

Beyond Deviation: Evolving Perspectives on Nasal Septum Morphology, Classification, and Clinical Relevance — A Comprehensive Review

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Abstract Background: Nasal septum deviation (NSD) represents one of the most frequent anatomical variations within the nasal cavity and is often associated with functional impairment and sinonasal disorders. Despite its high prevalence, variability in classification systems and diagnostic interpretation continues to challenge clinical standardization. **Purpose:** This study aims to provide a comprehensive evaluation of nasal septum deviation, focusing on its morphological patterns, classification approaches, and clinical relevance, with an emphasis on improving diagnostic clarity and treatment planning. **Methods:** A thorough evaluation was conducted of articles related to nasal septum. Electronic databases such as PubMed, MEDLINE, EMBASE, and the Cochrane Library were used for a thorough search, and only English-language publications were included. A structured analysis was conducted using radiographic imaging assessing the presence, type, and severity of septal deviations. Established classification systems were applied, and correlations with demographic variables and associated nasal findings were examined. **Results:** Nasal septum deviation was observed in a significant proportion of the study population, with distinct patterns such as C-shaped, S-shaped, and localized spurs being most prevalent. Certain deviation types demonstrated stronger associations with nasal obstruction and adjacent structural variations. The findings also highlighted inconsistencies between classification methods, underscoring the need for a unified framework. **Practical Implications:** A clearer understanding of nasal septum deviation patterns and their clinical implications can enhance diagnostic precision and guide individualized treatment strategies. Incorporating standardized classification and imaging-based assessment may improve surgical planning and patient outcomes.

Keywords: Nasal septum deviation, classification, morphology, nasal obstruction, radiographic analysis, clinical implications

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1. Introduction

Nasal septal deviations play a critical role in nasal obstruction symptoms, aesthetic appearance of the nose, increased nasal resistance, and sometimes snoring [1]. The assessment of anatomical variants of the nasal cavities with computed tomography (CT) and cone beam computed tomography (CBCT) has grown in importance, as different forms of such alterations may change the drainage pathways from the nasal cavity and paranasal sinuses, resulting in obstruction and sinusitis; that is, anatomical variants of the middle turbinate have a role in the pathogenesis of phlogistic processes of the paranasal sinuses [2,3]. The nasal septum is a complex osseocartilaginous structure that divides the nose into two nasal passages; However, nasal septum deviation (NSD) can be either developmental which is generally a smooth “C-shaped or S-shaped” deformity, or a result of trauma which is usually more dislocated and irregular [4].

The wide variation of NSD structure, symptoms and associated comorbidities has evolved the development of classification systems [5].

2. Classifications of Nasal Septal Deviation

Over time, several classification systems have been proposed to describe the wide morphological variations of nasal septal deviation. These systems aim to standardize diagnosis and assist in clinical and surgical decision-making.

2.1. Vidigal Classification

One of the earlier descriptive approaches, this system divides the nasal septum into anatomical regions and categorizes deviations based on their location. It is useful for understanding functional obstruction, particularly in relation to the internal nasal valve area. Vidigal et al. used a nasal septal deviation classification based on the relationship of the nasal septum to the inferior turbinate [9]. Degree I: the deviation did not reach the inferior turbinate, degree II: the deviation reached the inferior turbinate, and degree III: the deviation reached the lateral wall and compressed the inferior turbinate [9].

2.2. Mladina Classification

Mladina’s classification system has been proposed to classify the NSD according to the characteristics of the nasal septum seen horizontally and vertically on rhinoscopy or cone-beam computed tomography (CBCT)

[6]. A widely accepted and detailed system, it categorizes septal deviations into seven distinct types based on shape and position. These include anterior vertical deviations, posterior deformities, S-shaped deviations, horizontal spurs, and complex combinations. It is particularly valuable in surgical planning due to its comprehensive nature.

2.3. Guyuron Classification

This classification focuses on septal deformities in relation to external nasal appearance and aesthetic considerations. It is often applied in rhinoplasty, emphasizing deviations that influence nasal symmetry and contour. Guyuron et al. divided septal deviations into six classes to include C- and S-shaped deviations in the anteroposterior and cephalocaudal direction as well as localized deviation with nasal spur and septal tilt [8].

2.4. Baumann and Baumann Classification

A clinically oriented system that considers both septal deviation and its impact on surrounding nasal structures. It highlights the relationship between septal deformity and turbinate hypertrophy, aiding functional assessment.

Baumann and H. Baumann classified types of septal deviation into 6 types, where each type has several additional features: Type 1: septal crest, Type 2: cartilaginous deviated nose, Type 3: high septal crest deviation, Type 4: caudally inclined septum, Type 5: septal crest, and Type 6: caudally inclined septum [7].

2.5. Radiological (Imaging-Based) Classification

With the increasing use of CT and CBCT imaging, deviations are also classified based on radiographic appearance. Common patterns include C-shaped, S-shaped, reverse deviations, and septal spurs. This method provides objective assessment and is especially useful in research and preoperative evaluation.

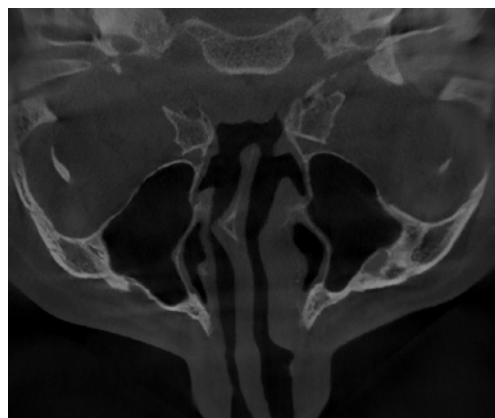




Figure 1 (a) and Figure 1 (b) The axial CBCT image demonstrates a clear right-sided deviation of the nasal septum, consistent with Deviated Nasal Septum

The axial CT sections (Figure 1 (a) and Figure 1 (b)) demonstrate a distinct rightward deviation of the nasal septum, indicative of Deviated Nasal Septum, resulting in marked asymmetry of the nasal cavities. The septum exhibits a smooth, likely C-shaped curvature with its convexity projecting into the right nasal passage, leading to appreciable narrowing of the ipsilateral airway. In contrast, the left nasal cavity appears relatively widened, possibly as a compensatory adaptation to altered airflow. The deviation seems to involve predominantly the bony components of the septum, including the vomer and perpendicular plate of the ethmoid. No obvious mucosal thickening, sinus opacification, or adjacent bony destruction is evident in the provided section. Such structural alteration may have clinical implications, including unilateral nasal obstruction, disturbed airflow dynamics, and a predisposition to sinonasal symptoms depending on severity.

3. Clinical Evaluation and Diagnosis

Clinical evaluation and diagnosis of Deviated Nasal Septum require a systematic correlation of patient symptoms with anatomical findings. A detailed history is essential, with patients commonly presenting with unilateral nasal obstruction, nasal congestion, mouth breathing, epistaxis, or reduced olfaction. A history of nasal trauma, allergy, or recurrent sinusitis should be carefully assessed, as these factors often contribute to symptom severity.

Physical examination begins with external nasal inspection to identify asymmetry or deformity, followed by anterior rhinoscopy to visualize the anterior septum and inferior turbinates. Septal deviation may appear as a C-shaped or S-shaped curvature, often associated with narrowing of one nasal cavity and compensatory widening of the opposite side. However, anterior rhinoscopy has limitations in assessing posterior deviations.

Diagnostic nasal endoscopy provides a more comprehensive evaluation, allowing visualization of the entire nasal cavity, including posterior deformities, septal spurs, and associated conditions such as turbinate hypertrophy or mucosal disease. Imaging, particularly computed tomography, is reserved for selected cases to assess the extent of deviation and associated sinus

pathology.

CBCT is considered a reliable radiological option for the evaluation of nasal obstruction and NSD. Different parameters such as septal deviation angle and septal deviation index can be computed from the CBCT that were found to be significantly different among patients with NSD [11].

4. Discussion

Septal deviations play a crucial role in functional nasal breathing. Unrecognized internal nasal septal deviations [10]. Nasal septum is most likely to be deformed in cases of nasal or facial trauma. The nasal septum separates the left and right side of the nasal cavity and thereby forms the two nostrils. It thus constitutes the medial wall of both nasal cavities and is coated with mucous membrane on both sides [12]. It is made of three parts columellar septum, membranous septum and the septum proper [13]. Deviated nasal septum is one of the main causes for nasal obstruction [14]. Most of the clinical features associated with DNS are due to obliteration of the nasal cavity of one side and over exposure of the nasal mucosa to air on the deviated part. As a result of air flow changes there is compensatory hypertrophy in the concave side, that is the side where the septum is deviated to [15]. Along with nasal obstruction, DNS is also associated with pressure headache. Specifically, spurs can present with headaches due to pressure on the lateral wall of the nose [16]. However, Deviated Nasal Septum is a common anatomical variation with variable clinical significance, depending on the degree of deviation and its impact on nasal airflow. In the present context, the observed deviation demonstrates how structural alteration of the septum can lead to asymmetrical nasal cavities, resulting in functional compromise and patient symptoms such as nasal obstruction. The association between septal deviation and impaired mucociliary clearance further explains the predisposition to recurrent sinonasal infections. Histological changes, including epithelial metaplasia and chronic inflammatory cell infiltration, highlight the long-standing nature of mucosal irritation in such cases.

Accurate diagnosis relies on correlating clinical findings with imaging and endoscopic evaluation to determine the extent and functional relevance of the deformity.

The (Figure 2) highlights common morphological patterns of Deviated Nasal Septum, demonstrating the variability in septal alignment and its impact on nasal airflow. The C-shaped deviation represents a unidirectional curvature causing unilateral obstruction, whereas the S-shaped deviation involves bilateral deformity with alternating narrowing of both nasal cavities. A septal spur appears as a localized bony projection that may impinge on adjacent structures, often contributing to contact point symptoms. Caudal dislocation refers to displacement of the anterior septum, frequently affecting nasal tip support and external nasal symmetry. Lastly, a thickened septum indicates generalized widening of septal components, which can reduce airway space without a distinct curvature. These

variations emphasize the importance of individualized assessment, as each type may present with different clinical manifestations and requires tailored management strategies. While mild deviations may remain asymptomatic, significant deviations often require intervention. Among surgical options, septoplasty has emerged as the preferred approach due to its conservative nature and ability to preserve structural integrity while effectively restoring nasal patency. Overall, early recognition and appropriate management are essential to prevent complications and improve patient quality of life.

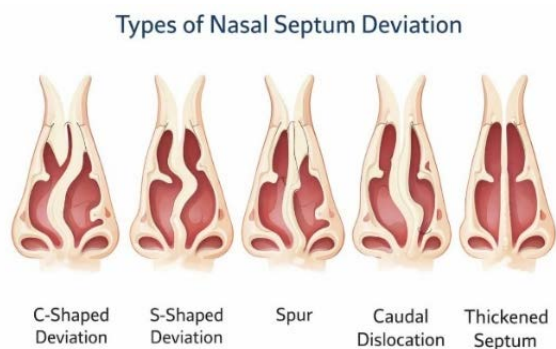


Figure 2. Types of nasal septum deviation

5. Conclusion

Nasal septum deviation remains one of the most prevalent structural abnormalities of the nasal cavity, most frequently presenting with features of nasal obstruction and, in certain cases, in association with recurrent or chronic sinusitis due to altered airflow dynamics and impaired mucociliary clearance. Histopathological changes such as squamous metaplasia and lymphocytic infiltration further reflect chronic mucosal irritation, while prolonged saccharin clearance time indicates compromised mucociliary function.

Management is primarily guided by the severity of symptoms and functional impairment. Surgical correction is indicated in symptomatic cases, with procedures such as submucous resection and septoplasty being commonly employed. However, septoplasty is generally favoured as it is a more conservative and tissue-preserving approach, allowing correction of the deformity while maintaining structural integrity of the septal cartilage and bone. This not only ensures restoration of nasal function but also minimizes complications, making it the preferred modality in contemporary clinical practice.

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