Original Article

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Morphometric Evaluation of Sell Turcica in Indian Ethinicity: A Cone Beam Computed Tomography Study

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Abstract

Objective: This study aims at age and sex related changes in length, width, depth and antero-posterior diameter of Sella turcica. The age and sex is also determined on the basis of length ,width, depth and antero-posterior diameter of sella turcica. *Material and Methods:* The CBCT images of 200 study subjects were analyzed prospectively. All the CBCT images are obtained at 90 Kvp, 4 mA for 11.3 seconds at FOV(17"x13.5") voxel size of 300. The length, width, depth and antero-posterior diameter of Sella turcica is measured by using Trophy Dicom Ink software programme on sagittal images (DICOM images). *Results:* The study population consists of 200 study subjects aged between 18 years to 70 years with a mean age of 30.49±14.626 years. The unpaired t-test shows no significant difference in length, anteroposterior diameter, width and depth of Sella turcica and gender of study subjects. One way ANOVA shows there is significant difference (P<.001) observed in length, width and depth in age groups while anteroposterior diameter has no significant difference in age groups. The study parameters are co-related with age by using Pearson correlation coefficient(r) and it shows that there was significant positive correlation between age of study subjects with length, width and depth of Sella turcica. However there was no significant correlation between age of study subjects with antero-posterior diameter. *Conclusion:* The Sella turcica can be used as morphometric tool in age and sex determination of a deceased person, medicolegal cases and forensic sciences.

Keywords: Sella Turcica; Cone Beam Computed Tomography; Age Determination**.**

Introduction

The Sella turcica, a saddle shaped depression in the upper surface of sphenoid bone is located between and bounded by the two anterior and two posterior clinoid processes. It is composed of three parts: the tuberculum sellae, pituitary (or hypophysial) fossa which lodging the pituitary gland and the dorsum sellae [1,2]. The Sella turcica can be classified into three segments: the anterior wall, the floor, and the posterior wall (dorsum sellae). Its shape can be round, oval or flat with the oval type being the most common.The pituitary gland is covered on its superior surface by the diaphragma sellae which is a fold of dura matter attached to the anterior and posterior clinoid process. Central part of the diaphragma sellae is pierced by an opening for pituitary stalk [2]. The lesser wing of the sphenoid bone is prolonged posteromedially to form the anterior clinoid processes. The posterior clinoid processes are located at the superolateral angles of the dorsum sellae. In constant and variable the middle clinoid processes are located posterolateral to the tuberculum sellae[1,3]. Occasionally the anterior and posterior clinoid process may fuse to form what is termed as a sella turcica bridge [3]. Similarly the middle clinoid process may at times be fused with the anterior clinoid process by a thin and small bony spicule to form a caroticoclinoid foramen [4].The pituitary gland is located in the Sella turcica. Thus, various pathologies of this gland can change the shape and size of Sella turcica. Some patients with an abnormal Sella turcica are suffering from several underlying diseases, intrasellar pituitary primary tumors, hypopituitarism or syndromes like Williams or Sheehan's syndrome

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[5,6]. This issue further emphasizes the significance of diagnosis of patients suffering from these conditions by noticing the abnormal shape of the Sella turcica [7,8]. The Sella turcica serves as an important anatomical reference in orthodontics partly because the s-point, placed centrally in the Sella region is a central fix point in cephalometric analysis and partly because the contour of the anterior wall is used in evaluation of craniofacial growth. Length, depth, and diameter of the Sella turcica have been calculated since the 1950s and 1960s [9,10]. Recently three-dimensional (3D) imaging modalities such as computed tomography (CT) and cone-beam computed tomography (CBCT) have played an important role in dentistry. CBCT requires relatively lower radiation doses than multi-slice CT [11] and has therefore become very popular for maxillofacial diagnosis and treatment planning. 3D images allow orthodontists to visualize craniofacial structures in three dimensions without involving the superimposition of anatomical structures [12,13,14].

Materials and Methods

This study was an observational study in which CBCT images of Head of 200 subjects aged between 18 years to 70 years were chosen. The CBCT images of subjects having no history of trauma, pathology diagnosed as normal have been included in study. Any CBCT with obvious pathology, trauma and facial asymmetry were excluded from this study. All the patients were examined on CS9300 carestream CBCT machine. The sagittal images were obtained at 90 Kvp 4 mA for 11.3 seconds at FOV(17"x13.5")voxel size of 300. Linear measurements of Sella turcica in the mid-sagittal plane were done by using Trophy Dicom Ink software programme. All the measurements are done in millimeters. The length of Sella turcica was obtained by measuring the distance between the tuberculum sellae to the tip of dorsum sellae. The depth of Sella turcica was measured at the deepest part of Sella and is at right angle to the direction of length of Sella turcica. The antero-posterior diameter of Sella turcica was measured by line drawn from the tuberculum Sella to the most posterior point on the posterior inner wall of the pituitary fossa (Figure 1& 2).

Statistical Analysis

Categorical variables will be presented in number and percentage (%) and continuous variables will be presented as mean and SD. Quantitative variables will be compared using Unpaired t-test between two groups and ANOVA test between three groups. Pearson correlation coefficients were used to determine the relationship between two scale parameters, while correlation was defined as a measure of the strength of a linear relationship between two variables. A p value of <0.05 will be considered statistically significant. The data will be entered in MS EXCEL spreadsheet and analysis will be done using Statistical Package for Social Sciences (SPSS) version 21.0.

Results

The study population consists of 200 study subjects aged between 18 years to 70 years with a mean age of 30.49±14.626 years (Table 1). Majority of the patients were between 18 to 35 years of age (Table 2). The sex ratio in our study population showed that male patient proportion was higher than female i.e. 56.5 % and 43.5% respectively (Table 3). The unpaired t-test is applied to know the significance between study parameters and gender.Table 4 shows mean distribution of parameters according to gender.No significant difference was observed in length, anteroposterior diameter, width and depth of Sella turcica and gender of study subjects.

The one way ANOVA test is applied to know the significance of study parameters in age groups. It was found that there is significant difference ($P<.001$) observed in length, width and depth in age groups while anteroposterior diameter has no significant difference compared to their age groups (Table 5). The study parameters are co-related in age groups in male population by using Pearson correlation coefficient. It showed that there was significant positive correlation between age of study subjects with length, anteroposterior diameter, width and depth of Sella turcica (Table 6). The mathematical equations derived by linear regression analysis can be used for prediction of sex if any of study parameters are known (Graph 1,2,3,4).

The study parameters are co-related in age groups in female population by using Pearson correlation coefficient (r). It showed that there was significant positive correlation between age of study subjects with length and width of Sella turcica in female population. However there was no significant correlation between age of study subjects with anteroposterior diameter and depth of Sella turcica (Table 7). The mathematical equations derived by linear regression analysis can be used for prediction of sex if any of study parameters are known(Graph

5,6). The study parameters are co-related with age by using Pearson correlation coefficient(r). It showed that there was significant positive correlation between age of study subjects with length, width and depth of Sella turcica. However there was no significant correlation between age of study subjects with antero-posterior diameter (Table 8). The mathematical equations derived by linear regression analysis can be used for prediction of sex if any of study parameters are known (Graph 7,8,9).

Table 1:

	Descriptive Statistics						
	N	**Range**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**	**Variance**
Age	200	67	3	70	30.49	14.626	213.909

Table 2:

Age Intervals	N	%
Below 18 years	32	16.0
18 to 35 years	112	56.0
36 to 60 years	42	21.0
Above 60 years	14	7.0
Total	200	100.0

Table 3:

Gender	N	%t
Male	113	56.5
Female	87	43.5
Total	200	100.0

Table 4:

	Gender	N	Mean	Std. Deviation	P value
Length	Male	113	10.4142	2.25721	0.170
	Female	87	9.9977	1.92178	
AP Diameter	Male	113	9.8115	1.79890	0.155
	Female	87	11.2092	10.20466	
Width	Male	113	10.4681	2.11649	0.062
	Female	87	11.0149	1.93694	
Depth	Male	113	9.8796	2.42381	0.213
	Female	87	9.4793	1.98583	

Applied unpaired t test for significance

Table 5:

	Age intervals	N	Mean	Std. Deviation	P value
Length	Below 18 years	32	9.7312	2.66100	<0.001*
	18 to 35 years	112	9.8098	1.51859	
	36 to 60 years	42	11.3452	2.67647	
	Above 60 years	14	11.4286	1.45466	
	Total	200	10.2330	2.12284	
AP Diameter	Below 18 years	32	9.2594	2.04559	0.741
	18 to 35 years	112	10.6009	8.96082	
	36 to 60 years	42	10.5024	2.47638	
	Above 60 years	14	11.3714	2.15386	
	Total	200	10.4195	6.87800	
Width	Below 18 years	32	9.9219	1.81619	<0.001*
	18 to 35 years	112	10.2902	1.83303	
	36 to 60 years	42	11.9214	2.22705	
	Above 60 years	14	12.1786	1.49470	
	Total	200	10.7060	2.05337	
Depth	Below 18 years	32	8.8094	2.53280	
	18 to 35 years	112	9.5723	1.94437	0.006*
	36 to 60 years	42	10.4595	2.45497	
	Above 60 years	14	10.5571	2.44437	
	Total	200	9.7055	2.24728	

Applied one way ANOVA test for significance. *Significant

Table 6:

	Pearson correlation coefficients (r)	P value	Mathematical Equations derived by linear regression analysis
Length	0.277	0.003*	11.531+1.933*Length
AP Diameter	0.367	<0.001*	0.212+3.206*AP Diameter
Width	0.336	<0.001*	5.522+2.497*Width
Depth	0.255	0.006*	15.304+1.656*Depth

Table 7:

	Pearson correlation coefficients (r)	P value	Mathematical Equations derived by linear regression analysis
Length	0.240	0.025*	12.771+1.620*Length
AP Diameter	-0.038	0.727	29.507+(-0.048)*AP Diameter
Width	0.415	<0.001*	(-1.689)+2.783*Width
Depth	0.193	0.073	17.010+1.261*Depth

Table 8:

	Pearson correlation coefficients (r)	P value	Mathematical Equations derived by linear regression analysis
Length	0.271	<0.001*	11.401+1.865*Length
AP Diameter	0.027	0.703	29.888+0.058*AP Diameter
Width	0.348	<0.001*	3.972+2.477*Width
Depth	0.240	0.001*	15.325+1.563*Depth

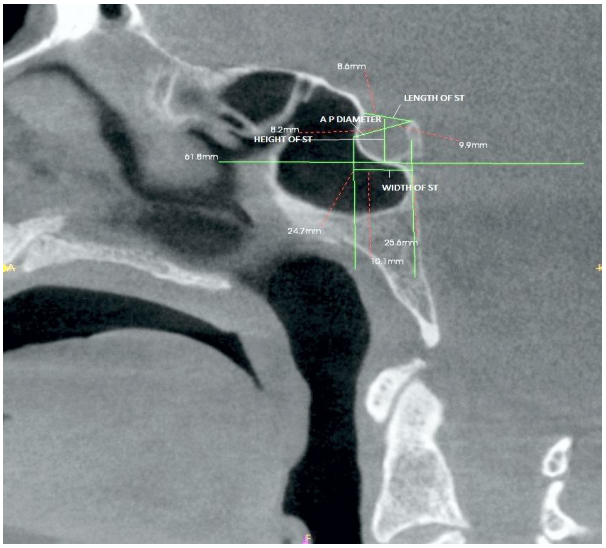


Fig. 1: The sagittal section (CBCT) showing the measurements of study parameters in male subjects

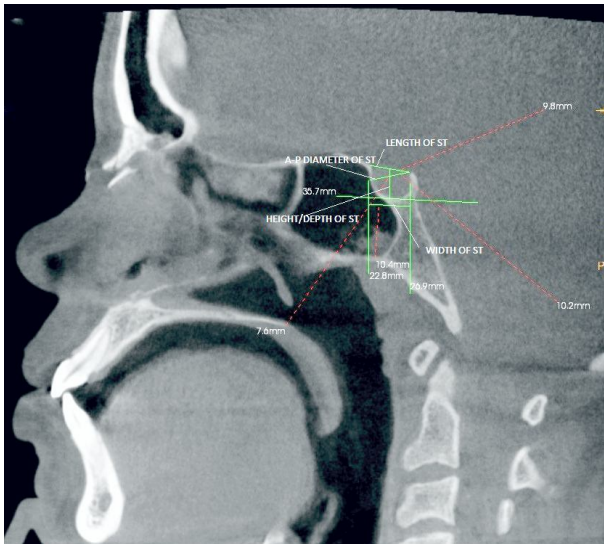
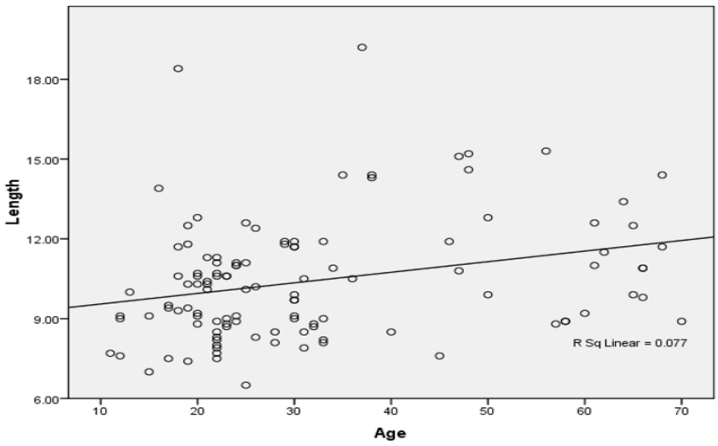
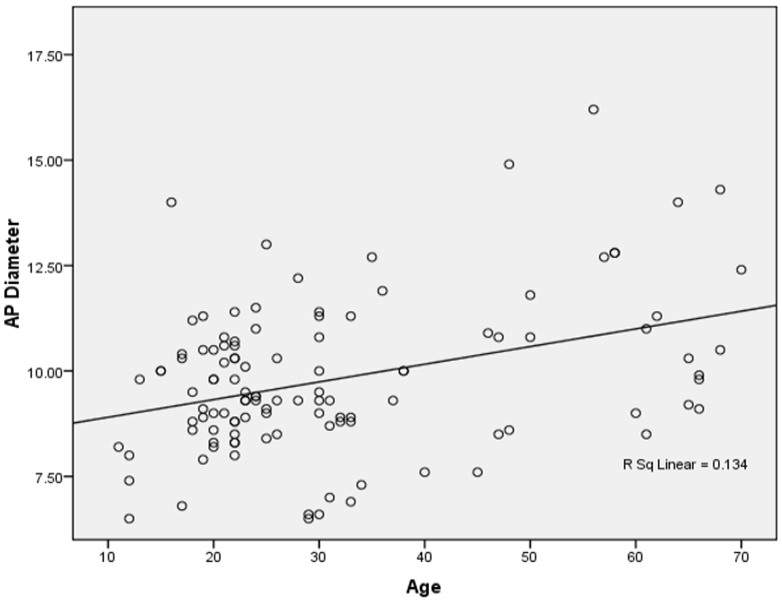


Fig. 2: The sagittal section (CBCT) showing the measurements of study parameters in female subjects

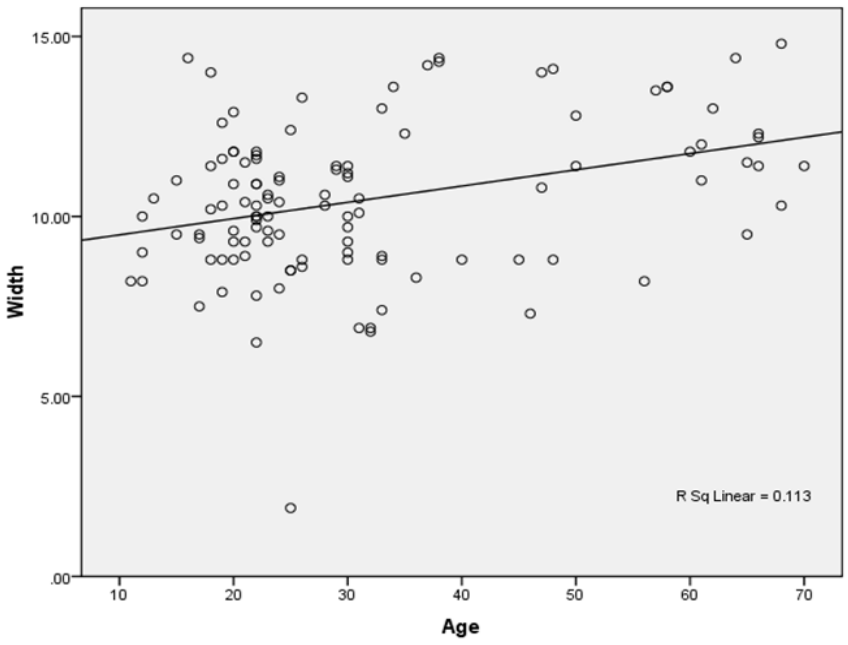


Graph 1

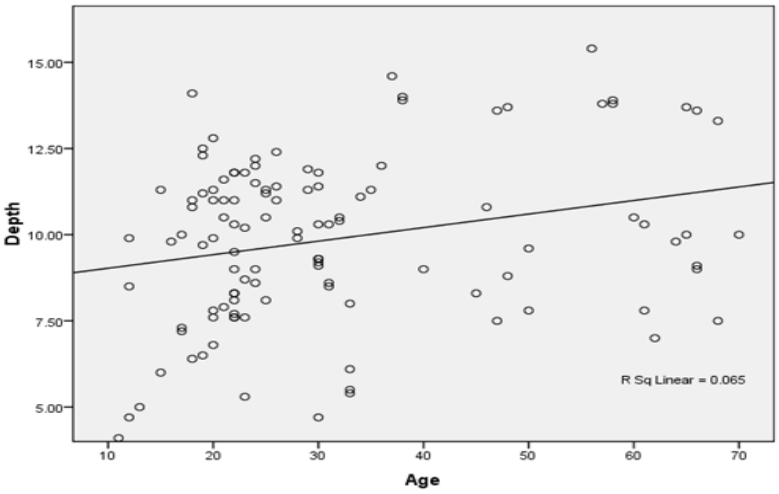
Graph 2



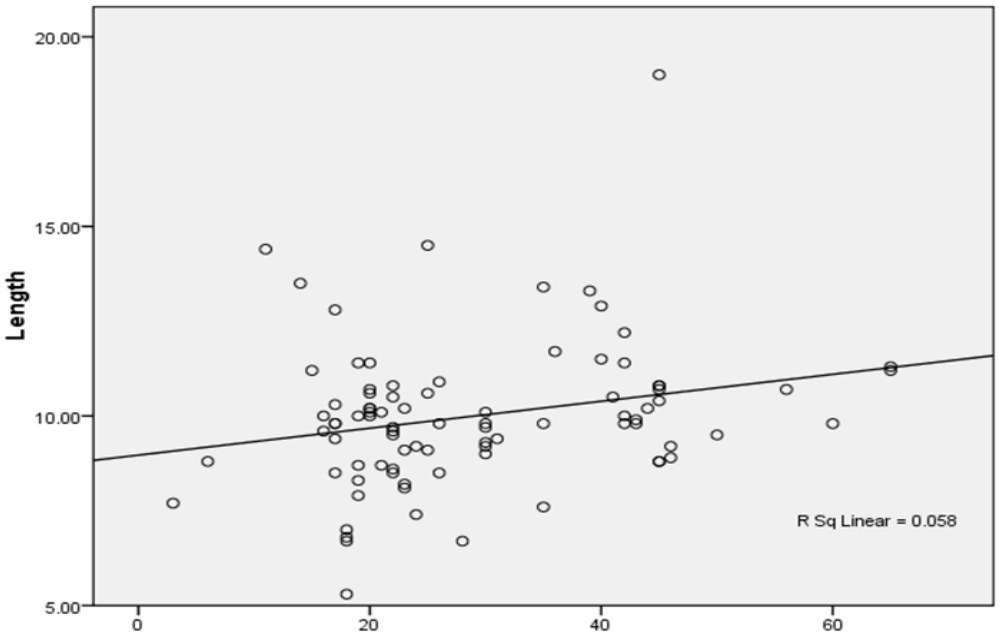
Graph 3



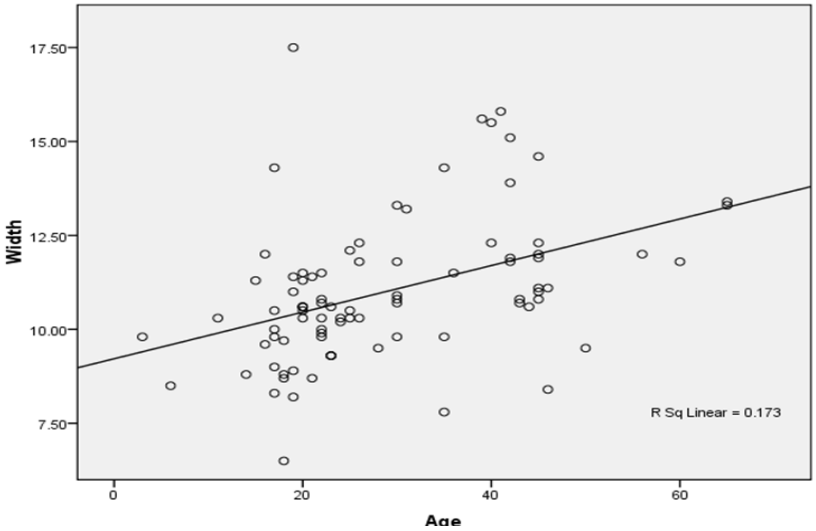
Graph 4



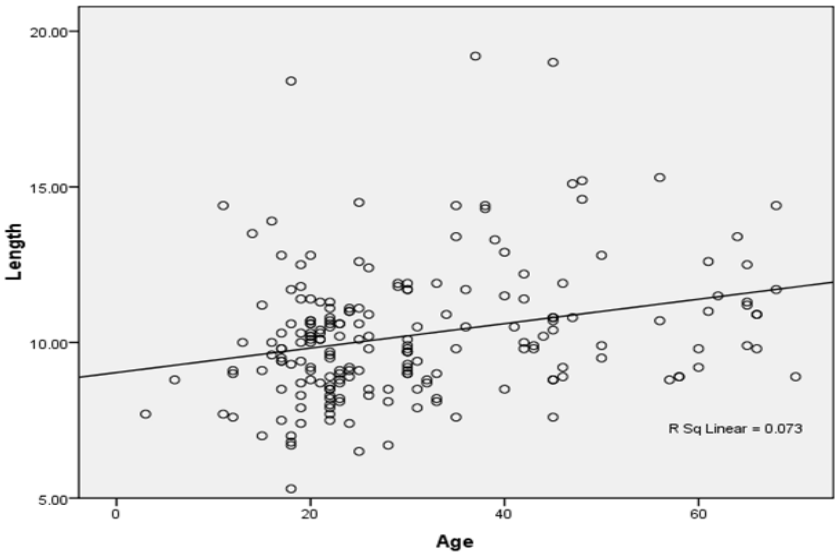
Graph 5



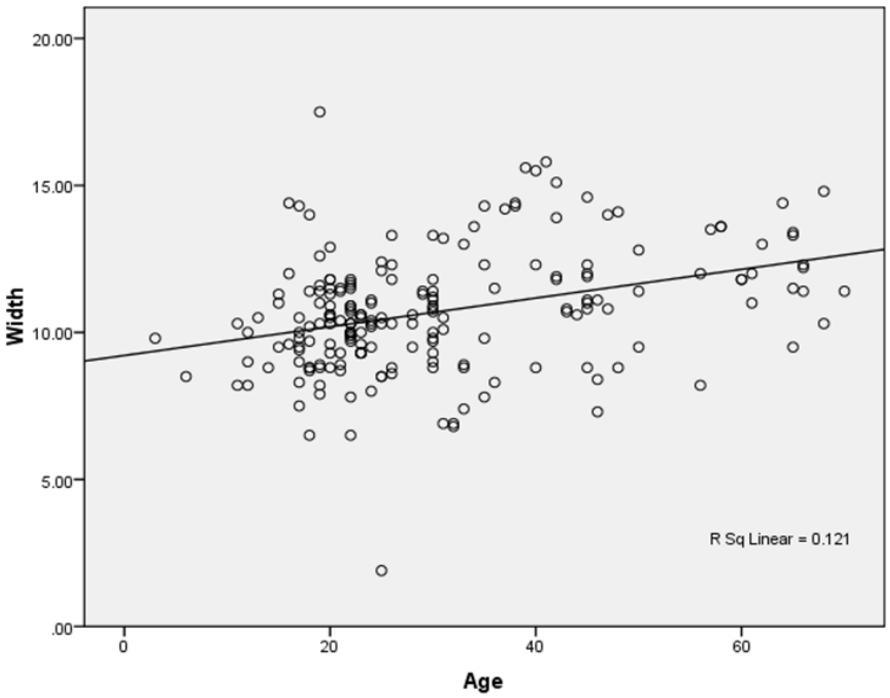
Graph 6



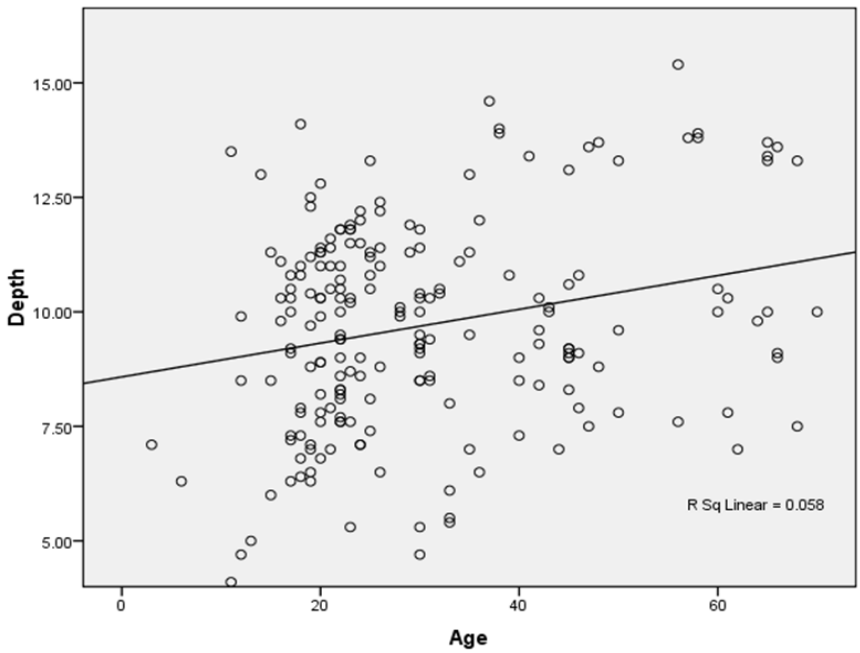
Graph 7



Graph 8



Graph 9



Discussion

The importance of understanding the anatomy of sellar region and its variations is important to neurologists and neurosurgeons dealing with pathologies in this region [15,16,17]. Also sella turcica is of importance because within its center lies the 'sella point' which helps in evaluation of craniofacial morphology [18].

The shape and diameters of diaphragma sella opening are variable. It is either elliptical or round in shape. Its size is important for protection of the optic chiasma fibers in cases of suprasellar extension of pituitary tumors and for protecting the gland from transmitted pulsations of choroid plexus . Variations in the size and shape of the sellar opening provide explanation for direction of growth of pituitary tumors towards cavernous sinus and supra sellar region [16].

The elliptic shape incidence was approximately similar in both sexes (57.1% for female and 54.5% for male) [19]. Considering the gender, the length and

anteroposterior diameters of sella turcica were higher in female than in male while the depth was more in male. However there was no significance difference for these three parameters in relation with gender [19].

Alkofide EA et al [20] in Saudi population using radiographs, found that the average for length, depth and anteroposterior diameterwere (10.85 mm, 9.1 mm and 13.95 mm) respectively. Shah AM et al [7], in Turkish population using radiographs, reported that the average for length,depth and anteroposterior diameter were(11.35mm, 9.9mmand 13.90mm) respectively [21].

The size and shape of aperture in the centre of diaphragm sellae are variable. It is either round or elliptical in shape and is for the passage of stalk of pituitary gland. Its size is important in protecting the gland from transmitted pulsations of choroid plexus and for protecting the fibers of optic chiasma in cases of suprasellar extension of pituitary tumours. Variations in the morphometry of the sellar opening provides explanation for direction of growth of pituitary tumours towards cavernous sinus and supra sellar region [22]. K S Ju et al [23] concluded that the mean largest dimension reported on a total of 33 adult Korean cadavers (20 male and 10 female) was 6.8±1.7mm. K Ongeti et al [24] reported the average diameter of 8.97±2.24 mm in Kenyan adult cadavers (96 males, 44 females).

Sella turcica is an important region in skull base. Changes in size of it are frequently related to pathologies in pituitary gland. Its size varies with race and geographical location. The range of ST length is 2 to 6 mm. and ST depth is 2 to 7 mm in prenatal cadavers. The range of ST length is 8 to 14 mm. and ST depth is 6 to 11 mm in postnatal cadavers [25].

Subhadra Devi et al [25] stated that The mean length in the present study in post-natal cadavers is 9.6±1.5 and the mean depth is 9.05±1.0 that are higher than that reported in literature. According to Samira Zabhiyan et. al [26] the mean length is 9.16 mm±1.11 with a range of 6.5 to 12.5 mm and the mean depth is 8.56±1.25 mm with a range of 7.50 – 15.0 mm.

There are few studies concerning the diameters of the posterior clinoid process (transverse diameter and length) and the interclinoid distance in the right and left sides. Paul and Das [27] in their case report found that the maximum transverse distance between the two posterior clinoid processes (PCPTR) was 10mmin the first case and five mm in the second one while the maximum height of the posterior clinoid processes (PCPL) was 10 mm in the first case and 11 mm in the second one. The distance between anterior clinoid processes and posterior clinoid processes (left side) was five mm in the first case and 10 mm in the second one, while (right side)(CPD) was six mm in the first case and 10 mm in the second one.

Study done by Ashraf Mohamed Elsayed Ali SAKRAN et al [19] revealed that the mean of PCPTR was 14.28mm and ranged between 7 and 23mm; the mean of the PCPL was 9.06 mm ranged between 6-11.5 mm. The CPD in the left side was 7.06 mm ranged between 4-11mm while CPD in the right side was 7.89mm and ranged between 5 and 12 mm. He further stated that The transverse distance between the posterior clinoid processes and the length of the posterior clinoid processes did not show any significant difference when compared in the male and females. However, there were significant difference between genders in relation with the interclinoid processes diameter in right and left sides respectively (p value = 0.004 for right and .001 for left). Where as in our study we found that there was no significant difference was observed in length, anteroposterior diameter, width and depth of Sella turcica and gender of study subjects. It was found that there is significant difference (P<.001) observed in length, width and depth in age groups while Anteroposterior diameter has no significant difference compared to their age groups.We also reported that there was significant positive correlation between age of study subjects with length, anteroposterior diameter, width and depth of Sella turcica. By using Pearson correlation coefficient(r). We concluded that there was significant positive correlation between age of study subjects with length and width of Sella turcica in female population. However there was no significant correlation between age of study subjects with anteroposterior diameter and depth of Sella turcica. We also found that that there was significant positive correlation between age of study subjects with length, width and depth of Sella turcica. However there was no significant correlation between age of study subjects with antero-posterior diameter.

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