

SHAPE AND DIMENSIONS OF SELLA TURCICA IN CLEFT AND NON-CLEFT PALATE SUBJECTS A RADIOGRAPHIC STUDY

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ABSTRACT

Introduction: The Sella turcica is a significant anatomical structure because the Sella point, S, is one of the most used landmarks in cephalometries. It is located at the center of the Sella turcica. In healthy individuals, the surface area of the Sella turcica varies from 18-115 mm in females and from 22-122 mm² in males. The shape of Sella turcica is usually oval but round and flat types can also occur. **Aim:** This study aimed to describe and compare the shape and dimensions of Sella turcica in cleft and non-cleft palate subjects. **Materials and methods:** Cone beam computed tomography of 80 individuals (40 normal and 40 clefts) with age range 12-30 years were collected and analyzed. The linear measurements of length, depth, and diameter were measured and compared between both groups. **Results:** The Sella turcica normally appeared in the majority of subjects 61.5% in non-cleft subjects while in cleft group was 40%, the oblique anterior wall in the non-cleft was found to be 19%, and in cleft left 17%. Regarding notching in the posterior wall was found 9% in non-cleft and 14% in cleft group, and bridging was found to be 7% in non-cleft group and 16% in cleft group. In the non-cleft group pyramidal Sella turcica was 3.5% while in cleft double contour of the floor was seen in 13%. For linear measurements length, depth, and diameter of Sella turcica showed no significant differences between non cleft and cleft groups. **Conclusion:** No significance differences in the size of Sella turcica were found regarding length, depth, and diameter of Sella turcica of cleft CBCTs (Cone Beam Computed Tomography) when compared to those of non-cleft CBCTs. On comparing different cleft groups to each other there was only a significant increase in length for unilateral right complete cleft palate compared to other groups. No significance differences were found in comparing volume of Sella turcica between non cleft and cleft groups.

INTRODUCTION

The Sella turcica is an important saddle-shaped structure that houses the pituitary gland and located in the middle cranial fossa. The structure consists of anterior and posterior clinoid processes, the tuberculum Sella, and the pituitary fossa. The tuberculum Sella is the slight anterior elevation on the body of the sphenoid bone. The pituitary fossa is a saddle-like depression in the middle that holds the pituitary gland, and the dorsum Sella is formed by a square plate of bone on the body of the sphenoid⁽¹⁾.

Lip and palate clefts are considered the most prevalent craniofacial congenital anomaly. Some studies have been conducted on the causes of cleft, as well as on the development of craniofacial structures in people with clefts ⁽²⁾.

The benefits gained from studying these structures range from assisting the orthodontist during diagnosis, as a tool to study growth in an individual. Lip and palate clefts are considered the most prevalent craniofacial congenital anomaly ⁽³⁾. Therefore, this study aimed to evaluate Sella turcica size and morphology in both cleft and non-cleft subjects.

MATERIALS AND METHODS

Sample size calculation:

Sample size was calculated using the equation:

$$n = 2 \left[\frac{\left(\frac{Z\alpha}{2} + Z\beta \right) * \alpha}{\mu_1 - \mu_2} \right]^2$$

Where: n = sample size, $Z\alpha/2 = 1.96$ (the critical value that divides the central 95% of the Z distribution from the 5% in the tail)

$Z\beta = 0.84$ (the critical value that separates the lower 20% of the Z distribution from the upper 80%)

α = the estimate of the standard deviation of the Sella turcica.

μ_1 = mean in group 1, μ_2 = mean in group 2 = 19391.3

This study included 80 CBCT scans divided into 40 CBCT of normal subjects seeking orthodontic treatment and 40 CBCT of complete cleft palate.

The cleft palate group was classified into 25 bilateral complete cleft palate, 10 unilateral complete left cleft and 5 unilateral right complete cleft.

All CBCT scans were taken with Soredex SCANORA 3D* present in the Radiology Department, Suez Canal University. All scans were taken with standard protocol where each patient was seated with his or her Frankfort horizontal plane parallel to the floor. The CBCT device was set to 90 KVP/4-12.5mA with exposure time 2.4-6 seconds for all the patients.

This study was approved by the Research Ethical Committee number (66/2017), Faculty of Dentistry, Suez Canal University.

Inclusion criteria: CBCT radiographs of patients in the age group of 12-30 years old. /- Full skull CBCT radiographs where the Sella turcica area appeared clearly /-CBCT of patients had complete cleft palate.

Exclusion criteria: Any congenital defect rather than cleft palate in cleft palate group. /- any radiographic error. / -Those who had incomplete clefts. /-The individuals whose radiographs were not clear for interpretation.

The CBCT radiographs were divided into two main groups:

Group 1: non cleft CBCT, and **Group 2:** cleft CBCT, and subdivided into: **Group 2a:** bilateral complete cleft CBCT, **Group 2b:** unilateral left complete cleft CBCT, and **Group 2c:** unilateral right complete cleft CBCT.

Shape and morphological appearance of Sella turcica were assessed according to the method described by Axelsson et al.⁽⁴⁾ as the five morphological variations described: oblique anterior wall, bridging of Sella turcica, double contour of the

floor, irregular surface (notch-like depression) in the posterior aspect of the dorsum Sella, and pyramid shape of dorsal Sella (fig.1) Distance from the tip of the dorsum Sella (DS) to the tuberculum Sella (TS) was measured and defined as the length (L) of Sella. The perpendicular drawn through the above-defined line towards the floor of Sella was measured and

defined as the depth (D) of the Sella turcica. The third line was drawn from the tuberculum Sella to the point which is furthest located on the posterior inner wall of the fossa, and this was measured as the anteroposterior diameter (APD) of the Sella (fig.2 and fig.3).

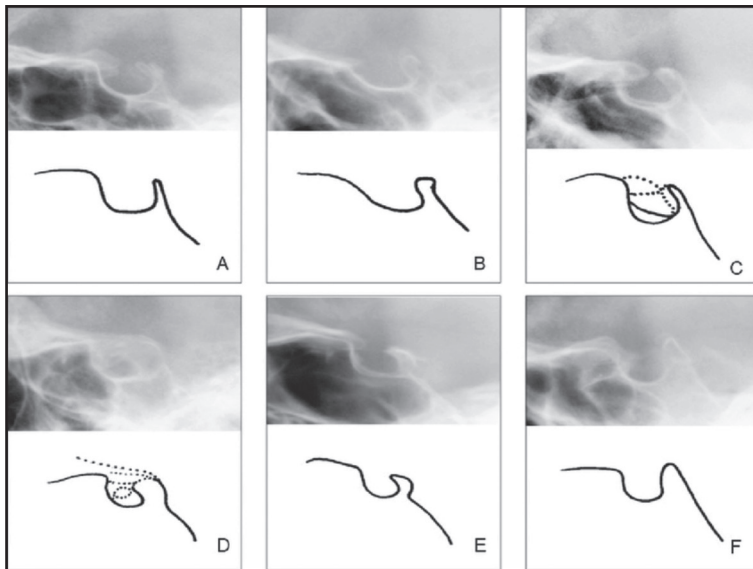


Fig. (1) Morphological variations of Sella turcica: (A) normal Sella turcica, (B) oblique anterior wall, (C) double contour of the floor, (D) Sella turcica bridge, (E) irregularity in posterior wall of Sella turcica, (F) pyramidal shape of dorsum Sellae. [Axelsson 2004]⁽⁶⁾

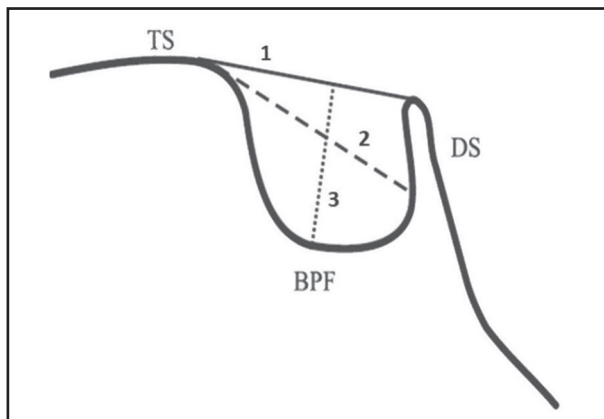


Fig. (2) The Sella turcica length (1), diameter (2) and depth (3); TS — tuberculum Sella; DS — dorsum Sella; BPF — base of pituitary fossa

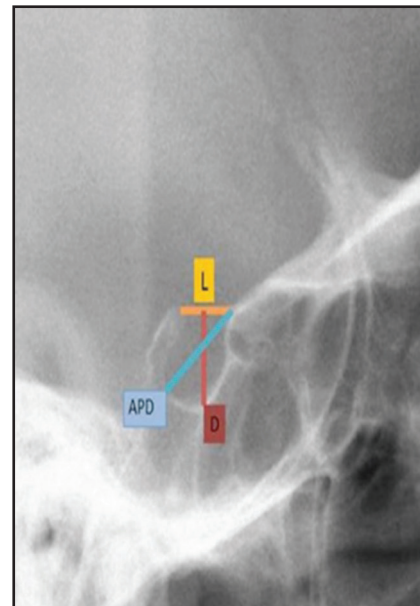


Fig. (3) Showing linear measurements of Sella turcica. L-Length, D-Depth, APD-Anteroposterior diameter

Statistical analyses:

Sample size was calculated using Microsoft office bundle and IBM SPSS (Statistical Package for Social Sciences) of IBM version 23.

Using pass program, setting alpha error at 5% and power at 80 %, result from previous study (Yasa, et al)⁽⁵⁾, showed that the length of Sella turcica in case group was 10.8 ±1.84 while for control group was 9.87±1.47, Based on this, the needed sample size was 40 cases and 40 controls.

RESULTS

1) Regarding the shape of Sella turcica:

The various morphological appearances of Sella turcica in cleft subjects and non-cleft subjects were evaluated in this study. For non- cleft group a higher percentage of normally shaped Sella turcica was present more often 61.5% (upper contour of anterior wall of Sella turcica appears to be perpendicular to the floor), while in cleft groups it was seen only in 40 %. While the oblique anterior wall in non-cleft found to be 19%, and in cleft it was 17%. Regarding irregularity in the posterior wall (notching) it was found in 9%, while it was 14% in cleft group. Sella turcica bridging was found to be 7% in non-cleft group and 16% in cleft group.

In non-cleft group the pyramidal shaped Sella turcica was found in 3.5 %, while in cleft group double contour of the floor was seen in 13%. The presence of more than one aberration in the Sella turcica (more than one feature) was found in subjects with bilateral complete cleft palate only 5.5% as shown in table (1).

Table 2 showed:

Non-significant difference in the mean length, the mean depth, and the mean diameter in mm between cleft and non-cleft palate groups.

Also, non-significant decrease in the mean volume of Sella turcica between cleft and non-cleft palate groups.

Table (3) showed:

Complete cleft palate 7.12mm (± 1.18) Group 2a showed a non-significant decrease in the mean length compared to group 2b [7.8mm (± 1.4)] and significant decrease to group 2c [9.2mm (±1.2)], regarding The depth of Sella turcica in mm for different cleft groups: a non-significant increase between cleft groups measured group 2a (bilateral complete cleft) 7.3 mm (±0.6), group 2b (unilateral left complete cleft) 7.1mm (±0.7) and group 2c (unilateral right complete cleft) 7.6 mm (±0.6),also table (2) cleared that non-significant decrease in the mean diameter between cleft groups measured group 2a (bilateral complete cleft) 11.2 mm (±1.5), group 2b (unilateral left complete cleft) 11.9mm (±1.8) and group 2c (unilateral right complete cleft) 11.6 mm (±0.9)

Non-significant decrease in the mean volume between cleft groups as group 2a (bilateral complete cleft) 626.6 mm³ (± 70.8), group 2b (unilateral left complete cleft) 658.2 mm³ (± 47.7) and group 2c (unilateral right complete cleft) 661.6 mm³ (± 56.6).

Table (1) Showed morphological variations of Sella turcica in cleft and non-cleft palate groups:

Shape of Sella turcica	Cleft group	Non-cleft group
Normal	40%	61.5%
Oblique anterior wall	17%	19%
Bridging	16%	7%
Notching in posterior wall	14%	9%
Double contour of the floor	13%	-
Pyramidal shaped	-	3.5%

Table (2) Showing the dimensions of Sella turcica in cleft and non-cleft palate groups:

Groups	Group 1 (non-cleft palate)	Group 2 (Cleft palate group)	Significance
Mean length of Sella turcica in mm	10.2 mm (\pm 1.38)	8.11mm (\pm 1.99)	P > 0.05 NS
Mean depth of Sella turcica in mm	10.3mm (\pm 1.39)	7.79 mm (\pm 2.1)	P > 0.05 NS
Mean diameter of Sella turcica in mm	14.25mm (\pm 1.7)	11.6 mm (\pm 1.58)	P > 0.05 NS
Mean volume of Sella turcica	1268.64 mm ³ (\pm 70.7)	1093mm ³ (\pm 43.6)	P > 0.05 NS

Values are means \pm SD NS: non significance P < 0.05 \rightarrow significant (S)

P > 0.05 \rightarrow non-significant (NS) P < 0.001 \rightarrow highly significant (HS).

Data evaluated using the One-way analysis of variance test (ANOVA).

Table (3) Showing comparison between different cleft groups:

Groups	Group 2a (Complete cleft palate)	Group 2b (Unilateral left complete cleft)	Group 2c (Unilateral right complete cleft)
Mean length of Sella turcica in mm	7.12mm (\pm 1.18)	7.8 mm (\pm 1.4)	9.2 mm (\pm 1.2)
Significance	P > 0.05 NS	P > 0.05 NS	P < 0.05 S
Mean depth of Sella turcica in mm	7.3 mm (\pm 0.6)	7.1 mm (\pm 0.7)	7.6 mm (\pm 0.6)
Significance	P > 0.05 NS	P > 0.05 NS	P > 0.05 NS
Mean diameter of Sella	11.2mm (\pm 1.5)	11.9mm (\pm 1.8)	11.6mm (\pm 0.9)
Significance	P > 0.05 NS	P > 0.05 NS	P > 0.05 NS
Mean volume of Sella turcica in mm	626.6 mm ³ (\pm 70.8)	658.2 mm ³ (\pm 47.7)	661.6mm ³ (\pm 56.6)
Significance	P > 0.05 NS	P > 0.05 NS	P > 0.05 NS

Values are means \pm SD

S: significant

NS: non significance

P < 0.05 \rightarrow significant (S), P > 0.05 \rightarrow non-significant (NS), P < 0.001 \rightarrow highly significant (HS).

Data evaluated using the One-way analysis of variance test (ANOVA).

DISCUSSION

The bony structure at which the pituitary gland harbored is the Sella turcica. This gland is fundamental because it maintains several functions in the body such as growth, metabolism, production of corticoids, menstruation, ovulation, production of sperms and production of maternal milk, any abnormality in size and/or shape of pituitary gland will be reflected on its surrounding bony structure⁽¹⁾.

Cleft palate is the most common congenital anomaly, occurring due to lack of fusion between lateral palatine processes, leading to wide range of disorders such as neonatal feeding disorders, eating disorders, language disorders, maxillary undergrowth, dental deficiencies, and malocclusion⁽²⁾.

Shape and dimensions of Sella turcica was focused on by this study through describing needs a reference morphological variation to understand the role of the pituitary gland and its Sella turcica housing and the relation whether found or not between cleft and the Sella turcica⁽³⁾.

Shape of Sella turcica:

Clinical significance for evaluation Sella turcica morphology is to obtain additional diagnostic information related to pathology of pituitary gland as deviation in the development of the pituitary gland may lead to a deviation in the morphology of the Sella turcica⁽⁴⁾.

Normal anatomy and variations in morphology of Sella turcica should be acquired by clinicians. For determination, the morphological variations of Sella turcica in this study, the different morphological appearances of Sella turcica described by Axelsson⁽⁴⁾ were used and compared to 80 CBCTs used in this study. Results obtained in this study for cleft and non-cleft groups shown in table (1).

This study revealed a higher percentage of normally shaped Sella turcica among the non-cleft group was found 61.5% while in non-cleft group was 39%, agreeing with a study made by Alkofide⁽⁶⁾ who figured out that more morphological variations of Sella turcica found in cleft lip and palate in most of patients such as double contour of the floor and irregular posterior wall with smaller Sella turcica size.

A study done by Alam et al.⁽⁷⁾ showed that Sella turcica bridging is higher in cleft subjects with significance morphometric variations when compared to non-cleft subjects, and Sinha et al.⁽⁸⁾ cleared that most of the cleft group had bridging of Sella turcica followed by irregular dorsum Sella which was seen in 26% of the individuals, followed by oblique anterior wall Sella (14.67%) and pyramidal shaped Sella (11.33%). The results obtained in this study is in close approximation to a study done by Yasa et al.⁽⁹⁾ so that the morphological features were significantly different between cleft and non-cleft group.

Also, this agrees with Nielsen et al.⁽¹⁰⁾ who conducted a study on radiographs of 40 newborns with cleft lip and palate and concluded that approximately half of the newborns had deviations in Sella turcica morphology, with the most severe deviations occurring in unilateral cleft lip and palate subjects.

Linear measurements of Sella turcica:

Linear measurements of Sella turcica evaluated in this study were on agreement with the study made by Akay et al.⁽²⁾ at which the differences in depth, length, and diameter of the Sella turcica between cleft patients and non-cleft individuals were non-significant, with a significant difference found in the interclinoid distance only.

On the other hand, using cephalometric radiographs, Alkofide⁽⁶⁾, Sinha et al.⁽⁸⁾, and Sundareswaran et al.⁽¹⁰⁾ showed that all dimensions of the Sella turcica were significantly smaller in cleft patients than in non-cleft individuals. Another study concerned with cone-beam computed tomography done by Paknahad et al.⁽¹¹⁾ showed that all linear dimensions of the Sella turcica were significantly smaller in patients with cleft than in healthy individuals. On the contrary, Yasa et al.⁽⁹⁾ concluded using CBCT images that the Sella turcica length was significantly higher in patients with cleft compared to non-cleft individuals. In the CBCT study by Yalcin⁽¹¹⁾, only the Sella turcica diameter was significantly lower in cleft lip and palate patients than in the healthy control group.

The discrepancy between the results of studies may be due to different age distributions and methodological differences (two-dimensional imaging techniques). Because Paknahad et al.⁽¹²⁾ evaluated the dimension of the Sella turcica in cleft patients in an older age group. Whereas Yasa et al.⁽⁹⁾ and Yalcin⁽¹¹⁾ examined a younger age group. It has been reported that the dimensions and morphology of the Sella turcica do not alter significantly after 12 years of age. Therefore, individuals over 12 years old were included in this study. The limitations of this study were a small sample size and non-homogeneous age distribution.

Volume of Sella turcica: non-significant decrease was found among non-cleft group and cleft group. Also, between different cleft palate groups.

RECOMMENDATION

Further studies using 3D investigation of Sella turcica morphology with a larger sample size and homogeneous age distribution could be useful.

CONCLUSION

Sella turcica morphology was abnormal in most cleft cases in comparison to non-cleft CBCTs. No significance differences in the size of Sella turcica were found regarding length, depth, and diameter of Sella turcica of cleft CBCTs when compared to those of non-cleft CBCTs.

While comparing different cleft groups to each other, there was a significant increase in length for unilateral right complete cleft palate group compared to other cleft groups. No significance differences among different cleft groups in relation to linear measurements of Sella turcica which are depth and diameter.

No significance differences were found in comparing volume of Sella turcica between non-cleft and cleft groups.

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