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Original Research Article

A CADAVERIC STUDY OF THE INTERNAL OCCIPITAL CREST AND VERMIAN FOSSA WITH ITS CLINICAL SIGNIFICANCE

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ABSTRACT

Background: The anatomical variabilities of the internal occipital crest (IOC) and vermian fossa (VF) may influence the related dural venous sinuses and further effect the flow of the cerebrospinal fluid. It is also associated with the pathologies around the foramen magnum like Arnold Chiari malformation, certain cases of cerebellar cortical dysplasia.

Aim: The present study was designed to explore and evaluate the morphological and morphometric details of the IOC and VF.

Materials and Methods: The study was conducted on 40 adult cadavers (23 males & 17 females). The morphology and morphometry of IOC and VF were studied. Based on the observations, the VF was classified into five types: Type 1- classical (well defined fossa), Type II-short triangular, Type III- elongated triangular, Type IV-quadrangular and Type V-deviated.

Results: The IOC was found to be variable both in terms of morphology and morphometry. The morphological observations included varied shapes, i.e., sharp (65%), blunt (30 %) and ill-defined (5 %). The length of the IOC was also variable with a mean length of 2.97 ± 0.16 cm. The mean width at upper, middle and lower levels were 0.9 ± 0.10 cm, 0.75 ± 0.17 cm, 1.10 ± 0.12 cm respectively.

The incidence of the VF was found to be about 80%. The VF was classified into types based on its varied shape: classical (Type I ;56.25 %), short triangular (Type II ;21.87%), elongated triangular (Type III;12.5%) and quadrangular (Type 1V;6.25 %) respectively. In one specimen, the VF was deviated to the left side (type V ;3.12%). The mean length and width of the fossa were 1.67±0.34 cm and 1.80±0.34 cm respectively.

Conclusion: The present study on the morphology and morphometry of the IOC and the VF may serve as database and further help clinicians to improve the diagnosis and therapeutic performances in the posterior cranial fossa.

KEY WORDS: Internal occipital crest, vermian fossa, foramen magnum, morphology, morphometry.

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INTRODUCTION

The internal occipital crest (IOC) is an elevated ridge that extends from the internal occipital protuberance (IOP) to the foramen magnum (FM). It provides an attachment to the falx cerebelli. The groove for superior sagittal sinus and the IOC are commonly aligned in straight line. IOP and IOC, as a group, are closely

related to dural venous sinuses [1].

The vermian fossa (VF) is small depression present at the lower part of the IOC. The inferior part of the vermis of the cerebellum overlies the VF [2]. The VF varies in its size and is found occasionally on the dorsal aspect of the foramen magnum (FM). The VF is also referred to as the middle cerebellar fossa of Verga [3]. It is bounded by the lips of the IOC which diverge around the FM rendering the VF a somewhat triangular outline [3].

The IOC and VF can influence the adjacent dural venous sinuses and further effect the flow of the cerebrospinal fluid. It has been reported that pathologies around the foramen magnum like Arnold Chiari malformation, certain cases of cerebellar cortical dysplasia are associated with vermian malformations [4].

However, the anatomical variabilities of the IOC and VF are less discussed in the literature. Therefore, the present study was designed to explore and evaluate the morphological and morphometric details of the IOC and VF.

MATERIALS AND METHODS

The study was conducted on 40 adult cadavers (23 males & 17 females). The interior of the posterior cranial fossa was observed after reflecting the calvaria. The presence of the IOC and VF were then examined after the removal of the duramater. The specimens showing signs of damage or any pathological vagaries were not included in the study.

The structure of the IOC was noted with special emphasis on its shape and position. Further the morphometric measurements of the crest were also considered using a Metal Casing Electronic Digital Calipers (series-sc02, Guilin Gunglv measuring instrument Co. Ltd, Guilin, China). The measurements considered were: Length of the crest (distance between the IOP and the point of formation of the VF), Width of the crest considered at three levels; Upper (at the level of the IOP), Middle (midway between the IOP and the point of bifurcation of the crest), Lower (at the point of bifurcation of the crest, i.e., formation of the VF).

Fig. 1: Showing the varied shapes of the Internal Occipital Crest (IOC). IOP- Internal occipital protuberance, VF-Vermian fossa.

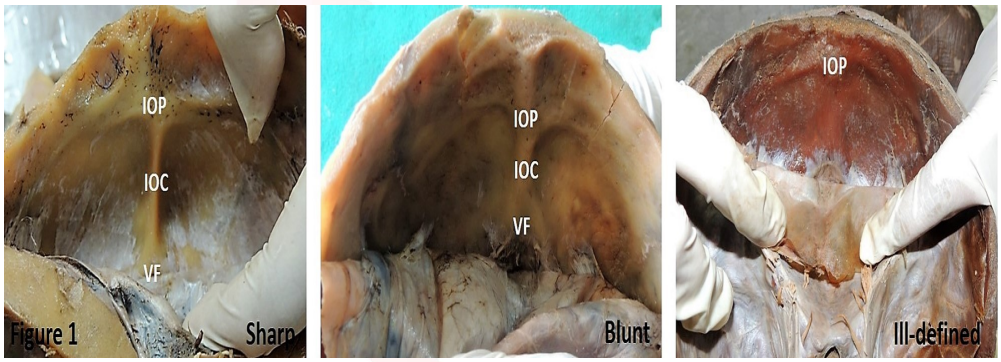
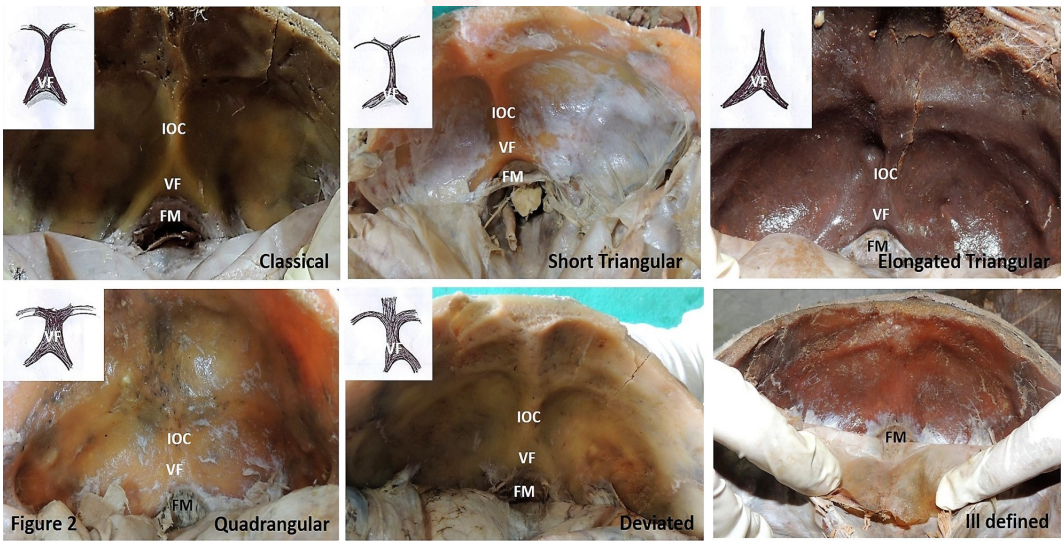


Fig. 2: Showing the types of the Vermian fossa (VF). IOC- Internal Occipital Crest, FM-Foramen magnum.



The shape and size of the VF were examined and documented photographically. Based on the observations, the VF was classified into five types: Type 1- classical (well defined fossa) as described in the standard textbooks (Standring 2005), Type II-short triangular, Type III-elongated triangular, Type IV-quadrangular and Type V- deviated. The length and width of the VF were also measured. The length was determined from the most superior to the most inferior part of the fossa. The width was measured at its maximum. The data are represented as mean ± SEM.

RESULTS

The IOC was found to be variable both in terms of morphology and morphometry. The morphological observations included varied shapes, i.e., sharp in 26 specimens (65%), blunt in 12 specimens (30 %) and ill-defined in 2 specimens (5 %) (Figure 1). The length of the IOC was also variable with a mean length of 2.97 ± 0.16 cm**.** The width of the IOC was measured at three levels. The mean width at upper, middle and lower levels were 0.9 ± 0.10 cm, 0.75 ± 0.17 cm, 1.10 ± 0.12 cm respectively.

The incidence of the VF was found to be about 80% (32 specimens) and was ill-defined in eight specimens. In the remaining 32 skulls; The VF was further classified into types based on its varied shape: classical (Type I) in 18 specimens (56.25 %), short triangular (Type II) in 7 (21.87%), elongated triangular (Type III) in 4 (12.5%) and quadrangular (Type 1V) in 2 (6.25 %) specimens respectively. In one specimen, the VF was d eviated to the left side (type V) (3.12%) (Fig 2). The mean length and width of the fossa were 1.67±0.34 cm and 1.80±0.34 cm respectively.

DISCUSSION

The IOC descends from the IOP and bifurcates near the FM forming the VF. The VF is bounded by the lips of the IOC which renders it a somewhat triangular outline [1,3].

The IOC may be sharp or blunt as observed in the present study. An ill-defined IOC was also encountered during the course of this study. Authors in the past have described the misalignment of the IOC, i.e., its deviation from the midline. This may or may not be associated with hydrocephalus as stated previously [5]. However, the possibility for hydrocephalus and cisterna magna due to the misalignment of the internal occipital crest remains uncertain [6].

The morphometry of the IOC was less considered in the available literature. However, in the present study, the length and width of the IOC was considered and recorded. This was because, the IOC is a prominent crest in the posterior cranial fossa which provides attachment to the falx cerebelli. The latter lodges the occipital sinus and is also related to the adjacent venous sinuses. Any alteration in the morphology of the IOC and the associated dural fold may potentially be associated with variations of the venous sinuses [7].

The IOC normally descends from the IOP and bifurcates near the FM to form the VF. On the contrary, Lang et al stated that the falx cerebelli is located in the midline and may divide inferiorly to create the VF [8]. This fossa lodges the inferior vermis of the cerebellum. It includes the tuber, pyramid, uvula and nodule [1].

A well-defined VF is present in animals like lemur and marmoset as reported in previous studies [9]. Studies on human skulls have also stated that the incidence of VF has been reported to be in the range of 4%-11.4% [10, 11, 12]. This is relatively low in comparison to other studies [13, 14]. Murlimanju et al had reported an incidence of 71.4% in their study on Indian human adult skulls [13].

A study on the vermian fossa in dry adult skulls of western Uttar Pradesh population, the incidence of the VF was as high as 72.7% [14]. In our study, the incidence of VF was 80% which is almost in alignment with the Yadav et al and Murli Manju et al [13, 14].

Literature review stated that the VF has been classified into different types, type 1 (triangular), type 2 (quadrangular), type 3 (atypical) i.e., shapes other than triangular and quadrangular [11, 13, 14].

In the present study, we have classified the VF into five types. Herein, the typical representation of the VF as described in the standard textbooks was designated as type 1 (56.25 %). The triangular VF further showed variability in its appearance as observed in different skulls. It was shortened and elongated as observed in

21.87% and 12.5% respectively.

The quadrangular shaped VF was also observed in the present study in 6.25% of the cases. The quadrangular shaped VF is also referred to as the fossa occipitalis mediana. The latter has a comparatively deeper fossa. The depth of the VF can determine the shape of the inferior cerebellar vermis [12, 15].

A deviated VF was also reported in the present study. This finding is unique and rarely reported.

The average length and width of the fossa were 1.67±0.34 cm and 1.80±0.34 cm as reported in the present study.

The observations made in the current study varies from the previous studies in terms of classification and morphometry. This difference might be due to the type of specimens chosen. In the present study, cadavers were used unlike the dried skulls considered in the older studies. The difference in racial and geographical distribution may also contribute to the same [11, 13, 14].

The aforementioned observations may be of significance in studies on pathologies that may alter the size and morphology of VF [16].

The VF, which accommodates the inferior part of the vermis, needs to be studied anatomically. This is because the vermian malformations may be associated with certain cases of cerebellar cortical dysplasia [4].

Siebert stressed on the anatomy of the posterior cranial fossa owing to its importance in the management of the associated pathologies [17]. Due to these reasons of clinical interest, the surgeon must be familiar with morphological and morphometric variations of the IOC and the VF as described in the present study. The clinician who operates intra-cranially or interprets radiological imaging should be aware of the anatomical variations which may be found in the posterior cranial fossa [18].

CONCLUSION

Accurate knowledge of the variability of the morphology and morphometry of the IOC and the VF may help to improve the diagnosis and therapeutic performances in the posterior cranial fossa. The present study may therefore serve as a database that could be surgically relevant and can further be correlated with radiological and surgical findings.

ABBREVIATIONS

IOC - Internal occipital crest

IOP - Internal occipital protuberance

FM - Foramen magnum

VF - Vermian fossa

Conflicts of Interests: None

REFERENCES

[1]. Standring S. Gray's Anatomy, The Anatomical Basis of Clinical Practice. 39th ed. Elsevier: Churchill Livingstone; 2005: 353, 463-464.

[2]. Poddar S, Bhagat A. Handbook of osteology, 12th ed. Patna: Scientific Book Co; 2007:43.

[3]. Bergman RA, Thompson SA, Afifi AK, Saadeh FA. Compendium of human anatomic variation. Urban & Schwarzenberg; 1988: 200.

[4]. 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.

[5]. Pozzati E, Piazza GC, Galassi E, Gaist G. Anomalous internal occipital crest causing hydrocephalus. Case report. J Neurosurg Sci. 1979;23(1): 87–90, 1979.

[6]. Robertson EG. Developmental defects of the cisterna magna and dura mater. J Neurol Neurosurg Psychiatry. 1949;12(1):39–51, 1949.

[7]. D'Costa S, Krishnamurthy A, Nayak SR, Madhyasta S, Prabhu LV, Jiji P, Ranade AV, Pai MM, Vadgaonkar R, Ganesh Kumar C, Rai R. 2009. Duplication of falx cerebelli, occipital sinus, and internal occipital crest. Rom J Morphol Embryol. 2009;50(1):107-10.

[8]. Lang J. Clinical anatomy of the posterior cranial fossa and its foramina. New York: Thieme; 1991:6.

[9]. East CFT. A rare abnormality of the occipital bone. J Anat. 1926;60:416-417.

[10]. Berge JK, Bergman RA. Variations in size and symmetry of the foramina of the human skull. Clin. Anat. 2001;14:406-413.

[11]. Kale A, Ozturk A, Aksu F, Taskara N, Bayraktar B, Gurses I.A, Zeybek F.G, Gayretli O. Vermian fossa – an anatomical study. J Ist Faculty Med. 2008;71:106-108.

[12]. Cireli E, Ozturk L, Yurtseven M, Baflalo.lu K. Protuberantia occipitalis interna olgesindeki sulkuslar›n incelenmesi veFossa Vermiana. Ege T›p Dergisi. 1990;29:793-796.

[13]. Murlimanju BV, Prabhu LV, Sharmada KL, Saralaya VV, Pai MM, Kumar CG, Jiji PJ, Dhananjaya KVN. Morphological and morphometricstudy of the vermian fossain Indian human adult skulls. J.Morphol Sci. 2010;30(3):148-151.

[14]. Arvind Yadav, Ketu Chauhan, GL Nigam, Archana Sharma, Anjoo Yadav. 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):478-80.

[15]. Elze C, Braus H. Anatomie des Menschen. Band I. Berlin: Springer-Verlag; 1954:642-643.

[16]. Hashimoto T, Tayama M, Miyazaki M, Murakawa K, Kuroda V. Brainstem and cerebellar vermis involvement in autistic children. J Child Neurol. 1993;8(2):149-153.

[17]. Siebert JR. A pathological approach to anomalies of the posterior fossa. *Birth Defects* Res A Clin Mol Teratol.2006;76(9):674-684.

[18]. Shoja MM., Tubbs RS, Khaki AA, Shokouhi G. A rare variation of the posterior cranial fossa: duplicated falx cerebelli, occipital venous sinus and internal occipital crest. Folia Morphol. 2006;65(2):171-173.

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