

Evaluation of the Effect of Age, Gender, and Skeletal Class on the Dimensions of Sella Turcica Using Lateral Cephalogram

Abstract

Context: Sella turcica or pituitary fossa is a saddle-shaped concavity housing the pituitary gland and seen clearly on lateral cephalogram. This makes it a good source of additional diagnostic information related to pathology of the pituitary gland or to various syndromes that affect the craniofacial region. **Aims:** The aim of this retrospective 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. **Settings and Design:** All the lateral cephalograms were taken by trained radiographic technicians using Planmeca Promax Ceph X-ray Machine, Finland, Inc., in a standardized manner using the same cephalostat. **Materials and Methods:** Four hundred and eighty lateral cephalograms were obtained under standardized conditions. With age range between 7 and 43 years, all the radiographs were distributed according to skeletal class and gender. Size and morphology of sella turcica were recorded and compared with age, gender, and skeletal class. **Statistical Analysis Used:** A Student's *t*-test, one-way ANOVA test, and Pearson's correlation coefficient were used. **Results:** The mean age of the study population was found to be 16.8 years comprising 48.6% males and 51.3% females. There was a gradual increase in linear dimensions of sella turcica with the advancement of age. The normal sella was observed in 20.6%, whereas 79.35% showed variation in morphology. Oblique anterior wall was a most common abnormal variant, whereas pyramidal shaped dorsum was rarest. **Conclusions:** There was no statistically significant difference in linear dimensions or morphological variations with age, gender, or type of malocclusion.

Keywords: Lateral cephalograms, oral and maxillofacial radiology, pituitary apoplexy, sella turcica, sella turcica anomalies

Introduction

Sella turcica or pituitary fossa is a saddle-shaped concavity housing the pituitary gland in the body of sphenoid bone in the middle cranial fossa of skull. It is seen clearly on lateral cephalograms which is very important for the cephalometric position for evaluating craniofacial morphology and orthodontic treatment. This makes it a good source of additional diagnostic information related to pathology of the pituitary gland or to various syndromes that affect the craniofacial region.^[1]

Clinicians should be familiar with the normal radiographic anatomy and morphologic variability of this area, to recognize and investigate deviations that may reflect pathological situations well in advance before these become clinically apparent. The enlarged sella turcica on a radiograph may indicate hyperpituitary function in conditions such as adenomas, meningioma, primary

hypothyroidism, and prolactinoma, and in syndromes such as empty sella syndrome, Nelson syndrome, Down's syndrome, William's syndrome, Seckel syndrome, and Axenfeld-Rieger syndrome.^[2,3]

A small size may indicate decreased pituitary function causing symptoms such as short stature and retarded skeletal growth. 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 retrospective study was conducted upon the Institutional Ethics Committee approval on lateral cephalograms obtained from the archives (January 2015–2016) of Department of Oral Medicine and Radiology, MCOCS, Manipal.

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All the lateral cephalograms were taken by trained radiographic technicians using Planmeca ProMax Ceph X-ray Machine, Finland, Inc., in a standardized manner using the same cephalostat. The mid-sagittal enlargement was adjusted to 100% uniformly for all cephalograms. All linear measurements were made with an inbuilt Romexis software [Figure 1].

Inclusion criteria

Lateral cephalograms with good visibility of all cephalometric structures including the sella turcica were included in the study.

Exclusion criteria

- Craniofacial congenital deformities
- Evidence of maxillofacial surgery/trauma.

Study design

A total of 586 lateral cephalograms were screened, of which 480 lateral cephalograms in accordance with the inclusion and exclusion criteria were included in the study with age range between 7 and 43 years.

All the radiographs were distributed according to skeletal Class and gender; 149 Class I, 173 Class II, and 158 Class III cases with nearly equal distribution between males and females (234 males and 247 females).

Distribution into skeletal classes

Based on the ANB angle (Stiener analysis), cephalograms were classified into Class I, II, and III.

- ANB angle of $\pm 2^\circ$ belongs to Class I skeletal base

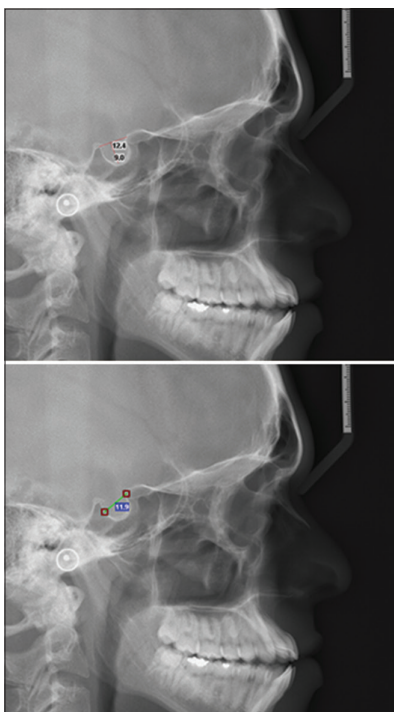


Figure 1: Measurement of linear dimensions on Romexis software

- ANB angle of $> 4^\circ$ belongs to Class II skeletal base
- ANB angle of $< 0^\circ$ belongs to Class III skeletal base.

Size of sella turcica

Three linear measurements of the sella turcica, i.e. length, diameter, and depth in mid-sagittal plane were obtained in accordance with Silverman and Kisling methods.^[4]

- Length – The distance between the tuberculum sellae to the tip of dorsum sellae
- Depth – A line perpendicular to the line drawn above to the deepest point on the floor
- Anteroposterior diameter – Line drawn from the tuberculum sellae to the most posterior point on the posterior inner wall of the fossa [Figure 2].

Morphology of sella turcica

The study of Axelsson *et al.*^[5] was used to determine the shape of sella turcica, according to which five variations in morphology of sella turcica are described apart from normal morphology [Figure 3].

- These are normal (A)
- Oblique anterior wall (B)
- Sella turcica bridging (C)
- Double contour of the floor (D)
- Irregularity in posterior part of dorsum sellae (notching) (E)
- Pyramidal shape of the dorsum (F).

Reliability of measurements

To ensure reproducibility, measurements were taken twice with a gap of 1 month.

The intraclass correlation coefficient, is a widely accepted index of measurement reliability, which was used in this study to evaluate the reproducibility of the readings. The reliability measurements were between 0.74 and 0.96, which shows moderate-to-good reproducibility of the retraced radiographs.

Results

A total of 480 lateral cephalograms across wide age range (7–43 years) were included in the study. These

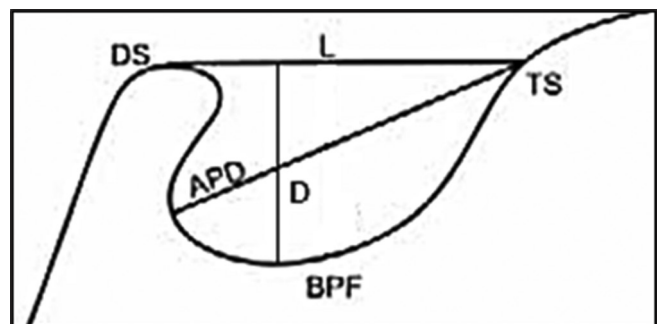


Figure 2: Linear dimensions of the sella turcica: L: Length; APD: Anteroposterior diameter; D: Depth; TS: Tuberculum sellae; DS: Dorsum sellae

radiographs comprised of 48.6% males (233) and 51.3% females (247). The mean age of the study population was found to be 16.8 years, where minimum was 7 years and maximum age was 43 years.

There was a gradual increase in linear dimensions of sella turcica with the advancement of age [Table 1]. However, there was no statistically significant difference among both the genders in terms of linear measurements of sella turcica. Although there were mild variations in linear dimensions among different skeletal classes, there was no statistical significance either in AP diameter or depth of sella turcica [Tables 2 and 3].

The morphology of sella turcica varied widely among the radiographs. The normal sella was observed in 20.6% whereas 79.35% showed variation in morphology as shown in Table 4.

Double floor (D)-shaped sella turcica was found to be most prevalent (53.3%) among radiographs of male participants, whereas pyramidal-shaped dorsum (F) was the least common (35.8%) [Table 5].

In contrast, pyramidal-shaped dorsum (F) was most common (64.2%) among females and double floor (D)-shaped sella turcica was found to be least prevalent (46.7%)

Table 5 reveals that pyramidal-shaped dorsum (F) was most common (34.3%) among Class I participants and oblique anterior wall (B) was rarest (22.5%).

Among Class II participants, oblique anterior wall (B) was observed to be most prevalent (53.9%) and double floor (D)-shaped sella turcica was the least common variant (34.7%).

Among Class III participants, double floor (D)-shaped sella turcica was found to be most prevalent (37.3%), whereas normal sella turcica (A) was the least common (22.2%).

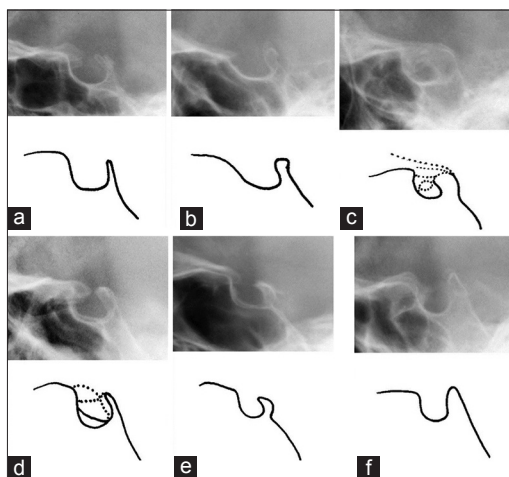


Figure 3: Various morphological types of sella turcica. Normal (a), Oblique anterior wall (b), Sella turcica bridging (c), Double contour of the floor (d), Irregularity in posterior part of dorsum sellae (notching) (e), Pyramidal shape of the dorsum (f)

Statistical analyses

Data from all measurements were transferred to a Statistical Package for the Social Sciences (SPSS 15.0, IBM SPSS Statistics software version 15.0). A student’s *t*-test was used to calculate the mean differences in linear dimensions of sella turcica between males and females and between different age groups at a significance level of 0.05. The relationship between skeletal type and size of sella turcica was assessed using one-way ANOVA test and to distinguish which skeletal class showed the most significant difference in linear dimensions.

Discussion

The lateral cephalometric radiograph displays numerous cranial, facial, and oral anatomic structures imaged from

Table 1: Comparison of linear measurements in sella turcica with age

| | AP diameter | Depth | Length |
|---------------------|-------------|-------|--------|
| Age | | | |
| Pearson correlation | 0.075 | 0.081 | 0.072 |
| <i>P</i> | 0.1 | 0.076 | 0.89 |
| <i>n</i> | 480 | 480 | 480 |

AP: Anteroposterior

Table 2: Comparison of linear measurements of sella turcica with gender

| | Gender | | | | <i>P</i> |
|------------------|----------|------|------------|------|------------|
| | Male (1) | | Female (2) | | |
| | Mean | SD | Mean | SD | |
| AP diameter (mm) | 10.20 | 2.37 | 10.53 | 2.46 | 0.143 (NS) |
| Depth (mm) | 7.18 | 2.00 | 7.35 | 1.93 | 0.343 (NS) |
| Length (mm) | 8.25 | 2.26 | 7.89 | 2.16 | 0.076 (NS) |

NS: Not significant; SD: Standard deviation; AP: Anteroposterior

Table 3: Comparison of linear measurements of sella turcica with skeletal class

| | Skeletal class | | | | | | <i>P</i> |
|------------------|----------------|------|-------|------|-------|------|------------|
| | 1 | | 2 | | 3 | | |
| | Mean | SD | Mean | SD | Mean | SD | |
| AP diameter (mm) | 10.46 | 2.55 | 10.32 | 2.36 | 10.37 | 2.38 | 0.87 (NS) |
| Depth (mm) | 7.27 | 1.99 | 7.22 | 1.95 | 7.35 | 1.96 | 0.822 (NS) |
| Length (mm) | 8.35 | 2.35 | 7.86 | 2.26 | 8.26 | 2.18 | 0.113 (NS) |

NS: Not significant; SD: Standard deviation; AP: Anteroposterior

Table 4: Prevalence of various morphological variations in sella turcica

| | Frequency <i>n</i> (%) |
|-------|------------------------|
| Shape | |
| A | 99 (20.6) |
| B | 89 (18.5) |
| C | 78 (16.3) |
| D | 75 (15.6) |
| E | 72 (15.0) |
| F | 67 (14.0) |

Table 5: Correlation of morphological shape of sella turcica with gender and skeletal class

| | Shape | | | | | | P |
|----------------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| | A, n (%) | B, n (%) | C, n (%) | D, n (%) | E, n (%) | F, n (%) | |
| Gender | | | | | | | |
| 1 | 48 (48.5) | 43 (48.3) | 38 (48.7) | 40 (53.3) | 34 (47.2) | 24 (35.8) | 0.442 (NS) |
| 2 | 51 (51.5) | 46 (51.7) | 40 (51.3) | 35 (46.7) | 38 (52.8) | 43 (64.2) | |
| Skeletal class | | | | | | | |
| 1 | 32 (32.3) | 20 (22.5) | 25 (32.1) | 21 (28.0) | 22 (30.6) | 23 (34.3) | 0.318 (NS) |
| 2 | 45 (45.5) | 48 (53.9) | 30 (38.5) | 26 (34.7) | 31 (43.1) | 25 (37.3) | |
| 3 | 22 (22.2) | 21 (23.6) | 23 (29.5) | 28 (37.3) | 19 (26.4) | 19 (28.4) | |

Normal (A), Oblique Anterior wall (B), Sella turcica bridging (C), Double contour of the floor (D), Irregularity in posterior part of dorsum sellae (notching) (E), Pyramidal shape of the dorsum (F). NS: Not significant

lateral aspect. Proper analysis of these structures depends on accurate identification and location of defined anatomical and constructed landmarks which serve as quantitative and qualitative measurements of lines and angles.^[6]

Shape of the sella turcica

The morphology of sella turcica appeared normal in only 20.6% of patients, regardless of the gender or the skeletal type. The variation in the shape of the sella was present in 79.3% of the subjects: an oblique anterior wall was found in 18.5%. A sella turcica bridge was present in 16.3%, double contour sella was found in 15.6%, notching was found in 15.0%, while finally pyramidal shape was found in 14.0%.

This finding was in accordance with the findings of Valizadeh *et al.*^[7] and Chauhan *et al.*^[8] who found that shape of the sella turcica was normal in 24.4% and 28% of the subjects, respectively.

However, on the contrary, Axelsson *et al.*,^[5] Alkofide,^[4] and Sathyanarayana *et al.*,^[9] 2004, found that the normal variation of sella turcica was seen in two-third of the subjects, while the remaining subjects showed dysmorphological appearance.

On assessment of the morphology of sella turcica of each of the three skeletal types, pyramidal shape of the dorsum (F) was most common (64.2%) among female subjects and double floor (D)-shaped sella was in males (53.3%). On correlating skeletal class with the shape of sella turcica, pyramidal-shaped dorsum (F) was most common (34.3%) among Class I subjects and oblique anterior wall (B) was rarest (22.5%). Among Class II subjects, oblique anterior wall (B) was observed to be most prevalent (53.9%) and double floor (D)-shaped sella turcica was the least common variant (34.7%). Among Class III subjects, double floor (D)-shaped sella turcica was found to be most prevalent (37.3%), whereas normal sella turcica (A) was the least common (22.2%).

These findings were not in accordance with study by Sathyanarayana *et al.*,^[9] wherein skeletal Class I patients, 75% of patients had normal sella, and 25% of the patients

had variations. In skeletal Class II patients, 60% of the patients had a normal sella and 40% of the patients had variations in the morphology. In skeletal Class III patients, 48% of the patients had a normal sella and 52% of the patients had variations in the morphology.

Size of sella turcica

In the present study, there was no significant difference in all three dimensions between males and females. This was correlating with studies done by Alkofide,^[4] 2007, Yassir *et al.*,^[10] 2010 in Iraq population, Shah *et al.*,^[11] 2011 in Pakistan population, Chavan *et al.*,^[12] 2012, in Maharashtra population, Osunwoke *et al.*,^[13] 2014, in Nigerian population, and by Nagaraj *et al.*^[2] in 2015 where there was no significant difference between genders in terms of length, depth, and diameter.

Conclusions

Approximately 20.6% of the investigated radiographs had a normal sella turcica.

Oblique anterior wall was most common abnormal variant whereas pyramidal-shaped dorsum was rarest. There was no statistically significant difference in linear dimensions or morphological variations with age, gender, or type of malocclusion.

The linear measurements obtained in this study gave us deep insight to normal variations in sella turcica morphology in South Indian population that can be used as a reference for future studies and may aid in clinicians to be familiar with the different shapes of the sella area, to help distinguish pathology from normal developmental patterns.

Clinical significance

Lateral cephalograms are one of the most common radiographs used to assess craniofacial morphology and to evaluate orthodontic treatment, but sella turcica region is often overlooked. Pituitary tumors are most common intracranial neoplasms which sometimes present as silent subclinical tumors that are diagnosed incidentally by cephalograms. Assessment of the sella turcica should be carried out during cephalometric analysis to extract

maximum details from available radiographs. A thorough screening of cephalogram by a trained eye with an educated mind could prevent life-threatening conditions like pituitary apoplexy.

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Conflicts of interest

There are no conflicts of interest.

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