Original Article

Morphological (Length, Depth, and Diameter) Study of Sella Turcica in Different Mandibular Growth Patterns in Indians

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ABSTRACT

Aim: This study aims to analyze the morphological dimensions of sella turcica to determine if differences exist due to gender, age or in subjects with different skeletal patterns. **Methods:** A total of 100 (43 males and 57 females) sella turcica cephalometric radiograph was traced. Linear dimensions of sella turcica (length, depth, and diameter [in mm]) were measured and skeletal shape/type (normal, bridging, double contour, oblique, irregular, and pyramidal) was assessed. 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, skeletal types. A Chi-square test was used to test the interrelationship of gender, age and skeletal types with the shape of sella turcica. **Results:** In low angle group subjects, 80% of the subjects had normal sella and 20% of the subjects had variations in morphology and in high angle group subjects, 76% of the subjects had a normal sella, and 24% of the subjects had variations in the morphology. **Conclusions:** The shape of the sella turcica was normal in 78% of the subjects, and there was a significant difference in length between high and low angle subjects, where the length of sella was larger in the low angle subjects and the distribution of shape of sella turcica was found to be significantly different among both high and low angle types.

Key words: Cephalogram, cranium, mandibular growth patterns, morphology, sella turcica

INTRODUCTION

Lateral cephalogram radiograph is mostly used in orthodontics to evaluate and assess the craniofacial morphology to assess distinguish features between the skeletal discrepancies and dentoalveolar malocclusion. Most of the changes in craniofacial morphology occur at the age of 6-18 years in males and 6-15 years in females. The sella turcica is a superior saddle-shaped depression located in the intracranial surface of sphenoid bone, containing the pituitary gland.

Access this article online	
Publisher	Website: www.renupublishers.com
RP	DOI: 10.5958/2394-4196.2016.00009.1

It consists of four clinoid processes (two anterior and two posterior), the anterior border represented by tuberculum sellae and the posterior border by the dorsum sellae. The anterior clinoid processes are larger and more diverse. The size and shape of clinoid processes may vary. They can be short and blunt or may protrude above the pituitary fossa and are sometimes connected. The floor of the sella turcica is the pituitary fossa with the pituitary gland.

The sella turcica is variable in size and shape.[2] It can be deep or shallow in both children and adults.[2] Camp[3] has classified normal sella turcica into three types: Circular, oval, or flat; circular was the most frequent, whereas flat was the least. In 70% of children, the sella turcica is round.[2] In profile, the sella at times has a somewhat high concave appearance caused by what appears to be an excavation beneath the anterior clinoids.[2] The floor of the sella turcica, which in most cases is concave, may be flat or even convex.[2]

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Submission: 16 Aug 2016; **Revision:** 10 Sep 2016; **Acceptance:** 23 Sep 2016

In lateral radiographs, the sella turcica is usually demarcated by a dense thin white line.[2] This feature seems to be more important than the size of the fossa.[2]

The cephalometric radiograph tracing involves the use of many landmarks within the cranium, which are used to measure the relative position of maxilla and mandible to the cranium and to themselves. One such landmark is sella turcica, which has been routinely used in various cephalometric analyses to act as a reference point for evaluating spatial position of both jaws. The sella turcica is located in the middle cranial fossa on the intracranial surface of the body of the sphenoid bone which contains the pituitary gland. On a lateral cephalometric radiograph, the image of sella turcica is "U" shaped. A deviation from normal size and shape of the sella turcica can be an indication of a pathological condition of the pituitary gland. Size of the sella turcica is variable with normal dimensions ranging from an anteroposterior diameter of 5-16 mm and depth of 4-12 mm.

The most frequent abnormality described in the orthodontic literature is sella turcica bridge.[3-7] Bridging is a fusion between the anterior and posterior structures of the sella turcica, specifically a calcification of interclinoid ligament[8-10] or it may be owing to superimposition of sella structures.[7] Sella bridging has been classified by Becktor *et al*.[7] into two groups:

- Type A: Ribbon-like fusion.
- Type B: Extension of the anterior and/or the posterior clinoid process.

A partial calcification of interclinoid ligament is defined as incomplete bridge.[9]

The purpose of this study was to analyze the morphological shape and to measure the linear dimensions of sella turcica to determine if differences exist due to gender or age or in subjects with different skeletal patterns.

METHODS

This investigation was a cross-sectional comparative study of lateral cephalogram of 100 patients (43 males and 57 females) in the age group of 15-19 years and 20-38 years.

All the lateral cephalograms were taken by the same trained operator on Rotograph Plus, cephalostat machine at 80 kVp, 10 mA, and 0.8 s exposure time using 8×10 inch Kodak green film with the patient's head in postural position.

The lateral cephalometric records for the patients were selected according to the following criteria:

1. All patients were above 15 years of age.
2. Based on American Board of Orthodontics Discrepancy Index, subjects were classified into two groups, i.e., high and low mandibular plane angles (SN-MP >38° for high angles and SN-MP <26° for low angles).[1]
3. Subjects should not have taken any form of orthodontic treatment.
4. Subjects should be well nourished, and free of any known serious illness.

Cephalometric Tracing of Sella Turcica

Outline of the sella turcica on each lateral cephalometric radiograph was traced using sharp 3H lead pencil and acetate matte tracing paper, 0.003″ thick and 8″×10″ under optical illumination.

Size of Sella Turcica

The linear dimensions (length, depth, and anteroposterior diameter) were measured according to the methods described by Silverman and Kisling.[2,3]

The length was measured as the linear distance from the tuberculum sella to the tip of the dorsum sella. The depth was measured as a perpendicular from the line above to the deepest point on the floor. The anteroposterior diameter of sella turcica is measured as a line drawn from the tuberculum sella to the furthest point on the posterior inner wall of the fossa [Figure 1].

Shape of Sella Turcica

Morphological appearance of sella turcica was assessed according to the method described by Axelsson *et al*.[4]

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 and the skeletal types at a

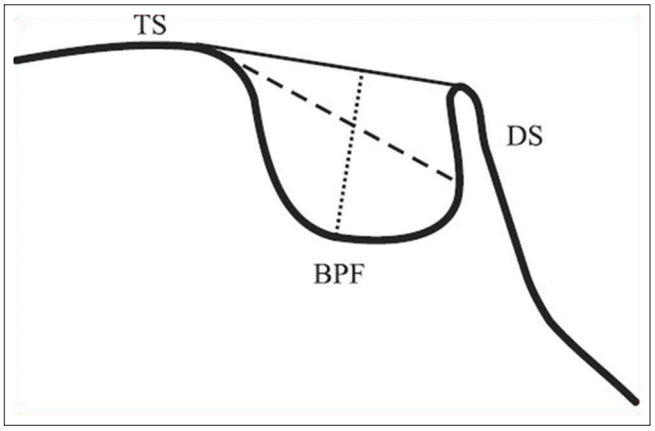


Figure 1: Method of measurement of sella turcica

significance level of 0.05. A Chi-square test was also used to test the interrelationship of gender, age and skeletal type with the shape of sella turcica.

RESULTS

Size of Sella Turcica

The linear dimensions were compared between the two age groups, i.e., 15-19 years age group and 20-38 years age group. (Table 1) The linear dimensions of sella turcica (length, depth, and diameter in mm) according to age group are shown in Table 2. All the three linear dimensions were not found to be statistically significant ($P > 0.05$) between the two age groups.

The linear dimensions of sella turcica (length, depth, and diameter in mm) according to gender are shown in Table 3. The linear dimensions were compared between the two gender groups of males ($n = 43$) and females ($n = 57$). Like age, all the three linear dimensions also not show any statistically significant ($P > 0.05$) difference between males and females.

Table 4 is showing average linear dimensions of sella turcica (length, depth, and diameter) of subjects belonging to low angle group ($n = 50$) and high angle group ($n = 50$). Mean length of the sella turcica between two skeletal types were found statistically significant ($P < 0.01$), however, depth and diameter were found similar ($P > 0.05$) between the groups.

Shape of Sella Turcica

On assessing the morphology of sella turcica of each of the two angle types, the results were as follows: In low angle group subjects, 80% of the subjects had normal sella and 20% of the subjects had variations in morphology. It was found that pyramidal type is the most common type of variation followed by bridging type and oblique type.

In high angle group subjects, 76% of the subjects had a normal sella and 24% of the subjects had variations in the morphology. It was found that oblique and irregular types are the most common type of variations. Thus, the distribution of type of sella turcica was found to be significantly ($P < 0.05$) different between high and low angle subjects [Table 5 and Graph 1].

When the morphology of sella turcica was assessed between the two age groups, sella turcica appeared to be normal in 78.6% in 15-19 years age group and 77.3% in 20-38 years age group and it was 1.3% higher in lower age group as compared to higher age group, but the difference was insignificant ($P > 0.05$) [Table 6].

On the other hand, when the morphology of sella turcica was assessed between males and females, sella turcica normal was 5.7% higher in males (83.7%) as compared to

Table 1: Subjects grouped on the basis of age, gender and skeletal type

Group	Males		Females	
	15-19 years age group	20-38 years age group	15-19 years age group	20-38 years age group
Low angle	10	15	14	11
High angle	12	6	20	12
Total	22	21	34	23

Table 2: Linear dimensions of sella turcica between two different age groups

Sella turcica size	Age group (year)	*n*	Mean±SD	Standard error of the mean	*P* value
Length (in mm)	15-19	56	8.69±1.94	0.26	0.434^{ns}
	20-38	44	8.38±1.98	0.29	
Depth (in mm)	15-19	56	10.38±1.53	0.21	0.654^{ns}
	20-38	44	10.52±1.57	0.24	
Diameter (in mm)	15-19	56	7.49±1.15	0.15	0.215^{ns}
	20-38	44	7.78±1.16	0.18	

ns: *P*>0.05

Table 3: Linear dimensions of sella turcica between two gender groups

Sella turcica size	Gender	*n*	Mean±SD	Standard error of the mean	*P* value
Length (in mm)	Males	43	8.26±1.94	0.29	0.199^{ns}
	Females	57	8.77±1.96	0.26	
Depth (in mm)	Males	43	10.19±1.18	0.18	0.151^{ns}
	Females	57	10.64±1.76	0.23	
Diameter (in mm)	Males	43	7.70±0.99	0.15	0.525^{ns}
	Females	57	7.55±1.28	0.16	

ns: *P*>0.05

Table 4: Size of sella turcica in different skeletal types

Sella turcica size	Skeletal type	*n*	Mean±SD	Standard error of the mean	*P* value
Length (in mm)	Low angle	50	9.09±1.83	0.26	0.005**
	High angle	50	8.01±1.95	0.28	
Depth (in mm)	Low angle	50	10.56±1.31	0.18	0.460^{ns}
	High angle	50	10.33±1.76	0.25	
Diameter (in mm)	Low angle	50	7.57±1.06	0.15	0.669^{ns}
	High angle	50	7.67±1.26	0.18	

ns: *P*>0.05, ***P*<0.01

Table 5: Frequency distribution of different shapes of sella turcica in different skeletal types

Sella turcica shape	*n* (%)		
	Low angle	High angle	Total
Normal	40 (80.0)	38 (76.0)	78 (78.0)
Bridging	3 (6.0)	1 (2.0)	4 (4.0)
Double contour	0 (0.0)	1 (2.0)	1 (1.0)
Oblique	3 (6.0)	5 (10.0)	8 (8.0)
Irregular	0 (0)	5 (10.0)	5 (5.0)
Pyramidal	4 (8.0)	0 (0.0)	4 (4.0)
P value	0.042*		

**P*<0.05

Table 6: Frequency distribution of different shapes of sella turcica between two age groups

Sella turcica shape	*n* (%)		
	15-19 years age group	20-38 years age group	Total
Normal	44 (78.6)	34 (77.3)	78 (78.0)
Bridging	2 (3.6)	2 (4.5)	4 (4.0)
Double contour	1 (1.8)	0 (0)	1 (1.0)
Oblique	5 (8.9)	3 (6.8)	8 (8.0)
Irregular	2 (3.6)	3 (6.8)	5 (5.0)
Pyramidal	2 (3.6)	2 (4.5)	4 (4.0)
P value	0.906^{ns}		

ns: *P*>0.05

Table 7: Frequency distribution of different shapes of sella turcica between two genders

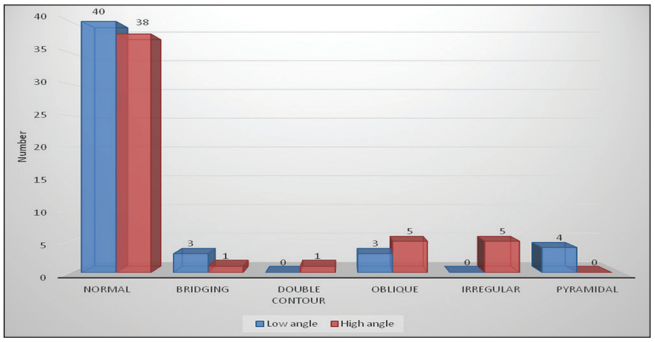
Sella turcica shape	*n* (%)		
	Males	Females	Total
Normal	36 (83.7)	42 (73.7)	78 (78.0)
Bridging	1 (2.3)	3 (5.3)	4 (4.0)
Double contour	0 (0.0)	1 (1.8)	1 (1.0)
Oblique	3 (7.0)	5 (8.8)	8 (8.0)
Irregular	0 (0)	5 (8.8)	5 (5.0)
Pyramidal	3 (7.0)	1 (1.8)	4 (4.0)
P value	0.210^{ns}		

ns: *P*>0.05

females (78.0%) but the difference also not reach statistical significant ($P > 0.05$) [Table 7].

DISCUSSION

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



Graph 1: Frequency distribution of different shapes of sella turcica in different skeletal types

skeletal patterns. The shape variations in the sella turcica have long been reported by many researchers[5-8] who examined the radiographs of children 1-12 years of age and classified the sella turcica into circular, oval, and flattened, or saucer shaped.

In a recent study by Axelsson *et al*.,[4] the shape of the sella turcica was categorized into six main types; normal sella turcica, oblique anterior wall, double-contoured sella, sella turcica bridge, irregularity (notching) in the posterior part of the sella, and pyramidal shape of the dorsum sellae.

Shah *et al*.[9] described the morphology of sella turcica and his findings were that morphology was normal in 66% of the subjects and variation was present in 34% of the subjects. Among the variations, irregular dorsum was seen in 16.7%, pyramidal shape in 7.7%, double contour of the floor in 5.5%, oblique anterior wall in 4%, and sella turcica bridging in 0%. The only difference, however, was observed that sella turcica bridging was seen in 8% of the patients.

The presence of a sella turcica bridge in normal individuals is not uncommon and has been shown to occur in 5.5-22% of the subjects,[6,8-11] with an increase in occurrence in patients with craniofacial deviations.

A microsurgical anatomical study of 250 sphenoidal blocks obtained from cadavers, showed that the average width of sella turcica was 12 mm, length (anteroposterior diameter) was 8 mm, and height (vertical diameter) was 6 mm.[12]

One study has described abnormally large or less commonly, small sella turcica.[13-17] Similar results were given in the

study conducted in South Indian population, which showed the difference in length of sella turcica between males and females.[14] The radiological diagnosis of an enlarged sella turcica has been found to be associated with adenomas, mucocele, meningioma, primary hypothyroidism, prolactinoma, gigantism, acromegaly, and Nelson syndrome.[17,18] There was a significant increase in the depth and anteroposterior diameter of sella turcica as age increases.[18-21]

Morphological aberrations of the sella turcica described in the literature are bridge, oblique anterior wall, double contour of the floor, irregularity (notching) in the posterior part of the dorsum sellae, and pyramidal shape of the dorsum sellae.[20,21] However, it should be remembered that the two-dimensional representation of an abnormality system does not really provide complete information about its three-dimensional structure. An infinitive number of three-dimensional sizes and shapes can yield an identical two-dimensional radiographic image, which constitutes a well proven mathematical fact inherent to two-dimensional radiography.[21,22]

The findings of the linear dimensions obtained from this study can be used to have an approximate idea of the size of the pituitary gland, which may help the orthodontist when faced with a dilemma of an abnormally large sella turcica on the lateral cephalograms, and this may help the clinician to have a complete knowledge of the different shapes of the sella turcica to distinguish between pathological and normal physiological patterns. Moreover, the growth of the individual can be assessed based on the size of the sella turcica at different age period.

CONCLUSION

The shape of the sella turcica was normal in 78% of the subjects. Assessment of the sella turcica should be carried out during cephalometric analysis in orthodontic treatment.

When sella size was compared with high and low angle subjects, there was a significant difference in length between high and low angle subjects, where length of the sella turcica was larger in the low angle subjects.

There was no significant difference in length, depth, and diameter of the sella turcica between the two genders and the two age groups, and additionally, a direct correlation was found existed between patients' age and the diameter of sella turcica and with increasing age; it was noticed that the diameter of the sella turcica was significantly increased.

The distribution of the shape of sella turcica was found to be significantly different among both high and low angle groups wherein the low angle group, pyramidal is the most common type followed by bridging and oblique types, and in the high angle group, oblique and irregular types were the most common types.

ACKNOWLEDGMENTS

Dr. B. K. Konwar provided immense technical help and support in completion of the research work.

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How to cite this article: Konwar SK, Singhla A, Bayan R. Morphological (Length, Depth, and Diameter) Study of Sella Turcica in Different Mandibular Growth Patterns in Indians. Int J Dent Med Spec 2016;3(3):4-9.

Source of Support: None; **Conflict of Interest:** None