Van Med J 32 (3):164 -169, 2025
DOI: 10.5505/vmj.2025.02419

Association Between Nasal Septal Deformity Types and Maxillary Sinus Retention Cysts

Volkan Güngör[1], Alptekin Tosun[2], Furkan Gündoğdu[1], Yonca Çoluk[1], Serhat Yaslıkaya[1], Devrim Bektaş[1]

[1]Giresun University, Faculty of Medicine, Department of Otorhinolaryngology Head and Neck Surgery, Giresun, Türkiye
[2]Health Sciences University, Faculty of Medicine, Department of Radiology, Trabzon, Türkiye

Abstract

Introduction: In this study, the relationship between maxillary sinus retention cysts (RCMs) and nasal septum deviation types was evaluated. In addition, their association with osteomeatal unit obstructions, conchal structural variations, and the presence of an accessory ostium were evaluated using paranasal sinus computed tomography (PNsCT).

Materials and Methods: A total of 439 patients were included in the study, 399 of whom underwent septoplasty, and 40 underwent rhinoplasty without nasal complains (control group). Paranasal CT scans were retrospectively analyzed for the presence of RCMs, osteomeatal complex obstruction, conchal pathologies, and accessory ostium. Statistical analyses included Fisher's exact test, Chi-square test, logistic regression analysis, and McNemar's test. P-values less than 0.05 were considered statistically significant.

Results: The frequency of RCMs was significantly higher in the septoplasty group (29.3%) compared to the control group (5.0%). A significant correlation was found between the type of septal deviation and RCMs formation, with in which the deviations at the level of the middle turbinate showing the highest frequency (49.1%). Additionally, a strong association was observed between osteomeatal complex obstruction and RCMs presence, as well as between the side of deviation and the side of the cyst. Females were significantly more likely to develop RCMs than males. No significant relationships were identified between retention cysts and accessory ostium or conchal pathology .

Conclusion: Septal deviation may be associated with RCMs formation. This relationship is especially evident in deformities close to the middle turbinate.

Key words: Nasal septum; tomography; maxillary sinüs; osteomeatal complex

Introduction

The paranasal sinuses are air-filled cavities lined with a thin mucous membrane that adheres to the periosteum. Retention cysts are not uncommon structures in the paranasal sinuses. Mucus retention cysts are common findings in radiographic examinations of the paranasal sinuses. Their prevalence in normal populations is estimated to be between 1.6% and 9.6%, based on studies using panoramic radiographs. (1, 2) Studies on the localization of retention cysts are inconsistent; while some publications indicate that mucosal cysts most commonly occur in the frontal and ethmoid sinuses, others report that they are most frequently observed in the maxillary sinus. (3, 4) In clinical studies examining maxillary sinus retention cysts, incidence rates have been observed to reach up to 27.6% in those using paranasal CT and 35.6% in studies utilizing magnetic resonance imaging. (5, 6) RCMs are the most frequent lesions of the maxillary sinus. (7, 8) They typically develop from the sinus floor and present as hemispherical soft tissue masses. (5) PNsCT has proven to be effective in distinguishing them from other maxillary sinus pathologies. Furthermore, PNsCT reliably detects additional concomitant paranasal pathologies and anatomical abnormalities. The septum provides structural support to the nose and is important for both the external shape and the regulation of nasal airflow. (9) During the developmental processes of the face, the nasal septum is continuously affected by the stresses exerted by the surrounding bony structures, which may result in deformities such as nasal septal deviation (NSD). (10) Although the reported incidence rates for NSD vary significantly depending on the diagnostic criteria, it is considered one of the most common nasal deformities (11) It has been suggested that NSD may be associated with pathologies involving the maxillary sinus, maxillary bone, and palatal bones. (12) The aim of this study is to evaluate the radiologic images of patients who underwent PNsCT and to investigate the relationship between retention cysts (RCMs) and nasal septal pathologies, as well as the pathologies and structural variations of the middle turbinate,

*Corresponding Author: Volkan Güngör Giresun Education and Research Hospital Mehmet Izmen Street No: 145 ENT clinic 2nd floor Aksu-Giresun Turkey. **Email:** vgungor@outlook.com **Orcid:** Volkan Güngör 0000-0003-1237-9751, Alptekin Tosun 0000-0003-1783-9171, Furkan Gündoğdu 0009-0006-0807-1462, Yonca Çoluk 0000-0002-5969-4321, Serhat Yaslıkaya 0000-0001-9298-7145, Devrim Bektaş 0000-0002-5951-7974

Received: 11.03.2025, Accepted: 10.06.2025

osteomeatal unit obstruction, and the accessory ostium of the maxillary sinus. Furthermore, this study is the first to clinically examine how various septal deformities influence the development of RCMs.

Materials and Methods

The study was approved by the Committee of Ethics (BAEK-154) of the Giresun Training and Research Hospital. Patients who were indicated for septal deviation and underwent surgery in our clinic between January 2023 and September 2024 were included in the study. In the scope of the study, previously taken PNsCT images of the paranasal region belonging to a total of 439 patients were evaluated. In this regard, 399 patients who underwent septoplasty were included as the study group. In addition, patients who had rhinoplasty without any septal pathology during the same period were screened and 40 patients were included in the study as the control group. Among the rhinoplasty patients, those who underwent the procedure solely for cosmetic purposes and did not exhibit septal pathology in their examination findings or CT images were selected. Patients with nasal polyposis, allergic rhinitis, nasal masses, revision septal surgeries, accompanying severe facial deformitie cases were excluded. RCMs, osteomeatal complex obstructions, and abnormalities of the middle turbinate (AMT) such as pneumatized middle turbinate, bifid middle turbinate were assessed separately on the right and left sides. Homogeneous, in spherical pattern, well-circumscribed lesions originating from the wall or floor of the maxillary sinus and larger than 5 mm in the sinus were considered RCMs. Lesions with bone destruction and concomitant tooth root-related pathologies such as dentigerous cysts were excluded from the evaluation. All patients were grouped according to the types of septal deviation using the Mladina (13) septal deformity classification system, based on operative notes and PNsCT images. Mladina's classification of nasal septal deviations comprises seven distinct types. Type 1 is characterized by a unilateral vertical septal deviation located in the anterior part of the nose, without extension to the nasal valve area and may create minor problems in nasal pathophysiology. In Type 2, in addition to the characteristics of Type 1, the deviation extends toward the valve area and impacts the width of the nasal valve. In Type 3, the nasal septum is characterized by a unilateral vertical ridge positioned deeper, opposite the middle turbinate. Type 4 describes S-like deformities consisting of type 3 on one side and type 2 on the opposite. Type 5 is defined a deviation from maxillary crest to one side (horizontal spur that extends laterally), while the opposite septal side remains flat. Type 6 is a big unilateral bone wing in intermaxillary area with a gap between it and the rest of the septum on that side. On the opposite side of the septal , there is an basal septal crest anteriorly. Type 7 represent a uncategorized deformities. We also noted the directions of the septal deformities (right or left).. In addition The presence of retention cysts, osteomeatal complex obstruction, conchal pathologies, and the accessory ostium was evaluated, including their laterality (right or left).

We used Fisher's Exact Test to analyze differences between the study and control groups in terms of the presence of RCMs, osteomeatal complex obstruction, conchal pathologies, and accessory ostium. Additionally, associations between the presence of RCMs and categorical anatomical findings (osteomeatal obstruction, accessory ostium, and conchal pathology) were evaluated using Fisher's Exact Test. For variables that showed statistically significant associations with RCMs, we subsequently examined whether the anatomical finding and the RCM occurred on the same side (right or left) within individuals. These laterality-based associations were analyzed using McNemar's Test, specifically assessing the concordance between the side of the septal deviation and the side of the RCM, as well as between the side of osteomeatal obstruction and the side of the RCM. We also performed a Chi-square test to examine the difference in RCM frequency among different septal deviation types. To further investigate the predictive value of deviation type on RCM development, a logistic regression analysis was conducted. In this model, the presence of RCM was the dependent variable, and deviation type was the independent variable.

Type 1 was used as the reference group, and no covariates were included in the model. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to assess statistical significance. Although multiple comparisons were conducted in the logistic regression analysis, no correction for multiple testing (e.g. Bonferroni adjustment) was applied due to the exploratory nature of the study and the limited sample sizes in some subgroups.

Statistical analysis: The statistical analysis was performed using R Program 4.3.1 (R Core Team, 2023) and the rrcov package (v1.7-5, Todorov, & Filzmoser 2009). All p-values under 0.05 were regarded as statistically significant.

Table 1: Retention cyst frequencies by cohorts with logistic regression results for septal deviation types

Deviation Type (n)	RCM Frequency Within Cohort (%)	p-value	Odds Ratio (OR)	%95 Confidence Interval (CI)
Total (439)	26.8%			
Control (40)	5.0%			
Septal deviation(399)	29.3%			
Type 1 (70)	14.2%	Reference	Reference	Reference
Type 2 (54)	29.6%	0.018	3.08	1.22 – 8.08
Type 3 (116)	49.1%	<0.001	6.19	2.94 – 14.11
Type 4 (16)	43.7%	0.612	1.27	0.51 – 3.25
Type 5 (79)	20.2%	0.22	1.73	0.73 – 4.27
Type 6 (40)	12.5%	0.71	0.81	0.24 – 2.48
Type 7 (24)	20.8%	0.48	1.53	0.43 – 4.93

Note:Logistic regression was performed for deviation types using Type 1 as the reference group.

Results

In the Control group (n = 40), the mean age was 27.6 ± 8.4 years. The group consisted of 8 males (20%) and 32 females (80%). In the Septoplasty group (n = 399), the mean age was 35.3 ± 11.8 years. This group included 286 males (71.7%) and 113 females (28.3%). A comparison between the control and study groups revealed statistically significant differences in the presence of retention cysts ($p < 0.001$, OR = 0.13, 95% CI: 0.015–0.513), conchal pathology ($p < 0.001$, OR = 0.067, 95% CI: 0.008–0.265), and osteomeatal obstruction ($p = 0.043$, OR = 0.25, 95% CI: 0.028–0.999). However, no statistically significant difference was found regarding the presence of accessory ostium ($p = 0.114$). In the Septoplasty group (n = 399), the distribution of deviation types was as follows: Type 1 (n = 70), Type 2 (n = 54), Type 3 (n = 116), Type 4 (n = 16), Type 5 (n = 79), Type 6 (n = 40), and Type 7 (n = 24). The frequency of retention cysts by deviation type was highest in Type 3 (49.1%), followed by Type 4 (43.7%) and Type 2 (29.6%). Lower rates were found in Type 1 (14.2%), Type 5 (20.2%), Type 6 (12.5%), and Type 7 (20.8%). A significant difference in retention cyst frequency among deviation types was observed (Chi-square test, $p < 0.001$). To determine in which deviation types this correlation was significant, a logistic regression analysis using deviation type 1 as the reference was performed. Group 1 was preferred because the incidence of RMs was considerably lower than the other groups, and the number of individuals was relatively high. The results showed the highest rate of retention cyst in Type 3, followed by Type 2, while no statistically significant differences were observed in the other deviation types. RMs distributions by groups are summarized in Table 1. The Fisher's Exact Test revealed a statistically significant relationship between the presence of osteomeatal obstruction and the presence of retention cyst ($p = 0.008$) This suggests that the presence of osteomeatal obstruction is associated with a higher likelihood of retention cyst development. No significant relationships were identified between retention cysts and accessory ostium ($p = 0.701$) or conchal pathology ($p = 0.183$). The McNemar test revealed statistically significant relationships between the side of septal deviation and the side of the retention cyst ($p < 0.001$), and between the side of osteomeatal obstruction and the side of the retention cyst ($p < 0.001$), indicating a strong tendency for these findings to occur on the same side. Additionally, when examining the likelihood of retention cyst development by gender, Fisher's Exact Test revealed a statistically significant association ($p = 0.006$), suggesting that females are nearly twice as likely as males to develop a retention cyst.

Discussion

This is the first study to specifically examine the relationship between different septal deformities and retention cysts in Literature. In our study group, we identified a high frequency of retention cysts. We also found a correlation between the type of the deviation and the formation of retention cysts, with certain deviation types-specifically, type 3 and type 1-showing significantly higher rates. Additionally, both

osteomeatal complex obstruction and female gender were positively correlated with the presence of retention cysts The true nature of PSMCs remains poorly defined. Although these cysts are generally accepted as an incidental finding in imaging studies of the paranasal sinuses, importantly large cysts may be symptomatic. The frequency of PSMCs has been reported in relatively few subjects, and there is no clear consistency across these studies. Although some studies have reported cyst incidence rates exceeding 30%, these findings generally come from patient populations selected from ENT clinics. In contrast, panoramic radiograph studies performed by dentists show rates as low as 2%. In MRI- and CT-based studies, the incidence rates tend to increase again, likely due to the higher accuracy of these imaging methods. (2, 6, 14-17) Our findings align with the existing literature: while the incidence of RCMs was determined to be 5% in the control group, this rate increased to 29% in the septal deviation group. Although the pathogenesis of RCMs remains unclear, the higher frequency in patients presenting with sinonasal complaints suggests a possible relationship.The underlying mechanism of PSMC formation is still not fully understood. It is believed that these cysts form when the duct of a seromucinous gland in the paranasal sinus becomes blocked by thickened mucus or is injured during an inflammatory episode, leading to ductal dilation and the formation of a cystic structure. (18) It has been proposed that cysts localized in the maxillary sinus may result from various etiological factors, including barotrauma, allergic rhinitis, allergic asthma, rhinosinusitis, dental diseases, and previous upper respiratory tract infections. (19, 20) However, some studies in the literature contradict this view; for instance, Bhattacharyya et al. found no evidence that any of the aforementioned etiological factors were linked to the formation of RCs in their study. (21) Some studies support that cysts above a certain size significantly delay mucociliary transport. (22) Given that reduced mucociliary transport capacity is an important risk factor for chronic rhinosinusitis (8), it can be argued that RCMs play a role in its etiology. (23) Despite this, contradictory findings exist in the literature regarding the relationship between osteomeatal complex obstruction—which is a significant sign of chronic rhinosinusitis—and the presence of retention cysts. (6, 8) This has been explained by suggesting that osteomeatal complex pathology has an initiating effect on cyst formation, and even if the obstruction in the osteomeatal complex resolves, the cyst formation persists as a chronic change. (14) In our study, osteomeatal complex obstruction was significantly more common in patients with septal deviation; however, it did not appear to influence the formation of RCs. NSD is a common septal disorder, a structure that plays a crucial role in nasal physiology. Paranasal sinus CT scans reveal that nasal septum deviation is present in about half of the population; however, only the more significant deviations tend to be symptomatic. (24) It is thought that NSD not only disrupts nasal airflow but also increases susceptibility to sinus diseases. (25) Although this issue remains controversial in the literature, theoretically, severe nasal deviations can lateralize the turbinates, narrow the middle meatus, and thereby blockages drainage pathways, impairs ciliary activity and ultimately leads to obstruction and secondary nasal infections in all sinuses by interfering with normal mucus drainage. (26, 27) Kapusuz Gencer et al. (28) found that on the septal deviation side the sinus volume was lower, suggesting that septal deviation had important role in the development of sinus pneumatization. Atsal et al. reported that maxillary sinus hypoplasia is generally seen on the deviation side, and its occurrence correlates with the degree of the deviation. (29) Arslan et al. found a significant correlation between the presence of septal deviation and the coexistence of retention cysts. However, the study did not examine the relationship between the direction of the deviation and the side on which the cysts were located. (6) Dağıstan et al. found that RCMs were significantly associated with NSD to the right (P=0.001), but not with NSD to the left . Furthermore, when the nasal septum was not deviated, the risk of developing RCMs was significantly lower. (15) It can be said that the findings of our study are generally parallel to those in the existing literature A correlation was observed between septal deviation and RCMs, and the deviation and cyst side matched each other. It can be suggested that disruptions in mucociliary flow or negative pressure caused by accelerated airflow on the deviated side may facilitate this. In addition, its higher frequency in Type 3 deviations may be attributed to the greater interaction of these deviations with the middle meatus.

Study limitations: First limitations of our study is the suboptimal sample size for evaluating all sub-deformity types. For example, while higher RMs rates were observed in the Type 4 group compared to Type 2, intergroup analysis did not reveal a statistically significant risk association . This is likely due to the limited sample size in the Type 4 group, which reduces statistical power and increases variability. The odds ratio (OR = 1.27,

95% CI: 0.51-3.25) suggests a potential increase in risk compared to the reference group; however, the wide confidence interval reflects high variability and uncertainty in the estimate. Furthermore, the lower boundary of the confidence interval falls below 1, indicating that the true effect may be negligible or even absent. The high p-value ($p = 0.612$) further supports the likelihood that this finding is due to random variation rather than a true association. However, despite this limitation, it seems possible to argue that the incidence of RMs increases as the deformity becomes more severe. Since our patient population seeking rhinoplasty is relatively younger and consists of female patients, the demographic difference between the control group (27.6 years, 80% female) and the study group (35.3 years, 28.3% female) can be considered a potential limitation of the study.When the literature is examined, conflicting results are seen in relation to age. (4, 30) Similarly, there is no consensus in the literature on gender. (3, 4) Furthermore, this study is the first to evaluate the association between septal deformity types and RCMs.

Conclusion

In our study, we observed that deviations at the level of the middle turbinate were significantly associated with RCMs formation, although they did not cause serious narrowing of the nasal valve. At this point, the presence of accompanying RMs may indicate a chronic physiological change in the maxillary sinus and its drainage mechanism and may be valuable in the decision-making process. At this point, it may be insightful to examine whether RMs regress in these patients after septoplasty or if chronic sinusitis symptoms develop in patients with RMs who are recommended septoplasty but choose not to undergo it.

Ethical consent: The study was approved by the Giresun Training and Research Hospital Ethics Committee (BAEK-154).

Conflict of interest: The authors report no conflicts of interest in this work.

Financial disclosure: The authors have declared that there is no financial support fort his study.

Data sharing statement: Data supporting these findings are available from the corresponding author upon request.

Authors' contribution: Concept (V.G., F.G., D.B ,S.Y), Design (V.G., A.T., S.Y,DB), Materials and Data (F.G), Analysis and Literature Review (V.G., , Y.Ç.), Writing and Revision (V.G., S.Y,YÇ, D.B).

References

1. Casamassimo PS, Lilly GE. Mucosal cysts of the maxillary sinus: a clinical and radiographic study. Oral Surg Oral Med Oral Pathol 1980;50(3):282-286.
2. Rodrigues C, Freire G, Silva L, Fonseca da Silveira M, Estrela C. Prevalence and risk factors of mucous retention cysts in a Brazilian population. Dentomaxillofac Radiol 2009;38(7):480-483.
3. Harar R, Chadha N, Rogers G. Are maxillary mucosal cysts a manifestation of inflammatory sinus disease? J Laryngol Otol 2007;121(8):751-754.
4. Moon IJ, Lee J-E, Kim S-T, Han DH, Rhee C-S, Lee CH, et al. Characteristics and risk factors of mucosal cysts in the paranasal sinuses. Rhinology 2011;49(3):309.
5. Hung K, Hui L, Yeung AWK, Wu Y, Hsung RTC, Bornstein MM. Volumetric analysis of mucous retention cysts in the maxillary sinus: A retrospective study using cone-beam computed tomography. Imaging Sci Dent 2021 Jan 29;51(2):117–127.
6. Arslan İB, Uluyol S, Demirhan E, Kozcu SH, Pekçevik Y, Çukurova İ. Paranasal sinus anatomic variations accompanying maxillary sinus retention cysts: a radiological analysis. Turk Arch Otorhinolaryngol 2017;55(4):162.
7. Anitua E, Alkhraisat MH, Torre A, Eguia A. Are mucous retention cysts and pseudocysts in the maxillary sinus a risk factor for dental implants? A systematic review. Med Oral Patol Oral Cir Bucal 2021 May 1;26(3):e276–e283.
8. Bhattacharyya N. Do maxillary sinus retention cysts reflect obstructive sinus phenomena? Arch Otolaryngol Head Neck Surg 2000;126(11):1369-1371.
9. Jongkhum N, Arayasantiparb R, Boonpratham S, Saengfai NN, Chaweewannakorn C, Satravaha Y, et al. Association between nasal septum deviation and transverse maxillary development: a retrospective cross-sectional study. Am J Orthod Dentofacial Orthop 2023;164(4):575-583.
10. Uzunçıbuk H, Marrapodi MM, Fiorillo L, Meto A, Cicciù M, Minervini G. The influence of orthopedic rapid maxillary expansion on the deviation of the nasal septum. J Clin Pediatr Dent 2024;48(1).
11. Lee H-J, Park JH, Seo HY, Choi S-K, Chang N-Y, Kang K-H, et al. A CBCT evaluation of nasal septal deviation and

related nasofacial structures after maxillary skeletal expansion. Appl Sci 2022;12(19):9949.
12. Savio S, Nagesh S. Association between nasal septum deviation and maxillary dimensions in an adult South Indian population: A retrospective observational cone-beam computed tomography study. Int Orthod 2025 Apr 15;23(3):101008.
13. Mladina R, Cujic E, Subaric M, Vukovic K. Nasal septal deformities in ear, nose, and throat patients: an international study. Am J Otolaryngol 2008;29(2):75-82.
14. Kanagalingam J, Bhatia K, Georgalas C, Fokkens W, Miszkiel K, Lund VJ. Maxillary mucosal cyst is not a manifestation of rhinosinusitis: results of a prospective three-dimensional CT study of ophthalmic patients. Laryngoscope 2009;119(1):8-12.
15. Dağıstan H, Cengiz C, Can İH. The relationship between maxillary sinus retention cysts and nasal septum. J Surg Med 2021;5(7):687-690.
16. Barka M, Donta C, Damaskos S, Chatzipetros E, Angelopoulos C. Evaluation of anatomical variants and pathological findings of the maxillary sinus prior to sinus floor elevation: A Cone Beam CT retrospective study in 660 patients. J Clin Exp Dent 2024;16(6):e740.
17. Dogan ME, Uluısık N, Yuvarlakbaş SD. Retrospective analysis of pathological changes in the maxillary sinus with CBCT. Sci Rep 2024;14(1):15529.
18. Kaffe I, Littner M, Moskona D. Mucosal-antral cysts: radiographic appearance and differential diagnosis. Clin Prev Dent 1988;10(1):3-6.
19. Rastegar H, Osmani F. Evaluation of mucous retention cyst prevalence on digital panoramic radiographs in the local population of Iran. Radiol Res Pract 2022 Aug 8;2022:8650027.
20. Ustabaş Kahraman F, Yazıcı M, Büyükpınarbaşılı N, Soylu N, İşcan A, Özkaya E. The association between paranasal mucous retention cysts and allergic sensitization. Asthma Allergy Immunol 2021;19(2):57–63.
21. Bhattacharyya T, Piccirillo J, Wippold FJ. Relationship between patient-based descriptions of sinusitis and paranasal sinus computed tomographic findings. Arch Otolaryngol Head Neck Surg 1997;123(11):1189-1192.
22. Behrbohm H, Sydow K. Nuclear medicine studies of the regenerative behavior of paranasal sinus mucosa after functional endoscopic ethmoid bone surgery. HNO 1991;39(5):173-176.
23. Albu S. Symptomatic maxillary sinus retention cysts: should they be removed? Laryngoscope 2010;120(9):1904-1909.
24. Koo SK, Kim JD, Moon JS, Jung SH, Lee SH. The incidence of concha bullosa, unusual anatomic variation and its relationship to nasal septal deviation: a retrospective radiologic study. Auris Nasus Larynx 2017;44(5):561-570.
25. Alghamdi FS, Albogami D, Alsurayhi AS, Alshibely AY, Alkaabi TH, Alqurashi LM, et al. Nasal Septal Deviation: A Comprehensive Narrative Review. Cureus 2022 Nov 10;14(11):e31317.
26. Subbotina MV, Kokhanov VS. The effect of various types of nasal septal deviation, concha bullosa and hypertrophic inferior turbinate on the development of sinusitis. Vestn Otorinolaringol 2021;86(3):78–83.
27. Kim TK, Jeong JY. Deviated nose: Physiological and pathological changes of the nasal cavity. Arch Plast Surg 2020 Nov 15;47(6):505–515.
28. Kapusuz Gencer Z, Özkırış M, Okur A, Karaçavuş S, Saydam L. The effect of nasal septal deviation on maxillary sinus volumes and development of maxillary sinusitis. Eur Arch Otorhinolaryngol 2013; 270(12):3069-3073.
29. Atsal G, Demir E, Yildirim O, Edizer DT, Olgun L. The relationship between degree of nasal septum deviation with sinonasal structures and variations. J Craniofac Surg 2022;33(5):e447-e449.