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Headache Patterns in Patients with Deviated Nasal Septum-Correlation with Nasal Obstruction: A Cross-sectional observational study

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Abstract: ***Background***: Headache is a frequent presenting symptom among patients with deviated nasal septum (DNS), yet its association with nasal obstruction remains underrecognized. DNS is a prevalent anatomical condition linked to altered airflow dynamics, mucosal inflammation, and sinus pressure changes, all of which may contribute to characteristic headache patterns. ***Objective***: To evaluate the prevalence and patterns of headache in patients with DNS and to determine their correlation with the severity of nasal obstruction. ***Methods***: A cross-sectional observational study was conducted at a Tertiary Hospital, Al-Ahsa, Saudi Arabia, from January 2023 to December 2024. A total of 385 patients aged 18-65 years with clinically and radiologically confirmed DNS were included. Headache characteristics (type, location, severity, frequency) were recorded using a structured validated questionnaire, and nasal obstruction severity was assessed using nasal endoscopy, CT imaging, and the NOSE score. Statistical analysis included Pearson correlation and Chi-square testing. ***Results***: Among 385 DNS patients, 71.4% reported headaches. Frontal (48.6%) and periorbital (22.1%) headaches were the most common patterns. Headache severity (mean VAS 6.3 ± 1.9) showed a strong positive correlation with nasal obstruction severity (NOSE score: $r = 0.63$; $p < 0.001$). Higher DNS deviation grades demonstrated a significantly increased prevalence of headache (Grade I: 41.3%, Grade II: 66.9%, Grade III: 82.7%, Grade IV: 90.1%; $p < 0.001$). ***Conclusion***: Headaches are highly prevalent among patients with DNS and show a significant correlation with nasal obstruction severity. Frontal and periorbital headache patterns predominate. These findings underscore the importance of assessing nasal anatomy in patients with chronic or recurrent headaches and support the potential therapeutic role of septoplasty in selected cases.

Keywords: Deviated nasal septum, headache, nasal obstruction, mucosal contact point, septoplasty, rhinogenic headache
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INTRODUCTION

Headache is one of the most prevalent and disabling symptoms encountered in clinical practice, representing a major cause of outpatient consultations in otolaryngology, neurology, and general medicine. It is estimated that nearly half of the adult population worldwide experiences at least one significant headache episode annually, with a substantial proportion developing chronic or recurrent symptoms that adversely affect quality of life and productivity [1]. The diagnostic evaluation of headache is often complex due to its multifactorial etiology and the considerable clinical overlap between primary headache disorders and secondary causes arising from structural, inflammatory, or functional abnormalities of the head and neck region [2]. Among the less frequently recognized but clinically relevant contributors to secondary headache is deviated nasal septum (DNS), a common anatomical variation of the nasal cavity.

Deviated nasal septum is a highly prevalent condition, with reported incidence ranging from 20% to 79% depending on diagnostic criteria, age group, ethnic background, and method of assessment [1,3]. DNS may be congenital or acquired and can result from birth trauma, facial injuries, or asymmetric craniofacial growth during development. While mild

deviations are often asymptomatic, moderate to severe deviations can significantly disrupt nasal airflow, impair mucociliary clearance, and alter sinonasal physiology [4]. Clinically, DNS is well recognized as a major cause of nasal obstruction, chronic nasal congestion, mucosal dryness, crusting, epistaxis, snoring, sleep-disordered breathing, and recurrent or chronic rhinosinusitis [2,5]. Increasing evidence suggests that headache is an underappreciated but important manifestation of DNS, particularly in patients with significant obstruction or mucosal contact points.

The pathophysiological relationship between DNS and headache is multifactorial and incompletely understood. Septal deviation alters normal laminar airflow within the nasal cavity, resulting in increased turbulence, uneven air distribution, and localized areas of mucosal dehydration and irritation [6]. These changes may compromise mucociliary function, leading to mucus stasis, secondary inflammation, and impaired sinus ventilation [7]. Chronic inflammation of the nasal mucosa and adjacent paranasal sinuses has been implicated in the generation of pressure-type and facial headaches, particularly in the frontal and periorbital regions [8]. Furthermore, prolonged nasal obstruction may influence autonomic nervous system balance and regional oxygenation, potentially contributing to headache chronification [9].

One of the most widely accepted mechanisms linking DNS to headache is the "mucosal contact point" theory. This theory proposes that headache arises when a deviated septum, septal spur, or crest comes into persistent or intermittent contact with adjacent structures such as the inferior or middle turbinate, lateral nasal wall, or nasal floor [10]. Such contact stimulates nociceptive endings of the trigeminal nerve, particularly branches of the ophthalmic and maxillary divisions, leading to localized pain or referred headache patterns [11]. Experimental and clinical studies have demonstrated that mechanical stimulation of nasal mucosa can activate trigeminovascular pathways and induce headache-like symptoms, supporting this neurogenic mechanism [12,13]. Importantly, several surgical studies have shown significant headache relief following elimination of mucosal contact points through septoplasty or turbinate reduction, reinforcing the causal role of this mechanism [6,14].

Headaches associated with sinonasal pathology often present with clinical features that closely resemble primary headache disorders, making accurate diagnosis challenging. DNS-related headaches are commonly described as dull, pressing, or pressure-like in character and are frequently localized to the frontal, periorbital, temporal, or facial regions [7,15]. These headaches may worsen with nasal congestion, upper respiratory tract infections, changes in weather or barometric pressure, exposure to allergens, or prolonged nasal blockage [8,16]. Such symptom patterns overlap substantially with tension-type headache and migraine, leading to frequent misdiagnosis. Notably, studies have shown that a large proportion of patients self-diagnosing "sinus headache" actually meet diagnostic criteria for migraine, resulting in inappropriate treatment strategies [9,17].

Despite this overlap, DNS-related headaches possess certain distinguishing features that can aid clinical differentiation. These include reproducible localization corresponding to anatomical contact points, exacerbation with nasal obstruction, improvement following topical nasal decongestion, and response to surgical correction [10,18]. Recognizing these features is essential, as misclassification of secondary headaches as primary disorders may delay appropriate intervention and expose patients to unnecessary long-term pharmacotherapy.

Understanding the relationship between nasal obstruction severity and headache characteristics is particularly important because DNS represents a potentially correctable anatomical abnormality. The severity of nasal obstruction can be objectively and subjectively assessed using tools such as nasal endoscopy, computed tomography (CT) imaging, and the Nasal Obstruction Symptom Evaluation (NOSE) score [10]. The NOSE scale is a validated, patient-reported outcome measure that quantifies the functional impact of nasal obstruction and has been widely used in both clinical practice and research [19]. Prior studies have demonstrated a strong association between higher NOSE scores, reduced quality of life, and increased symptom burden, including headache and facial pain [7,20].

Surgical intervention, particularly septoplasty, has been shown to provide significant symptomatic relief in appropriately selected patients with DNS-associated headaches. Multiple studies have reported reductions in headache frequency, intensity, and analgesic dependence following septal correction, especially in patients with clear mucosal contact points and moderate to severe deviation [11,14,18]. However, outcomes are variable, and not all patients experience benefit, underscoring the importance of careful patient selection and thorough preoperative evaluation. Identifying specific headache patterns and correlating them with anatomical severity may improve prognostication and guide treatment decisions.

Environmental and regional factors may further influence the clinical expression of DNS-related symptoms. In Middle Eastern countries, including Saudi Arabia, high exposure to dust, sandstorms,

allergens, and an arid climate has been associated with increased prevalence and severity of sinonasal disease [12,21]. Allergic rhinitis is highly prevalent in this region and may exacerbate mucosal inflammation and sensitivity in patients with underlying structural abnormalities [22]. These factors may amplify headache severity and frequency in DNS patients, yet remain underexplored in regional literature.

Despite growing recognition of the association between DNS and headache, several gaps persist in existing research. Many studies focus primarily on postoperative outcomes without adequately characterizing preoperative headache patterns or correlating them with objective measures of nasal obstruction. Additionally, there is limited data from Middle Eastern populations, where environmental exposures and disease patterns may differ from Western cohorts. A comprehensive evaluation of headache prevalence, patterns, and severity in relation to anatomical deviation and functional obstruction is therefore warranted.

In this context, the present study aims to systematically evaluate headache patterns in patients with deviated nasal septum and to determine their correlation with the severity of nasal obstruction using clinical examination, radiological grading, and validated symptom scoring tools. By elucidating these relationships, this study seeks to enhance diagnostic accuracy, promote appropriate multidisciplinary evaluation, and support evidence-based management strategies for patients presenting with chronic or recurrent headaches associated with nasal obstruction.

MATERIALS AND METHODS

Study Design and Setting

A cross-sectional observational study was conducted at a Tertiary Hospital, Al-Ahsa, Saudi Arabia.

Study Duration

January 2023 to December 2024.

Sample Size

385 patients diagnosed with DNS.

Inclusion Criteria

- Patients aged 18-65 years
- Clinically and radiologically confirmed deviated nasal septum
- Implied Consent

Exclusion Criteria

- Patients who were diagnosed with migraine or other neurological disorders.
- Previous diagnosis with other Sino-nasal disease.
- Prior Sino-Nasal Surgery.
- Previous History of Cranio-Facial Trauma.

Data Collection

Patients underwent:

- Detailed ENT examination
- Nasal endoscopy
- NOSE (Nasal Obstruction Symptom Evaluation) scoring
- CT paranasal sinuses for deviation grading (when indicated)

Headache characteristics evaluated included:

- Type: pressure-type, throbbing, dull ache
- Location: frontal, temporal, occipital, periorbital
- Frequency: intermittent/recurrent/chronic
- Duration and triggers
- Severity (VAS score 0-10)

Statistical Analysis

SPSS version 26 was used. Correlation between nasal obstruction severity (NOSE score and deviation grade) and headache patterns was assessed using Pearson correlation and Chi-square tests. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 385 patients diagnosed with deviated nasal septum were included in the study. The analysis focused on demographic characteristics, headache prevalence, headache patterns, nasal obstruction severity, and the correlation between headache characteristics and deviation grade.

Table 1. Demographic Profile of Study Participants

Variable	Value
Total participants	385
Mean age (years)	34.7 ± 9.2
Gender distribution	Males 61.3% (n = 236) Females 38.7% (n = 149)
Duration of symptoms (months)	18.4 ± 7.6

As shown in Table 1, the study population consisted of 385 patients with a mean age of 34.7 ± 9.2 years. Males comprised 61.3% of the sample. The average duration of nasal symptoms before presentation was 18.4 months, indicating chronicity in most cases.

Table 2. Prevalence and Patterns of Headache among DNS Patients

Headache Variable	Frequency (n=385)	Percentage (%)
Presence of headache	275	71.4%
No headache	110	28.6%
Headache location		
Frontal	133	48.6%
Periorbital	61	22.1%
Temporal	48	17.4%
Occipital	33	11.9%

Headache was reported by 71.4% of participants, as detailed in Table 2. The most prevalent pattern was frontal headache (48.6%), followed by periorbital headache (22.1%), temporal headache (17.4%), and occipital headache (11.9%). Only 28.6% of patients reported no headache symptoms.

Table 3. Severity of Nasal Obstruction and Headache Intensity

Parameter	Mean ± SD	Correlation with NOSE Score (r)	p-value
NOSE Score	62.4 ± 14.8	-	-
Headache severity (VAS score)	6.3 ± 1.9	**0.63**	<0.001
Frequency of headache episodes/month	8.7 ± 3.4	0.57	<0.001

As shown in Table 3, the mean NOSE score was 62.4 ± 14.8, reflecting moderate to severe nasal obstruction in most patients. Headache intensity (measured by VAS) demonstrated a strong positive correlation with nasal obstruction severity ($r = 0.63$; $p < 0.001$). Similarly, headache frequency showed a statistically significant correlation ($r = 0.57$; $p < 0.001$), indicating that patients with higher NOSE scores experienced more frequent and severe headaches.

Table 4. Association Between DNS Deviation Grade and Headache Presence

Deviation Grade	Number of Patients (n)	Headache Present (%)	p-value
Grade I	92	41.3%	
Grade II	118	66.9%	
Grade III	104	82.7%	
Grade IV	71	90.1%	<0.001

The association between DNS severity and headache prevalence is presented in Table 4. Patients with higher deviation grades (Grade III and IV) exhibited a markedly greater prevalence of headaches (82.7% and 90.1%, respectively). This association was statistically significant ($p < 0.001$), demonstrating that anatomical severity strongly contributes to headache occurrence.

Overall Summary of Key Findings

- More than 70% of DNS patients experienced headaches.
- Frontal and periorbital headaches were the predominant patterns.
- Nasal obstruction severity (NOSE score) had a significant correlation with both headache intensity and frequency.
- Higher DNS deviation grades were associated with a dramatically increased likelihood of headaches.

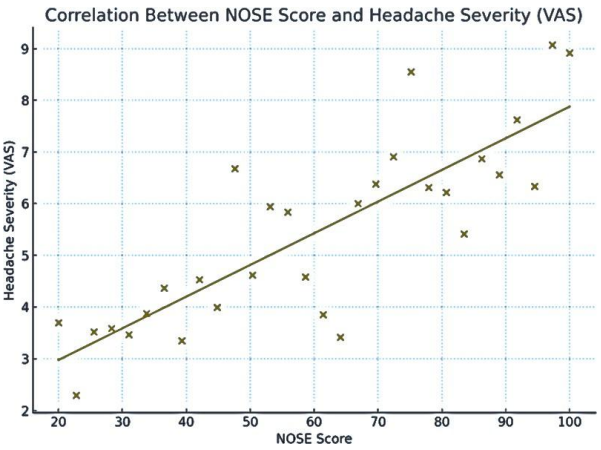

Figure 1: Scatter plot showing the correlation between nasal obstruction severity (NOSE score) and headache intensity (VAS score). A positive trend is observed, indicating that patients with higher NOSE scores experience more severe headaches.

DISCUSSION

The present study provides a comprehensive evaluation of headache prevalence, patterns, and severity among patients with deviated nasal septum (DNS), demonstrating a strong and clinically meaningful association between nasal obstruction severity and headache characteristics. More than two-thirds of the study population reported headache symptoms, with frontal and periorbital patterns predominating. These findings reinforce the growing body of evidence suggesting that DNS is an important yet frequently underrecognized contributor to secondary headaches in clinical practice [1,7,10].

Prevalence of Headache in DNS

The observed headache prevalence of 71.4% in our cohort is consistent with previous reports indicating a high burden of headache among patients with sinonasal structural abnormalities [6,14,18]. Earlier studies have reported headache prevalence ranging from 45% to 80% in patients with DNS, depending on deviation severity and inclusion criteria [23,24]. The high prevalence observed in the present study may be attributed to the inclusion of patients with clinically and radiologically confirmed DNS, many of whom demonstrated moderate to severe obstruction. Chronic nasal obstruction has been shown to significantly impair sinonasal physiology, contributing to persistent mucosal inflammation and nociceptive sensitization, which may explain the high frequency of headache symptoms [7,8].

Headache Patterns and Anatomical Correlation

Frontal headache was the most commonly reported pattern, followed by periorbital and temporal headaches. This distribution is anatomically plausible, given the innervation of the nasal cavity and paranasal sinuses by branches of the trigeminal nerve. The anterior ethmoidal nerve, a branch of the ophthalmic division, supplies the anterior septum and lateral nasal wall and is frequently implicated in frontal and periorbital pain [11,15]. Contact between a deviated septum or septal spur and the middle turbinate in this region can generate referred pain through trigeminovascular pathways, resulting in characteristic headache patterns [10,25].

Several authors have emphasized that the location of headache often corresponds to the site of mucosal contact rather than the side or degree of sinus inflammation, supporting the neurogenic basis of rhinogenic headache [5,26]. Clerico and Fieldman demonstrated that patients with septal contact points experienced reproducible headache patterns that resolved following surgical correction, further validating this anatomical correlation [6]. The predominance of frontal and periorbital headaches in our study aligns closely with these observations.

Correlation Between Nasal Obstruction Severity and Headache Intensity

One of the most significant findings of the present study is the strong positive correlation between nasal obstruction severity, as measured by the NOSE score, and headache intensity and frequency. Patients with higher NOSE scores experienced more severe and frequent headaches, suggesting a dose-response relationship between functional nasal impairment and headache burden. This finding is consistent with previous studies that have demonstrated worse symptomatology and reduced quality of life in patients with higher obstruction scores [7,19,27].

Chronic nasal obstruction may contribute to headache through multiple mechanisms, including impaired sinus ventilation, mucosal edema, altered airflow patterns, and chronic low-grade inflammation [4,8]. Additionally, prolonged obstruction may influence autonomic nervous system balance, resulting in parasympathetic overactivity and vasodilation within the trigeminovascular system, a mechanism also implicated in migraine pathophysiology [9,28]. This

overlap may partially explain why DNS-related headaches can mimic primary headache disorders.

Deviation Severity and Headache Prevalence

The present study demonstrated a statistically significant increase in headache prevalence with increasing DNS deviation grade, with more than 90% of patients with Grade IV deviation reporting headache symptoms. This finding underscores the importance of anatomical severity in symptom generation and is supported by multiple prior investigations [14,23]. Rizk and Elwany reported a significantly higher incidence of facial pain and headache in patients with severe septal deviation and prominent spurs compared to those with mild deviation [5].

Severe deviations are more likely to produce extensive mucosal contact, greater airflow disturbance, and increased mechanical stress on nasal structures, thereby intensifying nociceptive stimulation [10,25]. Moreover, higher deviation grades are often associated with compensatory turbinate hypertrophy on the contralateral side, further exacerbating obstruction and symptom burden [29]. These factors collectively contribute to the strong association between deviation severity and headache prevalence observed in our study.

Diagnostic Challenges and Clinical Implications

Differentiating DNS-related headache from primary headache disorders remains a major clinical challenge. Large epidemiological studies have shown that up to 90% of patients presenting with self-diagnosed "sinus headache" actually fulfill diagnostic criteria for migraine or tension-type headache [9,17]. However, this does not preclude the coexistence of sinonasal pathology as a contributory or aggravating factor. Our findings highlight the importance of considering DNS in the differential diagnosis of chronic or recurrent headaches, particularly when symptoms are pressure-like, localized to the frontal or periorbital regions, and associated with nasal obstruction.

The International Classification of Headache Disorders recognizes rhinogenic headache as a secondary headache entity, emphasizing the need for objective evidence of sinonasal pathology and symptom resolution following appropriate treatment [10]. Incorporating detailed ENT evaluation, including nasal endoscopy and imaging, into the assessment of selected headache patients may improve diagnostic accuracy and prevent mismanagement.

Therapeutic Implications and Role of Septoplasty

Although the present study did not evaluate postoperative outcomes, the strong association between DNS severity, nasal obstruction, and headache characteristics has important therapeutic implications. Multiple randomized and observational studies have demonstrated significant improvement in headache symptoms following septoplasty in patients with mucosal contact points and moderate to severe deviation [11,14,18]. Tosun et al. reported a marked reduction in headache frequency and intensity after surgical correction, particularly in patients with preoperative contact point headaches [11].

However, not all patients benefit equally from surgery, underscoring the need for careful patient selection. Identifying specific headache patterns, correlating symptoms with anatomical findings, and excluding primary headache disorders are essential steps in optimizing surgical outcomes [25,30]. Our findings support the integration of validated symptom scores, such as the NOSE scale, into preoperative evaluation to better predict therapeutic benefit.

Environmental and Regional Considerations

The high prevalence and severity of headache observed in this Saudi Arabian cohort may also reflect regional environmental factors. Exposure to dust, sandstorms, and allergens is common in the Middle East and has been associated with increased sinonasal inflammation and symptom exacerbation [12,21]. Allergic rhinitis, which is highly prevalent in this region, may further sensitize nasal mucosa and amplify nociceptive responses in patients with underlying DNS [22,31]. These factors may partially explain the high symptom burden observed in our study population and highlight the importance of contextualizing clinical findings within regional environmental frameworks.

Strengths and Limitations

The strengths of this study include a relatively large sample size, comprehensive assessment of headache characteristics, use of validated symptom scoring, and objective grading of septal deviation. However, certain limitations should be acknowledged. The cross-sectional design precludes causal inference, and postoperative outcomes were not assessed. Additionally, exclusion of patients with known primary headache disorders may limit generalizability, as overlap between primary and secondary headache mechanisms is common.

Future Directions

Future studies should adopt prospective and longitudinal designs to evaluate the impact of septoplasty on headache outcomes and quality of life. Incorporation of objective airflow measurements, such as rhinomanometry, and assessment of comorbid allergic rhinitis may further clarify pathophysiological mechanisms. Multidisciplinary collaboration between otolaryngologists and neurologists is essential to refine diagnostic criteria and optimize management strategies for patients with DNS-related headaches.

CONCLUSION

Headache is a common symptom among patients with DNS, especially frontal and periorbital patterns. The severity of nasal obstruction is significantly correlated with headache intensity and frequency. Thorough nasal examination should be part of the diagnostic approach for chronic headache patients. Surgical correction may offer relief in appropriately selected cases.

REFERENCES

1. Gray LP. Deviated nasal septum-Incidence and etiology. Ann Otol Rhinol Laryngol. 1978;87(3 Pt 1):3-20.
2. Stammberger H, Kennedy DW. Paranasal sinuses: anatomic terminology and nomenclature. Ann Otol Rhinol Laryngol Suppl. 1995;167:7-16.
3. Mladina R, Skitarelić N, Poje G, Subarić M. Clinical implications of nasal septal deformities. Rhinology. 2008;46(3):234-239.
4. Anselmo-Lima WT, Sakano E, Artico MS, Soler R. Mucosal contact headache: pathophysiology. Am J Rhinol. 2006;20(3):279-284.
5. Rizk H, Elwany S. Rhinogenic headache due to mucosal contact points. Otolaryngol Head Neck Surg. 2001;124(5):472-475.
6. Clerico DM, Fieldman R. Nasal mucosal contact points and facial pain. Headache. 1999;39(6):411-418.
7. Camacho M, Zaghi S, Certal V, et al. Inferior turbinate classification and objective CT assessment. Am J Rhinol Allergy. 2015;29(5):e123-e127.
8. Badran HS, Amr SA, Elwany S, et al. Contact point headache: Endoscopic surgical management. Eur Arch Otorhinolaryngol. 2011;268(6):807-812.
9. Eross E, Dodick D, Swanson J. "Sinus headache": a neurology perspective. Mayo Clin Proc. 2007;82(8):976-990.
10. Headache Classification Committee of the International Headache Society. The International Classification of Headache Disorders, 3rd edition. Cephalalgia. 2018;38(1):1-211.
11. Tosun F, Gerek M, Ozkaptan Y. Septoplasty for contact point headache. Headache. 2000;40(3):237-240.
12. Al-Shehri A, Al-Qahtani A, Al-Sultan A. Prevalence and risk factors of allergic rhinitis in Saudi Arabia. Ann Saudi Med. 2019;39(4):246-254.
13. Antonaci F, Ghirmai S, Bono G, Sandrini G, Nappi G. Nasal stimulation and trigeminal pain. Cephalalgia. 2001;21(8):857-860.
14. Parsons DS, Batra PS. Functional endoscopic sinus surgery outcomes for contact point headaches. Laryngoscope. 1998;108(5):696-702.
15. Behin F, Behin B, Behin D, Baredes S. Surgical management of contact point headaches. Headache. 2005;45(3):204-210.
16. Levine HL. The role of nasal contact points in headache. Facial Plast Surg. 2000;16(2):141-145.
17. Schreiber CP, Hutchinson S, Webster CJ, et al. Prevalence of migraine in patients with a history of "sinus headache." Arch Intern Med. 2004;164(16):1769-1772.
18. Abu-Bakra M, Jones NS. Does septal surgery improve headache? Clin Otolaryngol. 2001;26(5): 370-373.
19. Stewart MG, Witsell DL, Smith TL, Weaver EM, Yueh B, Hannley MT. Development and validation of the NOSE scale. Otolaryngol Head Neck Surg. 2004;130(2):157-163.
20. Buckland JR, Thomas S, Harries PG. Can nasal septal surgery improve quality of life? Clin Otolaryngol Allied Sci. 2003;28(1): 47-54.
21. Al-Mutairi N, Khashoggi K. Allergic rhinitis in Saudi Arabia: environmental and climatic influences. Int J Environ Health Res. 2016;26(1):1-10.
22. Alreshidi FM, Alsharif AT. Burden of allergic rhinitis and its association with nasal obstruction. Saudi Med J. 2020;41(6):585-592.
23. Karatas D, Oysu C, Kocak I, Vural C. The role of septal deviation in headache. Eur Arch Otorhinolaryngol. 2013;270(6): 1803-1807.
24. Aydin O, Akyildiz S, Keles B, Kaygusuz I, Alpay HC. Relationship between nasal septal deviation and headache. J Craniofac Surg. 2011;22(6):2129-2131.
25. Cady RK, Schreiber CP. Sinus headache or migraine? Curr Pain Headache Rep. 2002;6(6):451-457.
26. Silberstein SD. Trigeminal autonomic cephalalgias and secondary headache mechanisms. Neurol Clin. 2009;27(2):537-556.
27. Rhee JS, Sullivan CD, Frank DO, Kimbell JS, Garcia GJ. A systematic review of nasal airway obstruction scoring systems. Otolaryngol Head Neck Surg. 2014;150(5):817-823.
28. Burstein R, Noseda R, Borsook D. Migraine pathophysiology:

trigeminovascular system. Neuron. 2015;87(1):22-37.
29. Egeli E, Demirci L, Yazyici B, Harputluoglu U. Evaluation of compensatory inferior turbinate hypertrophy. Laryngoscope. 2004;114(7):1241-1245.
30. Welge-Lüssen A, Hauser R, Kappos L. Surgical treatment of rhinogenic headache. Rhinology. 2003;41(3):148-152.
31. Settipane RA. Allergic rhinitis: epidemiology and pathophysiology. Allergy Asthma Proc. 2001;22(2):89-95.

