

Anatomy

KEYWORDS: Age, gender, morphology, sella turcica

RELATIONSHIP BETWEEN THE MORPHOLOGICAL VARIATION OF SELLA TURCICA WITH AGE AND GENDER: A DIGITAL RADIOGRAPHIC STUDYV



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**Abstract**

Introduction: Sella turcica is a saddle-shaped concavity located in the middle cranial fossa of the skull. The exact dimensions of sella turcica are an important consideration in the diagnosis, prognosis, and treatment of diseases related to the pituitary gland and brain. The sella turcica size and morphology is different from person to person. Thus, obtaining any data in this regard will be a great help in detecting abnormalities within this anatomic area.

Aim: The objective of this study was to find out the correlation between the morphological variations of sella turcica with age and gender.

Materials and Methods: Study sample consisted of 316 cephalograms of patients with age ranging 9–40 years. The contour of the sella turcica was traced and the linear measurements – length, depth, and diameter of sella turcica – were measured according to Silverman.

Results: Morphology of sella turcica appeared to be normal shape in 32.6% of the study population followed by combination (30.7%), irregular (11.4%), pyramidal (6.3%), bridge (9.2%), oblique anterior wall (5.4%), and double contour (4.4%). Gender-wise comparison of the linear measurement was not statistically significant. Among the linear measurement, the parameter diameter was statistically significant ($P < 0.001$) when correlated with age.

Conclusion: There is no significant relationship between the linear measurements and gender. There is no significant relationship between the mean diameter, mean length and mean depth with age.

Introduction

The lateral cephalometric radiograph unveils a number of craniofacial and oral structures. Cephalometric radiography plays a major role in diagnosis, treatment planning, and predicting the prognosis.[1] The sella turcica is an anatomical structure that can be appreciated on lateral cephalometric radiographs and commonly traced for cephalometric analysis. This provides useful diagnostic information about any pathology in the craniofacial region.[2,3] The sella turcica is located on the intracranial surface of the body of the sphenoid and constitutes a central pituitary fossa surrounded anteriorly and posteriorly by the tuberculum sellae and the dorsum

sellae,

respectively. There are two anterior and two posterior clinoid processes which project from the pituitary fossa. The medial and anterior prolongations of the lesser wing of the sphenoid bone forms the anterior clinoid process, and the terminations of dorsum sellae are present in the form of posterior clinoid processes.[3-5] Previous studies on linear and angular radiographic measurements of sella turcica had significant personal and ethnic differences. Knowledge of such normal radiological anatomy and its morphological variations can be used to study the growth pattern in an individual to plan treatment and assess prognosis. Any morphological variations found in this area can be a leading method to further investigate a variety of pathological situations which are incidentally found in a lateral cephalograph.[2,6] With this background, the purpose of this study was to measure the shape, length, depth, and diameter of the sella turcica and establish normative reference standards of sella morphology, and to determine the relationship between the morphological variation of sella turcica with age and gender.

Materials and Methods**Source of the data**

The sample consisted of 311 cephalograms of patients from the archives in the database of the Department of Oral Medicine and Radiology. The age range in this study was 6–40 years. Only radiographs of good quality, depicting a reference ruler on the cephalostat for exact measurement of the magnification factors, were included. The contour of the sella turcica was traced between points tuberculum sella (TS) and posterior clinoid (PClin), and 9 additional equally spaced points along this contour were located. The total of these 11 points defined a smooth curve that represented the outline of the sella turcica from TS to PClin, and these points were used for shape analysis. Furthermore, the outline was used to calculate the position of the most posterior point (sella posterior), the most anterior point (sella anterior), and the deepest point of the sella (sella floor), using the Frankfort plane (FH) as the horizontal reference direction. The radiographs were traced by two qualified maxillofacial radiologists under standardized protocols for data collection, including training of study personnel, to minimize interobserver variability because multiple individuals were involved in gathering and entering data. Hence, attempts were made by the investigators to undergo calibration in the radiological assessment of the sella turcica, including shape identification, on 60 (20%) randomly selected radiographs. The tracing and assessment of sella turcica was repeated after 3 weeks. Post-calibration procedure obtained a good agreement between the assessment criterion, and independently each of the observer in the radiological assessment

of sella turcica.

Statistical Methods: The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as Mean±SD and categorical variables were summarized as frequencies and percentages. Graphically the data was presented by bar diagrams and scatter plots. Student's independent t-test was employed to compare various study parameters (length, depth and diameter) with respect to gender. Further comparison of various study parameters with respect age and shape was done by applying analysis of variance (ANOVA) test. Karl Pearson's correlation coefficient was applied to establish the correlation of various study parameters with age. A P-value of less than 0.05 was considered statistically significant.

Size of sella turcica

The linear measurements – length, depth, and diameter of sella turcica – were measured according to Silverman.[7] All reference lines used were situated in the mid - sagittal plane [Figure 1]. The length of sella turcica: was measured as the distance from the dorsum sellae (Sp) to the tuberculum sellae (TS). The depth of sella turcica: was measured as a perpendicular from the line above to the deepest point on the floor of the fossa (Si).

The anteroposterior greatest diameter of the sella turcica: was measured from the tuberculum sellae (TS) to the remote point on the posterior inner wall of the fossa.

Shape of sella turcica

For assessment of the morphological aberrations of the sella turcica, the different morphological appearance of the sella turcica described by Axelsson et al.,[8] in addition to the normal morphology of sella turcica were used for comparison with those in the current study. The six morphological variations that were rated as normal included oblique anterior wall, sella turcica bridging, double contour of the floor, irregularity (notching) in the posterior part of the dorsum sellae, extremely low sella turcica, and pyramidal shape of the dorsum sellae [Figure 2]. The collected data was subjected to statistical analysis.

Results

In the total sample of 316 radiographs of the patients, 196 were males and 120 were females [Table 1]. Large number of patients were in the age group of 11–20 years (52.2%) followed by 21–30 years (43.0%) [Table 1]. The most predominant shape observed was normal (32.6%) followed by combination (30.7%), irregular (11.4%), pyramidal (6.3%), bridge (9.2%), and oblique anterior wall (5.4%), and the least was observed in double contour (4.4%) [Table 1 and Graph 1].

On gender-wise comparison of length, depth, and diameter, the mean length in males and females were 7.76 and 7.17, respectively; the mean depth was 6.37 and 6.47 in males and females, respectively; the mean diameter in males was 9.96 and in females it was 10.11. This was not statistically significant [Table 2 and Graph 2]. On age-wise comparison of length, depth, and diameter, mean depth, mean length and mean diameter were not statistically significant in different age groups [Table 3].

Correlation between the participants' age and length, depth, and diameter of sella turcica using Karl Pearson correlation test showed weak correlation [Table 5 and Graph 3]. On comparing the mean values of the linear measurements with different shapes of the sella turcica using Kruskal-Wallis test, the length, depth, diameter was not statistically significant [Table 4].

DISCUSSION

The lateral cephalometric radiograph unveils many craniofacial and oral structures when imaged from the lateral aspect. Cephalometric radiography is a helpful aid in the diagnosis, treatment planning, and predicting treatment outcome in current orthodontic

practice.[1] 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 the sphenoid bone, which contains the pituitary gland. It is divided into anterior (adenohypophysis), intermediate, and posterior (neurohypophysis) lobes.^[9]

Several pathologies of this gland can alter the shape and size of sella turcica. Some patients with an unusual sella turcica are suffering from several underlying diseases, intrasellar pituitary primary tumors, hypopituitarism, or syndromes such as Down syndrome, Williams or Sheehan's syndrome, and Seckel syndrome.^[10,11]

The abnormal morphology of the sella turcica may provide insight to examine patients suffering from these conditions.[12] Clinicians should be conversant with the normal radiographic anatomy and morphologic variability of this area, even before these become clinically observable to distinguish and explore deviations that may reflect pathological situations in sella turcica.

In the present study, it was found that the parameter length and depth increases with age, but it was not statistically significant. The parameter diameter ($P < 0.001$) increased with age, which was statistically significant. Correlation between the age and the linear measurements using Karl Pearson correlation test, the parameters diameter was found to be statistically significant ($P < 0.001$). These findings support the findings of Chilton et al. who reported that volume of the sella turcica found to increase with age. It should be noted that an age-related increase of sella turcica size is expected because of its contents, i.e., the hypophysis, have been shown to increase in size with age.[12] Silverman reported that sella area increases steadily with age and follows the somatic growth pattern, possibly related to the function of the anterior lobe.[7] In the present study, the reliability of using the reference points according to Silverman[7] was high in comparison to other methods used by Kisling.[13] because of the 11 points defining the outline of the sella used in this study in addition to the conventional linear and area measurements in a morphometric analysis in a sagittal plane.

On gender-wise comparison of length, depth, and diameter, the mean length in males was higher than females which was similar to the findings of Nagaraj et al.[14] The mean depth and diameter was higher in females than males. The linear measurements had no statistical significance in comparison with gender. These findings were in support with the findings of Nagaraj et al.^[14]

In the present study, the predominant type of sella turcica was found to be the normal type (32.6%), which is in accordance with the study conducted by Chauhan et al. (28%).[15] The bridge-type of sella turcica was found in 9.2 % of the cases, which was in accordance with the study conducted by Axelsson et al.[8] and Alkofide et al.[6] Based on the results of a study performed by Axelsson et al. on morphology and size of sella turcica in patients suffering from Williams's syndrome, sella turcica bridge was seen in 13% of the patients.[8] Leonardi et al. reported that the prevalence of sella turcica bridge is higher in adolescents with dental anomalies.^[16]

Irregular dorsum sella was found in 11.4% of the patients, which was similar to the findings of Prarthna et al., where they found the prevalence of irregular dorsum sella in 15.91%.[17] Double contour was found in 4.4% of the patients, which was slightly lower than the studies conducted by Chauhan et al. who found double contour in approximately 7%.[16] The oblique anterior wall was found in approximately 5.4%, which is in contrast with the studies conducted by Prarthna et al. who found it to be 9.09%.[17] An oblique anterior wall has also been documented in normal as well as medically compromised subjects such as children with lumbosacral meningomyelocele and seckel syndrome.[16,12,18] Pyramidal

shape was observed in approximately 6.3% of the cases, which was higher than the findings of Prarthna et al. where they found it in about 4.5% cases.[17] In the present study, we found different types of sella in the same patient and grouped those patients as combined group and it was found in about 30.7%. Hence, this type can be included in classifying the different shapes of sella turcica. However, it is becoming more evident that what appears to be "abnormalities" in shape may not always reflect underlying pathology. For example, asymmetry (double outline) and cortical erosion of the sella floor are often considered signs of increased pathological significance.[19] It is arguable because such signs have been observed in a relatively large percentage of asymptomatic subjects, without being related to the presence of pituitary tumors. Conversely, pathology may exist without osseous manifestations. The largest percentage of intrasellar tumors is microadenomas (adenomas smaller than 10 mm in diameter), which is often too small to cause sella enlargement or shape change. Pituitary adenomas are reported to account for 12–15% of symptomatic intracranial neoplasms.[20]

On average, approximately 25% of the patients have pituitary adenomas, which are often found incidentally.[21] Gadolinium-enhanced pituitary magnetic resonance imaging (MRI), unveils lesions as small as 2 or 3 mm in diameter. High-resolution computed tomography (CT) is a reasonable alternative, but it is less sensitive.[22]

Conclusion

We conclude that the normal morphology of the sella turcica was found only in 32.6% of the patients. Hence, any abnormal findings in the morphology of the sella turcica, which are found in the lateral cephalograms, should be subjected to advanced imaging modalities such as CT and MRI for confirming the pathology. There is no significant relationship between linear measurements and gender. There is no significant relationship between mean length, mean depth and the mean diameter with age. There is no significant relationship between the length and depth and the different shapes of sella turcica.

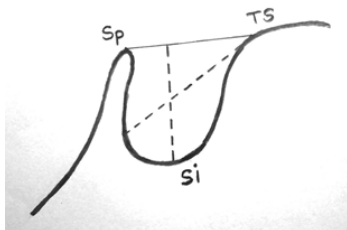


Figure 1: Normal morphology of sella turcica with reference lines used to measure its size: TS (Tuberculum sellae): Anterior boundary of the sella turcica. Sp (Dorsum sellae): The most posterior point on the internal contour of the sella turcica. Si (Floor of sella): The lowermost (deepest) point on the internal contour of the sella turcica.

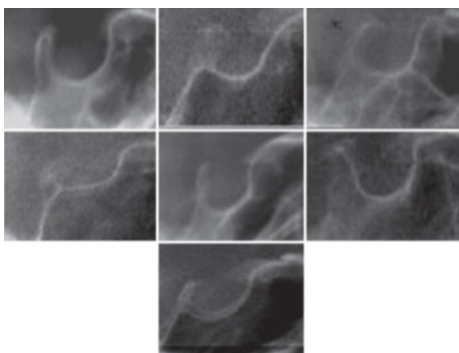


Figure 2: Morphology of sella turcica: (a) normal sella turcica, (b) oblique anterior wall, (c) sella turcica bridging, (d) extremely low sella turcica, (e) irregularity (notching) in the

posterior part of dorsum sellae, (f) pyramidal shape of the dorsum sellae, (g) double contour of the floor

Table 1: Distribution of demographic characteristics and shape of sella turcica

Variable	Category	Frequency	Percentage
Age	≤ 10 years	7	2.2
	11-20 years	165	52.2
	21-30 years	136	43.0
	31-40 years	8	2.5
Gender	Male	120	38.0
	Female	196	62.0
Shape	Normal	103	32.6
	Oblique anterior wall	17	5.4
	Bridge	29	9.2
	Double contour	14	4.4
	Irregular	36	11.4
	Pyramidal	20	6.3
	Combination	97	30.7

Table 2: Gender wise comparison of mean values of various study parameters

Parameter	Male [n=120]		Female [n=196]		P-value
	Mean	SD	Mean	SD	
Length	7.76	4.05	7.17	3.81	0.191
Depth	6.37	6.74	6.47	2.36	0.841
Diameter	9.96	2.75	10.11	2.98	0.672

Table 3: Age wise comparison of mean values of various study parameters

Parameter	Age group	N	Mean	SD	Min	Max	P-value
Length	≤ 10	7	8.83	1.83	6.82	11.14	0.771
	11-20	163	7.44	4.13	3.13	14.79	
	21-30	136	7.27	3.77	2.12	13.98	
	31-40	8	7.16	2.55	2.96	9.94	
Depth	≤ 10	7	7.13	0.76	6.10	7.87	0.605
	11-20	165	6.29	5.78	2.10	76.22	
	21-30	136	6.45	2.64	2.35	10.98	
	31-40	8	8.41	1.47	5.99	9.94	
Diameter	≤ 10	7	8.73	0.54	8.10	9.66	0.315
	11-20	165	9.87	2.61	6.24	13.78	
	21-30	136	10.28	3.31	6.33	14.96	
	31-40	8	10.87	1.49	8.22	12.90	

Table 4: Comparison of mean values of various study parameters based on various shapes of sella turcica

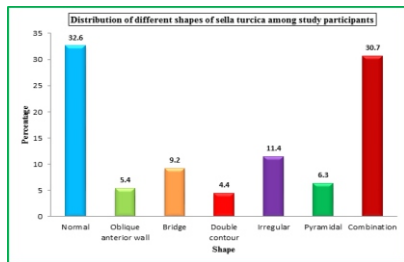
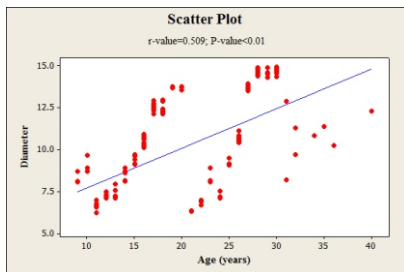
Parameter	Shape	N	Mean	SD	Min	Max	P-value
Length	Normal	102	7.76	3.92	2.86	13.98	0.632
	Oblique anterior wall	17	7.18	4.05	2.69	13.89	
	Bridge	29	7.26	3.78	2.94	13.78	
	Double contour	14	7.94	3.80	2.87	13.67	
	Irregular	36	7.93	4.06	2.85	13.93	
	Pyramidal	20	6.30	3.95	2.12	13.98	
	Combination	96	7.02	3.87	2.45	14.79	

Depth	Normal	103	6.89	7.26	2.10	76.22	0.947
	Oblique anterior wall	17	6.00	2.45	2.49	10.68	
	Bridge	29	6.27	2.12	3.19	10.32	
	Double contour	14	6.53	1.87	4.12	9.93	
	Irregular	36	6.22	2.49	2.35	10.53	
	Pyramidal	20	6.04	2.35	3.12	10.88	
	Combination	97	6.21	2.24	3.12	10.98	
Diameter	Normal	103	9.97	2.74	6.24	14.96	0.835
	Oblique anterior wall	17	10.69	3.05	6.39	14.96	
	Bridge	29	10.33	2.75	6.95	14.91	
	Double contour	14	9.08	2.76	6.57	13.82	
	Irregular	36	10.04	3.16	6.33	14.91	
	Pyramidal	20	10.18	3.25	6.38	14.86	
	Combination	97	10.05	2.96	6.37	14.90	

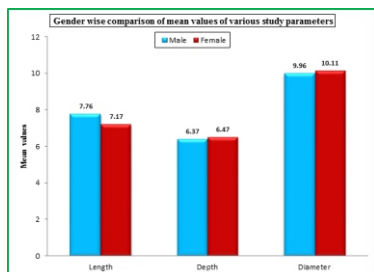
Table 5: Showing correlation of age with length, depth and diameter in study participants

Parameter	N	Correlation Coefficient	P-value
Length	316	0.137	0.065
Depth	316	0.132	0.079
Diameter	316	0.509	<0.001*

*Statistically Significant Correlation (P-value<0.05)



graph 1



graph 2