CBCT scan can increase the accuracy of obtained data.

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