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Original Research Article

A Morphologic and Morphometric Study of the Vermian Fossa and Internal Occipital Crest in Adult Indian Human Skulls

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ABSTRACT

Introduction: The inner surface of the squamous part of occipital bone shows a prominent internal occipital crest that descends and bifurcates close to foramen magnum to enclose a small depression called vermian fossa. It has been reported that the internal occipital crest and vermian fossa affect the dural venous sinuses close to it and influence the cerebrospinal fluid flow. Few studies have reported morphology the morphology and morphometric features of vermian fossa. There is a paucity of literature regarding the morphology and morphometry of the internal occipital crest. Hence, the present study evaluated the morphological and morphometric details of the vermian fossa and internal occipital crest.

Objectives: To provide morphologic & morphometric data of the vermian fossa and internal occipital crest in the Indian population.

Materials and Methods: This was a cross-sectional study, with a sample size of 64, carried out for a period of three months in the Department of Anatomy. The fossa's morphometric dimensions and the vermian fossa's different shapes observed were documented. The internal occipital crest was observed for shape & length. All data was tabulated, analyzed, and summarized using mean and standard deviation.

Results: The vermian fossa was present in 56(82.35%) bones. The type 1 variety was observed in 48(70.6%), type 2 variety in 1 (1.1%) bone and type 3 - atypical variety in 10.3%. The mean length and width of the vermian fossa was 8.9 ±4.41 mm and 8.02±3.50 mm, respectively. The internal occipital crest was sharp in 37(54.4%) bones, rounded in 24(35.3%) bones and wide in 6(8.8%) bones and ill-defined in one bone. The mean length of the internal occipital crest from the internal occipital protuberance to the posterior margin of the foramen magnum was 4.16±0.56 cm.

Conclusion: An accurate knowledge of morphology and morphometry of vermian fossa and internal occipital crest and their variations is of significance in diagnostic and therapeutic performance of clinicians and radiologists. Variations in normal anatomical features need to be explored. Hence, this is of importance to anatomists and morphologists.

KEY WORDS: internal occipital crest, vermian fossa, morphology, morphometry, cerebellum.

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INTRODUCTION

The inner surface of the squamous part of occipital bone shows an irregular bony elevation known as internal occipital protuberance. A prominent internal occipital crest descends and bifurcates close to foramen magnum to enclose a small depression called vermian fossa. The crest gives attachment to falx cerebelli in which lies the occipital sinus, single or double [1].

The inferior vermis of cerebellum lodges in the fossa [2]. The vermian fossa is also known as the middle cerebellar fossa of Verga which is somewhat triangular and may be divided into upper and lower parts by a bony ridge [3]. This fossa is reported to be well appreciated in animals like lemur and marmoset [4]. It has been reported that the internal occipital crest and vermian fossa affect the dural venous sinuses close to it and influence the cerebrospinal fluid flow. The vermian malformations are seen with cerebellar cortical dysplasia and in pathologies around foramen magnum like Arnold Chiari malformations [5]. Few studies are reporting the morphology and morphometric features of vermian fossa. There is paucity of literature regarding the morphology and morphometry of internal occipital crest. Hence, the present study evaluated the morphological and morphometric details of vermian fossa and internal occipital crest.

Aim: To provide morphologic & morphometric data of the vermian fossa and internal occipital crest in the Indian population.

MATERIALS AND METHODS

This was a cross-sectional study carried out for a period of three months. The source were 64 normal dry adult human cranial bases and 4 occipital bones from Department of Anatomy and student set of bones. Damaged skull and occipital bones and bones with pathological changes were excluded from the study.

Sample size rationale: In the previous study conducted by Rajasundaram Archana et al, it was found that the mean length and width of the vermian fossa was 14.6±4.1mm and 12.6±3.1 mm respectively. In the present study, assuming the expected standard deviation to be 4.1, the study requires sample size of 68 to estimate a mean with 95% confidence level & precision 1 (margin of error).

Parameters studied:

Vermian fossa:

a. Absent or present

b. Shape: type 1 - triangular; type 2 - quadrangular; type 3a – atypical, shallow, or deep; type 3b – atypical, partitioned; type 3c – atypical, wide.

c. Length and width of vermian fossa in millimetres.

Internal occipital crest:

a. Shape: sharp; rounded; wide; ill-defined.

b. Length: Length of internal occipital crest from internal occipital protuberance to posterior margin of foramen magnum; Length of internal occipital crest from internal occipital protuberance to its divergence to form vermian fossa.

Statistical Methods: All measurements were carried out using a non-expandable plastic measuring tape. The measurements were taken three times to compensate for measurement errors and their mean value has been considered. The morphometric dimensions of the fossa and different shapes of vermian fossa observed was documented. The shape of internal occipital crest and its length were observed and documented. All data was tabulated, analysed, and summarized using mean and standard deviation.

RESULTS

In this study, the sample size was 68 with 64 cranial bases and 4 occipital bones. The vermian fossa was present in 56(82.35%) bones and absent in 12 (17.6%) bones. The shape was predominantly type 1 variety which was observed in 48(70.6%) bones. The type 2 variety was the least observed shape in 1 (1.1%) bone. In the type 3 - atypical variety, type 3a – atypical, shallow was observed in 3 (4.4%); type 3b – atypical, partitioned and type 3b – atypical, wide were each observed in 2 (2.9%) bones. (Table 1)

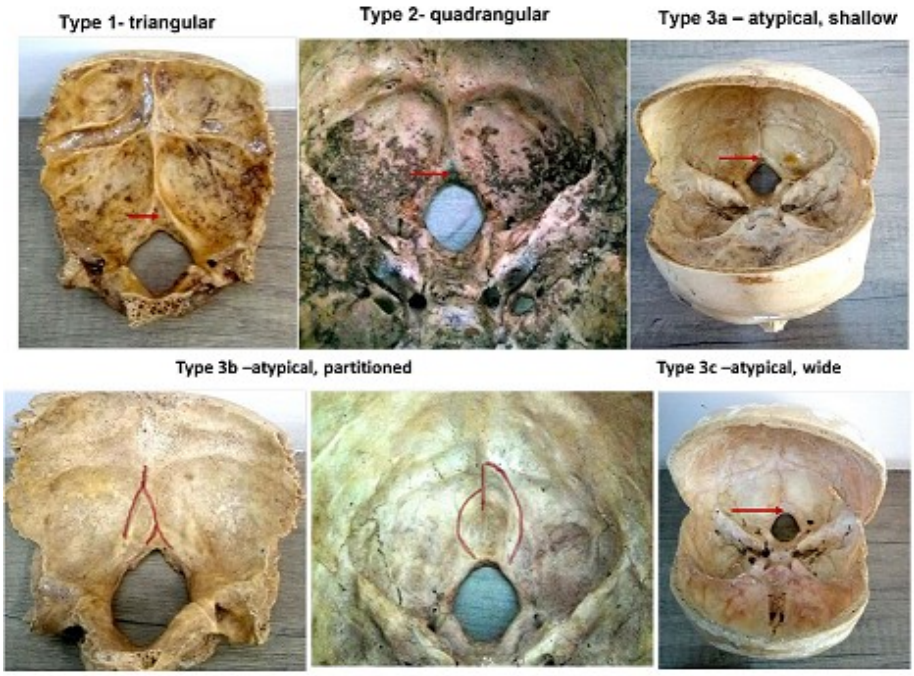

Fig.1: Shapes of vermian fossa.

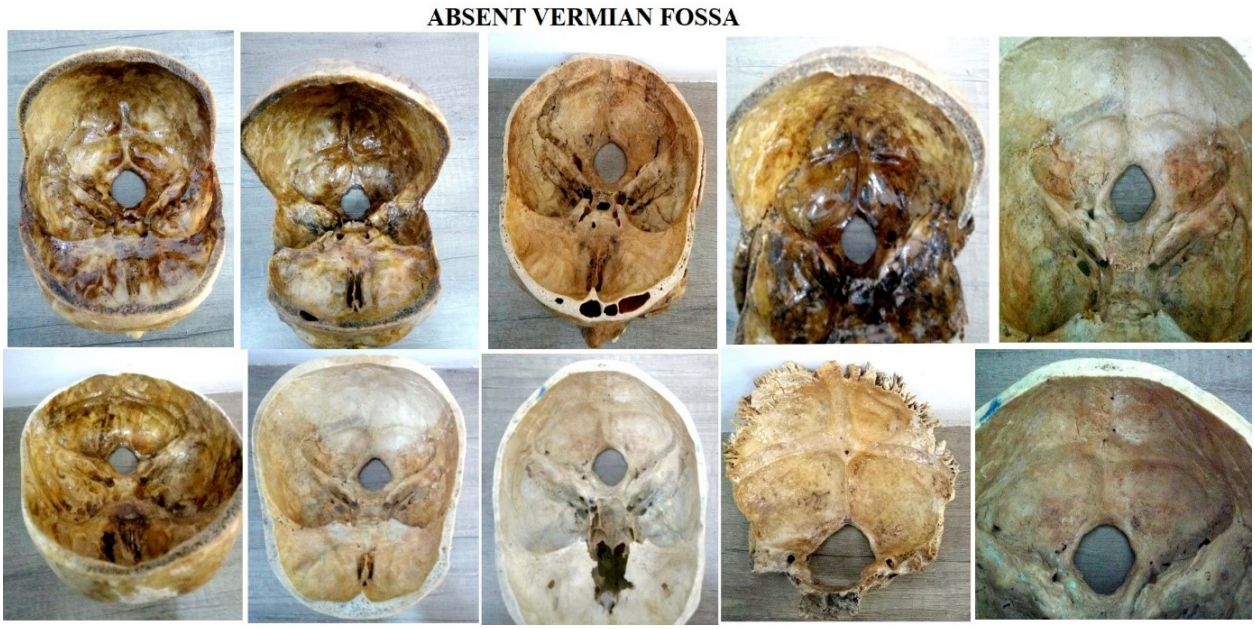

Fig. 2: Absence of Vermian fossa.

The mean length of vermian fossa was 8.9 ±4.41 mm and mean width 8.02±3.50 mm.

The internal occipital crest was sharp in 37(54.4%) bones, rounded in 24(35.3%) bones and wide in 6(8.8%) bones and ill-defined in one bone.

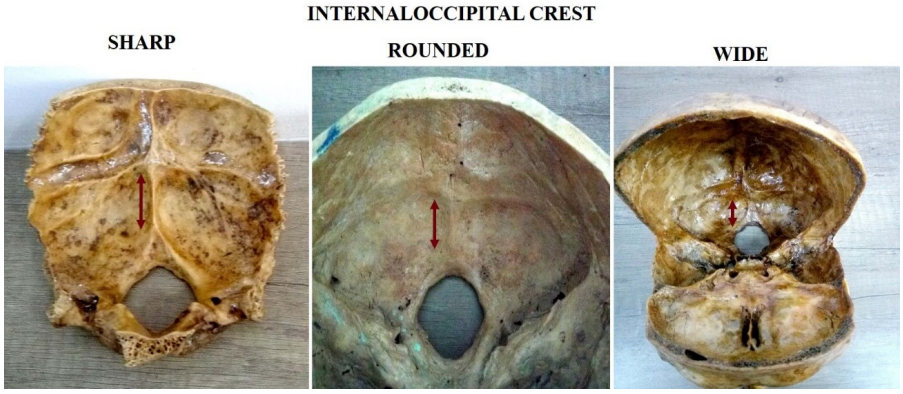

Fig. 3: Morphology of internal occipital crest

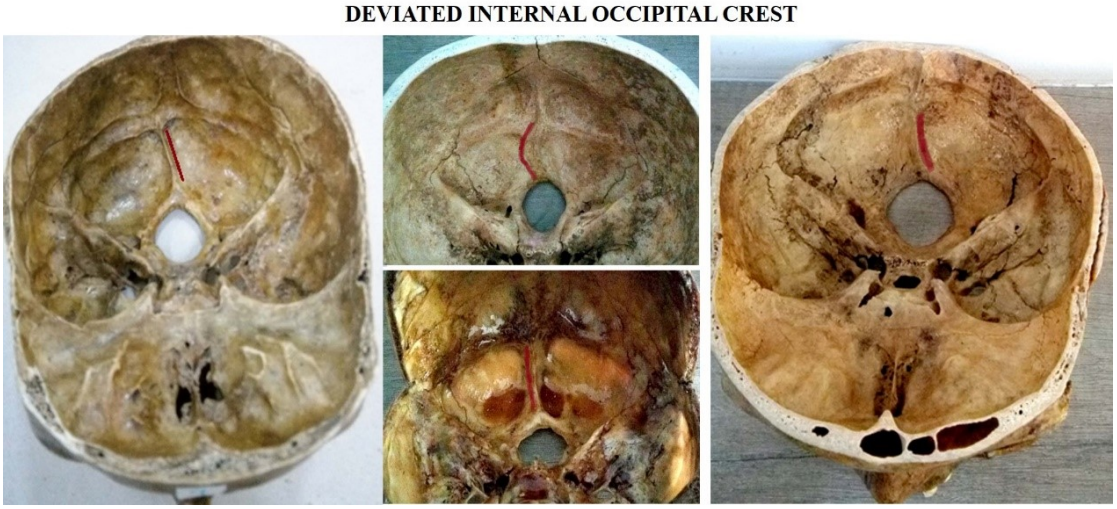

Fig. 4: Deviated internal occipital crest.

The mean length of the internal occipital crest from internal occipital protuberance to its bifurcation was 2.83±0.73 cm. The mean length of internal occipital crest from internal occipital protuberance to posterior margin of foramen magnum was 4.16±0.56 cm.

Table 1: Morphology of vermian fossa.

Vermian fossa	Observations
Present	56(82.35%)
Absent	12 (17.6%)
Type 1 - Triangular	48(70.6%)
Type 2 - Quadrangular	1 (1.1%)
Type 3a - Atypical – shallow/deep	3 (4.4%)
Type 3b - Atypical – partitioned	2 (2.9%)
Type 3c - Atypical- wide	2 (2.9%)

DISCUSSION

In the present study, 56(82.35%) bones had vermian fossa which has been reported similarly in previous studies in a range of 8.20% to 82.35%, the present study reporting the highest incidence. Type 1 vermian fossa wasfound in 70.6% samples like that observed by Rakesh Kumar Ranjan et al, 2015[9], while other studies [6,7, 8, 10, 11, 12, 13, 14] have reported it in a range of 27% to 80.56%. Type 2 vermian fossa was least observed, about 1.1% in the present study while the other studies [6,7,8,9,10,11, 12, 13, 14] have reported in the range of 8% to 30.76%. Type 3 vermian fossa was seen in 10.2% in the present study while previous studies [6,7,8,9,10,11, 14] have observed in the range of 8.33% to 27%.

The mean height and width of the vermian fossa in the present study was 8.9 mm and 8.02 mm respectively which were the lowest. Previous studies [6,7,8,9,10,11, 12, 13, 14] have reported height and width in the range of 13.40 mm to 27.80 mm and 11.9 mm to 18.40 mm respectively (Table 2)

Table 2: Various studies of morphology and morphometry of Vermian fossa.

Sl No	Author	Population	Sample size	Incidence (%)	Type 1 (%)	Type 2 (%)	Type 3 (%)	Height in mm	Width in mm
1	Kale et al, 2008[6]	Turkey	158	8.2	53.84	30.76	15.38	27.8	18.4
2	Murlimanju B.V et al, 2013[7]	India	35	71.42	76	8	16	13.6	13.9
3	Arvind Yadav et al, 2014[8]	India	55	72.70%	72.5	10%	17.5	14.2	12.1
4	Rakesh Kumar Ranjan et al, 2015[9]	India	110	80	**70.45**	7.95	21.59	13.4	12.1
5	Pushpalatha M et al, 2015[10]	India	35	71.4	76	8	16	13.6	11.9
6	Rajasundaram Archana et al, 2017[11]	India	50	72	80.56	11.11	8.33	14.6	12.6
7	Archana Singh et al, 2017[12]	India	60	66.7	80	20	0	16.98	13.52
8	Arvind Kumar Pandey et al, 2018[13]	India	40	80	56.25	12.5	0	16.7	18
9	Luckrajh JS et al, 2020[14]	South Africa	100	62	27	8	27	13.8	11.6
10	Present study	India	68	**82.35**	**70.6**	**1.1**	**10.2**	**8.9**	**8.02**

Table 3: Comparison of morphology and morphometry of internal occipital crest.

Internal occipital crest	Arvind Kumar Pandey et al, 2018 [12]	Present study
Sharp	26 (65%)	36(52.94%)
Rounded	12 (30 %)	26(38.23%)
Wide	-	5(7.35%)
Ill-defined	2(5 %)	1(1.47%)
Length of the internal occipital crest from IOP to it's bifurcation	2.97 ± 0.16 cm	2.83±0.73

A sharp internal crest was more observed while rounded and ill-defined internal occipital crest was less observed in the present study in comparison with the study reported by Arvind Kumar Pandey et al, 2018[13] (Table 3)

CONCLUSION

An accurate knowledge of morphology and morphometry of vermian fossa and internal occipital crest and their variations is of significance in diagnostic and therapeutic performance of clinicians and radiologists. Any pathological changes of posterior cranial fossa like that involving inferior vermis of cerebellum or around the foramen magnum need to be further explored for variations in normal anatomical features in that area. Hence, this is of importance to anatomists and morphologists.

Conflicts of Interests: None

Author Contributions

Veena Vidya Shankar: Study conception and design, Data Collection, analysis and interpretation of results
Anupama K: Assist in data collection, analysis and interpretation of results
Jyothi K C: Assist in data collection, draft manuscript preparation:
Note: All authors reviewed the results and approved the final version of the manuscript.

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