

Morphometric assessment of sella turcica using CT scan*

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Abstract

Objectives: Morphometry of sella turcica should be known to evaluate pathological sella turcica. The aim of this study was to measure the size and describe the morphology of sella turcica in a Turkish population.

Methods: This study included 101 individuals aged 17 to 70 years who went under CT scan. Sella length, sella width, sella height anterior, sella height median, sella height posterior, sella area, sella depth and sella anteroposterior (AP) diameter were measured.

Results: Sella length was measured as 9.18 ± 1.91 mm, sella width 10.41 ± 1.74 mm, sella height anterior 8.09 ± 1.65 mm, sella height median 7.71 ± 1.24 mm, sella height posterior 7.48 ± 1.34 mm, sella area 69.15 ± 17.45 mm², sella depth 7.87 ± 1.37 mm and antero-posterior sella diameter as 11.48 ± 1.82 mm. When these sizes were compared between males and females, only sella length and width differed significantly. When compared by decades, there was a statistically significant difference only in the sella area parameter.

Conclusion: Sella turcica dimensions of the Turkish population obtained by CT in this study can be used in estimating pituitary gland size and in determining any pathology in the sellar and parasellar regions. In addition, these results may help clinicians who encounter pathologically large sella areas in easily distinguishing it. Therefore, knowing the normal anatomy and variations of sella turcica is important for neurologists and neurosurgeons who deal with the pathologies of this area.

Keywords: computed tomography; morphometry; sella turcica

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Introduction

Sella turcica is a saddle-shaped depression located in the middle cranial fossa on the upper surface of the sphenoid bone. It is enclosed by the pituitary fossa in which the pituitary gland is lodged, tuberculum sellae on the front and dorsum sellae in the rear.^[1–4]

Two anterior and two posterior clinoid processes form a protrusion on the pituitary fossa, and these are the structures that protect the pituitary gland in the sella turcica. The extensions of the sphenoid bone's ala minor to the anterior and medial form the anterior clinoid processes.

The endings of the dorsum sellae form the posterior clinoid processes.^[1,4,5]

Sella turcica is a bony structure that is closely related with the pituitary gland, and is of both anatomical and clinical importance. The sellar and parasellar regions are anatomically complex structures where neoplastic, infectious, inflammatory, developmental and vascular pathologies may develop.^[2,6]

Research on sella turcica focuses not only on its dimensions, but also on its morphology. Sella morphology is important in both evaluating treatment outcomes

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and late developmental changes, and in assessing the cranial morphology. The anatomy of the sella turcica and clinoid processes may vary widely among individuals.^[5,7,8] Variations in sella turcica size are commonly observed and associated with the pathologies involving this region.^[1] Knowledge on the anatomy of the sellar region is important for neurologists and neurosurgeons in their assessments of the pathologies in this region. Acknowledgement of sellar area variations is also important in preventing injuries of the structures that surround the sella turcica during surgery. When surgeons are familiar with the variations, they can notice them during pre-operative radiological analyses. In addition, knowledge on potential variations may alter the choice of surgical technique, operative approach and surgical devices.^[1,9]

It is important to know the normal dimensions of the sella turcica in healthy individuals to be able to evaluate pathologic sella turcica. The purpose of this study was therefore to measure the size and describe the morphology of sella turcica in a Turkish population, and to compare them with earlier studies on the sella.

Materials and Methods

This study was conducted in the Research and Practice Hospital of Medical School of Afyon Kocatepe University. The subjects included were chosen amongst individuals from a Turkish population aged 17 to 70 years, admitted to the outpatient clinic of the Department of Radiology for any reason and underwent cranial computed tomography (CT) scanning. Individuals with pituitary gland pathology, e.g. tumor, cyst, hemorrhage, and those who suffered from a head trauma, high brain pressure and with cerebrovascular pathology were excluded from the study. The study included 101 (60 males, 41 females) healthy individuals. Morphometric measurements were performed using eight parameters on the sagittal section that is closest to the mid-sagittal section (**Figure 1**).

These parameters were:

- **Sella length (SL):** The distance between tuberculum sellae (TS) and dorsum sellae (DS) points.
- **Sella width (SW):** The longest antero-posterior length measured parallelly from the most anterior and posterior points of sella turcica to the Frankfort horizontal plane (FH).
- **Sella height anterior (SHA):** The vertical distance measured from TS through sella turcica base to the FH plane.
- **Sella height posterior (SHP):** The vertical distance measured from DS through sella turcica base to the FH plane.
- **Sella height median (SHM):** The vertical distance measured from the midpoint between TS and DS to the FH plane.
- **Sella area (STA):** The value, in mm², of the line between TS and DS included in the sella.
- **Sella turcica depth (DP):** The length of the line drawn vertically from the deepest point of the sella turcica in the direction of the sella turcica length.
- **Sella turcica antero-posterior diameter (AP):** The distance measured from the tuberculum sellae to the backmost point in the interior surface of the posterior wall of the pituitary fossa.

The subjects were grouped into seven decades: ages from 17 to 20 years as the second decade, from 21 to 30 years as the third decade, ages from 31 to 40 years as the fourth decade, ages from 41 to 50 years as the fifth decade, ages from 51 to 60 years as the sixth decade, and ages from 61 to 70 years as the seventh decade.

Data obtained from the study were evaluated using IBM SPSS (Statistical Package for the Social Sciences, version 20.0; IBM, Chicago, IL, USA) software. Descriptive data were presented as mean $\pm$ standard deviation. The independent samples t-test was used for paired groups when comparing parametric values, whereas Kruskal-Wallis test was used when comparing multiple groups for non-parametric data. Correlation analyses among the groups were performed using Pearson's correlation test. Statistical significance in inter-group comparisons was set at $p < 0.05$.

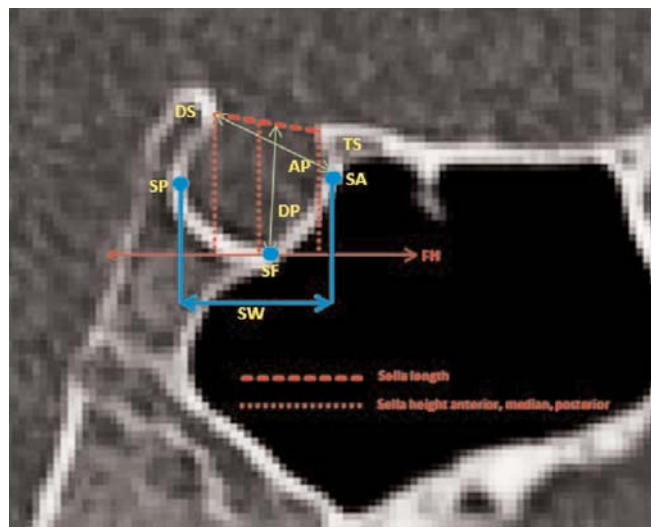


Figure 1. Linear measurements of sella turcica. TS: tuberculum sellae, DS: dorsum sellae, DP: sella depth, AP: sella anteroposterior diameter, SW: sella width, FH: Frankfort horizontal plane, SF: sella floor.

Table 1Parameters of sella turcica morphometry. Values are mean $\pm$ standard deviation (SD), all in mm, except for sella area (mm²).

Parameters	All patients (n=101)		Males (n=60)		Females (n=41)		p
	Min-Max	Mean $\pm$ SD	Min-Max	Mean $\pm$ SD	Min-Max	Mean $\pm$ SD	
Sella length	4.03-14.4	9.18 $\pm$ 1.91	4.03-14.05	9.64 $\pm$ 1.97	5.07-14.4	8.5 $\pm$ 1.63	0.003*
Sella width	6.55-15.07	10.41 $\pm$ 1.74	7.34-15.07	10.86 $\pm$ 1.81	6.55-12.8	9.75 $\pm$ 1.4	0.001*
Sella height anterior	4.07-11.83	8.09 $\pm$ 1.65	4.07-11.7	8.05 $\pm$ 1.79	5.11-11.83	8.15 $\pm$ 1.45	0.767
Sella height median	4.03-10.83	7.71 $\pm$ 1.24	4.03-10.83	7.7 $\pm$ 1.32	5.3-10.34	7.73 $\pm$ 1.12	0.898
Sella height posterior	3.45-10.54	7.48 $\pm$ 1.34	3.45-10.39	7.5 $\pm$ 1.39	4.47-10.54	7.45 $\pm$ 1.28	0.837
Sella area	27.79-121.01	69.15 $\pm$ 17.45	35.5-121.01	70.42 $\pm$ 18.24	27.79-104.67	67.29 $\pm$ 16.25	0.377
Sella depth	4.03-11.43	7.87 $\pm$ 1.37	4.03-11.43	7.79 $\pm$ 1.45	5.3-10.75	7.98 $\pm$ 1.26	0.508
Sella antero-posterior diameter	6.85-16.24	11.48 $\pm$ 1.82	6.85-15.7	11.73 $\pm$ 1.9	8.12-16.24	11.11 $\pm$ 1.66	0.093

*p $\leq$ 0.05.

Results

The subjects included in the study had an age range of 17 to 70 years, and the average age was 40. The mean sella turcica length was 9.64 mm in males and 8.5 mm in females, and 9.18 mm overall. The mean sella turcica width was 10.86 mm in males and 9.75 mm in females, and 10.41 mm in males and females. The length and width of sella turcica were different between males and females (p<0.05). Mean values for anterior, median and posterior heights, depth and anteroposterior diameter of the sella turcica were not found significantly different between males and females (p>0.05) (**Table 1**). There was an increase in all dimensions of sella turcica with age. However, this increase was statistically significant only in the length, width, median and posterior height, and area of the sella turcica (p<0.05) (**Figures 2–5**). When dimensions of sella turcica were assessed based on

decades, only the sellar area was found to increase significantly, with maximum dimension in the seventh decade (**Table 2, Figure 3**).

Discussion

Sella turcica is an important component of the middle cranial fossa, and knowing its normal dimensions is important in diagnosing some pathologies.^[10,11] Meschan^[12] emphasized that measurements of sella turcica should be undertaken so that intrasellar lesion enlargement as well as increased intracranial pressure can be identified.

Najim and Al-Nakib,^[13] in their lateral cephalometric radiography study in individuals aged 13 to 25 years from the Iraqi population, measured the sella turcica length, depth and anteroposterior diameter. Their findings were virtually close to our findings compared to

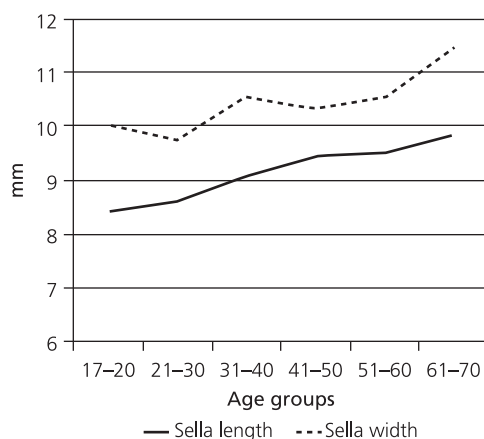


Figure 2. Graphic analysis of sella length and width according to age groups.

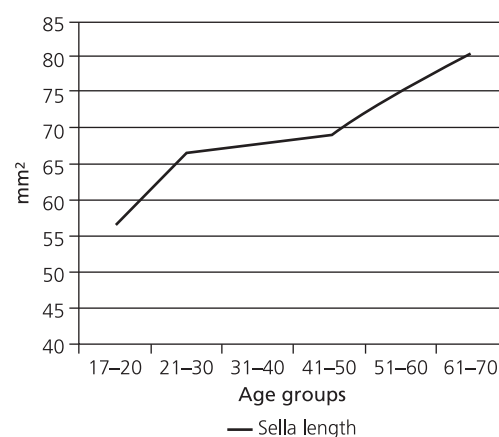


Figure 3. Graphic analysis of sella area according to age groups.

Table 2

Comparison of sella turcica morphometry according to the decades. Values are mean $\pm$ standard deviation, all in mm, except for sella area (mm²).

Parameters (n=101)	Decade 2 (17–20) (n=11)	Decade 3 (21–30) (n=15)	Decade 4 (31–40) (n=23)	Decade 5 (41–50) (n=26)	Decade 6 (51–60) (n=16)	Decade 7 (61–70) (n=10)	p
Sella length	8.43 $\pm$ 1.65	8.61 $\pm$ 1.19	9.06 $\pm$ 1.53	9.43 $\pm$ 2.28	9.51 $\pm$ 2.25	9.84 $\pm$ 2.13	0.352
Sella width	10.05 $\pm$ 2.05	9.74 $\pm$ 1.4	10.55 $\pm$ 1.85	10.33 $\pm$ 1.69	10.55 $\pm$ 1.44	11.45 $\pm$ 1.93	0.234
Sella height anterior	7.29 $\pm$ 2.01	8.52 $\pm$ 1.01	7.94 $\pm$ 1.67	8.07 $\pm$ 1.77	8.36 $\pm$ 1.92	8.22 $\pm$ 1.08	0.399
Sella height median	6.66 $\pm$ 1.49	7.88 $\pm$ 0.61	7.64 $\pm$ 1.11	7.71 $\pm$ 1.43	8.14 $\pm$ 1.11	8.00 $\pm$ 1.15	0.169
Sella height posterior	6.44 $\pm$ 1.52	7.44 $\pm$ 0.83	7.41 $\pm$ 1.16	7.30 $\pm$ 1.37	8.05 $\pm$ 1.3	8.35 $\pm$ 1.42	0.089
Sella area	56.40 $\pm$ 21.21	66.52 $\pm$ 10.05	67.71 $\pm$ 15.93	69.12 $\pm$ 18.42	75.30 $\pm$ 14.43	80.61 $\pm$ 19.61	0.038*
Sella depth	7.21 $\pm$ 1.95	7.96 $\pm$ 0.77	7.77 $\pm$ 1.31	7.76 $\pm$ 1.49	8.27 $\pm$ 1.19	8.25 $\pm$ 1.33	0.495
Sella anteroposterior (AP) diameter	10.89 $\pm$ 1.94	11.04 $\pm$ 1.36	11.74 $\pm$ 1.81	11.50 $\pm$ 1.92	11.61 $\pm$ 1.91	11.86 $\pm$ 2.07	0.696

*p $\leq$ 0.05.

other earlier studies. In a study on sella anteroposterior diameter in the Saudi Arabia population, Sakran et al.^[1] also found results similar to those in our study. We believe that sella depth does not decrease with age, and it can therefore be compared across studies regardless of the age groups studied. Our literature search did not yield enough studies on sella width, sella height anterior, sella height median, sella height posterior or sella area. However, of the studies performed, the study by Valizadeh et al.^[14] on the median height and area of the sella in Iranian subjects aged 14 to 26 years has the closest results to our study, with respect to lateral cephalometric radiography. When these consistent findings were pooled, geographical proximity seems apparent. One may conclude that this may be due to the racial and genetic closeness. However, the number of subjects in

our study and the differences in radiographic imaging, measurement methods and in individual performing the measurements etc. may influence the results, and we must underline that these differences should be taken into account during comparison (Table 3).

In our study, we determined that the sella turcica differed significantly between males and females only in length and width. When Hasan et al.^[14] compared the dimensions of the sella turcica by gender and found no relevant differences between males and females, except in sella height anterior. Ashraf et al.,^[1] Shah et al.,^[8] Najim and Al-Nakib,^[13] Olubunmi et al.^[15] and Nagaraj et al.^[16] reported that sella morphometry did not differ between males and females. Silverman^[17] found differences in the size of sella between genders in the pre-adulthood period, but no difference between males and

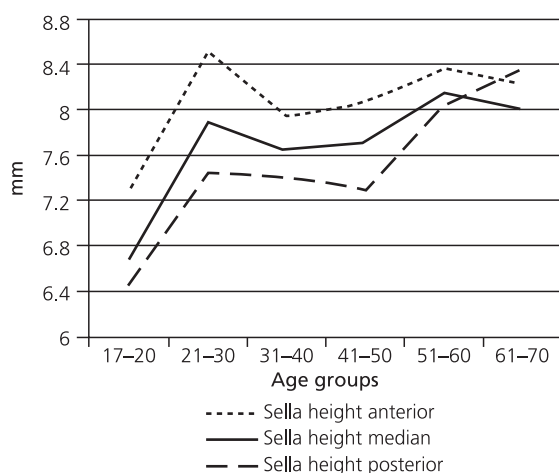


Figure 4. Graphic analysis of sella height anterior, median and posterior according to age groups.

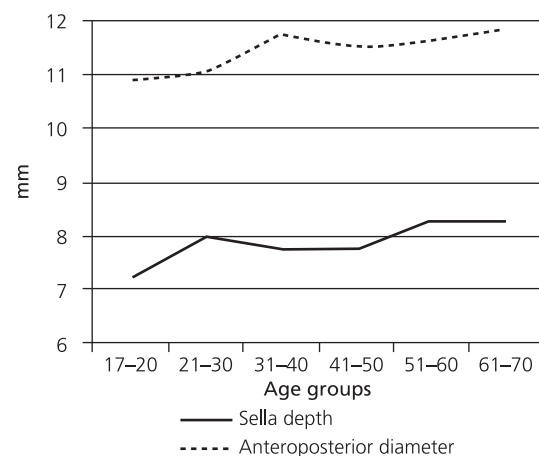


Figure 5. Graphic analysis of sella depth and anteroposterior diameter according to age groups.

Table 3

Comparison of the parameters of sella turcica in our study in a Turkish population with previous studies (data are in mm).

	Sella length	Sella width	Sella height anterior	Sella height median	Sella height posterior	Sella area	Sella depth	Sella AP diameter
Ruiz et al. ^[7]	10.31	-	-	6.33	-	41.21	-	-
Shah et al. ^[8]	11.3	-	-	-	-	-	9.9	13.9
Najim and Al-Nakib ^[13]	9.22	-	-	-	-	-	7.56	11.56
Olubunmi et al. ^[15]	9.81	-	-	-	-	-	8.49	11.37
Nagaraj et al. ^[16]	9.52	-	-	-	-	-	8.21	11.83
Present study	9.18	10.41	11.83	10.83	10.54	69.15	7.87	11.48

females in the adult period. In short, we could not find any studies to support these differences we observed between the genders.

In our study, there was a statistically significant increase in sella turcica length, width, median and posterior height and area with age. In the study by Najim and Al-Nakib,^[13] a statistically significant difference was noted only in sella depth. Chauhan et al.^[4] reported that sella dimensions were larger in the higher age group compared to the lower age group. Similarly, Preston^[18] determined a close correlation between sella area and age. Nagaraj et al.^[16] described increasing sella depth and AP diameter with increasing age. Hasan et al.^[14] reported that sella turcica dimensions differed significantly between age groups. Conversely, Olubunmi et al.^[15] determined that sella turcica dimensions showed no statistically significant difference with age. In summary, it appears from our study and the majority of earlier studies that there is an increase in sella dimensions with age.

It has been reported that radiological methods including CT and magnetic resonance imaging (MRI) provide more sensitive results compared to cephalometric radiography in conditions involving this anatomic area such as pituitary gland tumors.^[4,19] We, therefore, believe that our CT study provides more accurate results than other studies that typically use cephalometric radiography.

Knowing the normal anatomy and variations of sella turcica is important for neurologists and neurosurgeons who deal with the pathologies of this area. We believe that sella turcica dimensions of the Turkish population obtained with CT in this study will provide guidance to clinicians for pituitary gland morphometry and that these measurements can be used in detecting pathologies in the sellar and parasellar area.

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