
COMPARING SELLA TURCICA SHAPES AND DIMENSIONS IN SKELETAL CLASSES I, II AND III BIMAXILLARY PROTRUSION PATIENTS IN A NIGERIAN POPULATION

Idia N. IZE-IYAMU BDS, FWACS

*Consultant Orthodontist/Associate Professor, Department Of Preventive Dentistry,
University Of Benin Teaching Hospital and University of Benin, Nigeria*

ABSTRACT

BACKGROUND: Bimaxillary protrusion is a common type of malocclusion seen in Africans with marked protrusion of the maxillary and mandibular incisors and an increased procumbency of the lips. Management involves cephalometric radiographic evaluation and comparison with other structures within the skull. The sella turcica is one of these radiographic landmarks used in determining orthodontic parameters for management. The shape and dimensions in these patients may be affected as a result of the bimaxillary protrusion.

OBJECTIVE: The aim of this study was to evaluate sella turcica shapes and dimensions in skeletal classes I, II and III bimaxillary protrusion patients in a Nigerian population

STUDY DESIGN: This study was carried out at the Orthodontic unit of the University of Benin Teaching Hospital, Benin City Nigeria. Lateral Cephalometric radiographs of 64 patients (28 male and 36 female) with bimaxillary protrusion (interincisal angle of $\leq 107^\circ$) in the three skeletal classes was evaluated. Linear dimensions (length, depth and antero-posterior diameter) were measured. The student t-test was used to calculate the difference in linear dimensions. The one way analysis of variance (ANOVA) was done to study the relationship between sella turcica types, size, skeletal class and bimaxillary proclination.

RESULTS: The mean interincisal angle was $100.16^\circ \pm 7.004$. Bimaxillary protrusion was seen in classes I, II and III skeletal patterns in 28(43.7%), 33(51.6%) and 3(4.7%)

respectively. Six shapes of sella turcica were identified with the normal shape most prevalent in bimaxillary protrusion skeletal class II (52.4%) and absent in the oblique anterior wall shape in bimaxillary protrusion skeletal Class III. The double contour shape was also absent in bimaxillary protrusion skeletal classes I and III. The mean length ($9.932 \pm 2.14\text{mm}$), depth ($6.96 \pm 1.88\text{mm}$) and diameter ($9.30 \pm 1.41\text{mm}$) were determined. The dimensions of the sella turcica were longest in class III with mean values of $10.67\text{mm} \pm 0.577$ (length), $7.83\text{mm} \pm 2.466$ (depth) and $10.0\text{mm} \pm 1.732$ respectively.

CONCLUSION: Bimaxillary protrusion patients exhibit a mean interincisal angle of 100.16° ; various shapes of the sella turcica also exist for bimaxillary protrusion classes I, II and III respectively.

KEY WORDS: Bimaxillary protrusion, skeletal class, sella turcica

INTRODUCTION

Bimaxillary protrusion is a common orthodontic problem seen amongst Africans and those of African ancestry and also among Asians¹⁻³. It is characterized by protrusive upper and lower incisors and an increased procumbency of the lips² and is a common problem seen amongst orthodontic patients in our environment^{1, 4}. Cephalometric radiographs have been used to determine the severity of the protrusion with measurements varying for different ethnicities¹⁻³. The upper and lower incisors are easily identifiable on the cephalometric radiograph and an interincisal angle of $108-116^\circ$ signifies a normal incisal relationship in Nigerians¹. Values of $\leq 107^\circ$ indicate bimaxillary protrusion in Nigerians¹. The interincisal angle measures the degree of protrusion between the upper and lower teeth and is

Corresponding Author: DR I.N. IZE-IYAMU
Department Of Preventive Dentistry,
University Of Benin Teaching Hospital and
University of Benin, P.O. Box 7022, Edo State, Nigeria.
E-mail: idia.ize-iyamu@uniben.edu, Tel: +2348023388684

formed from the junction of two lines (a perpendicular drawn along the long axis of the upper and lower incisors)¹.

Cephalometric evaluation also utilizes various anatomic landmarks and the identification of the midpoint of the sella turcica is important in determining the skeletal protrusion and pattern^{1, 4, 5}. While studies found a variation in the shape in the three skeletal classes⁶, there appear to be limited data comparing the shape, dimensions and skeletal classes in bimaxillary protrusion patients⁷.

While studies on Caucasians identified skeletal class II patterns as being more prevalent in patients with bimaxillary protrusion², there appear to be few Nigerian studies^{1, 4} on this subject. A Nigerian study by Isiekwe⁴ identified skeletal class I pattern as being more prevalent in patients with bimaxillary protrusion. Other studies correlated the sella turcica and skeletal classes and identified a significant difference in the diameter of the sella turcica in skeletal classes II and III⁵. There however appear to be no studies in our environment comparing bimaxillary protrusion in the three skeletal classes with the dimension of the sella turcica. The aim of this study therefore was to compare bimaxillary protrusion in skeletal classes I, II and III with sella turcica shapes and dimensions in a Nigerian population

MATERIALS AND METHODS

A total number of 107 patients who were clinically diagnosed with bimaxillary protrusion were selected. Cephalometric radiographs were taken and the following inclusion criteria used:

Patients from 12-years of age and above

- Only Nigerian patients
- Clear cephalometric radiographs with clear visualization of the sella turcica and other structures
- Interincisal values of $\leq 107^\circ$
- Untreated orthodontic patients
- Patients with no congenital or facial anomalies

The total number of patients who met the inclusion criteria and constituted the final sample size were 64. All the patients' radiographs were taken by the same radiographic technician in a standardized manner using a digital cephalometric machine (Planmeca Proline XC with Dimax 3 X-ray, 2006 model) set at $\times 1.25$ magnification as recommended by the manufacturer. The images generated were stored directly in the computer data base created using the manufacturer's

software (Dimaxis Pro version 4.1.4; Planmeca, Helsinki, Finland). Conventional measurements were taken using hard-copy printouts of the digital radiographs.

Only radiographs with the clearest reproduction of the sella turcica and the incisal teeth were analyzed.

Tracing of sella turcica

The contour of the sella turcica was traced manually on matte acetate paper 0.003 inches thick using a 0.05 mm lead pencil placed over the printed image. Morphological shapes were identified as described by Axelsson et al.⁸

Measurement of sella turcica dimensions

The linear measurements of length, depth, and diameter were done using the method described by Silverman⁹. The following were determined as below:

- Length: The distance between the tuberculum sella to the tip of the dorsum sella.
- Depth: Was determined by a perpendicular line drawn from the tuberculum sella to the tip of the dorsum sella to the deepest point on the floor of the sella turcica.
- Diameter: This was done anteroposteriorly with a line drawn from the tuberculum sella to the most posterior point on the posterior wall of the sella turcica.

Determination of Orthodontic indices

Cephalometric analysis was also carried out

to determine the orthodontic indices (sella-nasion-maxillary points A; mandibular point B [SNA, SNB], and ANB were assessed) using the Steiner analysis¹⁰.

SNA-(the innermost and concave part of the bony maxilla) to determine maxillary prognathism or retrognathism

- Nigerian values^{1, 11} of 82-89° were regarded as a normal maxilla.
- Values of <81° were regarded as a retrusive maxilla and >90° as maxillary prognathism¹.

SNB-(the innermost and concave part of the bony mandible) to determine mandibular prognathism or retrognathism.

- Nigerian values of 79.5-85.9° were regarded as a normal mandible^{1,11}.
- Values of <79.4° were regarded as a retrusive mandible and >86° as mandibular prognathism.

ANB-point A to nasion to point B representing the skeletal pattern.

- Nigerian values of 2-4° represent skeletal pattern I^{1,11}
- <1° skeletal pattern III and >5° skeletal pattern II.

Interincisal angle- This was done by drawing a perpendicular line through the long axis of the maxillary and mandibular central incisors and measuring the angle where they meet anteriorly

- Nigerian values⁴ of ≤ 107° are bimaxillary protrusion
- Values of 108-116° indicated a normal incisal relationship

Intra operator reliability was assessed by

randomly selecting 20 lateral cephalometric radiographs 2 weeks after the initial analysis and re-measuring the linear dimensions of the sella turcica and the interincisal angle. The student t-test gave a non significant p value of >0.05.

STATISTICAL ANALYSIS

Data obtained was tested and analyzed with a Statistical Package for Social Sciences Software version 21.0 (SPSS Inc, IBM 2012 Armonk NY). The Student's t-test was used to calculate the differences in the linear dimension of the sella turcica. A one-way analysis of variance (ANOVA) was carried out to determine if there was any association between the diameter and different sella turcica shapes and skeletal classes. The confidence level was set at 95% and probability values of P<0.05 as significant.

RESULT

This study had a total number of 64 participants with 28 (43.8%) male and 36 (56.2%) female. The mean interincisal angle was 100.16 ±7.004. Table 1 shows the mean frequency distribution of the interincisal angle and sella turcica dimensions. Figure 1 demonstrates the incisal angle in bimaxillary protrusion skeletal classes II and III on cephalometric radiographs.

A normal shape of the sella turcica was seen in 42 (65.6%). Females exhibited the highest number in the normal shape in 23 (35.9%). The double contour shape was absent in females and the irregular dorsum sellae shape was absent in males. Figure 2 shows the association between sella turcica shape and gender.

TABLE 1: MEAN FREQUENCY DISTRIBUTION IN INTERINCISAL ANGLE AND SELLA TURCICA DIMENSIONS

Variable	Mean	Std Deviation	N
Interincisal angle	100.16	7.004	64
Length (mm)	10.05	2.029	64
Depth (mm)	7.05	1.759	64
Diameter (mm)	9.41	1.889	64

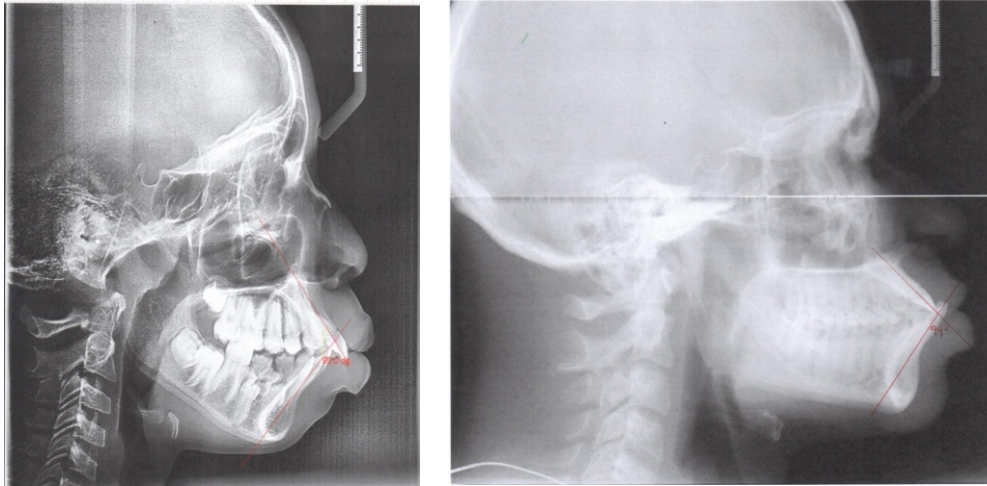
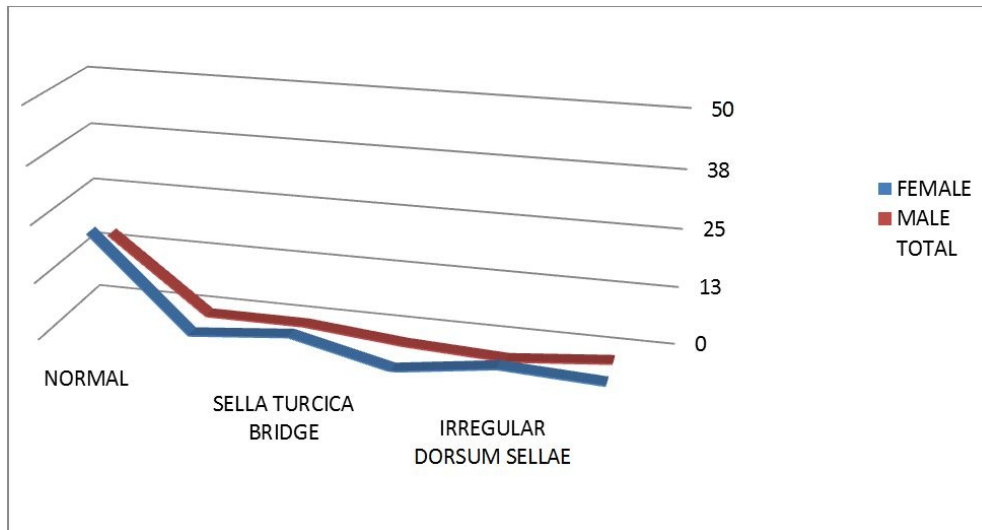
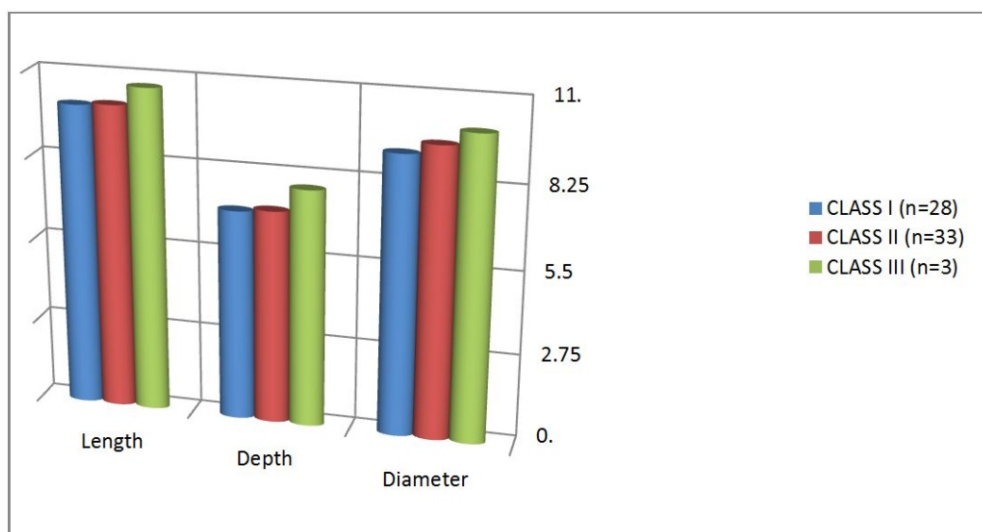


FIGURE 1: CEPHALOMETRIC RADIOGRAPHS SHOWING BIMAXILLARY PROTRUSION IN SKELETAL CLASSES II AND III WITH AN INTERINCISAL ANGLE OF 90° AND 99° RESPECTIVELY



$P > 0.05$, $DF = 5$

FIGURE 2: ASSOCIATION BETWEEN SELLA TURCICA SHAPE AND GENDER



$P > 0.05$

FIGURE 3: ASSOCIATION BETWEEN BIMAXILLARY SKELETAL CLASSES AND SELLA TURCICA DIAMETERS.

TABLE 2: ASSOCIATION BETWEEN SELLA TURCICA SHAPES AND BIMAXILLARY PROTRUSION CLASSES I, II AND III

Shape	Skeletal Classes						Total	
	Class I		Class II		Class III		No	%
	No	%	No	%	No	%		
Normal	18	42.9	22	52.4	2	4.8	42	100
Oblique anterior Wall	1	16.7	5	83.3	0	0.0	6	100
Sella Turcica Bridge	4	50.0	3	37.5	1	12.5	8	100
Double contour	0	0.0	1	100.0	0	0.0	1	100
Irregular Dorsum Sellae	2	66.7	1	33.3	0	0.0	3	100
Pyramidal Shape	3	75.0	1	25.0	0	0.0	4	100
Total	28	43.8	33	51.6	3	4.7	64	100

P>0.05, df=10

Bimaxillary protrusion was most prevalent in a normal sella turcica shape in skeletal classes I, II and III in 28 (43.8%), 33 (51.6%) and 3 (4.7%) respectively. Table 2 demonstrates the association between sella turcica shapes amongst the skeletal classes with bimaxillary class II exhibiting the highest number with 22 (52.4%) in a normal sella turcica shape.

The age of the study participants was grouped into three: 12-15-years (n=23), 16-25-years (n=28) and 26-30-years (n=13). Table 3 shows a one way analysis of variance between the various age groups and sella turcica dimensions

The dimensions of the sella turcica were longest in class III with mean values of 10.67mm ±0.577 (length), 7.83mm ±2.466 (depth) and 10.0mm ±1.732 respectively. This was however not statistically significant. The association between bimaxillary protrusion in the three skeletal classes and sella turcica dimensions is demonstrated in figure 3.

DISCUSSION

Malocclusion is prevalent amongst the three skeletal classes and also in bimaxillary protrusion which is a common orthodontic

problem in our environment¹⁻⁵. This study identified bimaxillary protrusion to be prevalent in all three skeletal classes. While studies by Isiekwe^{1,11} demonstrated values for Nigerians with bimaxillary protrusion of ≤ 107°, this current study agreed with this finding with a mean interincisal angle value of 100.16 ±7.004°. Other studies on bimaxillary protrusion however did not evaluate the association between the interincisal angle and sella turcica dimensions^{5,6}.

This present study demonstrated a mean length of the sella turcica in bimaxillary protrusion as 10.05±2.029mm. This is at variance with other studies⁷ where the mean length was 8.67±2.94mm. The values recorded from this current study of the mean depth and diameter of the sella turcica in bimaxillary protrusion patients was 7.05±1.759mm and 9.41±1.889mm. When compared with the other study⁷, the difference was also at variance with the results from this current study. Variations in dimensions of the sella turcica have been identified across ethnic lines and could be the factor attributable for this differences⁵⁻⁸.

This study identified three age groups and

analysed this with the sella turcica dimensions. The results revealed no significant differences in all age groups studied. Also, the mean length, depth and diameter from this study were close to the values obtained from a similar study¹⁵ but differed from the results obtained in other studies⁷

Bimaxillary protrusion has been identified by the interincisal inclination and angulation in Africans¹ and Afro-American² and Afro-Caribbean³ populations. While other studies have generalized bimaxillary protrusion⁷ this study identified the prevalence in skeletal classes I, II and III. This current study demonstrated that skeletal class II was most common in bimaxillary protrusion. This appears to agree with the observation from another study¹² where features of bimaxillary protrusion were suggested. While other studies¹³⁻¹⁴ focused on class I skeletal patterns for bimaxillary protrusion, this study identified Classes I, II and III cases also. Class III bimaxillary protrusion was seen in this present study but in a small number.

Other studies identified and correlated only skeletal pattern and sella turcica shapes^{5-7, 15} but this current studied correlated sella turcica shapes in bimaxillary protrusion patients in the three skeletal classes. The findings from this study revealed the highest prevalence of a normal sella turcica shape in the three skeletal classes. While these other studies^{5-7, 15} identified a normal shape as most prevalent which is in agreement with this study, theirs did not differentiate the prevalence for skeletal classes I, II and III bimaxillary protrusion. This study revealed skeletal class III bimaxillary protrusion in only two shapes namely, the normal and in the sella turcica bridge. While other studies^{6, 7, 15} identified a sella turcica bridge in 7.9%, 9.2% and 2.8% respectively, this finding was not in agreement with the results of this study where a prevalence of 12.5% was seen. This is probably due to the fact that some studies limit bimaxillary protrusion to a skeletal class I or II relationship^{12-14, 16}. The most predominant variation in shape from other

studies was the oblique anterior wall⁵⁻⁸. This study however demonstrated this shape in 9.4% which is far below the number recorded in other studies⁵⁻⁸. While other studies correlated the sella turcica shapes to skeletal class I, II and III normal patients^{5, 6}. This study correlated only sella turcica shapes in bimaxillary protrusion cases in the three skeletal patterns hence the possible reason for the variation.

CONCLUSION:

The mean dimensions of the sella turcica in bimaxillary protrusion differs from those of normal patients. The prevalence of sella turcica bridge in bimaxillary protrusion was 12.5%. While the Skeletal class I bimaxillary protrusion did not record the double contour shape, the Skeletal class II bimaxillary protrusion recorded the six shapes of the sella turcica. The Skeletal class III bimaxillary protrusion did not exhibit shapes in the oblique anterior wall, the double contour shape, irregular dorsum sellae and the pyramidal shape.

REFERENCES:

1. Isiekwe M. A. Cephalometric study of incisor angulations in a Nigerian population. *BJO* 1989; 16(3):177-181.
2. Bills DA, Handelman CS, BeGole EA. Bimaxillary dentoalveolar protrusion: Traits and orthodontic correction. *Angle Orthod* 2005; 75(3):333-339.
3. Carter NE, Slattery DA. Bimaxillary Proclination in Patients of Afro-Caribbean origin. *BJO* 1988; 15(3):175-184.
4. Isiekwe M. Prevalence of bimaxillary protrusion in a Nigerian population. *Odonto-Stomatologie Tropicale* 1990; 13(1):9-12.
5. Alkofide EA. The shape and size of the sella turcica in skeletal Class I, Class II and Class III Saudi subjects. *Eur J Orthod*

-
- 2007;29:457-463.
6. Ize-Iyamu IN. Sella turcica types in skeletal class I, II and III orthodontic patients in Benin City, Nigeria. *WAJM* 2015;34(3):161-171.
 7. Otuyemi OD, Fadeju AD, Adesina BA, Otuyemi DO. A Cephalometric analysis of the morphology and size of sella turcica in Nigerians with normal and bimaxillary incisor protrusion. *JWACS* 2017(7);2:
 8. Axelsson S, Storhaug K, Kjaer I. Post-natal size and morphology of the sella turcica. Longitudinal cephalometric standards for Norwegians between 6 and 21 years of age. *Eur J Orthod* 2004;26:597-604.
 9. Silverman FN. Roentgen standards for size of the pituitary fossa from infancy through adolescence. *Am J Roentgenol Radium Ther Nucl Med* 1957;78:451-460.
 10. Steiner CC. Cephalometrics in clinical practice. *Angle Orthod* 1959;29:8-29.
 11. Isiekwe MC, Sowemimo GO. Cephalometric findings in a normal Nigerian population sample and adult Nigerians with unrepaired clefts. *Cleft palate J* 1984;21:323-328.
 12. Keating PJ. Bimaxillary protrusion in the Caucasian: a cephalometric study of the morphological features. *Br J Orthod.* 1985; 12:193-201.
 13. Zhang J, Qiao M. Cephalometric analysis of the patients with bimaxillary protrusion in south China [in Chinese]. *Hua Xi Kou Qiang Yi Xue Za Zhi.* 2001;19:32-34.
 14. Hussein E, Mois MA. Bimaxillary Protrusion in the Palestinian Population. *Angle Orthod* 2007; 77(5):817-820.
 15. Ize-Iyamu IN. Sella turcica shape, linear dimensions and cervical vertebrae staging in preorthodontic patients in Benin City, Nigeria. *Sahel Med J* 2014;17(4):151-159.
 16. Sivakumar A, Sivakumar I, Sharan J, Kumar S, Gandhi S, Valiathan A. Bimaxillary protrusion trait in the Indian population: A cephalometric study of the morphological features and treatment considerations. *Orthodontic Waves* 2014; 73(3): 95-101.