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Sella Turcica Dimensions and Morphology in a Yoruba Ethnic Population: A Computed Tomography Study

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ABSTRACT

Background: Several sellar and *parasellar* pathologies affect the size and shape of sella turcica. A deviation from normal dimensions of sella turcica could be an indication of a pathological condition of the structure itself or the pituitary gland.
Aim: This study was designed to assess the dimensions and morphology of the sella turcica of Yoruba ethnic population using cranial computed tomography (CT) images.
Materials and Methods: This was a retrospective study involving 321 cranial CT images of the Yoruba subjects acquired in a tertiary health institution between January 2020 and April 2021. The sella turcica length, depth and anteroposterior diameter were measured using the digital calipers of the CT system while sella morphological shape was determined qualitatively by observing the floor of sella in the midsagittal slice and quantitatively by taking the ratio of superoinferior diameter to the transverse diameter.
Result: In general, the mean and standard deviation value of sella turcica length was 12.2±`2.35mm. The mean sella length for males was 12.62`±2.50 and that for females was 11.69 ±`2.04mm. The result showed that males' sella length differed significantly from that of females (t=3.635, p=0.000). A significant difference was noted between the sella depths of the two genders (p=0.032). The total mean anteroposterior diameter (APD) of sella turcica was 13.4`± 2.47mm. Male and female mean diameters were 13.6`± 2.45mm and 13.3±`2.17mm respectively. No significant difference was noted in sella length and APD across the age categories but sella depth showed a significant difference, which was noted to only exist between early adulthood (≤34 years) and late adulthood (≥65) (p=0.027). No statistically significant association was noted between sella shape and gender (χ^2=3.124, p=0.210) as well as age (χ^2=9.336, p=0.156).
Conclusion: Only the mean sella length and depth differ significantly between male and female genders. Anteroposterior diameter is the same irrespective of gender. The sella turcica dimensions obtained from this study will serve as reference values for physicians in the assessment of sellar and parasellar pathologies in the study population.

Keywords: Computed tomography, sella turcica, morphology.

INTRODUCTION

Sella turcica is the saddle-like bony formation on the upper surface of the body of the sphenoid, which is surrounded by the anterior and posterior clinoid processes. The four clinoid processes (two anterior and two

posteriors) surround the hypophysial fossa (pituitary fossa), which houses the pituitary gland. The pituitary gland which is housed by sella turcica is a very important endocrine gland whose hormones regulate the functions of many other glands and systems of the body. Sella turcica is also used as an important reference point in orthodontics and the cephalometric analysis of the neurocranial and craniofacial complex (1, 2). Several sellar and parasellar pathologies affect the size and shape of the sella turcica. A deviation from normal dimensions of sella turcica could be an indication of a pathological condition of the structure itself or the pituitary gland. A large size might be an indication of the pituitary tumour while a smaller size on the other hand can be an indication of the pituitary hypoplasia. There are various linear and non-linear parameters used by investigators to assess the size of sella turcica. The most commonly used linear dimensions are Sella length (SL), Antero-posterior diameter (APD) and the Depth (D)(3). The non-linear measurement of sella turcica size includes area and volume (4). The upper limit of normal for the maximum anteroposterior diameter of the sella is 17mm. The depth measured perpendicular to the sella floor, from a line drawn between dorsum and tuberculum sellae, should not exceed 13 mm in most cases. The normal width varies between 10 and 15 mm. These are only guidelines and sella turcica enlargement can only be used as a suggestion of pituitary abnormality and is certainly not sufficient for diagnosis (4).

The morphological appearance of sella turcica is established in early embryonic structure. Variations in the shape of sella turcica have long been reported by many researchers. In one of the methods of assessment, the shape of sella turcica is classified into circular, oval, and flattened or saucer-shaped (2). In another method, the sella turcica is classified based on the contours of the sella floor, the angles formed by the contours of anterior and posterior clinoid processes and tuberculum sellae and the fusion of both clinoid processes as sella turcica bridge. Based on these, Axelsson *et al* (5), categorized sella turcica into six main types-Normal sella turcica, oblique anterior wall, double contoured sella, irregularity (notching) in the posterior part of the sella, pyramidal shape of the dorsum sellae, and sella turcica bridge (2).

Various studies have been carried out on assessment of sellar dimensions and morphology using different methods such as cephalometric radiographs and computed tomography images but none with CT has been carried out on the Yoruba ethnic population. This is the gap this present study is aimed to bridge.

MATERIALS AND METHODS

This retrospective cross-sectional study was carried out in the Radiology Department of Obafemi Awolowo University Teaching Hospital, Ile-Ife, Osun State, Nigeria, after obtaining ethical approval (NHREC/27/02/2009a) from the Human Research and Ethics committee of Obafemi Awolowo University Teaching Hospital, Ile-Ife, Osun State. The relevant images of subjects of Yoruba origin scanned within the study period were retrieved from the archive but all the measurements were performed by the researcher (O.E.B). Cranial CT images of 321 subjects (188 males and 133 females) with ages ranging between 25 and 98 years were used in this study. The subjects were categorized into four age-grades, namely, early adulthood (≤34 years), early middle age (35-44 years), late middle age (45-64 years) and late adulthood (≥65 years). Only apparent healthy subjects as adjudged by the radiologist's reports and with no clinical history pointing to obvious sella turcica pathology were included in the study. Then the necessary measurements were carried out on the midsagittal slice using the measuring software of the General Electric 16-slice Revolution scanner used in the center.

Sella Turcica Dimensions and Morphology

The linear dimensions of sella turcica (length, depth and anteroposterior diameter) were measured according to the method used by Sathyanarayana *et al* (2) as follows:

1. Sella turcica length: the distance between the tuberculum sellae to the tip of the dorsum sellae.
2. Sella turcica depth: perpendicular distance from the intersellar line mentioned above to the deepest point on the floor of the pituitary fossa.
3. Sella turcica anteroposterior diameter: length of the line drawn from the tuberculum sellae to the furthest point on the posterior wall of the pituitary fossa.

The morphological shape of sella turcica

The morphological shape of the sella turcica was determined by observing the floor of the pituitary fossa at the midsagittal plane, adopting the method used by Yasin *et al* (6). This method was made quantitative by calculating the ratio of the distance of the longest superoinferior axis (D1) to that of the longest transverse axis (D2) of the pituitary fossa. A sella with a ratio of < 0.8 was considered as flattened, 0.8 - 1.2 as round or circular and > 1.2 as oval.

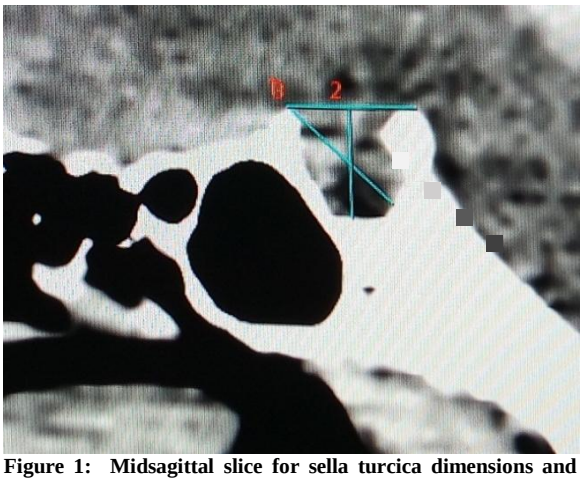

Figure 1: Midsagittal slice for sella turcica dimensions and morphology

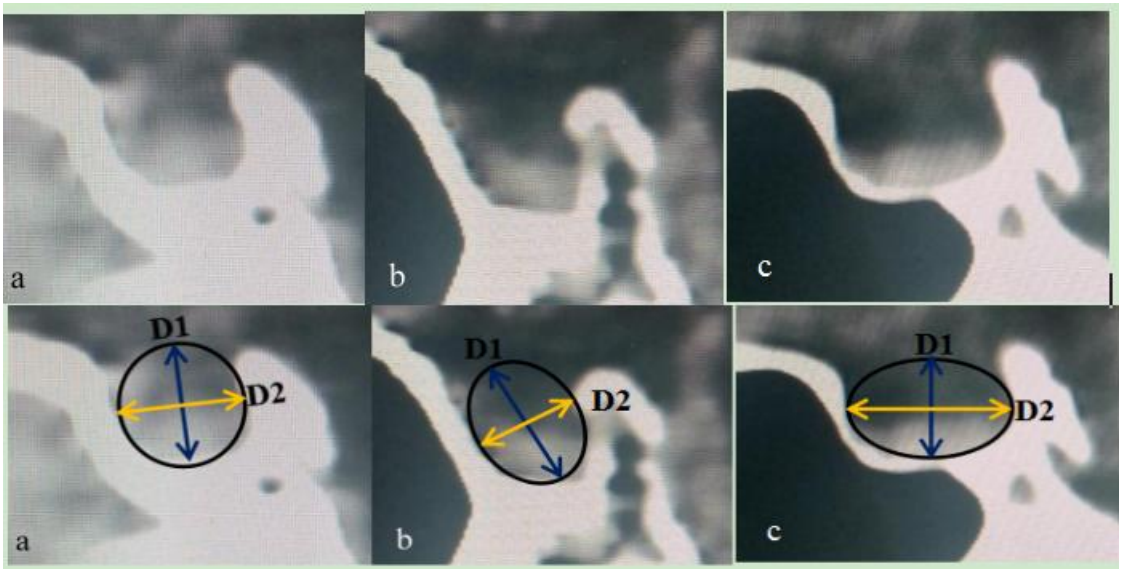

Figure 2: Different morphological shapes of sella turcica (a) Round (b) Oval (c) Flattened

Statistical Analysis

The data obtained from these measurements were subjected to statistical analysis using a statistical package for social sciences IBM SPSS 27. The data were analyzed descriptively for frequency, percentages, range, mean and standard deviation, and inferentially using independent sample t-test (or Mann Whitney U test), one-way ANOVA (or Kruskal Wallis Test) and Chi-square as appropriate. The level of statistical significance was set at $p< 0.05$.

RESULTS

Gender and Age Distribution of the Sample

The results illustrate that out of 321 subjects that constituted the study sample, 188 (58.6%) and 133 (41.4%) were males and females respectively. Of this, the majority 111 (34.6%) were of age 65 and above (late adulthood) and the least 49 (15.3%) were within the 25-34years (early adulthood) with the overall age of the subjects ranged between 25 and 98 while the mean age was 55±17 years (Table 1).

Test of Normality of the Relevant Parameters

Kolmogorov-Smirnov and Shapiro-Wilk tests for normality were positive (p-value >0.05) for sella length and anteroposterior diameter (APD) but negative for sella depth. Where both tests gave variant outcomes, the Shapiro-Wilk result was taken (Table 2).

Sella Turcica Dimensions and Gender

In general, sella turcica length ranged between 6.1mm and 19.1mm with a mean and standard deviation value of 12.2 ± 2.35mm. The mean sella length for males was 12.62 ± 2.50 and that for females was 11.69 ± 2.04mm. An independent t-test that compared the sella lengths of male and females showed a significant difference (t=3.635, p=0.000). Sella depth ranged between 3.6mm to 13.9mm with a mean value of 8.3`1.52mm. Mean sella depths of 8.2 ± 1.46mm and 8.55 ± 1.54mm were recorded for males and females respectively. Independent sample Mann-Whitney U test for comparison of male and female mean sella depths showed a significant difference between the two groups (p=0.032) (sella depth having been indicated not to being normality distributed). A general mean anteroposterior diameter (APD) of sella turcica was 13.4 ± 2.47mm (range: 6.1mm - 21.9mm). Male and female mean diameters were 13.6±2.45 and 13.3± 2.17 respectively. An independent t-test showed no statistically significant difference in APD across both genders (t=-2.316, p=0.221) (Table 3).

Sella Dimensions and Age

Table 4 shows the mean and standard deviation values for sella dimensions across the four age categories. One-way ANOVA tests for sella length and sella APD shows there is no significant difference across the age categories for both parameters (F = 0.226, p = 0.879 and F = 0.739 p=0.530 for length and APD respectively). However, an Independent-Samples Kruskal-Wallis test for sella depths across the four age grades concluded that there is a significant difference (p = 0.036), while post hoc pair-wise comparison, with Bonferroni correction showed that the significant difference only exists between early adulthood and late adulthood (p = 0.027)(Table 4).

Sella Turcica Shape (Morphology)

The most occurring sella shape was round shape (N=223, 69.5%), followed by an oval (15.9%, N=51) while flattened sella shape was the least occurring (14.6%, N=47). The results of Chi-Square test showed no statistically significant association between sella shape and gender (χ^2=3.124, p=0.210) as well as age (χ^2=9.336, p=0.156) (Table 5).

Table 1: Frequency Distribution of the Sample for Age and Gender

AGE IN YEARS	GENDER		
	FEMALE N (%)	MALE N (%)	Total N (%)
Early adulthood ≤34	12 (3.7%)	37 (11.5%)	49 (15.3%)
Early middle age 35 - 44	17 (5.3%)	35 (10.9%)	52 (16.2%)
Late middle age 45 - 64	50 (15.6%)	59 (18.4%)	109 (34.0%)
Late adulthood ≥65	54 (16.8%)	57 (17.8%)	111 (34.6%)
TOTAL	133 (41.4%)	188 (58.6%)	321 (100%)

Table 2 Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Sella length (mm)	.051	321	.041	.993	321	.158
Sella depth (mm)	.042	321	.200	.990	321	.031
Sella apd (mm)	.042	321	.200	.995	321	.397

Table 3 Sella Turcica Dimensions according to Gender

	Gender	N	Range	Mean	Std. Deviation	P - value
Sella length (Mm)	Male	188		12.616	2.5037	0.000
	Female	133		11.692	2.0393	
	Total	321	6.1 - 19.1	12.234	2.3520	
Sella depth (Mm)	Male	188		8.153	1.4563	0.032
	Female	133		8.548	1.5391	
	Total	321	3.6 - 13.9	8.317	1.5153	
Sella APD (Mm)	Male	188		13.567	2.4509	0.221
	Female	133		13.248	2.1737	
	Total	321	6.1 - 21.9	13.435	2.4733	

Table 4 Comparison of Sella Dimensions across the Age Grade

AGE IN YEARS (Binned)			SELLA LENGTH (mm)	SELLA DEPTH (mm)	SELLA APD (mm)
EARLY ADULTHOOD	(≤34)	N = 49	12.2 `2.39	7.9`1.25	13.3`2.43
EARLY MIDDLE AGE	(35 - 44)	N = 52	12.0`2.54	8.2`1.57	13.4`2.21
LATE MIDDLE AGE	(45 - 64)	N = 109	12.3`2.30	8.3`1.52	13.2`2.23
LATE ADULTHOOD	(≥65)	N = 111	12.3`2.35	8.6`1.52	13.7`2.47
P - value			0.879	0.036	0.530

Table 5: Distribution of sella shape across genders and age grades

Sella shape	Gender			Age in years (Binned)					
	Female	Male	Total	≤34	35 - 44	45 - 64	45 - 64	≥65	Total
Flattened	18	29	47	7	11	17	17	12	47
Oval	16	35	51	8	11	10	10	22	51
Round	99	124	223	34	30	82	82	77	223
Total	133	188	321	49	52	109	109	111	321
P - value	0.210			0.156					

DISCUSSION

Many sellar and parasellar pathologies affect the size and shape of the sella turcica. A deviation from normal dimensions of sella turcica could be indications of a pathological condition of the structure itself or the pituitary gland, hence the clinical significance of studying the normal dimensions and shapes of sella turcica.

The sella turcica length ranged between 6.1mm and 19.1mm with a mean and standard deviation value of 12.2 ±`2.35mm. The mean sella length for males was slightly higher than that of the females. The result showed that males sella length differed significantly from that of females (t=3.635, p=0.000). Sella depth ranged between 3.6mm to 13.9mm with a mean value of 8.3 ±`1.52mm. A mean sella depth for males was slightly higher than that of the females. A significant difference was noted between the sella depths of the two genders (p=0.032. The mean of APD for males was slightly higher than that of the female, and there was no statistically significant difference in APD across both genders was (p=0.221). No significant difference was noted in sella length and APD across the age categories but sella depth showed a significant difference which was noted to only exist between early adulthood (≤34 years) and late adulthood (≥65) (p=0.027). No significant difference was noted between the mean values of any of the sella dimensions across the various head shapes. These results agree to some extent with the observation of Marcel and Barry (4), that 17 mm is the upper limit of normal for the maximum anteroposterior diameter of the sella. The depth measured perpendicular to the sella floor, from a line drawn between dorsum and tuberculum, should not exceed 13 mm in most cases. The normal width varies between 10mm and 15 mm. A similar study entitled: computed tomography evaluation of Sella turcica dimensions and relevant anthropometric parameters in an African population carried out in Lagos State, Nigeria, Chukwuani *et al* (1) reported

mean sella turcica dimensions of 9.8mm length, 11.5mm AP diameter and 8.6mm depth. Their results also, illustrated that there is no difference between sella turcica dimension and the gender of the patient and there is no relationship between age and sella turcica dimensions. However, a positive correlation was established between sella turcica dimensions and the height of the subjects. Ozan *et al* (3) in a study on morphometric assessment of sella turcica on a Turkish population reported sella length of 9.18±1.91 mm, sella width of 10.41±1.74 mm, sella height anterior of 8.09±1.65 mm, sella height median of 7.71±1.24 mm, sella height posterior of 7.48±1.34 mm, sella area of 69.15±17.45 mm^2, sella depth of 7.87±1.37mm and antero-posterior sella diameter of 11.48±1.82 mm. When these sizes were compared between males and females, only sella length and width differed significantly. When compared by decades, there was a statistically significant difference only in the sella area parameter. In a similar study entitled: evaluation of sella turcica shape and dimensions in cleft subjects using Cone-Beam computed tomography conducted by Yasin *et al* (6), reported that the length ($p < 0.001$) of the sella turcica was smaller in non-cleft subjects than in cleft subjects (mean length for cleft subjects=10.83±8.4mm and 9.78±1.47 for non-cleft subjects). Diameter ($p = 0.014$) (mean diameter = 11.82±1.56 for cleft subjects and 11.54±1.38 for non-cleft subjects) and depth ($p = 0.005$) (depth =7.74 ± 1.29 for clefts subjects and 7.52 ±1.11for non-cleft subjects) was showed as constantly increasing from age <15 to >25 years in the overall assessment.

The most occurring sella shape was round shape, followed by oval and the least was flattened sella shape. No statistically significant association was noted between sella shape and gender (χ^2=3.124, p=0.210) as well as age (χ^2=9.336, p=0.156). This agreed partly with report of the study conducted by Yasin *et al* (6), which showed that the sella turcica presented with a round shape in the majority of subjects in both cleft and non-cleft subjects. A flattened shape in (40.7%) was observed frequently in the cleft group but rarely in the control group in (11.8%). The morphological features were significantly different between the groups ($p < 0.001$).

CONCLUSION

Only the mean sella length and depth differ significantly between male and female genders. Anteroposterior diameter is the same irrespective of gender. Among the three sella dimensions (length, depth and APD), only depth differ significantly between age grades, and that is only between early adulthood (≤ 34 years) and late adulthood (≥65 years). The round sella shape is the most common occurring sella shape in this study. The sella turcica dimensions obtained from this study will serve as reference values for physicians in the assessment of sellar and parasellar pathologies in the study population.

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