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CRANIOTOPOGRAPHIC ANATOMICAL INDIVIDUAL VARIABILITY AND VARIANTS OF THE STRUCTURE OF THE DURA MATER SUPERIOR SAGITTAL SINUS OF THE SKULL VAULT IN PEOPLE OF MATURE AGE

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For our investigation, we collected cadaveric material from 45 people of different ages and gender. We are proud of the sinus of investigations on macro-microscopic levels using advanced methods in morphology. The aim of our study was to establish the craniotopographical individual anatomical variability and variants of the structure of the superior sagittal sinus (SSS) of the dura mater of the brain of the cranial vault in adults. It has been revealed that the superior sagittal sinus has a close relationship with the bones of the skull vault, in connection with which it is possible to carry out a projection on these bones with the determination of craniometric points. It is quite possible to use these points in the fields of medical craniology and neurosurgery, taking into account the anatomical variability and variants of the structure of the superior sagittal sinus of the DMB of the cranial vault in adults during the implementation of surgical interventions during which intra- and extracranial venous-cerebral shunts will be created.

Key words: craniotopographic method, dura mater, superior sagittal sinus, vault and form of head structures (skulls), man, mature age.

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КРАНІОТОПОГРАФІЧНА ІНДИВІДУАЛЬНА АНАТОМІЧНА МІНЛИВІСТЬ ТА ВАРІАНТИ БУДОВИ ВЕРХНЬОЇ СТРІЛОВОЇ ПАЗУХИ ТВЕРДОЇ МОЗКОВОЇ ОБОЛОНКИ СКЛЕПІННЯ ЧЕРЕПА У ЛЮДЕЙ ЗРІЛОГО ВІКУ

Для нашого дослідження був використаний трупний матеріал від 45 людей різного віку та статі. Досліджуваний синус був вивчений на макро– мікроскопічному рівнях загальновідомими морфологічними методами. Метою нашого дослідження було встановлення краніотопографічної індивідуальної анатомічної варіативності та варіантів будови верхнього сагітального синуса твердої мозкової оболонки склепіння черепа у дорослих. Виявлено, що верхній сагітальний синус має тісний зв'язок з кістками склепіння черепа, у зв'язку з чим можливе виконання проекції на ці кістки з визначенням краніометричних точок. Використовувати ці точки цілком можливо в галузях медичної краніології та нейрохірургії, враховуючи анатомічну варіабельність та варіанти будови верхнього сагітального синуса твердої мозкової оболонки склепіння черепа у дорослих при виконанні оперативних втручань, під час яких і будуть створені інтра- та позачерепні венозно-мозкові шунти.

Ключові слова: краніотопографічний метод, тверда мозкова оболона, верхній сагітальний синус, склепіння та форма структур голови (черепа), людина, зрілий вік.

The study is a part of the research project "Morphofunctional study of human internal organs and laboratory animals in various aspects of experimental medicine", state registration No. 0121U108258.

Features of the anatomical structure of the superior sagittal sinus (SSS) are of great practical importance for modern medicine - evidence-based medicine.

Among the components of the venous outflow from the brain and head in general, the defined sinus plays a leading role, therefore, knowledge of the features of craniotopographic individual anatomical variability with variants of the structure of the specified sinus is of great importance for modern neurosurgery, neurology in the context of diagnosis and treatment of pathological conditions of the cerebral venous system [4, 6, 8–10].

From a clinical and morphological point of view, the clarified individual variability of SSS is very important, considered from the point of view of surgical intervention, during which intra- and extracranial veno-cerebral shunts will be created [1, 3, 5, 7].

Therefore, in our opinion, the topographic and anatomical perception of the structure of the SSS is of great importance for doctors in everyday clinical practice to determine the individual approach of diagnostic and treatment algorithms.

The purpose of the study was to establish the craniotopographical individual anatomical variability and variants of the structure of the superior sagittal sinus of the dura mater of the skull vault in adults.

Materials and methods. This research was carried out in the conditions of the patho-anatomical departments of Donetsk region (oblast) of the Department of Health of Donetsk Regional State Administration and the Department of Human Anatomy, Physiology and Pathological Physiology of Donetsk National Medical University (Lyman, Kropyvnytskyi) with the assistance of Department of Histology, Cytology and Embryology of Poltava State Medical University for the time period of 2015–2019 – obtaining material, and 2020–2023 – data processing and summarizing. This study was conducted on 45 preparations of veins and sinuses of the dura mater (Table 1).

Table 1

Number of anatomical objects depending on the shape of the head

Head Shape / Periods	Dolichocephals		Mesocephals		Brachycephals	
	Male	Female	Male	Female	Male	Female
First mature	1	1	2	1	8	3
Second mature	2	1	4	3	12	7
Total	3	2	6	4	20	10

The following methods were used in our research: macro- and micro-preparation; morpho- and craniometry; projection anatomy – to obtain data on the structure of venous and cerebrospinal fluid formations of the human brain; vascular injection; production of acrylic preparations of sinuses and veins of the dura mater and cerebrospinal fluid structures; variational-statistical analysis of the acquired morpho- and craniometric data; computer graphic modeling of circuits [1, 2, 11].

The work was carried out in accordance with the requirements of the "Instructions on conducting a forensic medical examination" (order of the Ministry of Health of Ukraine No.6 dated from 17.01.1995), in accordance with the requirements and norms, the standard regulation on ethics of the Ministry of Health of Ukraine No.690 dated from 23.09.2009, "The procedure for removing biological objects from the dead, whose bodies are subject to forensic medical examination and patho-anatomical examination, for scientific purposes" (2018).

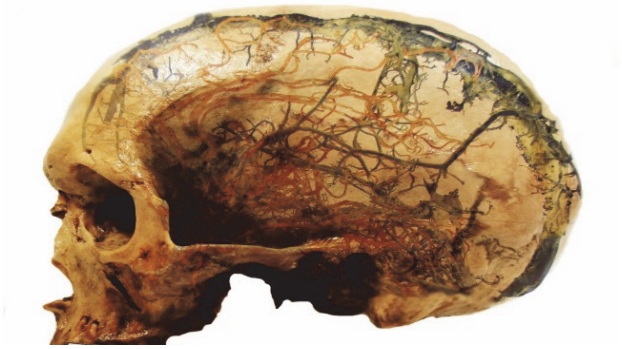


Fig. 1. Topographic-anatomical location of the SSS in an adult (diagram).

Results of the study and their discussion. SSS is characterized by the longitudinal location of the sagittal line of the skull vault. This collector starts from the cock's crest (crista galli) and ends in the upper part of the drain of the sinuses in the area of the projection of the internal occipital protuberance (Fig. 1).

The SSS has specific craniotopographic features of the position in relation to the sagittal plane. There are several variants of the location of this venous collector: middle position (central), left-sided position, right-sided, winding position (Fig. 2).

The SSS has the common border with the inner surface of the bones of the cranial vault in the form of a ribbon with a natural and gradual expansion of the posterior part. This phenomenon can be attributed to the dimensions of the upper wall of the collector and the direction of venous blood flow from the front to the back of the sinus drain.

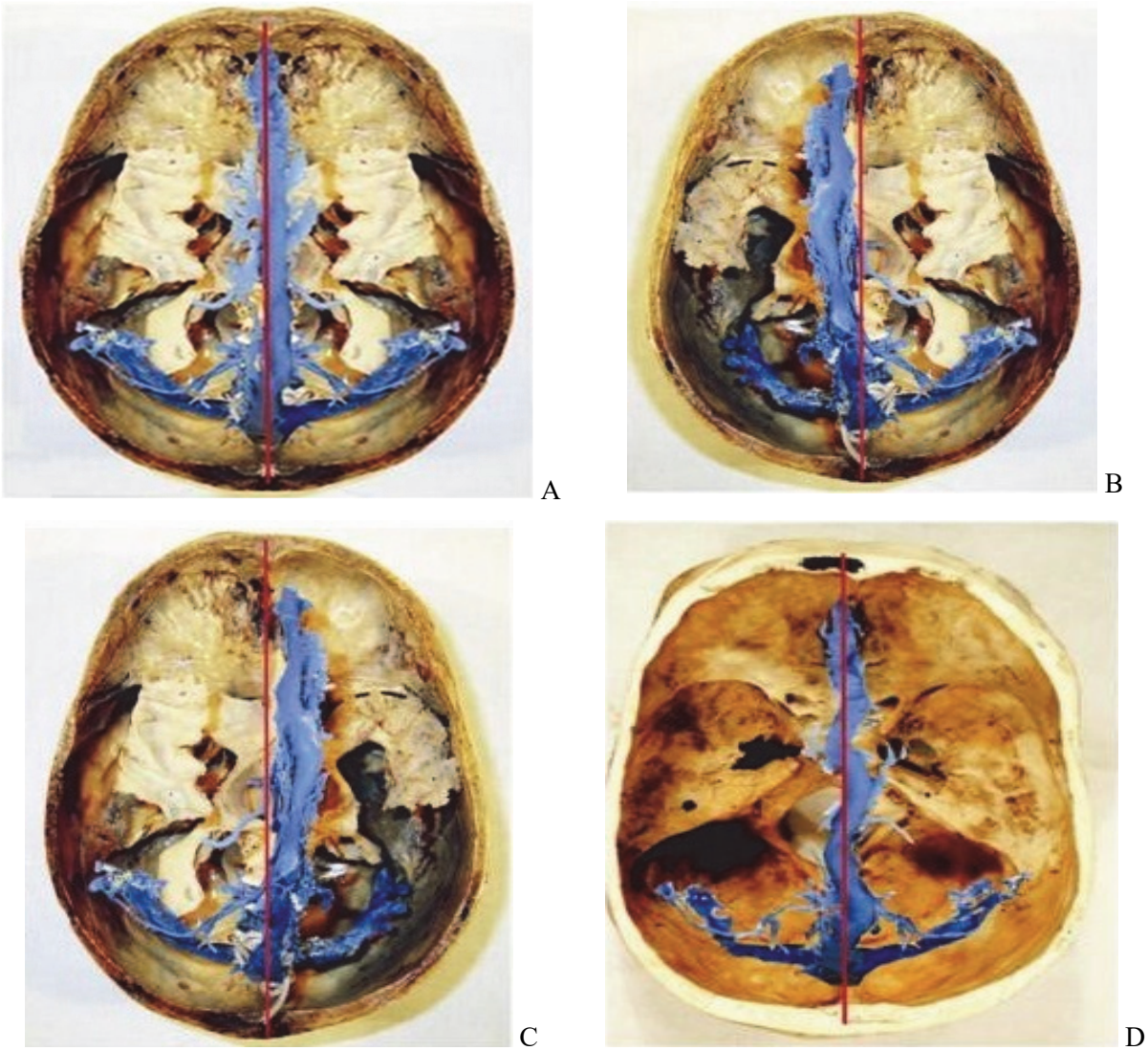
In a practical way, the craniological or clinical anatomy of this sinus is very important. Thus, in accordance with the main craniological points in the lateral projection of the skull, the SSS occupies the following position: the beginning and end of the SSS coincide with the gl – op line (nasal bridge and points on the occipital bone) (Fig. 3). It can be tentatively taken as the upper (suprafoveal) horizontal line in the Kronlein-Bryusova scheme. In these conditions, we should talk about the longest form of SSS. It can be located in the range of m – i, which indicates its shortened type of structure.

In the front (frontal) projection, the SSS has certain features associated with the deviation from the sagittal line.

It has been established that the length of the SSS in adults completely depends on the structure of the head and skull and varies from 12.8 to 27.5 cm. Moreover, in dolichocephals this parameter ranges from 14.5 to 27.5 cm, in mesocephals − from 13.4 to 22.0 cm, in brachycephals − from 12.8 to 20.8 cm (Table 2).

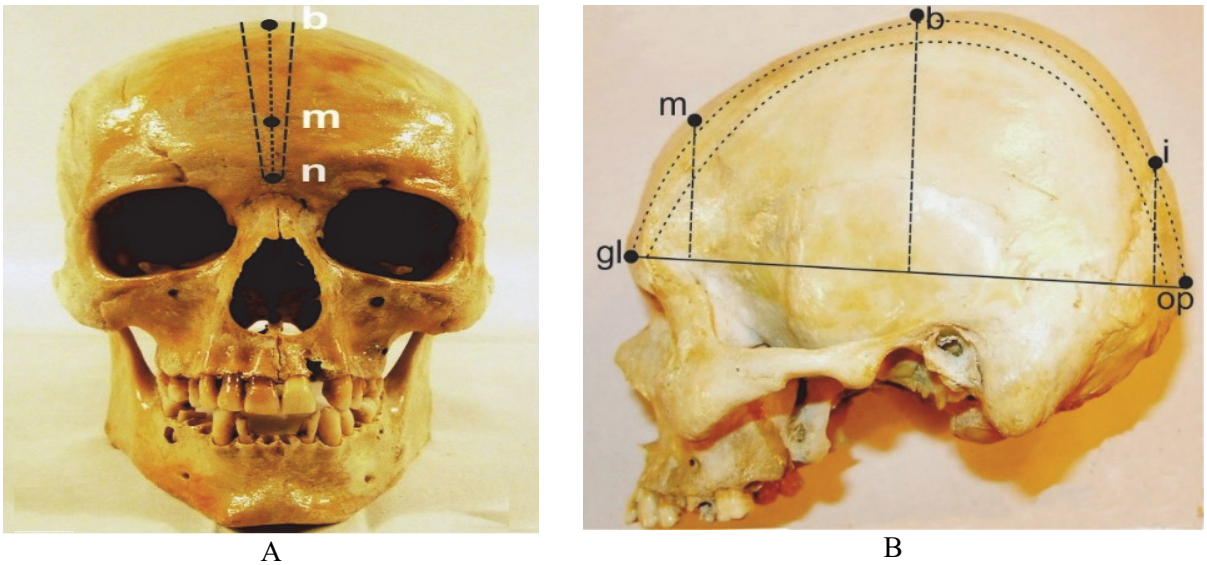
Accordingly, the width of the upper wall of this collector in mature and elderly people ranges from 0.8 to 1.4 cm, and the side walls − from 0.8 to 1.3 cm. At the same time, their gradual expansion is observed in people of meso- and brachymorphic structures of the body. It should be taken into consideration that all

the SSS parameters also increase, starting from the front third at the level of the front cranial fossa and ending at the point of confluence with the drain of the sinuses, already at the level of the posterior cranial fossa.



A B C D

Fig. 2. Characteristic position of the SSS in relation to the sagittal line: 2a – middle; 2b – left-sided; 2c – right-sided; 2d – winding (diagram).



A B

Fig. 3. Craniotopographic projection of the SSS in relation to the craniological points of the skull in the front (a) and side (b) projections, (diagram).

Table 2

Individual anatomical variability of the SSS in adults (in cm)

No.	Indicators \ Head shape	Dolichocephals	Mesocephals	Brachycephals
1.	Length	14.5−27.5	13.4−22.0	12.8−20.8
2.	The width of the upper wall	0.8−1.0	0.9−1.1	1.0−1.4
3.	The width of the upper side wall	0.8−1.0	0.8−1.1	1.0−1.3
4.	The width of the right-side wall	0.8−0.9	0.9−1.1	1.0−1.3
5.	The height of the lumen	1.2−1.5	1.1−1.3	1.0−1.2

Accordingly, the greatest length of the SSS is typical for dolichocephals, and the smallest for brachycephals. Depending on this, the shape of the venous collector changes, which allows distinguishing an elongated type of the SSS or, conversely, a shortened one (Fig. 4).

A B

Fig. 4. Different types of structure of the SSS: A – elongated; B − shortened.

Based on the practical goals of our study, it is appropriate to distinguish three main sections of the SSS: front, middle and back. Conventionally, they correspond to the above-mentioned craniological points: the front part occupies the space of the skull cavity from point gl (glabella) to point m (metopion); middle − between points m − v (metopion − vertex); back − between points v – l (vertex − lambda).

It has been revealed that the length of these axillary sections, established between the generally accepted points of the skull, varies depending on the shape of the human head. It has been shown that in adults with a dolichocephalic head shape, the length of each section varies from 4.5 to 9.1 cm, while with a brachycephalic shape from 4.0 to 6.6 cm.

The morphometry of the walls of the SSS is of practical importance, in accordance with the three sections selected. It has been found out that the width of the upper wall of this venous collector in people with a dolichocephalic head shape ranges from 0.6 to 1.0 cm, in mesocephals − from 0.6 to 1.1 cm, in brachycephals − from 0.7 to 1.4 cm.

The upper wall of the sinus has the greatest width in the posterior part of representatives of brachycephals.

The width of the side walls of the SSS also has an individual range of variability, taking into account the conditionally selected three departments.

The transverse parameter of the lateral axillary walls, according to the three departments, varies from 0.5 to 1.3 cm with a tendency to increase from the beginning to the end. For example, in dolichocephals, the width of the side walls of the SSS gradually increases from 0.5 to 1.0 cm; mesocephals − from 0.6 to 1.1 cm; brachycephals − from 0.6 to 1.3 cm.

During neurosurgical operations in the superior sagittal sinus (SSS) area, the neurosurgeon must adhere to clear anatomical boundaries, as bleeding from this dura mater sinus is possible, which is life-threatening [6]. Our study contributes to the optimization of surgical approaches when performing surgical interventions on the SSS.

In a study by Reis CV, Gusmão SN, Elhadi AM et al. (2015), it was shown that using the midline as a reference point for determining the position of the SSS is inappropriate, since there are quite a few anatomical variations of the sinus deviation in both directions [9]. Our study agrees with these data, but in our study, additional body types are taken into account.

For immediate neurosurgery, it is important to create shunts between the scapulae of the brain and the sinuses of the dura mater of the brain, as well as the creation of new devices and techniques in this

medical field [1, 3, 5, 7]. As demonstrated in the findings of this research study, it is possible to provide theoretical considerations for the implementation of surgical procedures which result in the creation of internal and cranial venous-liquid-liquid shunts.

The above facts indicate the importance of knowledge of craniotopography in the context of individual anatomical variability with variants of the structure of the sinuses of the dura mater of the brain, the cranial vault, the superior sagittal sinus in particular.

Conclusions

1. We have selected several options for the location of the SSS: 1 – middle position (central); 2 – left-sided position; 3 – right-sided; 4 – winding position.

2. The width of the upper wall of the SSS in mature and elderly people ranges from 0.8 to 1.4 cm, and the side walls – from 0.8 to 1.3 cm. At the same time, their gradual expansion is observed in people of meso- and brachymorphic structures. It should be taken into consideration that all the SSS parameters also increase, starting from the front third at the level of the front cranial fossa and ending at the point of confluence with the drain of the sinuses, already at the level of the posterior cranial fossa.

3. The longest SSS length is typical for dolichocephals, and the shortest for brachycephals. Depending on this, the shape of the venous collector changes, which makes it possible to distinguish an elongated type of SSS or, conversely, a shortened one.

4. It is appropriate to distinguish three main sections of the SSS: front, middle and back. Conventionally, they correspond to craniological points: the front part occupies the space of the skull cavity from point gl (glabella) to point m (metopion); middle – between points m – v (metopion – vertex); back – between points v – l (vertex – lambda).

5. The width of the upper wall of the SSS in people with a dolichocephalic head shape ranges from 0.6 to 1.0 cm, in mesocephals – from 0.6 to 1.1 cm, in brachycephals – from 0.7 to 1.4 cm. The upper wall of the sinus is widest in the posterior region of the brachycephalic group. The width of the side walls of the SSS also has an individual range of variability, taking into account the conditionally selected three departments.

6. The transverse parameter of the lateral axillary walls, according to the three departments, varies from 0.5 to 1.3 cm with a tendency to increase from the beginning to the end. For example, in dolichocephals, the width of the side walls of the SSS gradually increases from 0.5 to 1.0 cm; mesocephals – from 0.6 to 1.1 cm; brachycephals – from 0.6 to 1.3 cm.

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