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RESEARCH ARTICLE

COMPARATIVE ANALYSIS OF SIZE OF SELLA TURCICA WITH DIFFERENT SKELETAL PATTERNS

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ABSTRACT

Introduction: In the field of Orthodontics and dentofacial orthopeadics, for correct treatment of various malocclusions, diagnosis of facial skeletal type is very crucial. Sometimes results obtained from lateral cephalograms are not sufficient to determine the facial skeletal pattern. Hence, the relationship between size of sella turcica and various skeletal patterns can help in determining the skeletal type and can help in taking precise decision for treatment planning.

Aim and Objective: The aim of the study was to investigate the normalcy of the dimensions of sella turcica and compare the relationship of the sella turcica with the different skeletal malocclusion and also to find a relationship between the length of the mandible and the dimensions of the sella turcica.

Materials and Methods: A total of 60 pretreatment digital lateral cephalograms were selected according to the criteria and grouped into 3 groups, group 1: Class I (n=20), group 2: Class II (n=20) and group 3: Class III (n=20). Lateral cephalograms were traced and analyzed on basis of sella turcica i.e. the following linear measurements were recorded: length, depth and diameter of the sella and the length of the mandible.

Results: The linear measurements of length and diameter showed statistically significant differences in Class I, Class II, and Class III (p-value=0.0 and 0.02 respectively). However, the depth showed no significant statistical difference in the groups.

Conclusion: The importance of the sella turcica is established and the normalcy is set by statistical analysis and the standard values are given for the dimensions of the sella turcica. This can be used for further analysis and reference standards for the Indian population. The length and diameter of the sella were statistically significant with the different groups. Largest values were given in Class III. Length of the mandible and the length of the sella in each group can be correlated.

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INTRODUCTION

The sella turcica, latin for a Turkish seat, is a saddle shape bony depression in the body of the sphenoid bone. In the deepest part of the sphenoid bone lodges the pituitary gland or the hypophysis cerebri. The benefits gained from studying these structures range from assisting the orthodontist during diagnosis, as a tool to study growth in an individual through superimposition of structures on a longitudinal basis, and during evaluation of orthodontic treatment results. One of the most commonly used cranial landmarks for cephalometric tracing is sella point. This point is located in the centre of the sella turcica, with the turcica housing the pituitary gland in the cranial base. This gland lies within the pituitary fossa and consists of the anterior lobe (adenohypophysis), the intermediate lobe, and the posterior lobe.

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Any abnormality or pathology of gland could manifest from altered shape of sella turcica, to disturbance in regulation of secretion of glandular hormones Abnormal sella turcica causes various diseases like intrasellar pituitary primary tumors, hypopituitarism, or syndromes like Williams or Sheehan's syndrome (Elster, 1993; Andredaki *et al*., 2007). Thus diseases can be diagnosed by noticing abnormal shape and size of sella turcica (Weisberg *et al*., 1976; Friedland and Meazzini, 1996; Kjaer *et al*., 2001). Abnormal change in size and shape of sella turcica has been reported in linear and angular cephalometric measurements of sella turcica in previous studies (Zagga *et al*., 2008). On future note, keeping in mind the cephalocaudal gradient of growth the size of the sella may be a key diagnosing factor of Class III and Class II patients and early treatment can be planned. As the maturation of the sella will take place before the mandible and hence can help in diagnosis of a large or short jaw. Therefore, the purpose of this study was to finding the variation in size of the sella turcica in different skeletal types/ malocclusions. The mean linear dimensions of the normal sella may help clinicians diagnose abnormalities of the sella turcica

and it may also help diagnose abnormalities with the pituitary gland. The orthodontist should also be familiar with the sella area, in order to help distinguish pathology from normal developmental pattern. As the lateral cephalogram is a common diagnosing tool for an orthodontist and any abnormalities of the sella turcica or the hypophysis cerebri should not be over looked.

MATERIALS AND METHODS

60 pretreatment digital lateral cephalograms were selected on the criteria as mentioned below. All cephalograms were of the same dimension, magnification and printed from the same machine. Criteria for selection of the Cephalograms are as follows:

- Subject should be healthy with no systemic diseases, signs of trauma or a congenital disease.
- Subject should show no sign of previous orthodontic treatment.
- Subject should be between the age group of 16years to 30years.
- All Class I malocclusion patients had an ANB value between 1° to 4°.
- All Class II malocclusion patients had an amplitude of ANB value more 4°.
- All Class III malocclusion patients had amplitude of ANB value less than 1°.

MATERIALS AND METHODS

Cephalograms were categorized into 3 major groups on Group 1: Class I malocclusion, Group 2: Class II malocclusion, Group 3: Class III malocclusion. All Lateral cephalograms were taken by skilled and experienced technicians in a standard natural head position as recommended by Broadbent *et al*. (Albarakati *et al*., 2012; Devereux *et al*., 2011; Nijkamp *et al*., 2008; Atchison *et al*., 1991). The cephalograms were manually traced by a single researcher with the help of a 0.5mm thick lead pencil and a millimeter scale for the planes on Orthodontic tracing paper. For the linear measurements a millimeter precision digital vernier calliper for the registration of the reading. They were again evaluated by a second researcher and the arithmetical mean of these readings were taken as the standard value for statistical evaluation and assessment. Beside routine anatomical designs the Cephalometric points traced are given in table 1 and linear measurements taken are given in Table 2.

Statistical Methods

The data was statistically analyzed with SPSS 20 Software (IBM). Data was subjected to descriptive analysis for mean and standard deviation of all variables and ranges. One-way ANOVA (random effective analysis of variance) and a post hoc test (Bonferroni and Sidak) were used for multiple comparisons. $P<0.05$ was considered as the level for statistically significant data.

RESULTS

The linear measurements with the arithmetic mean and standard deviations are tabulated in Table 3. This sets the normalcy of the size of the sella turcica and can be used for further analysis and reference standard for further studies in the Indian population. The linear measurements of the length (a) and the diameter (d) of the sella turcica were statistically significant in the different groups Class I, Class II and Class III. (P-value= 0.00 and 0.002 respectively).

Table 1. Cephalometric Points

Point A	The deepest midline point on the premaxilla between the anterior nasal spine and prosthion.
Point B	The most posterior point in the concavity between the infradentale and pogonion.
N (nasion)	The anterior limit of the frontonasal suture.
Co	The most posterior and superior point on the condyle of mandible.
Gn (Gnathion)	The most anterior and inferior point on the symphysis of mandible.
Tuberculum sella (T)	The most anterior point on the body of the atlas vertebrae seen on the lateral cephalogram.
Dorsum sellae (D)	The tip of the posterior nasal spine seen on the lateral cephalogram or Spina nasalis posterior. (Arslan SG)
Sella Turcica Floor	The base of the sella turcica was considered as the floor.
Anterior and Posterior Clinoid Process	Also knows as the Tuberculum sellae and the dorsum sellae, are the bony elevations of the sella turcica anteriorly and posteriorly respectively.

Table 2. Linear Measurements

Co-Gn	The effective length of the mandible.
Length of Sella Turcica (a)	The linear distance from the tuberculum sella to the tip of the dorsum sellae.
Depth of Sella Turcica (b)	Was measured as a perpendicular from the line above to the deepest point on the floor.
Anterior-Posterior diameter of Sella Turcica (d)	A line drawn from the tuberculum sella to the furthest point on the posterior inner wall of the fossa.

Table 3. ANOVA to measure p value

		df	Mean square	F	P value	Significance
Length of sella turcica	Between the groups	2	47.4	8.841	0	Significant
	Within the groups	57	5.361			
	Total	59				
Depth of sella turcica	Between the groups	2	5.267	2.679	0.077	Non significant
	Within the groups	57	1.966			
	Total	59				
Diameter of sella turcica	Between the groups	2	27.05	6.936	0.002	Significant
	Within the groups	57	3.9			
	Total	59				
Effective length of mandible	Between the groups	2	313.814	3.738	0.03	Significant
	Within the groups	57	83.949			
	Total	59				

Table 4. Mean value and standard deviation for Class I

	N	Minimum	Maximum	Mean	Std Deviation
Length of sella turcica	20	4	14	9.3	2.43
Depth of sella turcica	20	4	12	8.05	1.572
Diameter of sella turcica	20	6	16	10.35	2.434
Effective length of mandible	20	95	131	112.05	9.501

Table 5. Mean value and standard deviation for Class II

	N	Minimum	Maximum	Mean	Std Deviation
Length of sella turcica	20	6	16	10.2	2.587
Depth of sella turcica	20	5	10	7.35	1.531
Diameter of sella turcica	20	8	15	11.2	1.609
Effective length of mandible	20	93	125	107.2	9.22

Table 6. Mean value and standard deviation for Class III

	N	Minimum	Maximum	Mean	Std Deviation
Length of sella turcica	20	10	15	12.3	1.867
Depth of sella turcica	20	6	9	8.35	1.04
Diameter of sella turcica	20	9	15	12.65	1.785
Effective length of mandible	20	108	132	115.05	8.751

Table 7. Bonferroni and Sidak methods were used for post hoc analysis

Dependent variable		(I) type	(J) type	P value
Length of sella turcica	Bonferroni	Class I	Class II	0.672
			Class III	0
		Class II	Class I	0.672
			Class III	0.017
		Class III	Class I	0
			Class II	0.017
	Sidak	Class I	Class II	0.533
			Class III	0
		Class II	Class I	0.533
			Class III	0.017
		Class III	Class I	0
			Class II	0.017
Depth of sella turcica	Bonferroni	Class I	Class II	0.36
			Class III	1
		Class II	Class I	0.36
			Class III	0.084
		Class III	Class I	1
			Class II	0.084
	Sidak	Class I	Class II	0.318
			Class III	0.876
		Class II	Class I	0.318
			Class III	0.082
		Class III	Class I	0.876
			Class II	0.082

Table 8. Bonferroni and Sidak methods were used for post hoc analysis (table 7 continued)

Dependent variable		(I) type	(J) type	P value
Diameter of sella turcica	Bonferroni	Class I	Class II	0.537
			Class III	0.002
		Class II	Class I	0.537
			Class III	0.072
		Class III	Class I	0.002
			Class II	0.072
	Sidak	Class I	Class II	0.446
			Class III	0.002
		Class II	Class I	0.446
			Class III	0.07
		Class III	Class I	0.002
			Class II	0.07
Effective Length of mandible	Bonferroni	Class I	Class II	0.299
			Class III	0.915
		Class II	Class I	0.299
			Class III	0.027
		Class III	Class I	0.915
			Class II	0.027
	Sidak	Class I	Class II	0.27
			Class III	0.664
		Class II	Class I	0.27
			Class III	0.026
		Class III	Class I	0.664
			Class II	0.026

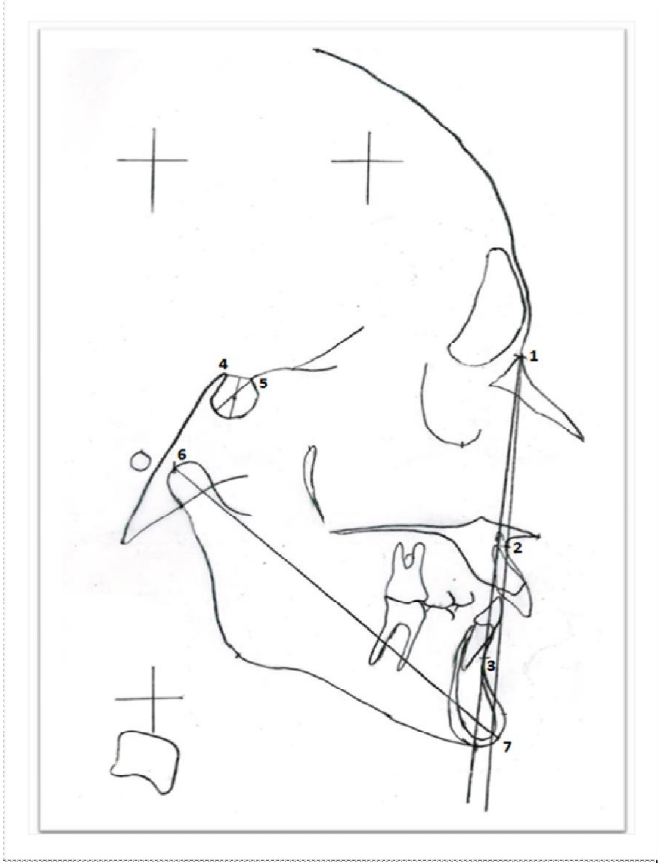

Figure 1. Various cephalometric lLandmarks that are required for the tracing of lateral cephalogram. 1: Nasion (N), 2: Supspinale (point A), 3: Supramentale (point B), 4: Dorsum Sella (D), 5: Tuberculum Sella (T), 6: Condylion (Co), 7: Gnathion (Gn)

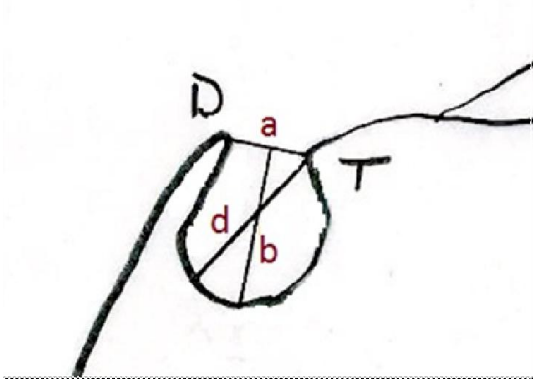

Figure 2. The point describe in the figure are as followed:- Dorsum Sella (D), Tuberculum Sella (T), the length of the sella turcica (a), the depth of the sella turcica (b),the anteroposterior diameter of the sella turcica (d)

The effectively length of the mandible was also statistically significant and shows the length of the mandible in the different classes. (P-value= 0.03) This shows the variation in length in the different classes. Post-hoc analysis shows that the effective length of the mandible is highest in Class III and is the shortest in Class II. This signifies the correlation of the mandible with the different classes. The length and diameter of the sella turcica in multiple comparison shows Class III and Class II to be statistically significant (p-value= 0.017 and 0.004) and Class I and Class III to be statistically significant (p-value= 0.0 and 0.002) showing the Length and diameter are the highest in Class III subjects. No statistical different was found between Class I and Class II which may be due to inconsistency of the reader or the small number of data. Also the depth of the sella was not statistically significant in Class I, Class II and Class III subjects and showed no correlation between the length of the mandible and the depth of the sella turcica (P-value=>0.05). This further also states that the size of the sella turcica is largest in Class III subjects as compared to Class I and Class II subjects.

DISCUSSION

From this study, it can be inferred that the diameter and length of sella turcica is directly correlated to the effective length of mandible i.e. the skeletal type. It is possible that the depth of sella may be correlated with the facial pattern. It is also possible to say that as in Class III malocclusion the size of the sella turcica is greater, so the size of pituitary gland may also be greater which can also lead to considerably more release of growth hormone that can increase the growth of mandible leading it to Class III malocclusion. From the previous studies, it can be inferred that the prenatal and postnatal growth and development of the pituitary gland and the sella turcica are complex processes. Both the structures which are located in a boundary region are separated by tissues of different origin and development. The neural crest cells that are not directly dependent upon the notochord, is believed to help in development of The anterior part while the paraxial mesoderm, which is closely related to notochordal induction is believed to help in development of posterior part (Kjær *et al*., 1999; Kjær *et al*., 1995; Kjær *et al*., 1999; Lieberman *et al*., 2000; Muller and O'Rahilly, 1980) The measurement and morphology of sella turcica and are valuable in assessment of pathology in the pituitary gland. Studies of sella turcica size on radiographs have been based either on linear, various methods of area and volume measurements. (Camp, 1924; Chilton *et al*., 1983; Davenport and Renfoe, 1940; Di Chiro and Nelson, 1962; Underwood *et al*., 1976; McLachlan and Williams, 1968) Various studies have been carried out previously to determine whether there is any relationship between sella turcica and other body dimensions. In 1910, Fitzgerald reported the length of the basis cranii affects more the size of pituitary fossa than the shape (Fitzgerald, 1910). Based on anteroposterior relation of maxilla with mandible, facial skeletal patterns are classified as Class I, Class II and Class III. The orthodontic treatment for all these three facial skeletal facial patterns is different. Before the commencement of the treatment it is necessary to determine the skeletal relation between both the jaws. Sometimes, measurement done during lateral cephalometric analysis may provide a borderline finding which is makes it difficult to differentiate between skeletal facial pattern (usually class I and class III). So in order to determine a proper treatment plan the shape and dimensions of sella turcica can help in determining in facial skeletal type and it treatment. In the present study, manual tracing was used for calculation of the length, depth and diameter of the sella turcica. Although in some studies the digital method was used to measure these factors, the manual technique has accuracy similar to that of digital technique in this regard (Axelsson *et al*., 2004). Thus, considering its affordability, the manual technique was used. It seems that further investigations in several centers with larger sample sizes can increase the accuracy of the obtained data and standards.

Conclusion

- The importance of the sella turcica is established and the normalcy is set by statistical analysis and the standard values are given for the dimensions of the sella turcica which may be used for further analysis and references.
- In Skeletal Class III or prognathic mandible, the anterio-posterior dimensions of the sella turcica that is the length and the diameter are the largest as compared to Class I and Class II.
- Depth of the sella turcica and the effective length of the mandible do not co-relate and also with the three skeletal types.

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Designing &concept development	✓	✓	✓
Data collection and entry	✓		
Manuscript writing	✓		
Manuscript Revision & editing		✓	✓
Statistical Analysis		✓	

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