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The Pneumatisation of the Maxillary and Frontal Sinuses of Human

Shavel Zhanna[1], Valchkevich Dzmitry[2]* and Bobrik Anzhelika[3]

[1]*Assistant Professor, Normal Anatomy Department, Grodno State Medical University, Grodno, Belarus*

[2]*Associate Professor, Normal Anatomy Department, Grodno State Medical University, Grodno, Belarus*

[3]*Assistant, Normal Anatomy Department, Grodno State Medical University, Grodno, Belarus*

***Corresponding Author**: Valchkevich Dzmitry, Associate Professor, Normal Anatomy Department, Grodno State Medical University, Grodno, Belarus.

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Abstract

The anatomy of the frontal and maxillary sinuses has been the subject of much research. With the advent of functional endoscopic sinus surgery (FESS) and coronal computed tomography (CT) imaging, considerable attention has been directed toward paranasal region anatomy. The object of study was 50 radiographs (25 male and 25 female) of the paranasal sinuses of a person aged 19 to 50 years. X-ray examination was performed in a coronal projection. The morphometric as well as statistical methods were used in study too. The relationship between quantitative indicators of the frontal and maxillary sinuses was examined. We investigated the septum, pneumatisation, forms of the maxillary and frontal sinuses. Our study allowed us to identify individual anatomical features of the structure of the paranasal sinuses, to establish the relationship between the quantitative indicators, what is of practical importance.

Keywords: *Maxillary Sinus; Frontal Sinus; Highmore's Sinus; Pneumatization; Skull Bones*

Introduction

Detailed knowledge of anatomic variations in paranasal sinus region is critical for surgeons performing endoscopic sinus surgery as well as for the radiologist involved in the preoperative work-up. The anatomy of the frontal and maxillary sinuses has been the subject of much research [1]. Thus, a morphological assessment of the paranasal sinuses of skulls from different historical periods was made, as a result of which the distinctive features of the shape, symmetry, and level of the paranasal sinuses development were established [2,3]. Bilateral absence of the frontal sinuses is observed more often in the skulls of the early middle ages compared with skulls of the XIII-XVIII centuries. In both groups of skulls, two types of frontal sinuses were distinguished: 1) smooth and 2) dentate. The large area of the sinuses is characteristic of skulls of the XIII-XVIII centuries.

The revealed morphological differences can be explained by a decrease in pressure during chewing, changes in the shape of alveolar arches and other skull structures, as well as more active participation of the sinuses in physiological breathing and thermoregulation [4].

It was studied not only the development of the sinuses, but also their age features. It is known that the size of the frontal sinuses in girls up to 10 years old is larger than that of boys, after 15 years the width of the frontal sinuses in male prevails over that in female [5].

The study of the anatomical features of the paranasal sinuses is important for practical medicine [6-8]. Thus, the shape, structure, pneumatisation of the maxillary sinus and the structure of the alveolar process of the upper jaw are in close anatomical dependence [1]. The high and narrow alveolar process is characteristic of middle pneumatic sinuses and more often for hypopneumatized sinuses, as well as for slit-like and indefinite form sinuses [4,9].

At adentia, the height of the alveolar process decreases by 25 - 30%. The proportion of hyperpneumatic sinuses increases from 62.5% with the complete preservation of the dentition in the upper jaw to 87% with full adentia. In this regard, during the operation of dental implantation in the upper jaw, it is necessary to take into account the shape and degree of pneumatization of the maxillary sinuses, because they have a direct impact on the ratio of parameters such as height and width of the alveolar process, and therefore determine the tactics of this surgical intervention.

Aim of the Study

The aim of the investigation was to study the morphological features of the maxillary (Highmore's) and frontal sinuses as well as their pneumatisation level.

Materials and Methods

A review of 50 (25 male and 25 female aged 19 to 50 years) paranasal sinus tomographic scans was carried out to expose remarkable anatomic variations of this region. There were no pathological changes of the nasal cavity were identified during radiography. X-ray examination was performed in a coronal projection, which is most favorable for the study, since there is no projection of the massive structures of the skull base.

The morphometric as well as statistical methods were used in study too.

Results and Discussion

The relationship between quantitative indicators of the frontal and maxillary sinuses was examined with the help of the correlation analysis method. Therefore, it is established that the width as well as height of the both left and right maxillary sinuses, are interrelated: the wider the right Highmore's sinus, the wider the left one, the higher the right sinus, the higher the left sinus.

The same regularities are typical for the height and width of the both frontal sinuses. In addition, the higher the frontal sinus is, the wider it is ($p < 0.05$). A significant correlation was also found between the both frontal and maxillary sinuses: in the case of high frontal sinus, the maxillary sinus is high also. If the frontal sinus is wide, the Highmore's sinus is wide too.

We investigated the septum, pneumatisation, forms of the maxillary and frontal sinuses. On the survey radiograph of the skull in the coronal projection, the frontal sinuses are located in the lower part of the frontal scale. With severe pneumatisation, they are layered on the upper wall of the orbit. The upper contour of the frontal sinuses is clear, intense, scalloped. The septum of the frontal sinuses looks as a thin linear shadow. The vertical position of the septum is in 42.86% of cases, oblique - in 44.2%. The frontal sinus septum was absent in 12.8% of cases. Two additional septum in the left frontal sinus were noted on two radiographs; in both, right and left, ones - on one radiograph.

According to the degree of pneumatisation, the frontal sinuses are most variable. The sinuses reaching the lateral wall of the orbit or extending beyond its limits were found in 20% of cases, in 48.6% of cases, the sinuses reached the middle of the upper wall of the orbit, and in 28.6% of cases, we met the sinuses reaching the medial wall of the orbit.

During studying of the maxillary sinus pneumatisation, in 80% of cases it was symmetrical. In the case of triangular sinus, the symmetrical pneumatisation is observed in 88.9% of cases, asymmetrical - in 11.1%. The quadrangular sinus was symmetrical in 94.7% and asymmetrical in 5.3%. The oval Highmore's sinus has symmetrical pneumatisation always, but a slit-like sinus always is asymmetric.

Study shows that 60% of the maxillary sinuses are hyperpneumatic (their floor is located below the bottom of the nasal cavity), 4% are hypopneumatic (the floor of the sinus is above the bottom of the nasal cavity). 27.1% of all sinuses have middle degree of pneumatisation (27.1%), their bottom is at the same level with the bottom of the nasal cavity. In the case of the asymmetric pneumatisation, the right sinus was larger than left one on 10% ($p < 0.05$).

Conclusion

Thus, our study allowed us to identify individual anatomical features of the structure of the paranasal sinuses. The relationship between the quantitative indicators, what is of practical importance, was established. For example, the correlation of width and height of both maxillary and frontal sinuses was noted. In addition, the pneumatisation degree of paranasal sinuses was shown.

Conflict of Interest

The authors declare that there is no conflict of interest.

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