

# The Size and the Morphology of Sella Turcica in Different Skeletal Patterns of South Indians: A Lateral Cephalogrametric Study

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## ABSTRACT

**Aim:** The present study was conducted to measure the size and describe the morphology of sella turcica in different skeletal types. **Materials and Methods:** 24 cephalometric radiographs of patients (8 each of Skeletal Class-I, II & III) aged 9 to 22 years were used in this study with approximately equal distribution of males and females. The subjects were categorized into three groups Class I, II and III according to the skeletal classification (ANB). **Results:** The linear dimensions were larger in older group than in a younger group ( $p < 0.01$ ) when the age groups were considered. It was noted that there was significant difference in length between males and females ( $p < 0.05$ ). There was significant difference in the length and diameter when skeletal types were compared to the sella size. **Conclusion:** In the majority of the subjects the shape of sella turcica appeared normal (55.55%) concluding that the linear dimensions and shape of sella turcica can be used as a reference parameter investigation regards skeletal patterns.

**KEYWORDS:** Sella Turcica, Bridging, Morphology

## INTRODUCTION

Cephalometric radiograph tracing involves the use of many landmarks within the cranium, which helps in knowing the relative position of maxilla and mandible to the cranium and to themselves. Analyzing these structures in depth helps in orthodontic diagnosis, measuring the growth through superimposition on a longitudinal basis and to evaluate orthodontic treatment results. Among them, Sella turcica (sella point S) is an important landmark and has been routinely used in various cephalometric analyses and for analyzing pathologies of the pituitary gland or several syndromes affecting the craniofacial region. With the help of normal radiographic anatomy and morphological variations of this region it would be easy to identify any deviations that may reflect the pathological conditions which is essential for the orthodontists and other clinicians even before they are clinically apparent.<sup>1,2</sup>

Sella turcica is saddle-shaped structure and located in the middle cranial fossa on the intracranial surface of the body of the sphenoid bone. It consists of 1) two processes anterior and posterior clinoid processes, 2) the tuberculum sellae, 3) pituitary or hypophyseal fossa covered by the diaphragma sellae.<sup>3,4</sup> The development of pituitary gland and sella turcica occurs through a complex process. The sella turcica area marks the migration of the neural crest cells to the frontonasal and maxillary developmental fields during embryological development. The anterior part of the pituitary gland, sella turcica and teeth share in common in formation and development, the

involvement of neural crest cells, and dental epithelial progenitor cells differentiate through sequential and reciprocal interaction with neural crest derived mesenchyme. The posterior part develops from the paraxial mesoderm, closely related to notochordal induction.<sup>2</sup>

Size of the sella turcica is variable from an anteroposterior diameter of 5 to 16 mm and depth of 4 to 12 mm.<sup>2-5</sup> Bridging of sella turcica represents the fusion of the anterior and posterior clinoid process, an anatomical abnormality reported to occur in skeletal, dental malformations and in several syndromes.<sup>6,7</sup>

Abnormal morphology can be identified only if normal standards of any given structure are established. Hence it is essential to establish Cephalometric norms for the morphology of sella turcica in order to identify the dysmorphology found in several craniofacial aberrations & syndromes.<sup>2</sup> Therefore, the purpose of this study was to assess the linear dimensions and morphological shape of sella turcica in subjects with different skeletal patterns.

**Aim of The Study:** To evaluate the linear dimensions & morphological differences of the sella turcica among different skeletal patterns

## MATERIALS AND METHODS

This study was carried out at GITAM Dental College and Hospital, Visakhapatnam. The study excludes individuals

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with the major illness or medical conditions. Upper and lower study models, panoramic and cephalometric records were obtained. 24 cephalometric radiographs of patients (8 each of Skeletal Class-I, II & III) aged 9 to 22 years were used in this study with approximately equal distribution of males and females. Further gender and Pubertal status were considered. (Males- 13, Female-11)

A single operator has taken all the radiographs in the same cephalostat in natural head position. For the present study only lateral cephalograms that had the clearest reproduction of the sella turcica were used. The subjects were categorized into three groups Class I, II and III according to the skeletal classification (ANB).

**Cephalometric Tracing of Sella Turcica:** Using an acetate paper under optical illumination Outline of the sella turcica on each lateral cephalometric radiograph was traced. The outline of the sella turcica which consisted of the tuberculum sella, floor, dorsum sella, anterior and posterior clinoid processes was drawn.

Linear measurements of the sella turcica (length, breadth, anteroposterior diameter) were measured on the tracing based on the methodology described by Silverman & Kisling.<sup>1,8</sup>

**Size of Sella Turcica:** All the reference lines were in the midsagittal plane, and the measurements were made with digital sliding calipers. The length represents the linear distance from the tuberculum sella to the tip of the dorsum sella. The depth is the perpendicular from the line above to the deepest point on the floor. The line drawn from the tuberculum sella to the furthest point on the posterior inner wall of the fossa gives the anteroposterior diameter of sella turcica.

**Shape of the Sella Turcica:** According to Axelsson et al, there are five morphological variations for sella turcica which include:<sup>2</sup>

1. Oblique anterior wall,
2. Sella turcica bridging,
3. Double contour of the floor,
4. Irregularity (notching) in the posterior part of the dorsum sella,
5. Pyramid shape of dorsal sellae.

**Statistical Analyses:** Data from all measurements were transferred to a statistical package of social sciences (SPSS 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 also assessed to distinguish which skeletal class showed the most significant difference in linear dimensions. Regression analyses were also used to test the interrelationship of gender, age, skeletal type, with the linear dimensions.

## RESULTS

**Size of Sella Turcica:** When the linear dimensions were compared there was a statistically significant difference

in length ( $p < 0.03$ ) where as difference in depth and anteroposterior diameter was not statistically significant. The size of sella turcica was larger in older age group and in males than in the younger age group and females. Any difference in the linear dimensions among different skeletal patterns, irrespective of age and gender were determined. A significant difference was noted between skeletal class, length and anteroposterior diameter of sella turcica.

**Shape of Sella Turcica:** Appearance of sella turcica was found to be normal in majority of subjects (55.55%). Younger age group and males showed greater normal morphology than older age group and females. The morphological variations were found in 39% of the subjects. An oblique anterior wall was seen in 2.8%; notching was seen in 27.8% while pyramidal shape was present in 13.8% of the subjects. On assessing the morphology of sella turcica of each of the three skeletal types, the results were as follows: in skeletal Class I patients, 62.5% of patients had normal sella and 37.5% of the patients had variations. In skeletal Class II patients 62.5% of the patients had a normal sella and 37.5% of the patients had variations in the morphology. In skeletal Class III patients, 36.65% of the patients had a normal sella and 63.35% of the patients had variations in the morphology. The most common variation seen in all the three skeletal types was the irregularity in the dorsum (notching). When the morphology was assessed in males and females irrespective of age and skeletal class, sella turcica appeared normal in 53.8% of the subjects. Between the two age groups, sella turcica appeared normal in 61% of the younger group and in 50 % of the older group. Sella turcica bridging showed an increase in older age group (Table 1-5).

Skeletal Relation	Normal	Notching	Pyramidal	Oblique
Class I	75	25	0	0
Class II	75	0	25	0
Class III	33.3	16.7	33.3	16.7

Table 1: AGE: Prepubertal- types of morphology(%)

Skeletal Relation	Normal	Notching	Pyramidal	Oblique
Class I	50	25	25	0
Class II	50	50	0	0
Class III	50	50	0	0

Table 2: AGE: Postpubertal- types of morphology(%)

Skeletal Relation	Normal	Notching	Pyramidal	Oblique
Class I	75	25	0	0
Class II	50	50	0	0
Class III	40	30	30	0

Table 3: GENDER: MALES - types of morphology(%)

Skeletal Relation	Normal	Notching	Pyramidal	Oblique
Class I	50	25	25	0
Class II	75	0	25	0
Class III	33.3	33.3	33.3	16.7

Table 4: GENDER: FEMALES- types of morphology(%)

Skeletal Relation	Normal	Notching	Pyramidal	Oblique
Class I	75	25	0	0
Class II	75	0	25	0
Class III	33.3	16.7	33.3	16.7

Table 5: MEAN: Types of morphology(%)

## DISCUSSION

This study describes the linear dimensions and morphological appearance of the sella turcica in subjects with different skeletal patterns.

**Size of Sella Turcica:** Difference between measurements was noted when the linear dimensions (length, depth and diameter) of sella turcica were compared with other studies.

When this study was compared with the study done by Alkofide in Saudi subjects it was observed that the linear dimensions of sella turcica in the Indian population sample were on average 1.7 to 2.9 mm smaller than those of the Saudi subjects.<sup>1</sup> Axelsson et al studied the size of sella turcica in a Norwegian sample longitudinally between the ages of 6 to 21 years and observed that the length was almost constant throughout the observation period where as the depth and diameter increased with age. They also found that there was no significant difference in depth and diameter between males and females while the length was more in males. Quakinine and Hardy showed that the average width of sella turcica was 12 mm, length (anteroposterior diameter) was 8 mm, and height (vertical diameter) was 6 mm,<sup>2</sup> in a microsurgical anatomical study of 250 sphenoidal blocks obtained from cadavers. This study shows that the gland does not fill the whole volume of sella turcica.<sup>9</sup> Ethnicity or to the difference in the method of measurements may be the probable reasons for these differences in the values.

When determining if there was any difference in the size of sella turcica between males and females, the significant difference for length was found in both the groups. Silverman studied the radiographs of 320 subjects from 1 month to 18 years of age and calculated the mean sella area. Pituitary fossa was larger in males than in females from 1 to 13 years of age were the findings of the study. The size increases from 11 to 15 years of age since the pubertal growth spurt occurs approximately 2 years earlier in females than in males. Due to the late pubertal growth spurt in males by 2 to 3 years the size of the sella becomes equal in both genders.<sup>8</sup> Haas studied the mean sella area in males and in females of 3 to 17 years, and reported that the size was slightly larger in boys than in girls up to 17 years after which the size was greater in females.<sup>1,2,8</sup> In the present study, when the effect of age on the size of sella was compared, the size was greater in older group than in the younger group. Preston et al. in his study on 182 lateral cephalometric radiographs in subjects within the age group of 5 to 17 years also found a close correlation between the sella area and age which shows that size of pituitary fossa increases with age.<sup>10</sup> This might be because of the adolescent growth spurt of females that occurs earlier than males. Choi et al. also found that the linear dimensions of sella turcica increased up to 25 years of age. There was no increase in size after 26 years of age.<sup>11</sup> Contrary to the results of the present study, a study done by H. Israel showed that the size of

sella was almost the same in males and females but the size tends to increase in males with age.<sup>12</sup>

There are only few studies in the literature which have evaluated the relationship between the size of sella turcica and skeletal type. In this study, it was found that the size of sella turcica was larger in skeletal Class III subjects. Alkofide found that the size was smaller in skeletal Class II subjects and larger in skeletal Class III subjects.<sup>1</sup> In contrast, Preston et al found no significant correlation between skeletal type and sella area when they divided the cephalometric radiographs into 3 groups (5-9, 10-14, 15-17 years) based on the age, and according to their skeletal type (Class I, II and III).<sup>10</sup> When age, gender and skeletal type were compared to the size of sella turcica, age was significantly related to the length of sella, size being larger in older group than in younger group irrespective of gender and skeletal type. The linear dimensions (length, depth, and diameter) can be used to predict the size of the pituitary gland. It might be of clinical importance when an abnormally large sella is found on the lateral cephalogram.

**Shape of Sella Turcica:** Variations in the shape of sella turcica have been well reported in the literature. Axelsson et al studied the morphology in a Norwegian sample and classified them in to six types. Seventy five percent of the subjects had a normal morphology while the remaining subjects showed an abnormal morphology.<sup>2</sup> Classifications were based on the contours of the sella floor, the angles formed by the contours of anterior and posterior clinoid processes and tuberculum sellae and the fusion of both clinoid processes as sella turcica bridge.<sup>11,13</sup>

Alteration in the shape can also be seen in normal subjects, and those with medically compromised conditions such as spina bifida and craniofacial deviations.<sup>13</sup> Jones et al found that incidence of bridging in patients treated by combined surgical orthodontics was 16.7% whereas it was present in 7.3% of patients treated with orthodontics alone.<sup>4</sup> When different skeletal classes were analyzed for bridging, Abdel Kaber studied the prevalence of a sella turcica bridge in relation to skeletal Class in Saudi subjects and found a higher percentage of sella turcica bridges in orthognathic-surgical patients with a skeletal Class III malocclusion (10.71%) as well as in orthodontic patients with a dental Class III malocclusion (7.14%). In total, the prevalence of a sella turcica bridge in 83 patients of that study with a skeletal Class III or a dental Class III malocclusion was 17.85%. In this study, 61% of the subjects had normal morphology whereas the remaining 39% had variations in the shape.<sup>14</sup>

Alkofide described the shape of sella turcica in Class I, II and III Saudi subjects and found that 67% of subjects had normal morphology and 33% of subjects had variation in the morphology. Irregularity in the dorsum sella was found in 11.1%, oblique anterior wall in 9.4%, pyramidal shape in 2.8% and sella turcica bridging in 1.1% of the subjects regardless of the gender, age or skeletal type.<sup>1</sup>

The results obtained in this study coincide with that of studies done by Axelsson et al and Alkofide et al.

From the present study, it can be used to estimate the approximate size of the pituitary gland which may help the clinician to identify an abnormally large sella turcica on a lateral cephalogram. For an orthodontist it is also important to be familiar with morphology of sella turcica in order to differentiate the pathology from normal developmental patterns.

## CONCLUSION

- Variations in sizes of the sella turcica were found between older & younger group, older group showing larger size
- Dimensions of the sella turcica were larger in males than females
- Normal Morphology was found to be more common
- Normal Morphology was found more in males than females and Class I and II skeletal patterns.
- Class III skeletal individuals also showed oblique morphology of the sella turcica
- Variations in sizes were found between 3 skeletal patterns
- Class I skeletal pattern shows larger dimensions

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