Evaluation of Shape and Size of Sella Turcica Using Computerized Tomography in Saudi Populations

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Abstract

This study design to measure the size and shape of normal Sella turcica, were samples chosen among individuals from adult Saudi populations aged 19-99 years. A total of 210 samples (125 males and 85 females), and the data collected in period from August 2019 to February 2020. Anteroposterior dimension, length and depth of Sella turcica were measured in each case and find out three unique shapes; the circle shape represents 40.5% with 85 patients, the ovoid shape 42.4% with 89 patients while the flat shape 17.1% with 36 patients, measurements obtained from measuring of Sella turcica, were the mean ± standard deviation for age was 47.59 ± 20.289 years, length, Width, AP and volume of Sella turcica was 8.07 ± 2.06mm, 7.408±1.64 mm, 10.11±2.08mm and 339.52±203.69mm respectively. The mean length of sella turcica for male and female was 8.010 and 8.165 mm, the Width for male was 7.215 mm and for female 7.692 mm, AP diameter for male 10.050 and for female 10.193mm, the volume of sella turcica for male was 329.139 and for female 354.781mm, so there is no difference between male and females. There is linear correlation between age of study group and the measured parameters from 19-99 years. Analysis of variance test show that there was no significant difference between the Sella measurements, for length and patients age, where the p-value was 0.285 and for Width, AP and volume the p.value was 0.222, 0.128 and 0.067 respectively. CT can be used to assess the Sella turcica, and further studies on how the dimensions of the Sella turcica are interrelated with pathological conditions should be conducted with the use of advanced imaging methods. Sella turcica dimensions of the Saudi population obtained by CT in this study can be used in estimating pituitary gland size and in determining any pathology in the sellar and parasailer regions.

Keywords: Sella turcica, pituitary gland, Computed Tomography, Brain.

INTRODUCTION

The sella turcica is an important saddle-shaped structure that houses the pituitary gland and is located in the middle cranial fossa [1]. 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 [2]. 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 [1, 3]. Close interactions exist during the development of the hypothalamus, pituitary gland, and oral cavity in early embryonic life [1, 4]. Any defect in the development of these tissues may lead to anatomical and functional disorders [5]. Many studies have focused on the morphology of the sella turcica and the relationship between its dimensions and general craniofacial deviations [6-9].

The effect of deviations in the morphology of the sella turcica in individuals with clefts has been reported in several 2-dimensional cephalometric studies [3, 4, 10]. However, the 2-dimensional representation of an abnormality does not actually provide complete information about its structure [4]. Only advanced imaging techniques such as computed tomography (CT) or cone-beam (CB) CT can generate more precise information about the sellar region [4]. CBCT produces hard-tissue images of a similar quality to those of CT. However, the images are obtained with less expensive equipment and components, a reduced patient
examination time, and a significantly lower radiation dose than with conventional CT [11].

For diagnosis of facial skeletal type and assessment of orthodontic treatments, several points in the craniofacial region of patients are used as reference points in tracing lateral cephalometry radiographs. Sella turcica is among the most important orthodontic landmarks. Sella point is of special significance due to its role as the central reference point in the assessment of cranial morphology and intermaxillary relations [12].

The various variables measured in anthropometry include; weight, height, length, widths and thickness of the various parts of the body. These indices are used for forensic analysis as well as gender, race and age determination [13]. Sella Turcica is an important anatomical structure that lies at middle cranial fossa of the skull, containing the pituitary gland. It derives its name from the comparative shape to Turkish saddle [14]. The desendency in saddle is distinguished as pituitary fossa or hypophyseal fossa while the pituitary gland is located in the fossa. Sella turcica is bounded anteriorly by tuberculum sellae, posteriorly by dorsum sellae and inferiorly by the bony roof of the sphenoidal air sinus [15-17]. There are 2 (two) anterior and two (2) posterior clinoid processes. The anterior clinoid process is derived from anterior and medial projections of lesser wing of sphenoid bone, while posterior clinoid process stand for termination of dorsum sellae. Computerized Tomographic Scan (CT Scan) on the other hand, refers to ionizing radiation that is made up of an X-rays which can be used for image reconstruction using a computer. However, CT Scan has lower radiation toxicity and more costly compared to simple radiograph [19, 20].

Changes in sella turcica of children are not prominent and visible as in adults. Some tumours and associated increased intracranial pressure conditions do not cause remarkable changes in sella shapes and size, unless they are chronic in nature and changes resolved rapidly with the treatment of the condition [21]. Other changes associated with pediatric sella turcica are hypertrophic and hypotrophic posterior clinoid process, oblique contour of the floor [22]. Oblique anterior wall sella has been documented in normal children and those with Seckel syndrome, lumbosacral myelomeningocele, Down’s syndrome as well as both prenatal and postnatal fragile X [23]. Sella bridge appears when there is union between anterior and posterior clinoid process of the sella turcica [24, 25]. It can be classified into type A and type B. Type A is a ribbon-like while type B is just a bony projection of either anterior or posterior clinoid process [26]. Sella bridge is a normal variant of sella shape and was reported by several workers.

Several studies conducted on the shape of sella turcica have concluded that the morphological appearance of the sella turcica is established in the early embryonic structure.

Profile radiographs of 16 children born with myelomeningocele revealed an altered shape of sella present during foetal life [27, 28] found, in a foetus with holoprosencephaly, that the area of the sella turcica also displayed malformations. In children with fragile X and Down syndrome, a change of sella shape was evident pre-natally and continued post-natally [29, 30].

**Methodology**

This is prospective descriptive study conducted in King Abdul-Aziz Specialist Hospital and King Faisal Specialist Hospital to determine the size and shape of Sella turcica using CT scan in relation to age and gender of individual. The subject included were chosen among individuals from adult Saudi population aged 19-99 years admitted to department of radiology for any reason and brain computed tomography (CT) scanning. A total of 210 samples (125 males and 85 females) who met the inclusion criteria, were recruited and studied from August 2019 to February 2020.

**Equipment’s and Accessories Used in Data Collection**

Two type of CT Scanner used to perform the study GE – discovery CT750 (180) detectors and GE – revolution discovery (256) detectors, Radiology CT Reports, Patient’s Records, Radiology Information System Software and Normal, lateral CT images

Data collection sheet was designed containing all the variables. The age and gender of the patients was taken before the CT scan. After scanning the patients, the consultant radiologists reported the examination. When the report indicates that the examination was normal, then the biometric dimensions (length, AP diameter and Width) of the Sella turcica were measured using the software measuring tools in the computers of the CT workstation.

**Measurements Technique**

Measurements were performed using 3 parameters on sagittal section is closest to mid sagittal section. The length of the Sella turcica was measured as the distance from the tuberculum Sella to the tip of the dorsum sellae, and the Width of Sella turcica was measured perpendicular to this line to the deepest point on the floor. The anterior-posterior greatest diameter of the sella was measured to a point on the posterior inner wall of the pituitary fossa furthest from the tuberculum sellae as shown in Figure-1 below [9].
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Fig-1: The following points were digitized: porion (Po) and orbitale (Or); tuberculum sella (TS), the most anterior point of the contour of the sella turcica; posterior clinoid (PClin), the most anterior point of the PClin process

Ethical consideration: Approval from the ethical committee of the College of scientific Research Center at Taif University was obtained.

RESULTS

Table-1: Show statistical parameters for all patient's variables

|       | Mean | Median | STD  | Min | Max |
|-------|------|--------|------|-----|-----|
| Age   | 47.59| 44.50  | 20.29| 19  | 98  |
| Length| 8.07 | 8      | 2.06 | 0.8 | 15.7|
| Width | 7.40 | 7.2    | 1.64 | 0.8 | 14.7|
| AP    | 10.11| 10     | 2.08 | 4.3 | 16.9|
| Volume| 339.52| 293.79| 203.69| 26.8| 1379.7|

Table-2: Show age group for all patients with mean and standard deviation for each group

| Age Group      | Mean of Volume | STD of volume |
|----------------|----------------|---------------|
| Less than 19 Years | 166.28         | 32.41         |
| 19 - 25 Years    | 279.46         | 133.73        |
| 26 - 40 Years    | 317.80         | 149.43        |
| 41 - 50 Years    | 363.75         | 259.36        |
| More than 50 Years | 374.22         | 228.66        |

Table-3: Show statistical parameters for measurement parameters of sella turcica according to the patients gender

| Gender | N   | Mean | Std. Deviation | Std. Error Mean |
|--------|-----|------|----------------|-----------------|
| Length | Male| 125  | 8.010          | 2.1078          | .1885           |
|        | Female| 85  | 8.165          | 1.9850          | .2153           |
| Width  | Male| 125  | 7.215          | 1.6770          | .1500           |
|        | Female| 85  | 7.692          | 1.5599          | .1692           |
| AP     | Male| 125  | 10.050         | 2.1858          | .1955           |
|        | Female| 85  | 10.193         | 1.9277          | .2091           |
| Volume | Male| 125  | 329.139        | 206.7629        | 18.4934         |
|        | Female| 85  | 354.781        | 199.3108        | 21.6183         |
Table-4: Show analysis of variance between the patients age with measurement variables of sella turcica

|       | Sum of Squares | df | Mean Square | F    | p.value |
|-------|----------------|----|-------------|------|---------|
| LENGTH |                |    |             |      |         |
| Between Groups | 309.658 | 68 | 4.554       | 1.120| .285    |
| Within Groups   | 573.421 | 141| 4.067       |      |         |
| Total            | 883.080 | 209|             |      |         |
| DEPTH         |                |    |             |      |         |
| Between Groups | 203.279 | 68 | 2.989       | 1.167| .222    |
| Within Groups   | 361.317 | 141| 2.563       |      |         |
| Total            | 564.596 | 209|             |      |         |
| AP            |                |    |             |      |         |
| Between Groups | 342.101 | 68 | 5.031       | 1.259| .128    |
| Within Groups   | 563.547 | 141| 3.997       |      |         |
| Total            | 905.648 | 209|             |      |         |
| Volume        |                |    |             |      |         |
| Between Groups | 3427935.340 | 68 | 50410.814  | 1.356| .067    |
| Within Groups   | 5243327.271 | 141| 37186.718  |      |         |
| Total            | 8671262.611 | 209|             |      |         |
| GENDER        |                |    |             |      |         |
| Between Groups | 16.923 | 68 | .249        | 1.042| .412    |
| Within Groups   | 33.672 | 141| .239        |      |         |
| Total            | 50.595 | 209|             |      |         |

Fig-2: Show correlation between the volume of sella turcica and patients age

**DISCUSSIONS**

The mean and standard deviation of various measurements obtained from measuring of Sella turcica were the mean ± standard deviation for age was 47.59 ± 20.289 years, length, Width, AP and volume of Sella turcica was 8.07 ± 2.06mm, 7.408±1.64 mm, 10.11±2.08mm and 339.52±203.69mm respectively.

Relations between age group with volume of Sella turcica, were the age divided to five group (less than 19 years), (19-25 years), (26-40 years), (41-50 years) and (more than 50 years), the mean ± standard deviation for patients with age < 19 years was 166.28±32.41 mm, 19-25 years was 279.46±133.73 mm, for age 26-40years, 41-50 years and > 50 years was 317.80±149.43mm, 363.75±259.36 mm and 374.22±228.66 mm respectively.

The mean and standard deviation for measurements obtained from males and females are tabulated above Table 3. The mean length of sella turcica for male and female was 8.010 and 8.165 mm, the Width for male was 7.215 mm and for female 7.692 mm, AP diameter for male 10.050 and for female 10.193mm, the volume of sella turcica for male was 329.139 and for female 354.781mm, so there is no difference between male and females. This finding confirmed with [31] reported that no statistically significant difference between Sella turcica diameters and gender. However, the study [32] reported significant different in linear dimension between genders in height and width.

The study found that Sella Turcica gave three unique shapes: the circle shape represent 40.5% with 85 patients, the ovoid shape 42.4% with 89 patients while the flat shape 17.1% with 36 patients, and found ovoid to be the most frequent shape and this result similar [33], for Bangladesh populations, who describe Sella shape with the three common shapes.

There is linear correlation between age of study group and the measured parameters from 19-99

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years. Analysis of variance test show that there was no significant difference between the Sella measurements, for length and patients age, where the p-value was 0.285. and for Width, AP and volume the p.value was 0.222, 0.128 and 0.067 respectively, and with gender give a good correlation were the p.value 0.412 and this is not consistent with [34] found a significant correlation between Sella Width and patient ages and this is agreed with [35] were found strong correlation between Sella height and gender.

The correlation between the volume of sella turcica and patients age, where the rate of change of volume increase with increase the patients age with rate 1.97 for each year as shown in Figure-2.

CONCLUSIONS

This study deal with measuring the size and shape of normal Sella turcica and find out three unique shapes; the circle shape represents 40.5% with 85 patients, the ovoid shape 42.4% with 89 patients while the flat shape 17.1% with 36 patients, measurements obtained from measuring of Sella turcica, were the mean ± standard deviation for age was 47.59 ± 20.289 years, length, Width, AP and volume of Sella turcica was 8.07 ± 2.06mm, 7.408±1.64 mm, 10.11±2.08mm and 339.52±203.69mm respectively. The mean length of sella turcica for male and female was 8.010 and 8.165 mm, the Width for male was 7.215 mm and for female 7.692 mm, AP diameter for male 10.050 and for female 10.193mm, the volume of sella turcica for male was 329.139 and for female 354.781mm respectively.

There is linear correlation between age of study group and the measured parameters from 19-99 years. Analysis of variance test show that there was no significant difference between the Sella measurements, for length and patients age, where the p-value was 0.285 and for Width, AP and volume the p. value was 0.222, 0.128 and 0.067 respectively. CT can be used to assess the Sella turcica, and further studies on how the dimensions of the Sella turcica are interrelated with pathological conditions should be conducted with the use of advanced imaging methods.

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