International Journal of Anatomy and Research,
Int J Anat Res 2015, Vol 3(1):927-34. ISSN 2321- 4287
DOI: http://dx.doi.org/10.16965/ijar.2015.118

Original Article

A MORPHOMETRIC STUDY OF THE SELLA TURCICA; GENDER EFFECT

Ashraf Mohamed Elsayed Ali SAKRAN *[1], Mohammad Afzal KHAN [2], Faris Mohammed Nour ALTAF [3], Hassan Elsiddig Hassan FARAGALLA [4], Amal Yousif Ahmed Elhaj MUSTAFA [5], Muhammad Mazhar HIJAZI [6], Rayan Abdulshakur NIYAZI [7], Abrar Jamal TAWAKUL [8], Abeer Zubair MALEBARI [9], Amal AbdulAziz SALEM [10].

[1,2,3,5,6] Department of Human Anatomy, Faculty of Medicine, Umm al Qura University, Makkah, Saudi Arabia.
[4] Department of Public Health, Health Sciences College at Al.leith, Umm al Qura University, Saudi Arabia.
[7,8,9,10] Medical students, Faculty of Medicine, Umm al Qura University, Makkah, Saudi Arabia.

ABSTRACT

Background and objective: Precise anatomical knowledge of the sella turcica is important for neurologists and surgeons operating in the region of cavernous sinus or the surrounding structures. The current study was undertaken to record normal morphometric parameters for future reference and to determine if there is any significance difference in the sella turcica morphometry regarding the gender.
Methodology: A Morphometric analysis of the Sella Turcica and structures in vicinity were done in thirty six adults' formalin fixed cadaver's skulls (22 male and 14 female).
Results: The pituitary stalk positions were middle in majority of male cases (72.7%), the remaining 27.3% were posterior. Among female; 57.1% were middle and the remaining 42.9% were posterior, no anterior position was detected among both genders with no different between male and female (p = 0.494) Normal Optic chiasma position was detected in all female cases and in 63.6% of male cases with no significant differences regarding gender (p= 0.070). No significant different in diaphragma sella shape and opening regarding gender (p.value = 0.170 and 0.914 respectively) No significant difference between males and females concerning linear dimensions of sella turcica (length, depth and Anteroposterior diameters). Concerning diaphragma sella opening; no significant different regarding gender in transverse diameter (p.value= 0.316) while significant different was detected in anteroposterior diameter (p.value= 0.046) For interclinoid (anterior, posterior) diameters, which represented statistically significant different regarding gender in both right and left sides (p.value = 0.004 and 0.001 respectively).
Conclusion: Present study will providing the normal morphometric data for future reference and further studies.
KEY WORDS: Sella turcica, Morphometry, Gender.

Address for Correspondence: Dr. Ashraf M. E.A. Sakran, Department of Human Anatomy, Faculty of Medicine, Umm al Qura University, P.O. Box: 7607, Makkah, Saudi Arabia. Phone: 00966568841873 or 00249912254379 **E-Mail:** ashrafsakran@hotmail.com

Access this Article online

Quick Response code

DOI: 10.16965/ijar.2015.118

Web site: International Journal of Anatomy and Research
ISSN 2321-4287
www.ijmhr.org/ijar.htm

Received: 13 Feb 2015 Accepted: 26 Feb 2015
Peer Review: 13 Feb 2015 Published (O):31 Mar 2015
Revised: None Published (P):31 Mar 2015

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 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. Inconstant 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]. Normal data on the size and various dimensions has been described in the literature [5,6]. Changes in the size of the sella turcica, however, are frequent and are related to pathology in this region. An enlargement in size not accompanied by bony erosion is usually found in intrasellar adenomas [7,8] and the empty sella sendrome [9]. Other not so common causes of enlargement may include Rathke's cleft cysts and aneurysms [7]. An uncommon small sella turcica may be seen in primary hypopituitarism, growth hormone deficiency, and William's syndrome [10,11].

Three different positions of the pituitary stalk have been described: anterior when it is close to tuberculum sellae; middle when central to diaphragm sellae; posterior where it is close to dorsum sellae [12]. The relationship of the sella turcica with the optic chiasma has been classified into 'prefix' in which the optic chiasm is located on top of the tuberculum sellae, 'normal' in which the optic chiasm is located on the top of diaphragma sellae and the 'postfix' variety where the optic chiasma is located on top of the dorsum sellae [13]. The diaphragma sellae, a small horizontal fold of dura that forms roof of pituitary when viewed from above has three different shapes: convex, concave, and flat [12,13]. Diaphragma sella has a central aperture of variable size, ranging from small foramen to a large hole which transmits the pituitary stalk and its blood vessels [14].

Thorough knowledge on anatomy of sellar region is important to neurologists and neurosurgeons dealing with pathologies in this region. Recognizing variations is important in preventing damage during surgery [12]. Also sella turcica is of importance because within its center lies the sella point which helps evaluating of craniofacial morphology [15]. The purpose of this study was to measure the dimensions, shape and the incidence of abnormalities of the sella turcica in skulls so as to contribute towards establishing reference standards that could assist in a more objective evaluation and detection of pathological conditions and possibly help in operative procedures in this region.

MATERIALS AND METHODS

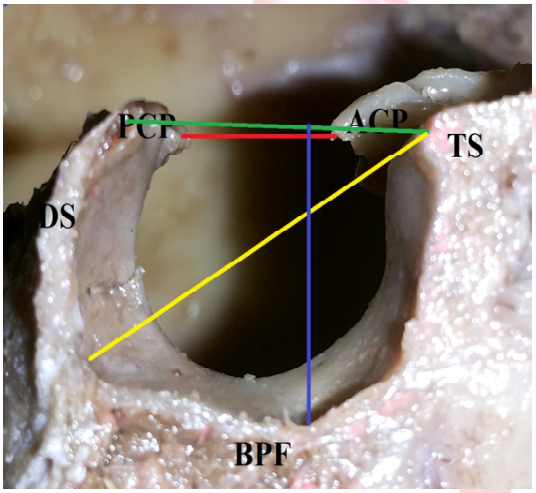
The study was conducted on 36 adult formalin fixed cadaver's skulls (22 male and 14 female), at the Department of Human Anatomy, Faculty of Medicine, Umm al Qura University, Makkah. The pituitary gland and the sellar region were observed after removal of the calvaria and brain. It will be checked that the subjects had no surgery or extensive disease involving the area under study. The position of pituitary stalk and optic chiasma, shape of diaphragm sellae and its opening were recorded. Linear measurements of sella turcica in the mid-sagittal plane were done by using Vernier calipers (General Tools Mfg. Co. LLC New York, NY 10013). Sellar opening, transverse diameter (SOTR) and sellar opening, antero-posterior diameter (SOAP) were recorded in millimeters. After careful removal of the pituitary gland along with its stalk the length of sella turcica (STL) was obtained by measuring the distance between the tuberculum sellae to the tip of dorsum sellae. The depth of sella turcica (STD) was measured at the deepest part of sella and is at right angle to the direction of length of sella turcica (STL). Also the antero-posterior diameter of sella turcica (STAP) 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). The anterior, middle and posterior clinoid processes were observed for any anomalies (sella turcica bridging or caroticoclinoid foramen).

The maximum transverse distance between the two posterior clinoid processes (PCPTR), the maximum height of the posterior clinoid processes (PCPL) and the distance between anterior clinoid processes and posterior clinoid processes (left side) and (right side) (CPD) were measured. All the measurements were recorded in millimeters.

Ethical consent: The study was approved by the biomedical ethics committee, faculty of medicine, Umm Al-Qura University, Makkah, Saudi Arabia.

Statistical analysis: For all statistical analyses, the SPSS statistical software version 15 was used. The ANOVA and Pearson chi square tests were used and P. values of 0.05 or less were regarded as statistically significant.

Fig 1: Showing reference lines and bony landmarks used for measuring of sella turcica size. TS, tuberculum sella; DS, dorsum sella; BPF, base of the pituitary fossa; ACP, anterior clinoid process; PCP, posterior clinoid process; green line, length of sella turcica ; yellow line, antero-posterior diameter of sella; blue line, depth of sella; red line, distance between anterior and posterior clinoid processes.



RESULTS AND TABLES

Anatomical and morphometric observations revealed: 66.7% of pituitary stalk position were middle and 33.3% were posterior, insignificant different regarding gender was found (p.value = 0.494); the optic chiasma position shows 77.8% normal and 22.2% were postfixed, insignificant different regarding gender was found (p.value = 0.070).

Regarding the shape of diaphragma sellae among study group; 72.2% were concave, 16.7% convex and 11.1% were flat with no significant different regarding gender (p.value = 0.170).

Insignificant different concerning the shape of diaphragma sella opening regarding gender was found (p.value = 0.914); 57.1% of the female cases were elliptic shape and 42.9% were round, 54.5% of the male were elliptic and 45.5% were round shape.

The mean length of sella turcica for female was 11.57 mm and for male 10.77 mm. The mean depth of sella turcica for female was 9.5 mm and in male 10.05 mm. The mean anteroposterior diameter of sella turcica for female was 11.57 mm and in male 11.23 mm, the present study revealed insignificant statistically difference in the length, depth and anteroposterior diameter of sella turcica regarding gender (p.value = 0.208, 0.391and 0.471 respectively).

Linear measurements of diaphragma sella opening were summarized in Table 6; the mean of anteroposterior diameter for diaphragm sella opening were 6.09 and 7.86 for the males and females respectively, statistically significant different regarding gender was detected (p.value = 0.046). While for transvers diameter the means were 7.27 and 8.57 for male and female respectively with insignificant different (p.value = 0.316).

The measurements of posterior clinoid process among study group show insignificant different regarding gender (p.value = 0.670 and 0.797) for transvers diameter PCP and Length PCP respectively).

While for interclinoid (anterior, posterior), statistically significant different regarding gende was detected in both right and left sides (p.value = 0.004 and 0.001 respectively).

Pituitary stalk position	Gender		Total (%) position-wise	significance
	Male (22)	Female (14)		
Anterior	0(0%)	0(0%)	0(0%)	0.494
Posterior	6 (27.3%)	6 (42.9%)	12 (33.3%)	
Middle	16(72.7%)	8 (57.1%)	24 (66.7%)	

Table 1: The position of the pituitary stalk in both genders.

Optic chiasma position	Gender		Total (%) position-wise	significance
	Male (22)	Female (14)		
Prefixed	0(0%)	0(0%)	0(0%)	0.07
Normal	14(63.6%)	14(100%)	28(77.8%)	
Post-fixed	8(36.4%)	0(0.00%)	8(22.2%)	

Table 2: The position of optic chiasma in both genders.

Diaphragma sella shape	Gender		Total (%) position-wise	significance
	Male (22)	Female (14)		
Concave	18(81.8%)	8(57.1%)	26(72.2%)	0.17
Convex	4(18.2%)	2(14.3%)	6(16.7%)	
Flat	0(0%)	4(28.6%)	4(11.1%)	

Table 3: The shape of diaphragma sella in both genders.

Shape of diaphragm sella opening	Gender		significance
	Male (22)	Female (14)	
Elliptic	12(54.5%)	8(57.1%)	0.914
Round	10(45.5%)	6(42.9%)	

Table 4: The shape of diaphragma sella opening in both genders.

Table 5: Linear measurements of sella turcica size in both genders (in millimeter).

Measurements	Gender	N	Mean	STD	Minimum	Maximum	significance
Length	Female	14	11.57	0.08864	10.5	13	0.208
	Male	22	10.77	0.14381	8.5	13.5	
Depth	Female	14	9.5	0.13229	8	11.5	0.391
	Male	22	10.05	0.12541	8	12	
Anteroposterior diameter	Female	14	11.57	0.08381	10	12.5	0.471
	Male	22	11.23	0.10335	9	12.5	

Table 6: Linear measurements of diaphragma sella opening in both genders (in millimeters).

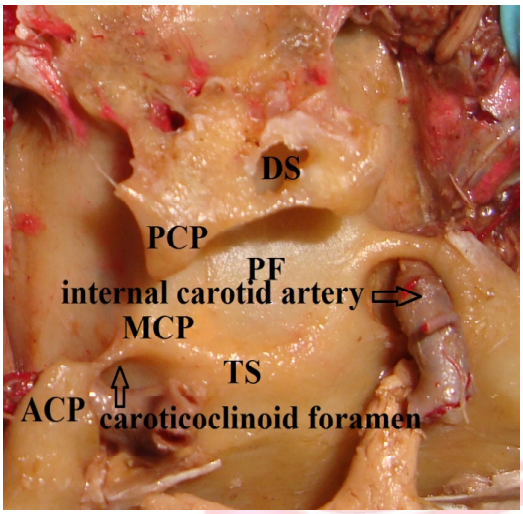
Measurements	Gender	N	Mean	STD	Minimum	Maximum	significance
Anteroposterior diameter	Female	14	7.86	0.1069	6	9	0.046
	Male	22	6.09	0.19725	4	9	
Transvers diameter	Female	14	8.57	0.11339	7	10	0.316
	Male	22	7.27	0.31652	4	12	

Table 7: The measurements of posterior clinoid process (PCP) and the interclinoid (anterior, posterior) diameter (ICD) in both genders (in millimeters).

Measurements	Gender	N	Mean	STD	Minimum	Maximum	significance
Transvers diameter PCP	Female	14	14.93	0.62877	7	23	0.67
	Male	22	13.86	0.41719	10	22.5	
Length PCP	Female	14	8.93	0.14268	7	11	0.797
	Male	22	9.14	0.1762	6	11.5	
ICD right side	Female	14	9.14	0.17008	7	12	0.004
	Male	22	7.09	0.08893	5	8.5	
ICD left side	Female	14	8.43	0.12392	7.5	11	0.001
	Male	22	6.18	0.10553	4	8	

Two cases have caroticoclinoid foramen in both sides (figure2). *

Fig. 2: Shows present of caroticoclinoid foramen in both sides.



TS- tuberculum sella; **DS-** dorsum sella; **PF-** pituitary fossa; **ACP-** anterior clinoid process; **PCP-** posterior clinoid process; **MCP-** middle clinoid process.

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 [12,16,17]. Also sella turcica is of importance because within its center lies the 'sella point' which helps in evaluation of craniofacial morphology [15].

Three anatomical positions for pituitary stalk have been described in the literature: anterior, middle and posterior in relation to the sella turcica; the middle position being the commonest [12,16]. Four different locations for pituitary stalk are reported in Turkish population with percentage incidence of anterior (13%), middle (40%) posterior (40%) and prominent tuberculum sellae (7%) [12]. In a Chinese cadaveric study a percentage incidence of anterior (53.3%), middle (40%) and posterior (6.7%) positions were reported [17]. In Indian postnatal cadavers the percentage incidence was: anterior 6%, middle 66% and posterior 28% [18]. Findings of this study were approximately similar as Indian population with the absence of anterior position but differ from Turkish and Chinese populations. Middle position incidence was higher in male (72.7%) than female (57.1%) while posterior position was higher in female (42.9%) than male (27.3%). Similar results were found in the Indian population [18].

Three different positions of optic chiasma have been described: prefixed, normal and post- fixed [12,13]. Rhoton [13] reported prefixed position in 15% of the patients, normal in 70% and post-fixed position in15%. Gulsen S, Dinc AH et. al. [12] found the values to be 5% for prefixed position, 78% normal and 17% for post-fixed. Our study shows that the normal position is approximately similar to the previous studies (77.8%) but post-fixed position was higher (22.2%) and the prefixed position was absent. In Indian population [18] in the post-natal cadavers the percentage incidence of pre- fixed was higher in females and post-fixed and normal positions were higher in males. In our study the incidence of normal position was higher than the prefixed and post-fixed positions in both sex. The prefixed and post-fixed positions were absent in female.

The shape of diaphragm sellae was described as concave in 80.1%, convex in 13.2% and 6.7% flat for Chinese population [17]. This study obtained nearly similar values as in Chinese population. In Indian post-natal cadavers the percentage incidence of flat, concave and convex appearance for diaphragm sellae was 48.44%, 40.63% and 10.93% respectively [18]. When analyzed sex wise it shows, concave appearance was higher in both sexes (81.1% for male and 57.1% for female), convex shape was higher in male (18.2% for male and 14.3% for female) and flat shape was 28.6% in female and absent in male.

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]. This study revealed that, the incidence of elliptic appearance for diaphragma sella opening was higher than rounded shape (55.6% and 44.4% respectively). The elliptic

shape incidence was approximately similar in both sexes (57.1% for female and 54.5% for male).The values obtained in this study differs from those of Indian post-natal population research (40% for elliptic and 60% for round appearance of diaphragm sella opening) [18].

There were no significant differences for gender in relation with the position of pituitary stalk, optic chiasma position, shape of diaphragma sella and its opening. The sex differences for these parameters observed in the present study have not been reported in the literature.

The mean of diaphragma sella opening anteroposterior diameter (SOAP) was 6.79 mm and ranged between 4-9 mm while its transvers diameter mean was 7.78 mm and ranged between 4-12 mm. Approximately similar results are reported for Indian post-natal population [18] (SOAP range 3-7 mm, SOTR range 4-12 mm) and Chinese population [17] (mean SOAP of 6.59 mm, range 2.20-12.10 mm, mean SOTR of 7.32 mm, range 3.10-13.40 mm). When analyzed sex wise our study shows that the SOAP and SOTR were higher in female but it was only statistically significant for SOAP ($p = 0.046$). In Indian post-natal population [18] female SOAP and SOTR were higher but they were not statistically significant.

Sella turcica linear dimension were measured using different methods and this must be taken into consideration when comparing the results. Alkofide EA (2007) [5] in Saudi population using radiographs, found that the average for length, depth and anteroposterior diameter were (10.85 mm, 9.1 mm and 13.95 mm) respectively. Shah AM et al [19], in Turkish population using radiographs, reported that the average for length, depth and anteroposterior diameter were (11.35 mm, 9.9 mm and 13.90 mm) respectively. In comparison with the previous studies, the present study shows: the mean length of sella turcica was higher than Alkofide finding (+ 0.23 mm) and smaller than Shah AM et al result (- 0.27 mm). The mean depth of sella turcica was higher than Alkofide finding (+ 0.74 mm) and smaller than Shah AM et al (- 0.06 mm, while the mean anteroposterior of sella turcica was smaller than Alkofide finding (- 2.59 mm) and Shah AM, et al. result (- 2.54 mm).

These discrepancies can be due to difference in method and ethnic origin.

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. Similar results have been recorded by Alkofide and Shah et al who reported that till the age of 17 years the area of sella turcica was more in males than in females while after the age of 17 years it was higher in females [20].

In the literature the anterior clinoid process has received more attention because it has been used by the surgeons, to gain entry into the clinoid space to explore the internal carotid artery and other structures in vicinity [21]. The posterior clinoid process is less accessed for such operations. Any abnormality in the posterior clinoid process may compress the surrounding structures especially the internal carotid artery and alter the attachment of the tentorium cerebelli to the posterior clinoid process. The anterior clinoid process has been reported to be joined to the middle clinoid process by a fold of dura mater [21]. Sometimes this middle clinoid process is connected to anterior clinoid process by a small bony spicule forming a foramen known as Carotico-clinoid Formen [4].

Surgeons have to operate on the dorsum sellae in order to expose the length of basilar artery in case of aneurysms[22]. Anatomical knowledge of the posterior clinoid process is important in order to avoid any damage to structures in relation.

There are few studies concerning the diameters of the posterior clinoid process (transvers diameter and length) and the interclinoid distance in the right and left sides. Paul and Das [11] in their case report found that the maximum transverse distance between the two posterior clinoid processes (PCPTR) was 10 mm in 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. This study revealed that the mean of PCPTR was 14.28 mm 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 4-11 mm, while CPD in the right side was 7.89 mm and ranged between 5 and12 mm.

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 0.001 for left). This finding has not been reported in the previous literature.

Bilodi [23] in 2005 found that thirteen (8.7%) out of one hundred and fifty dry human skulls showed the interclinoid bar of bones and carotico- clinoid foramina around the sella turcica. In nine skulls they were bilateral (69.23%) and in four skulls they were unilateral (30.76%).One skull showed complete ossified horizontal bar of bone connecting all the three clinoid processes (7.69%) which is of rare variety. This study shows two cases (6.25%) with caroticoclinoid foramen in both sides (one male and the other female), where there was no interclinoid bar of bone connecting anterior clinoid process and posterior clinoid process.

CONCLUSION

Precise anatomical knowledge of the sella turcica is important for neurologists and surgeons operating in the region of cavernous sinus or the surrounding structures. Any morphological variation may lead to an avoidable injury to structures in the vicinity to the sella turcica. Also morphometric knowledge of the sella turcica is of importance because the sella point which helps evaluating of craniofacial morphology lies within its center. This region needs more studies using other methods of investigations.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the help provided by the Synergism research club for medical students at the Faculty of Medicine, UQU, Makkah, Saudi Arabia, during this study by nominating students to participate as part of their hands-on training in research.

Conflicts of Interests: None

REFERENCES

[1]. Snell R S. The head and neck. In: Clinical Anatomy by Regions. 8th ed.;New York; Lippincott Williams and Wilkins. 2008 : 667-850.

[2]. Ju KS, Bae HG, Park HK, Chang JC, Choi SK, Sim KM. Morphometric study of the Korean adult Pituitary glands and the Diaphragma sellae Korean Neurosurg Soc. 2010;47:42-47.

[3]. Sinnatamby CS (ed). Last's anatomy: Regional and Applied. Edinburgh; Churchill Livingstone. 2004; 501-504.

[4]. Ranganathan TS,In: Text Book of Human Anatomy 5th Ed. S Chand and Company, New Delhi. 1993:528-529.

[5]. Alkofide EA. The shape and size of the sella turcica in skeletal Class I, Class II, and Class III Saudi subjects. Eur J Orthod. 2007;29:457-63.

[6]. Zagga AD, Ahmed H, Tadros AA, Saidu SA. Description of the normal variants of the anatomical shapes of the sella turcica using plain radiographs: experience from Sokoto, Northwest- ern Nigeria. Ann Afr Med. 2008;7:77-81.

[7]. Swallow CE, Osborn AG. Imaging of sella and parasellar disease. Seminars in Ultrasound, CT, and MRI. 1998;19:257-271.

[8]. Dostalova S, Sonka K, Smahel Z, Weiss V, Marek J. Cephalometric assessment of cranial abnormalities in patients with acromegaly. J Cranio-Maxillo-Facial Surg. 2003;31:80-87.

[9]. Giustina. A. Maira G, Bianchi A Bonadonna S, De Marinis L. Primary empty sella. J Clin Endocrin and Met. 2005;90:5471-5477.

[10]. Axelsson S, Storhaug K, Kjaer I. Post-natal size and morphology of the sella turcica. In Williams syndrome. European Journal of Orthodontics. 2004; 26:613-621.

[11]. Paul S, Das S. Anomalous posterior clinoid process and its clinical importance. Colombia Medica. 2007; 38(3): 301-304.

[12]. Gulsen S, Dinc AH, Unal M, Cantürk N, Altinors N. Characterization of the anatomic location of the Pituitary stalk and Its relationship to the Dorsum Sellae, Tuberculum Sellae and Chiasmatic Cistern, J Korean Neurosurg Soc. 2010;47 :169-173.

[13].Rhoton AL. The sellar region. Neurosurg 2002; 51:S335- S374.

[14]. Kirgis HD, Locke W. Anatomy and embryology. In: Locke W, Schally AV, editors. The hypothalamus and pituitary in health and disease. Springfield, IL: Charles C. Thomas.1972; p. 3–65.
[15]. Amar AP, Weiss MH. Pituitary anatomy and physiology. Neurosurg Clin N Am. 2003; 14:11-23.
[16]. Campero A, Martins C, Yasuda A, Rhoton AL Jr. Microsurgical anatomy of the diaphragma sellae and its role in directing the pattern of growth of pituitary adenomas. Neurosurgery. 2008;62:717–723.
[17]. Liang Jin, QI Song-tao, Fan Jun, Shi Jin, Lu Yun-tao,Yan Xiao-rong. Anatomic features of diaphragma sellae and its clinic implications. Chinese Journal Of Clinical Anatomy 2013; 31(2):123-126.
[18]. Subhadra Devi V, Baburao S. Age and sex related morphology and morphometry of sellar region of sphenoid in prenatal and postnatal human cadavers. Int. J. Res. Dev. Health . 2013 ; 1 (3): 141-148.
[19]. Shah AM, Bashir U, Ilyas T. The shape and size of the sella turcica in skeletal Class I, II, and III in patients presenting at Islamic International Dental Hospital, Islamabad. Pakistan Oral and Dental J. 2011; 31(1): 104-110.
[20]. Hass LL. The size of the sella turcica by age and sex. Am J Roentgenol Radium. Ther Nucl Med. 1954; 72: 754-761.
[21]. Inoue T, Rhoton ALJr, Theele D, Barry ME. Surgical approaches to the cavernous sinus: a microsurgical study. Neurosurgery 1990; 26: 903-932.
[22]. Chanda A, Nanda A. Anatomical study of the orbitozygomatic transsellar- transcavernous - transclinoidal approach to the basilar artery bifurcation. J Neurosurg 2002; 97: 151-160.
[23]. Bilodi AKSS. Study of sella turcica with associated anomalies in human skulls. J Institute Med Nepal. 2005; 27: 3-6.

How to cite this article:

Ashraf Mohamed Elsayed Ali SAKRAN, Mohammad Afzal KHAN, Faris Mohammed Nour ALTAF, Hassan Elsiddig Hassan FARAGALLA, Amal Yousif Ahmed Elhaj MUSTAFA, Muhammad Mazhar HIJAZI, Rayan Abdulshakur NIYAZI, Abrar Jamal TAWAKUL, Abeer Zubair MALEBARI, Amal AbdulAziz SALEM. A MORPHOMETRIC STUDY OF THE SELLA TURCICA; GENDER EFFECT. Int J Anat Res 2015;3(1):927-934. **DOI:** 10.16965/ijar.2015.118