Computerized Tomographic Assessment of the Normal Dimensions of the Sella Turcica in Adults in Benin City Edo State Nigeria

Catherine N OBASIKENE[1], Adenike O AKHIGBE[2], Chisolum O. OKAFOR[3], Michael E. ARONU[4]

ABSTRACT

Background: The sella turcica is a saddle-shaped structure in the sphenoid bone and it houses the pituitary gland within the pituitary fossa. The size of the sella turcica varies from individual to individual and the establishment of the normal standards will aid in the process of detecting variation from normality in this region. Computed Tomography (CT) is a preferred imaging modality in the study of sella turcica morphometry. **Objectives:** This study aims to determine the normal dimensions of the sella turcica using a CT-scan at different planes in an adult population in Benin City, and to assess the possible determinants of its size. **Methodology:** This was a prospective study of CT measurement of the normal dimensions of sella turcica in adults which was carried out at the University of Benin Teaching Hospital, Benin City. The sella turcica was measured on the monitor in different planes using a GE Bright speed series CT scanner. Data collected was analyzed using Statistical Package for Social Sciences version 16.0. The relationship between the dimensions of sella turcica with age, sex, weight, height and body mass index were analyzed using Pearson correlation(statistical significance at $p<0.05$) **Result:** The mean values for the dimensions of sella were 1.08±0.10 cm for height, 1.87±0.12 cm for width and 1.70±0.35 cm for length. There was no correlation found between the dimensions of the sella turcica and body biometrics. **Conclusion:** The normal reference values for description of the CT dimensions in Benin City were established.

Keyword: Sella Turcica, Computed Tomography, Pituitary gland, Normal measurements

INTRODUCTION

The Sella turcica is a cup-like depression or saddle shaped concavity in the intracranial portion of the sphenoid bone. The seat of this saddle known as the hypophyseal fossa houses the pituitary gland. This fossa which houses the pituitary gland is surrounded by many other structures of great anatomical and physiological importance.

The anterior border of the sella turcica is tuberculum sella which ends at the anterior clinoid process while the posterior border the dorsum sella ends at the posterior clinoid process and is continuous with the clivus inferiorlaterally.[1] Lying above the pituitary gland is a cerebro spinal fluid (CSF) space, the suprasella cistern which contains the optic chiasma.

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The dimensions of the sella turcica have clinical significance since its morphology reflects to some extent that of the pituitary gland. The dimensions and volume of the sella turcica have been evaluated in different populations with some variations noted in these studies. Usman *et al.* examined healthy adults in Sokoto, Northern Nigeria and revealed that the mean size of the length, depth, AP and transverse diameters were 12.4mm, 9.6mm, 14.1mm and 13.8mm respectively.[2] Chilton *et al.* in their study in America on healthy individuals reported that the volume of sella turcica increases as age progresses with larger volumes in males than in their female conterparts.[3] Another study on Norwegian adult reported that the length, depth and diameter of the sella varies from 6.2 mm to 12.1 mm, 4.9 mm to 9.6mm and 8.4 mm and 13.5 mm respectively.[4] These discrepancies among the various measurements might be probably due to the use of different landmarks for measurements, different radiographic techniques, race, ethnicity and methodology.

Plain skull radiographs were routinely used to study the sella turcica in the past. However, it has a low sensitivity and specificity in the detection of some pathological conditions, hence the choice of computerized tomographic assessment of the sella turcica which gives better characterization of the normal anatomy and pathologic processes of the sella turcica region.[5] Computerised tomography scan is believed to be an excellent imaging modality of choice for imaging the sella turcica while magnetic resonance imaging (MRI) gives better delineation of the anatomy of the pituitary gland.[6] The sella turcica and its surrounding can be examined both on axial and coronal CT sections.

The knowledge of its normal dimension is needed for the diagnosis of some pathological conditions. Thus, the aim of this study is to determine the normal dimensions of the sella turcica using CT-scan at different planes, in an adult population in Benin City and to assess the possible determinants of its size.

METHODOLOGY

This was a prospective non-experimental study of the sella turcica using CT, and was carried out in the Radiology Department of the University of Benin Teaching Hospital (UBTH) Benin City, Edo State Nigeria over a period of six months, from October 2012 to March 2013. This study was approved by the ethics committee of UBTH. Subjects were selected from adult patients that were routinely booked for CT examination of the brain in the Radiology Department of the hospital aged 18 years and above who were eventually found to have normal CT scan findings.

After the procedure was explained to the subjects, a written informed consent was obtained before the commencement of the procedure. Subjects were well positioned on the CT gantry by the radiographer and then immobilized using straps to steady the head and the trunk. Images were obtained using a GE four slice scanner Bright speed series (General electrical company, USA), Hangwei Medical System Company Limited Beljing China. Scanogram was obtained and 2.5 mm axial cuts were taken from the base of the skull to the vertex. The consented subjects with the normal findings after the investigation had their height and weight taken. Sagittal and coronal reconstructions were done to take the measurements. In direct coronal sections, the hypothalamus, pituitary gland, suprachiasmatic recess, sella floor, and the nerves transversing the cavernous sinus are visualized. The size of the sella turcica (length and height) was obtained in accordance with the method used by Ruiz and Wafae.[7] The length of the sella turcica was measured on the axial cut through a line that superiorly connects the tuberculum sella to the dorsum sella (as shown in figure 1a and illustrated as Line TD, Figure 1b).

The height was measured on the sagittal cuts using the reconstructed image closest to the medial sagittal plane, measuring the height with a perpendicular line extending from the midpoint of the dorsum and tuberculum sella to the floor of the sella turcica (as shown in figure 2a, illustrated as line yz, Figure 2b).The width was measured as the most lateral

aspects of the sella on the coronal reconstructed image (as shown in figure 3a,illustrated as Line xy ,Figure 3b) The volume of the hypophyseal fossa was calculated using the formula suggested by Nelson and Dichiro.[10] Volume = 1/2(length x width x height) in cm^3.

Data collected was analyzed using Statistical Package for Social Sciences version 16.0. The relationship between the dimensions of sella turcica with age, sex, weight, height and body mass index were analyzed using Pearson correlation(statistical significance at $p<0.05$)

Figure 1. An axial CT image of the brain at the level of the sella turcica (a) bone window (b) sketched diagram. T = Tuberculum sella, D=Dorsum sella, P = Pituitary fossa, F = Frontal sinus line TD =length of sella turcica

Figure 1b Images generated by the author

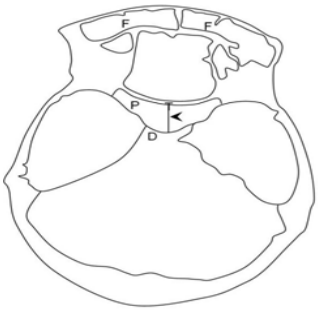

Figure 2. Midline saggital reconstruction of sella turcica (a) bone window (b) sketch diagram
(T= Tuberculum sella, D = Dorsum sella, S = Sphenoid sinus, C = Clivus, line yz =height of sella turcica

Figure 2a

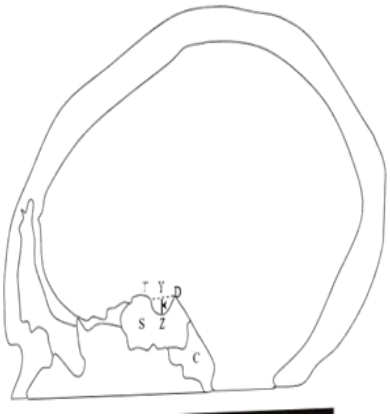

Figure 2b

Figure 3: Coronal reconstruction of the sella turcica (a) bone window; (b) line diagram:
S = Sphenoid sinus, D = Dorsum sella), line xy = width of sella turcica

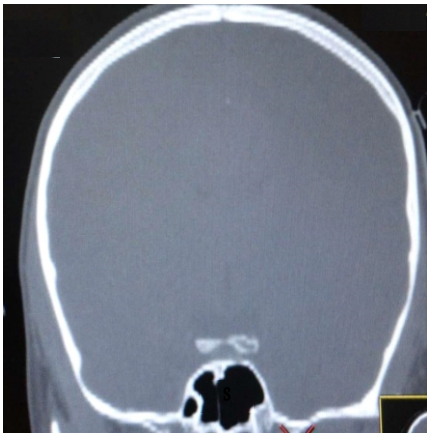

Figure 3a

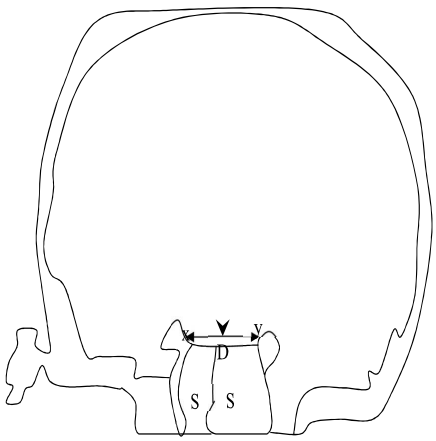

Figure 3b

RESULTS

This result comprises of normal cranial CT images of four hundred patients recruited from among the patients referred to the radiology department for cranial CT examinations. Two hundred and eleven patients (52.8%) were males while one hundred and eighty-nine were females (47.2%).

The age ranged from 18 years to 65 years with mean age of 42 ±1.35 years and the modal age range were 48-57 years. Table 1 shows the age range distribution of the study population.

The range and mean for dimensions of the sella turcica respectively were: the height; 0.79-1.35 cm and 1.08 ± 0.10 cm; the width; 1.60– 2.53 cm and 1.87 ± 0.12 cm; the length; 1.0 – 2.5cm and 1.70 ± 0. 21 cm and the volume were 1.04– 3.82 cm3 and 1.70 ±0.35 cm3 as shown in table 2. Pearson correlation showed that there was no correlation between the length, width, and height of the sella turcica with the patients' age, height weight and BMI (table 3). An independent t-test showed no statistically significant difference between the sella dimensions in males and females (Table 4).

Table 1: Age Range of study population

Age groups (years)	Sex		Percent (%)
	Males	Females	
18-27	46	39	21.25
28-37	32	32	16.00
38-47	40	41	20.25
48-57	63	51	28.50
58-67	30	26	14.00
Total	211	189	100

Table 2: Descriptive Statistics of sella turcica dimensions

Descriptive Statistics	Height (cm)	Width (cm)	Length (cm)	Volume (cm3)
Mean	1.08±0.10	1.87 ±0.12	1.70±0.21	1.69
Median	1.10	1.82	1.64	1.64
Mode	1.10	1.80	1.60	1.58
Minimum	0.79	1.60	1.0	1.04
Maximum	1.35	2.53	2.5	3.82

Table 3: Summary of statistical correlation between dimensions of the sella turcica and age, weight, height and BMI showing the P-value and Pearson correlation coefficient

		Age(years)	Weight(kg)	Height(M)	BMI(Kg/m2)
Height(cm)	Pearson Correlation(r) P-value	.086 .234	.014 .843	.088 .220	-.025 .734
Width(cm)	Pearson Correlation(r P-value	-.065 .371	.016 .827	.187 .190	-.082 .256
Length(cm)	Pearson Correlation(r P-value	.041 .571	.087 .225	.140 .150	.032 .662

P- value significant at 0.05

DISCUSSION

The central position of the sella turcica at the base of the skull and its association with physiological changes and pathological conditions in the pituitary gland may explain the observed variations in the sella dimensions.

The dimensions of the sella turcica found in this study were, the mean of 1.08±0.10 cm for height, 1.87 ± 0.1cm for width and 1.70 ±0.21cm for length. A study on shapes and sizes of sella turcica using CT scan done in Sokoto, northern Nigeria recorded that the mean size of the length, depth, AP and transverse diameters were 12.4mm,9.6mm,14.1mm and 13.8mm respectively.[2] Another study by Ogunnaike *et al.* in adult population in Lagos Nigeria recorded mean values of 9.88mm, 11.51mm and 8.61mm for length, AP diameter and depth respectively.[9] These values are slightly lower than that noted in this study. In a study done in African population in Ethiopia documented mean length of 10.46mm which is lower than the dimension of the length in this study.[10] However, they recorded a higher mean volume of 536mm^3. A study in Caucasian population in Jordan recorded lower values of 7.68mm, 6.32mm and 8.72mm for length, height and width respectively.[13] Sathyanarayana *et al*[14] in Indian population also recorded lower values of 9.1mm, 7.3mm and 10.9mm for length, width and diameter respectively. Other studies on dimensions of the sella turcica using lateral plain skull radiographs noted different values that are also lower than the values in the present study. Alkofide *et al.* examined healthy Saudi subjects using plain radiography and revealed that the mean size of the length, depth and diameter were 10.7 mm, 8.9 mm and 13.4 mm respectively.[13] These differences in the sella dimensions could be due to different imaging modalities and methods of measurements used. The ethnicity of the study population may have contributed significantly. There were no statistically significant relationships between the dimensions of the sella with the patient's biometrics in this study and no statistically significant difference in sella dimensions between males and females was recorded in this study which is similar to the findings in some studies done in Nigeria and in Caucasian population.[9,13,14.]

Previous studies on the sella dimensions in younger age groups documented that there was a progressive increase in the dimensions of sella turcica at puberty which slows down and ceases in the late teens or early adulthood.[15] Choi *et al.* reported on the size and shapes of normal sella turcica in 200 Korean orthodontic patients between the ages of 6 and 42 years. He noted that the dimensions of the sella increased steadily with age up to 25 years after which there was no significant increase found.[16]The findings in the present study that shows no statistically significant relationship between the sella dimensions and body biometry in the study population could be because all the patients in the present study were post-pubertal and probably have attained the maximum size of their sella turcica.

The mean volume of the sella in this study 1.70cm^3. A study in Caucasian population recorded mean volume of 342mm^3, which is higher than the value recorded in this study.[17] The differences between the values in these studies could be due to the different ethnic compositions of the study population the imaging modalities and the methods of calculation of the volume.

CONCLUSION

There is no correlation between the dimensions of the sella turcica with age, weight, height and BMI in both males and females. This result can serve as a reference in the description of CT dimensions of the sella turcica in Benin City.

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