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## MORPHOLOGICAL FEATURES OF THE GLOBOSE NUCLEUS OF THE CEREBELLUM

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**ABSTRACT. Background.** The study of the clinical anatomy and functional features of the cortex, subcortical and conductive pathways of the cerebellum is necessary for clinicians for elaboration of rational surgical approaches to these formations, for determination the localization of pathological processes associated with these formations. In this article morphological features of the globose nucleus of the cerebellum were studied. **Objective.** The aim of this study is to investigate the morphological features of spherical nuclei of the cerebellum. **Methods.** The study was conducted at 340 specimens of the cerebellum of people aged from 20 to 99 years old. Macro- and microscopic, morphometric, histologic methods and methods of statistical analysis were used. **Results.** Individual variability in size of spherical nucleus considering the size of the cerebellar vermis was established. It determines the location of the border relatively to the median sagittal plane, topographic and anatomic particular location in relation to other nuclei of the cerebellum. Variations of the nucleus were established. **Conclusion.** We have established dimensions of globose nucleus, its shape and location regarding the median-sagittal plane. The globose nucleus on the sections made in a horizontal plane has a bulk-rounded shape at 65,88% (224 cases). At 34,12% (116 cases) it consists of a cluster of different sizes` nuclei and it does not always correspond to the shape of the ball, since in this case it may be not only round, but also have an elongated oval outline in the longitudinal direction. The plate of its gray matter has small spherical winding cogs in the shape of wavy line.

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**Шиян Д.Н. Морфологические особенности шаровидного ядра мозжечка.**

**Реферат.** Целью данного исследования является изучение морфологических особенностей шаровидного ядра мозжечка. Исследование проводилось на 340 препаратах мозжечка людей в возрасте от 20 до 99 лет. Использованы макро- и микроскопические, морфометрические, гистологические методы и метод статистического анализа. Установлена индивидуальная изменчивость размеров шаровидного ядра с учетом размеров червя мозжечка. Определены границы расположения относительно срединной сагиттальной плоскости, топографоанатомические особенности расположения по отношению к другим ядрам мозжечка. Описаны варианты форм ядра.

**Ключевые слова:** морфология, шаровидное ядро, мозжечок.

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### Introduction

The study of the clinical anatomy and functional features of the cortex, subcortical and conductive pathways of the cerebellum is necessary for clinicians for elaboration rational surgical approaches to these formations, for determination the localization of pathological processes associated with these formations [1-8].

The questions of normal anatomy, histology of the cerebellum and its physiology are highlighted in the studied literature [9-12]. Almost no questions of neurosurgical anatomy of cerebellar nuclei, their

individual anatomical variability and its range, topographical and anatomical features of location were displayed, as well as the questions of stereotactic landmarks, which can be used during surgical interventions [13-15]. Without such data, it is impossible to individualize the surgical intervention. It is clearly that becoming more common stereotactic intervention on the cerebellar nuclei strongly requires doing this research [16-19].

Thus, according to the literature stereotactic interventions on the cerebellar globose nucleus have not been carried out yet and the information related

to the spatial landmarks in the literature are almost absent.

### Objective

To establish morphological features of the cerebellar globose nucleus.

### Materials and methods

Materials. 340 cerebellar specimens of people died at the age of 20 to 99 years.

Methods. Macro- and microscopic (dissection with a binocular microscope by V. Vorobiev), morphometric, histological methods (hematoxylin and eosin, by Krutsay), according to Ukrainian patent [20], the method of statistical analysis.

### Results and discussion

A globose nucleus is a paired formation located in the right and the left hemisphere of the cerebellum ventrally from the frontal edge of emboliform nu-

leus and it is covered by 1-3 convolutions of the dentate nucleus on the dorsal surface. The nucleus extends in the ventral and lateral direction in the thickness of the white matter of the gates of the dentate nucleus, the shape changes from a winding band-shaped to sigmoid oval, depending on its part. In a series of stained sections of the cerebellum the borders of the globose nucleus are differentiated clearly. The plate of its gray matter has small spherical winding cogs in the shape of wavy line. In its dorsal-medial part it is connected thin to the anterior-lateral part of the fastigial nucleus by the thin layer of the gray matter. In ventral-lateral part it is connected to the anterior-ventral part of the emboliform nucleus by the thin bundle of the gray matter (Fig. 1).



Fig. 1. Macromicroscopic preparation of nucleus of the cerebellum. Male, 54 years old. Staining for Ukraine patent [20]. Macrofoto.

The globose nucleus in the sections on a horizontal plane has a bulk-rounded shape at 65,88% (224 cases). At 34,12% (116 cases), it consists of a cluster of different sizes` nuclei and it does not always correspond to the shape of the ball, since in this case it may be not only round, but also have an elongated oval outline in the longitudinal direction (Fig. 2).

We have established its dimensions. Thus, the length vary from 1,8 to 6,1 mm, width - from 0,8 to 3,8 mm. The height ranged from 1,2 to 3,6 mm while the nuclei with small length and height were wider and vice versa. The location of globose nucleus regarding the median-sagittal plane varies individually. Its medial border is spaced from the pointed plane in the distance from 3 to 6 mm, and the lateral one - from 5 to 10 mm. The range of variability of the location of the globose nucleus regarding the median-sagittal plane is so wide that

definition the zone in which it would occur constantly in all preparations is impossible. However, at 90% (306 cases) it is constantly present in the range of 4 to 8 mm laterally of the median-sagittal plane that can be considered as the typical position of the nucleus. The position of the nucleus relatively to the horizontal plane passing through the top of the IV ventricle is also subjected to considerable differences. The top of it range from 0,5 to 4,2 mm, and the bottom - from 0,5 mm above the pointed plane up to 3,3 mm below it.

Because of so big amplitude of individual variation in the position of the nucleus relatively to the horizontal plane, passing through the top of IV ventricle it is impossible to define its limits at all preparations. However, at 89,12% (303 cases), the nucleus is constantly located in the range from 1,8 mm up to 2,2 mm below the horizontal plane passing through the top of IV ventricle.



Fig. 2. Histological preparation of globose nucleus of the cerebellum. Male, 48 years old. Staining by Krutsey.  $\times 100$ .

The position of the nucleus relatively to the frontal plane passing through the top of the IV ventricle is also subjected to individual differences. Its front limit range from 2,7 mm behind the pointed plane up to 4,2 mm anteriorly from it, the rear one - from 1,8 up to 6,2 mm posteriorly the plane. It has such a wide range that the nucleus constant position in all cases cannot be considered. But at 85,88% (292 cases) the nucleus will be present constantly in the range of 2,2 mm anteriorly to 4,8 mm posteriorly the frontal plane passing through the top of the IV ventricle.

Thus, individual variability in size of spherical nucleus considering the size of the cerebellar vermis was established. It determines the location of the border relatively to the median sagittal plane, topographic and anatomic particular location in relation to other nuclei of the cerebellum. Variations of the nucleus were established.

#### Conclusions

1. Globose nucleus can be represented by homogeneous structure or accumulation of separate cell groups macroscopically, its outlines on the horizontal slice correspond to the shape of a circle or an oval elongated in the horizontal or vertical direc-

tions.

2. The length of the nucleus varies from 1,8 to 6,1 mm, width - from 0,8 to 3,8 mm, height - from 1,2 to 3,6 mm.

3. The position of the nucleus relatively to the median-sagittal plane: the medial border is separated from the pointed plane by 3 to 6 mm, the lateral one - from 5 to 10 mm.

4. The upper border of the nucleus relatively to the horizontal plane passing through the top of IV ventricle varies from 0,5 to 4,2 mm and the lower - from 0,5 mm above pointed plane to 3,3 mm below it.

5. Its frontal limit relatively the frontal plane passing through the top of IV ventricle varies from 2,7 mm behind pointed plane to 4,2 mm anteriorly it back - from 1,8 to 6,2 mm posteriorly from the pointed plane.

#### Prospects for further investigations

The data can be implemented in practical neurosurgery, neurophysiology, neurology and neuro-morphology. They complement the existing understanding of conventional structure of the globose nucleus of the cerebellum.

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**Шиян Д.М. Морфологічні особливості кулястого ядра мозочка.**

**Реферат.** Метою даного дослідження є вивчення морфологічних особливостей кулястого ядра мозочка. Дослідження проводилося на 340 препаратах мозочка людей у віці від 20 до 99 років. Використано макро- і мікроскопічні, морфометричні, гістологічні методи і метод статистичного аналізу. За результатами дослідження встановлена індивідуальна мінливість розмірів кулястого ядра з урахуванням розмірів черв'яка мозочка. Визначені межі розташування відносно сагітальної площини, топографоанатомічні особливості розташування по відношенню до інших ядер мозочка. Описані варіанти форм кулястого ядра.

**Ключові слова:** морфологія, кулясте ядро, мозочок.