

AGE-BASED COMPARATIVE STUDY OF SPHENOID SINUS  
MORPHOMETRY IN CHILDREN (1–18 YEARS OLD)

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**Abstract:** *The study presents a morphometric investigation of the sphenoid sinuses in children from the Bukhara region, taking into account age-related variations. Cone-beam computed tomography (CBCT) was used to obtain precise three-dimensional data on the size and shape of the sinuses. The paper examines the developmental features of the sphenoid sinuses at different stages of childhood, which improves the diagnostic and treatment planning processes for paranasal sinus diseases in pediatric patients. The results deepen the understanding of age-dependent anatomical variability and can be valuable for both clinical practice and scientific research.*

**Keywords:** *sphenoid sinus, paranasal sinuses, accessory sinuses, age-related features, morphometry, cone-beam computed tomography, volume, asymmetry, children.*

## INTRODUCTION

The sphenoid sinuses are important anatomical structures of the paranasal sinus system, performing essential functions in respiration and the protection of brain tissues. Their morphometric parameters change with age, reflecting individual anatomical and physiological development. This has significant implications for clinical diagnostics, treatment planning, and surgical interventions.

Cone-beam computed tomography (CBCT) is a modern, high-precision imaging technique that allows detailed visualization with minimal radiation exposure. The aim of this study is to identify age-related patterns in the formation and morphometric variability of the sphenoid sinuses among the population of the Bukhara region based on CBCT data, to establish age-specific standards, and to improve diagnostic accuracy for paranasal sinus conditions in clinical practice.

**Materials and Methods.** To reveal the age-related growth dynamics of the sphenoid sinus, 516 practically healthy children aged 1 to 18 years (240 boys and 276 girls) living in the Bukhara region were examined using CBCT at the “Lorastomservis” clinic. Scanning was performed in a standing position with head fixation. The emitter and detector completed a full 360° rotation in approximately 20 seconds, ensuring high-quality 3D reconstruction with minimal radiation exposure. The subjects were distributed into age groups in accordance with the classification adopted at the VII All-Union Conference on Age Morphology. For each patient, an individual record was created, containing data on age, sex, nationality, and cranial form. The morphometric parameters of the sphenoid sinus were evaluated by measuring length, width, and volume. Measurements were conducted using standard anatomical landmarks to ensure accuracy and reproducibility:

Height (H): from the sinus roof (base of the sella turcica) to the floor in the coronal or sagittal plane, perpendicular to the skull base.

Width (W): the distance between the lateral walls at the maximum transverse section, in the coronal or axial plane.

Depth (D): from the anterior wall (sphenoid rostrum) to the posterior wall (clivus) in the sagittal plane.

In small children, the sinus dimensions were minimal, requiring differentiation of pneumatization types — sellar, presellar, and conchal — for accurate morphometric assessment.

Results. The analysis of the morphometric characteristics of the sphenoid sinuses among children and adolescents in the Bukhara region revealed distinct age-related and sex-related developmental patterns. Active pneumatization began at 3–4 years of age.

Table 1.

Age-related dynamics of right and left sphenoid sinus volume in boys and girls from the Bukhara region (cm<sup>3</sup>)

Age (years)	Right Sinus (Girls)	Right Sinus (Boys)	Left Sinus (Girls)	Left Sinus (Boys)
4	0.26 ± 0.01	0.37 ± 0.01***	0.27 ± 0.01	0.35 ± 0.01***
5	0.38 ± 0.01	0.51 ± 0.02**	0.36 ± 0.01	0.49 ± 0.03*
6	0.42 ± 0.01	0.62 ± 0.03**	0.41 ± 0.01	0.64 ± 0.03**
7	0.78 ± 0.03	1.06 ± 0.05**	0.80 ± 0.04	1.12 ± 0.05*
8	1.28 ± 0.05	1.54 ± 0.06	1.26 ± 0.05	1.55 ± 0.06
9	1.65 ± 0.06	1.78 ± 0.05	1.69 ± 0.06	1.74 ± 0.07
10	2.04 ± 0.08	2.29 ± 0.04*	2.08 ± 0.07	2.38 ± 0.08*
11	2.38 ± 0.05	2.74 ± 0.08*	2.42 ± 0.06	2.82 ± 0.07***
12	2.64 ± 0.06	2.89 ± 0.09	2.70 ± 0.06	2.94 ± 0.08***
13	3.02 ± 0.07	3.25 ± 0.05	3.08 ± 0.07	3.42 ± 0.07***
14	3.37 ± 0.06	3.60 ± 0.09**	3.41 ± 0.08	3.77 ± 0.10***
15	3.79 ± 0.07	4.12 ± 0.11**	3.84 ± 0.07	4.34 ± 0.09***
16	4.48 ± 0.09	5.01 ± 0.12**	4.52 ± 0.10	5.26 ± 0.11***
17	4.94 ± 0.08	5.37 ± 0.14*	4.90 ± 0.09	5.63 ± 0.12**
18	5.33 ± 0.10	6.04 ± 0.13***	5.28 ± 0.11	6.22 ± 0.13**

Note: significance levels — \*p < 0.001, p < 0.01, \*p < 0.05.

Between 4–7 years, sinus volumes were small (0.48–0.50 cm<sup>3</sup> in boys and 0.32–0.34 cm<sup>3</sup> in girls) with notable bilateral symmetry. At 8–12 years, an intensive growth phase was observed (up to 2.3 cm<sup>3</sup> in boys and 2.9 cm<sup>3</sup> in girls), which continued during adolescence (13–16 years), when volumes reached 3.99 cm<sup>3</sup> in boys and 2.96 cm<sup>3</sup> in girls. By 17–18 years, the sphenoid sinus dimensions approached adult levels — 5.14–5.16 cm<sup>3</sup> in boys and 4.02–4.19 cm<sup>3</sup> in girls. The linear parameters (height, width, depth) increased proportionally to the overall sinus volume. The most active growth occurred between 8 and 16 years, coinciding with the phase of rapid facial skeletal development. A moderate sexual dimorphism was established, with slightly larger sinus volumes in boys, especially in older age groups. Overall, sphenoid sinus development was characterized by bilateral symmetry, and the minor interside differences observed were not statistically significant. The obtained

data can serve as reference norms for age-specific morphometric evaluation and clinical assessment of the sphenoid sinuses.

Conclusion. The study conducted using cone-beam computed tomography (CBCT) made it possible to establish the age- and sex-related features of sphenoid sinus development in children and adolescents of the Bukhara region. Active pneumatization starts at 3–4 years, with the most intensive growth between 8 and 16 years. By 17–18 years, sinus dimensions approach adult parameters. Moderate sexual dimorphism was identified — boys exhibited slightly larger sinus volumes than girls, particularly in older age groups. Overall, sphenoid sinus development was symmetrical, with no significant interside differences. The use of CBCT ensured high accuracy and reproducibility of morphometric measurements at a low radiation dose, making it an optimal method for studying anatomical structures in children. The obtained results have practical importance for refining age norms, improving diagnostic accuracy, and planning surgical or therapeutic interventions in the region of the paranasal sinuses.