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CBCT evaluation of variations in the sella turcica in a Turkish population

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ABSTRACT

Background: The aim of the study was to analyze the variations of the sella turcica and their relationship to age and gender.

Materials and methods: The CBCT images of the patients who referred to Gaziantep University, Faculty of Dentistry, Department of Dentomaxillofacial Radiology were analyzed by two examiners and 200 CBCT images were evaluated retrospectively. Sella turcica shape of individuals were described according to Axelsson's classification as either normal or with aberrations including; oblique anterior wall, double contour of the floor, sella turcica bridging, irregularity in the posterior part of the dorsum sella, and pyramidal shape of the dorsum sella.

Results: Normal sella turcica was the most common type seen in 100 individuals (% 49, 8). The secondary common type was double contour of the floor of sella turcica seen in 46 patients (% 22, 9). 32 patients (% 15, 9) had oblique anterior wall. 17 individuals (% 8, 5) had pyramidal shape of the dorsum sella, %3 irregularity in the posterior part of the sella turcica. None of the patients had sella turcica bridging. Irregularity in the posterior part of the sella turcica and pyramidal shape of the dorsum sella reported significantly more frequent in female than male.

Conclusions: Sella turcica varies in shape and morphology apart from age. Normal sella turcica was the most frequent type in the study group. Irregularity in the posterior part of the sella turcica and pyramidal shape of the dorsum sella reported more frequent in female than male.

Key words: sella turcica, CBCT, variations

INTRODUCTION

The sella turcica, literally, the “Turkish saddle,” is an important structure in the radiographic analysis of neurocranial and craniofacial complexes. This area is a saddle-shaped depression of the sphenoid bone and is located very close to vital anatomical structures, including the sphenoid sinus, optic chiasm, and hypothalamus [1]. The size of the pituitary gland, which controls endocrine functions in the body, is also affected by the size of the sella turcica [2, 3]. Furthermore, abnormal growth of the sella turcica is associated with numerous developmental anomalies, including craniofacial malformations, abnormal thyroidal systems, malformations in the cerebellum and larynx (e.g., Cri-du-Chat syndrome), and heart problems (e.g., velocardiofacial syndrome [[3-5]). Different pathologies result in distinctive malformations of the sella turcica; these can be identified by specific morphologies and can cause phenotypes that range from mild to severe [5]. For example, deviations in the anterior wall are commonly associated with alterations in frontonasal developmental structures, whereas deviations in the posterior wall are specifically related to malformations in posterior areas, such as the cerebellum [5]. Detailed knowledge and a careful interpretation of sella turcica morphologies may provide significant clues about malformations and diseases. Thus, awareness of sella turcica morphology is essential for clinicians when identifying possible pathologies and planning treatment procedures.

Axelsson *et al.* [6] categorized the shape of the sella turcica into the following six types based on lateral cephalometric (LCR) measurements: normal sella turcica (type a); oblique anterior wall (type b); double contoured sella (type c); irregularity (notching) in the posterior part the sella turcica (type d); sella turcica bridge (type e); and pyramidal shape of the dorsum sella (type f). Although useful data have been obtained from two-dimensional (2D) imaging studies, it has been suggested that information about anatomical variations in the sella turcica cannot be completely obtained unless a 3D system is used [7] [8]. Issues inherent to 2D systems may prevent the appropriate diagnosis of important malformations of the sella turcica that lead to behavioral abnormalities and dysfunctions. However, recent advances in cone beam computed tomography (CBCT) may overcome limitations associated with 2D imaging and provide more detailed information about craniofacial structures. It is also important to note that the morphology of the sella turcica varies based on race-related structures and personalities [9]. Therefore, it would be useful to understand the diversity of racial variations in different populations to distinguish these normal alterations from those associated with anatomical disorders.

Further research will be necessary to obtain additional data regarding race-based differences in sella turcica morphology. Thus, the present study analyzed variations in the sella turcica in a population of Turkish individuals using CBCT, and categorized these differences using the classification system of Axelsson *et al.* [6]. Additionally, the relationships of these differences with age and gender were assessed.

MATERIALS AND METHODS

The present retrospective CBCT-based analysis of sella turcica morphology in Turkish individuals was approved by the local ethics committee. CBCT data were obtained from 200 randomly selected patients between 9 and 82 years of age (mean age: 35 ± 17.28 years) who had been referred to the Department of Dentomaxillofacial Radiology, Faculty of Dentistry, at the University of Gaziantep in Gaziantep, Turkey.

All CBCT images were obtained using the same scanner (Planmeca Promax 3D Mid; Helsinki, Finland) with the following characteristics: 140×140 -mm field of view, 90 kVp, 154 mAs, and 0.25-cm voxel size. Axial, sagittal, and coronal sections of the skull were imaged and then analyzed using special CBCT software (Planmeca Romexis). All assessments were performed twice in each individual by two experienced dentomaxillofacial radiologists with a 2-week interval between the assessments. The inclusion criteria were as follows: 1) good visibility of all tomographic structures, including the sella turcica; 2) no artifacts from patient movements or metal objects; and 3) the absence of craniofacial congenital deformities, syndromes, a history of facial trauma, and a cleft lip and/or palate. Figure 1 shows variations in the sella turcica that were identified using CBCT according to the categories of Axelsson *et al.* [6]; a partial calcification of the interclinoid ligament was considered an incomplete bridge [7]. Spearman's correlation analyses were used to assess correlations between age and the type of sella turcica, Chi-square tests were performed to assess associations between gender and the type of sella turcica, and Cohen's Kappa tests were conducted to examine intra- and interobserver agreement. All statistical analyses were performed in SPSS v. 15 (SPSS Inc., Chicago, IL), and p-values <0.05 were considered to indicate statistical significance.

RESULTS

In the present study of the sella turcica in a Turkish population, the most common type was a normal sella turcica (type a; 49.8%) followed by type c (22.8%), type b (15.9%), type f

(8.5%), and type d (3%); no case of type e was identified in the present study (Table 1). Types a, b, and c were more frequent in males than in females, whereas types d and f were more common in females. Although gender was not significantly correlated with types a, b, or c ($p > 0.05$), types d ($p = 0.041$) and f ($p = 0.045$) were significantly correlated with gender. The irregular notching of the posterior part of the sella turcica was observed in males as well as 24.3% of females. Additionally, a pyramidal shape of the dorsum sella was observed in males as well as in 35.2% of females. There were no significant correlations between variations in the sella turcica and age ($p = 0.606$). The levels of interobserver (0.89) and intraobserver (0.91) agreement were excellent.

DISCUSSION

A better understanding of sella turcica morphology is vital for assessing pituitary gland pathologies, for establishing surgical prognoses, and for cephalometric tracing. The shape of the sella turcica can provide information about anomalies or syndromes and may also be a reference for different racial groups [10]. Variations in the sella turcica are most often evaluated and classified using LCR measurements [11-15]. However, because the LCR system is 2D and the two-sided structures of the skull are superimposed in these images, the accuracy of the views and the accountability of the studies remain in question. Thus, it has been proposed that the Axelsson *et al.* [6] classification system be used when evaluating the sella turcica with 3D imaging systems. The primary aim of the present study was to analyze variations in the sella turcica using CBCT and the Axelsson *et al.* classification system [6], and the secondary aim was to determine the prevalence of these variations in a Turkish subpopulation and their relationships with age and gender.

Variations in the sella turcica are relatively uncommon, and accordingly, the proportion of cases showing the most frequently identified type (normal sella turcica) is 53–67% [6, 15, 16]. Alkofide [17] also found that a normal sella turcica is the most frequent type (66.7%), while the second most frequent type is an irregular dorsum sella (11.1%). A study by Magat *et al.* [16] found that 39% of Turkish subjects had a normal sella turcica, 15.5% had a pyramidal shape of the dorsum sella, 14.6% had a double contour floor, 14.4% had an oblique anterior wall, 8.6% had an irregular posterior part of the dorsum sella, and 8.0% had a sella turcica bridge. Similar to previous findings [16, 17], the present study found that most individuals (49.8%) had a normal sella turcica (type a). Individuals with a normal sella turcica generally exhibit good clinical health [18].

On the other hand, the most common altered sella turcica morphologies in the present study were a double floor contour (22.8%) and an oblique anterior wall (15.9%). These types of sella turcica are among the most prevalent deviations reported in previous literature [16, 18] and are frequently present in patients with unilateral and bilateral cleft lip and/or palate [18]. In the present study, the next most common alterations of sella turcica morphology were a pyramidal shape (8.5%) and an irregular posterior part of the sella (3%). Previous studies reported associations of irregularity of the dorsum sella with cleft lip and/or palate Alkofide [18] and with Williams syndrome Axelsson *et al.* [6, 18]. The rates of sella turcica types observed in the present study differ from those reported by Magat *et al.* [16]; however, those authors employed LCR measurements and did not use a 3D imaging system, which may explain these discrepancies.

A sella turcica bridge is a malformation that originates during the prenatal phase of life [3, 7]. Although a sella turcica calcification or bridge is not always associated with clinical abnormalities and may sometimes occur as a normal variant of the sella turcica [15], these abnormalities are generally associated with a high occurrence of severe craniofacial deviations and syndromes [13, 14, 19]. The present study did not identify any cases of sella turcica bridging (type e), which is consistent with a 3D-based study of a Bangladeshi population [20]. However, these findings are contrary to those of previous studies [10, 12]. This discrepancy may be due to the fact the previous studies generally assessed patients with orthodontic anomalies. In the present study, patients were randomly selected from the general population and the focus was not solely on patients with anomalies. Additionally, the previous studies were LCR based, whereas CBCT data were assessed in the present study. LCR uses a 2D imaging system, and variations in the sella turcica may be misdiagnosed due to the superimposition of the right and left parts of anatomical structures, which may result in images that do not accurately portray bony fusions.

In general, there is no relationship between sella turcica morphology and gender [17, 21]. On the other hand, Axelsson *et al.* [6] and Kucia *et al.* [6, 8] both reported a higher frequency of sella turcica bridging in females than males. Similarly, the present study found a relationship between gender and sella turcica morphology in that an irregularity in the posterior part of the sella turcica and a pyramidal shape of the dorsum sella were significantly more common in females than in males. This may indicate that anatomical differences exist between different populations [10] and/or that the working principles of 2D and 3D systems may affect outcomes.

The present study has several limitations that should be noted. Because this CBCT-based retrospective study assessed radiographic images of the sella turcica, there was no real image that could be used as a gold standard for comparisons. Thus, future studies should compare LCR-derived images with CBCT-derived images. Additionally, future studies should assess patients with a wide range of systemic anomalies.

CONCLUSIONS

In conclusion, the present results show that age was not associated with sella turcica shape or morphology and that a normal sella turcica was the most frequent type in this Turkish population. Additionally, the rates of irregularities in the posterior part of the sella turcica and pyramidal shape of the dorsum sella were significantly higher in females than in males. To further expand on these findings, more comprehensive evaluations of sella turcica anatomy should be carried out using CBCT and 3D imaging with a special focus on the relationship between sella turcica anatomy and dental anomalies or syndromes.

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Table 1. Distribution of variations in the sella turcica according to gender.

Variations	Females		Males		Total		p
	n	%	n	%	n	%	
Type a	35	44,9	64	52,5	99	49,8	0,149
Type b	11	14,1	21	17,2	32	15,9	0,280
Type c	17	21,8	29	23,8	46	22,8	0,374
Type d	5	6,4	1	0,8	6	3	0,037*
Type e	-	-	-	-	-	-	-
Type f	10	12,8	7	5,7	17	8,5	0,022*
Total	78	100	122	100	200	100	0,102

Figure 1. Variations in the sella turcica on CBCT images: (a) normal sella turcica, type a; (b) oblique anterior wall, type b; (c) double contour of the floor, type c; (d) irregularity (notching) in the posterior part of the sella turcica, type d; (e) sella turcica bridge, type e; and (f) pyramidal shape of the dorsum sella, type f.

