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Morphometric Analysis of Sella Turcica in Nigerian Adult Cadaveric Dry and Wet Skulls

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ABSTRACT

Background and Aim: The sella turcica is a saddle-shaped area of bone in the middle cerebral fossa. This region's morphologic heterogeneity may be a sign of pathologic conditions before they show up clinically. The study aimed at comparing the dimensions of sella turcica in both dry and cadaveric skulls and determining the variability in its morphology using dry skulls.

Methodology: Twenty-six (15 dry and 11 fresh cadaveric) adults males (16) and females (10) skulls identified as Nigerian by the University of Ilorin Teaching Hospital forensic pathologists, were used. The linear dimensions of the sella turcica were measured, and the shapes were traced out and compared. Social Statistical Package for Social Sciences version 20.0 and a glass prism were used to analyze the size of the sella turcica.

Results: The linear measurements showed a statistically significant increase in the depth of the sella turcica of the wet skulls when compared to the dry skulls, but no statistically significant difference ($p < 0.05$) in other parameters. When the measurements were compared in both sexes, linear measurements had no statistically significant difference. The shapes of sella turcica in dry skulls were concave in 80% and irregular in 20%.

Conclusion: Dry and wet skulls exhibited a notable difference in depth; the measurements of the sella turcica were comparable between both sexes. Using dry skulls, the shapes of sella turcica were concave in the majority. Its precise dimensions are helpful in the diagnosis, prognosis, and treatment of pituitary-related disorders.

Keywords: Sella turcica, cadaveric, skull, cranial fossa

INTRODUCTION

It is essential to differentiate between the pituitary fossa and the sella turcica, as the latter constitutes a part of the former. Anatomists and radiologists are interested in them because of their form and size, which in part correlate with those of a confined pituitary gland. The sella turcica is situated on the intracranial surface of the sphenoid body. It is constituted of a central pituitary fossa bounded posteriorly by the dorsum sellae and tuberculum sellae. Two clinoid processes, one anterior and two posterior, extend over the pituitary fossa (Jones *et al.*, 2005). The hypophyseal fossa/pituitary fossa is a cavity that lies between the tuberculum sellae and the dorsum sellae on the upper surface of the sphenoid bone (Tekiner *et al.*, 2015; Tomasz *et al.*, 2021). Thus, this structure forms the floor of the sella turcica and contains the lower part of the hypophysis/pituitary glands.

In order to identify and analyze variations that may be suggestive of pathologic conditions before they appear clinically, medical professionals need have a thorough understanding of the normal radiographic anatomy and morphologic diversity of this region

(Friedland and Meazzini, 1996; Feldkamp *et al.*, 1999; Alkofide, 2001). As a result, measuring the pituitary fossa and sella turcica diameters is essential.

Furthermore, the precise measurements of the sella turcica and pituitary fossa serve as guides when diagnosing, predicting, and treating conditions involving the pituitary gland and brain. Pathological disorders such as lumbosacral myelomeningocele, Williams syndrome, Seckel syndrome, and Down syndrome can also alter the form of the sella (Isman *et al.*, 2020; Polat *et al.*, 2020; Aghimien, 2022; Iskra *et al.*, 2023). Pathology and syndromes are often associated with variations in the sella turcica's size (Ammar *et al.*, 1999; Sage and Blumbergs 2000; Dostalova *et al.*, 2003; De Marinis *et al.*, 2005; Polat *et al.*, 2020). Although most of these conditions do not immediately endanger life, some can cause pituitary apoplexy, which is necrosis and bleeding and necessitates emergency medical care (Andredaki *et al.*, 2007).

Several approaches had been used to study the sella turcica size on radiographs such as linear measurements (Yassir *et al.*, 2010; Nagaraj *et al.*, 2015;

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Kumar and Govindraj 2017; Motwani *et al.*, 2017), area measurements (Jones *et al.*, 2005; Ogunnaike *et al.*, 2016; Ghaida *et al.*, 2017; Turamanla *et al.*, 2017), volume measurements (Yassir *et al.*, 2010; Kumar and Govindraj 2017; Choo *et al.*, 2021) or the sella turcica's perimeter (Hezam & Makarova, 2020).

The size of sella turcica can increase or decrease as a result of several diseases. One sign of primary pituitary growth hormone insufficiency could be a tiny sella (Fisher and Di Chiro, 1964). The radiographic differential diagnosis of a big sella includes aneurysms, craniopharyngiomas, adenomas, and Rathke's cleft cyst. (Swallow & Osborn, 1998).

Potentially fatal conditions may be avoided by early detection of sella anomalies. Since the sella turcica is sometimes the only sign of a cranial defect, it is important to understand its anatomy and radiological appearance (Isadore, 1975). For the safe and efficient treatment of a variety of pituitary diseases, including macroadenomas and craniopharyngiomas, microsurgery is recommended (Renn and Rhoton, 1975). To determine which technique (trans-frontal, trans-ethmoidal, trans-sphenoidal, or sublamina endonasal) to use, neurosurgeons must consider every anatomical feature pertaining to the potential variations of the sella region (Renn and Rhoton, 1975). Because of this, neurosurgeons additionally carry out anatomical research on dry skulls or cadaveric specimens to gather the extra data needed (Romano *et al.*, 2001). Another crucial consideration is the distance that the surgical endoscope must travel throughout each of the aforementioned operations. As a result, cadaveric specimens have been used in numerous research (Radojevic *et al.*, 1969; Spencer *et al.*, 1999; Das *et al.*, 2001) where the middle of the sella floor or the deepest point is used as a reference point.

To contribute to the body of knowledge, this study accurately measured the dimensions of the sella turcica, in which the pituitary gland is located, using wet cadaveric and dry skulls.

MATERIALS AND METHOD

Study sample

Materials for the study consisted of 15 dry human skulls and 11 fresh cadaveric adult male (16) and female (10) skulls obtained from the Anatomy Gross Laboratory of the University of Ilorin and identified as Nigerian by the University of Ilorin Teaching (UITH) forensic pathologists were used. The genders of the dry skulls were determined based on the following: -

- The size of the mastoid process
- The degree of supra-orbital margin.
- The shape of the forehead. (Manoonpol & Plakornkul, 2012, Blessy and Mohanraj, 2021).

Sample size

Twenty-six (15 dry and 11 fresh cadaveric) intact skulls comprising of 16 male and 10 female skulls that met the criteria were carefully selected and used for the measurement of dimensions of sella turcica. The twenty-six samples that were picked for this

study were based on the intact dry and wet cadaveric skulls that were available in the gross anatomy laboratory of the University of Ilorin at the time the study was carried out, and this is in line with a previous study done by Hlatshwayo *et al.* (2024) who used 21 dry and cadaveric skulls.

Inclusion/Exclusion criteria

Skulls without any deformities and that have the sella turcica and its boundary *in situ* were included in the study while skulls showing deformity were rejected as unsuitable for morphometric study.

Methodology

In each of the skull, the domes were removed and middle cranial fossa exposed. All measurements ((length, greatest antero-posterior diameter and depth) were measured with a ruler, a stick probe and a pair of Vernier calipers, calibrated at 0.01mm.

Description of selected landmarks

Measurements were done using the following landmarks on the skull.

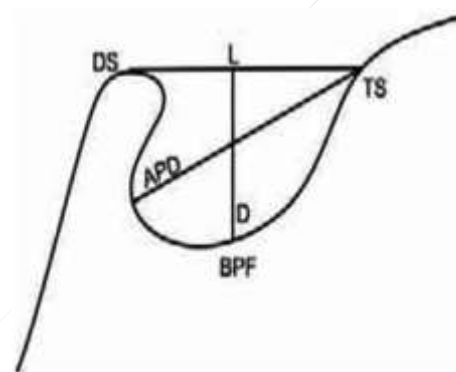


Figure 1 shows normal sella turcica morphology and reference lines used for measuring sella size. The reference lines used were situated in the midsagittal plane. DS to TS corresponds to the length of the sella turcica, APD to TS corresponds to the diameter of the sella turcica and L to BPF line indicates the depth of the sella turcica.

Parameters were measured as follows:

- Length of the sella turcica: the length was measured as the distance from the tip of dorsum sellae (DS) to the tuberculum sellae (TS).
- Greatest anteroposterior diameter of the sella turcica: this was measured from the tuberculum sellae (TS) to the remote point on the posterior inner wall of the fossa (SP) below the dorsum sellae.
- Depth of the Sella turcica: the depth was measured as a perpendicular line from the line above (L) to the deepest point on the floor of the fossa, that is the base of the pituitary fossa (BPF) (Silverman, 1957).

Shape of sella turcica

To ascertain the shapes of the sella turcica, the sella turcica cavity was meticulously filled with plasticine to the edge of the saddle-

shaped recess to cast of the sella, extracted with a slender iron rod, bisected with a blade into two equal halves, and the right half of the cast was outlined with an HB pencil on a white A4 sheet to delineate the shapes. This was done for all the 15 dry skulls.

Statistical analyses

Data from all measurements were analyzed using glass prism to determine the size of the sella turcica and Statistical Package of Social Sciences (SPSS 20.0). Student's t-test was used to calculate the mean differences in linear dimensions of sella turcica between males and females and between cadaveric skulls and dry skulls at a significance level of 0.05.

RESULTS

The linear dimensions of the average length, depth and anteroposterior diameters in dry skulls of males and females.

When the linear dimensions were compared between males and females' dry skulls, there was no statistical significant difference in the anteroposterior diameter and depth of the sella turcica but there was little difference in the length of the dry skulls with no statistical significance difference (Table 1).

Table 1: Linear dimensions of sella turcica (in mm) in dry skulls of females and males

SEX	Length of the Sella turcica (mm)	Arterio-posterior diameter (mm)	Depth of the sella turcica (mm)
MALE(16)	16.6±0.7	18.0±1.3	9.6±0.2
FEMALE(10)	14.7±0.5	18.8±0.8	9.3±0.3
P<0.05			

Linear measurements of the sella turcica in dry skull vs cadaveric skulls.

The result of the SPSS (20.0) analysis (Table 2) and glass prism below showed that there was no statistical significant difference in the length and greatest anteroposterior (A-P) diameter of dry skulls and fresh cadaveric skulls whereas there was a significant difference in the depth of cadaveric skulls and dry skulls.

Table 2: Linear dimensions in dry and cadaveric skull (in mm)

Parameters	Length in (mm) (mean±SEM)	A-P in (mm) (mean±SEM)	Depth in mm (mean±SEM)
Dry Skull	15.3±0.5	18.5±0.6	9.4±0.2
Cadaveric skull	14.5± 0.9	19.8± 1.7	12.3±1.7*
P<0.05			

Shape of sella turcica

Appearance of sella turcica was found to be concave in majority of the dry skulls. The variations that were observed showed that 12 (80 percent) had a concave shape whereas 3(20 percent) had

irregular shapes in their morphology. By mere visualization of the sella turcica some appeared low (Table 3).

Table 3: frequency distribution of different shapes of sella turcica in dry skulls.

SHAPES	NO OF SKULLS	% OF FREQUENCY
Concave	12	80%
Irregular	3	20%

DISCUSSION

This study delineates the linear dimensions of the sella turcica in dry skulls and cadaveric skulls, as well as the morphological variation of the sella turcica in the dry skulls. Disparities in the measures of the length, depth, and antero-posterior diameter of the sella turcica were observed in the current and other pertinent research (Alkofide, 2001). In the current research, the values for each measured parameter were elevated relative to the majority of existing studies. The disparity may be attributed to racial and environmental influences, as the sella turcica is subject to local and genetic variations significantly affected by these factors (Synder *et al.*, 1945, Ghaida *et al.*, 2017, Magat *et al.*, 2018). The disparity may also arise from the sample size and the study population employed. This study utilized dry and cadaveric skulls as against most of the previous studied that utilized imaging techniques of living subjects and quite a larger sample size.

Furthermore, in this study it was observed that the mean anteroposterior diameter in both males and females was comparable. Compared to males, females had a slightly larger mean anteroposterior diameter. (Table 1). This was consistent with research by Lal *et al.* (1965), Agrawal *et al.* (1968), and Chavan *et al.* (2012), who also discovered that females have a somewhat larger mean anteroposterior diameter than males. Similar to the anteroposterior diameter of the sella turcica, the depth of the sella turcica is slightly greater in males than females (table I). This is in line with Lal *et al.*, 1965; Agrawal *et al.*, 1968; and Chavan *et al.*, 2012, who also stated that the depth of the sella turcica is slightly greater in males than in females. The difference in the values might probably be due to differences in the age of the skull used. The age of the skulls used in this study could not be ascertained. Hormonal influences might also be a factor, as well as the difference in the instruments and material used. Vernier calipers and a ruler were used in this study as opposed to most of the studies that used radiological film.

According to this study, 80% of the sella turcica's morphology was concave, or regular, and 20% was convex, or irregular (table III). The findings of Lang and Tisch-Rottensteiner (1977), who found that the sella turcica's concave shape made up the largest percentage, are consistent with this. Our study also confirms the results of Quaknine and Hardy (1987), who found that convex shapes were the least common and concave shapes were the most common. The methods used to precisely delineate the fossa could be the cause of the small variation in the percentage.

In conclusion, the mean length, greatest anteroposterior diameter, and depth of sella turcica were comparable in both sexes. Cadaveric wet skulls and dry skulls showed a significant difference in their depth. Shapes of sella turcica were concave in the majority. Thus, this study gives baseline information for clinicians and forensic anthropologists about morphometric variation and linear dimensions of sella turcica for Nigerians and especially North-central metropolis, which helps in the diagnosing of sella turcica disorders and abnormalities of the craniofacial region.

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Conflicts of Interest: The authors declare that there is no conflict of interest.

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