Is There a Relationship Between Tonsillolith Formation and Nasal Septal Deviation or Chronic Sinusitis, with or without Nasal Polyps?

Original Investigation

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Abstract

Objective: The aim of this study is to assess the prevalence of tonsilloliths and investigate the potential role of nasal septal deviation (NSD) and/or chronic rhinosinusitis (CRS), with or without nasal polyps, in their development.

Methods: A retrospective analysis was conducted on computed tomography (CT) images of 3,516 patients obtained between January 2017 and December 2020. The presence of tonsilloliths was recorded along with NSD and CRS, with or without nasal polyps. The effects of age, gender, NSD, and CRS (with or without nasal polyps) on tonsillolith formation were analyzed. All CT images were re-evaluated for tonsilloliths, CRS, NSD and other pathological findings. The relationships between tonsillolith presence and NSD and CRS were statistically analyzed.

Results: A significant difference in age was observed between individuals with and without tonsillolith ($p<0.001$). Additionally, the prevalence of tonsillolith was markedly higher in patients diagnosed with NSD compared to those without this condition ($p<0.001$). Similarly, patients diagnosed with CRS exhibited a significantly increased incidence of tonsillolith when compared to individuals without CRS ($p<0.001$).

Conclusion: The incidence of tonsilloliths in this study was 27.6%. Tonsillolith prevalence increased with age, while no significant difference was observed based on gender. The presence of NSD, a condition associated with nasal obstruction, or CRS, an inflammatory disorder, was linked to a higher incidence of tonsilloliths.

Keywords: Tonsillolith, nasal polyps, rhinosinusitis, nasal septum, tomography

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Introduction

Tonsilloliths (TLs) are white- or yellow-calcified concretions within the palatine tonsils (1). They are composed of phosphate and/or carbonate salts along with calcium and a protein matrix. Although TLs are thought to form as a result of recurrent tonsillitis, the exact mechanism remains unclear (2). Several studies in the literature suggest a relationship between TL formation and inflammatory conditions such as tonsillitis and periodontal diseases (2,3).

If an association exists between inflammation and TLs, it is reasonable to consider the potential impact of other upper respiratory tract inflammatory conditions, such as sinusitis. However, the roles of sinonasal inflammatory diseases and nasal obstruction in the etiology of TLs have not been investigated. This study aims to explore the possible role of chronic rhinosinusitis with/without nasal polyps (CRS and CRSwNP), in TL formation. Additionally, we sought to evaluate the potential influence of nasal obstruction, specifically nasal septal deviation (NSD), on TL development.

Methods

Study Design

Computed tomography (CT) images of 3,516 patients obtained between January 2017 and December 2020 were analyzed and 3,259 images met the inclusion criteria for this study. The study was conducted at Süleyman Demirel University Research and Training Hospital and was approved by the Ethical Committee for Clinical Studies of Süleyman Demirel University (date: 12.02.2021, number: 75). Additional informed consent was not required, as patients had already been informed that their radiographic imaging data could be used for future research purposes.

CT scans were conducted using a 128-slice CT scanner (Somatom Definition; Siemens Healthcare, Forchheim, Germany), generating approximately 120-180 images per study. Imaging parameters included a tube voltage of 80 kVp, a tube current of 120 mA, a slice thickness and reconstruction interval of 1 mm, a pitch factor of 1, a matrix size of 512×512, and a field of view of 14cm×17cm. Window settings were defined as a width of 2000 Hounsfield unit (HU) and a level of 400 HU. Coronal and sagittal plane images were reconstructed using a dedicated workstation.

The indications for CT evaluation included suspected rhinologic headache, chronic and/or acute sinusitis with or without complications, nasal polyposis, sinonasal neoplasia, and preoperative assessment for rhinoplasty and/or nasal reconstruction. However, patients with a history of multiple CT scans, maxillofacial trauma, sinonasal neoplasia, prior sinonasal surgery, congenital anomalies, significant anatomic variations obstructing the nasal passages (e.g., large concha bullosa) or previous adeno/tonsillar surgery were excluded from the study.

After reviewing each patient's medical records, paranasal sinus CT data were independently assessed by an otolaryngologist and a radiologist in a blinded manner. The results were compared, and discrepancies were resolved through joint re-evaluation before finalizing the findings. The presence and laterality of NSD, the presence and laterality of chronic sinusitis, and the presence and laterality of nasal polyps were systematically recorded. Additionally, the presence and the number of TLs were documented. Following CT scan evaluation, findings were cross-checked with endoscopic nasal examination reports from patients' medical records. The relationship between TLs and the presence and laterality of NSD and CRS was then analyzed (Figures 1,2).

Statistical Analysis

Statistical analyses were done using SPSS version 24.0 (IBM Corp. IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY). Categorical variables were summarized as frequencies and percentages, while continuous variables

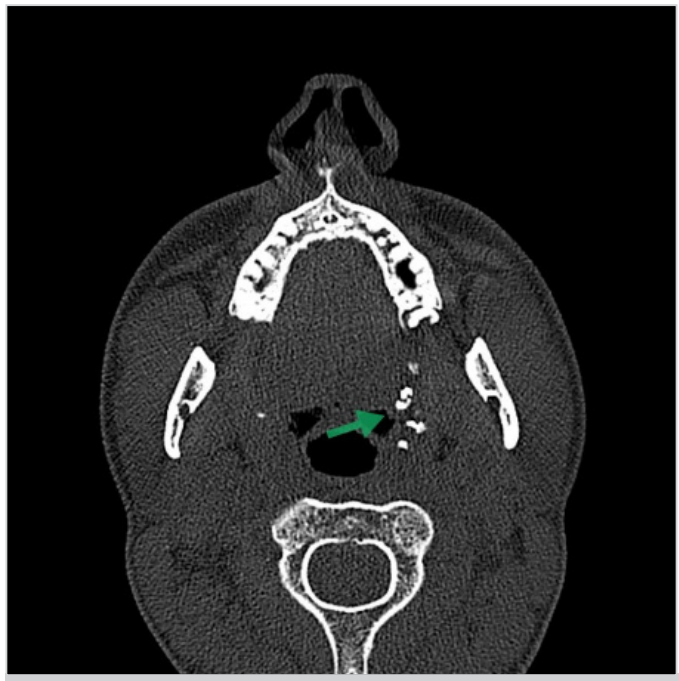

Figure 1. Axial CT image of multiple TLs in the left palatine tonsil (axial)
CT: Computed tomography, TLs: Tonsillolithiasis

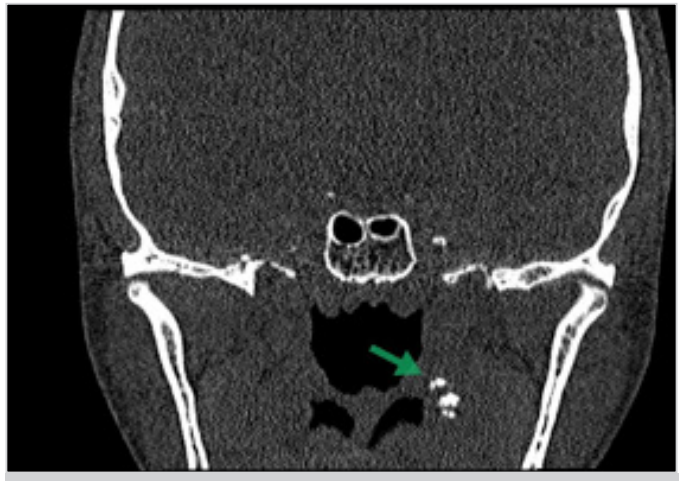

Figure 2. CT image of multiple TLs in the left palatine tonsil (coronal)
CT: Computed tomography, TLs: Tonsillolithiasis

were expressed as mean±standard deviation, along with their minimum and maximum values. The independent samples t-test was employed to assess differences in continuous variables, whereas the chi-square test was used for categorical data. To investigate the effect of nasal pathologies on the presence of TLs, logistic regression analysis was done within a multivariate logistic model. Results were reported as odds ratios (ORs) with 95% confidence intervals (CIs), and a p-value <0.05 was considered statistically significant.

Results

This study included paranasal sinus CT scans from 3,259 patients, namely, 1,411 females (43.3%) and 1,848 males (56.7%). The mean age of the patients was 38.85±15.84 years (range=18-91). Patients with TL had a mean age of 42.39±16.03 years, while those without TL had a mean age of 37.50±15.56 years. A statistically significant difference in age was observed between patients with and without TL (p<0.001); however, no significant difference was found in terms of gender (p=0.177). TL was absent in 2,358 patients (72.4%), while it was present on the right side in 312 patients (9.6%), on the left side in 301 patients (9.2%), and bilaterally in 288 patients (8.8%). In total, 901 patients (27.6%) presented with TL. Table 1 summarizes the relationship between TL and variables such as age and gender. The average number of TLs per patient was 2.63±2.18 (range=1-18).

The distribution of NSD among patients was as follows: 1,131 patients (34.7%) had no NSD, 896 patients (27.5%) had right-sided NSD, 845 patients (25.9%) had left-sided NSD, and 387 patients (11.9%) had bilateral NSD. In total, 2,128 patients (65.3%) had NSD. While 617 (29%) of 2,128 patients with NSD had TL, 284 (25.1%) of 1,131 patients without NSD had TL. The incidence of TL was significantly higher in patients with NSD than in those without (p<0.001). The presence of TL was 1.3 times more common in patients with NSD than in those without NSD (OR=1.302, p=0.002, 95% CI=1.102-1.538). Additionally, in patients with NSD, the side of deviation tended to correspond with the side of TL (Tables 2,3).

Of the total patients, 2,278 (69.9%) did not have CRS, 136 (4.2%) had right-sided CRS, 173 (5.3%) had left-sided CRS, and 672 (20.6%) had bilateral CRS. In total, 981 patients (30.1%) had CRS. While 342 (34.9%) of 981 patients with CRS had TL, 559 (24.5%) of 2278 patients without CRS had TL. The incidence of TL was significantly higher in patients with CRS than in those without (p<0.001). The presence of TL was 1.58 times more common in patients with CRS than in those without CRS (OR=1.588, p<0.001, 95% CI=1.333-1.892). Furthermore, in patients with CRS, the side of CRS tended to correspond with the side of TL (Tables 2,3).

While 90 (38.5%) of 234 patients with CRSwNP had TL, 811 (%26.8) of 3,025 patients without CRSwNP had TL. The incidence of TL was significantly higher in patients with CRSwNP than in those without (p<0.001). The incidence of TL was 1.35 times more common in patients with CRSwNP than in non-CRSwNP patients (OR=1.588, p<0.001, %95 CI=1.333-1.892). In patients with CRSwNP, the side with CRSwNP tended to be the same as the side with TL (Tables 2,3).

Discussion

TLs are calcifications, either single or multiple, within the palatine tonsils. Although they are typically asymptomatic, they can sometimes cause significant symptoms, occasionally necessitating tonsillectomy. TLs are known to be composed of phosphate and/or carbonated salts of calcium and a protein matrix. Potential symptoms associated with TLs include halitosis, cough, and throat discomfort. The incidence of TL has been reported in a wide range in the literature, varying from 0.43% to 30.3% across different studies (2,4-7). These discrepancies may be attributed to differences in evaluation

Table 1. The relationship of TL with age and gender

	TL (-) (n=2358)	TL (+) (n=901)	p-value
Female (n=1411)	1038 (73.6%)	373 (26.4%)	0.177
Male (n=1848)	1320 (71.4%)	528 (28.6%)	
Age	37.50±15.56	42.39±16.03	<0.001*

*Statistically significant, TL: Tonsillolith

Table 2. The relationship between TL and NSD/paranasal sinus pathologies

	TL (-)	TL (+)	p-value	OR (95% CI)	p-value
Nasal septal deviation (R)					
(-): (n=1131)	847 (74.9%)	284 (25.1%)	0.018*	1.302	0.002*
(+): (n=2128)	1511 (71%)	617 (29%)		1.102-1.538	
CRS with/without nasal polyps (R)					
(-): (n=2278)	1719 (75.5%)	559 (24.5%)	0.001*	1.588	<0.001*
(+): (n=981)	639 (65.1%)	342 (34.9%)		1.333-1.892	
CRS with nasal polyps (R)					
(-): (n=3025)	2214 (73.2%)	811 (26.8%)	0.001*	1.351	0.048*
(+): (n=234)	144 (61.5%)	90 (38.5%)		1.003-1.820	

The aspect of TL and nasal pathology tend to be on the same side

*Statistically significant, R: reference variable, NSD: Nasal septal deviation, OR: Odds ratio, CRS: Chronic rhinosinusitis, TL: Tonsillolith, CI: Confidence interval

Table 3. The directional relationship between TL and nasal pathologies

Nasal septal deviation	TL absent	TL right	TL left	TL bilateral	p-value
NSD (-) (n=1131)	847 (74.9%)	96 (8.5%)	81 (7.2%)	107 (9.5%)	
Right sided (+) (n=896)	662 (73.9%)	116 (12.9%)	64 (7.1%)	54 (6%)	
Left sided (+) (n=845)	602 (71.2%)	64 (7.6%)	118 (14%)	61 (7.2%)	<0.001*
Bilateral (+) (n=387)	247 (63.8%)	36 (9.3%)	38 (9.8%)	66 (17.1%)	
CRS with/without nasal polyps					
CRS (-) (n=2278)	1719 (75.5%)	201 (8.8%)	193 (8.5%)	165 (7.2%)	
Right sided (+) (n=136)	86 (63.2%)	33 (24.3%)	7 (5.1%)	10 (7.4%)	
Left sided (+) (n=173)	112 (64.7%)	10 (5.8%)	33 (19.1%)	18 (10.4%)	<0.001*
Bilateral (+) (n=672)	441 (65.6%)	68 (10.1%)	68 (10.1%)	95 (14.1%)	
CRS with nasal polyps					
CRSwNP (-) (n=3025)	2214 (73.2%)	289 (9.6%)	269 (8.9%)	253 (8.4%)	
Right sided (+) (n=12)	6 (50%)	5 (41.7%)	0 (0%)	1 (8.3%)	
Left sided (+) (n=11)	8 (72.7%)	0 (0%)	3 (27.3%)	0 (0%)	<0.001*
Bilateral (+) (n=211)	130 (61.6%)	18 (8.5%)	29 (13.7%)	34 (16.1%)	

Italic characters indicate the direction in which the presence of TL is highest, according to the direction of nasal pathology

*Statistically significant, TL: Tonsillolith, NSD: Nasal septal deviation, CRS: Chronic rhinosinusitis, CRSwNP: Chronic rhinosinusitis with/without nasal polyps

techniques (e.g., slice thickness in imaging), racial variations, and even dietary habits. The case numbers, inclusion and exclusion criteria of the studies can also be a reason for these differences. In our study, the incidence of TL was 27.6%. This value is within the range given in the literature and our study is also one of the largest series. TLs are a multifactorial condition that has gained increasing public attention, even on social media platforms (7).

Several studies in the literature have investigated the association between TLs and various factors. One such factor is patient age. There are contradictory results in the literature about the effect of patients' age. While Fauroux et al. (8) reported no significant association, Aragoneses et al. (9) found a higher prevalence of TLs in younger individuals, whereas Oda et al. (3) observed a greater incidence in older patients.

In our study, the mean age of participants was 38.85±15.84 years (range=18-91). Patients with TLs had a mean age of 42.39±16.03 years, whereas those without TLs had a mean age of 37.50±15.56 years. This age difference was statistically significant (p<0.001), indicating that TLs are more prevalent in older individuals.

Regarding the relationship between TL prevalence and gender, conflicting results exist in the literature. While some studies suggest that TLs are more common in women, others report a higher incidence in men (6,9,10). Additionally, several studies have found no significant gender-based difference in TL prevalence (3,8,11). In our study, 26.4% of female and 28.6% of male patients had TLs (p=0.177).

Aragoneses et al. (9) also studied racial differences in TL prevalence and reported that TLs were less common in Black individuals compared to Caucasian and Asian populations. However, our study did not assess racial differences.

It is known that TLs are formed by phosphate and/or carbonated salts of calcium and a protein matrix. While they are believed to result from recurrent tonsillitis, the exact mechanism of their formation remains unclear (2). TLs are also considered to be associated with chronic cryptic tonsillitis (12). Additionally, there is evidence suggesting a relationship between TLs and periodontal disease (3). If inflammation plays a role in the formation of TLs, it is plausible that other upper respiratory tract inflammations, such as sinusitis, could contribute to their development.

Among the 981 patients with CRS, 342 (34.9%) had TLs, compared to 559 (24.5%) of the 2,278 patients without CRS (p<0.001). In patients with CRS, the side affected by CRS was often the same side as the TL. Furthermore, TLs were found to be 1.35 times more common in patients with CRSwNP compared to those without CRSwNP, with a similar tendency for TLs to occur on the same side as CRSwNP. These findings suggest a potential relationship between chronic inflammatory diseases of the upper respiratory tract and TL formation. However, prospective clinical studies are needed to confirm these results with greater certainty. To our knowledge, there is no existing study directly comparing nasal obstruction (NSD) with TL formation.

In our study, the presence of TLs was 1.3 times more common in patients with NSD than in those without NSD. Moreover, in patients with NSD, the side of deviation often corresponded to the same side with TL. Prospective controlled clinical studies are necessary to validate these findings and strengthen the evidence supporting this relationship.

Our study has some limitations. Since this was not a prospective study and records of patient complaints regarding TLs were not consistently maintained, a clear comparison between complaints and findings could not be made. Since TLs tend to fall through the crypts from time to time, the records of cases with single TL in such studies appear to have limited data. The lack of rhinomanometry and/or acoustic rhinometry results, which provide objective

data about nasal obstruction, limits the effects of NSD on TL formation. Another limitation of our study is the absence of smoking, oral hygiene, and dietary habits in the inclusion and exclusion criteria.

Conclusion

This study represents one of the largest series studying TLs. The incidence of TL in this study was 27.6%, indicating that it is not a rare condition among adults. The incidence of TL was found to be higher with increasing age. The incidence of TL increases under conditions that cause nasal obstruction such as NSD and under inflammatory conditions such as CRS and/or nasal polyps. In addition, the incidence of TL increases on the side where there is a nasal obstruction or nasal inflammatory condition. In terms of cause-and-effect relationship, the development of TL with inflammatory conditions and nasal obstruction controlled prospective studies are needed.

Ethics

Ethics Committee Approval: The study was conducted at Süleyman Demirel University Research and Training Hospital and was approved by the Ethical Committee for Clinical Studies of Süleyman Demirel University (date: 12.02.2021, number: 75).

Informed Consent: Additional informed consent was not required, as patients had already been informed that their radiographic imaging data could be used for future research purposes.

Footnotes

Authorship Contributions

Surgical and Medical Practices: H.Y., M.E.S., Y.Ç,K,, B,B,, M,K., Concept:H.Y., M.E.S., Y.Ç,K,, B,B,, M,K., Design: H.Y., M.E.S., Y.Ç,K,, B,B,, M,K., Data Collection and/or Processing: H.Y., M.E.S., Y.Ç,K,, B,B,, M,K., Analysis and/or Interpretation:H.Y., M.E.S., Y.Ç,K,, B,B,, M,K., Literature Search: H.Y., M.E.S., Y.Ç,K,, B,B,, M,K., Writing: H.Y., M.E.S., Y.Ç,K,, B,B,, M,K.

Conflict of Interest: There is no conflict of interest to disclose.

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Main Points

- The incidence of TL in this study was 27.6%.
- TL was more common in patients with increased age.
- TL incidence increased in conditions causing nasal obstruction, such as nasal septal deviation, as well as in inflammatory conditions like chronic rhinosinusitis and/or nasal polyps.

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