

THE SHAPE AND SIZE OF THE SELLA TURCICA IN SKELETAL CLASS I, II & III IN PATIENTS PRESENTING AT ISLAMIC INTERNATIONAL DENTAL HOSPITAL, ISLAMABAD

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ABSTRACT

One of the most commonly used cranial landmarks for cephalometric tracing is sella point. The morphology and size of sella turcica is of importance because within its center lies sella point which helps in evaluation of craniofacial morphology.

The objective of this study was to measure and describe the size and shape of the sella turcica and find a correlation between males and females and the three different skeletal classes

Lateral cephalometric radiographs of a total of 180 patients above age 15 years were divided equally into class I, II and III (60 patients in each group) and with equal representation of both genders (90 males and 90 females). The sella turcica was carefully analyzed and measured in linear dimension of length, depth and diameter. In addition the shape was also described. A student t-test was used to calculate the linear dimension difference, while a One way analysis of variance was done to study the relationship between skeletal type and sella size.

Sella turcica presented with normal morphology in the greater part of the subjects (66.7 %). No significant difference was found in linear dimensions between males and females. When skeletal type was compared to sella linear dimensions no significant difference was found in any of the three dimensions as in length, depth or diameter.

Key words: *Sella turcica; Sella shape; Sella size*

INTRODUCTION

The lateral cephalometric radiograph displays numerous cranial, facial and oral anatomic structures imaged from lateral aspect. Cephalometric radiography is a helpful aid in diagnosis, treatment planning and predicting treatment outcome in current orthodontic practice.¹

Proper analysis of the craniofacial skeleton on lateral cephalogram depends upon accurate identification and location of defined anatomical and constructed landmarks. These landmarks serve as a guide for measurement and valid quantitative and qualitative measurements of lines and angles. Therefore they should be easily distinguished on a radiograph, their outline should be uniform and most importantly they should be easily reproducible.^{2,3}

The centre of sella turcica is routinely used as a cephalometric landmark to act as a reference point for evaluating spatial position of both jaws as they relate to the cranial base. Anatomically sella turcica is a saddle shaped depression in sphenoid bone which contains the pituitary gland. It is divided into anterior (adenohypophysis), intermediate and posterior (neurohypophysis) lobes.⁴ On a lateral cephalometric radiograph the image of sella turcica is U shaped. A deviation from normal size and shape of sella turcica can be an indication of a pathological condition of the gland.⁵ A larger size may be indication of pituitary tumor over producing hormones such as ACTH, Prolactin and Growth hormones, thyroid stimulating hormone and vasopressin leading to Cushing's syndrome, amenorrhea, acromegaly. A small size can lead to decreased pituitary function causing symptoms such as

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short stature, retarded skeletal maturation and growth. Small sella turcica are notable in humans who either have an absent or a partial formed diaphragma sellae.

Investigations concerning the sella turcica have not only focused on size but also on morphology. A normal morphological variation of sella turcica must be considered as it may vary greatly from individual to individual. Various attempts to classify the sella turcica shape have been made.⁶ Studies have been done in the past concerning sella turcica size and morphology in pre-pubertal groups (till age 14) revealing that its size increases with age until skeletal maturation.⁷ Conflicting results have been reported in the literature regarding the difference in size of sella turcica in males and females. A recent study of sella turcica size and shape in different skeletal types in Saudi population showed that the frequency of normal sella turcica was 66.7 percent and irregular dorsum sellae was 11%. Also the mean size for the length, depth and diameter of sella turcica in skeletal class I was 10.7 mm, 8.9 mm and 13 mm respectively. For skeletal class II they were 10.4 mm, 9 mm and 13.4 mm. And for skeletal class III they were 11.4 mm, 9.3 mm and 14 mm respectively.^{7,8}

In Pakistan, although many aspects relating to cephalometric radiography have been studied, dimension and shape of sella turcica has received little attention. There is as of yet no study which investigates the size of sella turcica to three facial skeletal variations or correlation of the sella turcica size to gender. Thus the aim of this study was to determine the average shape and size of the sella turcica in different skeletal types subjects in a Pakistani sample and to evaluate any difference among 3 different skeletal types and between males and females.

METHODOLOGY

This investigation was Cross sectional comparative study of patients seeking orthodontic treatment at Orthodontic Department, Islamic International Dental Hospital, Islamabad. All cephalometric radiograph included clear reproduction of Sella Turcica and were of patients above 15 years old. Syndromic patients or patients with major illness were not included. All the lateral cephalograms were taken by the same trained operator on Rotograph Plus, cephalostat machine at 80 kvp, 10 mA and 0.8-second exposure time using 8 × 10 inch Kodak green film with the patient's head in postural position. For exact calculation of mid-sagittal enlargement a scale of known dimensions was attached to the Cephalostat.

A total of one hundred and twenty lateral cephalograms were selected and distributed according to skeletal Class and gender; 60 Class I, 60 Class II, and 60 Class III cases with an equal distribution between males and females in each class (30 males and 30 females).

Distribution into skeletal classes

Classification of skeletal type into Class I, Class II, or Class III was based on the ANB angle (SNA and SNB) from Stiner Analysis. The ANB angle indicates the magnitude of the skeletal jaw discrepancy, regardless of which jaw is at fault. Skeletal base Class was categorized as follows: angles 0-4 degrees Class I skeletal base; angles more than 4 degrees Class II, and angles less than 0 degrees Class III.

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 to Silverman and Kisling methods.^{7,9}

Length: The distance between the tuberculum sella to the tip of dorsum sella

Depth: A line perpendicular to the line drawn above to the deepest point on the floor.

Antero-posterior Diameter: Line drawn from the tuberculum sella to the most posterior point on the posterior inner wall of the fossa. (figure 1)

SHAPE OF SELLA TURCICA

The study of Axellson was used to determine the shape of sella turcica, according to which 5 variations in morphology of sella turcica are described apart from normal morphology.

These variations are oblique Anterior wall, double contour of floor, sella turcica bridging, irregularity in posterior part of dorsum sellae, pyramidal shape of the dorsum and double contour of the floor.⁹ (See figure 2a and figure 2b)

Data Analysis Procedure

All statistical calculations were carried out with the SPSS software Version 10 (Chicago, Ill).

For qualitative variables like gender, shape of sella turcica, frequency and percentage were presented.

For quantitative variables like age, size (length, depth and diameter) mean and standard deviation were presented.

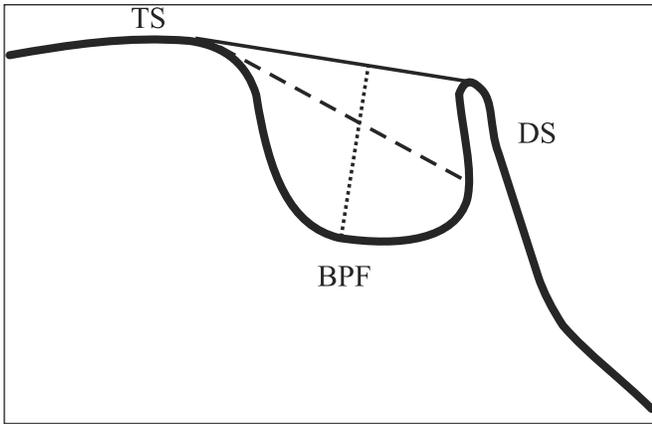


Fig 1: Reference lines used for measuring sella size: TS, tuberculum sella; DS, dorsum sella; BPF, base of the pituitary fossa; black line, length of sella; dashed line, diameter of sella; dotted line, depth of sella.

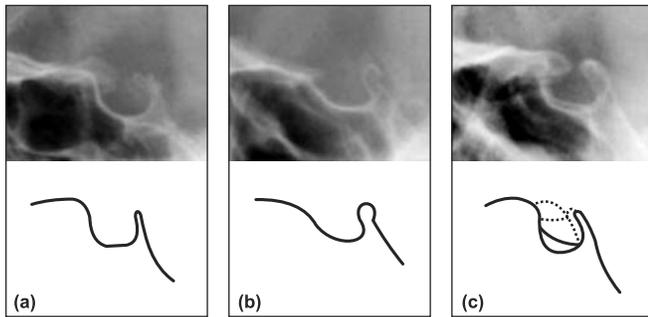


Fig2a: Tracing and details forms of sella turcica different morphological variants (a) Normal Variant. (b) Oblique anterior wall. (c) Double contour of the floor

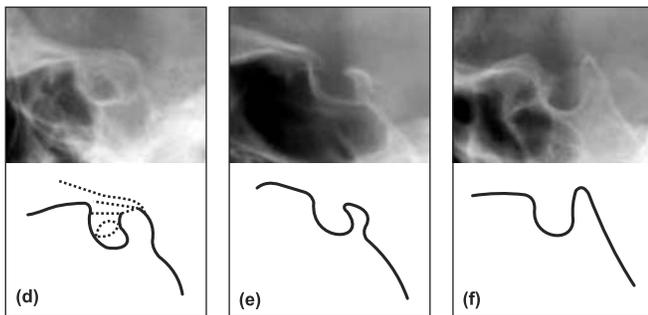


Fig2b: Tracing and details forms of sella turcica different morphological variants (d) Sella turcica bridging (e) Irregularity in the posterior wall of sella turcica (f) Pyramidal shape of the dorsum sellae.

RESULTS

Shape of the sella turcica

The morphology of sella turcica appeared normal in majority of patients presenting at Islamic International Dental Hospital (66 per cent), regardless of the patients gender or the skeletal type. The variation in the shape of the sella was present in 34% of the subjects: an irregular dorsum sella was found in 16.7%. A pyramidal shape was present in 7.7%, double contour sella was found in 5.5%, an oblique anterior wall was found in 4% while sella turcica bridge was found in none of the patients (Table 1).

On seeing the morphology of sella turcica of each of the three skeletal types the results were as follows;

In **skeletal class I** patients 65% of patient had normal sella and 13% of the patients had irregular dorsum sella (Table 2).

In **skeletal class II** patients 62% of the patients had a normal sella and 26% of the patients has irregular dorsum sella. (Table 3).

In **skeletal class III** patients 72% of the patients had a normal sella and similar to class I patient only 10% of the patients had irregular dorsum sella. Pyramidal sella shape was found in 10% patients as well. (Table 4).

Size of sella turcica

The linear measurement of sella turcica in the mid sagittal plane in both genders is presented in Table 5.

The average length, depth and diameter of the sella turcica is shown for both male and female. The mean length of sella turcica in males and females varied by only 0.01mm being 11.3 mm in females and 11.4 mm in females. Similarly comparison of the mean diameter between both genders the mean value varied by only 0.02 mm being 14.0 mm in females and 13.8 mm in males. On comparison of mean depth between the male and female the values were equal i.e. in both genders the mean was 9.9 mm. On comparison of the *p* value in all three linear dimension between genders no significant difference was found in terms of length, depth and diameter (see Table 5).

In order to determine if the patients with different skeletal pattern presented with different linear dimensions irrespective of age and gender, a one way analysis of variance (ANOVAs) test was performed. No significant difference was found between the different linear dimensions to skeletal pattern. The mean difference

TABLE 1: FREQUENCY OF MORPHOLOGICAL SHAPES IN PATIENTS

Sella type	Frequency	Percentage
Normal Sella Turcica	119	66.1
Oblique anterior wall	7	4.0
Sella turcica bridge	0	0.0
Double contour	10	5.5
Irregular Dorsum Sella	30	16.7
Pyramidal shape	14	7.7
Total	180	100.0

TABLE 2: FREQUENCY OF MORPHOLOGICAL SHAPE IN CLASS I PATIENTS

Shape	Class I	Percentage
Normal	39	65.0
Oblique	2	3.3
Double contour	6	5.0
Bridging	0.0	0.0
Irregular	8	13.3
Pyramid	5	8.3
Total	60	100

TABLE 3: FREQUENCY OF MORPHOLOGICAL SHAPE IN CLASS II PATIENTS

Shape	Class II	Percentage
Normal	37	61.7
Oblique	1	1.7
Double contour	3	5.0
Irregular	16	26.6
Pyramid	3	5.0
Total	60	100

TABLE 4: FREQUENCY OF MORPHOLOGICAL SHAPE IN CLASS III PATIENTS

Shape	Class III	Percentage
Normal	43	71.7
Oblique	4	6.7
Double contour	1	1.6
Bridging	0.0	0.0
Irregular	6	10.0
Pyramid	6	10.0
Total	60	100

between skeletal pattern with different linear dimension and standard deviation are shown in table 5 .

DISCUSSION

This prospective study describes the shape and size of the sella turcica i.e. the morphological shape and linear dimension of sella turcica in the patients presenting at Islamic international dental hospital.

1. Shape of sella turcica

The morphological variations in sella turcica has been reported by many researchers through time.¹⁰⁻¹⁴

Gorden and Bell in 1922 examined radiographs of children of age ranging from 1 year to 12 years classifying the sella into 3 shapes, the circular, the oval or the flat/saucer shaped. Their conclusion was that most of the subjects had either circular or a oval shaped sella turcica, They observed that not all cases could easily be put into such a broad three way classification.¹¹

Davidoff and Epstein in 1950 used the term J shaped sella while omega sella, another shape was introduced by Pournier and Denizet in 1965.¹⁵ However in 1969 Kier termed these definitions radiographical myths, advising that both should be disregarded since they were used to characterize abnormal pathology as well as normal developmental patterns.¹⁶

The other descriptions of the sella turcica have been proposed based on the contour of the sella turcica, the angle made by the contour of tuberculum sella, the contour of the anterior and posterior clinoid processes and the fusion of both the processes termed as ' sella turcica bridge'.^{12, 17, 18}

In a recent study by Axelsson et al in 2004, shape of the sella turcica was divided 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.

Their result showed that the normal variation of sella turcica was seen in 2/3rd of the subjects while the remaining subjects showed dysmorphological appearance. The variation of the sella turcica morphology apart from normal can be misleading since it may be present in normal patients as well as medically compromised patients e.g. spina bifida or craniofacial deviation.⁶

Alkofide in 2007 did a similar study using the same 6 main types of sella shapes as Axelsson et al had used

TABLE 5: LINEAR MEASUREMENTS OF SELLA TURCICA SIZE IN BOTH GENDERS

	Gender	n	mean	Standard deviation	Standard error of the mean	p Value
Length	Female	90	11.2	2.4	0.4498	0.6667
	Male	90	11.4	1.45	0.3962	
Depth	Female	90	9.9	2.2	0.4067	0.4770
	Male	90	9.8	1.3	0.2610	
Diameter	Female	90	1.8	1.9	0.3553	0.2800
	Male	90	13.9	2.11	0.3870	

TABLE 6: ONE WAY ANALYSIS OF VARIANCE TESTING THE EFFECTS OF SKELETAL CLASS OF LINEAR DIMENSION (IN MILLIMETERS)

		n	Mean	Standard deviation	Standard error	95% confidence interval for mean		Minimum	Maximum	p value
						Lower bound	Upper bound			
Length	Class I	60	10.7	2.240	0.2892	10.1	11.3	6.0	16.0	0.212
	Class II	60	11.3	2.487	0.3210	10.7	12.0	6.0	18.0	0.079
	Class III	60	12.0	2.286	0.2954	11.4	12.6	7.5	19.0	0.785
	Total	180	11.3	2.337	0.3018	10.7	12.0	6.5	17.7	0.359
Depth	Class I	60	9.73	1.694	0.2186	9.3	10.2	5.0	13.5	0.144
	Class II	60	10.0	1.873	0.2418	9.5	10.0	7.0	17.0	0.233
	Class III	60	9.9	2.041	0.2635	9.4	10.5	6.0	16.0	0.637
	Total	180	9.9	1.869	0.2413	9.4	10.4	6.0	15.5	0.338
Diameter	Class I	60	13.5	1.985	0.2562	13.0	14.0	8.5	20.0	0.220
	Class II	60	13.7	1.932	0.2494	13.2	14.2	9.0	17.0	0.244
	Class III	60	14.5	2.215	0.2860	13.9	15.1	10.5	20.0	0.644
	Total	180	13.9	2.044	0.2638	13.4	14.4	9.3	19.0	0.369

and he reported that similar findings that the normal variation of sella shape was almost in 67 % (2/3rd) of the subjects.⁷

In our study the normal variation was observed in 66% of the subjects whereas 36 % with different variation. These values are again similar to Axelsson study. The finding of an irregular notching of the dorsum sella was greater in the current study being 16.7% whereas in Axelsson study it was 11%. Similarly the pyramidal shape of the dorsum sella was more frequent in the current study than the former. The difference in the values between the two studies can be attributed to the ethnic difference between the two samples as Axelsson used Norwegian population whereas our study included a Pakistani population.

The double contour frequency was almost similar in both current and the former study.

The presence of sella turcica bridge in normal individual is not uncommon and is seen in 5.5% -22 %

of the subjects⁶, however there is increase in occurrence in patients with craniofacial deviation.

In our study however the bridge was found in none of the subjects. Thus being much lower than previously published. It raises an interesting point for future studies as to whether the bridging variation of sella type even exists in normal individuals in our population.

The oblique anterior wall has been documented in normal (Axelsson) as well children suffering from lumbosacral myelomeningocele and seckel syndrome.¹⁹ The current study showed only 4 % of subjects with an oblique anterior wall compared with 26 % found by Axelsson et al in 2004.

Size of sella turcica

Similar to the morphological studies numerous studies have been done on the size of sella turcica, however the methods differ widely.

Due to difference in the method of measurement, comparisons to other studies should be done with caution.

Camp in 1924 conducted a study on adults and reported similar value to the width (termed as length in our study) being 10.6 mm in his study and 11.3 mm in our study. Value for height (termed as depth in our study) in camp's study was 8.1 mm compared to 9.9 mm in our study, a difference of 1.8mm which can be explained by difference in the method of measurement.

When the linear dimension of length, depth and diameter of the sella turcica in the present study were compared to the previous studies a difference between the measurement was noted. Quakinine and Hardy studied upon 250 sphenoidal block obtained from the cadavers of different ages. They found that average transverse width of the sella turcica was 12mm, the length (antero-posterior diameter) 8mm, and the average height (vertical diameter) 6mm.²⁰ When compared to the current study the average length was about 5mm smaller than that of patient presenting at Islamic International Dental Hospital. When comparing height which in our study was described as depth the patients at Islamic International Dental Hospital had on average 4mm larger depth which again can be attributed to the difference in method of measurement between both the studies. Quakinine and Hardy add that when measuring the size of sella turcica the height of the gland was usually 2mm shorter than the depth of sella turcica. (i.e. the gland does not fill the whole volume of the sella turcica).²⁰

When our study's sample was compared to a Norwegian sample in another study by Axelsson et al.⁶ The linear dimension in this study sample were on average 2.5 mm to 3mm larger than those in Norwegian subjects. Although the size of sella turcica measured in a comparable manner in both studies the discrepancy can be attributed to factors such as ethnicity.

A comparison of this study to a study done by Asad and Hamid in De, Montmorency College of Dentistry, Lahore showed that the mean width (termed as length in our study) of sella turcica in subjects of the De, Montmorency College (14.9 mm) was larger compared to subjects of our study (11.3 mm). While comparing the mean depth showed that the depth in our study was larger (9.9 mm) compared to the De, Montmorency college subjects (6.4 mm).²¹ The discrepancy between the measurements is attributed to the different method of measurement.

In comparison to our study to the study done in Saudi population by Alkofide in 2007, the average length and depth in Saudi population was 1mm smaller than our sample again the discrepancy can be attributed to ethnic difference in the two samples. However while comparing diameter of the two studies it was observed that it was almost similar in both studies.⁷

In determining if gender played a difference in terms of sella size, there was no significance difference found. Similar finding were reported by Israel in 1970 concluding that the sella turcica size in young adults males and females were almost the same, although he noted that the sella turcica size may increase in males with age.²² In a study by Silverman in 1957 radiographs of 320 individuals, ranging in age from 1 month to 18 years, mean sella area was calculated (length and depth). The findings concluded that pituitary fossa of males tended to be larger than the females about 1 to 13 years of age. Because of the pubertal growth spurt which occurs 2 years earlier than males, a significant increase in size of the sella turcica occur from 11 to 15 years of age.²³ Thereafter the pubertal growth spurt in males occurs about 2-3 years later than females resulting in approximately equalization in sella area in both genders. Haas in 1954 compared the mean size of sella turcica in terms of sella turcica area in millimeters square. He reported that till the age of 17 the area of sella turcica in males was more however after age of 17 years the sella turcica area in females is slightly larger compared to males.²⁴

The literature shows that there have been very few studies comparing the skeletal type of individual with the sella turcica size to evaluate whether or not a relation between the two exist. Preston in 1979 divided the cephalometric radiographs of subjects into three groups according to age 5 to 9 years, 10 to 14 years and 15 to 17 years and according to their skeletal/ facial type: class I, class II and Class III. His finding though didn't show any co-relation between the two.²⁵

However contrary to Preston's study instead of taking the mean sella turcica area, Alkofide in 2007 in Saudi population evaluated three linear measurements. He did find correlation in Class III with the one of the three linear measurement, the diameter.⁷

In the current study three linear measurements were evaluated similar to Alkofide study on Saudi population however no correlation was found between any of the three skeletal types namely class I, class II

or class III with any of the linear measurement of the sella turcica namely the length, depth or height.

The linear dimension obtained from this study can be used to estimate the size of pituitary gland. It can also help the clinician when confronted with an abnormally large sella area on lateral cephalogram. The orthodontist should also be familiar with the different shapes of sella turcica, to help in differentiation and distinguishing pathology from the normal development patterns.

CONCLUSION

- 1 Approximately 66 percent of the investigated subjects had a normal sella turcica.
- 2 No significant difference in size of the sella turcica could be found between males and females.
- 3 When sella size was compared to skeletal type, no significant difference was found among them.
- 4 The results of the present study of sella shape and size may be used as reference guide for future studies about sella turcica morphology.

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