ORIGINAL ARTICLE

THE SHAPE AND SIZE OF SELLA TURCICA IN SKELETAL CLASS I, II, AND III MALOCCLUSIONS

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Background: The Sella point, located near the center of the Sella Turcica and providing cover for the pituitary gland in the skull, is one of the most frequently used cranial cephalometric landmarks for radiograph tracing. The research aimed to quantify the dimensions and delineate the anatomy of the sella turcica across various skeletal shapes. **Methods:** 180 subjects, aged 9 to 27 years, including 91 men and 89 females, had lateral cephalometric radiographs. These subjects were divided into three skeleton classes: Class I, II, and III, with 60 subjects in each group. Measurements of the length, depth, and anteroposterior diameter were made, and the shape was examined using linear dimensions. The difference in linear dimensions was determined using a student t-test, and the link between sella turcica size and skeletal types was examined using a one-way analysis of variance (ANOVA). When comparing the age groups, the older group's linear dimensions were bigger than the younger group's ($p < 0.01$). Male and female length differences were found to be significantly different ($p < 0.05$). The length and diameter of the skeletons differed significantly from the sella size when compared. Sixty-one percent of the individuals had normal-appearing sella turcica. Further research addressing the sella turcica in the South Indian population can use the current study's linear dimensions and form as reference standards.

Keywords: Sella turcica; Size of Sella; Shape of Sella; Lateral cephalogram; Malocclusions

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INTRODUCTION

Tracing Cephalometric radiograph requires the use of various cranial landmarks. These markers are used to calculate the mandible's and maxilla's relative positions to each other and to the cranium.[1] Examining these structures helps with orthodontic diagnosis, assesses the diagnosis of orthodontic therapy, and assesses growth through superimposition throughout time. Sella turcica, also known as Sella point S, is one such landmark that has been frequently utilized in a variety of cephalometric analysis.[2]

The Sella point is one of the most commonly utilized cranial cephalometric landmarks for radiograph tracing. It is situated close to the middle of the Sella Turcica and provides cover for the pituitary gland in the skull. To assess any peculiar appearance found in the Sella region, one must first look at the common morphology of Sella Turcica.[3] Since it is generally acknowledged that there may be individual variations in morphology, the average standard results help classify any anomalies that are present in a large cranial region. With the use of this additional diagnostic data, conditions affecting the pituitary gland or various disorders affecting the craniofacial region can be evaluated.[1,4] The normal radiographic structure and morphological changes of this region are therefore important to know for orthodontists and other clinicians in order to identify any aberrations that may suggest pathological problems even before they become clinically obvious. The tuberculum sellae, the anterior and posterior clinoid processes that comprise the Sella turcica, the pituitary or hypophyseal fossa, and the diaphragm sellae are all covered.[5] Pituitary and Sella turcica development are complex processes that occur during pregnancy and after delivery.[6] The two major structures that separate tissues with different developmental and origin histories are located in the boundary area. During embryonic development, the neural crest cells' migration to the frontonasal and maxillary developmental fields depends on the Sella turcica .[7]

The anterior pituitary gland, the Sella turcica, and teeth are all formed and developed by neural crest cells. Dental epithelial progenitor cells have reciprocal and sequential interaction with neural crest-derived mesenchyme in order to differentiate.[8] he posterior part is derived from the para-axial mesoderm, which is closely linked to notochordal induction. Anteroposterior diameters of the Sella turcica typically range from 5 to 16 mm, whereas its

depths typically fall between 4 and 12 mm.[9] The Sella turcica bridges when the anterior and posterior clinoid processes fuse together. Bridges have been documented in skeletal, dental, and other syndromes; they are believed to be anatomical anomalies.[6]

The purpose of this study is to evaluate the Sella turcica's linear dimensions and morphological shape in individuals with various skeletal types.

MATERIAL AND METHODS

Dental health is going to be investigated by the means of the retrospective study carried out at Peshawar Dental College in Pakistan. Those who were diagnosed with severe medical conditions and conditions that might affect their mental performance were also not permitted to participate. The archive included case study records, including the migrating model, missing superior and inferior records, panoramic pictures, and cephalometric x-ray in this research. The research comprised 180 radiographs (91 males and 89 females) demonstrated by only one operator to avoid differences in skills affecting the results using the same cephalostat. Lenticular views only of high quality and clarity in the picture of the Sella turcica were used for cephalograms. The lateral cephalograms were assigned to skeletal class and gender, with each case being relegated to 60 Class I, 60 Class II and 60 Class III cases. The distribution of these cases in each class was: even, distributed among males and females per class. This can be done based on age, considering that we use two groups: prepubertal (9–14 years) and during/post pubertal (15 years or above) groups. All classes of ANB angle comprised the triangle found in Class I, if the ANB was in the range of ±2 degrees, Class II was depicted by ANB angle which was greater than 4 degrees and a Class III ANB was declared by an ANB that was less than zero degrees. Wit, too, applied his analysis to the ANB problem and pointed out what it couldn't reach.

To be able to trace the Sella turcica outline, acetate sheets are used to place on top of both lateral cephalometric radiographs under the torch of optical illumination, following the methodology by Silveira.[8] The drawn contour contains the tuberculum sella, floor, dorsum sella and anterior & post clinoid processes.

Furthermore, we assessed three linear dimensions which were the length, depth, and anteroposterior diameter in line with the protocol mentioned by Silverman and Kisling.[10]. All data were acquired in the midsagittal plane using the digital sliding calipers. Statistical analyses resulted in a length that was given as the distance from the tuberculum sella to the tip of the Statistical Analyses.

All measurements were transformed on SPSS 23 (Statistical Package for the Social Sciences) for the statistical processing. The sella turcica or saddle turcica is used to examine the difference in linear dimensions across gender categories and different age groups, and the student's t-test with a significance level of 0. 05 is performed in this examination. 05. The ANOVA test employed to analyze the skeletal type and the size of the Sella turcica WW was a one-way ANOVA test. To identify the skeleton class of which the linear size is significantly different from others, post hoc tests is performed. Skeletal examinations by regression analysis were held to investigating how gender, age and type of skeleton relate to linear measurements.

RESULTS

There was a statistically significant difference (p <0.001, 0.02; between the two groups in all three linear dimensions when the linear dimensions were compared with age. In comparison to the younger age group, the older age group's Sella turcica had a bigger size.

Table-1 shows the dimensions of the length, depth and anteroposterior diameter for males and females that are the average of the three. We conducted a one sample t-test for linear measurements, and we noted that there was a significant difference between these measurements for males and females (p<0.03), but we did not find any significant variation between them in the depth or anteroposterior diameter.

To find out if there were any differences in the linear dimensions between the various skeletal patterns, regardless of age and gender, a one-way ANOVA was performed. The length, anteroposterior diameter, and skeletal class of Sella turcica were found to differ significantly (p-value = 0.004, 0.008; Table-2).

The majority of individuals (61%), had normal sella turcica appearances. In 39% of the individuals, the morphological differences were detected. Five percent of the participants had an oblique anterior wall, fifteen percent had an irregular posterior wall, eight percent had sella turcica bridging, five percent had a double floor contour, and five percent had a pyramidal form (Table 3).

Results of an analysis of the sella turcica morphology in each of all three skeletal types were as follows: of the patients in skeletal Class I, 75% had normal cells and 25% had deviations. Forty percent of skeletal Class II patients had morphological changes, while sixty percent of patients had a normal sella. Of the patients in the Skeletal Class III, 48% had a normal sella and 52% exhibited morphological abnormalities. The dorsum's irregularity was the most prevalent variance seen in all three skeletal types (Table 4).

59–63% of the participants had normal sella turcica when the morphology was evaluated in both males and females, regardless of age and skeletal class

(Table 5). In the younger group (65%) and the older group (57%), the sella turcica appeared normal. In the elder age group, sella turcica bridging was also higher (Table 6).

Table-1: Sella turcica linear measurements (in millimeters) scaled according to age group

	Age	N	Mean	SD	Standarderror of the mean	*p*-value
Length	9-14	91	8.8	1.607	0.168	0.001**
	15-27	89	9.6	1.569	0.166	
Depth	9-14	91	7.1	1.010	0.105	0.02*
	15-27	89	7.5	1.360	0.144	
Diameter	9-14	91	10.9	1.300	0.136	0.02*
	15-27	89	11.3	1.252	0.132	

*$p \leq 0.05$; **$p \leq 0.001$

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Table-2: Male and female Sella turcica's linear dimensions (in millimeters)

Gender		N	Mean	SD	Standarderror of the mean	*p*-value
Length	Female	89	8.9	1.611	0.170	0.03*
	Male	91	9.4	1.634	0.171	
Depth	Female	89	7.3	1.108	0.114	0.9
	Male	91	7.3	1.318	0.142	
Diameter	Female	89	10.9	1.311	0.135	0.1
	Male	91	11.2	1.262	0.136	

*$p \leq 0.05$

Table-3: One-way ANOVA evaluating the Sella turcica sizes across several bone types

	Class	N	Mean	Standard Deviation	Standard error of the mean	95% confidence interval for mean		minimum	maximum	*p*-value
						Lower bond	Lower bond			
Length	Class I	60	8.9	1.784	0.230	8.4	9.3	5.0	14.0	0.004*
	Class II	60	8.8	1.518	0.196	8.4	9.2	6.0	12.0	
	Class III	60	9.7	1.471	0.189	9.3	10.1	5.0	12.0	
	Total	180	9.1	1.639	0.122	8.9	9.4	5.0	14.0	
Depth	Class I	60	7.3	1.229	0.158	7.0	7.7	4.0	10.0	0.6
	Class II	60	7.2	1.309	0.169	6.8	7.5	3.0	10.0	
	Class III	60	7.3	1.093	0.141	7.1	7.6	5.5	10.0	
	Total	180	7.3	1.210	0.090	7.1	7.5	3.0	10.0	
Diameter	Class I	60	10.9	1.414	0.182	10.5	11.3	8.0	15.0	0.008*
	Class II	60	10.8	1.352	0.174	10.5	11.2	8.0	14.0	
	Class III	60	11.5	0.978	0.126	11.2	11.7	10.0	13.5	
	Total	180	11.1	1.291	0.096	10.9	11.2	8.0	15.0	

*$p \leq 0.01$

Table-4: The distribution of sella turcica morphologies in skeleton classes I, II, and III concerning frequency

	Class I		Class II		Class III		Total	
Sella Shape	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Normal sella turcica	45	75	36	60	29	48	110	61
Oblique anterior wall	2	3	3	5	4	7	9	5
Sella turcica bridge	3	5	2	3	9	15	14	8
Double contour	2	3	4	7	4	7	10	5.5
Irregular dorsum sella	7	12	10	17	10	17	27	15
Pyramidal shape	1	2	5	8	4	7	10	5.5
Total	60	100	60	100	60	100	180	100

Table-5: The frequency distribution of two age groups and both genders' distinct Sella turcica forms

Sella Shape	Gender				Age			
	Male		Female		10-14 years		15-27 years	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Normal Sella turcica	54	59	56	63	59	65	51	57
Oblique anterior wall	4	4	5	5.5	5	5.5	4	4.5
Sella turcica bridge	11	12	3	3	4	4.4	10	11
Double contour	6	7	4	5	5	5.5	5	6
Irregular dorsum sella	11	12	16	18	12	13	15	17

Pyramidal shape	5	6	5	5.5	6	6.6	4	4.5
Total	91	100	89	100	91	100	89	100

DISCUSSION

Discussing the Sella turcica proportions and bony features of normal and skeletal variation of skulls is the purpose of the current study in this work. The only difference was in the angular measurements and the results of our research differed from how they were measured in other studies. The raw data of Quakinine and Hardy's microsurgical anatomical analysis in sections under the sphenoidal blocks started at 12mm through 250 cadavers detected that there was majorly width difference of 12mm compared to the significant anteroposterior difference was seen in both groups when comparing the sizes (lengths) of the sella turcica between males and females.[11]

In contrast to our findings, an Israeli study revealed that while the size of the sella is nearly the same in males and females, it tends to get larger in males as they mature.[12] Silverman determined the mean sella area by examining the radiographs of 320 participants ranging in age from 1 month to 18 years. The study concluded that, between the ages of one and thirteen, males' pituitary fossas were larger than those of females. Females have the pubertal growth spurt around two years earlier than boys, so the size grows between the ages of 11 and 15. Due to the two to three years of late pubertal growth surge in boys, the size of the sella equalizes in both genders. Haas looked at the mean sella area in both males and females between the ages of three and seventeen. She found that, up until the age of seventeen, boys' sizes were somewhat larger than girls', but after that, female sizes were larger.

The variation factor of age on sella size was evaluated in this investigation and an eclectic finding that the size of the sella in the older group was more significant than in the younger was made. In their lateral cepahlometric radiographic study of 182 subjects comprising of age range of 5–17 years, Preston et al. identified a strong correlation between sella outline size and age. This implies that the sizeincreases gradually with the progress of age. They may lack the same level of muscle mass, height and some girls have a growth spurt early in the teenage stage as compared to boys. Along with that, the researchers stated that the sella turcica with the longest dimension reached its peak at age of 25.[13] Beyond two decades of age, after which I did not gain size. The investigation, based on magnetic resonance imaging on 169 people aged 1 to 30 years made by Elster et al. reveals that the difference in brain sizes refers to boys and females. These differences do not manifest throughout childhood but actually only occur during puberty. The pituitary gland was quite small in these males, and it measured only 7 mm in height. However, in females the gland ranged between 7 to larger, which was 10 mm height. By imposing a comparatipn between the glands of young adults and teenagers, scientists found out that the glands of the former were normally smaller in size.[14]

The association between skeletal type and sella turcica size has only been examined in a few number of research published in the literature. In this investigation, skeletal Class III individuals had bigger sella turcicas. Alkofide discovered that skeleton Class II participants had lower sizes, while skeletal Class III subjects had greater sizes. In contrast to that, Preston et al. split the cephalometric radiographs into three groups (5–9, 10–14, and 15–17 years) based on age and skeletal type (Class I, II, and III), declaring no connection between skeletal type in class III and the zygomatic arch growth rate as well. Age had an interesting relationship with the size of sella turcica, which was greater on those of older groups when compared to younger groups. This was held true of males, females and both types of skeletons.[15]

The size of the pituitary gland can be predicted using the three linear dimensions (length, depth, and diameter). If a lateral cephalogram reveals an excessively big sella, it may be clinically significant.

There are various Publication reports demonstrating great differences in sella turcica form in the available literature. Adjacent contours, that is, the tuberculum sellae, as well as the clinoid processes, both anterior and posterior, were utilized for classifications as well as the fusion of clinoid processes to create the sella turcica bridge. For the purpose of the research conducted by Axelsson *et al.* , they put the Norway sample's morphology into six groups analyzed later on.[16] Of the individuals we were preparing, about 75% of them (statistically speaking) had a normal morphology, and the rest of them, only 25%, showed an abnormal morphology. For instance, a typical person with a clinically impaired condition (spina bifida or craniofacial abnormality) is in some ways similar to those who sport a body with physical deformation. In Jones *et al.* , the prevalence of bridging reached 16Similar percentage is to be seen in group of patients who receive a mix of surgical orthodontics and 5%. 3% in people with only orthodontic treatment or in individuals treated with both orthodontic care and orthognathic surgery, indicating the effectiveness of the treatment. Abdel Kaber looked at the occurrence of a sella turcica bridge in relation to bony class (either 1,2, or 3) in Saudi subjects amongst the

different skeletal classes while studied for a bridge. He unveiled the fact that patients undergoing the surgical orthognatics along with those suffering from skeletal Class 13 malocclusions had the best outcomes. 63% of the adolescents (i.e., those 15–20 years) and 7. 14% of the individuals (who underwent orthodontic treatment) had sella turcica bridges (i.e., a higher percentage). As I found out, among the 83 enrolled participants with either a Skeletal Class III or a Class III Subtype, 17 cases of a sella-turcica bridge have been shown to occur in lateral skeletal surveys. 85% overall.[17]

Sixty-one percent of the participants in this study had normal morphology, while the remaining 39 percent exhibited morphological abnormalities. As Alkofide told that there were normal morphology on 67% ostentation and the variance of anatomical structure in 33% ostentation on Saudi subjects, Class I, II, and III,Independent of the subject's gender, age, or pelvic type we detected off-center sellae in twelve cases. 1° and for negative values, the oblique anterior walls are in 9°. 4% and 37% respectively. The pyramidal shape is the difference between countries with the highest numbers of international travelers and those with the lowest. Vasculature atrial wall, both appearance and texture 10 times rougher in 8 of the cases. 1% of the subjects. Just like the data of the investigations done by Alkofide *et al.* and Axelsson *et al.* coincide with our data, our finding is in accordance with the research conducted by Alkofide et al. and Axelsson *et al.*[18]

According to Shah et al.'s description of the sella turcica morphology, 34% of the participants had variance and 66% of the subjects had normal morphology. Of the variations, 16.7% had an uneven dorsum, 7.7% had a pyramidal form, 5.5% had a double floor contour, 4% had an oblique anterior wall, and 0% had a sella turcica bridging. The only distinction found was that 8% of the individuals in our study had sella turcica bridging.[19]

By estimating the pituitary gland's approximate size, the results of this study may aid clinicians in recognizing an unusually big sella turcica on a lateral cephalogram. Additionally, the orthodontist must be knowledgeable about the anatomy of the sella turcica in order to distinguish between disease and typical developmental patterns.[20]

Axelsson et al. conducted a longitudinal study on the size of sella turcica in a Norwegian sample of participants ranging in age from 6–21. His conclusions were that while the depth and diameter rose with age, the length remained nearly constant over the course of the observation period. Additionally, he discovered that while the length of men was greater than that of females, there was no discernible difference in depth or diameter. The difference in linear dimensions between our results and the Norwegian sample ranged from 0.3 to 1.1 mm. The linear dimensions of the Indian population sample were, on average, 1.7–2.9 mm smaller than those of the Saudi respondents, according to a comparison of Alkofide's study with Saudi subjects.[21] 9. 9-mm depth was the average for both genders. In both males and females and throughout the exercise of different skeleton patterns, the researchers concluded that no statistically significant difference of linear measurement exists between any of the three personal mensurations. Filipović et al. studied the sella turcica in brain MRIs of 90 college students of age 18–22, and found dimension values for anteroposterior and width, respectively, 9 mm and 7 mm. 2 but not 8.3, 5 but not 9.7, and 10. Angelico *et al.* also found that with the lowering of the size, there is no difference between genders and this was observed higher in Class 3 malocclusions and lower in Class 2 malocclusions. Our results showed the same lengths as nisi's conclusion, but the diameter and depth observed in nisi group students were greater than those in our study group. The reason behind the change in values could be either the approach to the measurement or ethnicity as this matter.[22]

A remarkable size difference was seen regarding both the groups and nothing less than the measure of the sella turcica in men and women. The results were found to differ from our findings that unequal growth of sella is observed in females but it is maintained equal in boys. With aging, the size of the sella is found to become larger in males as compared to females. She talked about mean sella area in terms of the measurement she made on the X-rays of 320 infants and young people who ranged from 1 month to 18 years of age. The researcher's findings indicated that at the ages of one to thirteen, the size of males' pituitary fossas (tiny depressions located at the base of the brain) was larger than that of females'. It reaches to 11 years old and then 17 before entering adulthood due to the fact that the growth spurt happens in about two years earlier in females than males. A two to three year period of pubertal growth surge among boys is the cause of balanced growth of sella in two sexes. Haas compared the perimeter of the sella (turcica) Measurements in both males and females between 3–17 years. Discovering, for example, that from birth to seventeen years of age, the only difference in size between boys and girls was the fact that the boys were on average slightly bigger, with girls' sizes slightly larger after that.[23]

The importance of age on sella size for the older group when compared to the group of the younger ages in this case was larger. Preston and

others found out that there are clear connections between the volume of sella and age as they examinined 182 lateral cephelometric radiographs and they tested the participants from 5–17 years of age. Consequently, we deduce that perineurium volume gets bigger as the age move forward. This may well be due to girls forgoing their teenage phase of growth earlier than the adolescents. Moreover, Choi *et al*. found the linear sella turcica dimensions rising up to the age of 25. In avoiding obscure vocabulary and using examples, you can engage your readers and ensure they understand your message clearly. Over 26 years of age no future increase in size entailed. The evidence from the results of a study by Researchers Ester et al. demonstrates that in contrast to the findings of the previous a study using magnetic resonance imaging or MRI on 169 individuals aged between one to thirty years found that there wasn't any child difference between the boys and females and the changes occurred during puberty only. It is worth noting that the pituitary gland was of size 7 mm in males and generally the females' had measurements between 7–10 mm. The young adulthood of an animal is another factor which might be responsible in their pituitary glands being smaller than those of a certain age in the last stage of their growth.[24]

The association between skeletal type and sella turcica size has only been examined in a few number of research published in the literature. In this investigation, skeletal Class III individuals had bigger sella turcicas. Alkofide discovered that skeleton Class II participants had lower sizes, while skeletal Class III subjects had greater sizes. On the other hand, Preston et al. separated the cephalmetric radiographs into three groups (5–9, 10–14, and 15–17 years) depending on the age and skeletal type (Class I, II, and III), and they discovered no connection between the two. Age was found to be substantially correlated with the length of the sella turcica, with size being larger in older groups than in younger groups, regardless of gender or skeletal type.[25]

CONCLUSIONS

The size of the sella varied significantly in all three dimensions between the older and younger age groups, with the size of the sella being larger in the former. There were notable differences in the length and diameter of the sella turcica between the two genders. There was a significant variation in the skeletal type and sella size between patients in Classes II and III. Class III subjects were larger in stature. When age, gender, and skeletal type were compared to the parameters (length, depth, and diameter), there was a significant correlation found between age and sella size. The form of the sella turcica was normal in 61% of the subjects. The results of this investigation can be used as standards for future studies on the morphology of the sella turcica in Pakistan patients.

AUTHORS' CONTRIBUTION

All authors equally contributed to this work according to ICJME criteia. GJ: Substantial contribution to the conception or design of the work; or the acquisition, analysis, or interpretation of data. SA: Drafting the work or eviewing it critically for important intellectual content. KZ: Final approval of the version to be published. OA, GW, WU: Arrangment to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and esolved.

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