Sella size and jaw bases - Is there a correlation???

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Abstract

Introduction: Sella turcica is an important cephalometric structure and attempts have been made in the past to correlate its dimensions to the malocclusion. However, no study has so far compared the size of sella to the jaw bases that determine the type of malocclusion. The present study was undertaken to find out any such correlation if it exists. **Materials and Methods:** Lateral cephalograms of 110 adults consisting of 40 Class I, 40 Class II, and 30 Class III patients were assessed for the measurement of sella length, width, height, and area. The maxillary length, mandibular ramus height, and body length were also measured. The sella dimensions were compared among three malocclusion types by one-way ANOVA. Pearson correlation was calculated between the jaw size and sella dimensions. Furthermore, the ratio of jaw base lengths and sella area were calculated. **Results and Conclusion:** Mean sella length, width and area were found to be greatest in Class III, followed by Class I and least in Class II though the results were not statistically significant. 3 out of 4 measured dimensions of sella, correlated significantly with mandibular ramus and body length each. However, only one dimension of sella showed significant correlation with maxilla. The mandibular ramus and body length show a nearly constant ratio to sella area (0.83–0.85, 0.64–0.65, respectively) in all the three malocclusions. Thus, mandible has a definite and better correlation to the size of sella turcica.

Keywords: Size of sella turcica, sella size and malocclusion, sella size and mandible

Introduction

The different skeletal malocclusions have various underlying developmental craniofacial features that are found to be characteristic of that morphological form. Attempts have been made in the past to correlate such features to the skeletal Class I, II, and III malocclusion, for example, the cranial base configuration and the frontal sinus.[1] Furthermore, the cranial base angle and the gonial angle have been found to vary depending on the skeletal base relationship.[2,3]

The sella turcica is a structure readily recognized on the lateral cephalometric radiographs and routinely traced for cephalometric analysis as the point sella. Being a prominent landmark located within the craniofacial region, it is used to measure the positions of maxilla and mandible in relation to the cranium and to each other. Numerous studies have been undertaken to determine whether a relationship exists between the size of the pituitary fossa and other body dimensions. In one of the earliest studies concerning the morphology of sella turcica, Fitzgerald in 1910 reported that the length of the basis cranii influences the size, and to a lesser extent, the shape of the pituitary fossa.[4]

Alkofide in 2007 analyzed the shape and size of the sella turcica in Saudi subjects with different skeletal types and found larger diameter values to be present in the skeletal Class III subjects while smaller diameter sizes were apparent in Class II subjects.[5] The finding of a larger sella in Class III malocclusion and a smaller one in Class II indicates that there could be some correlation between the jaw sizes and sella turcica as it is the variation in the sizes of the jaw bases that determines a particular malocclusion. Since none of the earlier studies have correlated the size of the jaws and that of sella, this study was undertaken to find out if any correlation exists between maxillary and mandibular dimensions and that of sella turcica.

Materials and Methods

The lateral cephalograms of 110 adult patients were taken from the records in the Department of Orthodontics, Manipal

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College of Dental Sciences, Mangalore-based on skeletal malocclusion which comprised of 40 Class I, 40 Class II with 20 males and 20 females in each category and 30 Class III skeletal bases including 15 males and 15 females. The sample size determination was done for this cross-sectional study at 5% level of significance with 0.5% permissible error in estimation of mean and was minimum 32 subjects in each category. The gender distribution ensured inclusion of uniform sample for the study for each type of malocclusion. The exclusion criteria included history of orthodontic treatment or any systemic abnormality. The following measurements were made on the tracings of the sample population in accordance to the method used by Andredaki *et al*.[6]

Sella dimensions

Sella width

The largest anteroposterior dimension, as measured parallel to the Frankfort horizontal (FH) plane, from sella posterior to sella anterior taking the points of greatest convexity [Figure 1].

Sella length

The distance from tuberculum sellae (TS) to posterior clinoid (PClin).

Sella height anterior

The vertical distance, as measured perpendicular to the FH plane, from TS to the sella floor.

Sella height posterior

The vertical distance, as measured perpendicular to the FH plane, from PClin to the sella floor.

Sella height median

The vertical distance, as measured perpendicular to the FH plane, from the sella floor to a point midway between PClin and TS.

Sella area

The area included by the outline of the sella and capped by a line joining PClin to TS. This tracing was superimposed on graph paper marked in square millimeters to calculate the sella area [Figure 2]. The sella area is denoted by A for ease of use in calculation of ratios.

Jaw base measurements

- maxillary length (ANS-PNS) denoted as B
- mandibular ramal height (Co-Go) denoted as C
- mandibular body length (Go-Gn) denoted as D.

Intra-operator variability was assessed by retracing 10 lateral cephalometric radiographs chosen at random in an interval of 3 weeks under identical conditions. The intraclass correlation coefficient was used in this study to evaluate the reproducibility of the readings. The reliability measurements were between 0.80 and 1.00 which shows acceptable reproducibility.

Sella – Jaw base ratio

The sella size in terms of area was compared to the size of the jaw bases:

- Sella area to maxillary length (A/B)
- Sella area to mandibular ramal height (A/C)
- Sella area to mandibular body length (A/D).

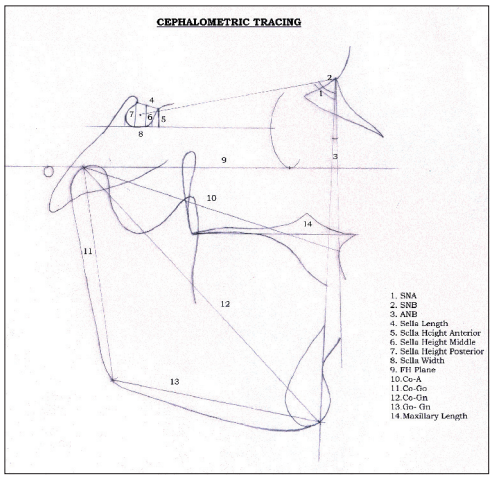

Figure 1: Cephalometric parameters

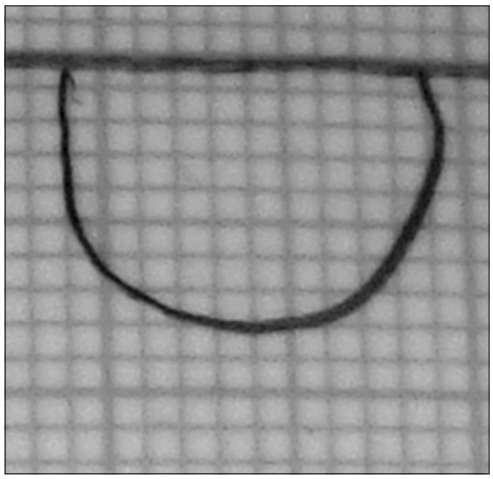

Figure 2: Assessment of sella area

Table 1: Mean sella measurements in class I, II and III

Class	Sella length	Sella width	Sella height anterior	Sella height median	Sella height posterior	Sella area (A)
I	8.19 (1.72)	9.01 (1.15)	7.81 (1.57)	7.84 (1.34)	7.91 (1.46)	50.66 (13.44)
II	7.96 (1.81)	8.81 (1.32)	7.75 (1.32)	7.75 (1.21)	7.71 (1.41)	50.06 (13.03)
III	8.70 (1.85)	9.23 (1.33)	7.77 (1.90)	7.63 (1.75)	7.48 (1.85)	52.40 (14.72)

Statistical analyses

- To study the relationship between the skeletal type and sella turcica, a one-way ANOVA test was performed
- Pearson correlation was evaluated between each of sella dimensions, i.e., sella length, width, sella height median and area to each of maxillary length, ramal height and mandibular body length in the total sample.

Results

The dimensions of sella turcica, i.e., mean sella length, width, and area was found to be greatest in Class III, followed by Class I and least in Class II [Table 1]. However, this difference was not found to be statistically significant on applying the one-way ANOVA test [Table 2].

Correlation of maxillary dimensions and sella turcica

Pearson's correlation was found to be significant only for sella length and maxillary length [Table 3]. All other dimensions of sella that were measured did not show any significant correlation to maxillary length.

Furthermore, the ratio between the maxillary length and sella area in each of the classes was different [Table 4].

Correlation of mandibular dimensions and sella turcica

Correlation of mandibular ramus height and sella dimensions showed that there is a significant correlation between mandibular ramus height and sella length, height and area [Table 5] while mandibular body length correlated significantly with sella length, width, and area [Table 6]. Thus, 3 out of the 4 sella dimensions measured correlated significantly with both the mandibular dimensions assessed. Furthermore, the ratio between mandibular ramus height as well as mandibular body length to sella area was found to be nearly constant, i.e. , 0.83–0.85 and 0.64–0.65, respectively in all the three classes [Table 4 and Figure 3].

Discussion

Various studies in the past have correlated malocclusion to other craniofacial structures like Hopkin *et al*.[7] who found that the cranial base length and angle increase from Angle's Class III through Class I to Class II division 1 malocclusion. Kerr and Adams examined a larger BaSN angle in Class II patients than Class I patients.[8] The size of the frontal sinus has also been found correlated to maxillary

Table 2: Comparison of sella dimension and correlation in all three classes - analysis of variance

	F	Significance
Sella length	1.739	0.132
Sella width	0.678	0.641
Sella height anterior	0.103	0.991
Sella height median	0.148	0.980
Sella height posterior	0.337	0.890
Sella area	0.170	0.973

Table 3: Correlation of maxillary length to sella dimensions

	Sella length	
	Maxillary length	**Sella length**
Maxillary length		
Pearson correlation	1	0.227*
Significant (two-tailed)		0.017
n	110	110
Sella length		
Pearson correlation	0.227*	1
Significant (two-tailed)	0.017	
n	110	110

*Correlation is significant at the 0.05 level (two-tailed)

	Sella width	
	Maxillary length	**Sella width**
Maxillary length		
Pearson correlation	1	0.086
Significant (two-tailed)		0.373
n	110	110
Sella width		
Pearson correlation	0.086	1
Significant (two-tailed)	0.373	
n	110	110

	Sella height median	
	Maxillary length	**Sella height median**
Maxillary length		
Pearson correlation	1	0.178
Significant (two-tailed)		0.063
n	110	110
Sella height median		
Pearson correlation	0.178	1
Significant (two-tailed)	0.063	
n	110	110

	Sella area	
	Maxillary length	**Sella area**
Maxillary length		
Pearson correlation	1	0.181
Significant (two-tailed)		0.058
n	110	110
Sella area		
Pearson correlation	0.181	1
Significant (two-tailed)	0.058	

Table 4: Ratio of sella dimensions and jaw base length

Class	Sella area (A)	Max length (B)	Co–Go (C)	Go–Gn (D)	A/B	A/C	A/D
I	50.66 (13.44)	57.23 (5.19)	61.33 (6.23)	78.70 (5.82)	0.89 (0.23)	0.83 (0.20)	0.65 (0.17)
II	50.06 (13.03)	57.99 (3.93)	61.08 (5.58)	76.95 (5.42)	0.87 (0.23)	0.83 (0.23)	0.65 (0.17)
III	52.40 (14.72)	55.33 (3.75)	61.55 (6.72)	81.67 (5.16)	0.94 (0.25)	0.85 (0.23)	0.64 (0.17)

CoGo: Ramal length; GoGn: Mandibular body length

Table 5: Correlation of mandibular ramus to sella dimensions

	Sella length	
	CoGo	Sella length
CoGo		
Pearson correlation	1	0.243*
Significant (two-tailed)		0.011
n	110	110
Sella length		
Pearson correlation	0.243*	1
Significant (two-tailed)	0.011	
n	110	110

*Correlation is significant at the 0.05 level (two-tailed)

	Sella width	
	CoGo	Sella width
CoGo		
Pearson correlation	1	0.026
Significant (two-tailed)		0.788
n	110	110
Sella width		
Pearson correlation	0.026	1
Significant (two-tailed)	0.788	
n	110	110

	Sella height median	
	CoGo	Sella height median
CoGo		
Pearson correlation	1	0.251**
Significant (two-tailed)		0.008
n	110	110
Sella height median		
Pearson correlation	0.251**	1
Significant (two-tailed)	0.008	
n	110	110

**Correlation is significant at the 0.01 level (two-tailed)

	Sella area	
	CoGo	Sella area
CoGo		
Pearson correlation	1	0.263**
Significant (two-tailed)		0.006
n	110	110

Contd....

Table 5: Contd...

	Sella length	
	CoGo	Sella length
Sella area		
Pearson correlation	0.263**	1
Significant (two-tailed)	0.006	
n	110	110

**Correlation is significant at the 0.01 level (two-tailed)

CoGo: Ramal length

length, mandibular length, symphysis width, and condylar length by Rossouw *et al*.[1]

The past studies have shown that the sella size can be correlated to the malocclusion like the study by Alkofide who reported the length and diameter to be decreasing in order from Class III > Class I > Class II [Table 1].[5] Similar to his findings, in this study also sella length and width were found to be the greatest in Class III followed by Class I and least in Class II though the difference was not statistically significant. However, no study has been done to find out if the sella size can be correlated to the size of the jaw bases as well as it is the discrepancy in the sizes of jaw bases that determines the malocclusion.

According to the findings of the current study, out of the 4 dimensions of sella that were measured, a significant correlation was found between 3 dimensions and each of mandibular dimensions, i.e., ramus and mandibular body length [Tables 5 and 6]. On the other hand, only 1 of the sella dimensions correlated significantly with the maxillary length. Hence, there is a definite strong correlation between mandibular size and that of sella turcica.

In support of this finding the ratio between sella area and ramal height and sella area to mandibular length were found to be nearly constant (i.e., ratio A/C - 0.83–0.85 and A/D 0.64–0.65) [Table 4 and Figure 3]. However, the ratio of maxillary length to sella area has a wider range (A/B - 0.89–0.94) showing weak correlation [Table 4 and Figure 3].

Thus, in all the three classes the size of sella turcica in terms of the area was in a constant proportion to the mandibular dimensions with respect to mandibular length and ramal height. This growth proportionality was not seen between maxilla and sella. One hypothesis proposed to explain this

Table 6: Correlation of mandibular body length and sella dimensions

	Sella length	
	GoGn	**Sella length**
GoGn		
Pearson correlation	1	0.242*
Significant (two-tailed)		0.011
n	110	110
Sella length		
Pearson correlation	0.242*	1
Significant (two-tailed)	0.011	
n	110	110
*Correlation is significant at the 0.05 level (two-tailed)		
	Sella width	
	GoGn	**Sella width**
GoGn		
Pearson correlation	1	0.195*
Significant (two-tailed)		0.041
n	110	110
Sella width		
Pearson correlation	0.195*	1
Significant (two-tailed)	0.041	
n	110	110
*Correlation is significant at the 0.05 level (two-tailed)		
	Sella height median	
	GoGn	**Sella height median**
GoGn		
Pearson correlation	1	0.156
Significant (two-tailed)		0.103
n	110	110
Sella height median		
Pearson correlation	0.156	1
Significant (two-tailed)	0.103	
n	110	110
	Sella area	
	GoGn	**Sella area**
Sella area		
Pearson correlation	0.215*	1
Significant (two-tailed)	0.024	
n	110	110
GoGn		
Pearson correlation	1	0.215*
Significant (two-tailed)		0.024
n	110	110
*Correlation is significant at the 0.05 level (two-tailed)		

GoGn: Mandibular body length

correlation can be that the sella turcica houses the pituitary gland that secretes the growth hormone. It has been shown

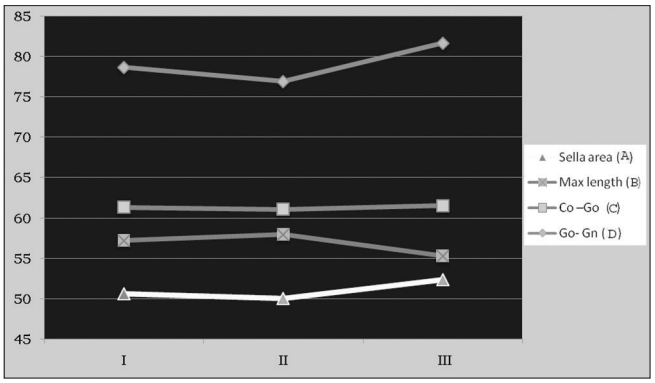

Figure 3: Graphic representation of ratio between jaw base sizes and sella area

that the growth hormone affects the growth of the mandible more than the maxilla.[9] Though there are no studies that correlate the size of sella turcica and the amount of growth hormone secreted by the normal pituitary to pituitary size, an indirect evidence of these correlations can be sought in cases of pituitary pathology. For example, in the case of pituitary adenoma, along with the glandular hypertrophy, the sella turcica is also enlarged. In the case of somatotrophic adenomas, the amount of growth hormone secreted also increases and in such cases of increased growth hormone secretion, usually the mandible is also enlarged while the maxilla is not affected to that extent. Pirinen *et al*. studied the growth hormone in patients with excessive or deficient growth hormone secretion and reported that the maxillary growth is less affected than the mandible by growth hormone levels.[10] Such relation is also quite evident in cases of excessive growth hormone secretion like acromegaly wherein the mandible is large and affected to a greater degree than the maxilla.[11]

The most important outcome of the study is the ratios A/C and A/D which were found to be nearly constant in all the 3 groups. Whether these are a universal constant needs further study on other populations. This finding is important in predicting the expected ramus height and body length based on sella area that is established earlier in a growing individual. Thus, interceptive procedures can be undertaken at an earlier stage for developing skeletal malocclusion.

Conclusion

The present study was undertaken to find any correlations between the sella size and that of jaw bases and hence to, malocclusion. The following results were obtained from the present study:

- Mean sella length, width, and area were greatest in Class III, followed by Class I and least in Class II
- The mandibular ramus height correlated significantly with the sella length, height, and area while the mandibular body length correlated significantly to the sella length, width, and area

- The maxillary length correlated significantly only to sella length
- The ratio of mandibular length and ramal height to the sella area showed nearly a constant ratio as compared to maxillary length to sella area ratio. Thus, mandibular dimensions demonstrated a better correlation to sella dimensions.

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Conflicts of interest
There are no conflicts of interest.

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