JOURNAL OF
CONTEMPORARY MEDICINE
DOI:10.16899/jcm.1438173
J Contemp Med 2024;14(2):94-100

Original Article / Orijinal Araştırma

# Evaluation of the Frequency, Localization and Relationship of Maxillary Sinus Pathologies with Dental Pathologies by Cone Beam Computed Tomography (CBCT)

## Maksiller Sinüs Patolojilerinin Sıklığı, Lokalizasyonu ve Dental Patolojiler ile İlişkisinin Konik Işınlı Bilgisayarlı Tomografi (KIBT) ile Değerlendirilmesi

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## Abstract

**Aim**: The proximity of the root tips of the maxillary posterior teeth to the maxillary sinus causes odontogenic infection to become a potential source of maxillary sinusitis. This study aims to evaluate the relationship between dental pathologies and maxillary sinus abnormalities using cone beam computed tomography (CBCT).

**Material and Method**: In this study, 300 patients who applied to our clinic for any reason 600 maxillary sinus cone beam computed tomography images of the patient were analyzed retrospectively. Maxillary sinus diseases and dental pathologies categoized among themselves.

**Results**: The age of all patients ranged between 18 and 77 years, with a mean age of 41.38 (±14.39) years. No pathology was detected in 359 (59.8%) of the maxillary sinuses examined which were considered healthy sinuses. The most common pathology in 241 (40.2%) of the maxillary sinuses in the imaging area was mucosal thickening (MT). A statistically significant relationship was detected between teeth with periapical lesions (PL) and MT ($p<0.05$). No statistically significant relationship was found between restorative applications, oro-antral fistula (OAF), periodontal bone loss (PBL), and maxillary sinusitis (MS) ($p<0.05$).

**Conclusion**: Odontogenic infections and inflammatory events are the causes of maxillary sinus pathologies and may play a role in their formation. CBCT, maxillary posterior teeth and maxillary sinüs in demonstrating the relationship between and in the diagnosis of odontogenous sinus pathlogies is quite useful.

**Keywords**: Cone beam computed tomography, maxillary sinus, mucosal thickening, periapical lesion, periodontal disease

## Öz

**Amaç**: Maksiller posterior dişlerin kök uçlarının maksiller sinüse yakınlığı, odontojen kaynaklı enfeksiyonun potansiyel bir maksiller sinüzit kaynağı haline gelmesine neden olmaktadır. Bu çalışmanın amacı, diş patolojileri ile maksiller sinüs anormallikleri arasındaki ilişkiyi konik ışınlı bilgisayarlı tomografi (KIBT) kullanarak değerlendirmektir.

**Gereç ve Yöntem**: Bu çalışmada kliniğimize herhangi bir nedenle başvuran 300 hastanın 600 adet maksiller sinüs konik ışınlı bilgisayarlı tomografi görüntüsü retrospektif olarak incelendi. Maksiller sinüs hastalıkları ve diş patolojileri kendi aralarında kategorize edilir.

**Bulgular**: Hastaların yaşları 18 ile 77 arasında değişmekte olup ortalama yaş 41,38 (±14,39) olarak tespit edildi. İncelenen maksiller sinüslerin 359'unda (%59,8) patoloji saptanmadı ve sağlıklı sinüs olarak değerlendirildi. Görüntüleme alanındaki maksiller sinüslerin 241'inde (%40,2) en sık görülen patoloji mukozal kalınlaşmaydı (MT). Periapikal lezyonlu dişler (PL) ile MT arasında istatistiksel olarak anlamlı bir ilişki tespit edildi ($p<0.05$). Restoratif uygulamalar, oro-antral fistül (OAF) ve periodontal kemik kaybı (PBL) ile maksiller sinüzit (MS) arasında istatistiksel olarak anlamlı ilişki saptanamadı ($p<0,05$).

**Sonuç**: Odontojenik enfeksiyonlar ve inflamatuar olaylar maksiller sinüs patolojilerinin oluşumunda rol oynayabilen nedenlerdir. KIBT, maksiller posterior dişler ve maksiller sinüs arasındaki ilişkinin gösterilmesinde ve odontojen sinüs patolojilerinin tanısında oldukça faydalıdır.

**Anahtar Kelimler**: Konik ışınlı bilgisayarlı tomografi, maksiller sinüs, mukozal kalınlaşma, periapikal lezyon, periodontal hastalık

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**Received *(Geliş Tarihi)*:** 17.02.2024 **Accepted *(Kabul Tarihi)*:** 18.03.2024

## INTRODUCTION

Due to the close anatomical relationship of the maxillary sinus floor and maxillary posterior teeth, odontogenic infections affect the sinus mucosa and pathological changes in the maxillary sinus may occur.[1] When the maxillary sinus mucosa is affected by pathogens, pathologies such as mucosal thickening in the sinus, mucus retention cyst, polyp, periostitis and sinusitis may occur.[2] Periapical lesion,[3-5] periodontal bone loss,[6-8] dental caries.[6] poorly performed restorative treatments,[9] endodontic treatment and materials used,[6-8] graft and implant applications[10,11] have been reported as iatrogenic and odontogenic factors that cause changes in the sinus mucosa.

The maxillary sinuses are defined as pneumatic (air-filled) spaces, and cystic, inflammatory, or neoplastic lesions may affect the sinuses.[12] As a result of paranasal sinus inflammation, nasal obstruction, congestion, facial pain, or pressure may occur. A decrease in the sense of smell may occur. Endoscopically, nasal polyps, mucopurulent discharge from the middle meatus, and mucosal obstruction may be observed.[13] Determining the relationship between odontogenic factors and sinus pathologies is essential to ensure the correct diagnosis and treatment planning of the patient. For this, adequate and high-sensitivity diagnostic methods should be preferred.[1]

Radiologically, panoramic and periapical radiographs are helpful in the evaluation of pseudocysts, the degree of pneumatization of the sinüs, and the relationship between the maxillary teeth and the sinus, and in the determination of foreign bodies, roots, or teeth in the sinus.[14] Water's projection provides an ideal visualization of the paranasal sinuses.[15] Magnetic resonance imaging (MRI) is extremely useful in distinguishing between fungal and bacterial infections in the sinonasal region. Bacterial and viral infections cause high signal intensity on T2-weighted[16] images, while fungal infections either cause no signal or show signal intensity similar to air Although computed tomography (CT) is considered the "gold standard" for the examination of the maxillary sinuses, its' use in dentistry has been limited due to the high cost, large footprint and high radiation emission of CT devices. Cone beam computed tomography (CBCT) has played an important role in dentistry, as it contains a lower radiation dose than CT and obtains images in a short time.[1,3,5]

This study aims to evaluate the frequency and localization of maxillary sinus pathologies and their relationship with odontogenic pathologies using CBCT imaging.

## MATERIAL AND METHOD

This study was reviewed by the Clinical Research Ethics Committee of Zonguldak Bülent Ecevit University and was decided to be ethically appropriate (2021/12). CBCT images of patients who applied to Zonguldak Bülent Ecevit University Faculty of Dentistry, Department of Oral and Dentomaxillofacial Radiology between 2019-2021 for various reasons were retrospectively analyzed. CBCT images of the patients were obtained by Veraviewepocs 3D R100 / F40 (J Morita Mfg. Corp., Kyoto, Japan) tomography device in our Department of Oral and Dentomaxillofacial Radiology using 90 kVp, 5 mA, and 0.125 mm3 voxel size in 8x10 cm FOV area. CBCT images were evaluated using i-Dixel 2.0 software (J. Morita Corporation, Osaka, Japan).

### Image Criteria

CBCT images of patients aged 18 years and older, in which both maxillary sinuses can be distinguished in the same patient. CBCT images of maxillary premolars and molars with any dental pathology were included in the study.

### Exclusion Criteria

Patients under the age of 18, patients with a history of trauma, cyst, or tumor formation in the area planned to be examined, and patients who had surgery in the relevant area for any reason were excluded from the study. Incorrect CBCT images that occurred due to device or patient-related reasons during the acquisition of the images were excluded from the study. CBCT images in which the areas planned to be studied and the entire maxillary sinus could not be observed completely were excluded from the study.

### Maxillary Sinus Pathologies and Evaluation Criteria

In the radiographic evaluation performed on 1 mm thickness coronal and 0.5 mm thickness axial sections, maxillary sinuses filled with air, in a radiolucent appearance and having clean borders were considered healthy.[17] The position of the teeth was adjusted using a digital protractor instrument so that the long axis of the tooth was parallel to the sagittal plane while measuring. Teeth and sinuses with multiple dental pathologies were not included in the study.

Pathologies in the maxillary sinus; were categorized into four groups; mucosal thickening (MT), maxillary sinusitis (MS), mucus retention cyst (MRC), and polyp. In order not to create a quantitative difference between the groups, the patients were divided into 5 groups according to their age: 18-29 years, 30-39 years, 40-49 years, 50-59 years, and 60 years and above.

Mucosal thickenings of 2 mm or more, well-defined at the base of the maxillary sinus, radiopaque as a strip along the sinus margin, were considered pathological.[18] To detect the presence of mucosal thickening, the distance of the line descended perpendicular to the floor of the maxillary sinus from the end of the mucosal thickening was measured using a digital ruler (**Figure 1**). Peripheral generalized thickening of the maxillary sinus mucosa, increased radiopacity in almost or all of the sinus, and radiolucent air bubbles within the air-fluid level were considered as maxillary sinusitis (**Figure 2**).[19] Mucus retention cysts were defined as low attenuation, well-circumscribed, radiopaque, and dome-shaped expansile soft tissue densities in the maxillary sinus of varying sizes (**Figure 3**).[20] Sometimes it is difficult to distinguish the radiographic appearance of a mucus retention cyst and an early mucocele. In the presence of bone erosion on CBCT, mucocele should be considered. Round and well-circumscribed masses with soft tissue density and accompanied by thickened adjacent sinus mucosa were defined as polyps (**Figure 4**).[21]

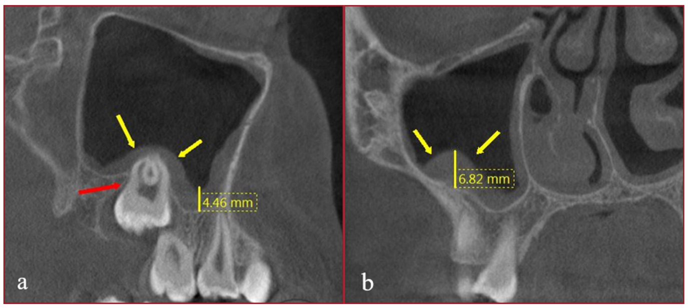


**Figure 1.** Mucosal thickening (MT) is indicated by the yellow arrow in sagittal (a) and coronal (b) sections. The red arrow (a) indicates the impacted tooth.

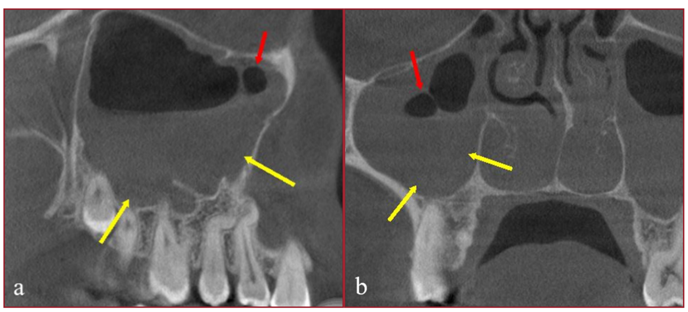


**Figure 2.** Maxillary sinusitis (MS) is shown in sagittal (a) and coronal (a) sections. The yellow arrow shows the liquid in the sinus and the red arrow shows the air bubbles (a,b).

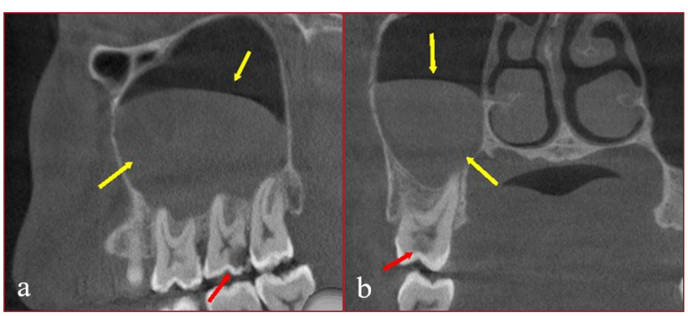


**Figure 3.** Mucus retention cyst (MRC) is shown with the yellow arrow on sagittal (a) and coronal (b) sections. The red arrow shows the caries in the related tooth (a,b).

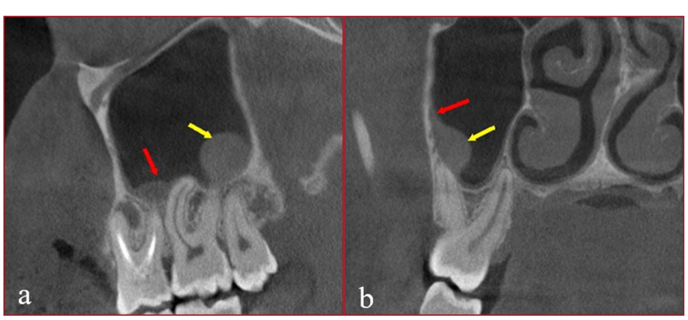


**Figure 4.** Polyp image in the maxillary sinus is shown with the yellow on sagittal (a) and coronal (b) sections. The red arrow indicates strip-shaped mucosal thickening (a,b).

### Radiographic evaluation of odontogenic factors

With the angulation tool in the sections, the position of each tooth, and the long axis of the tooth are adjusted to be parallel with the sagittal plane. All sections including the tooth of interest and the supporting tissues of the tooth were examined. Fixed prosthetic restorations may be observed on teeth due to metal artifact. It was excluded from the study because it may hinder the findings.

In this study, 9 different odontogenic factors were examined. These factors are; it include deep dentin caries (DDC), restorative treatment applications (RTA), root canal treatment (RCT), periodontal bone loss (PBL), periapical lesion (PL), radix, impacted teeth, oro-antral fistula (OAF) and dental implants.

### Statistical Analysis

The data obtained from the study were analyzed using the SPSS statistics software (version 20.0, Statistical Package for Social Sciences; IBM, Chicago IL, USA) program. All patient groups included in the study were recorded and data sets were created. Descriptive statistics were made on the data sets, and the distribution of gender and age, and the distribution of pathologies by age and gender were calculated. The relationship between gender, age, odontogenic pathologies, and maxillary sinus pathologies was calculated by applying the "chi-square (x2) test". While evaluating the data, continuous variables were expressed as mean standard deviation (±), and frequency data were expressed as numbers (%). In these tests, the statistical significance level was accepted as $p<0.05$. In the evaluation of maxillary sinus findings and dental pathologies, the Kappa test had an intra-observer agreement of 0.88 and an inter-observer agreement of 0.85. According to these values, the intra-observer and inter-observer agreement was determined to be close to perfect ($p<0.001$).

## RESULTS

In this study, 600 maxillary sinus and premolar and molar teeth with dental pathology in the related area were examined in CBCT images of 300 patients. Of the patients, 121 (40.3%) were male and 179 (59.7%) were female. The age of all patients ranged between 18 and 77 years, and the mean age was 41.38 (±14.39). The ages of the female patients ranged between 18 and 69, and the mean age was 39.09 (± 13.40) years. The ages of the males ranged from 18 to 77, with a mean age of 44.77 (± 14.36) years. A total of 933 teeth, 458 in the right upper jaw and 475 in the left upper jaw, associated with any dental pathology were evaluated in the CBCT images examined.

Of all the maxillary sinuses whose CBCT images were evaluated, 359 (59.8%) consisted of healthy sinuses. The most common pathology detected in the remaining 241 (40.2%) maxillary sinuses was MT. 48.5% (117) of all sinus pathologies were seen in men and 51.35% (124) in females. There was no statistically significant difference between sinus pathologies and genders in the study ($p>0.05$) (**Table 1**).

When the age groups of the patients were evaluated, the incidence of healthy sinuses (29.8%) was mostly between the ages of 18-29. Considering the sinus pathologies, the most common age group (24.9%) was between the ages of 40-49. However, when age groups and specific sinus pathologies were evaluated, no significant relationship could be detected (p>0.05). In the study, the most common pathology in all age groups was MT, while MS was most common in the 40-49 age group (**Table 1**).

While there was no statistically significant difference between right and left general maxillary sinus pathologies (p>0.05), 120 (49.8%) of the detected pathologies were in the right maxillary sinus and 121 (50.2%) were in the left maxillary sinus (**Table 1**).

When the relationship between odontogenic factors and maxillary sinus pathology is examined; A statistically significant relationship was found between the presence of DDC in teeth and polyps (p=0.035). A significant correlation was observed between MS (p=0.011) and sinus polyps (p=0.048) and the presence of RTA on teeth. A statistically significant relationship was determined between the presence of PBL and MS (p=0.003), while a statistically significant correlation was stated between teeth with PL and MT (p=0.046). No significant relationship was found between RCT application and any maxillary sinus pathology (p>0.05) (**Table 2**).

In this study, no statistically significant relationship was found between the presence of radix, dental implants, and impacted teeth and maxillary sinus pathologies (p>0.05) (**Table 3**). However, a strong correlation was determined between the presence of OAF and MS (p=0.000) and MT (p=0.005).

**Table 1. The relationship between gender, age groups, localization, and maxillary sinus pathologies.**

| Maxillary Sinus Abnormalities | | MT n (%) | p value | MS n (%) | p value | MRC n (%) | p value | Sinus Polyp n (%) | p value |
|---|---|---|---|---|---|---|---|---|---|
| Gender | Male | 81 (52.3%) | 0.282 | 23 (46.9%) | 0.750 | 8 (38.1%) | 0.362 | 5 (31,3%) | 0.797 |
| | Female | 74 (47.7%) | | 26 (53.1%) | | 13 (61.9%) | | 11 (68,7%) | |
| Age Groups | 18-29 years | 40 (25.8%) | 0.489 | 7 (14.3%) | 0.244 | 5 (23.8%) | 0.791 | 5 (31.3%) | 0.925 |
| | 30-39 years | 25 (16.1%) | | 11 (22.4%) | | 6 (28.6%) | | 3 (18.8%) | |
| | 40-49 years | 36 (23.2%) | | 17 (34.7%) | | 4 (19.0%) | | 3 (18.8%) | |
| | 50-59 years | 38 (24.5%) | | 10 (20.4%) | | 4 (19.0%) | | 4 (25.0%) | |
| | 60 years > | 16 (10.3%) | | 4 (8.2%) | | 2 (9.5%) | | 1 (6.3%) | |
| Localization | Right Maxillary Sinus | 73 (47.1%) | | 27 (55.1%) | | 12 (57.1%) | | 8 (50.0%) | |
| | Left Maxillary Sinus | 82 (52.9%) | | 22 (44.9%) | | 9 (42.9%) | | 8 (50.0%) | |
| | Localization p value | | | | | 0.833 | | | |

*MT: mucosal thickening MS: maxillary sinusitis MRC: mucus retention cyst

**Table 2. Relationship between odontogenic factors and maxillary sinus anomalies.**

| Odontogenic Factors | Tooth Type | MT n (%) | p value | MS n (%) | p value | MRC n (%) | p value | Sinus Polyp n (%) | p value |
|---|---|---|---|---|---|---|---|---|---|
| DDC | Premolar Teeth | 34 (24.3%) | 0.839 | 8 (5.7%) | 0.909 | 3 (2.1%) | 0.854 | 8 (5.7%) | 0.035 |
| | Molar Teeth | 55 (39.3%) | | 21 (15.0%) | | 6 (4.3%) | | 5 (3.6%) | |
| RTA | Premolar Teeth | 10 (19.2%) | 0.881 | 2 (3.9%) | 0.011 | 4 (7.7%) | 0.283 | - - | 0.048 |
| | Molar Teeth | 22 (42.3%) | | 8 (15.4%) | | 5 (9.6%) | | 1 (1.9%) | |
| RCT | Premolar Teeth | 22 (29.3%) | 0.443 | 13 (17.3%) | 0.388 | 4 (5.3%) | 1.000 | 1 (1.3%) | 0.181 |
| | Molar Teeth | 22 (29.3%) | | 6 (8.0%) | | 1 (1.3%) | | 6 (8.0%) | |
| PBL | Premolar Teeth | 18 (19.6%) | 0.906 | 9 (9.8%) | 0.003 | 1 (1.1%) | 0.642 | - - | 0.607 |
| | Molar Teeth | 39 (42.4%) | | 19 (20.6%) | | 3 (3.3%) | | 3 (3.3% | |
| PL | Premolar Teeth | 22 (44.0%) | 0.046 | 4 (8.0%) | 0.854 | 1 (2.0%) | 0.548 | - - | - |
| | Molar Teeth | 16 (32.0%) | | 4 (8.0%) | | 3 (6.0%) | | - - | |

*MT: mucosal thickening MS: maxillary sinusitis MRC: mucus retention cyst *DDC: deep dentin caries RTA: restorative treatment applications RCT: root canal treatment *PBL: periodontal bone loss PL: periapical lesions

**Table 3. Relationship between odontogenic factors and maxillary sinus anomalies.**

| Odontogenic Factors | Tooth Type | MK n (%) | p value | MS n (%) | p value | MRK n (%) | p value | Sinus Polyp n (%) | p value |
|---|---|---|---|---|---|---|---|---|---|
| Radix | Premolar Teeth | 13 (22.0%) | 0.887 | 6 (10.2%) | 0.743 | 4 (6.8%) | 0.284 | 1 (1.7%) | 0.763 |
| | Molar Teeth | 25 (42.4%) | | 7 (11.9%) | | 2 (3.4%) | | 1 (1.7%) | |
| OAF | Premolar Teeth | - - | 0.005 | - - | 0.000 | - - | 0.309 | - - | --- |
| | Molar Teeth | 1 (12.5%) | | 6 (75.0%) | | 1 (12.5%) | | - - | |
| Impacted Tooth | Premolar Teeth | - - | 0.321 | - - | 0.123 | - - | 0.572 | 1 (3.6%) | 0.198 |
| | Molar Teeth | 15 (53.6%) | | 6 (21.4%) | | 2 (7.1%) | | 4 (14.3%) | |
| Dental Implants | Premolar Teeth | 3 (23.1%) | 0.775 | 2 (15.4%) | 1.000 | - - | --- | - - | --- |
| | Molar Teeth | 6 (46.1%) | | 2 (15.4%) | | - - | | - - | |

*MT: mucosal thickening MS: maxillary sinusitis MRC: mucus retention cyst *OAF: oro-antral fistula

## DISCUSSION

Due to the anatomical proximity between the oral cavity and maxillary sinuses, different dental pathologies lead to disruption of the Schneiderian membrane integrity of the maxillary sinus and play a role in the formation of sinus diseases.[5,22] CBCT imaging provides the opportunity to accurately assess the relationship of the maxillary sinuses with adjacent anatomical structures and teeth. While obtaining high-resolution images with CBCT, these images are examined in different planes. CBCT imaging was used in this study due to its high accuracy and sensitivity compared to 2-dimensional radiographs for the detection of maxillary sinus changes. [1,3]

In this study, the relationship between age, gender, and maxillary sinus pathologies was evaluated and the findings were compared with the results of other studies in the literature. Raghav et al.[23] analyzed 402 CBCT images of 201 patients in their study in total, they detected maxillary sinus pathology in 87 (79%) of 110 male patients and 66 (72.5%) of 91 female patients. However, they reported that there was no significant relationship between gender and maxillary sinus pathologies. Ritter et al.[24] included 533 male and 493 female patients in their study. They detected sinus pathology in 326 (60.8%) of male and 253 (51.3%) of female. Ritter et al. reported that no significant relationship was found between gender and a specific maxillary sinus pathology.[24] CBCT images of 121 males and 179 females patients were used in our study. Of all sinus pathologies, 117 (48.5%) were detected in male and 124 (51.5%) in female. Similar to other studies, no significant relationship was stated between gender and maxillary sinus pathologies in this study. Vallo et al. reported that the more common maxillary sinus pathology in male may be because complications resulting from poor oral hygiene are more common in males.[8]

Ritter et al.[24] reported that pathologies are more common in patients aged ≥60 years and that there is a statistically significant relationship only between patients in this age group and maxillary sinus pathologies. Shanbhang et al. obtained similar results in their study and they obtained and reported that MT is seen twice as frequently in male and elderly patients.[5] Contrary to these results, Raghav et al. reported that maxillary sinus pathologies were mostly seen in the 20-29 age group and there was no significant relationship between age groups and sinus pathologies.[23] In our study, maxillary sinus pathologies were mostly seen in the 40-49 age group, but no statistically significant relationship was found between sinus pathologies and age groups.

Considering all sinus pathologies, no statistically significant relationship was found between the right and left maxillary sinuses. In our study, 121 of the sinus pathologies were localized in the left maxillary sinus, while 120 were located in the right maxillary sinus. According to the results of our study, MT (52.9%) was detected more in the left maxillary sinus. Vallo et al.[8] reported that pathologies were more common in the left maxillary sinus. On the other hand, Mahasneh et al.[4] reported that the incidence of MT was higher in the right maxillary sinus and determined that this difference might be the result of septum deviation affected by the presence of concha bullosa. When dental pathologies and other factors are taken into account, it has been reported by studies that an increase in MT may occur in the maxillary sinus. Brulmann et al.[25] reported a positive correlation between carious maxillary posterior teeth and MC. Sheikhi et al.[26] reported that there was an increase in the presence of MT with the presence of teeth with deep caries. As a matter of fact, in our study, no significant relationship was found between DDC and MT ($p>0.05$).

As a result of pulp necrosis, lysosomal enzymes, collagenase, and bacterial agents are released. From the relatively fine-pored maxillary bone, these infectious agents diffuse into the maxillary sinüs. Inflammatory changes in the maxillary sinus mucosa are thought to occur in this way.[15] Mahasneh et al.[4] reported that 54% of teeth with PL caused an increase in MT in the adjacent maxillary sinus, and this rate increased 2.52 times in the presence of PL. Lu et al.[3] reported that the amount of MK was significantly associated with the increase in the size of the periapical lesion and the number of teeth with the periapical lesion. In this study, 933 teeth were evaluated with CBCT, and 70 teeth were found to be associated with PL. Consistent with the results of other studies, a statistically significant relationship was determined between teeth with PL and MT in our study ($p<0.05$).

Phothikhun et al. argued that the thickening of the sinus mucosa is 3 times higher in areas where there is a violent PBL.[7] Similarly, Vallo et al.[8] they stated that furcation problems and periodontal problems caused by different bone losses are associated with MT. Nascimento et al. determined that generalized mucosal thickening was mostly associated with PBL.[1] Phothikhun et al.[7] reported that there was no relationship between root canal fillings and MT. Similarly, Nascimento et al.[1] determined that there was no statistically significant relationship between inadequate endodontic treatment and MT. However, in this study, it was observed that there was no significant relationship between the PBL, RCT, and the MT ($p>0.05$).

Other studies show that odontogenic causes account for 10-12% of MS cases. However, according to recent studies, the prevalence of odontogenic sinusitis reaches 40% with the increasing use of CBCT and CT.[27,28] In this study, the incidence of MS was determined to be 20.3% and the incidence was higher in females. Researchers have reported that many odontogenic conditions can cause MS, including periapical pathology, periodontal diseases, endodontic treatments, dental implants, tooth extraction, trauma, and surgical procedures.[27,28] Lee et al.[29] retrospectively evaluated 27 patients with odontogenic sinusitis, and determined the presence of complications due to dental implants in 10 patients and tooth extraction in 8 patients. Accordingly, they reported that dental implants and tooth extractions are the most common etiological factors associated with the development of odontogenic MS.[29] Jung et al.[10] placed 23 implants in 9 patients and evaluated sinus complications 6-10 months later and determined no signs of MS in any of the patients. However, they noted that 14 of 23 implants had MC in the sinuses in postoperative CT scans.[10] In this study, there were 13 dental implants included in the image scan and no significant relationship was stated between MS ($p>0.05$). In this study, 8 OAF was detected in 6 patients (75.0%). There are studies showing OAF as the most common cause of odontogenic MS among all dental etiologies. In addition, it should be considered that OAF especially leads to chronic MS cases.[30-32]

In this study, the prevalence of MRC was determined to be 8.7% among maxillary sinus diseases. Yeung et al.[33] reported the incidence of MRC as 20.5% in their studies. Nascimento et al.[1] stated that this rate could vary between 3.6% and 10.1% in CBCT studies involving the Brazilian population. Vallo et al.[8] reported that the incidence of MRC could vary between 5.2% and 14% in their studies using panoramic radiography. It can be thought that these differences in the incidence of MRC may be affected by the type of imaging (2-dimensional or 3-dimensional) or the size of the FOV field applied.

Considering the findings of this study, no significant relationship was found between MRC and any dental pathology or factor ($p>0.05$). Phothikhun et al. also obtained similar results and reported that there was no relationship between PBL, PL and root canal fillings and MRC.7 However, Curi et al.[34] revealed that in the presence of PL and endo-periodontal lesions, it increased 4.1 and 23.8 times in MRC cases. Recent studies have shown that the incidence of maxillary sinus polyp can vary between 6.5% and 19.4%.[29] Nunes et al.[35] evaluated the correlation between PL and sinus polyps and stated that polyps had the highest frequency (23%) after mucosal thickening in maxillary sinus abnormalities due to PL. In our study, the incidence of maxillary sinus polyp was found to be 6.6%. According to the results we obtained, a statistically significant relationship was found between teeth with DDC and RTA and maxillary sinus polyps ($p<0.05$).

## CONCLUSION

Many environmental and host factors cause inflammation in the paranasal sinuses. These factors include anatomical variations, odontogenic infections, allergens, and irritants such as smoking. The presence of odontogenic factors should be considered, especially in MS cases that do not improve as a result of conventional treatments.[1,13,29] The most common maxillary sinus pathology in this study was MT. The existence of a relationship between MT, PL and OAF was revealed as a result of the study. In addition, the existence of a relationship between MS and PBL, OAF, and RTA has been observed. Although a relationship was determined between maxillary sinus polyps and DDC and RTA in this study, no relationship was stated between MRC and dental pathologies. In addition, the relationship between dental implants, impacted teeth and the presence of radix and maxillary sinus pathologies was evaluated in this study.

## ETHICAL DECLARATIONS

**Ethics Committee Approval**: This study was reviewed by the Clinical Research Ethics Committee of Zonguldak Bülent Ecevit University and was decided to be ethically appropriate (2021/12).

**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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