



## Morphological Study of Sella Turcica in Gujarat State

**Mehul Tandel**

Department of Anatomy, Government Medical College Surat

**Daxa Kanjiya**

B.J. Medical College, Ahmedabad, Gujarat

ABSTRACT

Introduction: Sella turcica is situated on the intracranial surface of the body of the sphenoid bone. 80% of the sella is occupied by the pituitary gland. Any abnormality or pathology in the gland could manifest from an altered size, shape and functions of the sella turcica. Around 13% of brain tumour are found in the sella turcica. Precise knowledge of dimensions of sella turcica is required for effective and safe treatment of various pituitary disorders and in the procedure of pituitary ablation with radioactive implants. Aim: The purpose of this study is to measure the size and shape of the sella turcica and thus establish normative reference standards that could assist in evaluation and detection of pathological conditions. Materials and Methods: 263 skulls and 37 individual dried sphenoid bones (total 300 bones) were examined from the collection of the Anatomy Departments of various Medical Colleges of Gujarat. Length, depth, width and volume of sella turcica were measured with digital vernier caliper. Data were collected and statistically analyzed. Results: The mean length of sella turcica was 10.72mm and maximum length was 14.98mm and minimum was 6.46 mm. The mean width of sella turcica was 12.45mm and maximum width was 16.89mm and minimum was 8.01mm. The mean depth of sella turcica was 6.61mm and maximum depth was 11.98mm and minimum was 2.16mm. The mean volume of sella turcica was 442mm<sup>3</sup> and maximum volume was 990mm<sup>3</sup> and minimum was 122mm<sup>3</sup>. The mean area of sella turcica was 70mm<sup>2</sup> and maximum area was 133 mm<sup>2</sup> and minimum was 4mm<sup>2</sup>. Conclusions: In the present study the knowledge provided by various measurements of the size of sella turcica helps the neurosurgeon to decide which approach is to be chosen in surgery of pituitary tumours.

### KEYWORDS

Sella turcica, Sphenoid, Tuberculum sella, Morphology, Vernier Calliper

### 1. Introduction

Sella turcica is a Latin word that resembles Turkish saddle. The anterior boundary of sella turcica is formed by tuberculum sellae and laterally it is completed by middle clinoid processes. The posterior boundary presents a vertical pillar of bone, the dorsum sellae. Middle of sella present hypophyseal fossa which contains pituitary gland.<sup>1</sup>

80% of the sella is occupied by the pituitary gland.<sup>2</sup> Sella increases in size with age.<sup>3</sup> Any abnormality or pathology in the gland could manifest from an altered size and shape of the sella turcica, to a disturbance in the regulation of secretion of glandular hormones; prolactin, growth hormones, thyroid-stimulating hormone, follicular stimulating hormone, etc.<sup>4</sup> Around 13% of brain tumors are found in the sella turcica.<sup>5</sup>

Precise knowledge of dimensions of sella turcica is required for effective and safe treatment of various pituitary disorders such as macroadenomas or craniopharyngiomas and in the procedure of pituitary ablation with radioactive implants.<sup>6</sup>

All the anatomical details concerning the possible variants of the sellar region are taken into account by neurosurgeons in order to decide which approach (transfrontal, pterional, transsphenoidal sublabian or endonasal) is to be chosen.<sup>7</sup> For this reason, neurosurgeons also perform anatomical studies on cadaveric specimens or dry skulls to obtain the additional information required.

Sellar measurements have been employed in growth studies<sup>8</sup>, and in anthropological studies. Sella turcica is usually used as a reference point with nasion to establish the base of the skull in cephalometric analysis. This is commonly done prior to orthodontic treatment.<sup>9</sup>

It is essential to study the morphology of sella turcica

to know the various anomalies or unusual appearance of sellar region. Morphology may vary from individual to individual, and the establishment of normal standards will aid in the process of eliminating any abnormality in such an important region. Therefore, the morphological study was undertaken for present work involving the measurement of linear dimension of sella turcica. The study datas were then compared with studies done in past.

### 2. Materials and methods

263 skulls and 37 individual dried sphenoid bones (total 300 bones) were examined from the collection of the Anatomy Departments of various Medical Colleges of Gujarat. Length, depth, width and volume of sella turcica were measured with digital vernier caliper.

Keeping in view the aim of the study mentioned above, following observations were recorded in millimetres, using a Digital Vernier Callipers.

#### SIZE OF SELLA TURCICA:

Three linear measurements of the sella turcica i.e. length, width and depth were measured.

**Length:** The distance between the mid-point of tuberculum sella to the mid-point of dorsum sella determines the length of sella turcica(Fig. 1).

**Depth:** A line perpendicular to the line drawn by connecting above two points to the deepest point on the floor is the depth of sella turcica(Fig. 3).

**Width:** Maximum transverse diameter of the floor of sella turcica determines width of sella turcica(Fig. 2)

**Volume:** Volume was calculated by using the formula suggested by

Di Chiro & Nelson.21      Volume =  $\frac{1}{2}[L \times D \times B]$  mm<sup>3</sup>

**METHOD:**

The mid-point of tuberculum sella (Point- A): was determined by taking the centre of the distance between most lateral points of tuberculum sella with the help of Digital Vernier Calliper.

The mid-point of dorsum sella (Point- B): was determined by taking the centre of the distance between most lateral points of dorsum sella with the help of Digital Vernier Callipers.

For measuring the length of sella turcica the fixed end of the calipers was placed on point- A and movable end on point- B (Fig. 1).

The depth of sella turcica was measured by placing the flat end of calipers at point A and point B, and then depth probe was lower down in to deepest point of sella turcica (Fig. 3).

For measuring the width of sella turcica the fixed end of the calipers was placed on right side of floor of sella turcica and movable end on left side of floor of sella turcica(Fig. 2). This measurement was taken for three times and the maximum value was considered as a width of sella turcica.

All the observations and measurements were compiled and tabulated and analyzed statistically.



**Fig. 1 Measurement Of The Length Of Sella Turcica: Distance Between Midpoint Of Tuberculum Sella To Midpoint Of Dorsum Sella**



**Fig. 2 Measurement Of Breadth Of Sella Turcica: Transverse Diameter Of Sellar Floor**



**Fig. 3 Measurement Of Depth Of Sella Turcica**

**3. Results**

**TABLE-Ia Length Of Sella Turcica (n=300)**

Range of length (mm)	No.of bones	Range of length (mm)	No.of bones	Range of length (mm)	No.of bones	Range of length (mm)	No. of bones
6-6.5	2	8.5-9	17	11.5-12	41	14-14.5	1
6.5-7	0	9-9.5	23	12-12.5	30	14.5-15	1
7-7.5	2	9.5-10	39	12.5-13	18	15-15.5	1

7.5-8	3	10-10.5	34	13-13.5	2		
8-8.5	11	10.5-11	30	13.5-14	4		

**TABLE:-Ib Range, Mean, and SD of Length Of The Sella Turcica (n= 300)**

PARAMETER	RANGE	MEAN	STANDARD DEVIATION
Length(mm)	6.46-14.98	10.72	1.42

The maximum length of sella turcica was 14.98mm and minimum was 6.46 mm. The mean length of sella turcica was 10.72mm. The standard deviation of length was 1.42 (Table-Ia, Ib).

**TABLE:-IIa Width Of Sella Turcica (n=300)**

Range of width (mm)	No.of bones	Range of width (mm)	No.of Bones	Range of width (mm)	No.of bones	Range of width (mm)	No. of bones
7.5-8	1	10-10.5	11	13-13.5	38	15.5-16	3
8-8.5	2	10.5-11	15	13.5-14	51	16-16.5	0
8.5-9	2	11.5-12	27	14-14.5	24	16.5-17	1
9-9.5	8	12-12.5	25	14.5-15	26	17-17.5	3
9.5-10	6	12.5-13	48	15-15.5	9		

**TABLE:-IIb Range, Mean, and SD of Width Of The Sella Turcica (n = 300)**

PARAMETER	RANGE	MEAN	STANDARD DEVIATION
Width(mm)	8.01-16.89	12.45	1.48

The maximum width of sella turcica was 16.89mm and minimum was 8.01mm. The mean width of sella turcica was 12.45mm. The standard deviation of width was 1.48 (Table-IIa, IIb).

**TABLE:-IIIa Depth Of Sella Turcica (n=300)**

Range of depth (mm)	No.of bones	Range of depth (mm)	No.of bones	Range of depth (mm)	No.of bones	Range of depth (mm)	No. of Bones
2-2.5	1	4.5-5	23	7-7.5	21	9.5-10	9
2.5-3	2	5-5.5	26	7.5-8	30	10-10.5	7
3-3.5	7	5.5-6	35	8-8.5	27	10.5-11	2
3.5-4	11	6-6.5	28	8.5-9	12	11.5-12	1
4-4.5	15	6.5-7	30	9-9.5	13		

**TABLE:-IIIb Range, Mean, and SD of Depth Of The Sella Turcica (n = 300)**

PARAMETER	MEAN	STANDARD DEVIATION	RANGE
Depth(mm)	6.61	1.79	2.16-11.98

The maximum depth of sella turcica was 11.98mm and minimum was 2.16mm. The mean depth of sella turcica was 6.61mm. The standard deviation of depth was 1.79

(Table-IIIa, IIIb)

**TABLE:-Iva: Volume Of Sella Turcica (n=300)**

Range of volume (mm)	No.of Bones	Range of volume (mm)	No.of bones	Range of volume (mm)	No.of bones	Range of volume (mm)	No. of Bones
100-150	2	350-400	44	600-650	17	850-900	0
150-200	10	400-450	36	650-700	9	900-950	0
200-250	18	450-500	55	700-750	3	950-1000	2
250-300	18	500-550	30	750-800	8		
300-350	27	550-600	20	800-850	1		

**TABLE:-IVb Range, Mean, and SD of Volume Of The Sella Turcica (n = 300)**

PARAMETER	MEAN	STANDARD DEVIATION	RANGE
Volume(mm <sup>3</sup> )	442	144	122-990

The maximum volume was 990mm<sup>3</sup> and minimum was 122mm<sup>3</sup>. The mean volume of sella turcica was 442mm<sup>3</sup>. The standard deviation of volume was 144 (Table-IVa,IVb).

**TABLE:-Va: Area Of Sella Turcica (n=300)**

Range of area (mm <sup>2</sup> )	No.of bones	Range of area (mm <sup>2</sup> )	No.of bones	Range of area (mm <sup>2</sup> )	No.of bones	Range of area (mm <sup>2</sup> )	No. of Bones
4-14	1	44-54	26	74-84	54	104-114	10
14-24	0	54-64	61	84-94	36	114-124	5
24-34	4	64-74	55	94-104	20	124-134	1
34-44	27						

**TABLE:-Vb: Range, Mean, and SD of Area Of The Sella Turcica (n = 300)**

Parameter	Mean	Standard deviation	Range
Area(mm <sup>2</sup> )	70	19	4-133

The maximum area of sella turcica was 133mm<sup>2</sup> and minimum was 4mm<sup>2</sup>. The mean area of sella turcica was 70mm<sup>2</sup>. The standard deviation of area was 19 (Table-Va,Vb).

**4. DISCUSSION**

**TABLE: VI Comparison Of Various Parameters Of Sella Turcica Between Various Studies**

Name of authors	No of cases	Length (mm)	Depth (mm)	Width (mm)	Area <sub>2</sub> (mm <sup>2</sup> )
Jewett(1920) <sup>10</sup>	100	Av.9.9	Av.7.2	-	-

Camp(1924) <sup>11</sup>	500	5-16 (av.10.6)	4-12 (av.8.1)	-	-
Farinas(1939) <sup>12</sup>	50	-	-	18-20	-
Heublein(1946) <sup>13</sup>	100	Av.10.66	Av.8.30	-	-
Hare et al.(1949) <sup>14</sup>	700	-	-	-	Av.74
Schinz et al. (1952) <sup>15</sup>	-	12-15	9-12	-	90-120
Haas(1954) <sup>16</sup>	661	-	-	-	58-125
Pendergrass et al.(1956) <sup>17</sup>	-	9-10	8-9	-	-
Jupe et al.(1957) <sup>18</sup>	-	7-12	5-11	-	-
Mahmoud(1958) <sup>19</sup>	100	-	-	-	22-126
Joplin et al. (1960) <sup>20</sup>	50	8-14 (av.11)	7-10 (av.8)	12-22 (av.15)	50-118 (av.87)
C.L.Oon(1962) <sup>21</sup>	250	8-15 (av.11.3)	6.5-12.5 (av.8.9)	9-21 (av.13.8)	47-129 (av.84)
Present study	300	6.46-14.98	2.16-11.98 (Av.6.61)	8.01-16.89 (Av.12.45)	4-133 (av.70)

In 198714 Quakinine & Hardy studied 250 sphenoid bones & found the average length was 8mm, average width was 12mm & depth was 6mm. Asad and Hamid (2005) 17 showed that average width of sella turcica was 14.9mm and depth was 9.9mm which is relatively higher than present study. In 200922 K. Suba Ananthi reported a case of abnormal small sella turcica with average length of sella was 3.2mm, breath was 12mm, depth was 6.2mm and volume was 119mm<sup>3</sup>. In 200720 Eman A. Alkofied studied radiograph of 180 individual & found average length was 10.7mm & depth was 9.1mm which is nearer to result of present study.

In present study mean length of sella turcica is 10.72mm, mean depth is 6.61mm, mean breath is 12.45mm, and mean area of sella turcica is 70mm<sup>2</sup>.

**TABLE:XI Comparison Of Volume Of Sella Turcica Between Various Studies**

Name of authors	No.	Average(mm <sup>3</sup> )	Range(mm <sup>3</sup> )
Goldfarb (1918)	24	768	469-1226
Berblinger (1932)	37	964	500-1400
Casazzo (1932)	362	1292	-
Bokelmann (1934)	99	1204	640-2420
Meldolesi et al (1937)	12	985	411-1314

Ottaviani (1939)	70	1230	750-2000
Kadanoff (1939)	119	890	530-1670
Cardillo et al (1941)	17	911	270-1216
Marx et al (1947)	90	950	520-1740
Karlas (1948)	171	939	455-1750
Busch (1951)	243	890	450-1530
Dill (1952)	106	869	521-1780
Tori (1953)	429	763	400-1500
Frazao (1956)	91	1240	920-1620
C.L.Oon (1962)	250	1291	700-1960
Present study	300	442	122-990

The volume of sella turcica was calculated by using the formula given by

Di Chiro and Nelson:  $Volume = \frac{1}{2}[L \times D \times B] \text{ mm}^3$

According to Goldfarb, Berblinger, Casazzo, Bokelmann, Meldolesi et al, Ottaviani, Kadanoff, Cardillo et al, Marx et al, Karlas, Busch, Dill, Tori, Frazao the volume of sella turcica was 768mm<sup>3</sup>, 964mm<sup>3</sup>, 1292mm<sup>3</sup>, 1204mm<sup>3</sup>, 985mm<sup>3</sup>, 1230mm<sup>3</sup>, 890mm<sup>3</sup>, 911mm<sup>3</sup>, 950mm<sup>3</sup>, 939mm<sup>3</sup>, 890mm<sup>3</sup>, 869mm<sup>3</sup>, 790mm<sup>3</sup>, 1240mm<sup>3</sup> respectively. In present study average volume of sella turcica was 442mm<sup>3</sup> (range 122-990mm<sup>3</sup>) (Table-XI). According to Dionyssios Venieratos (2005)40, in study of 20 dry human skulls, the volume of sella turcica ranged from 460mm<sup>3</sup> to 1570mm<sup>3</sup> with mean value of 835mm<sup>3</sup>.

**5. Conclusion**

The study of normal values of sella turcica helps in the objective assessment of sellar enlargement. Sellar measurements have been employed in various growth studies<sup>1</sup>, and in anthropological studies. Sella turcica is usually used as a reference point in various cephalometric analyses. This is commonly done prior to orthodontic treatment.

All the linear measurements (length, depth, width, area, volume) of the sella turcica in the present study were within standard range. The results of the present study of sellar size may be used as reference guide for future studies about sella turcica morphology.

Sella turcica houses the pituitary gland hence the size of sella turcica increases or decreases in various pituitary pathology. In the present study the knowledge provided by various measurements of the size of sella turcica helps the neurosurgeon to decide which approach (trans-frontal, transethmoidal, transsphenoidal sublabian or endonasal) is to be chosen in surgery of pituitary tumours.

## REFERENCES

- [1] Standring, Gray's Anatomy, 38th edn; Churchill Livingstone Elsevier press Chapter 27 skull and mandible: p.459- 468. | [2] Dichiro, G, & Nelson, K.B. The volume of the sella turcica. *Amer. J. Roentgenol* 1962; 87: p.989- 1008. | [3] Isreal, H. Continuing growth in sella turcica with age. *Amer. J. Roentgenol* 1970; 108: p.516-27. | [4] Pisaneschi M, Kapoor G. Imaging of the sella and parasellar region. | *Neuroimaging Clinics of North America* 2005; 15: p.203-219. | [5] E1 Gammal T, Allen M B. Further consideration of sellar changes associated with increased intracranial pressure. *British Journal of Radiology* 1972; 45: p.561-69. | [6] Fraser, R. Joplin, G. F., Laws, J. W., Morrison, R. and Steiner, R. E., *Lancet*. | 1959; 1: p.382. | [7] Renn WH, Rhoton AL. Microsurgical anatomy of the sellar region. *J Neurosurg*, 1975; 43: p.288–298. | [8] Acheson, R. M., *Brit. J. Radiol* 1954; 27: p.298. | [9] Proffit, William R. *Contemporary Orthodontics*. 4th Edition. C.V. Mosby, 2006. (6.5.2.1). vbk: 978-0-323-04046-4#outline (6.5.2.1). | [10] Jewett, C. H. *Amer. J. Roentgenol* 1920; 7: p.352. | [11] Camp JD. The normal and pathologic anatomy of the sella turcica as revealed by roentgenograms. *Am J Roentgenol Rad Ther Nucl Med* 1924; 12: p.143–156. | [12] Farinas, P. L. *Radiology*, 1939; 32: p. 411. | [13] Heublein, G. W. *Amer. J. Roentgenol* 1946; 56: p.299. | [14] Hare, H. F., Silveus, E., and Smedal, M. I. *Radiology* 1949;52: p.193. | [15] Schinz, H. R., Baensch, W. E., Friedl, E., Uehlinger, E. *Roentgen-Diagnostics*, edited by J. T. Case, (Grune and Stratton, New York). 1952; 2: p.1598. | [16] Haas, L. L. *Amer. J. Roentgenol* 1954; 72: p.754. | [17] Pendergrass, E. P., Schaeffer, J. P., and Hodes, P. J. *The Head and Neck in Roentgen Diagnosis*, (Blackwell Scientific Publications, Oxford). 1956;2: p.947. | [18] Jupe, M. H., Northfield, D. W. C. *A Textbook of X-ray Diagnosis by British Authors*, 3rd edn. (H. K. Lewis, London). 1957; 1: p.48. | [19] Mahmoud, M. E. S., *Brit. J. Radiol Suppl* 1958; 8: p. 5. | [20] Joplin, G. F., Fraser. *RCiba Foundation Colloquia on Endocrinology*. 1960; p.13-14. | [21] C. L Oon. The size of the pituitary fossa in adults from radiograph. 1962 August; 36(424). | [22] Keyers JEL. Observations on four thousand optic foramina in human skulls of known origin. *Arch Ophthalmol* 1935; 13: p.538–568. |