

Study of Volume & Thickness of the Human Pineal Gland by 3d (Spiral) CT scan

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Abstract: The pineal gland has inspired novel avenues of research due to its unique nature and its discrete association with the sympathetic nervous system. The pineal gland is very important human endocrine gland because of its location and size. The aim of study was to find out the morphometric parameters of pineal gland and their variations in the different age groups. For this 100 cases were scanned by 3D CT Scan out of which 73 are males & 27 are females from mp region. All the measurements were taken in sagittal, coronal and axial view by CT scan & measurement done directly on computer on DICOM images using the DICOM viewer software. Statistical analysis was performed using SPSS 16.0 (SPSS Inc., Chicago, IL) & using statistical tools like mean, SD, t-test, diagrams, one way ANOVA analysis of variance for comparing different parameters. There was significant difference in thickness and volume ($p < 0.05$) between different age groups. In males significant difference was found in the volume between 41-50 and >50 age groups ($p < 0.05$). In females no significant difference was found in thickness and volume with respect to age groups. We concluded that to study the morphometric parameters of pineal gland by 3D CT Scan and their variations may help in certain radiological investigations & to distinguish healthy tissue from various pineal tumors.

Keywords: Pineal gland, Volume, Planimetry, Thickness, Variation.

I. Introduction

As advances in healthcare progress, more importance is being given to the glands of the endocrine system and the necessity of their proper functioning. Much is still to be researched and understood about the body's endocrine system, particularly the glands located in the brain.[1] The **pineal gland** also called the **pineal body**, **epiphysis cerebri**, or **epiphysis** is a small pine cone-shaped organ found in the brain of vertebrates. It produces and secretes melatonin in a circadian rhythm with higher levels in the dark phase and lower levels in the light phase. Scientific reports prove that there is significant relationship between the gland function and many systemic disorders. Obesity, hypertension and sudden infant death syndrome are examples of this. Structures like the adrenal cortex are also functionally connected with the pineal gland.[2] Pineal gland weight and volume vary greatly in respect of time, age, and physiological condition.[3] The present study was conceived, to see the any kind of variation in the different parameters of pineal gland with regard to the age of the individual, because its size and volume is related with its physiological functions.

II. Material and Methods

The study group consisted of 100 patients (age range: 21–79 years, average 39.69 SD 13.84 years) who had undergone cranial 3D CT scan studies at R.D. Gardi Medical College & Ujjain Charitable Hospital & Research Center Ujjain. It included 27 females & 73 males. Patients were excluded if there was any brain abnormality adjacent to the pineal gland, patients with any known endocrinologic disorder or malignant tumor as well as those who were undergoing radiation therapy or chemotherapy or if the required images were missing or destroyed.

All images were obtained with a 3D CT Scan Machine 128 slice of Wipro G Company. In this study, the pineal boundary was exactly identified on the sagittal sections taken in addition to coronal and axial views. Volume Estimation is done by using planimetry, which involves manually tracing the boundaries of objects of interest on images of sections is the most commonly used technique for estimation of volume.²⁰⁰

The volume (V) was calculated according to the formula: $V = 1/2 \times H \times L \times W$.²⁰¹ Statistical analysis was performed using SPSS 16.0 (SPSS Inc., Chicago, IL).

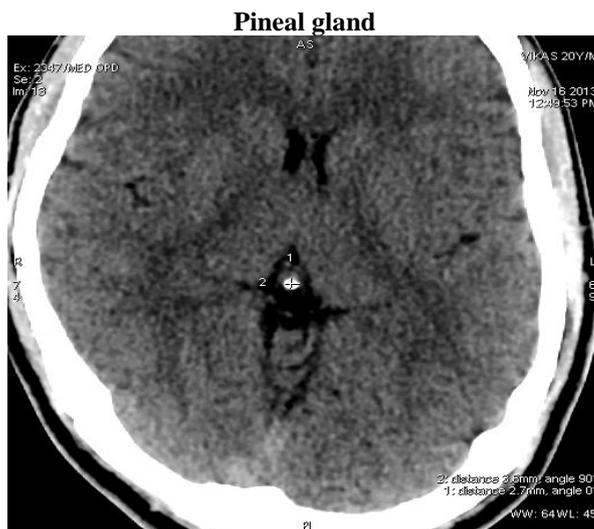


Figure No. 6: CT scan head (axial section) showing thickness of pineal gland.

III. Results & Observations

Statistical analysis was performed using SPSS 16.0 (SPSS Inc., Chicago, IL)

Table No. 1: One way ANOVA for different parameters of male with respect to age groups.

Variable	Source	Sum of Squares	Df	Mean Square	F	Sig.
Thickness	Between Groups	1.196	3	0.399	4.056	0.010*
	Within Groups	6.780	69	0.098		
	Total	7.976	72			
Volume	Between Groups	2061.033	3	687.011	2.500	0.067
	Within Groups	18964.880	69	274.853		
	Total	21025.913	72			

*** very significant; * significant; Ns – not significant

For comparing all age groups parameters in males we apply one way ANOVA technique. In the ANOVA table no significant difference was found in volume with respect to age groups ($p > 0.05$).

Table No. 2: One way ANOVA for different parameters of female with respect to age groups.

Variable	Source	Sum of Squares	Df	Mean Square	F	Sig.
Thickness	Between Groups	0.249	3	0.083	1.219	0.325
	Within Groups	1.563	23	0.068		
	Total	1.812	26			
Volume	Between Groups	1338.533	3	446.178	1.177	0.340
	Within Groups	8720.413	23	379.148		
	Total	10058.946	26			

*** very significant; * significant; Ns – not significant

Comparing all age groups parameters in females we apply one way ANOVA technique. Nosignificant difference was found in thickness & volume with respect to age groups ($p > 0.05$).

Table no. 3: One way ANOVA for different parameters with respect to age groups.

Variables	Source	Sum of Squares	Df	Mean Square	F	Sig.
Thickness	Between Groups	1.089	3	0.363	3.951	0.011*
	Within Groups	8.819	96	0.092		
	Total	9.908	99			
Volume	Between Groups	2892.561	3	964.187	3.256	0.025*
	Within Groups	28424.073	96	296.084		
	Total	31316.634	99			

*** very significant; * significant; Ns – not significant

For comparing all age groups parameters we apply one way ANOVA technique.

Table no. 4: Pineal gland length, width, thickness and volume mean values in age related groups.

Age group (in years)	n	THICKNESS		VOLUME	
		Mean	SD	Mean	SD
<30	28	4.108 ³	0.1942	194.49	13.98
31-40	26	4.187 ³	0.4330	199.81 ³	19.25
41-50	26	3.915 ³	0.2897	187.48 ⁴	17.85
>50	20	4.001	0.2309	201.45	17.62

*** very significant; * significant; Ns – not significant

1, 2, 3 & 4 represent different age groups of <30, 31-40, 41-50 & >50 respectively.

In above mentioned table, Significant difference was found in the thickness between <30 and 41-50 age groups (p<0.05), significant difference was found in the thickness between 31-40 and 41-50 age groups (p<0.05). Significant difference was found in the volumes between 31-40 and 41-50 age groups (p<0.05), significant difference was also found in the volumes between 41-50 and >50 age groups (p<0.05).

IV. Discussion

Present study evaluates the morphometric parameters on living subjects with the help of radio-imaging (3D CT scan) in mp India. In a study Tapp and Huxley reported a gradual increase in the size of the pineal gland from puberty to old age in humans.[4,5] One such study was conducted by Golan et al. in 2002 on the pineal glands which were dissected out from the cadavers. [6] They found that Minimal gland thickness was observed in the group of 41–50 years. Maximal mean value appeared in the group of 31–40 years. In the group of 31–40 years the average volume of the pineal gland was the lowest. The highest mean volume was observed in the 31–50 years group. In our study, We observed The highest mean thickness in 31-40 years and lowest in 41-50 years age group. The highest mean volume in >50 years and lowest in 41-50 years age groups. So, in present study, the highest and lowest mean values of volume in age groups are not concordance with the study results done by Golan et al. on cadaveric pineal glands. It is difficult to explain the discrepancy in observations but it might be because of difference in the study method (CT scan & Cadaveric), difference in the race and difference in the age of puberty due to climatic conditions.[7,8]

V. Conclusion

In the present study, we evaluate the morphometric parameters of pineal gland by 3 D CT scan in a tertiary care institute in Ujjain. The conclusions of present study are - There is no particular pattern of the thickness, as it first increased with age and then decreased. The volume of gland slightly increased up to the age of 40 years with age and then there is fall in 41-50 years age groups, then again increase in volume was noted. There was significant difference in thickness and volume (p<0.05) between different age groups but no significant difference was found in width. In males significant difference was found in the volume between 41-50 and >50 age groups (p<0.05). In females no significant difference was found in thickness and volume with respect to age groups. In the pineal region, where a variety of tumors occur, including germ cell tumors knowledge of the normal size of the developing gland can help to distinguish healthy tissue from tumor. In addition, the lack of a blood-brain barrier in the normal pineal gland results in an inability to separate a normal gland from a neoplasm on the basis of enhancement characteristics.[9]

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