Journal of Radiology Medicine in

Original Article

Doi: 10.51271/JRM-0001

Evaluation of pneumatized structures and osteoma frequency in the paranasal region

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Received: 01.01.2024 ◆ **Accepted**: 23.01.2024 ◆ **Published**: 29.01.2024

Cite this article: Özdemir A. Evaluation of pneumatized structures and osteoma frequency in the paranasal region. *J Radiol Med*. 2024;1(1):1-4.

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ABSTRACT

Aims: The aim of our study was to evaluate the incidence of pneumatized structures in the paranasal region and the presence of osteomas.

Methods: Paranasal CT images obtained with Multislice (Philips) 64-slice computed tomography (CT) at Kırıkkale University Hospital in 2023 were retrospectively analyzed. Pneumatized variations and the presence of osteoma were evaluated.

Results: The images of 186 patients (93 female and 93 male) with paranasal CT were analyzed. The most common pneumatized variation was middle turbinate bullosa with 40.3%, and the least common was pneumatization of the nasal septum with 2.1%. Anterior clinoid pneumatization was observed in 23.1%, posterior clinoid pneumatization in 2.2%, pneumatization of the uncinate process in 4.9%, and crista galli pneumatization in 4.3%. The frequency of osteomas in the paranasal region was 3.2% (n=6).

Conclusion: Our study will provide a better understanding of paranasal anatomy by providing information about the frequency of pneumatized paranasal variations and the presence of osteomas. This will guide the surgeon in surgical planning and at the time of surgery.

Keywords: Paranasal region, osteoma, paranasal variation, pneumatized structures

INTRODUCTION

Anatomical variations in paranasal sinus structures are frequently encountered. These differences in anatomy make the sinus drainage channels narrow or get blocked, which makes it harder for mucociliary activity and less air flow to reach the paranasal sinuses. Thus, infections are predisposed.[1] Although it is accepted that most of the paranasal sinus variations predispose to the development of sinusitis, there are significant differences between studies.[2] Pneumatized paranasal structures have an important place among these variations.

Better understanding of the anatomy of the paranasal sinuses is now necessary because Functional Endoscopic Sinus Surgery (FESC) is becoming more common as a medical and surgical way to treat paranasal sinus diseases. Before FESC, coronal CT provides information about the patient's current anatomy and guides the surgeon.[3] In paranasal sinus surgery, anatomy and variations should be well known.

Osteomas are slow-growing benign bone tumors and frequently follow an asymptomatic course unless they increase in size or disrupt the sinus drainage system.[4] However, depending on the size and location of the osteoma, it may cause complaints of chronic sinusitis, mucocele, chronic headache, proptosis, or diplopia. The most common symptom is a frontal headache and facial pain.[5] Since it usually proceeds asymptomatically, the actual incidence is not clear, but according to some authors, it varies between 0.002% and 0.98%.

There are studies in the literature on the anatomy and variations of the paranasal sinuses. However, there are no studies on pneumatization variations in paranasal structures. In addition, the evaluation of the presence of osteoma will also contribute to the literature.

METHODS

This retrospective study was performed according to the principles of the Declaration of Helsinki, with paranasal CT images taken in 2023. Kırıkkale University Faculty of Medicine Local Ethics Committee approval was obtained (Date:10.01.2024, Decision No: 2023.12.18).

Patients younger than 18 years of age, patients older than 75 years, patients with nasal polyposis, patients with a history of trauma or surgery in the sinonasal region, and patients with benign or malignant tumors were excluded.

Routine paranasal CT imaging was performed without the use of contrast or sedation. Images were obtained using a 64-slice CT (MSCT; Brilliance 64, Philips Medical System, Best, The Netherlands).

All of the scans were obtained using the following parameters: effective mAs=350, tube voltage=120 kV, field of view (FOV)=180 mm, slice thickness=1.00 mm, and image matrix=768×768. After scanning, coronal, axial, and sagittal images were reconstructed with a slice thickness of 1.00 mm.

Anterior clinoid process (ACP) pneumatization, posterior clinoid process (PCP) pneumatization, middle turbinate bullosa, uncinate process pneumatization, crista galli pneumatization, and nasal septum pneumatization were evaluated. Osteomas detected in the paranasal region were also analyzed.

The diameters of the osteomas observed in our study ranged between 4 and 8 mm.

RESULTS

186 paranasal sinus CT images were analyzed. Of these, 93 were male (mean age 35.49-SD 15.24) and 93 were female (mean age 35.42-SD 13.97). The most common pneumatized variation was middle turbinate bullosa with 40.3% (right 11.3%, left 10.2%, and bilateral 18.8%) (**Figure 1**), and the least common was pneumatization of the nasal septum with 2.1% (**Figure 2**). ACP pneumatization was 23.1% (right 11.3%, left 7%, and bilateral 4.8%) (**Figure 3**), PCP pneumatization was 2.2% (right 1.6%, left 0.6%), uncinate process pneumatization was 4.9% (right 2.2%, left 2.2%, and bilateral 0.5%) (**Figure 1**), and crista galli pneumatization was 4.3% (**Figure 4**). The frequency of pneumatized variations is shown in **Table 1**.

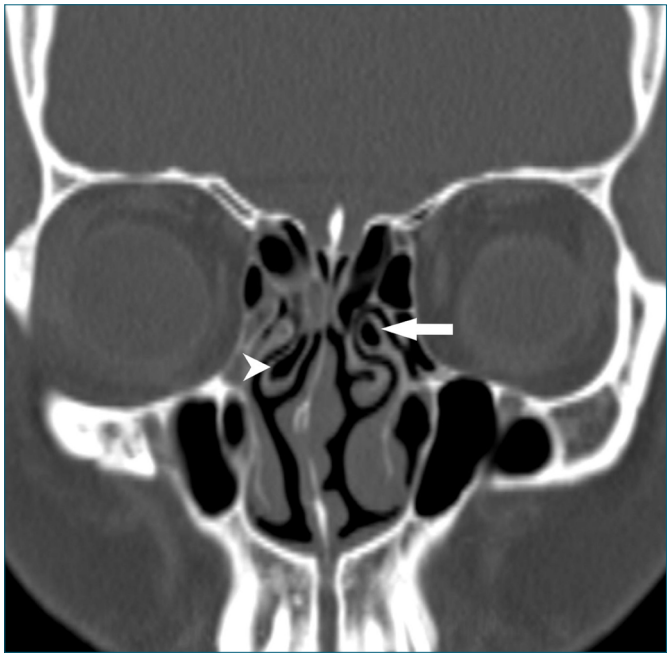

Figure 1. On coronal section CT, showing right middle turbinate bullosa (arrowhead) and left uncinate process pneumatization (white arrow)

Table 1. The incidence of pneumatized variations

Variation Type	Number (n)	Rate
Middle Concha Bullosa	75	40.3
Anterior Clinoid Process Pneumatization	43	23.1
Pneumatization of the Uncinate Process	9	4.9
Crista Galli Pneumatization	8	4.3
Posterior Clinoid Process Pneumatization	5	2.7
Nasal Septum Pneumatization	4	2.2

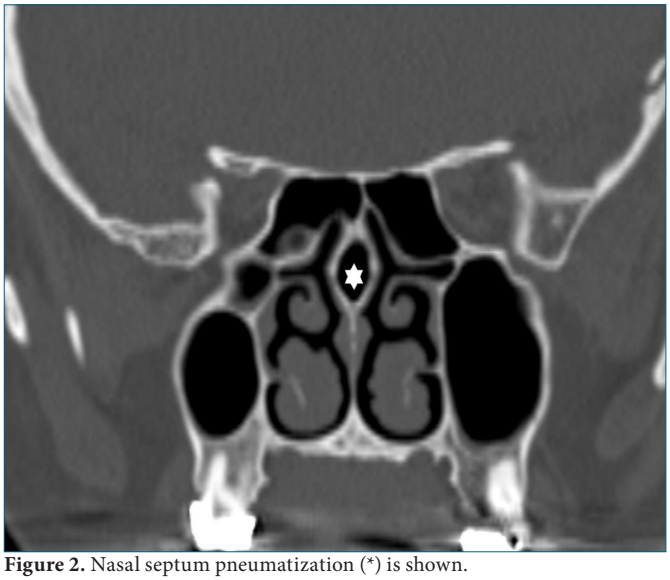

Figure 2. Nasal septum pneumatization (*) is shown.

Figure 3. Coronal section CT image of a 35-year-old male patient, showing anterior clinoid process pneumatization (*)

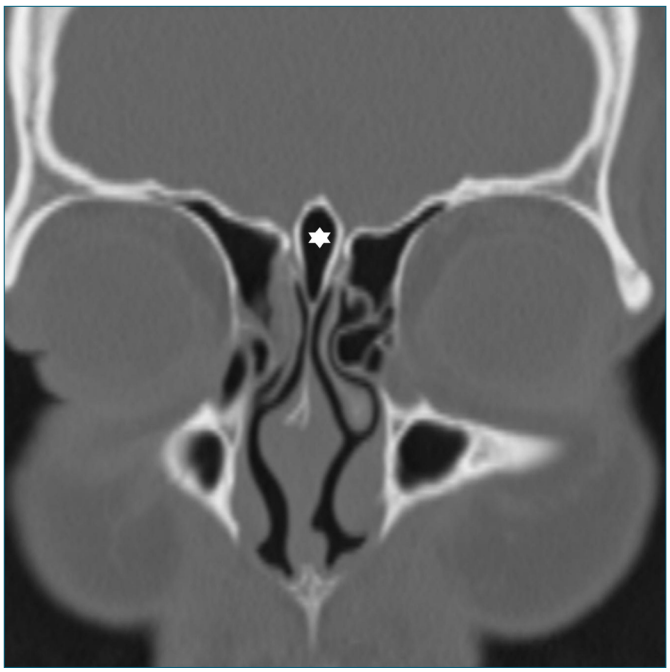

Figure 4. Coronal section CT image, crista galli pneumatization (*) is shown.

The frequency of osteomas in the paranasal region was 3.2% (n=6). Of those with osteomas, five were female and one was male. While 3 osteomas were found in the frontal sinus (**Figure 5**), 1 osteoma each was found in the sphenoid, maxillary and ethmoidal sinuses (**Figure 6**).

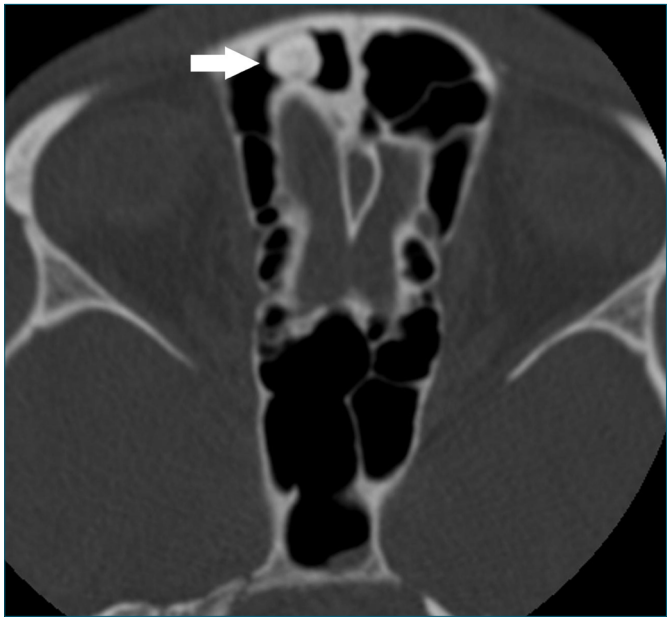

Figure 5. A 6 mm-diameter osteoma is seen in the frontal sinus (white arrow).

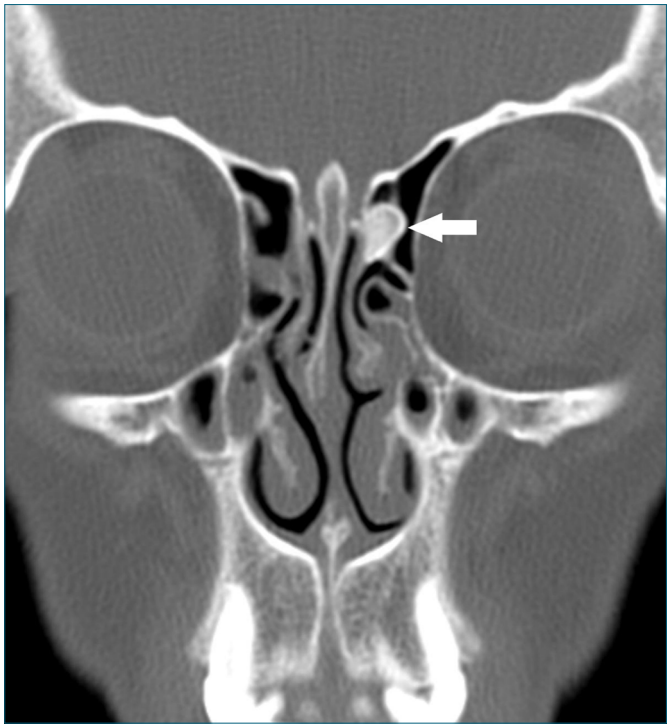

Figure 6. Coronal section CT image, showing anterior ethmoidal sinus osteom (white arrow).

DISCUSSION

There are numerous variations in the paranasal sinus region. Anatomical variations of the paranasal sinuses are one of the most important etiologic factors in the etiopathogenesis of chronic inflammatory paranasal sinus diseases with their obstruction in the ostiomeatal complex.[6,7]

The development of minimally invasive surgical techniques has necessitated a better knowledge of paranasal sinus anatomy. Anatomic variations should be well known to avoid complications that may occur during the operation and to perform the surgery safely. CT is the gold standard imaging method used in the evaluation of the patient before endoscopic sinus surgery.[8,9]

CT imaging is the imaging method that best demonstrates the relationship between chronic sinus infections and anatomic variations seen in the paranasal sinuses.

There are significant differences in the frequency of paranasal variations in most studies. Among the reasons for these differences is the fact that only the coronal plane is examined.

In the article by Mikami et al.[10] pneumatization of ACP was found in 55 of the 600 sides (9.2%) in 300 consecutive patients. In another study, this rate was found to be 26%.[11] In the study by Veysel et al.[12] this rate was found to be 33.3% in women and 37.5% in men. They stated that this difference may be related to genetic differences in subject populations or environmental exposure to different agents. In our study, the rate of ACP pneumatization was found to be 21.3%, which is in accordance with the literature.

Variations in PCPs are important in intracranial surgery. The PCP deepens the Sella turcica and provides a connection to the tentorium cerebelli. Therefore, any anomaly in the PCP may be responsible for the altered attachment of the tentorium cerebelli. In the study by Veysel et al.[13] PCP pneumatization was found in 20.7% of men and 11.5% of women. In addition, PCP pneumatization was found to be higher in men and young people. In our study, this rate was found to be lower and was 2.7% (n=5). Two of these patients were female, and three were male.

The frequency of Crista galli pneumatization was found to be 9.2-13.7% in various studies.[14-16] In our study, it was found to be 4.3%, which is lower than the literature.

The pneumatized uncinate process is a significant anatomical variation that can make it hard for the anterior ethmoid cells, infundibulum, and frontal recess to breathe. Its incidence varies between 0.4-6.1% in the literature.[14,17] In our series, this variation was observed at 4.9%.

The frequency of middle turbinate bullosa has been reported as 39.2% and 40.9% in some studies.[11,15] In our study, it was found to be 40.3%, in accordance with the literature.

Osteomas are the most common tumors of the paranasal sinuses.[5] Paranasal sinus osteomas are well-circumscribed, frequently asymptomatic tumors that are diagnosed incidentally.[5] In publications, clinical symptoms are observed in 4-10% of all osteomas.[18] Headache is reported as the most common symptom, with a rate of 71%.[19]

It is frequently detected in the 3rd and 4th decades, and its incidence is higher in men than in women.[20] In our study, osteomas were detected in 6 patients, and contrary to the literature, 5 were female and 1 was male. It can be detected in 0.43-1% of routine radiographic imaging and 3% of paranasal sinus CT.[21] In our study, the frequency of osteoma was found to be 3.2%.

Indications for surgery include rapid growth of the tumor, a symptomatic patient, chronic sinusitis due to tumor obstruction, bone erosion, facial deformity, osteoma occupying more than 50% of the frontal sinus, partial or complete blockage of the frontal recess due to osteoma, and the presence of complications.[22] The diameters of the osteomas observed in our study ranged between 4 and 8 mm. Since small osteomas were observed, the complications mentioned above were not observed.

CONCLUSION

Our study will provide a better understanding of paranasal anatomy by providing information about the frequency of pneumatized paranasal variations and the presence of osteomas. This will guide the surgeon in surgical planning and at the time of surgery.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of Kırıkkale University Faculty of Medicine Clinical Researches Ethics Committee (Date: 10.01.2024, Decision No: 2023.12.18).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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