PSUMJ
PSU MEDICAL JOURNAL

Original Article

Anatomical Variations of The Diaphragma Sellae and Pituitary Stalk in Human Adult Cadavers in Myanmar

Zaw Win Htun, M.B., B.S., M.Med.Sc.[1], Than Htut Aung, M.B., B.S., M.Med.Sc.[1], Tun Tun Win, M.B., B.S., M.Med.Sc., Ph.D.[2], Khine Zaw Oo, M.B., B.S., M.Med.Sc., Ph.D.[3], Myo Thiha Zaw, M.B., B.S., M.Med.Sc., Ph.D.[3], Aye Moe Moe Kyaw, M.B., B.S., M.Med.Sc., Ph.D.[1]

[1]Department of Anatomy, Defence Services Medical Academy, Mingalardon, Yangon 11021, Myanmar.

[2]Department of Preventive and Social Medicine, Defence Services Medical Academy, Mingalardon, Yangon 11021, Myanmar.

[3]Department of Special Operations Medical Research Division, Defence Services Medical Research Centre, Nay Pyi Taw 15021, Myanmar.

ABSTRACT

Objective: The middle cerebral fossa contains the sellar area. The diaphragma sellae, a dural fold, covers the sella turcica, which is located in the bony depression of the sphenoid bone. One of the most significant endocrine glands in the body, the pituitary gland's stalk protrudes from the base of the brain through the diaphragma sellae's primary hole.

Material and Methods: This study was a cross-sectional experimental study and carried out on 30 human adult cadavers (20 males and 10 females) in order to describe the anatomical variations of diaphragma sellae and pituitary stalk.

Results: The shapes of the diaphragma sellae were 17 flat types (56.7%), 12 concave types (40%) and 1 convex type (3.3%). The shapes of the central opening of the diaphragma sellae were 21 round types (70%), 5 coronal elliptical types (16.7%), and 4 sagittal elliptical types (13.3%). The mean anteroposterior diameter of the central opening of the diaphragma sellae was 6.92±1.47 mm and the transverse diameter was 7.06±1.46 mm. The mean anteroposterior diameter of the pituitary stalk was 1.83±0.41 mm and the transverse diameter of the pituitary stalk was 2.00±0.33 mm. The locations of the pituitary stalk were 20 posterior types (66.7%), 5 central types (16.7%), and 5 anterior types (16.7%).

Conclusion: Neurosurgeons, maxillofacial surgeons, and clinical radiologists may find the current study of the diphragama sellae and sellar region helpful in contemplating the diseases and operational techniques in this area.

Keywords: anatomical variation; diaphragma sellae; human adult; Myanmar; pituitary stalk

Corresponding author: Zaw Win Htun, M.B., B.S., M.Med.Sc.
Department of Anatomy, Defence Services Medical Academy, Mingalardon, Yangon 11021, Myanmar.
E-mail: zhtun75@gmail.com
doi: 10.31584/psumj.2023258100
https://he01.tci-thaijo.org/index.php/PSUMJ/

PSU Med J 2023;3(3):127-133
Received 11 August 2022
Revised 9 June 2023
Accepted 9 June 2023
Published online 26 December 2023

INTRODUCTION

The middle of the cerebral fossa contains the sellar area. The sphenoid bone has a saddle-shaped depression known as the sella turcica. The hypophyseal fossa contains the pituitary gland. The diaphragma sellae, a thin layer of dura covering the superior face of the pituitary gland, was punctured in the middle by an opening for the pituitary stalk[1]. The sellar region is one of the common sites for tumors, vascular, developmental, and neuroendocrine disorders. The diaphragma sellae is the roof of the hypophysis and is the dura membrane in the sellar area[2]. The diaphragma sellae's primary aperture varies in size, from a small foramen to a big hole, and it transmits the pituitary stalk and its blood supply[3]. Understanding the changes in the sella opening's size and shape helps to explain why pituitary tumors tend to form in the cavernous sinus and suprasellar area. In order to safely perform the transsphenoidal approach for the excision of the pituitary gland tumor, it provides the necessary anatomical knowledge.

With the aid of contemporary neuroimaging and microneurosurgical techniques, Sellar region diseases may be entirely removed, but patients may still produce endocrine disorders after this removal, which continue to be a difficulty for neurosurgeons globally. Knowing the several variants of the pituitary stalk position is crucial for preventing unintentional harm while addressing a sellar abnormality during transcranial surgery.

Anatomists, surgeons, and radiologists are interested in the anatomical variations of the diaphragma sellae and pituitary gland, not only for their academic studies, but also for the clinical implications of lessening the damage to the structures in and around the sella during transsphenoidal and transcranial surgery. As a result, the morphological variations, and biometrics of the sellar region are detailed in this study.

MATERIAL AND METHODS

Materials for dissection - Surgical gloves, masks, aprons, underbeds, saws, dissection sets (Gallenkamp–DKJ–0330–H) including pointed forceps, artery forceps, straight scissors, swabs and cottons, retractors, plastic rulers, digital camera (Sony camera Cyber-shot, DSC-P72 with optical zoom 25MP), and digital venire caliper wheel type stainless steel (12.5cm/5 inch) were used in the study.

Sample collection-Data were collected on a standard collecting sheet using proforma after each dissection was carried out in a methodical manner. For dissection, the cadavers were positioned supine. Under the neck, a "body block" made of plastic or rubber was positioned to raise the head. An incision was made behind one ear, over the crown of the head, and to a position behind the other ear in order to examine the brain. The front flap of the scalp was peeled away from the skull, covering the face, and the back flap, covering the back of the neck. The brain was then exposed after the skull had been cut using a circular (or semicircular) bladed reciprocating saw to create a «cap» that could be peeled off. Cutting the spinal cord, the major blood arteries that supply the brain, the fibrous attachment to the skull, the nerves to the eyes, and several other nerves and connections allowed the brain to be removed from the skull. The brain was then removed from the skull for additional analysis.

Procedure in morphometric study of sella region-To reveal the base of the skull, the brain and its skull covering were removed. The surface of the diaphragm sellae was attached in a straight line between the tuberculum sellae and the dorsum sellae (flat type of diaphragma sellae), curved inward between the tuberculum sellae and the dorsum sellae (concave type of diaphragma sellae), and curved outward between the tuberculum sellae and the dorsum sellae to record the shape of the (convex type of diaphragma sellae)[4]. Investigated were the many diaphragma sellae central openings and the connection between the dura enclosing the pituitary gland and the diaphragma sellae. There are 3 different shapes for the diaphragma sellae's central opening: round, coronal elliptical, and sagittal elliptical. Digital vernier calipers were used to measure the diameter of the diaphragma sellae and central opening in millimeters. It was between the 2 lateral places of the opening that they were the most widely spaced apart; the transverse diameter of the sella opening was measured. The distance between the sella opening's most distant anterior and posterior points, which is known as its anteroposterior diameter, was measured[3].

The pituitary stalk's location was noted. Pituitary stalk placement was governed by 3 factors: (1) the pituitary stalk was in the center of the diaphragma sellae, (2) it was more anteriorly situated on the diaphragma sellae (toward the tuberculum sellae), and (3) it was more posteriorly situated (toward the dorsum sellae)[5]. The posterior lobe of the pituitary gland was positioned in the concave cavity of the dorsum sellae and easily detached from the dura of the dorsum sellae without adhesion when the dorsum sellae was pushed downward by cutting its base. A digital vernier caliper set to millimeters was used to measure the pituitary stalk at its midpoint. Pituitary stalk measurements were taken from its anterior and posterior points, as well as its left and right points in order to determine its anteroposterior diameter and transverse diameter, respectively[3]. Three readings were taken and the average result was noted[6]. Data were gathered using quantitative data collection methods by "observing." The data master sheet was filled out with data proforma. The statistical computer program Statistical Package for the Social Sciences (SPSS) for Windows Standard version 25.0 statistics software was used for the data analysis.

RESULTS

"Anatomical Variations of Diaphragma Sellae and Pituitary Stalk in Human Adult Cadavers in Myanmar" was completed in this study. A total of 30 adult cadavers at the sellar region were taken from the Defence Services Medical Academy, Mingalardon, University of Medicine 1 and University of Medicine 2, Yangon. The age distribution was between 55 and 94 years old (mean age=57.77±9.05). Out of 30 samples included in this investigation, the diaphragma sellae had 17 flat shapes (56.7%), 12 concave shapes (40%) and 1 convex shape (3.3%). Out of 30 samples, the shapes of the diaphragma sellae openings were determined to be 21 round shapes (70%, 5 coronal elliptical shapes (16.7%), and 4 sagittal elliptical shapes (13.3%). There were 27 open types (90%) and 3 closed types of diaphragma sellae opening (10%). Figure 1 and Table 2 demonstrate that the average anteroposterior diameter of the central opening was 6.92±1.47 mm, and the average transverse diameter was 7.06±1.46 mm.

As shown in Figure 2 and Table 2, the mean anteroposterior diameter in this study was 1.83±0.41 mm, and the mean transverse diameter was 2.00±0.33 mm. Out of 30 samples, the sites of the pituitary stalk were discovered in 20 posterior types (66.7%), 5 central types (16.7%), and 5 anterior types (16.7%), as demonstrated in Figure 1 and Table 1

Table 1 Percentage of the shapes of the diaphragm sellae, shapes of the opening, and the locations of the pituitary stalk

Shapes of Diaphragma Sellae	Frequency	Percent (%)
Flat	17	56.7
Concave	12	40
Convex	1	3.3
Total	30	100
Shapes of Diaphragma Sellae Opening		
Round	21	70
Coronal elliptical	5	16.7
Sagittal elliptical	4	13.3
Total	30	100
Location of Pituitary Stalk		
Posterior	20	66.7
Anterior	5	16.7
Central	5	16.7
Total	30	100

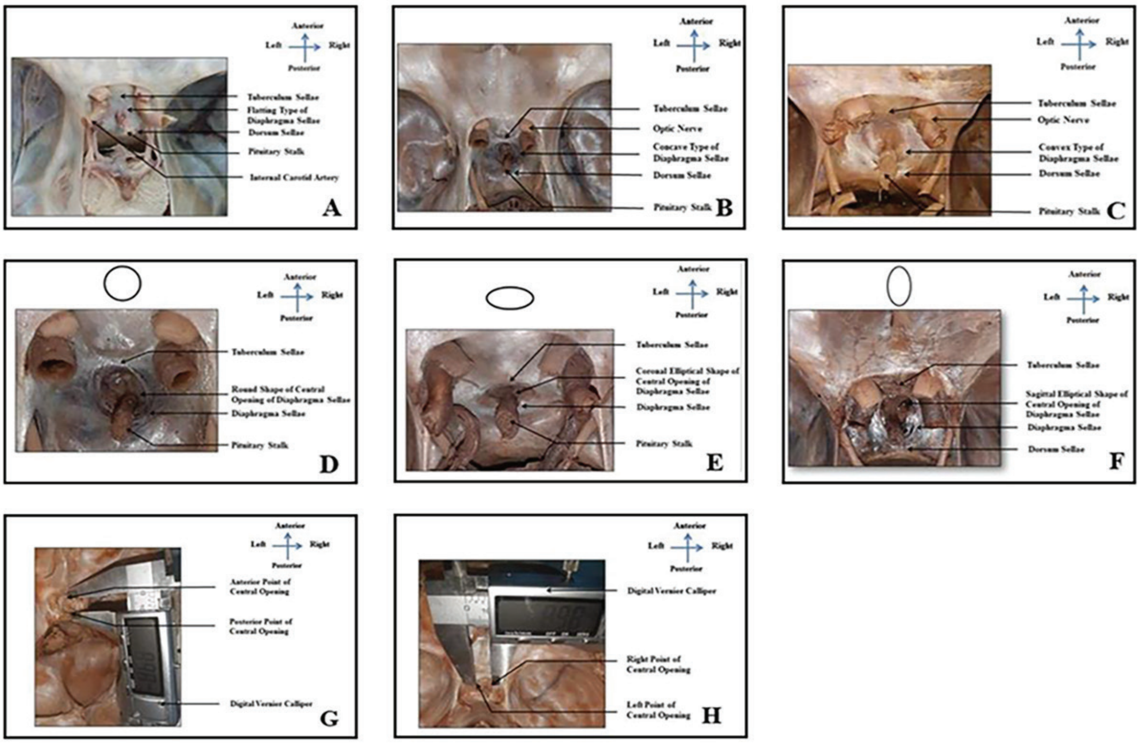

Figure 1 Shape of diaphragma sellae (superior view): (A) flat shape, (B) concave shape and (C) convex shape. Shape of the central opening of the diaphragma sellae (superior view): (D) round shape, (E) coronal elliptical shape and (F) sagittal elliptical shape. Measurement of the central opening of diaphragma sellae in males (superior view) (mm): (G) anteroposterior diameter and (H) transverse diameter

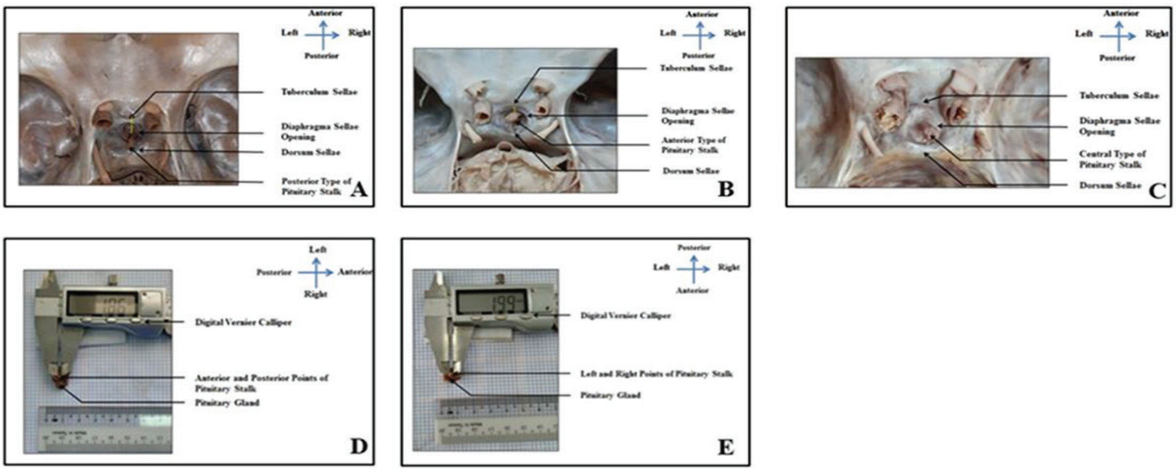

Figure 2 Shows the location of the pituitary stalk from the superior view. It is divided into 3 types: (A) anterior, (B) posterior, and (C) central. (D) anteroposterior diameter and (E) transverse diameter measurements of the pituitary stalk (superior view) in millimeters. Yellow dot line=distance between tuberculum sellae andpituitary stalk

Table 2 Measurement of the diaphragma sellae opening and pituitary stalk (mm)

Measurements of the diaphragma sellae opening	Mean	Standard deviation	Minimum	Maximum
Anteroposterior diameter	6.92	1.47	4.11	8.98
Transvers diameter	7.06	1.46	4.23	8.48
Measurements of Pituitary Stalk				
Anteroposterior diameter	1.83	0.41	1.09	2.63
Transverse diameter	2.00	0.33	1.32	2.55

DISCUSSION

In the current study, the majority of the 3 diaphragma sellae shapes in the population of Myanmar were flat (56.7%). This result was similar to that of the Turkish population (43%) reported by[7], the Kenyan population (40%) reported by[8], and the Indian population (48%) reported by[1]. However, the findings of the percentage of flat shapes in the Chinese population (6.7%) of[9] and Saudi Arabian population (11.1%) of[10] were different from the present study because these authors stated that the flat shape was the less common type. The diaphragma sellae was later discovered to have a concave form in 40% of the population of Myanmar. This result was somewhat in line with research on the Turkish population (40%) by[7], the Kenyan population (60%) by[8], and the Indian population (40.63%) by[1]. However, the present findings did not agree with the finding of 80.1% in[9] and 72.2% in[10], as these authors found the concave shape of diaphragma sellae was 80.1% in the Chinese and 72.2% in the Saudi Arabian populations, respectively. In this study, a convex shape of the diaphragma sellae was found in 3.3% of the Myanmar population. This finding in the current study was slightly lower than the previous studies observed, by 10% in[7], 10.93% in[1], 13.2% in[9] and 16.7% in[10]. Moreover, the convex shape of diaphragma sellae was not found in the Kenyan population by[8]. The results of the current investigation suggest that racial differences may have a major impact on the diaphragma sellae's form. The results of this study may be useful in assessing the likelihood that empty sella syndrome will manifest.

In the current study, 70% of the population of Myanmar had a diaphragm sellae with a circular center hole. Compared to the elliptical shape, it was more prevalent (30%). Coronal elliptical types (16.7%) and sagittal elliptical types (13.3%) were discovered in the current investigation as subtypes of the elliptical form. Seventy percent of Myanmar's population have diaphragm sellaes with round central openings. The finding was nearly consistent with the results of the previous studies by[11] in the Korean population (60.6%)[7], in the Turkish population (65%)[8], in the Kenyan population (60%), and[1] in the Indian post-natal population (58.6%). On the other hand, this result did not match research in the British population (54%) by[12] and the Saudi Arabian population (44.4%) by[10]. Compared to the findings of the British population (46%) by[12], the Korean population (39.4%) by[11], and the Saudi Arabian population (55.6%) by[10], the central aperture of the diaphragm sellae (30%) had an oval form in the present study[10]. However, the results from the present study and those from studies on the Turkish population (35%) by[7], the Kenyan population (40%) by[8], and the post-natal population of India (37%) by[1], were roughly comparable. However, the results of the present study were significantly different from those found in the Saudi Arabian population by[10], who noted a higher occurrence of elliptical (55.6%) and round (44.4%) shapes in the population.

The findings of coronal and sagittal elliptical shapes for the subdivision of the elliptical shape of the central opening did not agree with the study of[1] in the Kenyan population because the coronal elliptical shape in the Kenyan population was higher than the present study of the Myanmar population, and the sagittal elliptical shape of this population was significantly lower than the present study. In order to prevent unintentional neurovascular injury, neurosurgeons may find it advantageous to have anatomical knowledge of the geometry of the diaphragma sellae aperture before placing equipment in the hypophyseal fossa. In this study, the mean anteroposterior diameter of the central opening was 6.92±1.47 mm. This finding was nearly consistent with[9,10,13-15] and[16]. On the other hand, the mean values of[8] were larger than the present study. The mean transverse diameter of the central opening was 7.06±1.46 mm. This finding was approximately similar with[13,15] and[9]. But the previous study of[14] disagreed with the present study. Moreover, the mean value in the present study was not the same as the study of[8]. Since pituitary tumors could grow toward the cavernous sinus or toward the suprasella area, the variation in the diameter of the diaphragma sellae opening could be explained. The finding of a large opening in the diaphragma sellae in the current study could be interpreted as supersellar extension into the intracranial region, and the finding of a small opening could be interpreted as parasellar extension into the cavernous sinus for the purpose of guiding the growth of the pituitary tumors.

The mean anteroposterior and transversal diameters of the pituitary stalk were 1.83±0.41 mm and 2.00±0.33 mm, respectively, in the current investigation. The results of[11] and this finding were roughly comparable. The mean anteroposterior and transverse diameters of the pituitary stalk, assessed in the mid-section of the stalk, were found to be 2 mm or smaller in the current study. The investigation of infiltrative disorders for the presence or absence of pituitary stalk enlargement might benefit from this discovery.

The posterior type of pituitary stalk was commonly found in the present study. However, the present study was apparently (66.7%) higher than the findings of[7] in the Turkish population (40%)[1], in the Indian post-natal population (28%)[9], in the chinese population (6.7%) and[10] in the Saudi Arabian population (33.3%). For anterior type of location of pituitary stalk, the results in the present study (16.7%) did not agree with the previous studies of 13% in[7] and 6% in[1]. On the other hand, the finding of[9] revealed that the anterior type was more common (53.3%) in the Chinese population. Interestingly, this type of pituitary stalk was not found in the Saudi Arabian population by[10]. However, the central type of location of pituitary stalk revealed by previous authors was the most common type. These authors reported that this type was more common in their studies of 40% in[7], 66% in[1] and 66.7% in[10]. On the other hand, this central type was less observed (16.7%) in the present study. The posterior kind of pituitary stalk position was the most prevalent type in this study compared to other types. The possibility that the pituitary stalk will be preserved during an examination of this area may be increased if neurosurgeons are aware of the many locations of the pituitary stalk.

CONCLUSION

In the current study, the anatomical variations of the sellar region were examined, including the diaphragma sellae, its opening, and the pituitary stalk in adult human cadavers. These data are crucial for helping neurosurgeons and radiologists treat disorders in this area. Modern neuroimaging and micro neurosurgical methods have made it possible to eliminate sellar area diseases, but protecting patients against endocrine disorders following this removal has remained difficult for neurosurgeons worldwide. Knowing the different locations of the pituitary stalk is just as crucial as being aware of other anatomical variances. The debate has focused on the differences in the anatomy of the pituitary stalk and diaphragma sellae in adult humans for the population of Myanmar.

REFERENCES

1. Velichety SD, 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;1:141-8.
2. Sinnatamby CS. Last's anatomy: regional and applied, 12th edn. Ann R Coll Surg Engl 2013;95:230.

3. Ju KS, Bae HG, Park HK, Chang JC, Choi SK, Sim KB. Morphometric study of the Korean adult pituitary glands and the diaphragma sellae. J Korean Neurosurg Soc 2010;47:42.
4. Sage M, Blumbergs P, Mulligan B, Fowler G. The diaphragma sellae: its relationship to the configuration of the pituitary gland. Radiology 1982;145:703-8.
5. 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.
6. Rahman M, Ara S, Afroz H, Nahar N, Sultana AA, Fatema K. Morphometric Study of the Human Pituitary Gland. Bangladesh J Anat 2013;9:79-83.
7. 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;47:169-73.
8. Ongeti K, El-Busaidy H, Fundi N. Reappraisal Of The Dimensions Of The Diaphragma Sellae. Anat J Africa 2012;1:24-7.
9. Jin L, Q. S., FAN Jun, SHI Jin, LU Yuntao, Xiao-rong Y. Anatomic features of diaphragma sellae and its clinic implications. Chinese J Clin Anat 2013;31:123-6.
10. Sakran A, Khan MA, Altaf FMN, Faragalla HEH, Mustafa A, Hijazi MM, et al. A morphometric study of the sella turcica; gender effect. Int J Anat Res 2015;3:927-34.
11. Ju KS, Bae HG, Park HK, Chang JC, Choi SK, Sim KB. Morphometric study of the korean adult pituitary glands and the diaphragma sellae. J Korean Neurosurg Soc 2010;47:42-7.
12. Rhoton AL Jr. The sellar region. Neurosurgery 2002;51:S335-74.
13. 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;62:717-23.
14. Kursat E, Yilmazlar S, Aker S, Aksoy K, Oygucu H. Comparison of lateral and superior walls of the pituitary fossa with clinical emphasis on pituitary adenoma extension: cadaveric-anatomic study. Neurosurg Rev 2008;31:91-8.
15. Won HS, Han SH, Oh CS, Lee JI, Chung IH, Kim SH. Topographic variations of the optic chiasm and the foramen diaphragma sellae. Surg Radiol Anat 2010;32:653-7.
16. Yohannan DG, Krishnapillai R, Suresh R, Ramnarayan S. A Morphometric Study of the Foramen of Diaphragma Sellae and Delineation of Its Relation to Optic Neural Pathways through Computer Aided Superimposition. Anat Res Int 2015;2015:618042.