ORIGINAL PAPER

EVALUATION OF SELLA TURCICA TYPES WITH TWO DIFFERENT CLASSIFICATIONS IN CONE-BEAM COMPUTED TOMOGRAPHY

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ABSTRACT

Introduction: Sella turcica is a saddle-shaped depression in the sphenoid bone that contains the pituitary gland.

Objectives: To investigate the morphological types of sella turcica with two different classifications in cone-beam computed tomography (CBCT) images in a group of Turkish population.

Material and methods: Full head CBCT images of 1,000 patients (535 men, 465 women), aged 6-91 years, were retrospectively analyzed. Morphological types of sella turcica were evaluated in multiplanar planes of CBCT according to two classification systems, and a relationship between them was examined. Relationships between categorical variables were analyzed using χ^2 test.

Results: Frequency of basic morphological types of sella turcica was as follows: oval, 48%; flattened, 34.7%; circular, 17.3%. Flattened type of basic morphological sella types was significantly higher in males ($p = 0.001$). Except this type, there was no significant difference between genders. Normal type of sella turcica was detected in 532 (53.2%) of 1,000 patients. Frequency of other morphological types of sella turcica were as follows, respectively: irregularity (notching) in the posterior part of dorsum sella, 40.9%; sella turcica bridging, 2%; pyramidal shape of dorsum sella, 1.7%; oblique anterior wall, 1.2%; double contour of sellar floor, 1%. Irregularity (notching) in the posterior part of sella turcica type was observed significantly more in cases, in which basic morphological sella types were flattened ($p = 0.001$).

Conclusions: A higher rate of normal sella morphology was detected on CBCT compared with studies conducted with wider age range. Oval sella was mostly observed with normal sella, and flattened sella was mostly determined with irregularity in posterior part of dorsum sella. CBCT is a useful technique to examine morphological types of sella turcica.

Key words: sella turcica, morphology, cone-beam computed tomography, sphenoid bone.

J Stoma 2023; 76, 2: 117-121
DOI: https://doi.org/10.5114/jos.2023.128816

INTRODUCTION

Sella turcica is a saddle-shaped depression in the sphenoid bone that contains the pituitary gland [1]. It was named "sella turcica" because the anterior and posterior bone protrusions of the region seen in the lateral head images are similar to the Turkish saddle [2]. It has important anatomical proximity, including optic chiasma, sphenoid sinus, etc. [3]. When tomography images and conventional two-dimensional postero-anterior radiographs are evaluated, it is seen that the sella floor is a flat or downward convex structure in healthy indi-

JOURNAL OF STOMATOLOGY
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Received: 06.12.2022 • **Accepted:** 01.02.2023 • **Published:** 20.06.2023

viduals, with a maximum depth of 3.5 mm in the middle region. In the presence of pathologies, the convexity of the fossa may increase or the fossa may become shallow [4].

Orthodontists, who frequently refer to lateral cephalometric radiographs during clinical practice, often ignore the sella turcica area, only to determine the "sella" point. Detectable changes in the size and morphology of this region, together with clinical symptoms, may be useful in the early diagnosis of some diseases [5]. Sella bridging has been found to be more common in patients with severe cranio-facial anomalies [6, 7]. Also, sella shape and size can be affected by pathological conditions, such as Down syndrome, Williams syndrome, Seckel syndrome, and lumbo-sacral myelomeningocele [8-10].

It is not possible to verify third-dimensional data on conventional lateral cephalometric radiography [11]. The development of imaging diagnosis and methods made it possible to examine and characterize normal anatomy and morphology of human body structures using computed tomography (CT) images [12]. Cone-beam computed tomography (CBCT) is a more reliable method for examining bone structures due to its' low dose and short scan time [13].

To determine whether sella turcica has an abnormal appearance, it is necessary to know its' normal morphological appearance. Normal sella turcica contour morphology was described by Björk and Skieller [14]. The upper contour of the anterior wall of sella turcica appears upright and unchanged during the normal course of development. The increased size of sella turcica under normal conditions is the result of a resorption and apposition processes on dorsum sella [14]. Changes in sella turcica morphology during the growth period were examined, and it was reported that the morphology of sella turcica did not show any significant change after the age of 12 [15, 16]. In previous studies, different evaluations of the morphology of sella turcica were performed. Camp [17] classified sella turcica into three types, i.e., circular, oval, and flat. Axelsson *et al.* [18] categorized sella morphologically into six types on lateral cephalometric radiographs, such as normal, oblique anterior wall, sella turcica bridging, double contour of sellar floor, irregularity at posterior of dorsum sella, and pyramidal shape of dorsum sella. In previous studies, sella morphology was evaluated on lateral cephalometric radiography and CBCT images [19, 20]. To the best of our knowledge, there is no study examining the relationship between Camp's classification and Axelsson's classification.

OBJECTIVES

The aim of this study was to investigate the prevalence of the basic morphological classification and Axelsson's classification by mean age and gender in the South-Eastern Anatolian population, and to evaluate the relationship between the two classifications.

MATERIAL AND METHODS

The present study was approved by the Clinical Research Ethics Committee of the Gaziantep University (Approval No.: 2020/388).

In this study, all facial CBCT images of the patients who applied to the Department of Dentomaxillofacial Radiology of Gaziantep University for various reasons were retrospectively analyzed. Patients with evidence of bone disease, congenital disorder, trauma history, any tumor or malignancy history, undergoing surgery, and images containing artifacts were excluded from the study. Full head CBCT images of 1,000 patients (535 men, 465 women), aged 6-91 years, were retrospectively analyzed using Planmeca ProMax 3D Mid (Helsinki, Finland) device and Planmeca Romexis version 3.2.0 software (Helsinki, Finland). Images with a field of view (FOV) range of 16 cm x 16 cm, a voxel resolution of 0.4 mm^3, and a slice thickness of 1 mm, were used. All CBCT

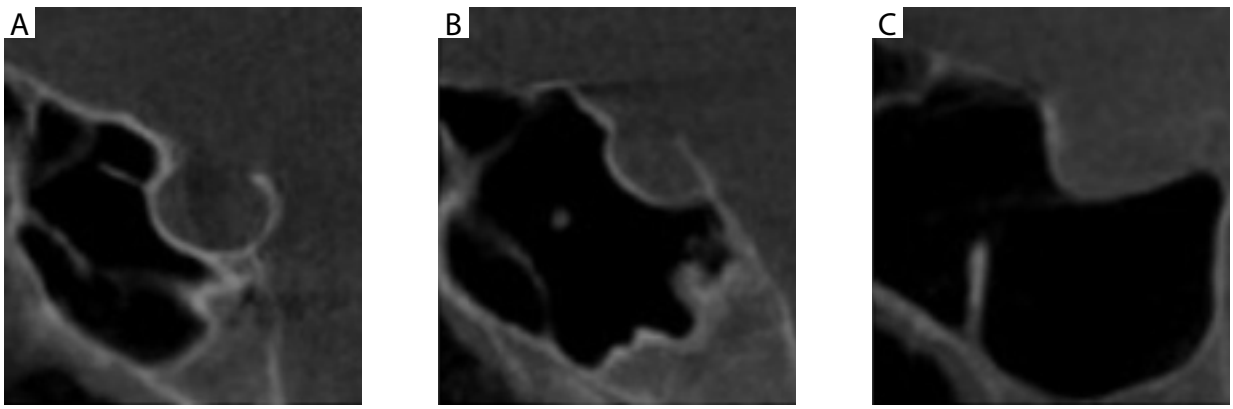

FIGURE 1. Sagittal cone-beam computed tomography images show (**A**) circular type, (**B**) oval type, and (**C**) flattened type sella turcica

scans were performed according to a standard screening protocol. Images were evaluated on multiplanar (axial, sagittal, and coronal) sections by two dentomaxillofacial radiologists with the first observer 2 (MED) and the second observer 9 (EDY) years of experience. Evaluations on 200 images (20% of all images) were examined again after 2 weeks for intra- and inter-observer agreement. Morphological types of sella turcica were examined as follows: the basic morphological types were circular type, oval type, and flattened type (Figure 1); according to Axelsson's classification, they were normal sella turcica, oblique anterior wall, double contour of sellar floor, irregularity (notching) in the posterior part of sella, sella turcica bridging, and pyramidal shape of dorsum sella (Figure 2).

Statistical analysis of the study was performed with SPSS program version 20.0 (IBM, Armonk, NY, USA). Kolmogorov-Smirnov test was applied to examine the suitability of available data for normal distribution. Relationships between categorical variables were calculated with χ^2 test. Significance level was accepted as $p < 0.05$.

RESULTS

The intra- and inter-observer reliability coefficient was found to be excellent for all assessments (0.91 and 0.88, respectively), and the examinations of the first observer were taken as basis. 1,000 CBCT images were evaluated according to two classifications. 535 of the cases were males and 465 were females. The mean age of all patients was 42.71 ± 18.16 years. The mean age of men was 42.85 ± 18.46 years, and 42.55 ± 17.83 years of women. According to the basic morphological classification, oval type with 48%, flattened type with 34.7%, circular type with 17.3% were detected. The distribution of basic morphological sella by gender is shown in Table 1. When the basic classification was examined by gender, the most prevalent type was oval in both the genders. While flattened and oval types of sella were more common in men than in women, circular sella was more frequent in women ($p = 0.001$). According to Axelsson's classification, the most common morphological type was normal sella turcica with 53.2%. Other morphological types were as follows, respectively: irregularity in

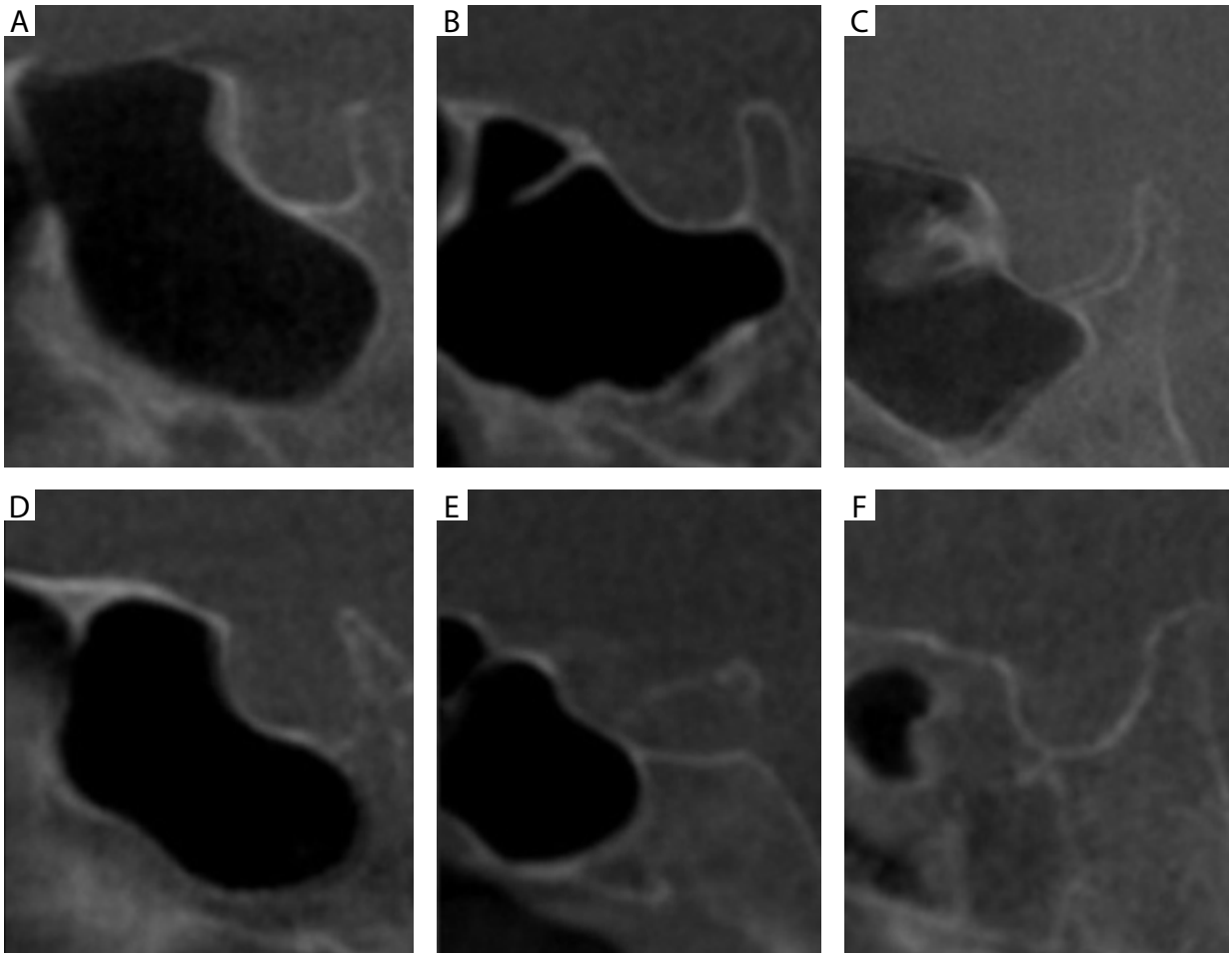

FIGURE 2. Sagittal cone-beam computed tomography images indicate (**A**) normal sella turcica, (**B**) oblique anterior wall, (**C**) double contour of sellar floor, (**D**) irregularity in the posterior part of dorsum sella, (**E**) sella turcica bridging, and (**F**) pyramidal shape of dorsum sella

the posterior part of the dorsum sella, 40.9%; sella turcica bridging, 2%; dorsum sella pyramidal shape, 1.7%; oblique anterior wall, 1.2%; double contour of floor, 1%. No significant relationship was found between Axelsson's classification and gender. The relationship between Axelsson's classification and basic morphological classification was investigated and presented in Table 2. Mostly, irregularity in the posterior part of dorsum sella was detected with flattened-shaped sella. A statistically significant relationship was found between the two classifications ($p = 0.001$). Normal sella was mostly seen together with oval-shaped sella with 32.0%. In the second row, flattened sella with a rate of 20.7% was most frequently observed with irregularity (notching) in the posterior part of the sella.

DISCUSSION

In the literature, the basic morphological structure was examined in sella studies using CBCT, but the relationship between Axelsson's classification and basic morphological classification has not been evaluated. In the present study, the relationship between these two classifications was examined with CBCT, and a statistically significant relationship was found between them.

Various researchers have reported that some anomalies and syndromes increase the incidence of sella turcica morphological variations. However, it is not recommended to associate every case with an anomaly because there are variations in healthy individuals [7, 8, 21-23]. In previous studies, different evaluations about the morphology of sella turcica were observed. Zagga *et al.* [24] in their study on 228 lateral cephalometric radiographs of healthy Nigerian individuals, examined sella turcica in three groups, as circular, oval, and flat. The authors reported that the oval type was seen in 83%, the circular type in 11%, and the flat type in 6% of the images. In a study of Islam *et al.* [25] conducted with CT in Bangladeshi population, sella type was found as 48.1% of oval, 28.3% of flat, and 23.4% of circular types. In a CBCT study of Yasa *et al.* [20], circular sella shape was found in 69.5%, flattened in 16.4%, and oval in 14.1%. In Yalcin's study on individuals with cleft palate using CBCT, flattened shape was reported to be the most common, with 38.2% [26]. In the present study, the oval sella shape was observed at a rate of 48%, consistent with the study of Islam *et al.* [25]. Unlike other studies, oval and flattened types were more common in males, and circular type was more common in females. It can be thought that this difference may be due to race, population difference, the imaging method used, and the number of individuals included in the study.

Axelsson *et al.* [18] made a new morphological classification of sella for the first time in 2004, and reported normal sella rate as 65% in women and 71% in men. In studies performed on lateral cephalometric films, normal sella was determined at a rate of 76.1%, 66.1%, 66.8%, 46.5%, and 39.0% [19, 27-30]. There is only one study investigating the morphology of sella on CT, in which normal sella turcica was found at a rate of 69.2% [25]. There are few studies with CBCT in the literature. In these studies, normal sella was seen in 69.1% and 49.8% [26, 31]. Consistent with other research, the most common type in this study was normal sella. No significant difference was found in normal sella turcica by gender. In studies conducted with cephalometry and CBCT, irregularity in the posterior of dorsum sella was observed at rates of 16.7%, 16.2%, 12.1%, 8.6%, 7.0%, 5.4%, and 3.0% [19, 26-31]. Unlike these studies, this rate was found to be 40.9% in the current study, and no significant difference was observed according to gender. This may be due to the higher average age and the higher number of scanned images in the present study.

Leonardi *et al.* [21] reported that sella turcica bridging was more likely to be seen in individuals with dental anomalies. Previous studies on cephalometric radiographs, sella bridging was found to be 8.0%, 7.5%, 1.1%, and 0.8% [19, 27-29]. The pyramidal shape of the dorsum sella was found to be 15.5%, 8.5%, 7.7%, 6.5%, 4.4%, 3.8%, 3.0%, and 2.6% [19, 25-31]. In this research, the pyramidal shape of the dorsum sella was found in 1.7%. In various studies in the literature, the oblique anterior wall was observed as 29.0%, 15.9%, 14.4%, 10.3%, 8.9%, 4.0%, and 3.8% [19, 24, 26-30]. In a study conducted by Axelsson *et al.* [18] among Norwegian individuals aged 6-21 years, oblique anterior wall was the most common anatomic variation in males, while bridging and irregularity in the posterior part of the dorsum sella were more common in females. In this research, no significant difference was found in the distribution by gender. In previous studies, the double contour of sellar floor was detected as 14.6%, 8.5%, 8.4%, 6.6%, 5.5%, and 3.5% [19, 25, 27-30]. The different rates in this study compared with others may be due to ethnic origin, population, and imaging device differences. Another reason why we found a lower rate than studies on cephalometric films may be that superpositions in CBCT were eliminated. In most of the cases with flattened sella, irregularity in the posterior of the dorsum sella was detected. Normal sella type was observed in most of the patients with oval-shaped sella. This may be due to differences in the resorption and apposition mechanism.

The limitation of this study was that the pituitary gland was not examined because the soft tissues could not be adequately visualized on CBCT. It is recommended to conduct multicenter studies using magnetic resonance imaging technique.

CONCLUSIONS

The results of this study indicated a higher rate of normal sella morphology on CBCT compared with stud-

ies performed with wider age range. The oval sella was mostly observed with normal sella, and the flattened sella was mostly observed with irregularity (notching) in the posterior part of the dorsum sella. Knowledge of the sella morphology can be important for accurate diagnosis and appropriate treatment planning for endoscopic trans-sphenoidal surgery. The morphological structure and variations of sella turcica can be evaluated effectively on CBCT.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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