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Bilateral oblique occipital venous sinus groove and asymmetry of the sigmoid sinus groove: A case report

Sulco do seio venoso occipital oblíquo bilateral e assimetria do sulco do seio sigmóideo: Um relato de caso

Surco venoso occipital oblicuo vilateral y asimetría del surco sigmoideo: Reporte de un caso

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Abstract
The occipital venous sinus is the smallest venous sinus described and typically communicates cranially with the confluence of sinuses and caudally with the vertebral venous plexus, resulting in the formation of a single groove between the internal occipital crest and the jugular foramen. Additionally, the sigmoid sinuses are responsible for draining the transverse sinuses on each side toward the internal jugular vein, which defines a bilaterally present groove on the petrous surface of the temporal bone. The aim of this case report was to describe an uncommon anatomical variation related to these grooves, identified in an adult dry skull from the Human Anatomy Laboratory of an educational institution located in the interior of the state of São Paulo, Brazil. Furthermore, to complement the study, a literature review was conducted in the PubMed and SciELO databases using the descriptors “occipital venous sinus” and “anatomic variation,” combined with the Boolean operator AND. Examination of the specimen revealed a peculiar anatomical variation: the groove of the occipital venous sinus was oblique and bilateral, with both depressions originating from the internal occipital crest and extending toward the groove of the ipsilateral sigmoid sinus. In addition, the groove of the right sigmoid sinus was nearly imperceptible, suggesting the presence of asymmetry in the cranial structure. Thus, understanding such variations is essential for planning neurosurgical interventions, in order to avoid complications and improve patient care.
Keywords: Blood vessels; Neuroanatomy; Anatomical variation.

Resumo
O seio venoso occipital é o menor seio venoso descrito e comunica-se, geralmente, com a confluência dos seios no sentido cranial e com o plexo venoso vertebral no sentido caudal, determinando a formação de um único sulco entre a crista occipital interna e o forame jugular. Ademais, os seios sigmóideos, por sua vez, realizam a drenagem dos seios transversos de cada lado em direção à veia jugular interna, o que define um sulco bilateralmente presente na face petrosa do osso temporal. O objetivo deste relato de caso foi descrever uma variação anatômica incomum relacionada

à tais sulcos descritos, encontrada em um crânio seco adulto no Laboratório de Anatomia Humana de uma instituição de ensino localizada no interior do estado de São Paulo. Além disso, para complementar o estudo, foi realizada revisão bibliográfica nas bases de dados PubMed e Scielo, por meio dos descritores "occipital venous sinus" e "anatomic variation", utilizando o operador *booleano* AND. A partir da observação da peça, verificou-se uma variação anatômica peculiar: o sulco do seio venoso occipital era oblíquo e bilateral, em que ambas as depressões se originavam da crista occipital interna e direcionavam-se para o sulco do seio sigmódeo ipsilateral. Somado a isso, também foi observado que o sulco do seio sigmódeio direito era quase imperceptível, o que infere uma assimetria presente na estrutura craniana. Dessa forma, é possível afirmar que o entendimento de tais variações é fundamental para o planejamento de intervenções neurocirúrgicas, a fim de evitar complicações e aprimorar os cuidados aos pacientes.
Palavras-chave: Vasos sanguíneos; Neuroanatomia; Variação anatômica.

Resumen
El seno venoso occipital es el seno venoso más pequeño descrito y, por lo general, se comunica cranealmente con la confluencia de los senos y caudalmente con el plexo venoso vertebral, lo que da lugar a la formación de un único surco entre la cresta occipital interna y el agujero yugular. Además, los senos sigmoideos drenan los senos transversos de cada lado hacia la vena yugular interna, lo que define un surco bilateral en la superficie petrosa del hueso temporal. El objetivo del presente reporte de caso fue describir una variación anatómica inusual relacionada con los surcos mencionados, identificada en un cráneo adulto seco del Laboratorio de Anatomía Humana de una institución de enseñanza ubicada en el interior del estado de São Paulo. Asimismo, para complementar el estudio, se realizó una revisión bibliográfica en las bases de datos PubMed y SciELO utilizando los descriptores "seno venoso occipital" y "variación anatómica", combinados mediante el operador booleano AND. A partir de la observación del espécimen, se identificó una variación anatómica peculiar: el surco del seno venoso occipital era oblicuo y bilateral, con ambas depresiones originándose en la cresta occipital interna y dirigiéndose hacia el surco del seno sigmoideo ipsilateral. Adicionalmente, se observó que el surco del seno sigmoideo derecho era casi imperceptible, lo que sugiere la presencia de una asimetría en la estructura craneal. Por lo tanto, la comprensión de estas variaciones es fundamental para la planificación de intervenciones neuroquirúrgicas, con el fin de evitar complicaciones y mejorar la atención al paciente.
Palabras clave: Vasos sanguíneos; Neuroanatomía; Variación anatómica.

1. Introduction

The dural venous sinuses are structures responsible for draining blood from the skull and brain and are located between the periosteal and meningeal layers of the dura mater (Kiliç & Akakin, 2007). These venous channels differ characteristically from veins by the absence of muscular and adventitial walls, as well as by the lack of valves (Tubbs et al., 2011). In this context, the main venous sinuses of the skull include the superior and inferior sagittal sinuses, the transverse, sigmoid, straight, occipital, and cavernous sinuses.

In this sense, the occipital sinus is the smallest venous sinus described and is located near the attachment of the cerebellar falx, generally communicating cranially with the confluence of sinuses and caudally with the vertebral venous plexus (Moore et al., 2014). Thus, this sinus typically defines a groove that extends from the internal occipital crest to the foramen magnum in the occipital bone of the posterior cranial fossa (Netter, 2019). The tributary veins of the occipital sinus may include veins of the hypoglossal canal, the basilar plexus, the occipital emissary vein, and diploic veins (Lang, 1991), in addition to draining the choroid plexus of the fourth ventricle (Çavdar et al., 2020). Furthermore, in patients with rudimentary transverse sinuses, the occipital sinus may act as the primary drainage channel for intracranial veins (Widjaja & Griffiths, 2004).

When analyzing possible anatomical variations involving the occipital sinus, the literature reveals a wide range of described scenarios, such as absence of this sinus, the presence of multiple branches, or caudal communication with the sigmoid sinus (Kobayashi et al., 2006). In this context, the term *oblique occipital sinus* is used when the occipital sinus drains into the sigmoid sinus (Alper et al., 2004), representing the third most frequent variation of the dural sinuses (Kalkmann et al., 2022). This configuration may pose risks during approaches to the posterior cranial fossa, particularly when the deviated sinus is large. Additionally, the oblique occipital sinus may occur bilaterally when it is divided into two venous channels draining

into the ipsilateral sigmoid sinuses (Shin et al., 2016), thereby forming two grooves that contour the posterior margin of the foramen magnum (Das et al., 2008).

Regarding the sigmoid sinuses, it is noteworthy that these venous structures play a primary role in cerebral circulation, as they drain the transverse sinuses on each side into the internal jugular vein (Moore et al., 2014). These sinuses define the formation of a bilaterally present groove, predominantly on the petrous surface of the temporal bone, which continues from the groove of the transverse sinus and terminates at the jugular foramen (Johannes Sobotta et al., 2013). Moreover, the literature indicates that the transverse and sigmoid sinuses are generally larger on the right side compared to the left within the same skull (Felipe et al., 2023), resulting in a wider depression formed by the passage of the right sigmoid sinus in dry adult skulls (Ramos Junior et al., 2014).

However, the presence of an oblique occipital sinus may be related to the caliber of the transverse and sigmoid venous sinuses. In this regard, Candanedo et al. (2020) reported a case of a left oblique occipital sinus draining into a hypoplastic ipsilateral sigmoid sinus. Shin et al. (2016) also described multiple presentations, including a case in which the oblique occipital sinus was bilateral and the right transverse and sigmoid sinuses were hypoplastic.

Therefore, the aim of this case report was to describe an uncommon anatomical variation related to these grooves, identified in an adult dry skull from the Human Anatomy Laboratory of an educational institution located in the interior of the state of São Paulo, Brazil.

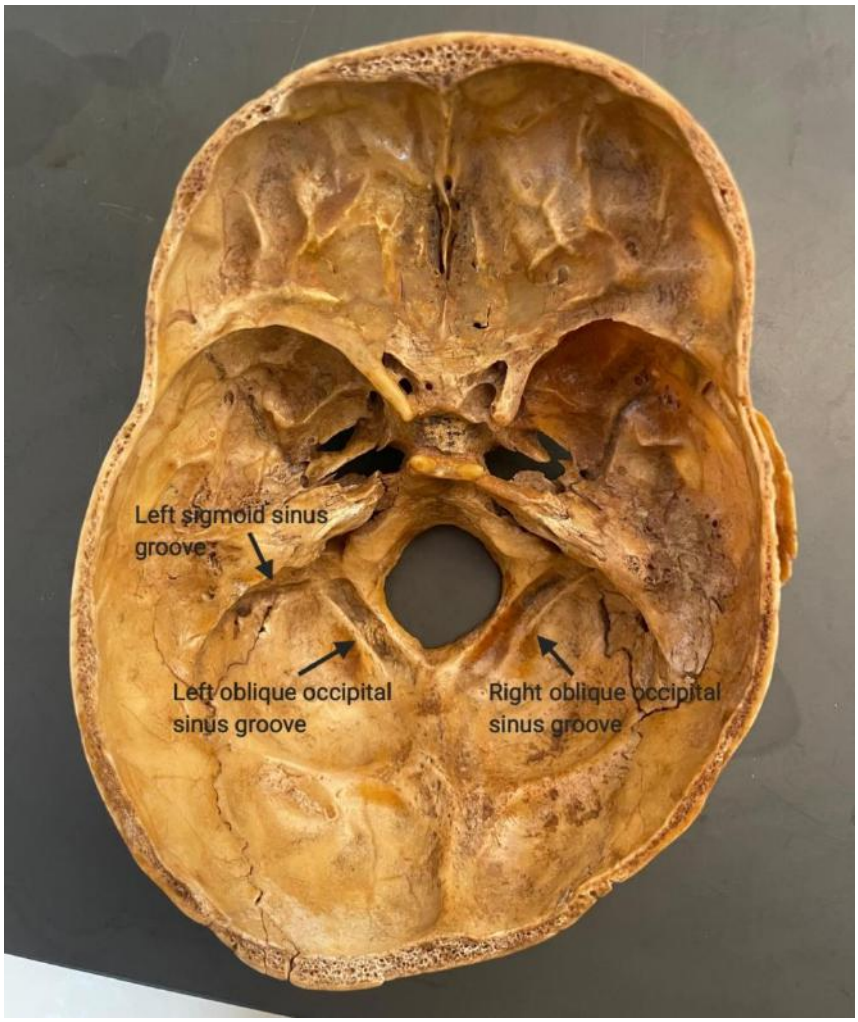
2. Methodology

A descriptive, qualitative case study (Toassi & Petry, 2021; Pereira et al., 2018; Yin, 2015) was conducted in an anatomical study that respected ethical criteria and confidentiality issues requested by the institution. This study is a case report addressing an anatomical variation observed in a dry adult skull housed in the Human Anatomy Laboratory “Professor Doctor Omar Cozac” at the Barão de Mauá University Center, located in Ribeirão Preto, São Paulo, Brazil. On the internal surface of the skull, within the posterior cranial fossa, a bilaterally present oblique occipital sinus groove was identified, along with asymmetry of the sigmoid sinus groove, in which the right side was hypoplastic compared with the left side. In addition, searches were conducted in the PubMed and SciELO databases using the descriptors “occipital venous sinus” and “anatomic variation,” combined with the Boolean operator AND, in order to perform a bibliographic survey aimed at understanding anatomical variations previously reported in the literature and to obtain data supporting the present study.

3. Results and Discussion

During examination in the Prof. Dr. Omar Cozac Human Anatomy Laboratory at the Barão de Mauá University Center, an atypical anatomical variation was identified in a dry adult skull. This finding consisted of a bilaterally present oblique occipital venous sinus groove in the posterior cranial fossa. Both depressions originated from a common point—the internal occipital crest—and bifurcated at the level of the posterior margin of the foramen magnum, with each extending to one side of the skull toward the groove of the ipsilateral sigmoid sinus. The anatomical literature describes the classic pattern of the occipital sinus as a single structure located on the internal surface of the posterior midline of the skull, communicating superiorly with the confluence of sinuses and inferiorly with the internal vertebral venous plexus or the marginal sinus (Netter, 2019). However, in the skull examined, the groove for the occipital venous sinus was duplicated and also connected with the groove of the sigmoid sinus, as illustrated in Figure 1.

Figure 1 – Anatomical variation of the occipital venous sinus.



Source: Author's collection.

In addition to the presence of bilateral oblique occipital sinus grooves, it is possible to observe in the specimen under analysis that the groove of the left sigmoid sinus is well defined, differing from the corresponding groove on the right side, which is smaller. It is well established that the sigmoid sinus groove is typically present bilaterally on the petrous surface of the temporal bone, beginning at the groove of the transverse sinus and terminating at the jugular foramen (Netter, 2019), as the sigmoid sinus drains into the internal jugular vein at this foramen. Accordingly, asymmetry is evident in the analyzed skull, since the groove of the right sigmoid sinus is virtually imperceptible in the specimen, a finding that indicates the prior presence of a hypoplastic right sigmoid sinus. Thus, the coexistence of bilateral oblique occipital sinus sulci and asymmetry of the sigmoid sinus sulci in the same specimen reveals a cerebral venous drainage architecture that differs from the pattern typically described in the literature.

Finally, it should be noted that this specimen is housed in the Prof. Dr. Omar Cozac Human Anatomy Laboratory and is used in anatomy classes for health sciences programs. This fact is particularly important, as it allows students to recognize an atypical configuration of cranial venous drainage and to understand that diverse anatomical patterns may occur. Concurrently, students are able to examine the most common model of venous sinus formation described in the literature in other specimens available in the laboratory and compare them with the variation presented here, which is significant for fostering clinical and surgical reasoning.

To discuss the topic, it is noted that the venous sinuses of the dura mater constitute a complex system responsible for drainage of the encephalic region (Kalkmann et al., 2022). Among these sinuses, the occipital sinus is located along the attached margin of the cerebellar falx, communicating cranially with the confluence of sinuses and caudally with the vertebral venous plexus (Moore et al., 2014). However, when the occipital sinus drains into the sigmoid venous sinus, an anatomical variation known as the oblique occipital sinus may be observed (Shin et al., 2016).

In another anatomical configuration, the sigmoid sinus drains into the internal jugular vein and is present bilaterally in most individuals, with its sulcus located on the petrous surface of the temporal bone on both sides (Netter, 2019). Nevertheless, variations involving this sinus may also occur, such as the presence of a hypoplastic sigmoid sinus, either on the right or left side, which consequently results in reduced prominence or imperceptibility of its sulcus in the cranial structure.

Therefore, knowledge of these structures and their possible variations is of paramount importance for establishing appropriate therapeutic strategies (Reis et al., 2012). In the context of venous sinuses, awareness of all described anatomical arrangements is particularly relevant for surgical planning, especially during procedures such as tumor resections, as it reduces the risk of complications during neurosurgical interventions (Kalkmann et al., 2022).

In neurosurgical practice, access to the dural region is often achieved through the retrosigmoid approach, and the presence of an oblique occipital sinus may lead to serious clinical consequences, including venous hemorrhage due to vascular injury, air embolism, and even venous hypertension in cases involving a hypoplastic or aplastic contralateral transverse sinus (Candanedo et al., 2020). Thus, recognizing the existence of this anatomical variation and identifying its presence in patients constitute essential practices in clinical management to prevent postoperative complications.

Accordingly, the study by Candanedo et al. (2020) described surgical interventions in two patients presenting with an oblique occipital sinus. In both cases, the surgical approach involved a suboccipital retrosigmoid craniotomy, with incision of the dura mater in the inferolateral region to access the cisterns and allow cerebrospinal fluid drainage. This incision was extended to the posterior margin of the oblique occipital sinus, thereby preventing its rupture. In these patients, preoperative identification of this variation was fundamental to avoiding severe intraoperative injury.

Furthermore, knowledge of anatomical variations is also relevant in the context of certain clinical syndromes. For example, Chiari malformation type I is generally associated with hypoplasia of the occipital bone, which may cause compression at the craniovertebral junction, and the therapeutic approach with the most favorable outcomes involves decompression of the foramen magnum (Tochigi et al., 2023). In this regard, because the surgical treatment of Chiari malformation involves regions and structures related to the described venous variation, understanding the possible configurations of the venous sinuses—such as the oblique occipital sinus—is of critical importance, with the primary objective of avoiding harm to patients (Hayashi et al., 2018).

4. Conclusion

Therefore, based on the information presented, it is understood that the identification and description of anatomical structures and their possible variations are of fundamental importance in medical practice, particularly in surgical interventions, in which knowledge of all potential anatomical scenarios may help minimize harm to patients. In this context, the oblique occipital sinus is recognized as a possible variation of the occipital sinus, characterized by drainage into the sigmoid sinus, which results in the formation of a double groove produced by the course of this structure in the posterior cranial fossa. Additionally, the sigmoid sinuses may exhibit concomitant variations, such as hypoplasia or even aplasia, leading to asymmetry between their respective grooves. From this perspective, awareness of this anatomical arrangement is essential in surgical approaches involving the occipital bone region, in order to reduce the likelihood of injury to these structures during

incision of the dura mater when accessing deeper brain regions. Consequently, neurosurgeons must be familiar with this variation to minimize risks such as intraoperative hemorrhage. Furthermore, it is important to emphasize that understanding this anatomical scenario is also crucial for the accurate interpretation of neuroimaging studies during clinical and radiological evaluation of patients.

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