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Original Research

Evaluation of Sella Turcica and Maxilla Morphometry of Individuals with Cleft Lip and Palate on Lateral Cephalometric Radiographs

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ABSTRACT

Objective: The objective of this study was to evaluate the dimensions and the morphology of the sella turcica, as well as maxillary cephalometric landmarks, in patients with and without clefts.

Methods: Lateral cephalometric radiographs of 55 cleft patients and 55 non-cleft (control) patients were included in the study. The morphology of the sella turcica, including its shape, height, width, and diameter was evaluated. Additionally, maxillary cephalometric measurements, comprising four lengths and two angles, were assessed on the radiographs. The chi-squared test was employed to compare sella turcica shapes between the cleft and non-cleft groups. Independent samples t-tests were conducted to analyze dimensional parameters between groups and genders.

Results: Significant relationship was found between groups with cleft and non-cleft for sella shapes ($p=0.032$). There was no statistical association for sella dimensions according to the cleft presence ($p>0.05$). All maxillary cephalometric measurements were significantly greater in individuals of the non-cleft group compared to those in the cleft group (ANS-PNS, A-PNS, S-N-ANS , S-N-A, N-A) except R-PNS.

Conclusion: Patients with clefts more frequently exhibited a flattened sella shape, whereas those without clefts tended to have a round sella shape. Maxillary cephalometric dimensions were lower in the individuals of cleft group.

Keywords: Cleft lip; cleft palate; lateral cephalometric radiography; maxilla

INTRODUCTION

Cleft lip and palate (CLP), a widespread developmental malformation, affecting the craniofacial region [1]. Significant ethnic differences exist in the incidence of CLP, the reported range changes between 1/700 and 1/1000 [2]. Although the etiology of CLP is not known exactly, it is known that many cases are multifactorial [1].

Embryonic development entails intricate interactions among the oral cavity, hypothalamus, and pituitary gland. Any abnormalities during the development of these structures can lead to anatomical and functional disorders [3]. The sella turcica has a shape resembling a saddle, located on the sphenoid bone body and hosts the pituitary gland [3, 4]. The pituitary gland develops prior to the

formation of the sella turcica, so any abnormalities in pituitary gland development could influence the size and morphology of the sella turcica [1,5]. Literature shows some differences in shape and size of the sella in the presence of pathologies, syndromes and anomalies associated with the craniofacial region [1,5-9]. The presence of CLP has been determined to cause abnormal and/or smaller sella turcica [1,3,8-9].

CLP influences the craniofacial development in many different ways as developmental defects, secondary functional disturbances, and iatrogenic factors secondary to surgical treatment [10]. Iatrogenic outcomes such as surgical technique, time of performing the surgery, approach and experience of the surgeon affect maxillary growth to some extent. However, significant interindividual differences were observed in a group of patients operated on by a single surgeon, minimizing iatrogenic variations. This implies that individual-specific intrinsic factors can have a notable impact on maxillary growth potential. Because maxillary growth potential is influenced by multiple factors, ongoing research continues to explore the causes of maxillary hypoplasia and associated occlusion disorders [6,11].

The lateral cephalometric radiographs provide imaging and evaluation of many oral and craniofacial structures. Cephalometric radioraphy is still frequently used in cleft patients [4,12]. In these images, which are already taken for diagnostic reasons, the sella turcica region is visible. Significant changes in both the morphology and dimesion of the sella turcica can be demonstrated on lateral cephalometric radiographs [4,6]. At the same time, lateral cephalometric radiographs are considered clinically valuable to identify growth predictors [12].

Main Points

- CLP influences the craniofacial region in many different ways.
- Cleft presence does not affect the sella dimensions but causes a decrease in maxillary dimensions.
- Maxillary dimensions are lower in cleft group compared to non-cleft group.
- Flattened sella was most common in cleft group, and round sella was most common in non-cleft group.

The objective of the present study was to compare the sella turcica morphology, sella turcica dimensions and maxillary cephalometric dimensions between individuals with nonsyndromic cleft and non-cleft counterparts by using lateral cephalometric radiographs. The null hypothesis of this research proposed that there would be no difference in the morphology and dimensions of the sella turcica, as well as in maxillary cephalometric measurements, between cleft and non-cleft patient groups.

MATERIALS AND METHODS

Ethics committee approval of the study was obtained from the Non-Interventional Ethics Committee of Selcuk University Faculty of Dentistry. (Approval No: 2022/41).

Sample Size Estimation

The sample size of the study was assigned using G*Power (v. 3.1.9.7). Sample size for the independent samples t-test was calculated according to the Cohen's medium effect size (d=0.5) as a minimum 51 individiuals in each group with %80 power and %95 confidence interval (α=0.05). Considering the possibility of data loss, the number of samples for the groups was set to 55.

Study Design

Our retrospective study was conducted on 55 non-syndromic cleft and 55 non-cleft patients, aged 9-24 years, who applied to Selcuk University Department of Orthodontics for diagnosis and treatment. Our study was carried out on radiographs that were taken with the same device (Planmeca ProMax 2D, Planmeca Oy, Helsinki, Finlandiya) in accordance with standard lateral cephalometric radiograph taking rules. The cephalostat also had a reference ruler thus magnification could be measured. All sella turcica and maxillary cephalometric measurements on radiographic images were made with ImageJ (1.52a) (a publicly available software for image analysis). The radiographs of the patients whose anamnesis revealed any surgical intervention in the maxillofacial and pituitary region, syndrome and systemic disease related to the craniofacial region except cleft lip and palate, orthodontic treatment history, hormonal drug usage, and any disease or trauma affecting the craniofacial region were exclusion criteria for the study. Inclusion criteria included images with adequate image quality and no artifacts that would affect the evaluation.

Sella Turcica Dimensional Measurements and Morphology

Size of the sella turcica (length, depth, and diameter) was measured according to method of Silverman [13]. The length was determined as the distance between tuberculum sella and tip of dorsum sella and the depth was measured perpendicular to this line to the deepest point of sellar floor. The diameter of the sella turcica was evaluated as the distance from tuberculum sella to a point on the posterior inner wall of the fossa located at the farthest point from the tuberculum sella [1, 4]. All measurements were converted to milimeter (mm) according to the reference ruler. Morphologies of sella turcica were evaluated by using the method described by Camp [14] (Figure 1). A maxillofacial radiologist with 11 years of experience peformed all the measurements and an orthodontist with 19 years of experience evaluated the morphology of sella turcica seperately.

Maxillary Cephalometric Measurements;

Six lateral cephalometric structures were identified (Sella (S), nasion (N), registration point (R), anterior nasal spine (ANS), posterior nasal spine (PNS) and cephalometric A point (A). Four length and two angle measurements were made over these anatomical structures (Figure 2).

Statistical Analysis;

SPSS 22.0 was used for all statistical analyses. The distribution of data by groups and gender was analyzed with descriptive statistics. Interobserver reliability was calculated by using kappa (κ) statistics. Shapiro-wilk test was used to test the normality of data. A chi-squared test was applied to determine the relationship between cleft presence and sella morphology. To analyze the difference between cleft group and non-cleft group in terms

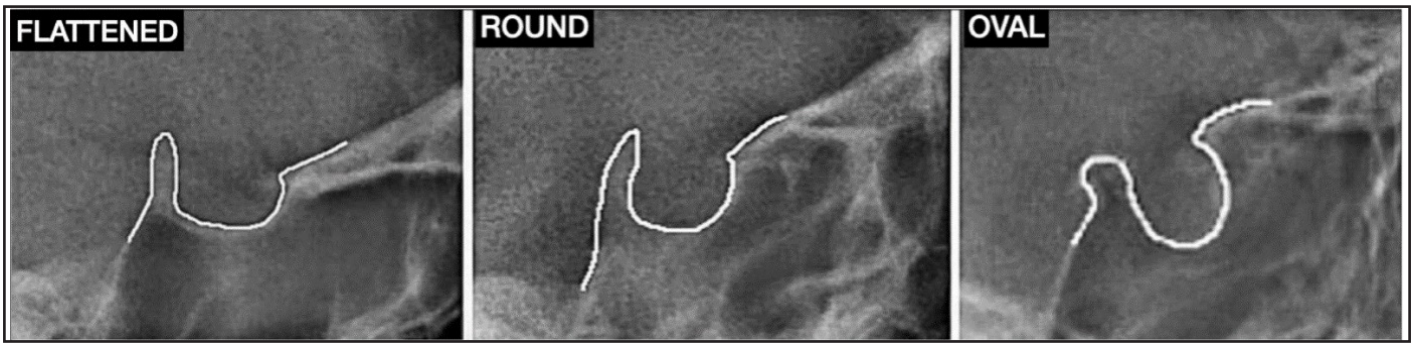

Figure 1. The basic classification method of sella turcica morphology as flattened, round and oval.

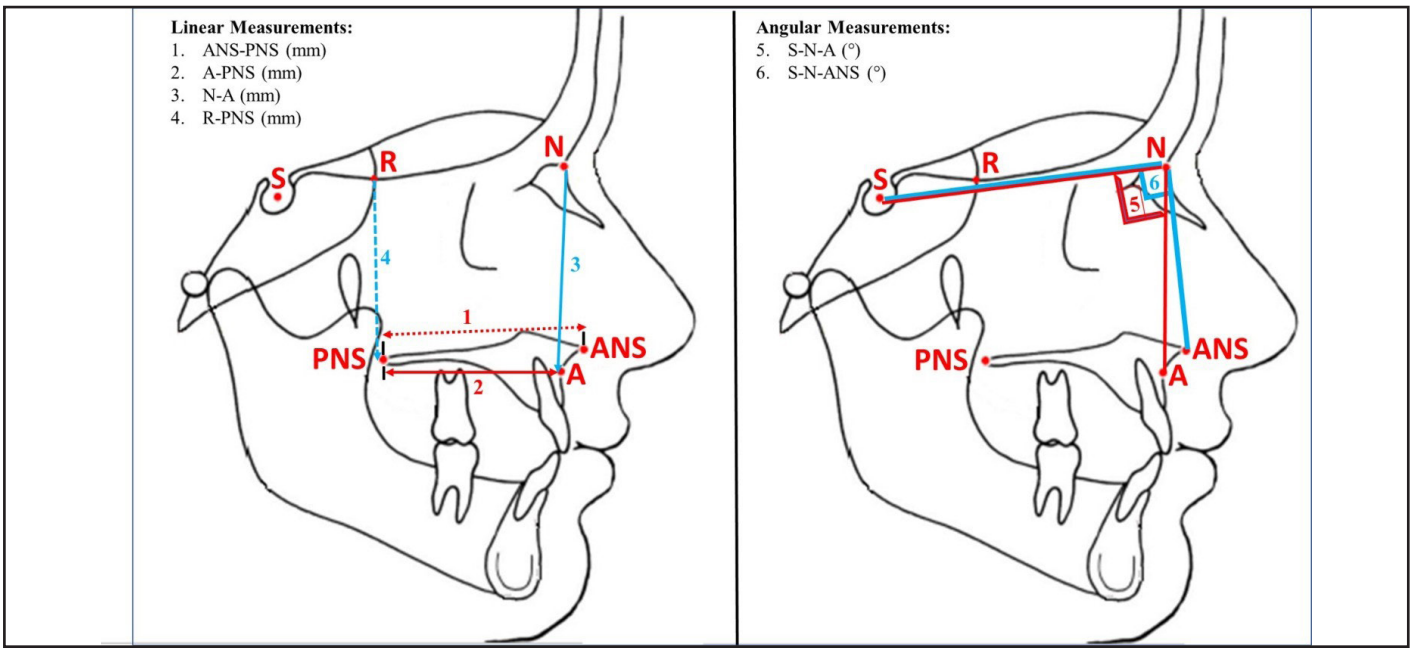

Figure 2. Tracing of a lateral cephalometic radiography showing landmarks and measurements.

of sella turcica and maxillary cephalometric measurements independent sample t-test was used.

RESULTS

The average age of patients with cleft palate was 14.53 years (±3.99), while for the non-cleft group it was 13.93 years (±2.97). Among the participants, 61 (55.5%) were under 15 years old, and 49 (44.5%) were 15 years or older. Demographic data of the patients are shown in Table 1.

There was a very high agreement between the two observers in the evaluation of sella tucica morphologies (κ-value=0.945). The different observations were re-evaluated by the two observers and the final decision was made. The predominant sella shape in the non-cleft group was round, whereas in the cleft group, it was flattened. The difference in sella shapes between the groups was statistically significant (p=0.032). The distribution of the sella shapes according to the cleft presence was seen in Table 2. The shapes of the sella turcica based on gender in both groups are given in Table 3 and there was no statistical difference between the genders for both groups (p>0.05).

When comparing the linear measurements of sella turcica no statistically significant difference was observed between cleft and non-cleft groups. When we compared the maxillary cephalometric measurements between the groups, it was seen that all dimensions were higher in the non-cleft group and this difference was statistically significant for all measurements except R-PNS (Table 4). The distribution of dimensional measurements in cleft and non-cleft groups according to gender and age groups is shown in Table 5.

Table 1. Demographic data of the patients.

		Cleft Presence		
		Non-cleft	**Cleft**	**Total**
Gender n (%)	**Female**	23 (20.9%)	37 (33.6%)	60 (54.5%)
	Male	32 (29.1%)	18 (16.4%)	50 (44.5%)
	Total	55 (50%)	55 (50%)	110 (100%)
Age	**Min.**	9	9	9
	Max.	19	24	24
	Mean±SD	13.93±2.97	14.53±3.99	14.23±3.51

Table 2. The distribution of different shapes of sella turcica in cleft and non-cleft groups.

	Cleft group n(%)	**Non-cleft group n(%)**	**p**
Round	29 (52.7%)	17 (30.9%)	0.032
Oval	7 (12.7%)	16 (29.1%)	
Flattened	19 (34.5%)	22 (40%)	
Total	55 (100%)	55 (100%)	

Table 3. The distribution of different shapes of sella turcica according to genders in the groups.

	Cleft group n (%)			**Non-cleft group n (%)**		
	Female	**Male**	**Total**	**Female**	**Male**	**Total**
Round	4 (7.3%)	13 (23.6%)	17 (30.9%)	19 (34.5%)	10 (18.2%)	29 (52.7%)
Oval	6 (10.9%)	10 (18.2%)	16 (29.1%)	2 (3.6%)	5 (9.1%)	7 (12.7%)
Flattened	8 (14.5%)	14 (25.5%)	22 (40%)	11 (20%)	8 (14.5%)	19 (34.5%)
Total	18 (32.7%)	37 (67.3%)	55 (100%)	32 (58.2%)	23 (41.8%)	55 (100%)
χ^2	0.622			0.206		

Table 4. Dimensions of the sella turcica and cephalometric landmarks according to the cleft presence. (Independent samples t test; p<0.05 is statisticallly significant)

	Cleft group n=55	Non-cleft group n=55	p
Diameter (mm)	8.41±1.86	8.36±1.68	0.897
Depth (mm)	7.53±1.88	7.35±1.59	0.598
Length (mm)	8.44±2.18	8.62±2.19	0.667
ANS-PNS (mm)	45.57±4.34	48.31±3.95	**0.001**
A-PNS (mm)	40.91±4.9	43.09±3.62	**0.009**
S-N-ANS (º)	82.32±4.8	84.96±3.59	**0.001**
S-N-A (º)	77.49±5.41	79.23±3.47	**0.047**
N-A (mm)	50.05±4.55	52.43±3.66	**0.003**
R-PNS (mm)	44.1±5.14	45.84±4.28	0.055

Table 5. Dimensions of the sella turcica and cephalometric landmarks in the subjects according to gender and age in cleft and non-cleft groups. (Independent samples t test; p<0.05 is statisticallly significant)

	Cleft group (mean±SD)			Non-cleft group (mean±SD)		
	Female n=18	**Male n=37**	**p**	**Female n=32**	**Male n=23**	**p**
Diameter (mm)	8.11±2.43	8.6±2.08	0.907	8.16±1.2	8.64±2.17	0.344
Depth (mm)	7.96±1.93	7.31±1.84	0.235	7.17±1.32	7.61±1.89	0.311
Length (mm)	8.44±1.79	8.38±1.93	0.441	8.17±1.66	9.24±2.68	0.098
ANS-PNS (mm)	45.48±3.47	45.61±4.76	0.918	47.47±3.18	49.48±4.66	0.062
A-PNS (mm)	40.88±4.58	40.93±5.11	0.976	42.18±2.81	44.35±4.28	**0.028**
S-N-ANS (º)	83.32±5.65	81.82±4.33	0.280	84.68±3.72	85.35±3.46	0.501
S-N-A (º)	78.38±6.37	77.06±4.93	0.400	78.81±3.59	79.82±3.29	0.292
N-A (mm)	49.27±3.27	50.43±5.06	0.379	52.43±3.35	52.41±4.12	0.987
R-PNS (mm)	42.26±3.19	44.99±5.69	0.064	45.14±2.9	46.82±5.6	0.195
	<15 n=29	**≥15 n=26**	**p**	**<15 n=23**	**≥15 n=32**	**p**
Diameter (mm)	8.05±2.01	8.81±1.62	0.132	7.92±1.73	8.99±1.39	**0.018**
Depth (mm)	7.19±1.75	7.9±1.98	0.161	6.89±1.38	8±1.65	**0.009**
Length (mm)	7.95±2.19	8.98±2.09	0.081	8.46±2.18	8.83±2.23	0.548
ANS-PNS (mm)	44.96±4.04	46.24±4.65	0.278	49.83±3.93	47.22±3.64	**0.014**
A-PNS (mm)	40.97±4.4	40.85±5.5	0.929	44.03±3.94	42.42±3.28	0.105
S-N-ANS (º)	83.1±4.96	81.44±4.56	0.205	84.61±3.59	85.45±3.62	0.394
S-N-A (º)	78.69±5.37	76.15±5.22	0.081	79.06±3.32	79.47±3.72	0.673
N-A (mm)	47.47±2.91	52.93±4.35	**0.000**	51.85±3.6	53.23±3.66	0.169
R-PNS (mm)	41.33±4.29	47.17±4.22	**0.000**	44.25±3.74	48.07±4.04	**0.001**

DISCUSSION

In this study the morphology, sella dimensions, and maxillary cephalometric measurements on lateral cephalometric images were assessed and compared between CLP patients and non-cleft patients. The present study results showed no significant difference in the sella dimensional measurements between cleft and non-cleft groups. In the literature, it is seen that there are different results in studies evaluating the interrelation between the cleft presence and the sella dimensions [1,3,8,15-21]. Yalcin [1] reported that, only the difference for length was statistically significant, dimensions of the sella turcica was smaller in the cleft group compared to non-cleft indviduals. On the contrary, Yasa et al [3] conducted larger depth, length and diameter for the sella turcica in cleft group according to the non-cleft group. Alike our results, Canıgür Bavbek et al [9] told that, the difference between the cleft and non-cleft groups was not statistically significant as to sella dimensions. Similar to this study, no statistically significant difference was found between the groups in our study. In a recent three-dimensional study conducted by El Tabakh et al [19] on cone beam computed tomography images, no relationship was found between sella dimensions and the presence of cleft. Van der Plas et al [22] analyzed the difference in pituitary volume between isolated cleft and non-cleft patients, and reported no significant difference in average pituitary volumes between groups. The significant differences between study results may be due to the study population size, imaging methods, age distribution and the study group's cleft phenotypes.

There were no gender-based differences observed in sella turcica dimensions within both groups like the studies of Yalcin [1], Yasa et al [3] and Shah et al [23]. Kumar and Govindraju [4] noticed that the sella length was higher in men, depth was higher in women and there was no difference in mean diameter in both genders.

In point of the age of the individuals although sella dimensions were not statistically significant in cleft group, depth and diameter was longer in patients ≥15 years of age in the non-cleft group. Similarly to our results, Yalcin [1], stated that diameter and depth of sella were found to be longer in the older non cleft age group. Yasa et al [3] conducted that the length of the sella turcica in the cleft group and the depth of the sella turcica in the non-cleft group are affected by age. In the general evaluation, it was observed that age increases the sella depth and diameter. Alkofide et al [8] found a significant increase in all sella turcica dimensions in both cleft and non-cleft subjects. Shresta et al [24] assessed the interrelation between sella dimensions and age, in the group of 18-30 years old individuals, and the authors found no statistically significant relation. Choi et al [25] deduced that the sella turcica size increase continues up to 25 years old and over the age of 26, no significant difference is seen. Considering all these findings, it is seen that age has an effect on the sella dimensions of non-cleft individuals.

According to our study, morphology of sella was evaluated according to the basic classification method (round, oval, flattened). Flattened sella turcica was more common in cleft group. In the studies by Yalcin [1] and Yasa et al [3], in which the shape of the sella turcica was evaluated with a similar classification method, they found that the flattened shape was more common in the cleft group, similar to our study. Since the objectivity and reproducibility of the morphological evaluations were controversial, the two observers were evaluated all radiographs separately and then the different ones were re-evaluated together.

Cleft also affects craniofacial development for different reasons such as intrinsic developmental deficiencies, functional distortions, and iatrogenic consequences [10]. According to the cephalometric studies spatial relationships between maxilla and mandible varies in children with and without cleft [10, 26]. In the present study, all ANS-PNS (mm), A-PNS (mm), S-N-ANS (°), S-N-A (°), N-A (mm) values were statistically higher in the non-cleft group. According to Khanna et al [10] observations reflect the posterior positioning of the premaxilla with respect to cranial base in surgically operated cleft patients. Similarly, in this study, the S-N-A measurement was significantly reduced in patients belonging to the cleft group. In a study it is reported that in all age groups of the study population S-N-ANS angle was decreased in un-operated cleft patients according to non-cleft group [27]. This has been interpreted as supporting the possibility of maxillary hypoplasia. In the same study, it was concluded that dimensional parameters related to facial height also varied between cleft and non-cleftgroups, and maxillary hypoplasia was observed even in the absence of surgical intervention [27].

The limitations of this study are that a two-dimensional imaging method was used, although it still maintains its importance in the orthodontic treatment process. Apart from this, the presence of clefts was not separated as unilateral and bilateral. It is thought that these subgroups to be formed in larger sample groups will contribute to the literature.

CONCLUSION

In our study on cephalometric radiographs, which are still indispensable in orthodontic diagnosis and treatment, it was shown that cleft did not affect the sellar dimensions, but caused a decrease in maxillary dimensions and maxillary hypoplasia. Also the study demonstrated flattened sella was most common in cleft group, and round sella was most common in non-cleft group.

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Author Contributions: Conception: Dİ - Design: Dİ, HK - Supervision: HK - Data Collection and/or Processing: Dİ, HK - Analysis and/or Interpretation: Dİ - Literature Review: Dİ, HK - Writing: Dİ- Critical Review: HK.

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