Cephalometric Analysis of Sella Turcica for Age Determination from Sokoto, Nigeria: A Radiological Study

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Authors' contributions

This work was carried out in collaboration among all authors. Author ZU designed the study, authors IMA, SSB and BOO performed the statistical analysis. Authors MAM, TA and AA wrote the protocol, and authors JDU and AB wrote the first draft of the manuscript. Authors AMA, GBM, UA and HAB managed the analyses of the study. Authors RB and ZU managed the literature searches. Final manuscript review was done by authors GHY and ADZ. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Cephalometry deals with the measurement of the head or radiological specimen of the head. Sella turcica is an important anatomical structure located in the middle cranial fossa, housing the pituitary gland. Various shapes and sizes of the sellae turcica have been reported. However, in this study, using computerized tomographic (CT) scans, one hundred and seventy-five (175) scans were

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analyzed using Radiant version 4.2 for determination of sizes and shapes of the sella. Average dimensions from the study include length (12.4mm), A-P diameter (14.1 m), depth (9.6 mm) and transverse diameter (13.8mm). Shapes were classified as being round (56.6%), oval (32%) and flat (11.4%). Males tend to have higher sella sizes than females and there are statistically significant differences between them especially in respect to A-P diameter and length parameters. Also, there is a statistically significant relationship between age groups in terms of A-P diameter and depth of the sella turcica. However, there is no correlation between age and shapes found in the study.

1. INTRODUCTION

Cephalometry can be defined as an aspect of anthropometry that deals with the measurement of human parts such as head and face in cadavers, living subjects or radiological specimen through the use of imaging modalities [1]. The various variables measured in anthropometry include; weight, height, length, widths & thickness of the various parts of the body. These indices are used for forensic analysis as well as gender, race and age determination [2]. Sella Turcica is an important anatomical structure that lies at middle cranial fossa of the skull, containing the pituitary gland. It derives its name from the comparative shape to Turkish saddle [3]. The despondency in the saddle is distinguished as pituitary fossa or hypophyseal fossa while the pituitary gland is located in the fossa. Sella turcica is bounded anteriorly by tuberculum sellae, posteriorly by dorsum sellae and inferiorly by the bony roof of the sphenoidal air sinus. [4,5,6,7]. There are 2 (two) anterior and two (2) posterior clinoid processes. The anterior clinoid process is derived from anterior and medial projections of the lesser wing of the sphenoid bone, while posterior clinoid process stands for termination of dorsum sellae [4,8,9,10]. Computerized Tomographic Scan (CT Scan) refers to ionizing radiation that is made up of an X- rays which can be used for image reconstruction using a computer. However, the CT Scan has lower radiation toxicity and more costly compared to simple radiograph [11,12].

Empty sella syndrome is one of the causes of sella enlargement. It is defined as the intrasellar herniation of suprasellar subarachnoid space [13,14,9]. It is shrinking or flattening of the pituitary gland as a result of cerebrospinal fluid pressure on the gland. It disappears on Computerized Tomography (CT) or Magnetic Resonance Image (MRI) scan and therefore called "empty sella syndrome". It can be classified into primary or secondary type. The primary type occurs if the arachnoid layer herniates into the fossa hypophysis while secondary type occurs due to conditions like tumour and radiation etc [15].

CT evaluation of sella turcica is clinically relevant in the following areas:

– Planning of neurosurgical operations related to pituitary gland abnormalities and diseases [16]
– Establishment of baseline data [17,18]
– Orthodontic treatment evaluation [19]
– Evaluation of sella turcica abnormalities and other craniofacial defects [20].

1.1 Aims and Objectives

This study aims to determine age from Sella Turcica cephalometry using computerized tomography (CT) from Tertiary Hospital in Sokoto, Nigeria.

The specific objectives are to:

1. Establish basic dimensions (length, depth and AP diameter) of sella turcica using CT scan amongst residents of Sokoto (study population)
2. Determine the presence of anatomical variations of sella turcica in the study population.
3. Compare and contrast the various measurements obtained from the CT scan of sella turcica between genders.

2. MATERIALS AND METHODS

The study was conducted in line with Medical Research Ethics of Helsinki Declaration of 1975 (Revised 2008). Research Ethical approval was obtained from the Ethical Committee of Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria. All skull computerized tomography (CT)

scans were taken in the Radiology Department of Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto from 2013– 2017 (five years) was retrieved and used for the study. This was a retrospective cross-sectional study involved the use of One hundred and seventy-five (175) skull CT scans. All the computerized tomography (CT) scans were ensured to have been taken by a qualified radiographer(s) under standard condition. The scans were reported by the qualified radiologist to be normal.

2.1 Inclusion Criteria

CT scans selection for the study was based on the following criteria:

- Good and proper positioning of the subjects.
- Absence of sella turcica abnormality
- Clarity of sella turcica dimensions
- Reported normal by qualified Radiologist.
- Only CT Scans done during the study period were retrieved.

2.2 Exclusion Criteria

- Skull CT scans with a poor position of subjects.
- Skull CT scan with sella turcica Pathology.
- CT scans with poor quality of images.

- CT Scans with incomplete information.

2.3 Dimensions Measurement

Computerized Tomographic(CT) Scan images were obtained from a GE Bright Speed Multidectetor Helical CT (GE Healthcare, U.S.A, 2005) scanner with the following parameters: 200 mAs, 120 KVp, 15 cm Field of View (FOV), 2.5 mm slice thickness, 512 x 512 matrix and a standard reconstruction algorithm. Coronal and Axial images were obtained from the scanner. The images taken were those with the head of the patient in a horizontal position so that the Frankfort horizontal line was perpendicular to the table. The axial images were then reconfigured to sagittal reconstructed images for measurements using RadiAnt Version 4.2 (Medixant, 2017) Digital Imaging and Communication in Medicine (DICOM) software. Images were viewed on both soft tissue and bone windows. A qualified and experienced radiologist will provide the necessary training for the intake of measurements.

Based on Silverman [21] and Kisling [22], the following dimension will be measured to determine the size of the sella turcica. The reference lines used were situated in the mid-sagittal plane.
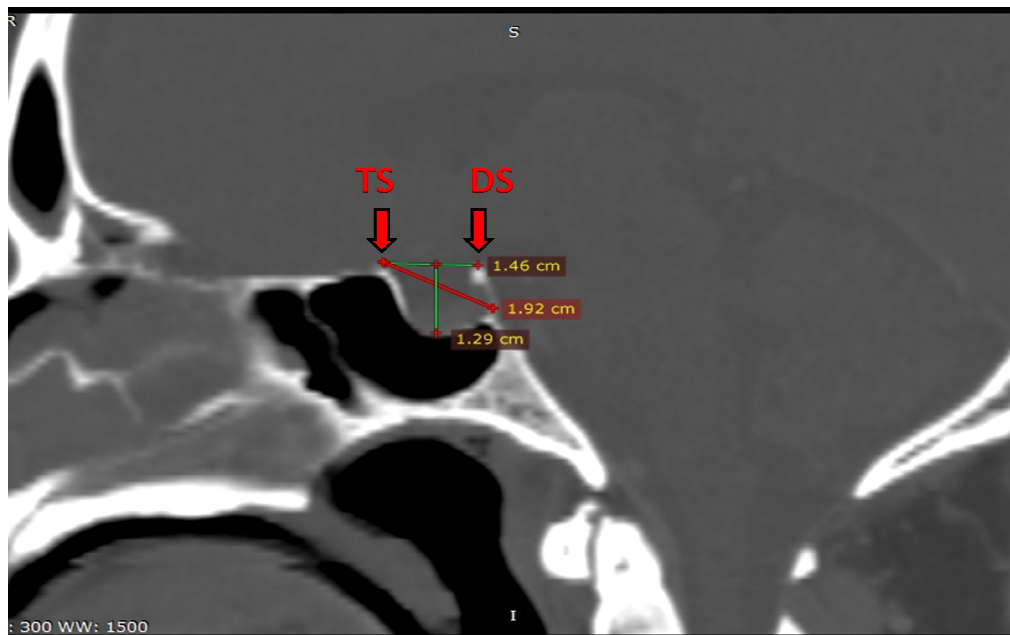

Fig. 1. Sagital CT slide of sella turcica of a 45-year-old male showing depth measurements
TS= Tuberculum Sellae, DS= Dorsum Sellae, BPF = Base of the Pituitary Fossa

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2.3.1 Length of sella turcica

This was measured between the tip of the tuberculum sellae (TS) to the tip of dorsum sellae (DS). It was done according to Silverman methods [21].

2.3.2 Depth of sella turcica

This was obtained from measuring a perpendicular line from the length above to the deepest point on the floor of the fossa; that is the base of the pituitary fossa (BPF). This was done according to methods devised by Silverman [21].

2.3.3 Antero-posterior diameter of the sella turcica (apd)

It was determined by taken measurement from the tuberculum sellae (TS) to the furthest point on the posterior inner wall of the pituitary fossa, below the dorsum sellae. This is also by following the method of Silverman [21].

2.3.4 Transverse diameter

It will be measured between the two (2) lateral walls of the sella turcica at their midpoints and the same level of measurement of length and A-P diameter but only on axial plane.

2.3.5 Shapes of sella turcica

Several shapes of Sella turcica were described by different workers. Principal variations of shapes established according to H.T. Martin [23].

2.4 Statistical Analysis

Data was sorted out, tabulated and then entered into the computer using Microsoft Excel manually. It was analyzed using SPSS Version 23.1. Statistical tests were employed for data analysis.

Comparison of mean values was done using student's t-test (Harry & Steven, 1995), while proportions were compared using the chi-square test. One-way ANOVA was used to compare the sella turcica size measurements across the different age groups.

Statistical significance was set at $p<0.05$.

3. RESULTS

One hundred and seventy-five (175) skull CTs of subjects with age ranging from 1 to 85 years were involved in this study. One hundred and twelve (112) subjects (64%) were males and 36% amounting to sixty-three (63) females. The male to female ratio was approximately 2:1.

3.1 Sella Turcica Dimensions

The mean length of sella turcica was 12.39 ± 2.66 mm, Antero-posterior (AP) diameter was found to be 14.12 ± 3.06 mm from the study, depth of 9.57 ± 2.30 mm and transverse diameter of 13.77 ± 3.67 mm. Statistical significance was set at < 0.05. This was shown in Table 1.

3.2 Comparison of Sella Dimension among the Different Age Groups

Table 2 shows Sella dimensions against various age groups in the study. Using one way ANOVA, Antero-posterior diameter and depth showed statistical significance of 0.001 and 0.01 respectably.

3.3 Comparison of Age Groups and Shape (traditional) Classification

Table 3 compares shape (traditional) variations with various age groups. One way ANOVA showed no statistically significant association between them. Highest proportion seen in those with round shape, followed by an oval shape and the least observed was the flat shape.

3.4 Comparison of Age Groups and Shape (Modern Classification) Variation

Table 4 compares shape (modern) variations with various age groups. One way ANOVA showed no statistically significant association between them. Highest proportion seen in those with normal shape followed by anterior oblique, pyramidal, double contour floor, notching on the posterior wall and the least observed was Sella Bridge.

Table 1. Basic dimensions of sella turcica

Parameter	Mean (mm)	Standard deviation	P value
Length	12.4	12.39 ± 2.66	0.001
A-P diameter	14.1	14.12 ± 3.06	0.03
Depth	9.6	9.57 ± 2.30	0.85
Transverse diameter	13.8	13.77 ± 3.67	0.439

*One way ANOVA: Data are expressed as mean (SD). * Statistically significant at p < 0.05 within the parameters of length, AP diameter, Depth and Transverse diameter*

Table 2. Comparison of sella dimension among the different age groups

Age group	AP (mm)	Length (mm)	Depth (mm)	Transverse (mm)
1-10	12.01 ± 3.14	11.65 ± 2.92	7.91 ± 1.94	12.54 ± 3.90
11-20	12.89 ± 2.84	11.4 ± 2.74	9.3 ± 1.85	13.63± 3.30
21-30	15.16 ± 2.58	13.11 ± 2.12	10.31 ± 1.94	13.83 ± 4.20
31-40	14.12 ± 2.12	12.26 ± 1.93	9.15 ± 2.18	14.30±2.40
41-50	14.74 ± 3.51	12.52± 3.56	9.77 ± 2.59	13.87 ±3.37
51-60	15.50 ± 2.50	13.0 ± 2.23	10.44 ± 2.12	13.80 ± 4.71
61-70	15.23 ± 2.60	13.23 ± 2.24	10.27 ± 2.43	14.43 ± 3.24
71-80	13.36 ± 3.31	11.9 ± 2.02	9.60 ± 1.63	13.76 ± 3.12
81-90	16.3 ± 0.00	12.60± 0.00	12.60 ± 0.00	15.10 ±0.00
P-value	0.001	0.171	0.01	0.834

One way ANOVA. p < 0.05. Data expressed as mean (±S.D). There were statistically significant differences between age groups and A- P diameter (0.001), Depth (0.01) parameters of subjects used in the study

Table 3. Comparism of age groups and shape (traditional) classification

Age group	Flat	Oval	Round	Total
1-10	11 (40.7%)	05 (18.5%)	11 (40.7%)	27 (100%)
11-20	05 (15.6%)	09 (28.1%)	18 (56.3%)	32 (100%)
21-30	01 (4.0%)	09 (36%)	15 (60%)	25 (100%)
31-40	01 (5.6%)	06 (33.3%)	11(61.1%)	18 (100%)
41-50	01 (4.2%)	07 29.9%)	16 (66.7%)	24 (100%)
51-60	01 (4.5%)	11 (50%)	10 (45.5%)	22(100%)
61-70	0 (0%)	07 (35%)	13 (65%)	20 (100%)
71-80	0 (0%)	01 (20%)	04 (80%)	05 (100%)
81-90	0 (0%)	01 (50%)	01 (50%)	02 (100%)

One way ANOVA. P < 0.05. There was   no statistically significant differences between age groups and shape (traditional classification) variations observed in the subjects used in the study

Table 4. Comparism of age groups and shape ii (modern classification) variation

Age group	Sella bridge	Double contour floor	Normal	Notching on posterior wall	Anterior oblique	Pyramidal	Total
1-10	0 (0%)	03 (11.1%)	14(51.9%)	02 (7.4%)	07 (25.9%)	01(3.7%)	27 (100%)
11-20	01 (3.1%)	03 (9.4%)	21 (65.6%)	02(6.3%)	05 (15.6%)	0 (0%)	32 (100%)
21-30	02 (8%)	01 (4%)	19 (76%)	0 (0%)	01 (4%)	02 (8%)	25(100%)
31-40	0 (0%)	0 (0%)	14 (77.8%)	01 (5.6%)	02 (11.1%)	01(5.6%)	18 (100%)
41-50	02 (8.3%)	02 (8.3%)	18 (75%)	0 (0%)	01 (4.2%)	01 (4.2%)	24 (100%)
51-60	02 (9.1%)	0 (0%)	16 (72.7%)	02 (9.1%)	0 (0%)	02 (9.1%)	22 (100%)
61-70	01 (5%)	01 (5%)	14 (70%)	01 (5%)	0 (0%)	03 (15%))	20 (100%)
71-80	0 (0%)	0 (0%)	03 (60%)	01(20%)	0 (0%)	01 (20%)	05 (100%)
81-90	0 (0%)	0 (0%)	01 (50%)	0 (0%)	0 (0%)	01(50%)	02 (100%)

One way ANOVA. p < 0.05. There were no statistically significant differences between age groups and shape (modern classification) variations observed in the subjects used in the study

4. DISCUSSION

This study was able to establish a non-significant relationship between age and sella turcica dimensions. It was in agreement with several scholars[24-27,28,29,30,31,32] who stated that there is a linear progression of the sella sizes as age progresses to the third (3rd) decade of life and the declines [33,34,35]. Also, anteroposterior (A-P) diameter and depth showed statistically significant differences between the age group.

5. CONCLUSION

This study was able to established basic dimensions of sella turcica using computerized tomography (CT) cephalometry (length, AP diameter, depth and transverse diameter). It was also able to established shape variations either classified into round, oval and flat or classified into normal, anterior oblique, pyramidal, double contour floor, posterior wall notching and sella bridge. There are statistically significant differences between the sella dimensions of

males and females, especially with AP and length parameters [36,9]. And males have greater sella dimensions than that of females [18,19,36,32]. There is no statistically significant relationship between shapes and sizes among the various age groups in the study [36,37].

CONSENT

It is not applicable.

ETHICAL APPROVAL

The study was conducted in line with Medical Research Ethics of Helsinki Declaration of 1975 (Revised 2008). Research Ethical approval was obtained from the Ethical Committee of Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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