Deviated Nasal Septum: A Comprehensive Clinical Review

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Abstract—

Background: Deviated nasal septum (DNS) is one of the most common anatomical variations affecting the nasal cavity, with significant implications for respiratory function and quality of life. This condition represents a major cause of nasal obstruction and contributes to various sinonasal pathologies.

Objective: This review aims to provide a comprehensive overview of the etiology, pathophysiology, clinical presentation, diagnostic approaches, and management strategies for deviated nasal septum.

Methods: A narrative review of current literature was conducted, synthesizing evidence from clinical studies, systematic reviews, and established clinical guidelines.

Results: DNS affects a substantial proportion of the population, with varying degrees of severity. The condition can be congenital or acquired, often resulting from developmental abnormalities or trauma. Clinical manifestations range from asymptomatic deviation to severe nasal obstruction, recurrent sinusitis, and epistaxis. Diagnosis relies primarily on clinical examination supplemented by imaging when necessary. Surgical intervention through septoplasty remains the definitive treatment for symptomatic cases, while conservative management may suffice for mild presentations.

Conclusion: Understanding the multifaceted nature of DNS is essential for appropriate patient evaluation and treatment selection. A systematic approach to diagnosis and individualized treatment planning can significantly improve patient outcomes.

Keywords—**Deviated nasal septum, nasal obstruction, septoplasty, sinonasal disorders, rhinology**

I. INTRODUCTION

The nasal septum serves as the central partition dividing the nasal cavity into two chambers and plays a crucial role in maintaining proper nasal airflow, humidification, and olfaction. A deviated nasal septum occurs when this midline structure is displaced from its normal position, resulting in asymmetry of the nasal passages (1). This anatomical variation represents one of the most prevalent conditions encountered in otorhinolaryngology practice, affecting both pediatric and adult populations.

The prevalence of DNS in the general population varies considerably across studies, with estimates ranging from 20% to 80%, depending on the definition of deviation and the population studied (2). While many individuals with septal deviation remain asymptomatic, a significant proportion experience symptoms that substantially impact quality of life, including nasal obstruction, facial pain, recurrent sinusitis, and sleep disturbances (3).

The clinical significance of DNS extends beyond simple anatomical variation. The altered nasal airflow patterns associated with septal deviation can predispose individuals to various complications, including chronic rhinosinusitis, obstructive sleep apnea, and recurrent epistaxis (4). Furthermore, DNS may complicate the management of other nasal and sinus pathologies, making accurate diagnosis and appropriate treatment essential components of comprehensive rhinological care.

This review examines the current understanding of deviated nasal septum, including its embryological basis, classification systems, clinical manifestations, diagnostic methodology, and evidence-based treatment approaches. By synthesizing contemporary literature and clinical evidence, this article aims to provide clinicians with practical insights for managing patients with this common condition.

II. ANATOMY AND EMBRYOLOGY

Normal Septal Anatomy

The nasal septum comprises both cartilaginous and bony components. The anterior portion consists primarily of quadrangular cartilage, while the

posterior septum is formed by the perpendicular plate of the ethmoid bone superiorly and the vomer inferiorly (5). The septum articulates with the nasal spine of the maxilla anteroinferiorly and the nasal bones superiorly. The mucoperichondrium and mucoperiosteum cover the cartilaginous and bony portions respectively, providing vascular supply and structural support.

Embryological Development

The embryological development of the nasal septum is a complex process that begins during the sixth week of gestation. The septum develops from the fusion of multiple mesodermal elements, including contributions from the frontonasal prominence and the maxillary processes (6). Any disruption in this developmental process can result in septal abnormalities. The cartilaginous and bony components develop at different rates, with the perpendicular plate of the ethmoid and vomer ossifying from separate centers. This differential growth pattern contributes to the high prevalence of septal deviations, as disproportionate growth can lead to buckling or displacement of septal structures (7).

III. ETIOLOGY AND PATHOGENESIS

Congenital Factors

Congenital deviations result from developmental abnormalities during fetal growth or trauma during the birth process. Intrauterine positioning and birth trauma, particularly during difficult deliveries, have been implicated in the development of early septal deviations (8). Genetic factors may also play a role, as evidenced by familial clustering of septal abnormalities, though specific genetic mechanisms remain incompletely understood.

Acquired Causes

Traumatic injury represents the most common acquired cause of DNS. Nasal trauma, whether from sports injuries, motor vehicle accidents, or interpersonal violence, can displace septal cartilage and bone, resulting in deviation (9). The pediatric population is particularly vulnerable, as trauma during active growth periods can alter subsequent septal development, leading to progressive deviation over time.

Developmental Factors

Differential growth rates between septal components during childhood and adolescence can produce deviation even in the absence of trauma. The septum grows in multiple dimensions through both endochondral and membranous ossification, and any imbalance in these processes can result in buckling or displacement (10). Maxillary and midface development also influences septal alignment, with craniofacial growth abnormalities potentially contributing to secondary septal deviations.

Classification of Deviated Nasal Septum

Several classification systems have been proposed to categorize septal deviations based on anatomical location, severity, and morphology. Cottle described seven types of septal deviations based on anatomical characteristics and functional impact (11). More contemporary classifications consider the direction of deviation (left, right, or bilateral), location (anterior, posterior, or diffuse), and morphology (C-shaped, S-shaped, or localized spur formation).

Modified Functional-Anatomical Classification System

We propose a modified classification system that integrates anatomical location with functional impact and surgical complexity, providing a practical framework for clinical decision-making and prognostication. Table 1 presents the comprehensive classification framework.

Table 1: Modified Functional-Anatomical Classification of Deviated Nasal Septum

Type	Classification	Anatomical Location	Structures Involved	Morphological Features	Associated Findings	Surgical Complexity	Expected Outcomes
I	Simple Anterior Deviation	Anterior one-third	Quadrangular cartilage	Unilateral, single deflection point	Minimal turbinate hypertrophy	Low	Excellent (>90% success)
II	Complex Anterior-Middle	Anterior to middle third	Cartilage + bony-cartilaginous	C-shaped or S-shaped, maxillary crest	Moderate compensatory changes	Moderate	Good (75-85% success)

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III	Posterior-Dominant Deviation	Posterior two-thirds	Perpendicular plate of ethmoid, vomer	Impingement on middle turbinate	Chronic rhinosinusitis, ostial obstruction	Moderate to High	Good (70-80% success)
IV	Pan-Septal Deviation	Entire septum (all segments)	All septal components	Multiple deflection points, 3D complexity	Severe bilateral turbinate changes	High	Fair to Good (65-75% success)
V	Caudal Septal Deviation	Caudal septum and columella	Caudal quadrangular cartilage, anterior nasal spine	External nasal deviation, loss of tip support	Visible cosmetic deformity	High	Good with open approach (70-80% success)
VI	Basal Deviation with Floor Asymmetry	Septal base and nasal floor	Maxillary crest, vomer base	Bilateral floor spurs, significant asymmetry	Floor mucosal thickening	Moderate	Good (75-85% success)

This classification system correlates anatomical complexity with surgical approach requirements and helps predict potential complications. Type I deviations generally respond well to conservative septoplasty with excellent outcomes. Types IV and V often require more extensive reconstruction, possible grafting, and carry higher revision rates. The system also facilitates standardized reporting in clinical research and outcome studies.

The clinical utility of classification lies in surgical planning and outcome prediction. Anterior deviations typically produce more noticeable external nasal deformity and may be more symptomatic due to involvement of the nasal valve region. Posterior deviations primarily affect nasal airflow in the deeper nasal cavity and may contribute more significantly to sinus ostial obstruction (12).

IV. CLINICAL PRESENTATION

Symptoms

The clinical manifestations of DNS vary considerably among patients. The most common presenting complaint is unilateral or bilateral nasal obstruction, which may be constant or alternating depending on the nasal cycle and mucosal congestion (13). Patients may report preference for sleeping on one side to optimize nasal breathing, or they may experience positional changes in nasal patency.

Additional symptoms include facial pressure or pain, particularly over the maxillary or frontal regions, which may result from sinus ostial obstruction and secondary sinusitis. Recurrent epistaxis can occur when the deviated septum creates areas of turbulent airflow and mucosal desiccation. Some patients experience anosmia or hyposmia due to altered airflow patterns affecting the olfactory region (14).

Sleep-related symptoms warrant particular attention, as DNS frequently contributes to snoring and may exacerbate obstructive sleep apnea. Patients may report daytime fatigue, morning headaches, and poor sleep quality. The chronic mouth breathing that often accompanies severe nasal obstruction can lead to xerostomia and increased susceptibility to oral and dental problems (15).

Physical Examination Findings

Anterior rhinoscopy reveals the degree and location of septal deviation. Examination should assess the entire nasal cavity, including the nasal vestibule, anterior septum, inferior and middle turbinates, and visible portions of the nasal floor and lateral wall.

The examiner should note the presence of compensatory turbinate hypertrophy, which commonly develops on the contralateral side of the deviation due to increased airflow exposure (16).

Nasal endoscopy provides superior visualization of posterior septal deviations and allows assessment of the ostiomeatal complex and other structures not visible during anterior rhinoscopy. The examination should document septal spurs, perforations, or other anatomical variants that may influence treatment planning. External nasal examination may reveal asymmetry or deviation of the dorsum in cases of significant anterior septal displacement.

V. DIAGNOSTIC EVALUATION

Clinical Assessment

The diagnostic evaluation begins with a thorough history focusing on the onset, duration, and severity of symptoms, previous nasal trauma or surgery, and impact on quality of life. Several validated instruments exist for quantifying symptom severity, including the Nasal Obstruction Symptom Evaluation (NOSE) scale, which provides a standardized measure of obstruction-related quality of life impairment (17).

Physical examination findings should be systematically documented, including the degree of deviation, location, morphology, and associated findings such as turbinate hypertrophy, mucosal inflammation, or polyps. The Cottle maneuver, performed by laterally displacing the cheek to open the nasal valve area, can help determine whether symptoms result primarily from septal deviation or valve collapse (18).

Imaging Studies

While diagnosis of DNS is primarily clinical, imaging plays an important role in selected cases. Computed tomography (CT) of the paranasal sinuses provides detailed visualization of bony and cartilaginous septal anatomy and is particularly valuable when concurrent sinus disease is suspected or when surgical planning requires precise anatomical delineation (19). CT imaging can identify septal spurs impinging on the middle turbinate or lateral nasal wall, posterior deviations not visible on anterior examination, and the relationship between septal deviation and sinus ostia.

Magnetic resonance imaging is rarely indicated for DNS alone but may be considered when soft tissue pathology requires characterization or when complications such as intracranial extension of disease are suspected. Routine imaging is not recommended for straightforward cases of DNS without complicating factors (20).

Differential Diagnosis

The differential diagnosis of nasal obstruction extends beyond simple DNS and must be carefully considered during evaluation. Allergic and non-allergic rhinitis can produce similar symptoms and frequently coexist with septal deviation. Turbinate hypertrophy, whether compensatory or independent, contributes significantly to nasal obstruction. Nasal valve dysfunction, adenoid hypertrophy in children, and nasal polyposis must be distinguished from or identified as concurrent conditions (21).

Neoplastic processes, though less common, should be considered in cases of unilateral obstruction with associated symptoms such as epistaxis, anosmia, or facial pain. Systemic conditions affecting nasal mucosa, including granulomatous diseases and vasculitides, may present with obstructive symptoms and require specific diagnostic evaluation (22).

VI. MANAGEMENT STRATEGIES

Conservative Management

Not all patients with DNS require surgical intervention. Conservative management is appropriate for individuals with minimal symptoms, mild deviations, or those who prefer to avoid surgery. Medical therapy addresses inflammatory components and symptomatic relief rather than correcting the anatomical abnormality.

Topical nasal corticosteroids reduce mucosal inflammation and can improve nasal patency, particularly in patients with concurrent rhinitis or compensatory turbinate hypertrophy (23). Nasal saline irrigations help maintain mucosal health, clear secretions, and may provide modest symptomatic improvement. Oral decongestants offer temporary relief but are not suitable for long-term use due to side effects and potential for rebound congestion with topical preparations.

Environmental modifications, including use of humidifiers, avoiding irritants, and optimizing sleep positioning, may benefit some patients. Patient education regarding realistic expectations and the limitations of medical therapy is essential. Regular follow-up allows reassessment of symptom progression and treatment effectiveness (24).

Surgical Management

Septoplasty represents the definitive treatment for symptomatic DNS unresponsive to conservative measures. The procedure aims to straighten the septum while preserving structural support and mucosal integrity. Modern septoplasty techniques emphasize conservative cartilage preservation, recognizing the septum's importance in nasal support and facial growth, particularly in pediatric patients (25).

The surgical approach varies based on deviation type and surgeon preference. Most commonly, a hemitransfixion or Killian incision provides access to the septal cartilage and bone. The mucoperichondrial flaps are elevated, deviated portions are identified, and correction is achieved through controlled fractures, cartilage scoring, or limited resection. Care must be taken to preserve at least a 10-15mm L-strut of dorsal and caudal septal support to prevent saddle nose deformity or loss of tip support (26).

Concurrent procedures are frequently performed during septoplasty. Turbinate reduction addresses compensatory hypertrophy or independent turbinate enlargement contributing to obstruction. Functional endoscopic sinus surgery may be indicated when DNS contributes to chronic rhinosinusitis through ostial obstruction. Rhinoplasty techniques can be incorporated when external nasal deviation accompanies internal septal pathology, a combined procedure termed septorhinoplasty (27).

Outcomes and Complications

Septoplasty demonstrates high success rates, with 70-90% of patients reporting significant improvement in nasal breathing in most series (28). Patient selection, realistic expectations, and technical precision contribute to favorable outcomes. Factors associated with poorer outcomes include revision surgery, severe deviations, and inadequate addressing of concurrent pathology such as turbinate hypertrophy or valve dysfunction.

Complications, while generally uncommon, include bleeding, infection, septal perforation, saddle nose deformity, changes in nasal appearance, and persistent or recurrent deviation. Septal hematoma represents an urgent postoperative complication requiring prompt drainage to prevent cartilage necrosis and subsequent deformity (29). Changes in olfaction and dental sensation can occur due to nerve injury but are typically temporary.

Long-term follow-up reveals that patient satisfaction generally correlates with objective improvement in nasal airflow and symptom resolution. Quality of life measures demonstrate significant improvement in patients undergoing successful septoplasty for symptomatic DNS (30).

VII. SPECIAL CONSIDERATIONS

Pediatric Population

Management of DNS in children requires special consideration of ongoing craniofacial growth. While septoplasty can safely be performed in carefully selected pediatric patients with severe symptoms, most surgeons prefer to delay surgery until completion of facial growth when possible (31). Conservative approaches involve managing inflammatory components and deferring definitive correction until adolescence unless severe obstruction, recurrent sinusitis, or significant quality of life impairment necessitates earlier intervention.

Elderly Patients

Septal deviation in elderly patients may be complicated by age-related changes in nasal anatomy, including atrophic rhinitis and decreased mucosal resilience. Careful patient selection and modified surgical techniques may be necessary to optimize outcomes while minimizing risks in this population (32).

Future Directions

Advances in imaging technology, including three-dimensional reconstruction and computational fluid dynamics modeling, offer promise for improving preoperative planning and outcome prediction. These technologies allow detailed analysis of nasal airflow patterns and can identify areas of maximal resistance, potentially guiding more targeted interventions (33).

Tissue engineering approaches to septal reconstruction are under investigation, with potential applications in cases of severe deviation or revision surgery where adequate native cartilage is lacking. Biomaterials and autologous tissue constructs may eventually provide alternatives to traditional surgical techniques (34).

Patient-reported outcome measures continue to evolve, providing more sophisticated tools for assessing treatment success and guiding clinical decision-making. Incorporation of validated quality of life instruments into routine practice enables more objective evaluation of intervention effectiveness and facilitates comparison across studies (35).

VIII. CONCLUSION

Deviated nasal septum represents a common anatomical variation with significant potential impact on respiratory function and quality of life. Successful management requires thorough understanding of nasal anatomy, careful patient evaluation, and individualized treatment planning. While conservative measures may suffice for mild cases, septoplasty remains an effective definitive treatment for appropriately selected patients with symptomatic DNS.

The multifactorial nature of nasal obstruction necessitates comprehensive assessment to identify all contributing factors, as optimal outcomes depend on addressing the full spectrum of pathology. Continued advances in diagnostic imaging, surgical techniques, and outcome measurement promise to further refine our approach to this prevalent condition.

Clinicians must maintain realistic expectations regarding surgical outcomes and ensure that patients understand both the benefits and limitations of intervention. When performed for appropriate indications using sound surgical principles, septoplasty significantly improves nasal breathing and quality of life for the majority of patients with symptomatic deviated nasal septum.

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