Review Article

Rishi Bhatta

Department of ENT, KIST Medical College Teaching Hospital, Nepal

Corresponding Author

Dr. Rishi Bhatta, Department of ENT, KIST Medical College Teaching Hospital, Nepal

Email: drrishient@gmail.com

Phone: +977-9841364427

PARADIGM SHIFTS IN RHINOLOGY: THE INTERSECT OF ENDOSCOPIC PRECISION AND PACK-LESS COMFORT IN SEPTOPLASTY

ABSTRACT

Aims and Objectives: Septoplasty is evolving towards improved surgical precision and patient-centered postoperative care. Endoscopic techniques and pack-free approaches represent important advances in this regard. To review global evidence and Nepal-specific literature on endoscopic septoplasty and pack-free postoperative management.

Methods: A narrative review of published literature comparing conventional and endoscopic septoplasty, as well as nasal packing and alternative pack-free techniques.

Results: Endoscopic septoplasty offers enhanced visualization, particularly for posterior and focal deviations, with potential benefits in mucosal preservation and reduced complications. Evidence also suggests that routine nasal packing increases postoperative discomfort, pain and synechiae without significantly reducing major complications in uncomplicated cases. Nepalese studies show mixed outcomes regarding endoscopic techniques, while evidence on pack-free surgery remains limited.

Conclusion: Individualized adoption of endoscopic and pack-free techniques may improve surgical precision and patient comfort, considering clinical indications and available resources.

Keywords: Conventional, endoscopy, pack-less, septoplasty

INTRODUCTION

Nasal septal deviation is a common anatomical variation, affecting approximately 70-80% of the population, although only 25-30% experience clinically significant nasal obstruction. Not all deviations are symptomatic or require surgery. Septoplasty is indicated when persistent nasal obstruction is attributable to septal deviation and remains troublesome despite appropriate medical management of coexisting conditions, such as rhinitis. Assessment involves clinical history, anterior rhinoscopy and, when indicated, nasal endoscopy to differentiate septal deviation from other causes of obstruction, including turbinate hypertrophy, nasal valve dysfunction, polyps and chronic inflammatory disease. Surgical decisions should therefore be based on symptoms and clinical findings rather than septal appearance alone.

Septoplasty is one of the most commonly performed procedures in otolaryngology, primarily aimed at correcting septal deformities, improving nasal airflow and enhancing quality of life. Successful surgery should restore nasal function while preserving septal support and minimizing complications. Conventional septoplasty remains widely practiced because of its familiarity, accessibility and effectiveness in treating many anterior and extensive septal deviations. However, its limitations are more apparent in posterior, focal and anatomically complex deformities.

Traditionally, septoplasty was performed under headlight illumination and frequently involved bilateral nasal packing. Although effective in maintaining septal alignment and reducing postoperative hematoma formation, this approach was associated with considerable patient discomfort, including nasal obstruction, forced oral breathing, facial pressure, dysphagia, sleep disturbance and pain during pack removal.

Contemporary rhinology increasingly emphasizes patient-centered care and functional outcomes. Surgical success is no longer defined solely by anatomical correction but also by postoperative comfort, reduced pain, rapid recovery, uninterrupted sleep and early return to daily activities. These changing expectations have encouraged the adoption of two important innovations: endoscopic septoplasty and pack-free surgery using internal silicone splints with integrated airway tubes.

Together, these techniques offer improvements in surgical visualization and postoperative recovery. However, neither approach is universally appropriate, and their selection should consider patient anatomy, bleeding risk, surgical

complexity, surgeon expertise and available resources. This review examines the global evidence alongside the limited Nepal-specific literature, highlighting clinical implications, challenges and priorities for future research.

From Blind Pressure to Airway Patency: The Rise of Pack-Less Splints

For decades, anterior nasal packing was routinely used after septoplasty to control bleeding, stabilize the septum, prevent septal hematoma and maintain mucosal flap approximation. [1, 2] Common materials included ribbon gauze, expandable polyvinyl alcohol sponges and inflatable balloons. However, nasal packing is widely recognized as one of the most uncomfortable aspects of septal surgery [3-6] By exerting circumferential pressure and completely obstructing the nasal passages, packing forces mouth breathing, causing dry mouth, dysphagia, sleep disturbance, facial pain and headache. These effects are particularly concerning in elderly patients and those with obstructive sleep apnea or cardiopulmonary comorbidities. [7,8] Furthermore, the stagnant environment created by nasal packing may increase the risk of toxic shock syndrome. [1,9] Pack removal can also cause considerable pain, mucosal trauma and bleeding [3,5]

Evidence suggests that routine nasal packing is unnecessary in most uncomplicated septoplasties when meticulous surgical technique and adequate intraoperative hemostasis are achieved with only 3.8% of patients requiring postoperative packing as per a study done in England. [10] Studies have demonstrated that packing does not significantly influence surgical outcomes or complication rates.[6]

To overcome the limitations of conventional packing, contemporary practice increasingly favors pack-free techniques. Although transseptal sutures have been successfully used to achieve pack-free septoplasty,[11] internal silicone splint with integrated airway tubes is an upcoming employed alternative. Made from medical-grade biocompatible silicone, these splints provide localized compression and stabilize the septal mucosal flaps while maintaining nasal airway patency. They also help prevent septal hematoma and reduce synechiae formation without completely obstructing the nasal cavity.

The principal advantages of airway-integrated silicone splints include preservation of postoperative nasal breathing, reduced discomfort and edema, and less mucosal trauma during removal. Their smooth silicone surface minimizes adhesion to healing mucosa, reducing pain and bleeding compared with conventional packing[12,13] Furthermore, airway-integrated splints may help prevent postoperative nocturnal hypoxia by maintaining nasal airflow[14-16]. Studies have also reported reduced postoperative Eustachian tube dysfunction with silicone nasal splints. [17]

Internal nasal splints with an integrated airway tube (e.g., silicone septal splints with airway) offer several advantages over conventional nasal packing, particularly in maintaining postoperative nasal airflow. However, they also have certain disadvantages.

1. Tube blockage [12]: The airway tube may become obstructed by blood clots, crusts and nasal secretions, resulting in impaired nasal breathing and requiring frequent saline irrigation or suctioning.

2. Inadequate control of postoperative bleeding[12]: Unlike conventional nasal packing, which provides direct pressure over a relatively large mucosal surface, splints may provide less effective tamponade in patients with significant postoperative bleeding.

3. Higher cost: Commercially available silicone splints with integrated airway tubes are generally more expensive than conventional nasal packing materials.

4. Difficulty in insertion and positioning: Insertion of splints requires adequate surgical expertise. Improper positioning may cause mucosal trauma, turbinate injury or pressure-related complications.

5. Risk of displacement: Splints may become displaced or migrate if not adequately secured, potentially causing discomfort or airway obstruction.

Shifting Focus: The Endoscope vs. The Headlight

The evolution of septoplasty is closely linked to improvements in intraoperative visualization. Conventional septoplasty uses a headlight and nasal speculum, which provide adequate visualization for anterior septal deviations but may offer limited illumination and restricted access to deeper posterior regions.[18] In contrast, endoscopic septoplasty, typically performed using a 0° or 30° rigid Hopkins telescope, provides magnified, direct illumination of the operative field. This facilitates identification of the subperichondrial and subperiosteal planes, reduces unnecessary mucosal flap elevation, and allows precise correction of posterior spurs and bony deviations while preserving mucosal integrity[4,19, 20]

Endoscopic visualization offers several advantages, including improved tissue-plane identification, reduced risk of mucosal tears and septal perforation, and better access to posterior septal abnormalities, including vomerine deviations and bony spurs. It also facilitates identification of associated intranasal pathology, such as concha bullosa, nasal polyps and masses, allowing simultaneous management when indicated. [18] Furthermore, endoscopic septoplasty serves as an effective teaching tool by providing enhanced visualization of surgical anatomy.[21, 22] Improved visualization enables targeted correction with less tissue trauma and bleeding, potentially reducing postoperative morbidity and

improving functional outcomes.

Comparative studies, systematic reviews and meta-analyses have generally reported favorable outcomes with endoscopic septoplasty, particularly for posterior and complex septal deviations.[20,21,23-28] However, findings are not entirely consistent. A study from Nepal reported no significant difference between conventional and endoscopic techniques [29] with similar findings reported in an Israeli study. [30] A meta-analysis suggested comparable long-term improvement in nasal obstruction between the two approaches, although endoscopic septoplasty was associated with a lower risk of complications. [31]

Although endoscopic septoplasty offers several advantages, particularly improved visualization and precision, it has certain disadvantages compared with conventional (traditional) septoplasty.

1. Steep learning curve: Requires familiarity with endoscopic anatomy, hand-eye coordination and two-dimensional visualization. Surgeons experienced in conventional septoplasty may require additional training.

2. Frequent soiling of the endoscope lens[25]: Blood and secretions from the operative field frequently contaminate the endoscope lens, necessitating repeated cleaning. This can interrupt the surgical procedure.

3. Difficulty in correcting complex septal deformities: Severe anterior deviations, caudal dislocations, S-shaped deformities and extensive cartilaginous deviations may be more difficult to correct using an endoscopic approach.[32]

4. Limited surgical field and instrument mobility[24]: Working through a narrow nasal cavity with an endoscope and instruments simultaneously can restrict manoeuvrability, particularly in patients with narrow nasal passages.

5. Dependence on specialized equipment: Requires an endoscopic camera, monitor, light source and specialized instruments, increasing initial equipment costs and maintenance requirements.

A Synergistic Approach to Patient Satisfaction

Combining endoscopic precision with pack-free surgery using airway-integrated silicone splints may improve surgical outcomes and patient satisfaction. Endoscopic visualization facilitates accurate septal correction while preserving mucosal integrity, whereas airway-integrated splints stabilize the septum and maintain nasal patency during early healing.

The future of septal surgery lies in combining anatomical correction with improved perioperative comfort and recovery. Routine nasal packing should be reserved for selected cases, such as persistent bleeding, extensive mucosal injury or complex revision surgery, rather than used universally. Similarly, endoscopic guidance offers important advantages through enhanced visualization, precise tissue-plane identification and detection of associated nasal pathology.

Ultimately, septoplasty success should be assessed not only by improved nasal airflow but also by postoperative comfort, recovery and patient satisfaction. Combining endoscopic techniques with pack-free surgery may reduce tissue trauma, postoperative pain and complications such as septal perforation and synechiae, while facilitating surgical training and potentially shortening hospital stays. This patient-centered approach represents an important advancement in contemporary septal surgery.

Global Overview

In high-income healthcare systems across North America, Western Europe and East Asia, endoscopic septoplasty and pack-free techniques are increasingly adopted, supported by improved endoscopic equipment and biocompatible silicone splints. These approaches facilitate minimally invasive surgery, preserve postoperative nasal airflow and support early discharge in uncomplicated cases.

Comparative evidence generally favors endoscopic septoplasty for selected technical and postoperative outcomes. A review of 29 comparative studies, including five randomized trials, reported less mucosal damage, fewer synechiae and residual deformities, reduced postoperative pain and shorter operating times, although functional outcomes were comparable.[26] Similarly, a 2022 systematic review and meta-analysis of 38 studies involving 2,733 patients found greater improvement in nasal obstruction scores and fewer mucosal tears with endoscopic surgery, although differences in operative time and intraoperative bleeding were not significant.[20] Another meta-analysis of 13 randomized trials involving 735 patients also reported improved nasal obstruction and fewer complications with endoscopic septoplasty.[24] However, variations in patient selection, surgical techniques, surgeon experience and outcome measures limit direct comparisons. Endoscopy therefore offers improved visualization but does not guarantee superior outcomes in every patient; conventional septoplasty remains appropriate for selected deformities.

Evidence also increasingly supports avoiding routine nasal packing after uncomplicated septoplasty when adequate hemostasis and septal stabilization are achieved. A 2017 meta-analysis of 20 randomized trials involving 2,568 patients found no significant advantage of non-absorbable packing in preventing major complications, while non-packing approaches were associated with less pain, headache and synechiae.[5] Similarly, a 2021 meta-analysis of 47 studies involving 4,087 patients reported higher rates of respiratory

distress, pain, sleep disturbance, crusting, epiphora, dysphagia and adhesions with packing, without significant differences in bleeding, hematoma, infection, perforation or residual deviation.[6] These findings support avoiding routine packing in uncomplicated cases. Similar findings have been reported in neighboring countries, where intranasal packing is increasingly avoided in septoplasty in favor of alternative approaches, considering improved patient comfort and fewer postoperative complications.[33]

However, pack-free surgery does not eliminate the need for septal stabilization. Available alternatives include transseptal quilting sutures, silicone splints, airway-integrated splints, absorbable materials or no intranasal support in selected patients. Packing remains appropriate in selected situations, including persistent bleeding, extensive mucosal injury and complex revision surgery. Thus, the choice of postoperative stabilization should be individualized according to surgical findings and patient requirements.

A Closer Look at Nepal

Nepal faces clinical challenges similar to those encountered internationally in managing symptomatic septal deviation. Although conventional septoplasty remains widely established, the adoption of endoscopic and pack-free techniques is influenced by socioeconomic, infrastructural and geographical factors. Limited access to endoscopic equipment, maintenance facilities, trained personnel and postoperative follow-up, particularly in peripheral and community hospitals, may restrict their implementation. Cost is another important consideration, as traditional ribbon gauze packing is considerably cheaper than commercial silicone splints, particularly for self-paying patients. Geographic barriers also influence postoperative management, as patients traveling from remote districts may prefer longer hospital stays until pack removal because of concerns about complications during travel.

There are studies using endoscopes on partial[34,35] or total basis[3,29,36] for septal surgery from Nepal. The findings are mixed. While one study reported comparable efficacy of conventional and endoscopic septoplasty using Freer's incision in improving symptoms associated with a deviated nasal septum[29], another demonstrated superior functional outcomes with the endoscopic approach.[36]

Studies evaluating septoplasty without nasal packing have also been reported, primarily using transseptal sutures as an alternative.[3,37] These studies generally suggest that nasal packing is associated with increased postoperative morbidity, particularly pain and synechiae formation

There are limited studies using pack-less total endoscopic technique, however an important Nepal-specific contribution is the prospective study by Basnet and colleagues at Nobel Medical College Teaching Hospital, Biratnagar, involving 65 patients who underwent endoscopic septoplasty without nasal packing.[3] This study demonstrates the feasibility of pack-free endoscopic septoplasty in a Nepalese tertiary-care setting.

However, study from Nepal with single-center design and relatively small sample limit generalizability. Without a comparative group, it cannot establish the superiority of endoscopic over conventional septoplasty or pack-free over packed surgery, nor can it represent national practice patterns. Larger multicenter studies using standardized outcome measures are needed to establish the effectiveness and applicability of these techniques across Nepal.

A stepwise implementation strategy may be appropriate for Nepalese healthcare settings. Endoscopic assistance can be prioritized in hospitals with adequate equipment and trained personnel, particularly for posterior deviations, isolated spurs, revision surgery and suspected associated nasal pathology. Conventional septoplasty remains appropriate for selected cases. Similarly, pack-free techniques may be adopted when adequate hemostasis and septal stabilization are achieved, while nasal packing should remain available for persistent bleeding and complex procedures. Such an approach allows gradual modernization while considering local resources, patient needs and surgical safety.

DISCUSSION

The central message of current evidence is the shift from technique-centered septoplasty toward patient-centered care. Endoscopic visualization improves surgical precision and facilitates targeted dissection, while pack-free management reduces discomfort associated with postoperative nasal occlusion. Although complementary, these approaches address different sources of morbidity and should be considered independently.

Conventional septoplasty relies on headlight illumination and a Killian speculum, which may restrict visualization of posterior and complex septal deviations. In contrast, rigid 0° and 30° endoscopes provide magnified illumination, improve identification of subperichondrial and subperiosteal planes, and facilitate precise correction while preserving mucosal integrity. Comparative studies generally report less mucosal trauma and fewer adhesions with endoscopic surgery, particularly for posterior and focal deviations.[19,20] However, functional outcomes are not consistently superior, and results depend on patient selection and surgical expertise. Equipment costs, maintenance, sterilization and the learning curve also influence its implementation.

Evidence increasingly supports avoiding routine nasal packing after uncomplicated septoplasty when adequate hemostasis and septal stabilization are achieved. Systematic

reviews report less postoperative pain, headache and sleep disturbance with non-packing approaches, without significant increases in major complications such as bleeding, hematoma, infection or septal perforation[5,6] Nevertheless, these findings do not exclude risks in patients with extensive mucosal injury, persistent bleeding or complex revision surgery. Safe pack-free management requires meticulous hemostasis, mucosal flap approximation, appropriate stabilization and postoperative monitoring.

Pack-free alternatives include transseptal quilting sutures, silicone splints with or without integrated airway tubes, absorbable materials and, in selected cases, no intranasal support. Airway-integrated silicone splints provide septal support while maintaining partial nasal airflow, although postoperative edema, blood and crusting may still restrict breathing. The choice should depend on surgical findings, bleeding risk, mucosal integrity and surgeon experience.

Patient-centered outcomes should be assessed using validated measures, including the Nasal Obstruction Symptom Evaluation (NOSE) score, postoperative pain, sleep quality, analgesic requirements, return to daily activities and patient satisfaction. Longer follow-up is also necessary to evaluate persistent obstruction, synechiae, septal perforation and residual deviation. Standardized outcome measures would improve international comparisons and facilitate evaluation of results in Nepalese healthcare institutions.

Economic and infrastructural considerations are particularly important in resource-limited settings. Avoiding routine packing may reduce material costs, nursing requirements and pack-related discomfort, potentially facilitating earlier discharge. Conversely, endoscopic systems require substantial initial investment, maintenance and trained personnel. Economic evaluations should therefore consider the overall costs of treatment rather than assuming that either approach is universally more cost-effective.

Endoscopic septoplasty also involves a learning curve, requiring surgeons accustomed to conventional techniques to adapt to monitor-based visualization and endoscopic instrumentation.[19] However, shared visualization may improve surgical teaching and anatomical understanding among trainees. Its implementation should therefore be accompanied by appropriate training and institutional support.

Overall, current evidence supports endoscopic septoplasty for selected anatomical deviations and discourages routine non-absorbable packing following uncomplicated procedures when adequate hemostasis is achieved. However, neither approach is universally necessary. Rather than establishing a single mandatory technique, contemporary practice should emphasize individualized, evidence-based surgical care that improves functional outcomes, minimizes postoperative morbidity and accommodates patient needs and available healthcare resources.

CONCLUSION

Endoscopic septoplasty and selective pack-free management represent important advances in modern rhinology. Endoscopy improves visualization, particularly for posterior and focal deviations, with potential benefits in mucosal preservation and complication reduction. Evidence also suggests that routine nasal packing increases postoperative discomfort without significantly reducing major complications when adequate hemostasis and alternative stabilization are achieved. Ultimately, individualized patient selection, surgical safety and patient-centered outcomes should guide clinical practice.

Recommendations

The combination of endoscopic precision and selective pack-free management offers improved surgical visualization and patient comfort. Based on the available evidence, the following recommendations are proposed:

1. **Surgical Practice**

a. Consider endoscopic septoplasty for posterior deviations, isolated spurs, revision surgery and associated intranasal pathology.
b. Avoid routine non-absorbable nasal packing in uncomplicated cases when adequate hemostasis and septal stabilization are achieved. Reserve packing for persistent bleeding, extensive mucosal injury and complex revisions.
c. Individualize postoperative stabilization using silicone splints, airway-integrated splints, quilting sutures or other appropriate alternatives.

2. **Institutional Adoption**

a. Gradually improve access to endoscopic equipment and specialized instruments, particularly in resource-limited settings such as Nepal.
b. Establish protocols for hemostasis, packing indications, postoperative monitoring, pain management and emergency follow-up.

3. **Surgical Training**

a. Integrate structured endoscopic septoplasty training into ENT residency curricula, covering anatomy, flap elevation, instrumentation, equipment maintenance and complication management.
b. Introduce new techniques through supervised training and clinical audits.

4. **Resource Allocation**

a. Encourage local manufacturing and bulk procurement of

medical-grade silicone airway splints to reduce costs.

b. Maintain conventional surgical expertise while progressively expanding access to endoscopic techniques according to available resources.

5. Patient-Centered Outcomes

a. Incorporate validated patient-reported measures, including NOSE scores, visual analogue pain scores and satisfaction assessments.

b. Monitor objective outcomes, including bleeding, synechiae, septal perforation, readmission, hospital stay and time to return to normal activities.

6. Future Research

a. Conduct multicenter Nepalese studies comparing endoscopic with conventional septoplasty and routine packing with clearly defined pack-free alternatives.

b. Standardize reporting of patient characteristics, surgical expertise, complications, follow-up duration and direct and indirect costs.

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