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Assessment of the Size of Sella Turcica among Nepalese Population by Computed Tomography

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ABSTRACT

Introduction: The deformity of the sella turcica is often a major clue that an abnormality exists within the cranium, hence a familiarity with the sella turcica anatomy and radiological appearance is important. The aim of this study was to assess the dimension of sella turcica of normal Nepalese people by using computed tomography scan of head and to correlate the dimension with the patient's age and gender.

Methods: This prospective study was performed in a tertiary hospital in Kathmandu. Data were collected over the period of 4 months from June to September 2018 with the total of 73 patients who underwent CT of head. The age and gender of the patients were noted. The dimensions of sella turcica were measured at the predefined three directions: length, depth and antero-posterior diameter of the sella turcica.

Results: The sella turcica had a mean length of 8.375mm, AP diameter of 7.029mm, and depth of 10.13mm.The dimensions of the sella turcica increased with age till the age of 80 years and then decreased.

Conclusions: This study concluded that the length, AP diameter and depth of the sella turcica vary with respect to age group. The length and depth of sella turcica were higher in males while AP diameter in females.

Keywords: *Cranium; Sella Turcica; Skull*

INTRODUCTION

The deformity of the sella turcica is often a major clue that an abnormality exists within the cranium, hence a familiarity with the sella turcica anatomy and radiological appearance is important.[1] One of the clinical significance of the sella turcica is the empty sella syndrome which is the condition of a shrunken or flattened pituitary gland.[2,3]

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The sella turcica also known as hypophyseal fossa is a saddle shaped depression in the body of the sphenoid bone in the human skull that houses the pituitary gland; it is a cephalometric landmark in the skull.[4] Anatomically, it is located in the sphenoid bone behind the chiasmatic groove and the tuberculum sellae situated within the middle cranial fossa and on a lateral skull radiograph, the image of the sella turcica is U-shape.[5] Any abnormality of the pituitary gland could manifest from an altered shape of sella turcica, to disturbance in regulation of secretion of glandular hormones.[6] Also, a deviation from the normal size and shape of the sella turcica due to its malformation may be implicated in an undetected underlying disease and it can be an indication of a pathological condition of the gland.[7,8] The anatomy of the sella turcica varies in size and shape; it has been classified into three types: round, oval and flat.[9] The floor of the sella turcica, which in most cases is concave, may be flat or even convex.[10] The sella turcica is usually demarcated by a dense, thin white line in lateral radiographs. It is sometimes more important to recognize this feature than to estimate the size of the fossa.[11] Many studies have reported several changes in the size of the sella turcica in various pathological conditions such as Down syndrome, Williams's syndrome, Sickle disease and lumbosacral myelomeningocele. The present study made use of lateral Computed Tomography images of the skull was undertaken to establish the normal dimensions of sella turcica in Nepalese population with a view to establish whether the size of the sella turcica vary with age and gender.

The result of this study will provide a base line data on the normal size of the sella turcica for this population, which could be of assistance in the evaluation and detection of pathological conditions of the sella turcica.

METHODS

This cross sectional prospective study was performed in a tertiary hospital in Kathmandu. Data were collected over the period of 4 months from June to September 2018 with the total of 73 patients who underwent CT of head. Siemens Somatom Definition AS+ machine was used. Patients having pathological conditions like Down syndrome, Williams syndrome, Sickle disease, lumbosacral myelomeningocele, associated hypopituitarism and dwarfism with small sella turcica were excluded.

The age and gender of the patients were noted. The dimensions of sella turcica were measured at the predefined three directions: length, depth and antero-posterior diameter of the sella turcica. The normal size of the sella turcica was measured by tracing the contour of the pituitary fossa from the tip of the dorsum sellae to the turberculum sellae and then following a straight line from the turberculum sellae back to the origin. This corresponds to the position of the diaphragmatic sellae. The length of the sella turcica was measured as the distance from the turberculum sella to the tip of the dorsum sellae, and the depth of sella turcica was measured perpendicular to this line to the deepest point on the floor.

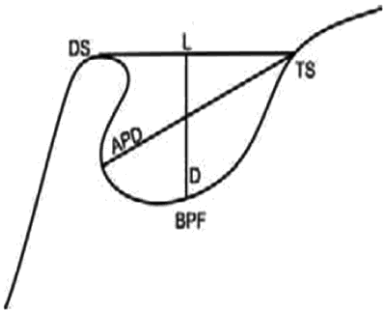

Figure 1: *Illustration of normal morphology of sella turcica (TS = Turberculum Sellae, DS = Dorsum Sellae, BPF = Base of pituitary fossa).*

According to Silverman et al.[12,13] the following lines in the above diagram were measured

to determine the size of the sella turcica; the reference lines used were situated in the midsagittal plane.

A) The Length: was obtained by measuring the distance from the tuberculum sellae to the tip of dorsum sellae.

B) The Depth: was obtained by measuring a perpendicular from the line mentioned above to the deepest point on the floor of the fossa.

C) The Antero-posterior Greatest Diameter: was obtained by measuring from the tuberculum sellae to the furthest point on the posterior inner wall of the fossa, below the dorsum sellae.

Multiple planar reconstructions were generated on a view workstation (Siemens Medical Systems). The slices were manually adjusted for mid sagittal section of the brain in bone window with sharp resolution. The dimensions were measured with an electronic caliper. Data were analyzed using SPSS Windows Version 20. Descriptive statistics of Mean ± Standard error of mean (S. E. M) were used to summarize the data obtained. Two-sided P values were calculated using the Paired sample T-test for observed variables. P values < 0.05 were considered statistically significant.

RESULTS

The sample consisted of 73 subjects; 33 female (45.2%) and 40 male (54.8%). The samples were classified according to the age from <10 to >81, as presented in Table 1. Data were presented as mean and standard deviation for all variables. Detailed results are shown in the tables and figures below. (Figure 2)

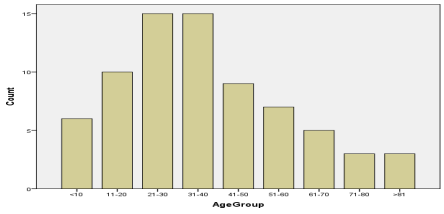

Figure 2: *Bar chart of the distribution of sample size according to the age group.*

Table 1: Distribution of sample size according to age group

Age group	Frequency	Percentage
<10	6	8.2
11-20	10	13.7
21-30	15	20.5
31-40	15	20.5
41-50	9	12.3
51-60	7	9.6
61-70	5	6.8
71-80	3	4.1
>81	3	4.1
Total	73	100

Table 2: Calculation of mean and standard deviation of Age, Length, AP diameter and Depth of the sella turcica.

Variables	N	Mean	Std. Deviation
Age	73	38	20.76
Length	73	0.8375	0.20115
AP diameter	73	0.7029	0.13183
Depth	73	1.0130	0.20219

The length, AP diameter and depth for female subjects were 0.8267cm, 0.7112cm and 1.0021cm respectively where as these measured 0.8465cm, 0.6961cm and 1.02202cm for male subjects. (Table 3)

Table 3: Mean and Standard deviation of Length, AP diameter, and Depth of sella turcica with respect to gender.

Gender		Length [cm]	AP diameter (cm)	Depth (cm)
Female	**Mean**	0.8267	0.7112	1.0021
	SD	0.16378	0.12978	0.18854
Male	**Mean**	0.8465	0.6961	1.0220
	SD	0.22914	0.13476	0.21475
Total	**Mean**	0.8375	0.7029	1.0130
	SD	0.20115	0.13183	0.20219

The length of sella turcica was found to be highest for the age group of 71-80 years measuring 1.1167cm and lowest for the age group less than 10 years measuring 0.7276cm. The AP diameter was found to be highest for the age group of 71-80 years measuring 0.87cm and lowest for the age group of less than 10 years measuring 0.5067cm. The depth is highest for the age group of 71-80 years measuring 1.42cm and lowest for age group less than 10 years measuring 0.7517cm. (Table 4).

Correlation between Age, Length, AP diameter and Depth of the sella turcica and paired sample t-test between all the variables are shown in table 5 & 6.

Table 4: Mean and standard deviation of length, AP diameter and depth of sella turcica with respect to age group.

Age Group		Length[cm]	AP diameter[cm]	Depth[cm]
<10	**Mean**	.7267	.5067	.7517
	Std. Deviation	.08501	.07891	.06524
11-20	**Mean**	.7520	.5970	.8820
	Std. Deviation	.15605	.09044	.12506
21-30	**Mean**	.8253	.7707	1.0167
	Std. Deviation	.16080	.09369	.13468
31-40	**Mean**	.8513	.7117	1.1087
	Std. Deviation	.27034	.10145	.25139
41-50	**Mean**	.8211	.7067	1.0300
	Std. Deviation	.19029	.09670	.13000
51-60	**Mean**	.8729	.7371	.9914
	Std. Deviation	1.3187	1.2958	0.9026
61-70	**Mean**	.9040	.7500	1.0160
	Std. Deviation	.25442	.17088	.10668
71-80	**Mean**	1.1167	.8700	1.4200
	Std. Deviation	.25166	.17321	.29462
>81	**Mean**	.9133	.7300	1.0633
	Std. Deviation	.16862	.06557	.07095
Total	**Mean**	.8375	.7029	1.0130
	Std. Deviation	.20115	.13183	.20219

Table 5: Correlation between Age, Length, AP diameter and Depth of the sella turcica.

		Age	Length	AP diameter	Depth
Age	**Pearson correlation**	1	.332**	.423**	.447**
	Sig. (2-tailed)		.004	.000	.000
Length	**Pearson correlation**	.332**	1	.336**	.472**
	Sig. (2-tailed)	.004		.004	.000
AP diameter	**Pearson correlation**	.423**	.336**	1	.581**
	Sig. (2-tailed)	.000	.004		.000
Depth	**Pearson correlation**	.447**	.472**	.581**	1
	Sig. (2-tailedd)	.000	.000	.000	

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6: Paired sample t- test between all variables.

Mean		Paired Differences					t	df	Sig. (2-tailed)
		Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
Pair 1	**Length – AP diameter**	.13459	.20001	.02341	.08792	.18125	5.749	72	.000
Pair 2	**AP diameter – Depth**	-.31007	.16527	.01934	-.34863	-.27151	-16.030	72	.000
Pair 3	**Depth – Length**	.17548	.20726	.02426	.12712	.22384	7.234	72	.000

The scatter plot diagrams showed the high positive correlation between age and dimensions of the sella turcica. (Figures 3, 4, 5)

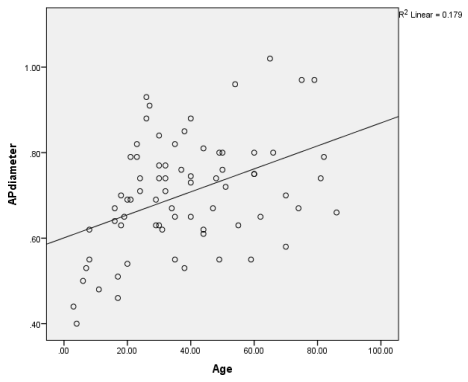

***Figure**3: Scatter plot diagram of Antero-posterior diameter of sella turcica and age.*

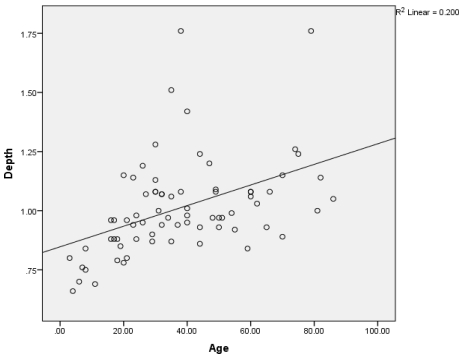

***Figure 4:** Scatter plot diagram of the depth of sella turcica and age.*

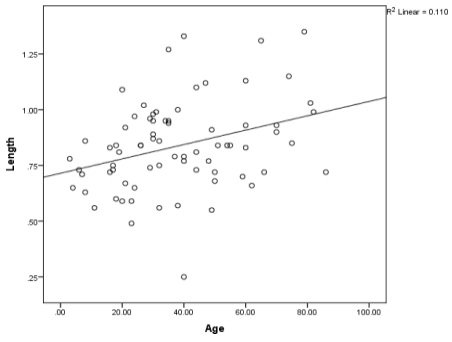

***Figure 5:** Scatter plot diagram of length of sella turcica and age.*

DISCUSSION

The present study investigated the normal dimensions of the sella turcica and the relationship with gender and age in Nepalese population, using computed tomography of patients who underwent CT head examination. There was a statistically significant difference between the dimensions of the sella turcica. Sella turcica dimensions reported by many researchers were based on Caucasian populations and the data were mostly obtained from skull radiographs.[11,15] Based on our investigation, it was observed that, this was the first time the sella turcica being investigated by computed tomography in Nepalese population. Comparing the values from the study with that of Zegga who reported values of length 11.4mm, depth 9.3mm and antero- posterior diameter 14.0 mm; it was obvious that the values of our study were less.[14] This difference could be due to the radiographic method. Similar pattern was noted by Asad et al.[16] who reported that the mean length of sella turcica of 14.9mm. Axelsson et al.[17] reported linear dimension (antero-posterior diameter) even larger than the values reported by Zegga. Kantor conducted a study in 1999 with sample of 325 orthodontic patients, varying from 6 to 49 years with mean age of 14.8 years. They measured linear dimensions of sella turcica on the lateral cephalogram. The antero-posterior diameter ranged from 6.0 to 17.0mm, mean value was found to be 10.9 ± 1.8 mm, while the depth varied from 2.5 to 12.5mm with a mean of 7.6 ± 1.7 mm.[7]

There was a significant correlation of mean length, antero-posterior diameter and depth of the sella turcica with the age of the individuals. The study done by Nagaraj et al.[18] confirmed that the depth and AP diameter gradually increased with age, however length showed no significant increase. The outcome of our study concluded that the all the dimensions of the sella turcica increased with age till the age of 80 years and then decreased.

Our study concluded there was no significant difference in the size with gender. Ogunnaike et al.[19] concluded that the males tend to have slightly larger sella turcica dimensions than the females. The study done by Arshiya S et al. found no difference in the size of sella turcica between males and females.[21]

Our study used the computed tomography which gave a more exact impression of

anatomical features thereby avoiding this drawback associated with the radiographic method. The values reported were lower than those reported in Caucasian studies. The sample size was not adequate to generalize the result.

The size of pituitary gland can be roughly estimated from the dimensions of sella turcica obtained in pathological conditions since disease conditions of the pituitary ultimately affect the size of the sella turcica. CT and MRI give more accurate values than radiographic method and in this regard, the sella turcica has a "largely constant dimensions" except in pathological conditions. It is recommended that further investigations should be carried out on the assessment of the possible correlations between sella turcica dimensions and cephalometric parameters and variations in sella turcica dimensions among the various ethnic groups.

CONCLUSIONS:

The sella turcica has a mean length of 8.375mm, AP diameter of 7.029mm, and depth of 10.13mm. This study concluded that the length, AP diameter and depth of the sella turcica vary with respect to age group. The length and depth of sella turcica were higher in males while AP diameter in females.

CONFLICT OF INTEREST

None

SOURCES OF FUNDING

None

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