

## **A Study of Morphologic and Morphometric Features of Vermian Fossa and Internal Occipital Crest in Adult Indian Human Skulls in Tertiary Care Centres**

**Dr Arish Nazir shora<sup>1</sup>, Dr Nowsheeba Khurshid<sup>2</sup>, Dr Uzma Rasool\*<sup>3</sup>**

<sup>1</sup>Assistant Professor Anatomy Government Medical College Handwara

<sup>2</sup>Assistant Professor Anatomy GMC Srinagar

<sup>3</sup>Assistant Professor Anatomy Government Medical College Srinagar

**Corresponding Author:**Dr Uzma Rasool

Assistant Professor Anatomy Government Medical College Srinagar

Email: [azahaqsaali@gmail.com](mailto:azahaqsaali@gmail.com)

### **Abstract-**

**Introduction-** A noticeable internal occipital crest is visible on the inside surface of the squamous portion of the occipital bone. It descends and bifurcates around the foramen magnum, enclosing a tiny depression known as the vermian fossa. The single or double occipital sinus is located in the falx cerebelli, which is connected to the crest. The fossa houses the inferior vermis of the cerebellum. A bony ridge that divides the vermian fossa into upper and lower parts might give the structure a somewhat triangular shape. There are not many research that describe the morphometric and morphologic characteristics of vermian fossa. Hence, the present study was done to evaluate the morphological and morphometric parameters of vermian fossa and internal occipital crest in the Indian adult human dry skull.

**Material and method-** This study was a cross-sectional study conducted in department of Anatomy of Government Medical College, Handwara and Government Medical College Srinagar for a period of 9 months i.e. 1<sup>st</sup> September 2023 to 1<sup>st</sup> June 2014. A total of 140 bones were analysed. Any injured or pathologically altered skulls and occipital bones were excluded from the study. The vermian fossa were examined for their presence and morphology. Internal occipital crest were also seen for its shape and length. The data were recorded and tabulated in SPSS software version 20 and analysed.

**Result-** In the present study the incidence of vermian fossa was found to be 80% of total skull. Vermian fossa was mainly triangular in shape (71.42% cases), followed by quadrangular (8.03% samples) and atypical (20.53% bones). The mean height and width of vermian fossa was

measured to be  $9.4\pm 4.12$  mm and  $8.4\pm 3.82$  mm respectively. A sharp internal crest was more observed followed by rounded, widened. Ill-defined internal occipital crest was least observed in the present study. The internal occipital crest was  $2.82\pm 0.74$  cm in length, measured from the internal occipital protuberance to its bifurcation. From the internal occipital protuberance to the posterior margin of the foramen magnum, the internal occipital crest was  $4.25\pm 0.46$  cm in length on average.

**Conclusion-** It is important for clinicians and radiologists to accurately understand the morphology, morphometry, and changes of the internal occipital crest and vermian fossa when performing diagnostic and therapeutic procedures. It is necessary to investigate variations in typical anatomical features. For this reason, morphologists and anatomists find this important.

**Keywords-** Vermian fossa, internal occipital crest, morphology, morphometry, Human skull etc.

### **Introduction-**

Internal occipital protuberance is an uneven bony elevation seen on the inner surface of the squamous section of the occipital bone. A small depression known as the vermian fossa is enclosed by a prominent internal occipital crest that descends and bifurcates at the foramen magnum. [1,2] The crest provides connection to the falx cerebelli, which houses the single or double occipital sinus.[3] The fossa houses the inferior vermis of the cerebellum. [4] The vermian fossa, also called the middle cerebellar fossa of Verga, is a somewhat triangular structure that can have a bony ridge dividing it into upper and lower sections.[5] Lemurs and marmosets are among the species that are said to have this fossa in higher proportion.[6] The vermian fossa and internal occipital crest have been shown to impact the dural venous sinuses nearby and affect the flow of cerebrospinal fluid. Cerebellar cortical dysplasia and disorders around the foramen magnum, such as Arnold Chiari malformations, are associated with vermian abnormalities.[7]

There are not many research that describe the morphometric and morphologic characteristics of vermian fossa. The anatomy and morphometry of the internal occipital crest are similarly poorly documented in the literature. Hence, the present study was done to evaluate the morphological and morphometric parameters of vermian fossa and internal occipital crest in the Indian adult human dry skull.

## Material and Methods-

This study was a cross-sectional study conducted in department of Anatomy of Government Medical College, Handwara and Government Medical College Srinagar for a period of 9 months i.e. 1<sup>st</sup> September 2023 to 1<sup>st</sup> June 2014. A total of 140 bones were analysed for the study; of which, 55 were cranial bases (removed vaults) and 85 were separate occipital bones. Any injured or pathologically altered skulls and occipital bones were excluded from the study. We looked for the presence of the fossa directly posterior to the foramen magnum on the inner surface of the squamous section of the occipital bone. The fossa were examined for its shape and classified as: triangular (type 1), quadrangular (type 2), atypical, shallow, or deep (type 3a), atypical, partitioned (type 3b), and atypical, wide (type 3c) according to the classification system used by Kale and Öztürk.[8] The vermian fossa's length and width were also measured in millimetres. The breadth was measured at its maximum, while the length was measured from the fossa's most superior to its most inferior part. Internal occipital crest were also seen for its shape and length. Shape classified as sharp; rounded; wide; ill-defined. Length of internal occipital crest was taken from internal occipital protuberance to posterior margin of foramen magnum. A non-expandable plastic measuring tape was used for all measurements. The data were recorded and tabulated in SPSS software version 20 and analysed.

## Result-

This study was conducted by combined efforts of department of anatomy, Government Medical College, Handwara and Government Medical College Srinagar. The sample size was 140 with 55 cranial bones and 85 occipital bones. As shown in table 1, we could identify a total of 112 vermian fossa on examination., No fossa was discovered in the 28 remaining bones. Thus, it was estimated that VF occurred in 80% of Indian skulls.

**Table 1: presence of vermian fossa**

Vermian fossa	Number	Percentage
Present	112	80.0
Absent	28	20.0

Total	140	100.0
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Table 2 shows that out of 55 cranial bases, 41 vermian fossa were found (74.54%) and out of 85 occipital bones, 71 vermian fossa were found (83.53%). The association of presence of vermian fossa with type of skull is non-significant.

**Table 2: Association of vermian fossa with cranial bases and occipital bones**

Vermian fossa	Cranial bases	Occipital bones	Total	Chi-square	p-value
Present	41	71	112	1.684	0.194
Absent	14	14	28		
Total	55	85	140		

As can be seen in Table 3 and Figure 1, vermian fossa were further divided into different categories on the basis of morphology. Vermian fossa were predominantly triangular in shape in 80 specimens (71.42%). Least observed shape was quadrangular present in 9 samples (8.03%). Others vermian fossa were atypical in the rest 23 (20.53%) bones. In the atypical variety, fossa were shallow or deep (type 3a) whereas 11 were partitioned (type 3b). Rest 8 atypical fossa were, widened (type 3c) as the lateral borders get farther separated from one another. The vermian fossa was measured to have a mean height of  $9.4 \pm 4.12$  mm and a mean width of  $8.4 \pm 3.82$  mm.

**Table 3: Shape of vermian fossa**

Vermian fossa	Shape	Number	Percentage
Present	Triangular (type 1)	80	71.42
	Quadrangular (type 2)	9	8.03
	Atypical, shallow, or deep (type 3a)	4	3.57
	atypical, partitioned (type 3b)	11	9.82
	Atypical, wide (type 3c).	8	7.14
Total		112	100

triangular (type 1), quadrangular (type 2), atypical, shallow, or deep (type 3a), atypical, partitioned (type 3b), and atypical, wide (type 3c).

Figure 1: Variations of morphology of vermian fossa

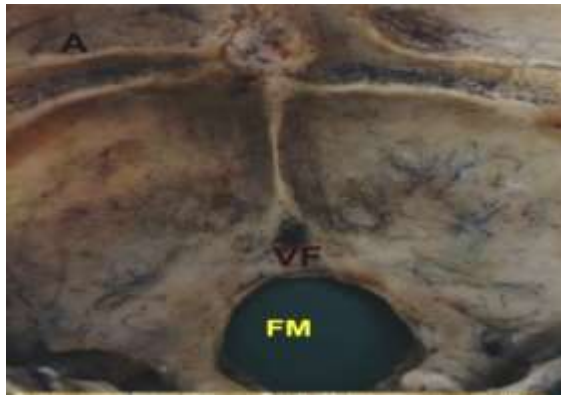


Figure 1A

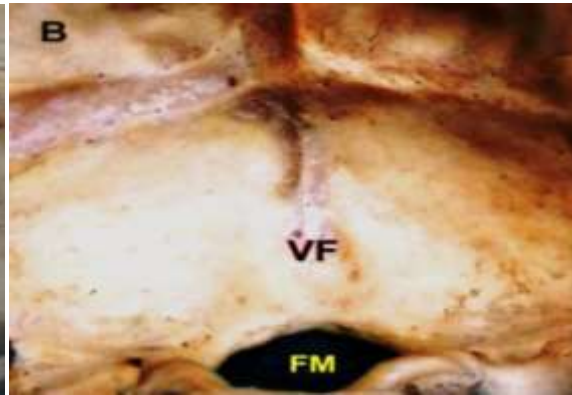


Figure 1B

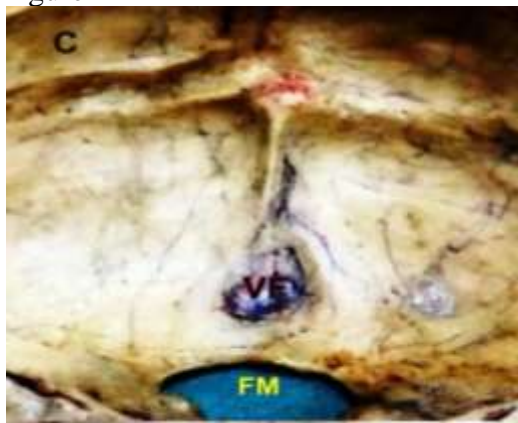


Figure 1C

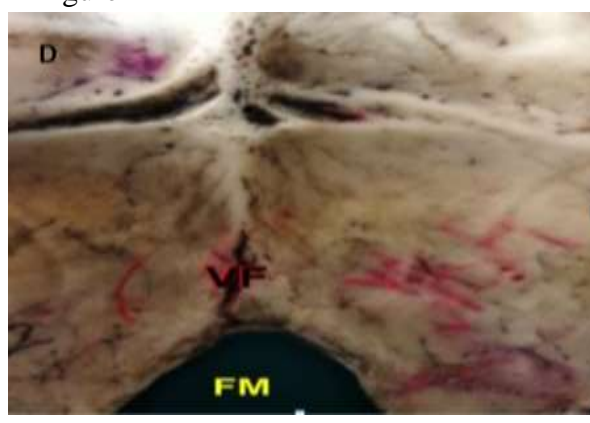


Figure 1D

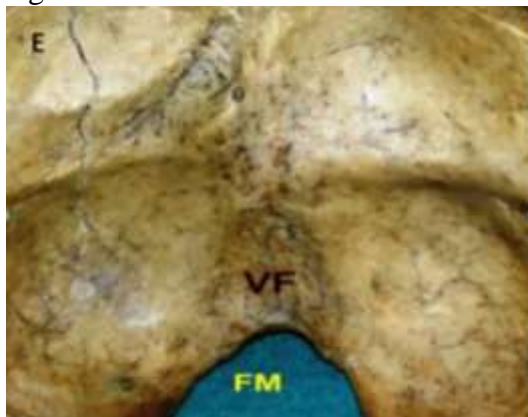


Figure 1E

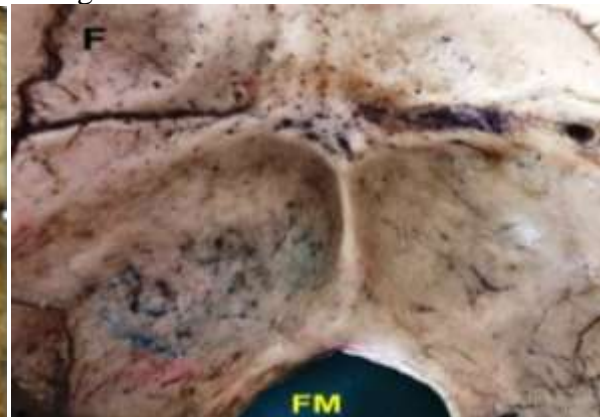


Figure 1F

A:triangular (type 1), B: quadrangular (type 2), C: atypical, deep (type 3a); D: atypical, widened (type 3c); E: atypical, partitioned (type 3b); F: absent vermian fossa. (VF= vermian fossa; FM= foramen magnum).

On 64 (57.14%) of the bones, the internal occipital crest was found to be sharp; on 36 (32.14%) of the bones, it was rounded; on 10 (8.92%) of the bones, it was wide; and on 2 bones (1.78%), it was ill-defined. The internal occipital crest was  $2.82 \pm 0.74$  cm in length, measured from the internal occipital protuberance to its bifurcation. From the internal occipital protuberance to the posterior margin of the foramen magnum, the internal occipital crest was  $4.25 \pm 0.46$  cm in length on average. (Figure 2)

**Figure 2: Morphology of internal occipital crest**



### **Discussion-**

A typical degree of flexibility in the morphology of anatomical bodily compositions is normal. Under normal circumstances, variations normally have little effect on bodily functions, yet they may change how patients are managed. A prominent internal occipital crest descends from the internal occipital protuberance, for attachment of the falx cerebelli, and bifurcates near the foramen magnum; the occipital sinus, sometimes double, lies in the attachment. The VF is bounded by the lips of the IOC which renders it a somewhat triangular outline.[\[9,10\]](#) Hence the present study was done to examine morphologic and morphometric features of vermian fossa and internal occipital crest on a total of 140 samples comprising of 55 cranial bases and 85 occipital bones.

In the present study the incidence of vermian fossa was found to be 80% of total skull. In the cranial bases, 41 vermian fossa were found (74.54%) and in the occipital bones, 71 vermian

fossa were found (83.53%).a study by Ranjan RK found similar result estimating incidence of VF in Indian skulls to be 80%. Out of 65 separate occipital bone, vermian fossa was found in 80% and out of 45 cranial base vermian fossa was present on 77.78%.[11] Same result (80% incidence) was found by N Pankaj et al. in their study.[12]

In this study, vermian fossa was triangular in shape in 71.42% cases, quadrangular in 8.03% samples and atypical in the rest 20.53% bones. Murlimanju et al. discovered in 2013 that 71.42% of Indian human skulls have VF, with 76% of those cases being triangular and 8% being quadrangular. The remaining 16% were regarded as atypical.[13] In 2014, Arvind Yadav and colleagues conducted a comparable study and discovered VF in 72.7% of the specimens. 72.5% of the vermian fossa that they saw were triangular, 10% were quadrangular, and 17.5% were atypical.[6] The limited sample size of the current study cannot be ruled out as a potential factor in these kinds of morphological and morphometric discrepancies. Vermian malformations have reportedly been linked to some occurrences of cerebellar cortical dysplasia.[14] The mean height and width of vermian fossa was measured to be  $9.4\pm 4.12$  mm and  $8.4\pm 3.82$  mm respectively. Study by Veena Vidya Shankar showed nearly similar results. In their study mean height and width of vermian fossa was found to be 8.9 mm and 8.02 mm respectively.[15] The height and width recorded in the previous studies were found to be between 13.40 mm and 27.80 mm and 11.9 mm and 18.40 mm, respectively.[6,11,16,17,18,19,20] A sharp internal crest was more observed followed by rounded, widened. Ill-defined internal occipital crest was least observed in the present study. These findings were comparable with the study reported by Arvind Kumar Pandey et al. in 2018.[19]

### **Conclusion-**

It is important for physicians and radiologists to accurately understand the morphology, morphometry, and changes of the internal occipital crest and vermian fossa when performing diagnostic and therapeutic procedures. Any pathological alterations in the posterior cerebral fossa, such as those involving the inferior vermis of the cerebellum or the region around the foramen magnum, should be investigated further to look for differences in the area's typical anatomical features. Incidence of vermian fossa was found to be 80% of total skull. Our study found a higher incidence of vermian fossa than prior studies, which may be related to racial

variances. Vermian fossa was triangular in shape in 71.42% cases, quadrangular in 8.03% samples and atypical in the rest 20.53% bones. Height and width of vermian fossa was found to be 8.9 mm and 8.02 mm respectively. A sharp internal crest was more observed followed by rounded, widened and ill-defined internal occipital crest was least observed in the present study. For morphologists and anatomists, these informations may be significant.

**Conflict of Interest:** None

**Source of funding:** NIL

### References-

1. Standring S. Gray's Anatomy. The Anatomical Basis of Clinical Practice, 39th ed. Elsevier: Churchill Livingstone; 2005; 353, 463-464.
2. Bergman R.A, Thompson S.A, Afifi A.K, Saadeh F.A. Compendium of human anatomic variation. Urban & Schwarzenberg; 1988. p:200.
3. Grant JCB and Basmajian JV. Grant's Method of Anatomy. Seventh edition. Baltimore: The Williams & Wilkins Co; 1965. p:720-721.
4. Poddar S, Bhagat A. Handbook of osteology, 12th Patna: Scientific Book Co; 2007:43.
5. Bergman RA, Thompson SA, Afifi AK, Saadeh FA. Compendium of human anatomic variation. Urban & Schwarzenberg; 1988: 200.
6. Yadav A, Chauhan K, Nigam XL, Sharma A, Yadav A. et al. Morphological and morphometrical analysis of the vermian fossa in dry adult skulls of Western Uttar Pradesh population: an osteological study. Int J Anat Res. 2014; 2(3):478-480.
7. Soto-Ares G, Delmaire C, Deries B, Vallee L, Pruvo JP. Cerebellar cortical dysplasia: MR findings in a complex entity. Am J Neuroradiol. 2000;21(8):1511-1519.
8. Kale A, Öztürk A. Vermian fossa An anatomical study Journal of Istanbul Faculty of Medicine. 2008;71:4
9. Hollinshead WH., Anatomy for surgeons. Vol. 1. The Head and Neck, 2nd edition, Harper and Row, New York, 1969, 84–85
10. Sargon MF, Brohi Özekşi P, Tonak AK, Cumhuri M. Agenesis of the corpus callosum and septum pellucidum together with a multiple layered duramater. Neuroanatomy 2002; 1: 2–4.
11. Ranjan RK, Kataria DS, Yadav U. Vermian Fossa: An Anatomical study of Indian human dry skull. Int J Health Sci Res. 2015; 5(8):238-242.
12. N Pankaj Mahadeo, KVS Nagiswar Rao. Evaluation of Vermian Fossa and Internal Occipital Crest in Dry Adult Human Skulls: An Institutional Based Study. Int J Med Res Prof. 2017; 3(3): 475-77. DOI: 10.21276/ijmrp.2017.3.3.103



13. Murlimanju, BV, Prabhu LV, Sharmada KL, et al. Morphological and morphometric study of the vermian fossa in Indian human adult skulls. *J. Morphological Sci.* 2010; 130(3):148- 151.
14. Soto-Ares, G., Delmaire, C., Deries, B., et al. Cerebellar cortical dysplasia: MR findings in a complex entity. *American Journal of Neuroradiology.* 2000; 21(8):1511-1519.
15. Veena Vidya Shankar, Anupama K, Jyothi K C. A Morphologic and Morphometric Study of the Vermian Fossa and Internal Occipital Crest in Adult Indian Human Skulls. *Int J Anat Res* 2023;11(3):8705- 8710. DOI: 10.16965/ijar.2023.177
16. Pushpalatha M, Sharmadha KL Morphological analysis, and morphometry of the vermian fossa in dry skulls. *J Evid Based Med Healthc.* 2015; 2(56), 8849-8851.
17. Rajasundaram A, Merlin KJ, Bhaskaran S, William MSJ. Morphology of Fossa of Verga in South Indian Human Adult Skull Bones. *International Journal of Anatomy, Radiology and Surgery.* 2017; Vol6(3): AO01-AO04.
18. Singh A, Gupta R. Morphological and Morphometric Study of Vermian Fossa. *International Journal of Advanced & Integrated Medical Sciences,* October-December 2017;2(4):198-200
19. Pandey AK, Sumalatha S, Kotian SR. A Cadaveric Study of the Internal Occipital Crest and Vermian fossa with its clinical significance. *Int J Anat Res.* 2018; 6(3.2):5520-5524.
20. Luckrajh JS, Naidoo J, Lazarus L. An anatomical description of the vermian fossa: The reappraisal of an overlooked entity. *J Anat Soc India* 2020;69: 233- 236.