

Original Research Article

Normal and Abnormal Variations of Sella Turcica in Three Facial Types of Adolescent Iraqi Samples

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Abstract

Sella(S) turcica is a structure resemble a saddle and based on the roof of the sphenoid bone. For cephalometric tracing, sella point is one of the most commonly used cranial landmarks and it is located in the centre of the sella turcica of the skull. This study were to assess the shape and size of sella in a sample of Iraqi adolescent and with different skeletal classes. The study sample consist of (91) Iraqi adolescent subjects aged 10-16 years (47 females, 44 males); every subject provided with true lateral cephalometric radiograph. The sample was classified into three skeletal classes according to ANB angle. The size of Sella was measured using three linear measurements (S. length, S. depth, and S. diameter). It showed that most of the measurements of sella turcica were not different statistically among the skeletal classes. Normal sella was the predominant over the other morphological aberrations, while these morphologies occurred more frequently in class II and III. throughout the pubertal period specific sella turcica linear measurements cannot be obtained for each specific skeletal class; except between class I and II patterns, Sella depth was statistically higher in the former.

Key words: Sella Turcica, Pubertal growth, Size, Morphology.

التغيرات الطبيعية والغير طبيعية في السرج التركي في ثلاثة أصناف من سوء الاطباق الهيكلية لمجموعه من عينه من المراهقين العراقيين

الخلاصة

السرج التركي هو تركيب يشبه السرج، يستند الى سطح العظم الوتدي. للبحوث بالأشعة السينية المتعلقة بالأسنان، فان موقع السرج التركي هي واحدة من معالم الجمجمة الأكثر شيوعا، وتقع في الوسط من الجمجمة. وكانت هذه الدراسة لتقييم شكل وحجم السرج التركي في عينه من المراهقين العراقيين ومع فئات مختلفة من سوء الاطباق العظمي. وتتكون عينة الدراسة من (91) شخصا من الذين تتراوح أعمارهم بين 10-16 عاما (47 إناث و 44 ذكور)؛ كل شخص تم تزويده بالتصوير الشعاعي للقياسات الرأس الجانبية الحقيقية. وقد صنفت العينة إلى ثلاث فئات من الهيكل العظمي وفقا ل زاوية ANB. وقد تم قياس حجم السرج التركي باستخدام ثلاثة قياسات خطية (الطول والارتفاع والقطر). وقد بينت الدراسة ان معظم قياسات السرج التركي لم تكن مختلفة إحصائيا بين أصناف سوء الاطباق الهيكلية. وكان السرج التركي هو السائد على مدى الانحرافات الشكلية الأخرى، في حين وقعت هذه الأشكال التضاريسية على نحو أكثر تواترا في الصف الثاني والثالث من سوء الاطباق الهيكلية. طوال فترة البلوغ، القياسات الخطية للسرج التركي لا يمكن الحصول عليها لكل فئة من سوء الاطباق الهيكلية؛ إلا بين الصف الأول والثاني من سوء الاطباق، عمق سيلا أعلى إحصائيا في السابق.

Introduction

Sella turcica is consider the key for many of radiographic analysis of the neurocranial and craniofacial complex. In orthodontics, sella point-which is located at the center of sella turcica- is one of the important and most commonly used landmarks in

cephalometrics analysis. Such landmark is used to measure the positions of maxilla and the position of mandible in relation to the cranium base and to themselves. The gained benefits from studying these structures range from assisting the orthodontist during diagnosis, which is

very important tool to study growth in an individual through superimposition of structures on a longitudinal basis, and during evaluation of orthodontic treatment results. Since sella area is an important region, and morphology may be differ from individual to individual, establishing normal standards will aid in the process of eliminating any abnormality in the shape or size of sella turcica [1, 2].

Any abnormality or pathology in the gland could manifest from an alteration of sella turcica shape and/or a disturbance in the regulation of glandular secretion of hormones.[3-6] The anatomy of the sella turcica is variable as it has been described [7]. Morphologically, there is a three basic types—flat, round, and oval—have been classified, the oval and round types consider the most common. During embryological stage, the sella turcica area is consider a key point for the migration of the neural crest cells to the frontonasal and maxillary developmental fields [8]. For this reason, it is very important to study the effect of puberty (a period of significant body changes) on the normal morphology of this landmark clearly in a young sample, as it is studied in an adult sample, since this has a great importance in diagnosis in orthodontic and also in treatment planning.

Previously, when studying the sella turcica size (length, depth and diameter) and its relation to different skeletal patterns, there is no statistically significant correlation between facial type and the mean sella turcica area of the pituitary fossa had been presented.[9] However, Alkofide [1] found a significant difference when evaluated skeletal type and linear dimensions of sella turcica, When comparing skeletal class II and class III subjects, there was a significant difference between the diameter of the sella turcica in both skeletal classes which may be attributed to genetic factors.

Although the dimensions and morphology of sella turcica have been studied by previous researchers on adult Iraqi samples [10,11], until now no Iraqi study has been done to evaluate the linear dimensions and morphological structure of sella turcica in an adolescent Iraqi sample.

So the present study was the first Iraqi study that evaluated the linear dimensions and morphological structure of sella turcica in an adolescent Iraqi sample.

Materials and Methods

The Sample

The sample of this study consisted of radiographs for patients who were attending the preventive and orthodontic clinics at the teaching hospital of the College of Dentistry – Baghdad University seeking paedodontic and orthodontic treatments. The sample was all of Iraqi origin, with an age ranging between 10-16 years. Out of 105 subjects examined, only 91 subjects (44 males and 47 females) met the inclusion criteria including no history of systemic disease (clinically healthy patient) or trauma in the craniofacial complex, also no syndromes (clefts of the lips and palate), and finally no history of previous orthodontic treatment.

The sample has been classified according to ANB angle [12-14] into skeletal class I (13 males, 16 females), class II (15 males, 17 females), and class III (16 males, 14 females).

Method

Cephalometric Analyses

All Lateral Cephalometric Images were analyzed by an AutoCAD program (version 2007) to measure the ANB angle and to calculate the linear measurements of Sella Turcica.

Sella Turcica size

According to Silverman [15] and Kisling [16] the following lines were measured to determine the size of the Sella Turcica, the reference lines used were situated in the midsagittal plane (Figure 1):

A) The Sella Turcica length: Was obtained from measured the distance from the Tuberculum Sellae (TS) to the tip of Dorsum Sellae (DS).

B) The Sella Turcica depth: Was obtained from measured a perpendicular from the line mentioned above to the deepest point on the floor of the fossa (BPF).

C) The anteroposterior greatest diameter of the Sella Turcica: Was obtained from measured the Tuberculum

Sellae (TS) to the furthest point on the posterior inner wall of the fossa (SP).

Sella Turcica shape

For the assessment of the morphological aberrations of the sella turcica (after enlargement of its view), added to that the normal morphology of sella turcica traced in (Figure 2); the different morphological appearances of the sella turcica described by Axelsson et al [17,18] (Figure 2), were used to classify sella shapes in the current study. The six morphological variations that are 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.

Statistical Analysis

The statistical analysis included:

I. Descriptive Statistics: Including (Mean value, Standard deviation, Number and Percentage, and Statistical tables).

II. Inferential Statistics: Including (ANOVA test, LSD test, Independent t-test, and Likelihood Ratio test (Lx2))

Results and Discussion

This prospective study describes the size and the shape of the sella turcica i.e. the linear dimension and the morphological shape of sella turcica. The literature involves different age ranges, with the puberty may begin as early as 9 or 10 years, and may end as late as 18 or 19 years of age. Depending on the chronological age; by selecting the 10-16 years age range, therefore, the beginning of rapid and diminished growth will be reconciled. Size measurements of the sella turcica have, to-date, almost solely been used as a diagnostic tool concerning expanding tumors or tumor-like processes in the pituitary gland [1,19,20].

Statistically, there were non-significant gender differences in all the linear measurements of the sella turcica (S. length, S. depth and S. diameter) in skeletal class II and III, while the two measurements (S. depth and S. diameter) were significantly higher in females than in

males dealing with skeletal class I (Table 1). This may be explained by: 1st, The explicit discrepancy in gender distribution in this skeletal pattern. 2nd, The earlier pubertal growth spurt in females which may influence their sella measurements.

The Genetic factors it is most likely play a leading role in male-female growth differences. The marked advancement of girls over boys in the rate of maturation is attributed to the delaying action of the Y chromosome in males. By delaying growth, the Y chromosome allows males to grow over a longer period of time than females, therefore making possible greater overall growth [21].

On the other hand, non significant gender mean difference was found concerning the sella length in class I. This may be attributed to a greater pubertal growth influence on the vertical than on the anteroposterior (Sella length) dimension. In comparing the subjects' linear dimensions of sella turcica with normative data from the literature, the former result was in agreement with Alkofide [1] and Yassir et al.[10], while the latter result was in agreement with Silverman [15], Chilton et al [22], and Elster et al.[23] who revealed that the pituitary fossa of females tended to be smaller than that of females during childhood. After that, due to the pubertal growth spurt in males which begins 2 years later than females, a significant change in pituitary fossa size occurs in females from 11 to 14 years of age. Thereafter, the late growth acceleration in males, which is usually about 2 years later than females, results in an approximate equalization in sella area in both genders.

On the other hand, by comparing sella measurements among the skeletal classes, it was found that the sella depth was significantly higher in class I than in class II (Table 1). This finding may be attributed to genetically determined growth factors. According to this study result, the linear measurements of sella turcica cannot be obtained for each specific skeletal class throughout the pubertal period.

In comparison with adult studies Meyer-Marcotty [6], Yassir et al [10], and Al-Ani[11], it could be demonstrated that the

diameter, depth, and length of the sella turcica region of all examined patients in this study tended to be smaller, a finding that confirms the effect of age on sella measurements.

All the research that concerning the sella turcica have not only focused on size, but also on morphology [1, 2, 6, 10, 11, 17, 18, 24-26]. No previous studies concerning sella morphology have mentioned the gender difference in each skeletal class separately during pubertal period alone, rather previous studies have either compared between males and females as a total sample (Yassir et al [10]; Haritha et al [27] and Axelsson et al [7,18]) or they compared between the classes (as a total in each class) without giving gender difference (Meyer-Marcotty et al [6]; Yassir et al [10]; Abdel-Kader [28]. Furthermore, these studies used the frequency and percentage as a baseline for comparison, i.e. descriptive statistics only, and they did not use inferential statistical analyses between genders and among the classes.

Normal sella turcica was the predominant shape over the other morphological variations in all skeletal classes in both genders (Table 2). This predominance can be attributed to growth and development basis. Sella turcica is expected to become oval to more round (i.e. normal) with craniofacial growth progression. This is true if we follow the normal growth and development of sella turcica, as it appears as a shallow-like depression at the fetal stage, while as the growth of the cranium proceeds it becomes slightly oval to round at the permanent dentition stage (at adolescence). This result comes to be in agreement with (Alkofide [1]; Yassir et al. [10]; Al-Ani [11]; Axelsson et al. [17,18] and Haritha et al. [27]) their results demonstrated that a normal sella turcica morphology was seen in two-thirds of the subjects, while the remainder subjects showed dys-morphological appearances.

Any deviation from the above mentioned sella growth and development map can account for the occurrence of these less frequently occurred shapes. Statistically,

only in class III, Likelihood Ratio test showed significant difference between males and females for the different shapes of sella turcica. Skeletal class III can be considered as a type of craniofacial deviation in which growth pattern is abnormal. Furthermore, greater percentage of males are affected by this type of malocclusion than females. So, if we consider morphological sellar aberrations as a deviation from the normal development of sella turcica, abnormal sella may occur more frequently in this class and mostly in males.

The predominance of non significant sella morphology differences between genders enabled dealing with the subjects as a total sample within each skeletal class. Although multiple comparisons were made among the classes, a significant difference only was present between class II and III (table 3). Genetically determined growth factors may have a role. Development and Formation of the sella turcica and dental structures commonly share the involvement of neural crest cells. Actually, the anterior part of the sella turcica is believed to develop from neural crest cells mainly, [29,30] so any structural deviations in the anterior wall are believed to be associated with considerable deviations in the facial skeleton [31]. Moreover, During embryological development stage, the sella turcica area is a key point for the migration of the neural crest cells to the frontonasal processes and maxillary developmental fields [8].

The majority of normal sella turcica appeared to be present in skeletal class I followed by class III and then by class II. This may be attributed to structural adaptation phenomenon. The sella turcica structural development is influenced by growth and development of the surrounding structures (i.e. anterior and posterior cranial bases, brain, and nasomaxillary complex). Normal and harmonious growth behavior of these structures would result in a normal sella shape, while any deviation from this harmonious growth might lead to sella turcica morphological aberrations which occurred mostly in class III.

Conclusions

- 1- During puberty, specific sella turcica dimensions for each skeletal class cannot be obtained.
- 2-Normal sella was the predominant shape over the other morphological aberrations which occurred less frequently in all skeletal classes.
- 3- No gender differences were found in sella size and shapes in all skeletal classes; except in class I group, a difference was found in sella depth and diameter.

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Table 1: Descriptive and Inferential Statistics for Sella measurements in (mms).

sk. class	Sella length					Sella depth					Sella diameter				
	Sex	<i>n</i>	Mean	SD	P.value	sex	<i>N</i>	Mean	SD	P.value	sex	<i>N</i>	Mean	SD	P.value
cl. I	♂	13	6.94	1.8	.39 (NS)	♂	13	6.26	0.8	.001** (HS)	♂	13	9.11	1.57	.006** (HS)
	♀	16	6.54	1.33		♀	16	7.52	1.25		♀	16	10.3	1.2	
	total	29	6.64	1.46		total	29	7.2	1.27		total	29	10.0	1.39	
cl. II	♂	15	7.08	1.69	.7 (NS)	♂	15	6.7	1.06	.36 (NS)	♂	15	9.5	1.33	.48 (NS)
	♀	17	6.88	1.5		♀	17	6.34	1.37		♀	17	9.79	1.27	
	total	32	6.98	1.58		total	32	6.52	1.22		total	32	9.64	1.29	
cl. III	♂	16	6.64	2.08	.3 (NS)	♂	16	6.41	1.25	.26 (NS)	♂	16	9.17	1.57	.1 (NS)
	♀	14	7.17	1.45		♀	14	6.9	1.47		♀	14	9.92	1.42	
	total	30	6.99	1.67		total	30	6.74	1.41		total	30	9.68	1.5	
ANOVA			0.46 (NS)			ANOVA			0.041*		ANOVA			0.37 (NS)	

Variable	Class I- Class II		Class I- Class III		Class II- Class III	
	Mean difference	P-value	Mean difference	P-value	Mean difference	P-value
Sella depth	0.68	0.015*	0.46	0.08 (NS)	-0.22	0.44 (NS)

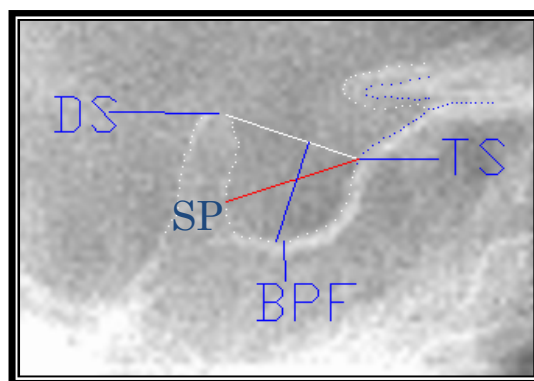
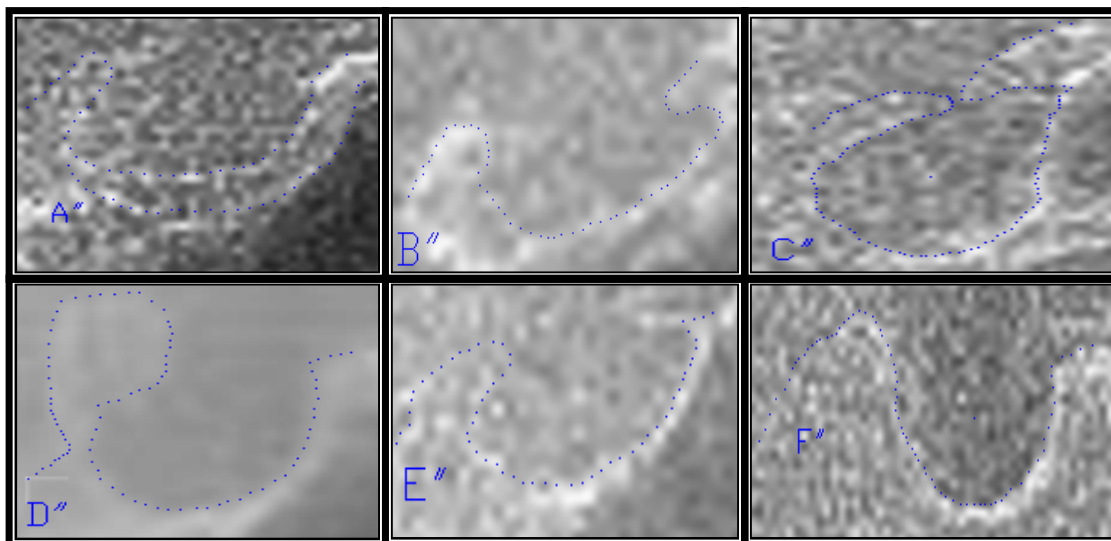
Table 2: Number distribution and percentage of Sella shape in skeletal classes with gender difference

S.shape	Class I (n=29)					Class II (n=32)					Class III (n=30)				
	Male		female		p-value	Male		Female		p-value	Male		Female		p-value
	n	%	n	%		n	%	n	%		n	%	n	%	
Normal	9	69.2%	10	62.5%	0.194	9	60%	11	64.8%	0.429	8	50%	8	57.2%	0.035
Oblique	1	7.7%	1	6.25%		2	13.3%	2	11.7%		2	12.5%	0	0.0%	
Bridge	2	15.4%	1	6.25%	significance	3	20%	2	11.7%	significance	3	18.75%	1	7.1%	significance
Notching	0	0.0%	2	12.5%		0	0.0%	1	5.9%		1	6.25%	2	14.3%	
Double	0	0.0%	1	6.25%		0	0.0%	0	0.0%		0	0.0%	1	7.1%	
Pyramidal	1	7.7%	1	6.25%		0	0.0%	0	0.0%		1	6.25%	2	14.3%	
Low	0	0.0%	0	0.0%		1	6.7%	1	5.9%		1	6.25%	0	0.0%	
Total	13	100%	16	100%	NS	15	100%	17	100%	NS	16	100%	14	100%	S

Table 3: Number distribution and percentage of Sella shape for total sample with shape difference among skeletal classes.

Sella shape	Skeletal class						Shape difference			C. S
	Class I		Class II		Class III					
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%				
Normal	19	65.5%	20	62.5%	16	53.3%	Cl. I- II	P-value	0.205	N S
Oblique	2	6.9%	4	12.5%	2	6.7%				
Bridge	3	10.3%	5	15.6%	4	13.4%				
Notching	2	6.9%	1	3.1%	3	10.0%	Cl. I- III	P-value	0.162	N S
Double	1	3.5%	0	0.0%	1	3.3%				
Pyramidal	2	6.9%	0	0.0%	3	10.0%	Cl. II- III	P-value	0.048*	S
Low	0	0.0%	2	6.3%	1	3.3%				
Total	29	100%	32	100%	30	100%				

NS = $P > 0.05$ Non significant. * = $0.05 \geq P > 0.01$ Significant. ** = $P \leq 0.01$ highly significant.

**Figure 1:** Normal sella turcica morphology and reference lines used for measuring sella size. TS, tuberculum sella; DS, dorsum sella; BPF, base of the pituitary fossa; SP, sella posterior; white line, length of sella; red line, diameter of sella; blue line, depth of sella.**Figure 2:** Tracings and details from lateral cephalograms of the different morphological types of sella turcica: (A) Double contour of the floor, (B) extremely low sella turcica, (C) Sella turcica bridging, (D) Irregularity (notching) in the posterior part of the dorsum sellae (E) oblique anterior wall and (F) Pyramidal shape of the dorsum sellae.