PHYSICAL FEATURES VARIABILITY OF SPHENOID BONE ANATOMIC STRUCTURES IN ADULT POPULATION

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ABSTRACT — The article is dedicated to the variability of linear parameters, the area, the volume of the Turkish saddle and pituitary fossa of the sphenoid bone in adults, depending on the skull base type. The study was carried out through stereotopometric and craniometric methods on 87 registered skulls of mature age people (aged 21–60) from the scientific craniological collection of the Human Anatomy Department, V.I. Razumovsky Saratov State Medical University. The following parameters were identified: the basilar angle, which allowed identifying the type of the skull base and the linear parameters of the Turkish saddle, the pituitary fossa of the sphenoid bone, as well as their area and volume of the pituitary fossa. The obtained results show that the skull base of the platibasilar type features a long and narrow Turkish saddle, a small and rounded pituitary fossa with a larger area and a smaller volume; medio- and flexibasilar types of cranium can be described as having a short and wide Turkish saddle, a deep pituitary fossa of oval shape with a smaller area, yet with a large volume. There has been no typical variability of the Turkish saddle area identified.

KEYWORDS — sphenoid bone; Turkish saddle; pituitary fossa; craniotype.

INTRODUCTION

One of the important issues in neurosurgery implies the selection of proper operative access to the pituitary neoplasms adjacent to the pituitary fossa, and the involvement into the pathology of such vital anatomical structures of the Turkish saddle area as the internal carotid artery, the cavernous sinus, the oculomotor, the pathetic and the abducent cranial nerves [11]. The variability of the Turkish saddle shape and physical features allows one to make indirect judgment about the condition of the pituitary gland as well as about the pathological processes developing in there, in view of the fact that the average volume of the pituitary gland is 86% of the Turkish saddle volume [9]. The level of the Turkish saddle is where a bend in the skull base develops, the morphological basis of that being the basilar angle [16, 18]. The angle size determines the type of cranial basement (plati-, medio- and flexibasilar craniotypes) affecting the structural variability of its local structures [17, 19, 20]. Given that, establishing the variation patterns in the sphenoid bone architectonics, which is part of the anterior and middle cranial fossae, involves craniometric studies taking into account the typical features of the skull structure [3, 12, 15], since its shape variants and exact local structures dimensions generally determine the choice of surgical access to their contents [10, 13, 14].

The data on the skull morphological variability obtained by a number of authors [3–5, 8, 21–28], are used to objectively evaluate the results of the available modern diagnostic methods, as well as to develop proper approaches and carry out radical resections with the minimal number of complications [6].

Aim of study: to identify the variability of the linear parameters, the area, the Turkish saddle volume and of the sphenoid bone pituitary fossa in adults, depending on the skull base type.

MATERIALS AND METHODS.

The study was carried out on 87 registered skulls of mature age people (aged 21–60) from the scientific craniological collection of the Human Anatomy Department, V.I. Razumovsky Saratov State Medical University. The stereotopometric method, through which the device of craniosterebasiometer was used, allowed identifying the basilar angle, which in turn made it possible to detect one average and two extreme types of the skull base — mediobasilar, flexibasilar, and platibasilar [2].

Within the craniometry method, following the technique commonly employed in craniology [1], a

technical caliper with a divide value of 0.01 mm was used to measure the linear parameters of the Turkish saddle and sphenoid bone pituitary fossa — the longitudinal diameter of the Turkish saddle (length), i.e. the distance from the saddle tubercle to the saddle back base and the transverse diameter (width), i.e. the distance between the most medial edges of the carotid sulci; the longitudinal diameter of the pituitary fossa — the distance between the most distant points in the sagittal plane and the transverse diameter — the distance between the most distant points in the frontal plane; the pituitary fossa depth — a perpendicular from the line drawn between the saddle tubercle and back, to the deepest point at the pituitary fossa bottom. The area and the volume of these anatomical structures of the sphenoid bone body were identified subject to the standard mathematical calculation methods.

The statistical processing of the obtained data was done using the Statistica 6.0 application software (Windows OS). For all studied parameters, the variation statistics elements were determined — M, m, σ, Cv%, P. Since the variant distribution revealed little difference from the normal values, the statistical significance of the differences between the average values were calculated using Student's criterion. The differences were considered statistically significant at $p<0.05$.

Results and discussion. In the platibasilar type, the Turkish saddle length (14.7±0.2 mm) was 2.0 mm longer than that of the medio- (12.7±0.2 mm; $P <0.05$), and 2.6 mm over that in the flexibasilar craniotypes (12.1±0.3 mm; $P <0.01$); however, the two latter types of the skull base had no statistical difference ($P> 0.05$) in this parameter. The sphenoid bone Turkish saddle length (14.7±0.2 mm) in the platibasilar type exceeded its width (11.8±0.1 mm; $P <0.05$) by 2.9 mm, while in the medio- and flexibasilar craniotypes the width dominated (12.7±0.2 mm; 12.1±0.3 mm) over length (13.9±0.3 mm; 14.3±0.3 mm; $P <0.05$; $P <0.01$) by 1.2 mm and 2.2 mm, respectively.

The Turkish saddle area had the highest average value in the mediobasilar type (176.53 mm^2) and the smallest, equal in value, in the plati- and flexibasilar (173.46 mm^2; 173.03 mm^2) craniotypes. The predominance of the Turkish saddle area in the mediobasilar type compared to the area of the plati- and flexibasilar types was by 3.07 mm^2 and 3.5 mm^2, respectively.

In the platibasilar type of the skull base, the width of the pituitary fossa (10.1±0.4 mm) was slightly above (0.2 mm) the length (9.9±0.3 mm; $P> 0.05$) and exceeded its depth by 3.7 mm (6.4±0.3 mm; $P <0.01$). In the mediobasilar type, the width (10.3±0.4 mm) prevailed over its length by 1.5 mm (8.8±0.2 mm) and by 2.7 mm — over its depth (7.6±0.3 mm; $P <0.01$). In the flexibasilar craniotype, the fossa width (10.8±0.4 mm) exceeded its length (8.7±0.2 mm) by 2.1 mm and by 1.1 mm — its depth (7.6±0.3 mm; $P <0.01$).

A comparative analysis of the variability showed that in the platibasilar type the length of the pituitary fossa (9.9±0.3 mm) was 1.1 mm and 1.2 mm longer than that of the medio- and flexibasilar craniotypes (8.8±0.2 mm and 8.7±0.2, respectively; $P <0.01$); however, talking of the two latter skull base types, this parameter was observed to feature no significant differences ($P> 0.05$). The average pituitary fossa width of each craniotype did not have significant differences and ranged from 10.1±0.4 mm for the platibasilar to 10.8±0.4 mm for the flexibasilar craniotypes ($P> 0.05$). The average depth of the fossae in the medio- and flexibasilar craniotypes was equally variable (7.6±0.3 mm; $P> 0.05$) and the value of this parameter in the platibasilar type prevailed by 1.2 mm ($P <0.05$).

The highest average value of the pituitary fossa area was in the platibasilar type and was 78.53 mm^2, whereas the lowest value was in the medio- and flexibasilar (71.18 mm^2; 73.79 mm^2) craniotypes. The predominance of the pituitary fossa area in the platibasilar type compared with the respective area in the medio- and flexibasilar fossae was 7.35 mm^2 and 4.74 mm^2, respectively.

In the flexibasilar type, the pituitary fossa volume was on average 373.8 mm^3; in the medio- and platibasilar craniotypes — 360.68 mm^3 and 261.79 mm^3, respectively. The biggest volume difference between the flexi- and platibasilar types was 112.11 mm^3, between the plati- and the mediobasilar types — 98.89 mm^3, while it was the lowest between the flexi- and mediobasilar types — 13.22 mm^3.

The longitudinal diameter of the Turkish saddle, as our research showed, ranged on average from 12.1±0.3 mm (flexibasilar craniotype) to 14.7±0.2 mm (platibasilar craniotype), transverse — from 11.8±0.1 mm (platibasilar craniotype) to 14.3±0.3 mm (flexibasilar craniotype). The longitudinal diameter variability range of the pituitary fossa, depending on the skull base type, was from 8.7±0.2 mm (flexibasilar craniotype) to 9.9±0.3 mm (platibasilar craniotype); depth — from 6.4±0.3 mm (platibasilar craniotype) to 7.6±0.3 mm (medio- and flexibasilar craniotypes), while the transverse diameter did not have typical variability and averaged 10.1 — 10.8±0.4 mm. The available literature offers data supplied by a number of authors regarding the average values of the dimensional specifics of the sphenoid bone structure in adults, the Turkish saddle: longitudinal size — 11.6 mm,

14.0 mm; transverse — 14.5 mm; vertical — 8.5 mm, 12.0 mm; pituitary fossa — length – 12.0 mm, width — 13.0 mm, height — 3.5 mm [3, 7, 8], however comparison is not possible due to difference in the research methodologies.

As our study revealed the pituitary fossa in the platibasilar type is rounded, small, with an area of 78.5 mm^2, whereas in the medio- and flexibasilar craniotypes it is oval-shaped, deep, with an area of 71.2 mm^2 and 73.8 mm^2, respectively, which cannot be matched against the data from V.S. Maikova-Stroganova and D.G. Rokhlin [8], who, using only the correlation of vertical and sagittal dimensions, ponted at flat, round and deep types of shape. The pituitary fossa area predominated in the platibasilar type by 7.4 mm^2 compared with the medio- and 4.7 mm^2 compared with the flexibasilar craniotype.

CONCLUSION

The above means that the highest prevalence of the Turkish saddle area in comparison with the pituitary fossa area was 105.3 mm^2 for the mediobasilar type (occupies 40.3% of the area of the saddle); the lowest ratio for the platibasilar type was 95.0 mm^2 (45.2% of the saddle area), whereas for the flexibasilar type, the Turkish saddle area was 99.6 mm^2 above the fossa area (42.4% of the saddle area). A typical variability of the linear parameters of the sphenoid bone body structures, determining their configuration, was identified — the platibasilar type of the skull base features a long and narrow Turkish saddle, a small and round pituitary fossa, with a larger area and a smaller volume. For the medio- and flexibasilar craniotypes, the Turkish saddle is short and wide; the pituitary fossa is deep, oval-shaped with a smaller area, yet with a large volume. There has been no typical variability for the Turkish saddle area revealed.

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