KUDAS, Zuzanna, GÓRKA, Mateusz, STEC, Weronika, WOJTKIEWICZ, Anna, PIEKARSKA, Magda and SZEREJ, Krzysztof. The Comprehensive Review of Deviated Septum: Anatomy, Diagnosis, and Treatment Approaches. Quality in Sport. 2025;37:57018. eISSN 2450-3118.
https://doi.org/10.12775/QS.2025.37.57018
https://apcz.umk.pl/QS/article/view/57018

The journal has been 20 points in the Ministry of Higher Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Higher Education and Science of 05.01.2024. No. 32553.
Has a Journal's Unique Identifier: 201398. Scientific disciplines assigned: Economics and finance (Field of social sciences); Management and Quality Sciences (Field of social sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 r. Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398.
Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 15.12.2024. Revised: 17.01.2025. Accepted: 17.01.2025 Published: 20.01.2025.

Comprehensive Review of Deviated Septum: Anatomy, Diagnosis, and Treatment Approaches

1. **Zuzanna Kudas**
https://orcid.org/0009-0009-6750-6886
Independent Public Complex of Health Care Facilities, Marshal Józef Piłsudski in Płońsk, 7 Henryk Sienkiewicz Street, 09-100 Płońsk, Poland
md.zuzannakudas@gmail.com

2. **Mateusz Górka**
https://orcid.org/0009-0004-6201-4691
Voivodeship Integrated Hospital of Stanisław Rybicki in Skierniewice 1 Rybickiego Street, 96-100 Skierniewice, Poland
mateusz.a.gorka@gmail.com

3. **Weronika Stec**
https://orcid.org/0009-0009-8495-3573
Independent Public Complex of Health Care Facilities, Marshal Józef Piłsudski in Płońsk, 7 Henryk Sienkiewicz Street , 09-100 Płońsk, Poland
weronikastec1234@gmail.com

4. **Anna Wojtkiewicz**
https://orcid.org/0009-0002-3451-124X
District Medical Centre in Grójec, 10 Piotra Skargi Street, 05-600 Grójec, Poland
anna.a.wojtkiewicz@gmail.com

5. **Magda Piekarska**
https://orcid.org/0000-0002-3583-8802
Bielanski Hospital, Cegłowska 80, 01-809 Warsaw, Poland
madzia12792@gmail.com

6. **Krzysztof Szerej**
https://orcid.org/0009-0003-7581-4965
District Hospital in Sochaczew, Batalionów Chłopskich 3/7, Sochaczew, Poland
krzychszerej@gmail.com

Abstract

Deviated septum, a common nasal structural abnormality, often leads to symptoms like nasal obstruction, sinusitis, and sleep disturbances, impacting respiratory function and quality of life. This clinical review emphasizes the critical role of septoplasty in the treatment of nasal septum deviation (NSD). While the nasal septum's anatomy is essential for proper airflow, deviations can cause significant issues, particularly in severe cases.

Diagnosis involves clinical evaluation and imaging to assess the extent of deviation. Septoplasty, the gold standard treatment, realigns the septum to restore normal airflow and alleviate symptoms. The review also explores advances in septoplasty techniques aimed at improving outcomes and reducing recovery time. Overall, septoplasty remains the most effective intervention for managing NSD, with ongoing research focused on refining surgical methods and enhancing patient care.

Keywords: Nasal septal deviation, nasal septoplasty, NOSE score, otolaryngology, quality of life, rhinosinusitis

Introduction

The nasal septum, a complex osseocartilaginous structure, is crucial for maintaining proper respiratory function by dividing the nasal cavity into two passages, thereby facilitating balanced airflow and effective filtration of inhaled air [1]. Although minor deviations in the septum are common and generally considered normal anatomical variations, more pronounced deviations can significantly impair nasal function. This can lead to symptoms such as nasal obstruction, difficulty breathing, and an increased risk of conditions like chronic rhinosinusitis and sleep-disordered breathing. The integrity of the nasal septum is vital not only for aesthetic symmetry but also for maintaining the overall health and function of the nasal passages [2].

A straight nasal septum is crucial for maintaining balanced airflow through both nostrils, ensuring adequate ventilation, effective filtration of inhaled air, and optimal function of the mucociliary clearance system [3].

Nasal septum deviation (NSD) can arise from various factors. Developmental deviations typically present as smooth "C-shaped" or "S-shaped" curves that gradually displace the septum during growth. In contrast, traumatic causes of NSD often result in more irregular and dislocated septal contours, leading to more severe functional impairments [1]. The integrity and alignment of the nasal septum are not only important for maintaining aesthetic symmetry but also play a critical role in overall nasal health and function.

Given that nasal obstruction due to septal deviation is one of the most common conditions encountered by ENT surgeons, understanding the underlying anatomy, pathophysiology, and treatment options is essential. This review will explore the anatomy of the nasal septum, the clinical manifestations of NSD, and the various treatment strategies available, with a particular focus on septoplasty as a key intervention for restoring nasal function and improving patient outcomes.

Review methods and materials

A systematic review of nasal septum deviation (NSD) was conducted by searching major databases including PubMed, Embase, Cochrane Library, and Google Scholar. The search encompassed studies published from January 2000 to August 2024 using terms such as “upper airway dysfunction”, “septoplasty”, “nasal obstruction”, “deviated septum”, “rhinomanometry”. Included were peer-reviewed articles, clinical guidelines, and case studies focusing on the causes, symptoms, diagnosis, and treatment of NSD.

Potential limitations include publication bias and heterogeneity in study designs. The review process involved screening, full-text review, data synthesis, and peer review to ensure accuracy and completeness.

Anatomy

The respiratory tract’s most cephalic part is the nasal cavity. Through the nares, which are it’s anterior openings, it communicates with the outside world. The choanae are the posterior apertures and they connect the nasal cavity with nasopharynx [4].

The nasal cavity is a bilateral structure in the midface. Limitation of the nasal cavity inferiorly is the horizontal plate of the palatine bone and palatine process of the maxilla. The roof of the nasal cavity consists of nasal spine of the frontal bone and nasal bone, and more posteriorly cribriform plate of the ethmoid and the body of the sphenoid [4]. The medial walls of the maxillary sinuses are the component of on the lateral side. Nasal cavity contains the nasal septum, nasal mucosa, and nasal turbinates. The cavity is divided into two bilateral cavities by a midline septum that is orientated in the sagittal plane.

The nasal septum, a combination of osseous and cartilaginous elements, separates the right and left nasal cavities. It is composed of five parts: the vomer, the nasal crest of the maxillary and palatine bones, the quadrangular cartilage, and the perpendicular plate of the ethmoid bone. The posterior, osseous portion of the septum is composed of the ethmoid bone and the vomer. The internal maxillary artery, which arises from the external carotid artery, and the anterior and posterior ethmoidal arteries, which are branches of the internal carotid artery, give blood to the nasal cavities. The trigeminal and facial nerves' olfactory, ophthalmic, and maxillary branches innervate the nose cavity [5].

The frontal sinuses (superior anterior), ethmoid sinuses (superior), paired maxillary sinuses (lateral), and sphenoid sinuses (posterior) are mucosal-lined sinuses that store air and surround the nasal cavities. With the exception of the sphenoid, all of these paranasal sinuses are connected to the nasal cavity by ducts that empty into lateral wall spaces after draining through ostia. The posterior roof is where the sphenoid sinus empties. Understanding the functioning of the nasal cavity requires a basic understanding of its anatomy [4].

The bone structures known as nasal turbinates, or conchae, protrude infero-medially from the lateral and superior walls of each nasal cavity [6]. Maxilloturbinals, or lower turbinates, and ethmoturbinals, or middle and superior turbinates, are the two types of turbinates that are typically found in three pairs. The ultimate turbinate, also known as Santorini's concha, is a fourth turbinate that is sporadically observed. This is located on the lateral boundary of the ostium of the sphenoid sinus, at the posterosuperior portion of the lateral nasal wall. An endochondral ossification process produces each pair of turbinates, with cartilaginous precursors seen as early as eight weeks in utero [6,7]. Usually, the superior concha is the smallest and the inferior concha is the largest.

Pneumatization of the nasal turbinate results in Concha Bullosa (CB), an anatomical variant of the sinonasal structure. Although the precise origin of CB is still unknown, earlier research attempting to investigate the connection between CB and NSD found that individuals with NSD who also had a greater incidence of CB had unclear etiological explanations for their condition. On the other hand, the magnitude of the CB is favorably influenced by the angle of the deviation [8]. On the other hand, individuals with moderate forms of NSD had greater rates of CB than those with severe NSD, even though the difference was not statistically significant [9]. Additionally, it was discovered that the side of the septal malformation affected the incidence of CB in the opposite direction of NSD [10].

Epidemiology of deviated septum

More than half of patients have nasal septum deviation, which is defined as any variation of the septal contour towards one side of the nasal cavity. It is characterized as an S-shaped, left-sided, or right-sided curvature. A non-deviated septum is significantly less prevalent than septal abnormalities. However, only around 30% experience significant symptoms, such as nasal obstruction or sinus infections. The condition can be congenital or caused by trauma, and its prevalence of symptoms increases with age. Epidemiologically, there is no significant gender difference, but it is often diagnosed in those with chronic nasal issues. Understanding its distribution helps guide healthcare, particularly in deciding when surgical intervention is needed [11].

Classification

The creation of classification systems has emerged because to the considerable heterogeneity in the structure, symptoms, and associated comorbidities of NSD. The degree of nasal deviation on the inferior turbinate can be used to categorize NSD [14].

There are three degrees in this classification:

- Degree I is a septal deviation that does not reach the inferior turbinate
- Degree II is a deviation that does reach the inferior turbinate

- Degree III is a deviation that both reaches and compresses the inferior turbinate

An additional classification is based on the patterns of deviation that are frequently observed, such as C- and S-shaped deviations [15] [Figure 1].

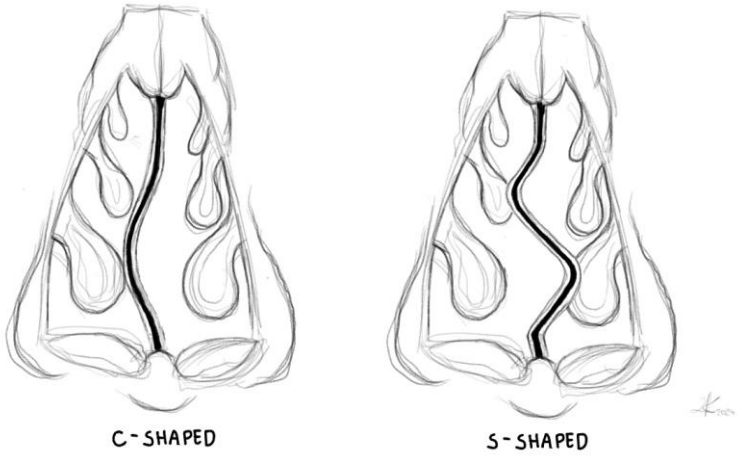

Figure 1. Types of deviation based on the shape.

In order to categorize the nasal septum based on its features as observed both horizontally and vertically on rhinoscopy or cone-beam computed tomography (CBCT), Mladina's classification system has been proposed [16]. Mladina's classification system divides nasal septum deviations into seven types:

- **Type I:** The vertical ridge does not impact the nasal dorsum.
- **Type II:** The vertical ridge extends up to the nasal dorsum.
- **Type III:** The vertical ridge is situated in a deeper area of the septum.
- **Type IV:** Both the front and deeper parts of the vertical ridge are affected.
- **Type V:** There is a horizontal deformity on one side of the nose, with the other side being flat.
- **Type VI:** The septum is involved on both sides, with one side dislocated and the other deviated.
- **Type VII:** A combination of two or more of the above types [2,16] [Figure 2].

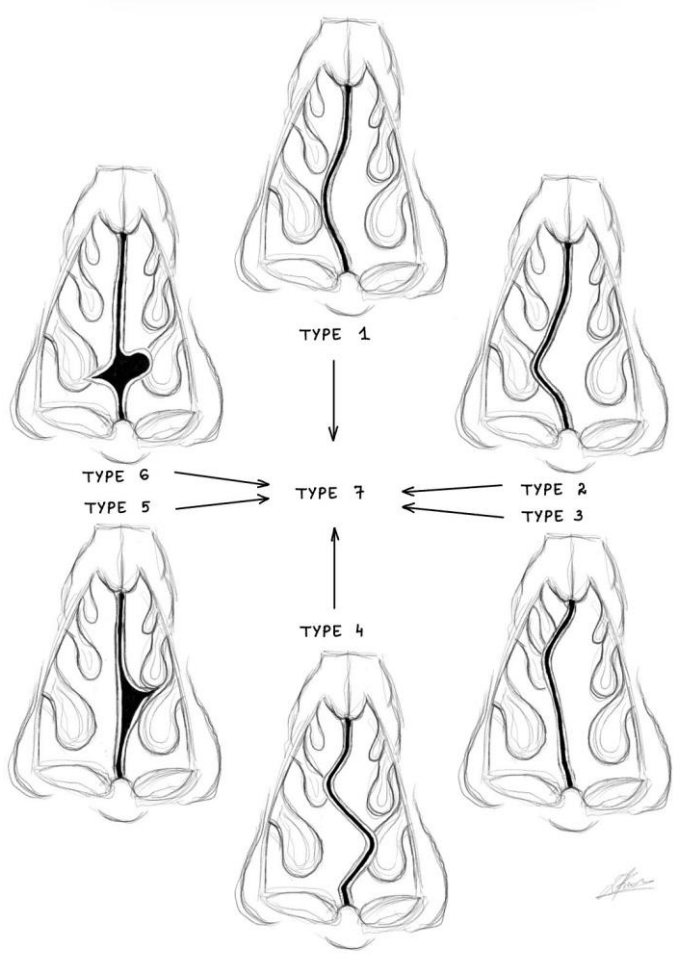

Figure 2. Mladina's classification.

Associated conditions

Rhinosinusitis and postnasal drip

In ENT doctor's office patients commonly present with unilateral or bilateral nasal obstruction, which results in impaired nasal airflow and chronic congestion. This obstruction is often exacerbated by mucosal swelling or inflammation, further complicating the patient's ability to breathe through the nose.

Variations in the nasal cavity's architecture may affect airflow but have minimal impact on warmth. The differences between the various forms of nasal deviation were clearly visible [12]. Consequently, a significant deviation in the nasal septum will interfere with the regular breathing process, resulting in sinusitis, snoring, and nasal obstruction [13].

Fifty percent of individuals with rhinosinusitis also had NSD in a research looking at the connection between the two conditions. Rhinosinusitis was more common in classifications I, II, and V, although the connection was not statistically significant. Because type I and type II include the nasal valve region, it is believed that they are linked to rhinosinusitis [17].

Patients might also report postnasal drip, where excess mucus accumulates and drains into the oropharynx, leading to throat irritation and a chronic cough [18].

Changed airflow dynamics result in mucosa compensating in hypertrophy. Squamous metaplasia, lymphocytic infiltration, and disrupted mucociliary dysfunction are other alterations brought on by altered air flow dynamics. Although the nasal mucosa on both sides presents similar alterations, the concave side demonstrates more severe consequences. You can prevent all of these changes by surgically correcting deviated nasal septum [19].

Epistaxis

Another frequent symptom associated with a deviated septum is epistaxis which arise due to the altered airflow patterns that cause drying and irritation of the nasal mucosa. About 60% of people have nose-bleeding episodes, with incidence higher in those over 50 and younger in those under 10 years old [20]. Studies reviewing epistaxis based on sex indicate that males are more likely to experience it [21]. Because upper respiratory tract infections are more common in the spring and winter, as well as because indoor air is dryer and warmer and has less humidity, epistaxis occurs more frequently during these seasons [22]. Most people experience minimal bleeding that stops on its own.

Obstructive sleep apnea

In cases where the deviation is severe, there may be associated sleep disturbances, including snoring or obstructive sleep apnea, as a result of the compromised airway during sleep. Obstructive sleep disorder (OSA) is a condition characterized by substantial decrease or an abrupt cessation in airflow with observed effort in the act of breathing during sleep.

Patients with NSD have much more higher risk of obtaining OSA. In fact, the prevalence of obstructive sleep apnea is 4.39 times higher in patients with deviated septum. Overweight patients with increased BMI are the ones where OSA is more severe. Septoplasty turns out to be the procedure which decreases the prevalence of OSA [23].

Headaches

A possible explanation for the appearance of headache as a presenting symptom in certain individuals is that the convex side comes into touch with the mucosa of the lateral nasal wall of the nasal septum or the peripheral nasal wall of the inferior or middle turbinate [11]. Between them is where the sensory nerve ends, which will be impacted and result in discomfort. According to reports, surgical intervention is superior to medicinal intervention for certain types of rhinogenic headaches [11]. The same research recommended septoplasty as a possible course of treatment for headaches that don't seem to go away. Additionally, patients may experience facial pain or headaches, which are typically localized to the side of the deviation and are often due to the compromised drainage of the paranasal sinuses, leading to sinus pressure and discomfort.

Impaired olfactory function

Furthermore, the altered nasal anatomy can impede olfaction, resulting in a diminished sense of smell, or hyposmia. Although the main complaint of these individuals is nasal blockage, olfactory impairment is also a common complaint. On the deviated side of a septal deviation, higher olfactory thresholds and worse olfactory recognition have been reported.

According to studies, the nasal cavity's shape controls how air passes through the nose and, in turn, how many odorant molecules are carried to the olfactory epithelium [24, 25].

Evaluation

Physical exam

Diagnosing a deviated septum involves a combination of patient history, physical examination, and sometimes imaging studies. ENT surgeon usually does external nasal examination and anterior rhinoscopy to evaluate the anatomy of the septum and visualize potential mucosal changes.

Imaging test

A computed tomography (CT) scan may be ordered in cases where the diagnosis is unclear, or if the patient has recurrent sinus issues. The CT scan provides a detailed image of the nasal septum and surrounding structures, which helps in evaluating the severity of the deviation and any associated sinus pathology.

Questionnaires

The physician also can use specific questionnaires to understand patient’s severity of symptoms and how it affects their quality of life. Two most popular ones are NOSE (Nasal Obstruction Symptom Evaluation) and SNOT-22 (Sino-Nasal Outcome Test-22).

The NOSE (Nasal Obstruction Symptom Evaluation) test is a validated questionnaire widely used in otorhinolaryngology to assess the severity of nasal obstruction symptoms. It consists of five questions that evaluate the patient's perception of nasal blockage, trouble breathing through the nose, and the impact of these symptoms on sleep and daily activities. Each question is scored on a scale from 0 (not a problem) to 4 (severe problem), with the total score providing a quantifiable measure of nasal obstruction. The NOSE test is a valuable tool for diagnosing nasal obstruction, monitoring treatment outcomes, and guiding clinical decision-making [26].

The SNOT-22 (Sino-Nasal Outcome Test-22) is an essential tool in evaluating the impact of a deviated septum on a patient’s quality of life. A deviated septum often leads to symptoms such as nasal obstruction, congestion, facial pain, and postnasal drip - issues that are directly assessed by the SNOT-22 questionnaire. By capturing the severity and frequency of these symptoms, as well as their effect on daily activities and emotional well-being, the SNOT-22 provides a comprehensive overview of how a deviated septum affects overall health. It is particularly useful in both diagnosing the extent of the problem and in monitoring the effectiveness of treatment interventions, such as septoplasty, in alleviating the associated symptoms [26].

Rhinomanometry

Rhinomanometry is a technique, in which nasal resistance is computed by measuring nasal airflow and pressure reduction concurrently between the nasal anterior region and the nasopharynx. Rhinomanometry has been more popular over the last ten years as a result of the increased accessibility of microcomputers that can be linked to measurement devices. All mathematical analyses may be completed with these devices in a couple of seconds.

While rhinomanometry has been the subject of several research, few of them have been sufficiently rigorously scientific, and doctors continue to disagree over the device's therapeutic use [14].

Treatment

Septoplasty

Septoplasty is the most widely used surgical technique for treating NSD in adults [27]. A common otolaryngological surgical surgery called septoplasty includes straightening up a deviated septum in order to widen the nasal channel and provide enough airflow [27,28]. Septoplasty is recommended for lead point headaches, endoscopic sinus surgery access, and septal deviation with symptomatic blockage [27]. When treating a caudal septal deviation, surgeons often perform an open operation called septoplasty. However, when treating a posterior septal deviation, they prefer to perform endoscopic septoplasty since it offers the surgeon a greater visual aid than open septoplasty. However, the surgeon's talents, aptitudes, and preferences will determine which of these methods they choose [29].

Research that evaluated the effectiveness of a septoplasty technique employing bone batten grafting on 141 patients with caudal septal deviation revealed a satisfactory outcome with a positive outcome [30]. Extracorporeal septoplasty is advised in situations of severe NSD. The whole (cartilaginous and bony) septum is removed and rebuilt during an open or closed operation. According to reports, this process provides the best possible functional improvement [31].

Depending on the kind of nasal deviation a patient has, several techniques may be chosen for septoplasty. Extracorporeal septal repair was reported to be more efficient than endonasal septoplasty for antero-caudal septal deviation [32]. For children however, the procedure need to be performed as soon as it is possible in order to preserve cartilage and improve results [33]. Patients with difficult caudal septal deviation have found that fashioned mucoperichondrium flaps are adequate [34].

Rhinoseptoplasty

Rhinoplasty, also known as rhinoseptoplasty, is a treatment that is frequently combined with septoplasty to treat and alleviate obstruction-related symptoms and enhance breathing. In addition to being used for cosmetic or aesthetic purposes, rhinoplasties may be viewed as a backup treatment option for deviations in the nasal cartilage. Turbinate hypertrophy can also occur in conjunction with septal deviation; hence, septoplasty and turbinate surgery can be executed together [27]. The Nasal Obstruction Septoplasty Effectiveness (NOSE) and the Sinonasal Outcome Test-20 (SNOT-20) questionnaire scale can also be used to evaluate nasal symptoms in septoplasty patients and to control the effect of the performed procedure [35].

Endoscopic septoplasty

Endoscopic septoplasty is a minimally invasive technique that helps us to correct deformity of septum under excellent visualization. When compared with standard head light technique endoscopic septoplasty provides important advantages which include adequate visualization, room for instrumentation during FESS, access to Para nasal sinuses and for other surgeries like trans septal approach to the sphenoid sinus, visualization & stoppage of post nasal bleeds. But before introduction of FESS majority of septoplasties were done for nasal airway obstruction [36].

Effects

Improved nasal and olfactory functioning, as well as cosmetic benefits, are the patient's goals in having a septoplasty. Physicians should be urged to execute the procedure to enhance cardiovascular function in addition to the patient's wish. The respiratory and olfactory aspects have been used to quantify patient happiness. There have also been reports of septoplasty's cardiovascular outcomes. Systolic blood pressure in individuals who had septoplasty was lowered following the procedure when compared to pre- and post-surgery [37]. This case scenario frequently occurs in individuals with idiopathic hypertension who are less than 35 years old [38].

Complications

According to reports, the procedure's most frequent side effects include bleeding, rhinorrhea from cerebrospinal fluid (CSF), extraocular muscle damage, septal perforation, sensory alterations, saddle nose deformity, nasal tip depression, infection, septal abscess, and toxic shock [38]. Deformities, infections, and perforations are the most prominent negative consequences following septoplasty, according to one research, while another reported that profuse bleeding was the most common outcome [40,41]. Additionally, post-operative bacteremia is a possibility and is more common in patients who bled more during the surgery [42]. Furthermore, a different research discovered that the only short-term issues were postoperative infection (3.3%) and intervention-required epistaxis (4.5%). Nonetheless, 2.8% of the group had long-term issues, such as hyposmia and a subsequent septoplasty [43].

Quality of life

Patients' quality of life (QOL) has been reported to be considerably impacted by nasal blockage, and the psychological well-being of such patients has been positively impacted by olfactory nerve repair [44]. The clinical improvement of nasal functions was associated with an improvement in psychological state [44]. Patients with NSD were shown to have greater rates of anxiety and depression in addition to a lower quality of life [45]. This finding should promote psychological distress therapy.

The decrease in quality of life is mostly due to obstruction, as NSD had no effect on the QOL of individuals with inferior turbinate hypertrophy [46]. It is hypothesized that nasal obstruction impacts both the quality of sleep and, as a result of compromised physical health, psychological symptoms such as somatization, anxiety, aggression, and interpersonal sensitivity [47]. There has been a documented improvement in children's QOL [48], despite the low probability of septal deviation being the primary cause of lower QOL.

The influence of patient symptoms on daily activities and QOL can be significant, particularly in cases of headache and face discomfort. The psychological profile of the patients may be further impacted by undergoing many clinic examinations before being cleared to see an otorhinolaryngology (ORL) clinic, particularly if there is no current nasal inflammatory problem [49].

The self-rating anxiety scale (SAS) and self-rating depression scale (SDS) were used to analyze patients with nasal septal deviation before and after surgery in order to further evaluate the psychological profile of patients. The results of this research revealed that patients with nasal septal deviation had preoperative SAS/SDS scores higher than those of national standards, postoperative levels of anxiety and depression were lower than the national norm, and patients with normal to moderate SAS/SDS scores recovered better from their surgery, while patients with severe SAS/SDS scores had poor symptom improvement [50].

Conclusions

This review work has highlighted the complex interplay between the anatomy, symptoms, and treatment options for deviated septum. The nasal septum's structure plays a crucial role in maintaining proper nasal function, and deviations from the midline, whether congenital or acquired, can lead to a range of symptoms, from mild nasal obstruction to significant respiratory complications and a decreased quality of life. Effective diagnosis of a deviated septum requires a thorough clinical evaluation, often supplemented by imaging studies, to assess the extent of the deviation and its impact on nasal airflow. Treatment approaches should be tailored to the severity of symptoms and the patient's overall health. While conservative management, including pharmacological interventions and lifestyle modifications, may be sufficient for mild cases, surgical correction through septoplasty remains the definitive treatment for more severe deviations, particularly when associated with chronic symptoms or complications.

Emerging techniques and minimally invasive procedures hold promise for improving patient outcomes and reducing recovery times. However, careful patient selection and individualized treatment planning are essential to achieve optimal results. Future research should continue to explore advances in surgical techniques and the long-term outcomes of different treatment modalities, aiming to refine and enhance therapeutic strategies for managing deviated septum.

In conclusion, a multidisciplinary approach, involving otolaryngologists, radiologists, and primary care providers, is crucial for the effective management of deviated septum. Early diagnosis and appropriate intervention can significantly improve patients' respiratory function, quality of life, and overall well-being.

Disclosure

Authors' contribution

Conceptualization: Zuzanna Kudas and Mateusz Górka
Methodology: Weronika Stec and Magda Piekarska
Software: Mateusz Górka, Krzysztof Szerek
Check: Anna Wojtkiewicz, Magda Piekarska
Formal Analysis: Magda Piekarska
Investigation: Zuzanna Kudas
Data Curation: Krzysztof Szerej
Writing-Rough Preparation: Weronika Stec
Writing-Review and Editing: Magda Piekarska
Visualization: Zuzanna Kudas
Supervision: Zuzanna Kudas
Project Administration: Krzysztof Szerej

All authors have read and agreed with the published version of the manuscript.

Funding statement:
The study did not receive special funding.

Institutional review board statement:
Not applicable.

Informed consent statement:
Not applicable

Data availability statement:
Not applicable

Conflict of interest:
The authors declare no conflict of interest

References:

1. Teixeira, J., Certal, V., Chang, E. T., & Camacho, M. (2016). Nasal Septal Deviations: A Systematic Review of Classification Systems. *Plastic surgery international*, *2016*, 7089123. https://doi.org/10.1155/2016/7089123
2. Alghamdi FS, Albogami D, Alsurayhi AS, et al. Nasal Septal Deviation: A Comprehensive Narrative Review. *Cureus*. 2022;14(11):e31317. Published 2022 Nov 10. doi:10.7759/cureus.31317
3. Strohl KP, Butler JP, Malhotra A. Mechanical properties of the upper airway. *Compr Physiol*. 2012;2(3):1853-1872. doi:10.1002/cphy.c110053 [7]
4. Sobiesk JL, Munakomi S. Anatomy, Head and Neck, Nasal Cavity. [Updated 2023 Jul 24]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-.

5. Pérez-Piñas, Sabaté J, Carmona A, Catalina-Herrera CJ, Jiménez-Castellanos J. Anatomical variations in the human paranasal sinus region studied by CT. *J Anat*. 2000;197 (Pt 2)(Pt 2):221-227. doi:10.1046/j.1469-7580.2000.19720221.x
6. Maier W, Ruf I. Morphology of the nasal capsule of primates--with special reference to Daubentonia and Homo. *Anat Rec (Hoboken)*. 2014;297(11):1985-2006. doi:10.1002/ar.23023
7. Dalgorf DM, Harvey RJ. Chapter 1: Sinonasal anatomy and function. *Am J Rhinol Allergy*. 2013;27 Suppl 1:S3-S6. doi:10.2500/ajra.2013.27.3888
8. El-Taher M, AbdelHameed WA, Alam-Eldeen MH, Haridy A. Coincidence of Concha Bullosa with Nasal Septal Deviation; Radiological Study. *Indian J Otolaryngol Head Neck Surg*. 2019;71(Suppl 3):1918-1922. doi:10.1007/s12070-018-1311-x
9. Al-Rawi NH, Uthman AT, Abdulhameed E, Al Nuaimi AS, Seraj Z. Concha bullosa, nasal septal deviation, and their impacts on maxillary sinus volume among Emirati people: A cone-beam computed tomography study. *Imaging Sci Dent*. 2019;49(1):45-51. doi:10.5624/isd.2019.49.1.45
10. Kucybała I, Janik KA, Ciuk S, Storman D, Urbanik A. Nasal Septal Deviation and Concha Bullosa - Do They Have an Impact on Maxillary Sinus Volumes and Prevalence of Maxillary Sinusitis?. *Pol J Radiol*. 2017;82:126-133. Published 2017 Mar 4. doi:10.12659/PJR.900634
11. 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. doi:10.1016/j.anl.2017.01.003
12. Li L, Zang H, Han D, London NR Jr. Impact of Varying Types of Nasal Septal Deviation on Nasal Airflow Pattern and Warming Function: A Computational Fluid Dynamics Analysis. *Ear Nose Throat J*. 2021;100(6):NP283-NP289. doi:10.1177/0145561319872745
13. Kamani T, Yılmaz T, Sürücü S, Bajin MD, Günaydın RÖ, Kuşçu O. Histopathological changes in nasal mucosa with nasal septum deviation. *Eur Arch Otorhinolaryngol*. 2014;271(11):2969-2974. doi:10.1007/s00405-014-2990-x
14. Dadgarnia MH, Baradaranfar MH, Mazidi M, Azimi Meibodi SM. Assessment of Septoplasty Effectiveness using Acoustic Rhinometry and Rhinomanometry. *Iran J Otorhinolaryngol*. 2013;25(71):71-78.
15. Lawson VG. Management of the twisted nose. *J Otolaryngol*. 1978;7(1):56-66.
16. Mladina R, Cujić E, Subarić M, Vuković K. Nasal septal deformities in ear, nose, and throat patients: an international study. *Am J Otolaryngol*. 2008;29(2):75-82. doi:10.1016/j.amjoto.2007.02.002
17. Li L, Zang H, Han D, London NR. Impact of Varying Types of Nasal Septal Deviation on Nasal Airflow Pattern and Warming Function: A Computational Fluid Dynamics Analysis. Ear, Nose & Throat Journal. 2021;100(6):NP283-NP289. doi:10.1177/0145561319872745
18. Bugten V, Nilsen AH, Thorstensen WM, Moxness MH, Amundsen MF, Nordgård S. Quality of life and symptoms before and after nasal septoplasty compared with healthy individuals. *BMC Ear Nose Throat Disord*. 2016;16:13. Published 2016 Oct 28. doi:10.1186/s12901-016-0031-7

19. Kumar L, Belaldavar BP, Bannur H. Influence of Deviated Nasal Septum on Nasal Epithelium: An Analysis. *Head Neck Pathol*. 2017;11(4):501-505. doi:10.1007/s12105-017-0819-9
20. Abdesallam HA, Mahrous AK, Hashim AH. Epistaxis Management. *EJHM.* 2007;26:55–62
21. Gilyoma JM, Chalya PL. Etiological profile and treatment outcome of epistaxis at a tertiary care hospital in Northwestern Tanzania: a prospective review of 104 cases. *BMC Ear Nose Throat Disord*. 2011;11:8. Published 2011 Sep 5. doi:10.1186/1472-6815-11-8
22. Özturan O. Epistaksis. In: Çelik O, editor. *Kulak Burun Boğaz hastalıkları ve Bas Boyun cerrahisi.* İstanbul: Turgut Yayıncılık; 2002. pp. 357–67
23. Yeom SW, Kim MG, Lee EJ, et al. Association between septal deviation and OSA diagnoses: a nationwide 9-year follow-up cohort study. *J Clin Sleep Med*. 2021;17(10):2099-2106. doi:10.5664/jcsm.9352
24. Gupta N, Singh PP, Bagla RK. Will Septal Correction Surgery for Deviated Nasal Septum Improve the Sense of Smell? A Prospective Study. *Surg Res Pract*. 2015;2015:496542. doi:10.1155/2015/496542
25. Leopold DA. The relationship between nasal anatomy and human olfaction. *Laryngoscope*. 1988;98(11):1232-1238. doi:10.1288/00005537-198811000-00015
26. Behnke J, Dundervill C, Bulbul M, Armeni M, Ramadan HH, Makary CA. Using the sino-nasal outcome test (SNOT-22) to study outcome of treatment of nasal obstruction. *Am J Otolaryngol*. 2023;44(4):103879. doi:10.1016/j.amjoto.2023.103879
27. van Egmond MMHT, Rovers MM, Tillema AHJ, van Neerbeek N. Septoplasty for nasal obstruction due to a deviated nasal septum in adults: a systematic review. *Rhinology*. 2018;56(3):195-208. doi:10.4193/Rhin18.016
28. Most SP, Rudy SF. Septoplasty: Basic and Advanced Techniques. *Facial Plast Surg Clin North Am*. 2017;25(2):161-169. doi:10.1016/j.fsc.2016.12.002
29. Shah J, Roxbury CR, Sindwani R. Techniques in Septoplasty: Traditional Versus Endoscopic Approaches. *Otolaryngol Clin North Am*. 2018;51(5):909-917. doi:10.1016/j.otc.2018.05.007
30. Kim DY, Nam SH, Alharethy SE, Jang YJ. Surgical Outcomes of Bony Batten Grafting to Correct Caudal Septal Deviation in Septoplasty. *JAMA Facial Plast Surg*. 2017;19(6):470-475. doi:10.1001/jamafacial.2017.0092
31. Tasca I, Compadretti GC, Losano TI, Lijdens Y, Boccio C. Extracorporeal septoplasty with internal nasal valve stabilisation. *Acta Otorhinolaryngol Ital*. 2018;38(4):331-337. doi:10.14639/0392-100X-1525
32. Tian Q, Chu T, Sun H, Pang M. Outcomes of Endonasal Septoplasty and Extracorporeal Septal Reconstruction in Anterocaudal Septal Deviation. *Ear Nose Throat J*. 2021;100(5_suppl):645S-651S. doi:10.1177/0145561320903147
33. Maniglia CP, Maniglia JV. Rhinoseptoplasty in children. *Braz J Otorhinolaryngol*. 2017;83(4):416-419. doi:10.1016/j.bjorl.2016.04.019
34. Nofal AAB. Fashioned Mucoperichondrium Flap Technique in Caudal Septal Deviation. *OTO Open*. 2021;5(2):2473974X211013744. Published 2021 May 10. doi:10.1177/2473974X211013744

35. Dizdar D, Bozan A, Dizdar SK, Göde S, Alpay HC. Evaluation of nasal symptoms in septoplasty patients using SNOT-22. *Acta Otorhinolaryngol Ital*. 2019;39(2):98-102. doi:10.14639/0392-100X-2061
36. Gupta N. Endoscopic septoplasty. *Indian J Otolaryngol Head Neck Surg*. 2005;57(3):240-243. doi:10.1007/BF03008021
37. Avcı D, Hartoka Sevinç A, Güler S. The systolic pulmonary artery pressure and the E/e' ratio decrease after septoplasty in patients with grade 2 and 3 pure nasal septal deviation. *Braz J Otorhinolaryngol*. 2021;87(5):497-504. doi:10.1016/j.bjorl.2020.10.006
38. Smitha SG, Jagannath B, Mathew AS. Impact of Septal Correction on the Blood Pressure of Hypertensive Patients with Deviated Nasal Septum. *Indian J Otolaryngol Head Neck Surg*. 2016;68(1):46-51. doi:10.1007/s12070-015-0840-9
39. Ketcham AS, Han JK. Complications and management of septoplasty. *Otolaryngol Clin North Am*. 2010;43(4):897-904. doi:10.1016/j.otc.2010.04.013
40. Dąbrowska-Bień J, Skarżyński PH, Gwizdalska I, Łazęcka K, Skarżyński H. Complications in septoplasty based on a large group of 5639 patients. *Eur Arch Otorhinolaryngol*. 2018;275(7):1789-1794. doi:10.1007/s00405-018-4990-8
41. Rettinger G, Kirsche H. Complications in septoplasty. *Facial Plast Surg*. 2006;22(4):289-297. doi:10.1055/s-2006-954847
42. Koc S, Uysal IO, Uysal EB, Yenişehirli G, Duygu F. The comparison of bacteremia and amount of bleeding during septoplasty. *Eur Arch Otorhinolaryngol*. 2012;269(4):1139-1142. doi:10.1007/s00405-011-1789-2
43. Joshi RR, Riley CA, Kacker A. Complication Rates Following Septoplasty With Inferior Turbinate Reduction. *Ochsner J*. 2019;19(4):353-356. doi:10.31486/toj.19.0002
44. Valsamidis K, Printza A, Constantinidis J, Triaridis S. The Impact of Olfactory Dysfunction on the Psychological Status and Quality of Life of Patients with Nasal Obstruction and Septal Deviation. *Int Arch Otorhinolaryngol*. 2020;24(2):e237-e246. doi:10.1055/s-0040-1701269
45. Ma Q, Su K, Fu Z, Wang P, Shi H. Anxiety and depression in patients with nasal septal deviation. *Am J Otolaryngol*. 2020;41(3):102450. doi:10.1016/j.amjoto.2020.102450
46. Carmel Neiderman NN, Eisenberg N, Caspi I, et al. The effect of septal deviation on postoperative quality of life in patients undergoing radiofrequency-assisted turbinate reduction. *Laryngoscope Investig Otolaryngol*. 2022;7(2):325-334. Published 2022 Feb 18. doi:10.1002/lio2.759
47. Fidan T, Fidan V, Ak M, Sütbeyaz Y. Neuropsychiatric symptoms, quality of sleep and quality of life in patients diagnosed with nasal septal deviation. *Kulak Burun Bogaz Ihtis Derg*. 2011;21(6):312-317. doi:10.5606/kbbihtisas.2011.048
48. Saniasiaya J, Abdullah B. Quality of life in children following nasal septal surgery: A review of its outcome. *Pediatr Investig*. 2019;3(3):180-184. Published 2019 Sep 26. doi:10.1002/ped4.12145
49. Bilal N, Selcuk A, Karakus MF, Ikinciogullari A, Ensari S, Dere H. Impact of corrective rhinologic surgery on rhinogenic headache. *J Craniofac Surg*. 2013;24(5):1688-1691. doi:10.1097/SCS.0b013e31827c7d8f
50. An R, Tian L, Liu M, et al. *Lin Chuang Er Bi Yan Hou Tou Jing Wai Ke Za Zhi*. 2016;30(1):35-38.