ORIGINAL PAPER

THE RELATIONSHIP BETWEEN ACCESSORY MAXILLARY OSTIUM, MAXILLARY SINUS PATHOLOGIES, AND SINONASAL REGION VARIATIONS

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ABSTRACT

Introduction: The accessory maxillary ostium (AMO) is an anatomical variation that can be associated with the pathologies of the maxillary sinus, sinonasal variations, and dentition status.

Objectives: The aim of this study was to evaluate the prevalence of AMO and its association with age, sex, sinus variation, pathological formations, the status of dentition, and tooth endodontic and periodontal status using cone-beam computed tomography (CBCT).

Material and methods: The retrospective analysis of CBCT scans from 390 patients over the age of 18 years (232 female and 158 male) was carried out in this study. All the CBCT images were analysed with sagittal, coronal, and axial sections. The intra-class correlation coefficient (ICC) was used to test intra-observer agreement. *P*-values of 0.05 were considered statistically significant at a 95% confidence interval (95% CI).

Results: In the present study, 780 sinuses from a total of 390 CBCT scans were analysed. The prevalence of AMO was 33.1% on the right side and 35.4% on the left. There was no statistically significant relationship between the presence of AMO and pathological formation in all individuals ($p > 0.05$). No statistically significant difference was observed between the prevalence of AMO and sinonasal variations.

Conclusions: There was no significant difference in AMO prevalence related to age, presence of mucosal thickness, mucus retention cysts, maxillary sinusitis, sinonasal variation, the status of dentition, and the periodontal status of posterior maxilla. However, there was a relationship between AMO and both sex and endodontic status.

Key words: accessory maxillary ostium, maxillary sinus, variation, dentition, cone beam computed tomography.

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INTRODUCTION

The maxillary sinus is the largest paranasal sinus and thus is an important and popular structure for both otolaryngology and dentistry [1]. The primary maxillary ostium (PMO) is a natural opening between the floor of the orbit and the medial wall of the maxillary sinus [1, 2]. The PMO contributes to drainage from the sinuses towards the hiatus semilunaris, middle meatus, and nasal cavity, thus helping the maxillary sinus remain physiologically healthy [1, 3].

Accessory maxillary ostium (AMO) is a relatively common anatomical variation observed in the maxillary sinus, and its prevalence has been reported to be between 18% and 30% of the general population [4, 5]. It is usually located in the fontanel, the membranous part of the lateral nasal wall that is covered with mucoperiosteum in the middle meatus, between the uncinate

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process and the inferior meatus. It should not be confused with the maxillary hiatus. The fontanel is divided into an anterior nasal fontanel (ANF) and a posterior nasal fontanel (PNF) by the uncinate process. An AMO is most often located in the PNF of the middle meatus and can be unilateral or bilateral [5-7].

Normally, an AMO takes a round or oval shape and is parallel to the vertical plane of the lateral nasal wall. Unlike the PMO, which is hidden behind the uncinate process, an AMO can be easily seen in nasal endoscopic examinations [5]. It has not yet been determined whether an AMO is a congenital or an acquired structure. It is well known that some anatomical variations in the paranasal sinus can predispose individuals to sinus infections and may even complicate sinus surgery [8].

The presence of an AMO increases the ventilation rate of the maxillary sinus but also leads to reverse drainage from the middle meatus to the sinus. This leads to decreased nitric oxide concentration in the sinus and results in mucus accumulation; this possibly contributes to the formation of pathological changes such as mucosal thickening, mucosal retention cyst formation, and maxillary sinusitis [1, 7]. In one study, it was stated that 70-100% of antrochoanal polyps originated from an accessory ostium [9].

Cone-beam computed tomography (CBCT) is a safe, accurate, cost-effective, and relatively low-radiation three-dimensional (3D) imaging technique widely used in dentistry to obtain three-dimensional images of the jaw. In addition, it is frequently used in dentistry to allow three-dimensional examination of maxillary sinuses and adjacent structures [10]. Most studies evaluating the presence of an AMO in the literature use CBCT images.

Many studies have investigated the causes and effects of AMO. Arslan *et al.* [11] analysed the correlation between the presence of mucus retention cysts and osteomeatal complex obstruction, middle turbinate anomalies, AMO, and nasal septal deviation. They reported that the presence of a mucus retention cyst is an indicator of paranasal sinus anomalies. Hung *et al.* [1] evaluated AMO in 160 CBCT images and detected the presence of it at a rate of 47%. They argued that pathological formations in the maxillary sinus affect AMOs.

Yenigün *et al.* [7] investigated the prevalence of AMO with mucus retention cysts, mucosal thickening, maxillary sinusitis, agger nasi cells, Haller cells, nasal septal deviation, inferior concha hypertrophy, and middle turbinate pneumatization. They stated that the presence of AMO increased the possibility of mucus retention cysts approximately three-fold (48.6%), and the possibility of mucosal thickening two-fold (43.0%), and maxillary sinusitis (29.1%) also two-fold. In another study, Bani-Ata *et al.* [6] evaluated the prevalence of AMO in the CBCT images of 928 patients and found the frequency to be 27.5%. They concluded that the presence of AMO contributes to the formation of maxillary and ethmoid sinusitis. In a study investigating the incidence of accessory ostium in patients with chronic maxillary sinusitis, a close association of accessory ostium with chronic maxillary sinusitis was revealed [12]. According to Shetty *et al.* [13], there was a clear association between the degree of mucosal thickening and the occurrence of AMO.

OBJECTIVES

While many studies of AMO have been performed, few have focused specifically on the Turkish subpopulation. The effect of accessory AMO on the variations of adjacent structures of the maxillary sinus was investigated in a recent computed tomography (CT) study in the Turkish population, and it was reported that the parameters including agger nasi cell, Haller cell, nasal septum deviation, inferior concha hypertrophy, and pneumatization of middle concha had an increasing incidence in the presence of AMO [14]. In another study, it was determined that 77.8% of patients had at least one anatomical variation, with accessory ostium being the most common [15].

Therefore, this study aimed to investigate the prevalence of AMO and its association with sinus variations, pathological formations, the status of dentition, tooth endodontic and periodontal status, age, and sex using CBCT.

MATERIAL AND METHODS

SAMPLE COLLECTION

This study examined data from patients referred to the Department of Oral and Dentomaxillofacial Radiology, Faculty of Dentistry at Altınbaş University. From these, 390 patients aged 18 years and older were selected as the study group. These patients had been referred for various reasons including impacted teeth, pathologies of the jaws, temporomandibular disorder, and implant or orthodontic planning.

The study's inclusion criteria included these items: sufficient image quality and the absence of artifacts, the absence of a history of maxillofacial fracture in CBCT images including bilateral maxillary sinuses, images not containing any pathological structure or deformation, and the patient having not undergone previous surgical intervention in the relevant area. Patients with maxillofacial fractures, pathological structures in the relevant region, and a history of previous trauma, surgical intervention, or deformation in the maxillofacial area were not included. The study was conducted in full accordance with the 2013 Helsinki Declaration (Finland) and was approved by the Clinical Research Ethical Committee of Altınbaş University (approval number: 2021/47).

CBCT IMAGE ANALYSIS

CBCT images of all patients were obtained with a NewTom VGİ evo (CeflaGroup, Verona, Italy) and with operating parameters (1-32 mA, 110 kV, and 0.3 mm voxel size) specified by the manufacturer. During the exposure time, the patients were standing, with their heads, sagittal and vertical planes perpendicular to the ground. The orbitomeatal plane was positioned parallel to the ground, and the device made a single 360° rotation around the patient's head in each exposure. This ensured that it remained stable; in addition, patients were given a special headband and chin support to prevent movement.

The parameters were evaluated using the NNT Viewer software program (CeflaGroup, Verona, Italy). To ensure an effective evaluation, the radiological images were evaluated on a 22", high image quality, 1920 × 1080 display resolution Barco medical monitor in a dark, quiet room.

All measurements were evaluated by the first author, and 4 weeks later, 20% of the CBCTs were randomly selected from all the samples and re-evaluated by the same researcher to test the agreement (intra-observer agreement).

The presence of PMO and AMO, maxillary sinus pathologies, and sinonasal variations were investigated.

Maxillary sinus pathologies were classified as follows: mucus retention cysts, mucosal thickening (more than 2 mm), and maxillary sinusitis.

Sinonasal variations were classified as follows: agger nasi cells, Haller cells, middle turbinate pneumatization (concha bullosa), inferior concha hypertrophy, paradoxical middle turbinate, nasal septal spur, and nasal septal deviation existence.

Furthermore, a potential association of influencing factors including sex, age, and dentoalveolar disease with AMO features was evaluated to provide additional information that could be beneficial in the assessment of maxillary sinuses before sinus-related procedures.

CBCT images evaluated according to the dentition status in the posterior maxilla (from the distal of the canine) were recorded as follows:
- dentate,
- partially edentulous,
- completely edentulous.

If there were teeth of the maxilla posterior, the conditions of these teeth were evaluated to investigate dental origin endodontic or periodontal pathology that could affect the maxillary sinus. The endodontic status of teeth in the respective posterior maxilla was classified as follows:
- absence of endodontic pathology or treatment,
- endodontic treatment(s) without pathology,
- apical lesion(s) with or without endodontic treatment(s), based on Hung *et al.* [1] and Yeung *et al.* [16].

Teeth with periodontal pathology were classified as follows:
- absence of periodontal lesions,
- horizontal and/or vertical periodontal bone lesions deeper than the midlevel of the respective root without furcation involvement,
- periodontal bone lesions with furcation involvement.

The endodontic/periodontal status was categorized into healthy (1) or pathological (2, 3), based on Hung *et al.* [1] and Yeung *et al.* [16].

STATISTICAL ANALYSIS

For the statistical analysis, IBM SPSS Statistics (version 22.0; SPSS Inc., Chicago, IL, USA) was used. The normality of the data distribution was assessed using the Kolmogorov-Smirnov test. Data were analysed using descriptive statistical methods (mean, standard deviation, and frequency). The one-way analysis of variance (ANOVA) test was used to compare the parameters between the groups in comparison to the quantitative data, and Tamhane's T2 test was used to determine which group caused the difference. Student's *t*-test was used to compare normally distributed parameters between the 2 groups. The Fisher-Freeman-Halton exact test, χ^2 test, and continuity (Yates) correction were used to compare qualitative data. The intra-class correlation coefficient (ICC) was used to test intra-observer agreement. *P*-values of 0.05 were considered statistically significant at a 95% confidence interval (95% CI). The ICC values calculated for all the measurements were 1.00 and close to 1.00. There was high intra-observer agreement.

RESULTS

In the present study, 780 sinuses from a total of 390 CBCT scans were analysed. Overall, 158 patients (40.5%

TABLE 1. The presence of AMO and PMO by age and sex

Parameter	AMO		*p*-value	PMO		*p*-value
	Presence	Absence		Presence	Absence	
Age, mean ± SD	46.27 ± 16.79	47.79 ± 16.85	0.232[1]	47.28 ± 16.77	47.10 ± 18.07	0.947[1]
Sex, *n* (%)						
Male	121 (38.3%)	195 (61.7%)	0.049[2,*]	296 (93.7%)	20 (6.3%)	0.268[2]
Female	146 (31.5%)	318 (68.5%)		443 (95.5%)	21 (4.5%)	

[1]Student's t-test, [2]χ^2, *$p < 0.05$

TABLE 2. Distribution of parameters (right-left-total)

Parameter	Right, *n* (%)	Left, *n* (%)	Total, *n* (%)
PMO			
Presence	370 (94.9)	369 (94.6)	739 (94.7)
Absence	20 (5.1)	21 (5.4)	41 (5.3)
AMO			
Presence	129 (33.1)	138 (35.4)	267 (34.2)
Absence	261 (66.9)	252 (64.6)	513 (65.8)
Sinonasal pathologies			
Absence	193 (49.5)	198 (50.8)	391 (50.1)
Maxillary sinusitis	29 (7.4)	29 (7.4)	58 (7.4)
Mucosal thickening	131 (33.6)	124 (31.8)	255 (32.7)
Mucus retention cysts	37 (9.5)	39 (10)	76 (9.7)
Agger nasi cells			
Presence	341 (87.4)	346 (88.7)	687 (88.1)
Absence	49 (12.6)	44 (11.3)	93 (11.9)
Haller cells			
Presence	130 (33.3)	119 (30.5)	249 (31.9)
Absence	260 (66.7)	271 (69.5)	531 (68.1)
Concha bullosa			
Presence	187 (47.9)	208 (53.3)	395 (50.6)
Absence	203 (52.1)	182 (46.7)	385 (49.4)
Inferior concha hypertrophy			
Presence	132 (33.8)	131 (33.6)	263 (33.7)
Absence	258 (66.2)	259 (66.4)	517 (66.3)
Paradoxical middle turbinate			
Presence	47 (12.1)	38 (9.7)	85 (10.9)
Absence	343 (87.9)	352 (90.3)	695 (89.1)
Nasal septal spur			
Presence	–	–	130 (33.3)
Absence	–	–	
Nasal septal deviation			
Presence	–	–	243 (62.3)
Absence	–	–	
Dentition status			
Completely edentulous	52 (13.3)	58 (14.9)	110 (14.1)
Partially edentulous	171 (43.8)	175 (44.9)	346 (44.4)
Dentate	167 (42.8)	157 (40.3)	324 (41.5)
Endodontic status			
Absence of endodontic pathology or treatment	216 (64.1)	229 (69.0)	445 (66.5)
Endodontic treatment without pathology	44 (13.1)	33 (9.9)	77 (11.5)
Apical lesion with or without endodontic treatment	77 (22.8)	70 (21.1)	147 (22.0)
Periodontal status			
Absence of periodontal lesions	253 (75.1)	245 (73.8)	498 (74.4)
Horizontal and/or vertical periodontal bone lesions deeper than the midlevel of the respective root without furcation involvement	30 (8.9)	33 (9.9)	63 (9.4)
Periodontal bone lesions with furcation involvement	54 (16.0)	54 (16.3)	108 (16.1)

of the total) were male and 232 were female (59.5% of the total). The age of patients ranged between 18 and 86 years, with an average age of 47.27 ± 16.84 years. The ages of the male patients ranged from 19 to 85 years, with an average age of 48.62 ± 16.55 years. The ages of the female patients ranged from 18 and 86 years, with an average of 46.35 ± 17.01 years.

PREVALENCE OF PMO-AMO AND ITS RELATIONSHIP WITH AGE AND SEX

The prevalence of PMO on the right side was 94.9% and on the left side 94.6%. The prevalence of AMO was 33.1% on the right side and 35.4% on the left. While there was no statistically significant difference between the mean age in terms of the presence of AMO ($p > 0.05$), the rate of AMO in males (38.3%) was more statistically significant than that of females (31.5%) ($p < 0.05$) (Table 1). The distribution of parameters including the presence of AMO, pathological formations, sinonasal variations, dentition status, and endodontic and periodontal status is presented in Table 2.

AMO AND ITS RELATIONSHIP WITH MAXILLARY SINUS PATHOLOGIES

On the right side, there was no statistically significant relationship between the presence of AMO and pathological formation ($p > 0.05$). While 5.4% of the cases with AMO had maxillary sinusitis, 35.7% had mucosal thickening and 7.8% had retention cysts in the cases without AMO, maxillary sinusitis was observed in 8.4%, mucosal thickening in 32.6%, and retention cysts in 10.3%.

On the left side, there was no statistically significant relationship between the presence of AMO and pathological formation ($p > 0.05$). Maxillary sinusitis was observed in 4.3% of the cases with AMO, mucosal thickening in 31.9%, and retention cysts in 13%. Of the cases without AMO, maxillary sinusitis was observed in 9.1%, mucosal thickening in 31.7%, and retention cysts in 8.3%.

There was no statistically significant relationship between the presence of AMO and pathological formation in all individuals ($p > 0.05$). Maxillary sinusitis was observed in 4.9% of cases with AMO, mucosal thickening in

TABLE 3. Relationship between maxillary accessory ostium and sinonasal pathology, sinonasal variation, and endodontic and periodontal status

Parameter	Right Accessory ostium		*p*-value	Left Accessory ostium		*p*-value	Total Accessory ostium		*p*-value
	Presence, *n* (%)	Absence, *n* (%)		Presence, *n* (%)	Absence *n* (%)		Presence, *n* (%)	Absence, *n* (%)	
Sinonasal pathology									
Maxillary sinusitis	7 (5.4)	22 (8.4)	0.570[2]	6 (4.3)	23 (9.1)	0.104[2]	13 (4.9)	45 (8.8)	0.261[2]
Mucosal thickening	46 (35.7)	85 (32.6)		44 (31.9)	80 (31.7)		90 (33.7)	165 (32.2)	
Mucus retention cysts	10 (7.8)	27 (10.3)		18 (13)	21 (8.3)		28 (10.5)	48 (9.4)	
Endodontic status									
1	79 (71.2)	137 (60.6)	0.066[2]	90 (75)	139 (65.6)	0.117[2]	169 (73.2)	276 (63)	0.007[2,*]
2	15 (13.5)	29 (12.8)		12 (10)	21 (9.9)		27 (11.7)	50 (11.4)	
3	17 (15.3)	60 (26.5)		18 (15)	52 (24.5)		35 (15.2)	112 (25.6)	
Periodontal status									
1	84 (75.7)	169 (74.8)	0.262[2]	96 (80)	149 (70.3)	0.154[2]	180 (77.9)	318 (72.6)	0.183[2]
2	13 (11.7)	17 (7.5)		9 (7.5)	24 (11.3)		22 (9.5)	41 (9.4)	
3	14 (12.6)	40 (17.7)		15 (12.5)	39 (18.4)		29 (12.6)	79 (18)	
Variations									
Agger nasi cells	116 (89.9)	225 (86.2)	0.379[1]	120 (87)	226 (89.7)	0.518[1]	236 (88.4)	451 (87.9)	0.846[1]
Haller cells	49 (38)	81 (31)	0.171[2]	42 (30.4)	77 (30.6)	0.980[2]	91 (34.1)	158 (30.8)	0.351[1]
Concha bullosa	64 (49.6)	123 (47.1)	0.644[2]	72 (52.2)	136 (54)	0.734[2]	136 (50.9)	259 (50.5)	0.905[1]
Inferior concha h.	37 (28.7)	95 (36.4)	0.130[2]	43 (31.2)	88 (34.9)	0.452[2]	80 (30)	183 (35.7)	0.109[1]
Paradoxical middle t.	20 (15.5)	27 (10.3)	0.191[1]	13 (9.4)	25 (9.9)	1.000	33 (12.4)	52 (10.1)	0.344[1]
Nasal septal spur	–	–	–	–	–	–	44 (34.1)	86 (33.0)	0.819[2]
Nasal septal deviation	–	–	–	–	–	–	84 (65.1)	159 (60.9)	0.421[2]

[1]Continuity (yates) correction, [2]χ^2 test.
Endodontic status: 1 – Absence of endodontic pathology or treatment, 2 – Endodontic treatment without pathology, 3 – Apical lesion with or without endodontic treatment.
Periodontal status: 1 – Absence of periodontal lesions, 2 – Horizontal and/or vertical periodontal bone lesions deeper than the midlevel of the respective root without furcation involvement, 3 – Periodontal bone lesions with furcation involvement.

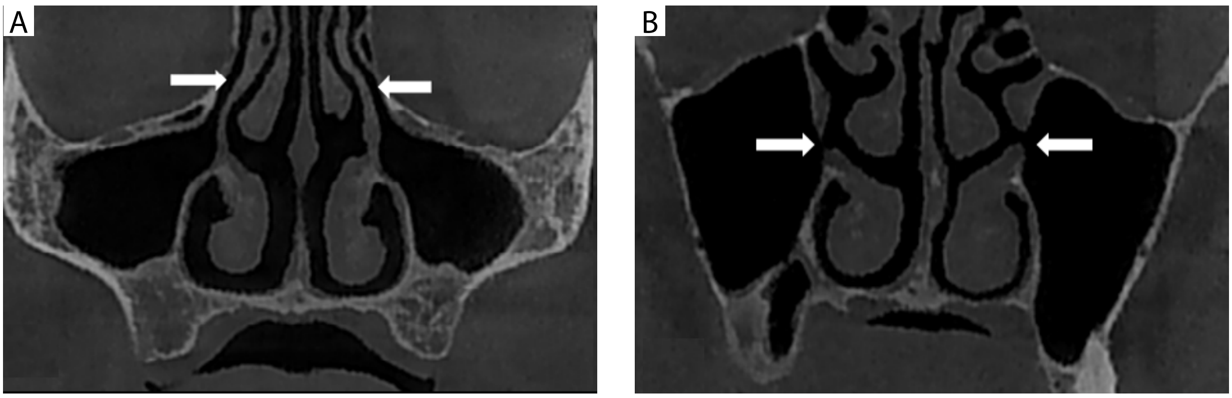

FIGURE 1. A) Primary maxillary ostium, **B**) accessory maxillary ostium

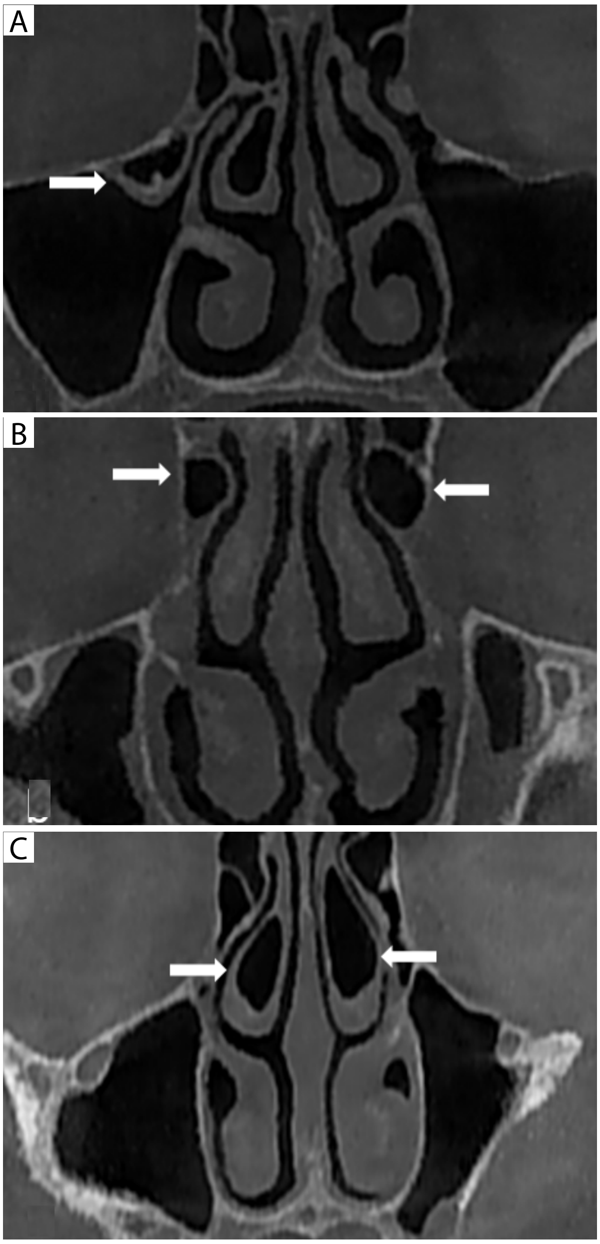

FIGURE 2. A) Haller cells, **B**) agger nasi cells, **C**) concha bullosa

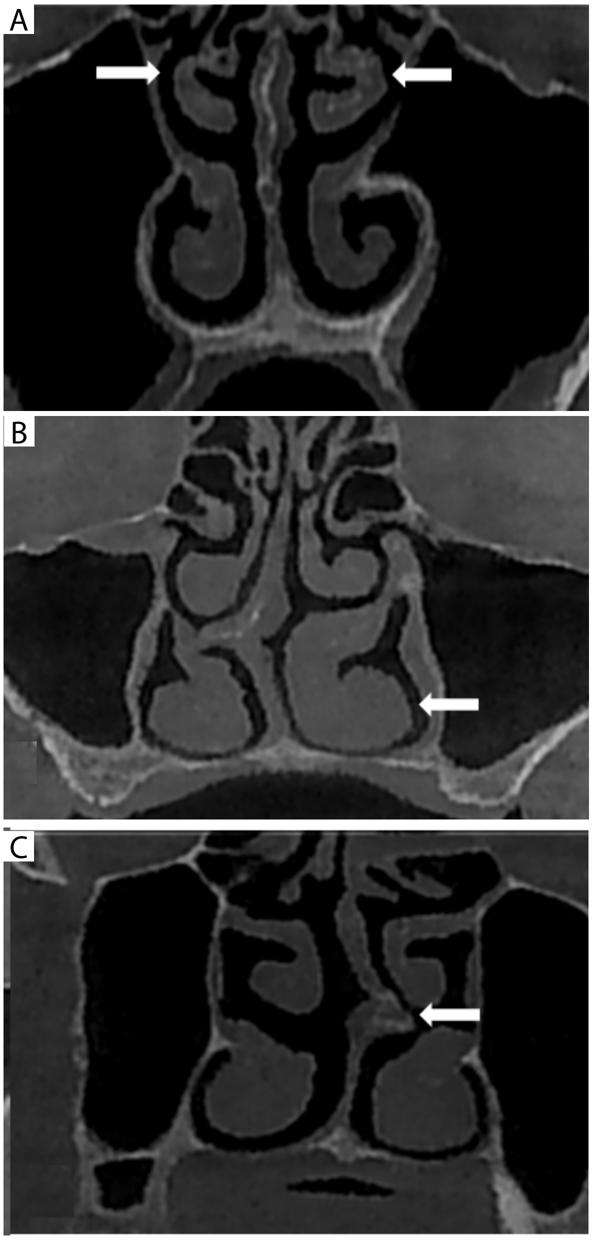

FIGURE 3. A) Paradoxical middle turbinate, **B**) inferior concha hypertrophy, **C**) nasal septal deviation and septal spur

33.7%, and retention cyst in 10.5%. Of the cases without AMO, maxillary sinusitis was observed in 8.8%, mucosal thickening in 32.2%, and retention cyst in 9.4% (Table 3).

AMO AND ITS RELATIONSHIP WITH SINONASAL VARIATIONS

There was no statistically significant difference between the prevalence of AMO and the prevalence of agger nasi cells, Haller cells, concha bullosa, inferior concha hypertrophy and paradoxical middle turbinate, spur formation, and nasal septal deviation ($p > 0.05$) (Table 3).

AMO AND ITS RELATIONSHIP WITH ENDODONTIC AND PERIODONTAL STATUS OF TEETH

There was no statistically significant difference in the prevalence of AMO based on dentition status. The relationship of the AMO with the endodontic and periodontal status of the teeth in the posterior maxilla is presented in Table 3.

There was no statistically significant relationship between the presence of AMO and the endodontic status of the teeth on both the right and left sides ($p > 0.05$). In total, the rate of absence of endodontic pathology or treatment with AMO (73.2%) was significantly higher

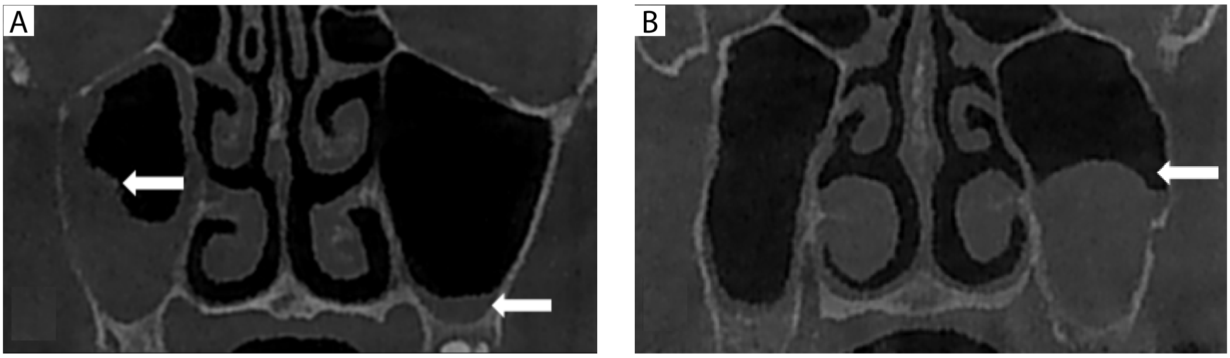

FIGURE 4. A) Maxillary sinusitis (right), mucosal thickness (left), **B**) Mucus retention cysts

than in patients without AMO (63%). There was no statistically significant relationship between the presence of AMO and periodontal status ($p > 0.05$).

DISCUSSION

The present study assessed the frequency of AMO in 780 maxillary sinuses from 390 CBCT images, examining them in terms of age, sex, association with sinus variation, pathological formations, the status of the dentition, and endodontic and periodontal pathology. In the literature, the prevalence of AMO in humans is reported to be in the range 0-43%. Detailed radiological evaluation of the presence of AMO before surgical interventions in the sinus area is normally recommended and takes the form of functional endoscopic sinus surgeries, maxillary sinus floor elevation, apical surgery, and extraction of impacted teeth in the posterior maxilla [1, 7].

The literature varies regarding the amount of mucosal thickening that is accepted as pathology. Rak *et al.* [17] noted that a mucosal thickening of > 3 mm may not cause symptoms in the patient, and Phothikhun *et al.* [18] concluded that 5 mm mucosal thickening does not accompany clinical symptoms in most cases. In this study, the thickness of the mucosa greater than 2 mm is considered pathological as proposed by Capelli *et al.* [19], Maillet *et al.* [20], and Lu *et al.* [21].

Mucus retention cysts are usually located in the maxillary sinus, and their prevalence in the general population has been reported to be approximately 9-22%. On CBCT scans, they appear as well-circumscribed hypodense masses [7]. In the literature, it is unclear whether chronic sinusitis causes the formation of AMO or whether the presence of AMO causes chronic sinusitis by recirculation of mucus secretions [6]. While some studies state that 30% of patients diagnosed with chronic maxillary sinusitis have AMO, the rate of AMO in healthy individuals is 10-20% [22, 23]. Some studies state that there is a strong relationship between chronic maxillary sinusitis and AMO [7, 24]. The present study showed that there is no statistically significant relationship between the presence of AMO and pathological formation in all individuals. This result is in line with the 3 previous CBCT studies, which reported that AMO was not associated with the morphological changes of the sinus mucosa [1, 16, 19] and chronic sinusitis [22, 23].

Haller cells play a possible obstructive role in sinus drainage. It has been reported in the literature that the prevalence of Haller cells is highly variable, between 2.7% and 45.1%. Ali *et al.* [8] suggested that sinusitis caused by Haller cells may cause the development of AMO. In contrast, Mathew *et al.* [25] stated that there was no statistically significant association between the existence and size of Haller cells and maxillary sinusitis. Özcan *et al.* [26] stated that there was no significant relationship between maxillary sinuses with Haller cells and the presence of AMO. Similarly, in the present study, there was no statistically significant difference between the prevalence of AMO and Haller cells. In another study, Göçmen *et al.* [27] examined the prevalence of Haller cells, nasal septal deviation, concha bullosa, and the correlation of maxillary sinus inferior pneumatization with these structures using CBCT in the Turkish population. They reported that 44.3% of scans had concha bullosa, 37.3% nasal septal deviation, and 19.3% Haller cells, and these structures did not affect pneumatization.

The middle turbinate plays an important role in the drainage of the maxillary sinus. While extreme nasal septal deviation may occlude the osteomeatal unit, the role of the minimal or moderately abnormal middle turbinate and nasal septal deviation in the aetiology of inflammation in the paranasal region is controversial. Similarly, sinonasal variations such as concha bullosa, inferior concha hypertrophy, pneumatization of the middle concha, septal spur, and septal deviation may cause narrowing or obstruction of the osteomeatal unit by reducing the normal airflow and mucociliary clearance of the sinuses [28]. Yenigün *et al.* [7] assessed the frequency of AMO, the simultaneous occurrence of AMO and agger nasi cells, concha bullosa, inferior concha hypertrophy, pneumatization of the middle concha, and septal deviation. Their research concluded that there was no statistical significance for the simultaneous occurrence of AMO and these sinonasal variations [7]. Similarly, in this study, there was no statistically significant difference between the prevalence of AMO and agger nasi cells, concha bullosa, inferior concha hypertrophy, paradoxical middle turbinate, septal spur, or nasal septal deviation. Contrarily, in a study using CT, the anatomical variations of the nose and paranasal sinuses were examined, and it was shown that the nasal septal deviation (83.4%) and concha bullosa (49%) were the 2 most prevalent variations [29]. In another multidetector CT investigation, the nasal septal deviation (65.8%) was the most common variance [30]. In this presented study, the agger nasi cell was the most prevalent (88.1%), followed by concha bullosa (50.6%).

Hung *et al.* [1] stated that AMO was observed more in sinuses not associated with endodontic pathology in their study. Similarly, Yeung *et al.* [16] revealed that endodontic pathology did not have a significant influence on AMO presence. In the current study, although there was no statistically significant relationship between the presence of AMO and endodontic status on the right and left sides ($p > 0.05$), in total, there was a statistically significant difference between the presence of the AMO and the endodontic state ($p < 0.05$). The absence of endodontic treatment or pathology in AMO cases (73.2%) was significantly higher than in cases without AMO (63%), which is in line with Hung *et al.* [1].

In addition, Lu *et al.* [21] found that the prevalence and severity of maxillary sinus mucosal thickening were positively correlated with the degree of apical periodontitis. Phothikhun *et al.* [18] reported that sinuses adjacent to teeth with severe periodontal bone loss were 3 times more likely to have mucosal thickening. Hung *et al.* [1] evaluated AMO and periodontal pathology and reported that having periodontal pathology seems to be a factor associated with a decrease in the length of the AMO long axis and AMO surface. In the present study, there was no statistically significant relationship between the presence of AMO and periodontal status.

In terms of dentition status, Dedeoğlu *et al.* [31] concluded that the frequency of AMO was increased in the elderly, especially regarding edentulism. However, Hung *et al.* [1] demonstrated that dentition did not have a significant effect on the presence of AMO. They also stated that the dentition of the posterior maxilla had a significant effect on the shape of AMO. Similarly, in the present study, there was no significant difference between the prevalence of AMO according to the dentation ($p > 0.05$).

LIMITATIONS

This study has some limitations, such as the fact that it was conducted retrospectively and that all evaluations were performed by a single observer. Another limitation was the small sample size. Further studies are needed on larger groups in this area.

CONCLUSIONS

There was a relationship between AMO and sex and endodontic status; however, no relationship was identified between AMO and age, the presence of mucosal thickness, mucus retention cysts, maxillary sinusitis, sinonasal variation, dentition status, or periodontal status of the posterior maxilla. In addition, to determine the presence of AMO before surgical interventions of the sinonasal region, a detailed radiological assessment should be reported. CBCT imaging is a reliable diagnostic method that can be used to evaluate the sinonasal region.

CONFLICT OF INTEREST

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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