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RESEARCH ARTICLE

MORPHOMETRIC ANALYSIS OF SELLA TURCICA IN DIFFERENT SAGITTAL MALOCCLUSIONS OF SOUTH INDIAN POPULATION - A RETROSPECTIVE STUDY

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ABSTRACT

Aim: The objective of this study was to assess the shape and size of the sella turcica in a fraction of south Indian population with different skeletal types.
Methods: Lateral cephalometric radiographs of 90 individuals (30 males and 60 females) between the age group 10-30 years were taken and distributed according to skeletal types as class I, II, III based on ANB. Morphology was assessed using silvermans method, and dimensions using Axelssons method. Comparison between older and younger age groups was also done. Student's t test was used to calculate differences in linear dimensions in age group and ANOVA was performed to study relationship between skeletal type and sella size.
Results: It was found that majority of subjects had normal morphology of sella, significant differences were found between older and younger age groups and between skeletal types and sella size.
Conclusions: Approximately 66 percent of the subjects had a normal Sella shape. Significant differences in Sella size between the older (15 years or more) and younger (10-14 years) age groups were founded for all three linear dimensions (length, depth, diameter), Sella size in the older age groups were larger. Significant differences in Sella Turcica size in all three dimensions was found for different skeletal classes. Class III subjects had the greatest dimensions while class II subjects had the smallest dimensions.

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INTRODUCTION

Sella turcica is a trough like bony formation in the middle cranial base on the upper surface of the body of sphenoid bone. Anteriorly represented by tuberculum sellae and posteriorly by dorsum sellae. It hosts the pituitary gland and has to processes i.e, anterior and posterior clinoid processes which project over the pituitary fossa. The anterior clinoid processes are formed by the medial and anterior projections of the lesser wing of the sphenoid bone and posterior clinoid process by the endings of dorsum sellae. Any abnormality or pathology in the gland might result in altered shape of sella turcica (Sathyanarayan *et al*., 2013). Cephalometric radiographs are essential diagnostic aids used to qualitatively and quantitatively evaluate the development, growth, and interrelationships of craniofacial and dental structures and the related pathologies. On the other hand, most of these pathologic conditions, developmental abnormalities, or normal variants are associated with a significant problem in other systems. Interestingly, some of these findings are detectable very early in life and often precede other signs or symptoms in syndromes. Therefore, in some cases, they could potentially be valuable for an early diagnosis (Alkofide, 2007). Sella turcica has a depth of 4 to 12 mm and an anteroposterior diameter of 5 to 16 mm. Bridging, an anatomical abnormality caused by fusion of two clinoid process has been reported to occur in skeletal, dental malformations and in several syndromes (Alkofide, 2007). The purpose of this study was to morphometrically analyse the shape and size of sella turcica in subjects with different antero-posterior skeletal patterns.

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MATERIALS AND METHODS

This retrospective study was carried out by collecting diagnostic records of the cases in the department which include upper and lower study models, panoramic and cephalometric records. No individual in this study had any major medical conditions. The cephalometric radiographs of 90 patients (30 males and 60 females) aged 10-30 years were used in this study. All the radiographs were taken in the same cephalostat by single operator and only lateral cephalograms that had clearest reproduction of sella turcica were included. Lateral cephalograms selected for the study were further divided in to three groups accordingly as skeletal class I, class II, class III relationships as shown in table 1 based on ANB angle.

Table 1. Subjects grouped on the basis of age and skeletal type

Skeletal type	10-15	16-30
Class I	17	17
Class II	13	16
Class III	12	15
Total	42	48

Cephalometric tracing of sella turcica

The sella turcica on each cephalometric radiograph was traced on thin acetate paper under optimal illumination by the author. This tracing was superimposed on graph papermarked in square millimeters to calculate the sella area (Silverman, 1957), and measurements were made to the nearest 0.1 mm.

Shape of the sella turcica

In addition to the normal morphology of sella turcica shape, Axelsson *et al.* (Fig. 1) described five morphological variations which included oblique anterior wall, sella turcica bridging, double contour of the floor, irregularity (notching) in the posterior part of the dorsum sellae, and pyramidal shape of the dorsum sellae. This is used to determine and compare the variations in the shapes of sella.

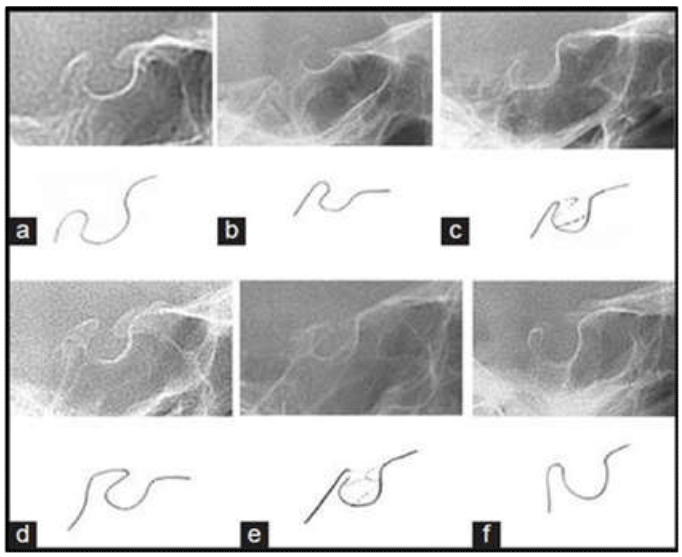

Figure 1. Different morphological types of sella turcica: a. Normal sella turcica b. Oblique anterior wall c. Sella turcica bridging d. Double contour e. Irregular dorsum sellae f. pyramidal shape

Size of the sella turcica

The linear dimensions of sella turcica were measured using the methods of Silverman and Kisling (Gordon and Bell, 1922).

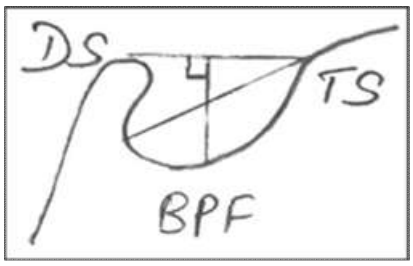

Figure 2. Size of sella turcica: DS, dorsum sella; TS, tuberculum sella; BPF, Base of pituitary fossa

The length of sella turcica was measured as the distance from the tuberculum sella to the tip of the dorsum sellae. The depth of the sella turcica was measured as a perpendicular from the line above to the deepest point on the floor. A line was also drawn from the tuberculum sella to the furthest point on the posterior inner wall of the fossa. This was considered as the antero-posterior diameter of sella turcica (Figure 2).

Statistical analysis

Data was analysed using SPSS 16.0 software for Windows (SPSS Inc., Chicago, Illinois, USA). A Student's *t* -test was used to calculate the mean differences in sella turcica linear dimensions between the different age groups (significance level 0.01). A one-way ANOVA was performed to study the relationship between skeletal type and sella turcica size in three different groups.

RESULTS

Morphology of sella turcica

Regardless of gender, age, or skeletal type the morphology of the sella turcica appeared to be normal in shape in the majority of subjects as shown in Table 2. Variation in morphological appearance was present in 34.5 per cent of the individuals; an irregular dorsum sella was found in 8 per cent, while an oblique anterior wall 11.1 percent and a double-contoured sella turcica were present in 7.7 per cent.

Table 2. Frequency distribution of sella turcica type

Sella type	Frequency	Percentage
Normal sella turcica	59	65.5
Oblique anterior wall	10	11.1
Sella turcica bridge	5	5.5
Double contour	7	7.7
Irregular dorsum sellae	8	8
Pyramidal shape	1	1.1
Total	90	100

Size of the sella turcica

When linear dimensions were compared with age, there were significant differences between the older and the younger age groups ($P< 0.01$, $P < 0.001$; Table 3) for all three linear dimensions. It was noted that sella turcica in the older group was consistently larger than that in the younger age group. A significant difference was found between skeletal types (Table 4) when a one-way ANOVA test was performed in order to determine if subjects with different skeletal patterns presented with different linear dimensions of the sella turcica, irrespective of age or gender.

DISCUSSION

This retrospective study describes the morphological appearance and linear dimensions of the sella turcica in a proportion of south Indian population with different skeletal types. Many researchers have reported the variation in shape of sella turcica (Camp, 1924; Teal, 1977; Kantor and Norton, 1987; Tetradis and Kantor, 1999; Gordon and Bell, 1922). Gordon and Bell (1922) examined 1200 radiographs of children 1–12 years of age and classified the sella turcica into circular, oval, and flattened, or saucer shaped. Most common are circular or oval-shaped sella. (Gordon and Bell, 1922) Davidoff, (1950) used the term 'J-shaped sella', while 'omega sella' was introduced by Fournier (1952). These were later termed as radiological myths by Kier (1969), who advised disregarding both since they were used to characterize abnormal pathology as well as normal developmental patterns. Other descriptions of the sella were also proposed based on the appearance of flatness or concavity of the contours of the sella floor, the angles made by the contours of the tuberculum sella, the contours of the anterior and posterior clinoid processes, and the fusion of both processes in what is termed a 'sella turcica bridge (Becktor *et al*., 2000; Choi *et al*., 2001). In the current study, approximately 65.5 percent of the subjects were found to have a normal shaped sella turcica, while 34.5 percent presented with different aberrations. This is in agreement with a study Axelsson *et al* and alkofide *et al*. The finding of an irregular notching of the dorsum sella was the same for both studies that is 8 per cent, while a pyramidal shape was found in 1.1 percent. A doubled contour floor was present in 7.7 per cent of the subjects of the current study, which is higher than that reported by Axelsson *et al*. (2004). An alteration in the shape of the sella turcica can be misleading since it may be present in 'normal 'subjects as well as in medically compromised subjects such as those with spina bifida and craniofacial deviations (Kjaer *et al*., 2001). The presence of a sella turcica bridge in normal individuals is not uncommon and has been shown to occur in 5.5-22 per cent of subjects, with an increase in occurrence in patients with craniofacial deviations (Becktor *et al*., 2000). In the current study, a sella bridge was found in only 5.5 per cent of the subjects which is in a much lower range than that previously reported. When the size of sella turcica in the present study was compared with other investigations (Axelsson *et al*., 2004; Quakinine and Hardy, 1987), a difference between measurements was noted. Quakinine *et al* performed a microsurgical anatomical study on 250 sphenoidal blocks obtained from cadavers of different ages and revealed that the average transverse width of the sella turcica was 12 mm, the length (antero-posterior diameter) 8mm, and the average height (vertical diameter) 6mm. When compared with the current study, all mean dimensions were on average 1.07 – 2.85 mm smaller than those in the Saudi sample (Alkofide, 2007).

Table 3. Sella turcica linear dimensions (in mm) by age group

	Age group (years)	N	Mean	Standard deviation	Standard error of mean	P value
Length	10-15	42	10	1.780	.222	<.01
	15-30	48	11	2.143	.234	Significant
Depth	10-15	42	8.5	1.333	.190	<.01
	15-30	48	9.1	1.123	.124	Significant
Diameter	10-15	42	13.1	1.589	.175	<.001
	15-30	48	14.1	2.534	.213	Significant

t test outcome by age.

Table 4. One- way analysis of variance testing the skeletal class on sella linear dimensions (in millimeters)

		N	Mean	Standard deviation	Standard error	min	max	p- value
Length	Class1	30	11.24	1.38	.256	9	14	0.0401 (significant)
	Class2	30	8.59	1.40	.260	6	11	
	Class3	30	13.79	1.63	.303	10	17	
	total	90	11.16	1.47	.159	9	15	
Depth	Class1	30	10.59	1.08	.202	9	12	0.0334 (significant)
	Class2	30	8.48	1.24	.231	6	11	
	Class3	30	13.38	1.34	.250	10	15	
	total	90	8.66	1.43	.155	6	12	
Diameter	Class1	30	11.66	1.69	.315	9	15	0.0333 (significant)
	Class2	30	8.97	1.63	.304	6	12	
	Class3	30	14.69	1.19	.223	13	17	
	total	90	13.94	1.49	.162	10	17	

The difference may be due to change in ethnicity or method of measurement. In this study the sella sizes of the older age group were consistently larger than the younger group. Similar findings were reported by Preston (Preston, 1979) who found a close correlation between the area of sella and age. His findings on 182 lateral radiographs of individuals aged 5 – 17 years revealed that the pituitary fossa increased in size with age. Few studies have compared the skeletal type of individuals with their sella turcica size to determine if a relationship exists. Preston (Preston, 1979) findings showed no statistically significant correlation between facial type and the mean sella area of the pituitary fossa which is contrary to the current study where an increase in diameter size appears to be more common in Class III subjects, while a reduced diameter size is more prevalent in Class II individuals. This may due to the longer period of mandibular growth compared to maxillary growth. The linear dimensions are helpful to predict large gland and its systemic effects which means lateral cephalogram can be used as a diagnostic in determining gland abnormalities.

Conclusion

- Approximately 66 percent of the subjects had a normal Sella shape.
- Significant differences in Sella size between the age groups was found for all three linear dimensions (length, depth, diameter). Sella size in the older age groups were larger.

- Class III subjects had the greatest dimensions while class II subjects had the smallest dimensions.

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