



## The size and morphology of sella turcica: A lateral cephalometric study

Tejavathi Nagaraj<sup>1</sup>, R. Shruthi<sup>2</sup>, Leena James<sup>3</sup>, I. Keerthi<sup>2</sup>, Lakshmi Balraj<sup>2</sup>, Rahul Dev Goswami<sup>2</sup>

<sup>1</sup>Professor and Head, Department of Oral Medicine and Radiology, Sri Rajiv Gandhi College of Dental Sciences & Hospital, Bengaluru, Karnataka, India,

<sup>2</sup>Post-graduate Student, Department of Oral Medicine and Radiology, Sri Rajiv Gandhi College of Dental Sciences & Hospital, Bengaluru, Karnataka, India,

<sup>3</sup>Professor, Department of Oral Medicine and Radiology, Sri Rajiv Gandhi College of Dental Sciences & Hospital, Bengaluru, Karnataka, India

### Keywords

Lateral cephalogram, sella turcica, sella turcica morphology and size

### Correspondence:

Dr. R. Shruthi, Department of Oral Medicine and Radiology, Sri Rajiv Gandhi Dental College and Hospital, Cholanagar, Bengaluru - 560 032, Karnataka, India. Phone: +91-9686666902, Email: drshruthir@gmail.com

Received 15 February 2015;

Accepted 28 March 2015

doi: 10.15713/ins.jmrps.14

### Abstract

**Background:** Sella turcica is a saddle-shaped concavity in the body of sphenoid bone situated in the middle cranial fossa of skull, clearly seen on lateral cephalometric radiograph.

**Aim:** The purpose of the study was to measure the size and describe the morphology of sella turcica in different age groups and gender.

**Materials and Methods:** Lateral cephalometric radiographs of 200 subjects of which 100 males and 100 females in the age group of 8-30 years were included in the study population. Linear dimensions which include the length, depth, and anteroposterior diameter were measured and the shape of sella turcica was analyzed and skeletal class of malocclusion was noted. Chi-square test and ANOVA test were used for statistical analysis.

**Results:** In the present study, morphology of sella turcica appeared to be normal shape (upper contour of anterior wall of sella turcica appears to be perpendicular to floor) in 46.5% of the study population and morphological variations in shape were seen in 53.5% of study population. Whereas size was considered there was statistically significant increase in the depth and anteroposterior diameter of sella turcica as age advanced. There was no significant difference in the linear measurements of sella turcica between males and females.

**Conclusion:** The most common shape of sella turcica in the study population was normal shape. There is a gradual increase in the size of sella turcica as age advances.

### Introduction

Sella turcica is a saddle-shaped concavity in the body of sphenoid bone situated in the middle cranial fossa of the skull. Sella turcica gets its name from Turkish language because of its similarity to the Turkish saddle. The depression in saddle is noted as pituitary fossa or hypophyseal fossa. The pituitary gland is situated in the hypophyseal fossa. It is limited by bony constituents of the sella turcica, anteriorly by tuberculum sellae, posteriorly by dorsum sellae and inferiorly by the bony roof of sphenoid air sinus.<sup>[1,2]</sup> Sella turcica on lateral cephalometric radiograph can be observed clearly and consecutively traced during cephalometric analysis.<sup>[3]</sup> A larger size may be an indication of pituitary tumor over producing hormones such as an adrenocorticotrophic hormone, prolactin, growth hormone, thyroid stimulating hormone, antidiuretic hormone. The enlarged sella turcica on a radiograph has been found to be associated with adenomas, meningioma, primary hypothyroidism, prolactinoma, gigantism,

acromegaly, empty Sella syndrome, and Nelson syndrome. A small size may lead to decreased pituitary function causing symptoms such as short stature and retarded skeletal growth.<sup>[4]</sup> Research concerning the sella turcica has focused on both size and morphology. A normal morphological variation of sella turcica vary greatly from individual to individual.<sup>[5]</sup> The aim of this study was to determine the average dimensions and morphological variations of the sella turcica in different age groups and to evaluate any difference in size between males and females in the study population.

### Materials and Methods

This radiographic study was conducted during a time period of 6 months, from July 2014 to December 2014. The study included a total of 200 digital lateral cephalometric radiographs of 100 males and 100 females (between 8 and 30 years of age)

who attended the Department of Oral Medicine and Radiology and were grouped into five categories based on age i.e., <10 years, 10-15 years, 15-20 years, 20-25 years, 25-30 years.

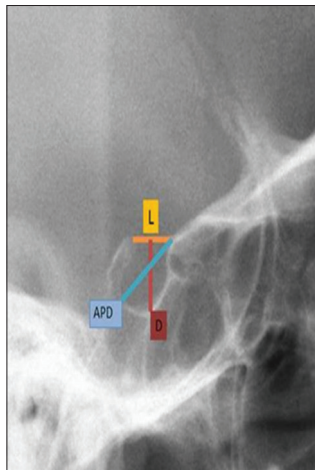
#### Inclusion criteria

- Healthy patients without any history of systemic diseases
- Patients in the age group of 8-30 years
- Patients advised for lateral cephalometric radiographs for orthodontic treatment.

#### Exclusion criteria

- Individuals with congenital defects in the craniofacial region like clefts and malformations
- History of craniofacial fractures
- Patients suffering from disorders of bone, nutritional deficiencies and endocrinal disturbances.

Digital lateral cephalometric radiographs were taken by using ORTHOPHOS XG machine with a tube voltage of 73 kV, tube current of 15 mA and exposure time of 9.4 s. The distances were measured using Sidexis Programs (Sirona) software. The length was measured as the linear distance from the superior most point on the tuberculum sella to the tip of the dorsum sella. The depth was measured as a line perpendicular from the line joining tuberculum sella and dorsum sella to the inferior most point on the floor. The anteroposterior diameter of sella turcica is measured from the superior most point on tuberculum sella to the furthest point on the posteroinferior aspect of the hypophyseal fossa [Figure 1]. Based upon the ANB angle, subjects were classified into Class I, II, and III. ANB angle of  $\pm 2^\circ$  belongs to Class I skeletal base. ANB angle of  $>4^\circ$  belongs to Class II skeletal base. ANB angle of  $<0^\circ$  belongs to Class III skeletal base. Shape and morphological appearance of sella turcica were assessed according to the method described by Axelsson *et al.* According to Axelsson *et al.*, the five morphological variations are oblique anterior wall, bridging of sella turcica, double



**Figure 1:** Linear measurements of sella turcica. L-Length, D-Depth, APD-Anteroposterior diameter

contour of the floor, irregular surface (notch like depression) in the posterior aspect of the dorsum sella, and pyramid shape of dorsal sellae [Figure 2].<sup>[6]</sup>

#### Statistical analysis

The following methods of statistical analysis have been used in this study. Data were entered in Microsoft excel and analyzed using SPSS (Statistical Package for Social Science, Ver.10.0.5) package. Univariate analyses of the dichotomous variables encoded were performed by means of the Chi-square test and were used to calculate the mean differences in linear measurements of sella turcica between males and females. One-way analyses of variance were used to test the difference between different age groups. To find out which of the two groups means is significantly difference *post-hoc* test of Schiff's test was used.  $P < 0.05$  was considered statistically significant.

#### Results

The mean age of study population was 16.8 years, minimum age was 8 years and maximum age was 30 years. Majority of the study group had skeletal Class I malocclusion of 77.5%, skeletal Class II and skeletal Class III were 17.5% and 5%, respectively.

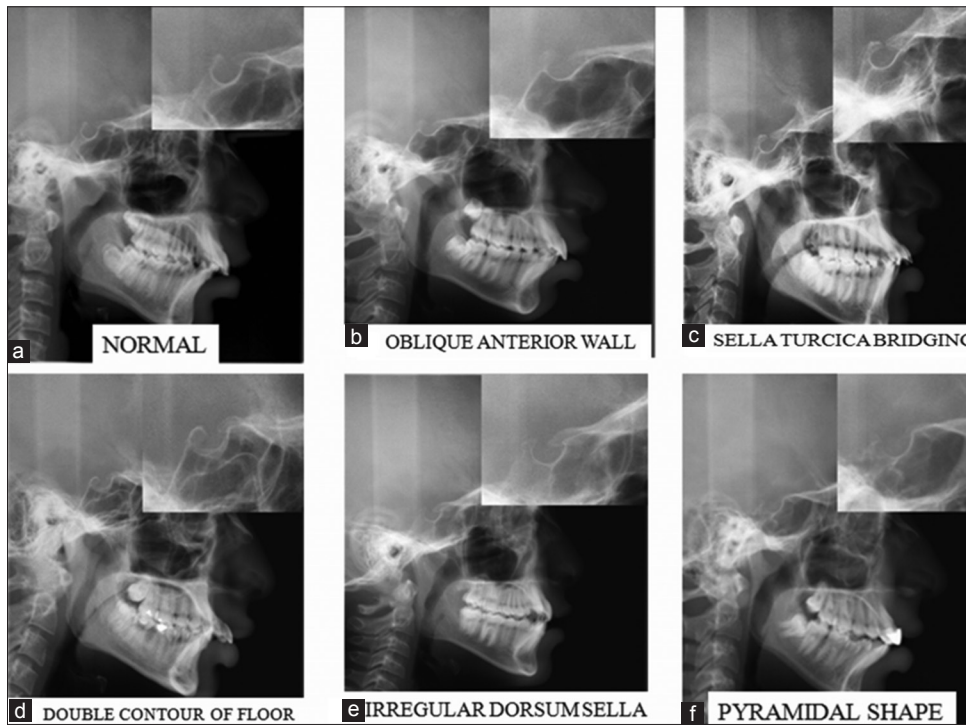
The different morphological shape of sella turcica seen are normal (upper contour of anterior wall of sella turcica appears to be perpendicular to floor) 46.5%, followed by oblique anterior wall 29%, sella turcica bridge 7.5%, double contour of floor 3.5%, irregular dorsum sella 7%, pyramidal shape 6.5%. The least common type of sella turcica in study population found to be double contour of the floor of 3.5% and most common type was normal type of 46.5%.

The linear dimensions of sella turcica in different age group are given in Table 1. The patients were grouped into five different categories, <10 years, 10-15 years, 15-20 years, 20-25 years, 25-30 years. There was difference in the linear measurements of depth, and anteroposterior diameter in each age group which increased as age increased and the difference was statistically significant with  $P < 0.05$ . The difference in the length of different age groups was not significant.

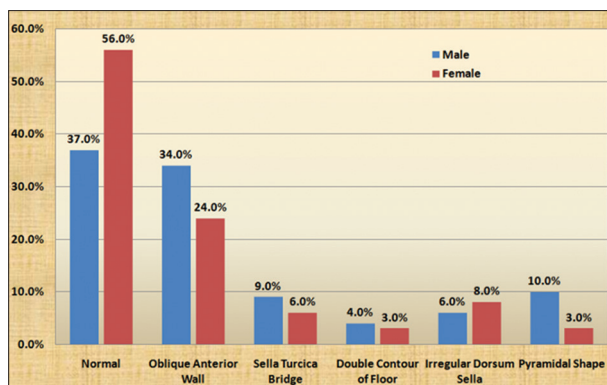
The linear dimension of sella turcica among males and females are given in the Table 2 where there was no statistically significant difference in the size of sella turcica between males and females. The distribution of different shapes of sella turcica among males and females are given in Graph 1. The normal shape of sella turcica was seen more commonly in females. Irregular dorsum sella was more common in females and other morphological variations were more commonly seen in males. There was no significant difference in size between skeletal Class I, II, and III malocclusion.

#### Discussion

This study describes the morphological variations in structure and size of the sella turcica of both genders under a wide range of age group.



**Figure 2:** Different morphological shapes of sella turcica: (a) Normal, (b) Oblique anterior wall, (c) sella turcica bridging, (d) double contour of floor, (e) irregular dorsum sella, (f) pyramidal shape



**Graph 1:** Distribution of different shapes of sella turcica among genders

**Shape of sella turcica**

Gorden and Bell in 1922 examined radiographs of normal children in between 1 and 12 years of age and categorized sella turcica into three shapes, circular, oval, flat/saucer shaped. Circular or oval shaped sella turcica were observed in majority of subjects, and they arrived at a conclusion that not all cases could easily be put into such a broad three-way classification.<sup>[5]</sup>

Axelsson *et al.* conducted a study in Norway using lateral cephalometric radiographs of males and females in age range of 6-21 year in 2004 to determine variations in size and shape of sella turcica. The sella turcica morphology was analyzed and five types of different morphological aberration like oblique

anterior wall, bridging of sella turcica, double contour of the floor, irregular surface (notch like depression) in the posterior aspect of the dorsum sellae, pyramid-like shape of the dorsum sellae were recognized.<sup>[6]</sup>

Alkofide conducted a study to evaluate the morphological shapes of sella turcica in cleft lip and palate patients in 2008, according to study he arrived at result majority of cleft subjects had morphological aberrations such as a double contour of the floor, an irregular posterior wall found more commonly than the normally shaped sella turcica. Contrary to individuals with clefts, in most non-cleft subjects the morphology of the sella turcica appears to be normal.<sup>[7]</sup>

The morphological variations of sella turcica with greater severity are more commonly seen in syndromic patients such as Down’s syndrome, William’s syndrome, Seckel syndrome, and Axenfeld-Rieger syndrome.<sup>[8-11]</sup>

A study was done by Sathyanarayana *et al.* in 2012 to assess the size and morphology of sella turcica in south Indian population having Class I, Class II, and Class III skeletal patterns. In this study, 61% of the subjects had normal morphology whereas the remaining 39% had variations in the shape, lowest being oblique anterior wall in 5%, double contour of the floor in 5.5%, pyramid-like shape of the dorsum sellae in 5.5%, bridging of sella turcica in 8% of subjects, irregularity (notch like depression) in the posterior surface of the dorsum sellae in 15% of study population.<sup>[12]</sup>

In contrast to above, study done by Chauhan *et al.* in 2014 showed morphology of sella turcica to be typical in just 28% of cases. Within the atypical sellae most had oblique anterior wall

**Table 1:** Age-wise distribution of sella turcica parameters

Parameters	N	Mean	SD	Minimum	Maximum	F value	P value
<b>Length</b>							
≤10 years	13	9.12	1.464	7.07	13.00	0.638	0.636
11-15 years	93	9.45	1.716	5.93	14.83		
16-20 years	39	9.86	1.945	5.62	14.91		
21-25 years	39	9.39	1.586	6.76	12.07		
26-30 years	16	9.67	2.216	5.26	15.32		
Total	200	9.52	1.762	5.26	15.32		
<b>Depth</b>							
≤10 years	13	7.65	1.238	5.47	10.81	3.919	0.004
11-15 years	93	7.94	1.545	4.37	13.69		
16-20 years	39	8.31	1.470	5.66	11.73		
21-25 years	39	8.53	1.312	6.03	11.65		
26-30 years	16	9.26	1.160	6.34	10.62		
Total	200	8.21	1.484	4.37	13.69		
<b>Diameter</b>							
≤10 years	13	11.19	1.171	9.61	13.31	7.899	<0.001
11-15 years	93	11.26	1.703	6.03	15.64		
16-20 years	39	11.93	2.000	4.32	15.55		
21-25 years	39	12.84	1.679	9.34	15.98		
26-30 years	16	12.92	1.669	9.74	17.23		
Total	200	11.83	1.847	4.32	17.23		

N: Number of cases, SD: Standard deviation,  $P < 0.05$  significant,  $P > 0.05$  not significant

**Table 2:** Linear measurements of sella turcica size in both gender

Measurements	N	Mean	SD	Minimum	Maximum	F value	P value
<b>Length</b>							
Male	100	9.69	1.907	5.26	15.32	2.047	0.154
Female	100	9.34	1.593	5.93	14.83		
Total	200	9.52	1.762	5.26	15.32		
<b>Depth</b>							
Male	100	8.34	1.488	4.37	13.69	1.412	0.236
Female	100	8.09	1.477	5.30	11.69		
Total	200	8.21	1.484	4.37	13.69		
<b>Diameter</b>							
Male	100	11.59	2.006	4.32	17.23	3.478	0.064
Female	100	12.07	1.648	6.03	15.98		
Total	200	11.83	1.847	4.32	17.23		

N: Number of cases, SD: Standard deviation

(23%), followed by irregular sellae (18%) bridging in 17% of cases, double contour of floor 10%. None of the sella was seen to be pyramidal in type in north Indian population.<sup>[13]</sup> In the current study, the normal type of sella turcica is 46.5% of the study population, morphological variations were 53.5%.

The presence of a sella turcica bridge in normal individuals has been shown to occur in 5.5-22% of subjects, with an increased incidence in patients with craniofacial deviations.<sup>[14-16]</sup> Najim and Al-Nakib conducted a cephalometric study in 2011 to assess morphology of sella turcica in patients with maxillary malposed canine and normal population and found that prevalence of sella turcica bridging was comparatively greater in subjects with abnormally placed canine as compared to control group.<sup>[17]</sup> In our study, 7.5% of the population had bridging of sella turcica.

### Size of sella turcica

Tetradis and Kantor conducted a study in 1999 with sample of 325 orthodontic patients in which 134 patients were males and 191 were female patients, varying from 6 to 49 years with mean age of 14.8 years. They measured linear dimensions of sella turcica on the lateral cephalogram, the anteroposterior diameter ranged from 6.0 to 17.0 mm, mean value was found to be  $10.9 \pm 1.8$  mm, while the depth varied from 2.5 to 12.5 mm with a mean of  $7.6 \pm 1.7$  mm.<sup>[18]</sup>

The size of sella turcica was studied by Axelsson *et al.* in a Norwegian sample longitudinally between the ages of 6 and 21 years. His study results found that the length was almost constant throughout the observation period whereas the depth and diameter increased with age.<sup>[6]</sup> Similarly, statistically significant values ( $P < 0.05$ ) were derived from present study where the depth and anteroposterior diameter gradually increased with age, and regarding length there is no significant increase with age. The average length, depth, and anteroposterior diameter ranged as  $10 \pm 5$  mm,  $8 \pm 3$  mm,  $12 \pm 4$  mm, respectively. Based on the above result, growth of the individual can be assessed based on the size of the sella turcica at different age periods.

Study done by Axelsson *et al.* also revealed that there was significant difference in the length of sella turcica in gender which was more in males compared to females, whereas there is no difference in depth and anteroposterior diameter.<sup>[6]</sup> Similar results were given in the study done in south Indian population which showed the difference in length of sella turcica between males and females.<sup>[12]</sup>

In the present study, there was no significant difference in all three dimensions in males and females. This result is correlating with studies done by Yassir *et al.* 2010 in Iraq population, Shah *et al.* 2011 in Pakistan population, Chavan *et al.* 2012 in Maharashtra population, Osunwoke *et al.* 2014 in Nigerian population, where between genders no significant difference was found in terms of length, depth, and diameter.<sup>[5,19-21]</sup>

### Conclusion

The most common morphological shape of sella turcica was normal shape of about 46.5%. There was a significant increase in the depth and anteroposterior diameter of sella turcica as age increases. There was no difference in the size of sella turcica between males and females. Normal shape of sella turcica was



seen more commonly in females than males. The results can be used as a reference in future studies with larger study population.

### Clinical significance

The normal anatomy and variations in the morphology and size of sella turcica on a lateral cephalometric radiograph should be acquainted by clinicians, in order to analyze deviations that may reflect pathological situations. Growth of the individual can be assessed based on the size of the sella turcica at different age period.

### References

- Subhadra Devi V, Baburao S. Age and sex related morphology and morphometry of sellar region of sphenoid in prenatal and postnatal human cadavers. *Int J Res Dev Health* 2013;1:141-8.
- Chaurasia BD. *BD Chaurasia's Human Anatomy. Head Neck and Brain*. 4<sup>th</sup> ed., Vol. 3. New Delhi: CBS Publishers; 2004. p. 22.
- Leonardi R, Barbato E, Vichi M, Caltabiano M. A sella turcica bridge in subjects with dental anomalies. *Eur J Orthod* 2006;28:580-5.
- Meyer-Marcotty P, Reuther T, Stellzig-Eisenhauer A. Bridging of the sella turcica in skeletal Class III subjects. *Eur J Orthod* 2010;32:148-53.
- Shah AM, Bashir U, Ilyas T. The shape and size of the sella turcica in skeletal class I, II, III in patients presenting at Islamic International Dental Hospital, Islamabad. *Pak Oral Dent J* 2011;31:104-10.
- Axelsson S, Storhaug K, Kjaer I. Post-natal size and morphology of the sella turcica. Longitudinal cephalometric standards for Norwegians between 6 and 21 years of age. *Eur J Orthod* 2004;26:597-604.
- Alkofide EA. Sella turcica morphology and dimensions in cleft subjects. *Cleft Palate Craniofac J* 2008;45:647-53.
- Axelsson S, Storhaug K, Kjaer I. Post-natal size and morphology of the sella turcica in Williams syndrome. *Eur J Orthod* 2004;26:613-21.
- Korayem M, Alkofide E. Size and shape of the sella turcica in subjects with Down syndrome. *Orthod Craniofac Res* 2015;18:43-50.
- Kjaer I, Hansen N, Becktor KB, Birkebaek N, Balslev T. Craniofacial morphology, dentition, and skeletal maturity in four siblings with Seckel syndrome. *Cleft Palate Craniofac J* 2001;38:645-51.
- Meyer-Marcotty P, Weisschuh N, Dressler P, Hartmann J, Stellzig-Eisenhauer A. Morphology of the sella turcica in Axenfeld-Rieger syndrome with PITX2 mutation. *J Oral Pathol Med* 2008;37:504-10.
- Sathyanarayana HP, Kailasam V, Chitharanjan AB. The size and morphology of sella turcica in different skeletal patterns among South Indian population: A lateral cephalometric study. *J Indian Orthod Soc* 2013;47:266-71.
- Chauhan P, Kalra S, Mongia SM, Ali S, Anurag A. Morphometric analysis of sella turcica in North Indian population: A radiological study. *Int J Res Med Sci* 2014;2:521-6.
- Becktor JP, Einersen S, Kjaer I. A sella turcica bridge in subjects with severe craniofacial deviations. *Eur J Orthod* 2000;22:69-74.
- Sathyanarayana HP, Kailasam V, Chitharanjan AB. Sella turcica - Its importance in orthodontics and craniofacial morphology. *Dent Res J (Isfahan)* 2013;10:571-5.
- Andredaki M, Koumantanou A, Dorotheou D, Halazonetis DJ. A cephalometric morphometric study of the sella turcica. *Eur J Orthod* 2007;29:449-56.
- Najim AA, Al-Nakib L. A cephalometric study of sella turcica size and morphology among young Iraqi normal population in comparison to patients with maxillary malposed canine. *J Bagh College Dent* 2011;23:53-8.
- Tetradis S, Kantor ML. Prevalence of skeletal and dental anomalies and normal variants seen in cephalometric and other radiographs of orthodontic patients. *Am J Orthod Dentofac Orthop* 1999;116:572-7.
- Yassir AY, Nahidh M, Yousif HA. Size and morphology of sella turcica in Iraqi adults. *Mustansiria Dent J* 2010;7:23-30.
- Chavan SR, Kathole MA, Katti AS, Herekar NG. Radiological analysis of sella turcica. *Int J Recent Trends Sci Technol* 2012;4:36-40.
- Osunwoke EA, Mokwe CR, Amah-Tariah FS. Radiologic measurements of the sella turcica in an adult Nigerian population. *Int J Pharm Res* 2014;4:115-7.

**How to cite this article:** Nagaraj T, Shruthi R, James L, Keerthi I, Balraj L, Goswami RD. The size and morphology of sella turcica: A lateral cephalometric study. *J Med Radiol Pathol Surg* 2015;1:3-7.