Radiological Analysis of Sella Turcica

S. R. Chavan[1], M. A. Kathole[1], A. S. Katti[2], N. G. Herekar[3]

{[1]Assistant Professor, [2]Associate Professor, [3]Professor and Head}Dept. of Anatomy, Govt. Medical College, Miraj (MS) INDIA

Corresponding Address:

swapna.chavan2012@gmail.com

Research Article

Abstract: The exact dimensions of sella turcica are an important consideration in the diagnosis, prognosis and treatment of diseases related to pituitary gland and brain. Present study was aimed to present a set of baseline measurements of sella turcica by studying the various dimensions by radiographs In the present study, lateral radiographs of skulls of four hundred and forty seven subjects of known age (between 13 to 55 years) and sex (two hundred and thirty seven males; two hundred and ten females) were studied. The various parameters of sella turcica were studied in present study these were greatest anteroposterior diameter, depth & area of sella turcica It was found that greatest anteroposterior diameter of sella turcica, depth of sella turcica showed statistically no significant difference in their mean values of males and females indicating no sexual dimorphism. The area also showed no sexual dimorphism. Careful study of these parameters can help in radiological detection of pituitary tumours, suprasellar or parasellar tumours etc. The normal dimensions of sella turcica and shape can be used as reference values for evaluating various pathological (clinical) conditions related to sella turcica in Western Maharastra population.

Key Words: sella turcica, parameters, tumours.

Introduction:

The importance of size and shape of the sella turcica in connection with the occurrence of symptoms of pituitary diseases has long been recognized. The exact dimensions of sella turcica are an important consideration in the diagnosis, prognosis and treatment of diseases related to pituitary gland and brain. The careful study of plane radiographs of skull can accurately estimate dimensions of sella turcica. Furthermore, it is easily available and more economical from patient's point of view. Various pathologies may affect size of sella turcica leading to increase or decrease in its size. A small sella may be indicative of primary pituitary or growth hormone insufficiency (Di chiro) [1]. The radiographic differential diagnosis of a large sella includes adenomas, Rathke's cleft cyst, craniopharyngioma, aneurysm. Early detection of sellar abnormalities may avert potentially life-threatening episodes. Clinicians should be familiar with the normal radiographic anatomy and morphologic variability of this area, in order to recognize and investigate deviations that may reflect pathological situations, even before these become clinically apparent (M. Andredaki)[2]. According to Isadore Meschan[9], the deformity of sella turcica is often the only clue that abnormality exists within the cranium; hence a familiarity with its anatomy and radiological appearance is essential.

Several studies describing the dimensions of sella turcica have been done in Western countries. Significant statistical differences have been found to exist between different population groups. Also, it is observed that there is racial variation in these dimensions. Similar studies describing the dimensions of sella turcica done in normal Indian subjects are relatively few. So, present work was undertaken to establish the normal dimensions of sella turcica in the Maharashtrian population.

Material and Method:

For the present study, normal lateral radiographs of skull (four hundred and forty seven subjects) from Maharashtra were utilised. These radiographs were of known sex (males- two hundred and thirty seven; females - two hundred and ten) and of known age groups (between thirteen to fifty five years). Computed radiographs were obtained and measurements taken in the radiology department of various medical colleges and private hospitals in Maharashtra.

Computed radiography (CR) method used. Radiographs of both sexes were taken with subject position being – Lateral rotation of skull. X-ray tube focussed on head. The centering point is over the pituitary fossa – 1 cm above the orbitomeatal line and 2.5 cm anterior to the external auditory meatus with head in the true lateral position (Sutton) [3]. .Cassette is placed below head. Bucky is used. Exposure is made with tube voltage 50 – 90 KVP. The distance between x-ray tube and film plate was 100 cm. Computerised radiograph cassettes of size 10 X12 inches were used. These radiographs were diagnosed as 'normal' by experienced radiologist.

Inclusion criteria

Selection of radiographs for the study was based on the following:

(a) Perfect superimposition of the anterior clinoid processes and orbital roofs of two sides, to rule out tilting of the skull during positioning of the patient.

(b) Clear visualization and recognition of the dorsum sellae and tuberculum sellae.

Exclusion criteria

(a) Radiographs showing abnormal sella turcica

(b) Poor quality radiographs.

The radiographs showing any obvious abnormality were excluded from the study.

The measurements were made by using scale calibrated to 0.1mm.

Before taking greatest anteroposterior diameter measurement a consistent orientation is given to skull as suggested by Joplin and Fraser [4]. and C. L. Oon [5]. This orientation to skull is achieved by first establishing the nasion – tuberculum line and then the anteroposterior diameter is measured parallel to this line (Plate no. 1). The following measurements were obtained from the computerised lateral radiographs of skull (sella turcica)…..

Plate No. 1

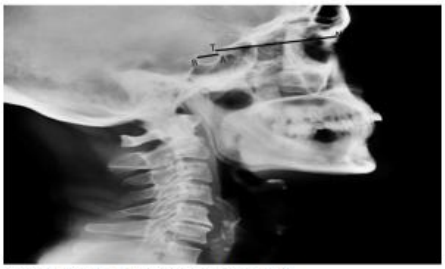

Photo no.1 N - T Nasion to Tuberculum.
A - B Greatest Anteroposterior diameter.

Photo no. 2 C – D Depth of Sella Turcica.
E – F position of Diaphragma sellae.

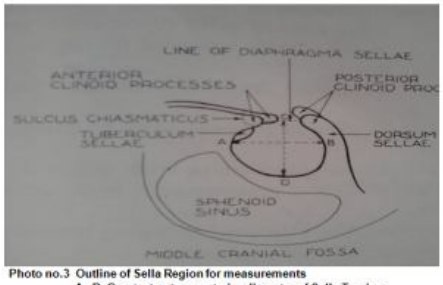

Photo no.3 Outline of Sella Region for measurements
A - B Greatest anteroposterior diameter of Sella Turcica
C - D Depth of Sella Turcica.

1. Anteroposterior diameter of sella turcica-

This is the greatest distance between anterior wall and posterior wall of sella turcica. A line is drawn between a point below tuberculum sellae and anterior margin of dorsum sellae.

2. Depth of sella turcica-

This is the distance from midpoint of tuberculum sellae and dorsum sellae to the floor of sella turcica.

3. Area of sella turcica-

It is calculated by multiplication of greatest anteroposterior diameter and depth of sella turcica.

The age group selected for present study is 13 years to 55 years as; in children the pituitary fossa enlarges with the pituitary gland and becomes smaller if the gland decreases in size. The pituitary gland enlarges during the period of active growth, causing sella to enlarge with it. Later the pituitary gland may decrease in size but sella remain unchanged (Taveras and Wood) [6]. As age advances (result of age) atrophy of dorsum sellae may occur (Schulller) [7].

Thus various dimensions of sella turcica in males and females were evaluated for statistical significance.

Observations and Results:

Range, mean and standard deviation (S.D.) of each measurement was calculated. By using the formula "mean $\pm$ 3 S.D." calculated range was derived. This calculated range will cover 99.75% of sample population of this study. Any value lying outside the calculate range, suggest pathological condition of the sella or oituitory and require further investigations and clinical evaluation. The statistical significance of difference between means of males and females i.e., value of 'P' was calculated by applying 'Z' test [8].

In the above table no 1, it is observed that, in both males and females the pattern of anteroposterior diameter of sella turcica was almost similar. In both sexes the mean anteroposterior diameter of sella turcica goes on increasing from (age group 13 - 25 and 26 - 40 years) 13 years of age to 40 and later on decreases or remains constant (or is not increasing) in the age group of 41 - 55 years. In the age groups 26 - 40 years and 41- 55 years the mean values of males are higher than in females. Whereas in 13 - 25 years age group,the mean anteroposterior diameter of sella turcica was comparatively larger in females than males.

Similar to anteroposterior diameter of sella turcica, the pattern of depth of sella turcica was almost similar in both males and females (table no 2). The depth of sella turcica is gradually increasing in all age groups. The mean values are greater in male than females, in all age groups.

From the above table no 3, it was observed that, in both males and females the pattern of area of sella turcica was almost similar. The area goes on increasing from 13- 40 years of age afterwards either it remains constant or decreases marginally. The

mean area of sella turcica was found minimum in 13-25 years of age group and the mean area of sella turcica was found maximum in 26-40 years of age group. The values of area are greater in males than females except in first age group where female values are more than in males.

Table No. 1 Anteroposterior diameter of sella turcica in males and females (in mms).

Age Group in years	Males (n = 237)			Females (n = 210)			Z score	P value	Significance
	Mean	SD	No.	Mean	SD	No.			
13 to 25	10.23	1.74	75	10.43	1.98	78	0.664	> 0.05	Not Significant
26 to 40	11.45	1.93	81	10.86	1.94	73	1.89	> 0.05	Not Significant
41 to 55	11.12	1.93	81	10.61	1.98	59	1.52	> 0.05	Not Significant

Table No. 2 Depth of sella turcica in males and females

Age Group in years	Males (n = 237)			Females (n = 210)			Z score	P value	Significance
	Mean	SD	No.	Mean	SD	No.			
13 to 25	7.39	1.48	75	7.36	1.44	78	0.127	> 0.05	Not Significant
26 to 40	8.06	1.89	81	7.94	2.18	73	0.362	> 0.05	Not Significant
41 to 55	8.15	1.96	81	7.88	2.13	59	0.765	> 0.05	Not Significant

Table No. 3 Area of sella turcica in males and females in different age groups

Age Group in years	Males (n = 237)			Females (n = 210)			Z score	P value	Significance
	Mean	SD	No.	Mean	SD	No.			
13 to 25	75.10	17.56	75	77.64	23.49	78	0.759	> 0.05	Not significant
26 to 40	93.29	33.38	81	85.72	25.69	73	1.59	> 0.05	Not significant
41 to 55	89.71	22.25	81	84.24	29.99	59	1.18	> 0.05	Not significant

Discussion:

1. Anteroposterior diameter of Sella turcica

Greatest anteroposterior diameter defined as greatest distance between anterior wall and posterior wall of sella turcica (Isadore Meschan) [9].

There are various methods for measuring pituitary fossa described by various authors. Some authors measured length as interclinoid distance, failing to recognize that the anterior clinoids shadow are projected onto fossa, in no way enter into the formation of the membranous and bony enclosure for pituitary gland.

Others have mentioned length as the greatest anteroposterior measurements of the fossa (Jewett) [10], no consideration was given in its measurement to the consistent orientation of the skull or sphenoid bone with respect to horizontal and vertical planes.

Silverman (1957) [11] measured length, the distance from the dorsum sellae to the tuberculum sellae as his study was restricted to children in which greatest anteroposterior diameter corresponds to length or length exceeded the greatest anteroposterior diameter. He stated that in older children the greatest anteroposterior diameter could occasionally be greater than these measurements because of the effect of the bulbous posterior clinoids.

For the present study greatest anteroposterior diameter was taken as suggested by Isadore Meschan[9]. Who has described Greatest anteroposterior diameter as a line usually taken between point below tuberculum sellae and anterior margin of dorsum sellae.

Before taking greatest anteroposterior diameter measurements a consistent orientation is given to skull as suggested by Joplin and Fraser [4] and C. L. Oon [5]. This orientation to skull is achieved by first establishing the Nasion – Tuberculum line and then the anteroposterior diameter is measured parallel to this line.

From the table no 4, it was observed that, in the studies of Lal et al (1965) [12] and Agrawal et al (1968) [13], values of mean anteroposterior diameter of sella turcica goes on increasing from 13 years to 40 years of age (i. e.13 - 25 to 26 - 40 age group) and later on remains constant or decreases marginally (i.e. in the age group of 41 - 55 years), in both sexes. Similar pattern was also observed in the present study, in both sexes. The difference in the val;ues of of Lal et al and Agrawal et al and present study could be due to obvious difference in the build of these groups.

These findings were also supported by the findings of V. K. Shrivastav [14] who has mentioned that sella shows adult measurements from fifth year of life and then grows very slowly, till it reaches a peak of 40 years. Beyond which it remains stationary. values of females are less than the males in all age group except 13 - 25 years, where it is more in females. This is due to the fact that females mature earlier than males and since this reference period coincide with the child bearing age, the pituitary gland increases slightly with repeated pregnancies [13].

Table 4 showing comparison of mean anteroposterior diameter (in mm) of sella turcica in male & female of present study with the findings of previous studies.

Author	13-25 (mm)		26-40 (mm)		41-55 (mm)	
	Male	Female	Male	Female	Male	Female
Lal et al 1965	10.12	10.42	11.42	11.05	11.37	10.66
Agrawal et al 1968	10	11	11	11	11	10.5
Present study	10.23	10.43	11.45	10.86	11.12	10.61

2. Depth of Sella Turcica

Some authors have measured the 'depth' from interclinoid line to the bottom of the projected fossa rather than from a line corresponding to the position of diaphragma sellae (silverman 1957) [11] .

For present study the depth is the greatest distance between the floor of hypophyseal fossa and a line drawn between tuberculum sellae and top of dorsum sellae. This latter line represents the position of diaphragma sellae (Isador Meschan) [9] .

Lal et al [12] observed that the smallest mean depth in males is in 13 - 25 years age group which goes on increasing slowly as the age advances (Table no 5). He has also stated that "depth of the sella turcica keeps on increasing till much later age than length of sella." Similar pattern was observed in the present study. The values of present study in both sexes are comparable with the study of Lal et al.

Statistical difference in Anteroposterior diameter and Height according to sex -

In the present study, male and female data applied for statistical analysis and found no statistically significant difference in both sexes.Similar findings are mentioned by V. K. Shrivastsva. Where he found no significant difference in mean anteroposterior measurements and mean depth of sella turcica in either sexes. Thus the present study correlates with findings of V. K. Shrivastsva [14].

Table 5 showing comparison of mean depth (in mm) of sella turcica in male & female of present study with the findings of previous studies.

Author	13-25 (mm)		26-40 (mm)		41-55 (mm)	
	Male	Female	Male	Female	Male	Female
Lal et al 1965	7.15	7.15	8	8.26	8.43	7.73
Agrawal et al 1968	8	-	8	-	8	-
Present	7.39	7.36	8.06	7.94	8.15	7.88

.

3. Area of the Sella Turcica.

According to Hare et al [15] , the area of the sella turcica can be determined by multiplying the length by the depth.

Many techniques have been used to make an estimate of area, ranging from the relatively simple, such as product of length and depth or planimetry [11] to more complex methods such as either tracing the outline of the sella from the X-ray film on to a transparent sheet, superimposing finely calibrated graph paper and counting the squares contained by the shadow of the fossa [16] .

For the present study, area of sella turcica is calculated by multiplication of length (anteroposterior) and depth. As seen in table no 6 , in males, the mean area of sella turcica of present study correlate with values mentioned by Haas and Joplin and Fraser [17]. In females, the values of mean area of sella turcica are less than values mentioned by Haas and Joplin and Fraser. This may be due to racial or ethnic factors.

Table 6 showing comparison of mean area of sella turcica in males and females of present study with the findings of previous studies.

Author	No. of Radiographs	Area (sq. mm)	
		M	F
Haas (1954)	661	86.1	87.2
Joplin and Fraser (1960)	50	-	87
Present study	447	86.3	81

Summary and Conclusions:

In the present study, lateral radiographs of skulls of four hundred and forty seven subjects of known age (between 13 to 55 years) and sex (two hundred and thirty seven males; two hundred and ten females) were studied. The various parameters of sella turcica were studied in present study these were greatest anteroposterior diameter, depth & area of sella turcica. Making use of anteroposterior diameter and depth, area of the sella turcica was calculated. It was found that greatest anteroposterior diameter of sella turcica, depth of sella turcica showed statistically no significant difference in their mean values of males and females indicating no sexual

dimorphism. The area also showed no sexual dimorphism.Comparison of these sella turcica dimensions with corresponding dimensions from other ethnic groups showed evidence of racial variation.

Careful study of these parameters can help in radiological detection of pituitary tumours, suprasellar or parasellar tumours etc. Thus this study presents comprehensive data about morphometry of sella turcica. The normal dimensions of sella turcica and shape can be used as reference values for evaluating various pathological (clinical) conditions related to sella turcica in Western Maharastrian population.

Bibliography

1. RL Fisher and GH. Di Chiro. The small sella turcica, American Journal of Roentgen, 91: 996-1008, 1964.
2. M. Andredaki, A. Koumantanou, D. Dorotheou and D. J. Halazonetis. A cephalometric morphometric study of the sella turcica. The European Journal of Orthodontics, 29(5): 449-456, 2007.
3. David Sutton. Textbook of Radiology and Imaging. Seventh Edition. Churchill Livingstone, (11):1617, 1626, 2003.
4. Joplin G. f. and Fraser R. (1960), Ciba Foundation Colloquia on endocrinology13, 14. Quoted by Oon C. L., 1963.
5. Oon C. L. The size of pituitary fossa in adults. British journal of Radiology. 36: 294 – 299, 1963.
6. Taveras J.M. and Wood E.H. Diagnostic Radiology. Second edition. The Williams Wilkins Company, Baltimore, 1: 65-90, 1976.
7. Schuller A.: The sella turcica, American journal of roentgenol, 16: 336 – 340, 1926.
8. Mahaian B. K. Methods in Biostatistics. 6th edition, Jaypee Brothers. pp: 126-129, Reprint 2004.
9. Isadore Meschan. An Atlas of Anatomy Basic to Radiology; W B Saunders, Philadelphia, 343 – 348, 1975
10. Jewett C. H. American Journal of Roentgenol. (1920); 7: 352.Quoted by C. L. Oon., 1963.[17]
11. Silverman F N. Roentgen standards for size of the pituitary fossa from infancy through adolescence. American Journal of Roentgenology, 78: 451-460, 1957.
12. B. N. Lal, P. N. Tondon, S. K. Ghosh and G. N. Agrawal, Radiological study of normal sella turcica. Indian journal of Radiology 19/29: 84-90, 1965.
13. G. N. Agrawal, G. B. Newton, Radiologiacal Study of Normal Sella Turcica in Indians. Journal Indian M. A., 51 no.7: 519-522, 1968.
14. V. K. Srivastava. Normal Anatomy of Sella Turcica in Indian Subjects. Indian Journal of Radiology, 43: 102-106, 1989.
15. H F hare, E Silveus and M I. Smedal Roentgenologic Diagnosis of Pituitary Tumours. Radiology (1949); 52: 193-198. Quoted by Bernard et al and Silverman, 1957.
16. Haas LL. The size of the sella turcica by age and sex. American Journal of Roentgenology, Radium Therapy and Nuclear Medicine, 72: 754–761, 1954.
17. Joplin G. f. and Fraser R. (1960), Ciba Foundation Colloquia on endocrinology13, 14. Quoted by Oon C. L., 1963.

Corresponding Author

Dr Swapna Ramesh Chavan
C/o Dr. Girish V. Thakur
Doctors Quarter Building A
Govt Medical College Campus,
Gandhi chowk, Latur - 413512.
Maharashtra. INDIA.
Email address – swapna.chavan2012@gmail.com