Journal of Anatomical Sciences

Email:anatomicaljournal@gmail.com

J Anat Sci 13 (1)

Sella Turcica Measurement: An Index for Skull-Base Reconstructive Surgery

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ABSTRACT

The research was conducted to radiologically measure the dimensions of sella turcica using skull x-rays amongst Port Harcourt residents. The research examined the length, depth and anteroposterior diameter of a total of 200 skull radiographs. Simple random sampling technique was used to select 120females and 80 males from two different hospitals (University of Port Harcourt Teaching Hospital and Rivers State University Teaching Hospital) of which their age ranged from 18-50years. The data collected was analyzed using Statistical Package for Social Sciences Version 20.0 and presented in table with mean scores, standard deviation, variance, standard error and percentages. The result revealed that the age ranged from 18-50years. 31-40, 41-50 made up the greater percentage of the population. The males have a higher mean values for length, AP diameter and depth when compared to that of the females. (male: Length: 13.33mm, AP diameter = 11.70mm, Depth = 11.40) (Female: Length = 13.56, AP diameter = 11.20mm, depth = 8.38mm 11.40mm) respectively. There was a significant correlation at the 0.001 level of the mean length, AP diameter and depth. However, there is significant difference between length and depth. AP diameter and length at P-value <0.05. From the Z-test score analysis, the mean length for the sella turcica shows statistically a non- significant differences in the length of the male sella turcica when compared to female, the mean depth for the sella turcica shows a statistically significant differences in the depth of male sella turcica when compared to the female. Also the mean anteroposterior diameter shows a statistically significant difference in the AP diameter of male sella turcica when compared to the female. The data obtained will be useful in the management and diagnosis of clinical conditions associated with pituitary gland.

INTRODUCTION

The sella turcica (ST) is considered as one of the critical anatomical references in orthodontics because the S-point, located in the center part of sella, has been reported to be a fixed landmark in cephalometric analysis and the anterior wall of sella turcica is utilized to assess craniofacial growth and interrelationship between jaws[1]. Such assessments are beneficial to predict orthodontic treatment outcomes, prescribe convenient orthodontic plans, and describe craniofacial patterns. On the other hand, any pathological or anatomical abnormalities in the pituitary gland could well reveal changes in the shape of ST.

Several studies have shown that certain pathological conditions, such as William syndrome[2], primary hypopituitarism[3], growth hormone deficiency [4], congenital lumbosacral abnormality, and seckel pear syndrome[4], could alter the shape and size of ST. One of the most popular forms of ST alteration is the fusion of the anterior and posterior clinoid processes, that known as ST bridging [5]. This form can also be highly related to severe craniofacial deviation, tooth agenesis[6], canine impaction[7], and individuals with cleft palate8.

To detect anatomical disorder of the sella area, the normal morphology of the Sella Turcica has to be demonstrated. However, the normal pattern varies from individuals to individuals. Hence, the evaluation must be conducted in races individually. That has been embodied in the published literature[9,10,11,12].

In recent times, there has been increasing incidence of neurological disorders and unexplained visual loss which have hypophyseal origin. There have been many reports and a few reviews discussing the variation on the dimension of Sella turcica and its possible role in the pathogenesis of neurological disorder and visual loss[13]. Localities like Nigeria, there have been features suggestive of neurological and visual disorders which may not have been diagnosed. It is from the foregoing that the present study is designed to investigate the measurements of Sella turcica dimensions radiologically using skull X-rays amongst Port Harcourt residents.

MATERIALS AND METHODS

Data Collection: The data was gotten from the radiographs of patients from radiology department in University of Port Harcourt Teaching Hospital, and

Rivers State University Teaching Hospital, all-in Port Harcourt, river state Nigeria. A total of 200 lateral skull radiographs was examined of ages between 18-50 years: all are residents in Port Harcourt.

The radiographs of the skull X-ray were placed on the X-ray box and digital venier caliper was used to take the measurement of the sella turcica dimension.

Measurement and Calculation: The following measurements were taken and calculated.

a. **The antero posterior Diameter**: This is the greatest distance between anterior wall and posterior wall of Sella turcica. This was measured by drawing a line on the sella radiograph, tracing between a point below the tuberculum sella and anterior margin of dorsum sellae.

b. **The depth of Sella turcica**: This was measured at the distance from the midpoint of tuberculum sellae and dorsum of sellae to the floor of sellae turcica.

c. **Length of sella turcica**: The distance between the dorsum Sellae and the tuberculum sellae were measured.

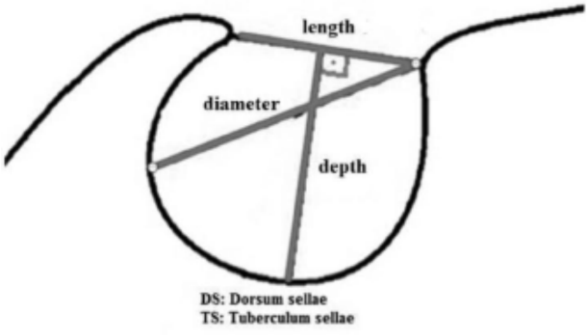

Figure 3.2: Diagram of Sella turcica showing all the measurement above.

Study Design: This study is a cross- sectional descriptive study which the value the radiological measurement of Sella turcica using skull X-rays in Port Harcourt residents which were manually collected.

Sampling Method: The simple random sampling technique was used.

Sample Size Determination: Determination of the sample size was done using the formular called Taro Yamane Formula:

Mathematically $n \frac{N}{(1+Ne^2)}$

$N = \frac{S}{(1-Se^2)}$

Where N = population size

e = 0.05

S = Sample size

$N = \frac{200}{(1-200\ (0.05)^2}$

$= \frac{200}{(1-200\ (0.0025)}$

$= \frac{200}{(1-0.5)}$

$= \frac{200}{1-0.5}$

N = 400 (Population size)

To verify this, using the sample size formation

$n \frac{N}{(1+Ne^2)}$

$n = \frac{400}{1+(400 \times 0.05)^2}$

$= \frac{400}{1+(400 \times 0.0025)}$

$= \frac{400}{1+1}$

$= \frac{400}{2}$

Sample size (n) = 200

Study Population: The study was concluded with the radiographs of 200 patients which consist of hundred (80) males and hundred (120) female within the ages of range of 18-50 years of all are Port Harcourt residents.

Inclusion Criteria: The radiographs used for this study fulfilled the following criteria:

A. Normal lateral radiographs of skulls of known sexes and ages group especially 18-50years.
B. A perfectly superimposing anterior clinoids process and orbital root of two sides.
C. A clearly recognizable dorsum and tuberculum sella.
D. Skull with no degenerative change.
E. Well ossified cranium with no presence of neoplastic growth in

the sella substance.

Exclusion Criteria: The following radiograph were excluded.

A. Radiographs that has poor quality.
B. Distorted radiographs
C. Radiograph of deformed skull.
D. Skull with altered ossification and distorted sella.
E. Radiograph of abnormal sella turcica

Statistical Analysis: Data were analyzed using statistical package for social sciences (SPSS) version 20. Descriptive statistics mean and standard deviation were used to summarize the data obtained. Two sided p values were calculated using paired sample T – test and z test were for the variables. P values <0.05 were considered statistically significant.

RESULTS

Table 1: Calculation of mean and standard deviation of Age, Length, AP diameter and Depth of the sella turcica in males

Variables	N	Mean	Standard Deviation	Range		Variance	SEM
				Minimum	Maximum		
AGE	80	38.09	9.80	18	50	91.32	0.87
LENGTH	80	13.43	0.97	11.88	15.10	0.947	0.11
AP DIAMETER	80	11.71	0.69	10.05	13.35	0.48	0.08
DEPTH	80	8.80	0.96	7.00	10.24	0.95	0.11

N= Sample size; SEM = Standard Error of Mean

The mean values for the length and AP diameter of male sella turcica was 13.43 and 11.71 while the standard deviations were 0.97 and 0.69 respectively making them to be greater than depth.

Table 2: Calculation of mean and standard deviation of Age, Length, AP diameter and Depth of the sella turcica in females

Variables	N	Mean	Standard Deviation	Range		Variance	SEM
				Minimum	Maximum		
AGE	120	35.58	9.58	18	50	111.50	1.17
LENGTH	120	13.26	0.84	11.70	15.08	0.71	0.08
AP DIAMTER	120	11.20	1.35	1.58	15.52	1.85	0.12
DEPTH	120	8.38	0.90	7.00	12.28	0.81	0.08

The mean values for the length and AP diameter of the female sella turcica was 13.26 and 11.20 while the standard deviations were 0.84 and 1.35 respectively showing that they are greater than depth.

Table 3: Mean and Standard deviation of Length, AP diameter, and Depth of sella turcica with respect to gender.

Gender		Length (mm)	AP Diameter (mm)	Depth (mm)
Female	Mean	13.26	11.20	8.38
	SD	0.84	1.35	0.90
Male	Mean	13.33	11.71	11.40
	SD	0.90	8.80	0.96

The mean values of the length, AP diameter and Depth of sella turcica in the male subjects are higher (13.33mm, 11.71mm and 11.40) respectively compared to the female subjects (Table 6).

Table 3: Correlation between Age, Length, AP Diameter and Depth of Sella turcica

		Age	Length	AP Diameter	Depth
Age					
	Pearson correlation	1	.431**	0.334**	.422
	Sig. (2 tailed)		.003	.000	.000
Length					
	Pearson correlation	.431**	1	.357**	.476**
	Sig. (2 tailed)	.003		.003	.000
AP Diameter					
	Pearson correlation	0.334**	.321**	1	.552**
	Sig. (2 tailed)	.000	.003		.000
Depth					
	Pearson correlation	.422**	.476**	.552**	1
	Sig. (2 tailed)	.000	.000	.000	

** Correlation is significant at the 0.001 level (2 – tailed).
From table 7, there was a significant correlation of mean length, antero - posterior diameter and depth of the Sella turcica with the age of the subjects studied.

Table 4: Z – test of the means between length of males and females

z-Test: Two Sample for Means

	Male LENGTH (MM)	Female LENGTH (MM)
Mean	13.430125	13.26175
Known Variance	0.947285	0.711206
Observations	80	120
Hypothesized Mean Difference	0	
Z	1.263167767	
P(Z<=z) one - tail	0.103264447	
z Critical one - tail	1.644853627	
P(Z<=z) two - tail	0.206528894	
z Critical two - tail	1.959963985	

From table 9 above, the z score for means of male and female Sella turcica length is 1.263 which is less than the z critical (two tail) value of 1.959 with p value of 0.206. This shows a statistically non - significant difference in the length of male sella turcica when compared to the female.

Table 5: Z – test of the means between depth of males and females

z-Test: Two Sample for Means

	Male DEPTH (MM)	Female DEPTH (MM)
Mean	8.80075	8.380667
Known Variance	0.949167	0.809895
Observations	80	120
Hypothesized Mean Difference	0	
Z	3.079065663	
P(Z<=z) one -tail	0.001038255	
z Critical one -tail	1.644853627	
P(Z<=z) two -tail	0.002076509	
z Critical two -tail	1.959963985	

From table 10 above, the z score for means of male and female Sella turcica depth is 3.079 which is greater than the z critical (two tail) value of 1.959 with p value of 0.002. This shows that there is a statistically significant difference in the depth of male sella turcica when compared to the female.

Table 6: Z – test of the means between AP Diameter of males and females

z-Test: Two Sample for Means

	AP Diameter of Males	AP Diameter of Females
	12.31	11.19
Mean	11.6978481	11.19756
Known Variance	0.484172	1.846767
Observations	80	120
Hypothesized Mean Difference	0	
Z	3.400247773	
P(Z<=z) one-tail	0.000336624	
z Critical one-tail	1.644853627	
P(Z<=z) two-tail	0.000673248	
z Critical two-tail	1.959963985	

From table 11 above, the z score for means of male and female Sella turcica AP Diameter is 3.400 which is greater than the z critical (two tail) value of 1.959 with p value of 0.000. This shows that there is a statistically significant difference in the AP Diameter of male sella turcica when compared to the female.

DISCUSSION

The topic investigated the radiological measurement of Sella turcica dimension using skull x-rays among Port Harcourt residents. A total number of 200 subjects were used in the study. From the findings obtained, 45% of the population were between the age range of 31-40years which was the highest with those between the ages of 41-50years accounting for 32.5%. These age ranges (31-40, 41-50) is said to form a greater number of residents in Port Harcourt as those age ranges make up a greater percentage of the youth population.

Result obtained from table 2 showed that subject between ages 31-40 and 41-50 had a higher mean value for length, anterior-posterior diameter and depth of Sella turcica. Sella grows rapidly during the first few

years of life according to longitudinal studies after which it decreases. A second phase of increased growth slows down and complete by early adulthood. On the other hand, Alkofide[9] reported that all three linear dimensions were found to be consistently larger in an older group when compared to the younger group. However, younger adults were confirmed to have smaller Sella turcica sizes and there was no significant differences in the subject[14]. Moreover, the variations in the study might be due to the different methods the measurements were taken (MRI, CT SCAN, X-ray), environment and materials that can be used for the comparison.

The result also indicated that females have lesser mean value (length 13.26mm, AP diameter 11.20mm and depth 8.38mm) than males (Length 13.33mm, AP diameter 11.71mm and Depth 11.40mm) consecutively. Males have larger Sella than females at all times except during the Pubertal stages. This was because puberty occurs at least two years earlier in females. This is in contrast with the report of Francis [15] who stated that the size of Sella was large in females than males. Alkofide[9] did not find any gender differences for all the three dimensions. From this particular study, the variations in males and female might be due to the testosterone in males which is an important hormone for bone gain and maintenance in men. This is the major reason for bone strength and bone mass density in males.

Furthermore, the result showed that there was a significant correlation at the 0.001 level of the mean length, Anterior-Posterior diameter and depth of the Sella turcica with the age of the subjects studied using Pearson Product Moment Correlation Coefficient. In different populations the size of the Sella turcica varies [2]. These changes might be due to environment (Weather, climatic changes, altitude, etc), different methods and tools used. However, there is a significant difference between length and depth, anterior-posterior diameter and depth, anterior-posterior diameter and length at P-value < 0.05 when a paired sample t-test was done between all the variables.

Also, from the Z-test analysis, the mean length for male (13.43mm) is more than that of female (13.26mm). The Z-score for means of male and female turcica length is 1.263 which is less than the critical value of 1.959 with P-value of 0.206 which shows statistically non-significant difference in the length of male Sella turcica when compared to the female.

The result of the statistical analysis showed that, for the depth, the mean value of males is 8.80 while that of female is 8.38 making the Z-score for the depth of male and female sella turcica to be 3.079 which is greater than the Z-critical value of 1.959 with P-value of 0.002. This means that there is a statistical significant difference in depth of male Sella tucica when compared to the female.

The result for the anterior-posterior diameter indicated that the mean value for male is 11.69mm female 11.19mm which means that their Z-score for the diameter is 3.40 which is greater than the Z-critical value of 1.959 with P-value of 0.000 showing that there is a statistical significant difference in the AP diameter of male Sella turcica when compared to the female.

CONCLUSION

The result obtained from this study has helped in establishing a reliable standard on the various dimensions of the Sella turcica of residents in Port Harcourt. The analysis has provided the dimension differences in both sexes is not significant thus, making us realize that most previously established standards could still be verified and correlated. The study is very useful in the management of diagnosis of clinical conditions associated with pituitary gland.

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