


ORIGINAL RESEARCH **OPEN ACCESS**

A Three-Layer Composite Graft Technique for Repair of Medium and Large Nasal Septal Perforations

Yavuz Sultan Selim Yıldırım  | Öner Sakallıoğlu  | Nihat Susaman  | Hasan Çetiner  | Sertaç Düzer  | Muhammed Emin Can  | Cahit Polat 

Health Sciences University Fethi Sekin Training and Research Hospital Otorhinolaryngology Clinic, Elazığ, Türkiye

Correspondence: Yavuz Sultan Selim Yıldırım (yssyildirim@hotmail.com)

Received: 19 November 2025 | **Accepted:** 29 March 2026

Keywords: nasal septal perforation | polydioxanone plate | rhinoplasty | septoplasty | temporalis fascia | tragal cartilage

ABSTRACT

Background: Repairing nasal septal perforations (NSPs) is a complex procedure involving various surgical techniques, with success rates that vary significantly. As the size of the perforation increases, the surgical challenge intensifies and success rates tend to decline. This highlights the need for more effective and reliable repair methods.

Objectives: The aim of this study is to evaluate the effectiveness of a three-layer sandwich technique using a polydioxanone (PDS) plate, tragal cartilage, and temporalis fascia in repairing medium- and large-sized NSPs.

Methods: Between March 2022 and November 2024, 21 patients who underwent surgery for nasal septal perforation at our clinic were evaluated. Of these patients, 6 had medium-sized perforations (11–20 mm), while 15 had large perforations (> 20 mm). In all cases, the perforation was repaired using a combination of a PDS plate, tragal cartilage, and temporalis fascia grafts. The patients were followed for an average of 8 months postoperatively. Complete closure of the perforation was defined as the criterion for surgical success.

Results: Complete closure of the septal perforation was achieved in 18 out of 21 patients (85.7%). Two patients experienced partial closure, yet both reported symptomatic improvement. No major postoperative complications were observed during the follow-up period.

Conclusions: The surgical technique utilizing a combination of PDS plate, tragal cartilage, and temporalis fascia appears to be a reliable method for the repair of medium and large septal perforations, with a high success rate and a low risk of complications. Compared to techniques described in the existing literature, this approach offers significant advantages in terms of structural support and mucosal healing.

1 | Introduction

Nasal septal perforations are defects characterized by the loss of mucosa on both sides of the septum along with the intervening cartilage or bone tissue, resulting in an abnormal communication between the nasal cavities. Although not all patients are symptomatic, some may present with severe symptoms that require surgical intervention. The most commonly reported symptoms include crusting, nasal obstruction, epistaxis, whistling, and dryness [1].

The etiologies of septal perforations are varied and include previous septal surgeries, trauma, prolonged use of topical vasoconstrictors such as oxymetazoline, cocaine abuse, cauterization, and systemic vasculitides [2]. Numerous surgical techniques have been developed to treat this complex pathology, ranging from local rotational flaps and interpositional grafts to pericranial flaps, alloplastic materials, allografts, and autologous grafts. However, these techniques yield variable success rates, and challenges remain in terms of surgical complexity and achieving optimal functional outcomes. Reported success rates

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial-NoDerivs](https://creativecommons.org/licenses/by-nc-nd/4.0/) License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

© 2026 The Author(s). *Laryngoscope Investigative Otolaryngology* published by Wiley Periodicals LLC on behalf of The Triological Society.

in the literature range widely, from 30% to 100% [1, 3]. Among interpositional techniques, the anterior ethmoidal artery flap is one of the most frequently employed methods, offering high success rates for septal perforation repair. Nevertheless, its applicability requires intact septal cartilage around the perforation. Therefore, this method cannot be used in patients who have undergone previous septoplasty where the septal cartilage has been resected [4, 5]. Based on the original description of the GPA flap, while direct visualization of the pedicle can confirm flap vascularization, dissecting around the pedicle within a confined space to facilitate proper flap rotation may be technically challenging and pose significant risks, including inadvertent arterial injury. Moreover, the incisional techniques described by the authors could result in a bulky pedicle, thereby complicating the reconstructive process. Consequently, this may lead to nasal obstruction at the inferior aspect of the nasal valve [6].

To our knowledge, this is the first study to report the integration of tragal cartilage through a polydioxanone (PDS) plate as part of a novel three-layer “sandwich” technique, together with a temporalis fascia (TPF) graft, for the repair of septal perforations—aiming to simplify the surgical procedure and enhance success rates, especially in large septal perforations and in cases where the surrounding area is deprived of cartilage support.

2 | Materials and Methods

A total of 21 patients, consisting of 9 females and 12 males with a mean age of 34.3 years, were included in the study. The study encompassed patients who underwent surgery for nasal septal perforation at the Department of Otorhinolaryngology, University of Health Sciences Elazig City Hospital, between March 2022 and November 2024, excluding those with bleeding diathesis,

a diagnosis of granulomatosis with polyangiitis, or perforations smaller than 10 mm in diameter. Ethical approval was obtained from the Fırat University Ethics Committee (approval number: 24-1330). The study was conducted in accordance with the Declaration of Helsinki, and informed written consent was obtained from all participants after being informed about the details of the study.

Demographic, clinical, and operative data were prospectively recorded, including patient age, sex, presenting symptoms, etiology of the septal perforation, history of nasal surgery (septoplasty or septorhinoplasty), smoking status, perforation size (defined by the greatest diameter) and location, perioperative and postoperative complications, follow-up duration, nasal splint retention time, and duration of antibiotic therapy. Perforation size was classified as medium (1–2 cm) or large (> 2 cm) [1]. Because perforations smaller than 1 cm were not included in our study, classification as “small” was not performed.

The primary outcome assessed was complete closure of the nasal septal perforation. Secondary outcomes included the incidence of postoperative complications and improvement in preoperative symptoms such as nasal obstruction, crusting, epistaxis, and whistling.

3 | Surgical Technique

Prior to the incision, the septal perforation was visualized endoscopically, and its dimensions were re-measured (Figure 1). All patients underwent open surgical repair. Initially, a Goodman incision was made at the columella, and dissection was carried out through the skin and subcutaneous tissues. The alar cartilages were dissected in the supraperichondrial plane, and access to

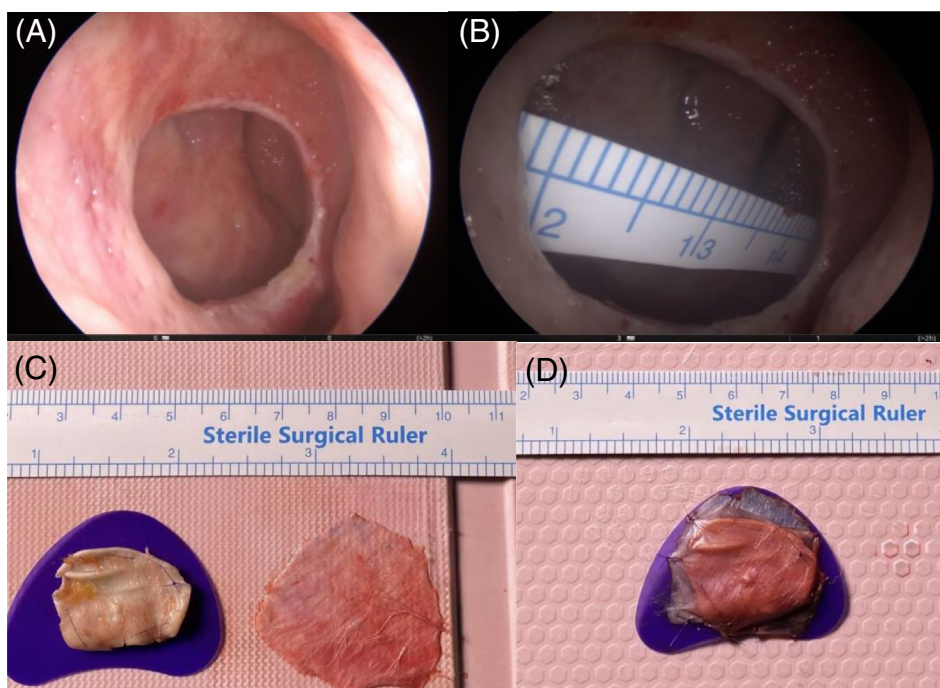


FIGURE 1 | (A, B) Intraoperative left sided endoscopic view demonstrating the size and extent of the septal perforation prior to surgical intervention. (C) Polydioxanone (PDS) plate, tragal cartilage, and temporoparietal fascia (TPF) grafts. (D) Intraoperative view of the three-layered graft, consisting of a polydioxanone (PDS) plate, tragal cartilage, and temporoparietal fascia (TPF); (PTT graft).

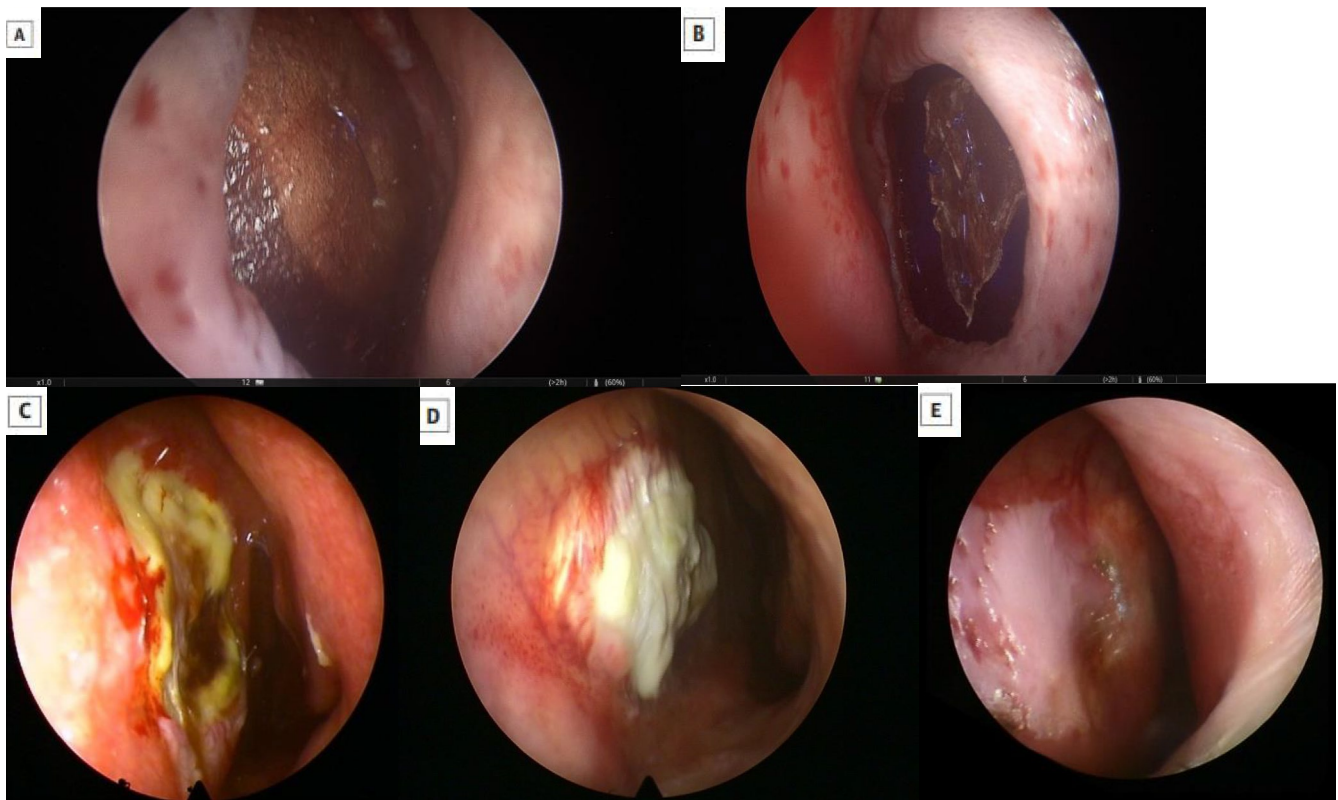
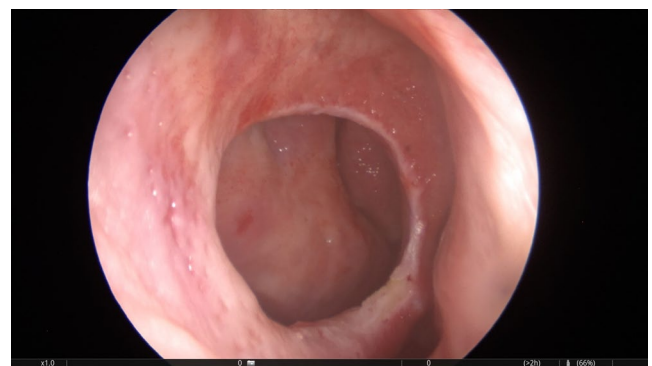


FIGURE 2 | (A) Intraoperative left-sided endoscopic view of the septal perforation after placement of PTT graft. (B) Corresponding intraoperative endoscopic view from the right side post-repair, depicting the PTT construct securely in position. (C) Endoscopic view at 21 days postoperatively immediately following internal splint removal from the left nasal cavity. (D) Endoscopic view from the left nasal cavity at 8 weeks after surgery. (E) Endoscopic view from the left nasal cavity at 6 months after surgery also demonstrates full remucosalization.

the septum was obtained superiorly. The upper lateral cartilages were separated from the septum via sharp dissection, and access to the anterior septal angle was achieved. The septal mucosa was carefully elevated in the submucoperichondrial plane to prevent enlargement of the perforation. After elevating the superior and anterior margins of the perforation, a no. 15 blade was used to incise the perforation and sharply define all its borders. Subsequently, the mucosa on the inferior and posterior aspects was also elevated, completing the mucosal elevation (Figure 2). Any septal deviation or bony crests at the base that could narrow the airway or impair graft contact with the mucosa were removed. Temporalis fascia and tragal cartilage grafts were then harvested. Tragal cartilage was first sutured onto the PDS plate (Ethicon, Johnson & Johnson Inc., New Brunswick, NJ), followed by the application of temporalis fascia, creating a three-layer sandwich graft, which was secured using 6-0 PDS sutures. If the harvested fascia graft was large enough to cover more than one side of the perforation—as shown in the accompanying video—any excess fascia was sutured to the opposite side of the PDS plate. The prepared graft, consisting of a PDS plate, tragal cartilage, and temporalis muscle fascia (PTT), was trimmed and shaped to extend at least 3 mm beyond the mucosal edges of the perforation, and was placed intranasally (Video 1). No mucosal rotational flaps or mucosal approximation sutures were used. To prevent potential dead spaces and ensure close contact between the fascia and the mucosa, loose mattress sutures were placed. At the end of the procedure, silicone Doyle splints were inserted into both nasal cavities.



VIDEO 1 | Technique for repair of septal perforation using a three-layer sandwich graft. The septal mucosa is elevated in the submucoperichondrial plane to prevent enlargement of the defect. The superior and anterior margins of the perforation are elevated and sharply delineated. Septal deviations or bony crests that may compromise airway patency or graft-mucosa contact are removed. Temporalis fascia and tragal cartilage grafts are assembled by suturing the cartilage to a PDS plate, followed by the addition of temporalis fascia to create a three-layer sandwich graft, secured with 6-0 PDS sutures. When sufficient fascia is available, excess tissue is sutured to the contralateral side of the PDS plate. The composite graft is trimmed to extend at least 3 mm beyond the perforation margins and is placed to close the perforation. Video content can be viewed at <https://onlinelibrary.wiley.com/doi/10.1002/lio2.70401>.

4 | Postoperative Follow-Up

All patients received a 7-day course of oral antibiotics after surgery, maintained Silicone Doyle splints for 21 days, and were followed for at least 4 months.

5 | Results

Over a 31-month follow-up period, nasal septal perforation (NSP) repair using the described PTT sandwich interposition graft technique was performed in a total of 21 consecutively selected

patients. The demographic characteristics and preoperative medical histories of the patients are presented in Table 1. The duration of septal perforations ranged from 12 months to over 25 years. The etiologies of the perforations were classified as follows: iatrogenic causes related to nasal surgery in 62% of patients ($n=13$), trauma in 14.2% ($n=3$), prolonged oxymetazoline use in 9.5% ($n=2$), cauterization in 4.7% ($n=1$), and idiopathic in 9.5% ($n=2$). Preoperatively, 17 patients (80.9%) reported nasal obstruction or congestion. Additionally, 62% ($n=13$) experienced crusting, 19% ($n=4$) reported whistling sounds during breathing, 28.5% ($n=6$) had episodes of epistaxis, and 4.5% ($n=1$) presented with a saddle nose deformity. Moreover, 7 patients reported active nicotine use,

TABLE 1 | Demographic data and medical history of patients.

Patient	Age	Gender	Ethiology	Nicotine use	Comorbid disease	Symptoms
1	21	M	Trauma	+	HCV+	Obstruction, saddle nose
2	19	F	Septal surgery	—	—	Crusting, epistaxis, whistling
3	33	M	Septal surgery	—	—	Crusting, obstruction, epistaxis
4	31	M	Septal surgery	+	—	Epistaxis, whistling
5	23	M	Trauma	—	—	Crusting, epistaxis, obstruction, whistling, nasal dryness
6	20	M	Septal surgery	—	—	Crusting, epistaxis, obstruction, whistling
7	33	M	Idiopathic	—	—	Crusting, obstruction, whistling
8	36	M	Septal surgery	—	Diabetes mellitus, fibromyalgia	Crusting, epistaxis
9	31	F	Cauterization	—	—	Crusting, epistaxis, obstruction, whistling
10	48	F	Septal surgery	+	Hypertension, reflux, atherosclerosis	Obstruction, nasal dryness
11	38	F	Idiopathic	+	—	Crusting, whistling
12	34	M	Septal surgery	—	—	Obstruction, whistling, nasal dryness
13	29	F	Septal surgery	—	—	Crusting, obstruction, whistling
14	42	F	Oxymetazoline usage	+	—	Crusting, epistaxis, obstruction, whistling
15	50	M	Septal surgery	+	—	Epistaxis, obstruction
16	33	F	Septal surgery	—	Asthma, cardiac arrhythmia	Obstruction, crusting, nasal dryness
17	54	M	Oxymetazoline	—	—	Obstruction, crusting
18	38	M	Septal surgery	—	—	Epistaxis, obstruction
19	43	F	Septal surgery	—	hypertension	Epistaxis, obstruction
20	42	F	Septal surgery	+	—	Obstruction, crusting
21	13	M	Trauma	—	—	Epistaxis, obstruction

1 patient used oxymetazoline intermittently, and 4 patients used daily intranasal corticosteroids. Six patients (28.5%) had medium-sized perforations (10–20 mm), and 15 patients (71.5%) had large perforations (>20 mm). The mean diameter of the perforations was 19.8 mm, with a range from 11 to 32 mm (Table 2). Of the septal perforations, 85% ($n=18$) were located in the anterior septum, while 15% ($n=3$) were posteriorly located. Two of the posterior perforations were observed in an inferior position along the nasal floor, likely due to previous septoplasty procedures (one patient had a history of two separate septoplasty operations).

Thirteen patients with nasal septal perforation and a documented history of one or more prior procedures—including open or closed septoplasty, revision septoplasty, functional endoscopic sinus surgery (FESS), septal button placement, nasal valve repair, or inferior turbinate reduction—were enrolled in the study.

Postoperative complications were infrequent and minor. One patient developed an intranasal synechia, another experienced persistent columellar inflammation, and a third demonstrated delayed mucosalization over the graft site. Among these, only the intranasal synechia persisted as a sequela, while the other complications resolved over time without additional intervention. Complete closure of the septal perforation using the PTT interpositional sandwich technique was achieved in 18 out of

21 patients (85.7%). Residual perforations remained in three patients. One of these patients had undergone two previous septoplasty surgeries, while the others had large perforations and one of these was an active smoker with a history of one septoplasty. All patients reported improvement in preoperative symptoms following surgery. A complete resolution of preoperative symptoms was achieved in 81% of patients ($n=17$). Two patients reported persistent nasal obstruction postoperatively; however, both noted significant improvement relative to their preoperative condition. No donor site-related complications were observed in any case during the follow-up period.

6 | Discussion

Repairing nasal septal perforations remains a significant surgical challenge, largely due to the wide array of techniques and graft materials described in the literature. To the best of our knowledge, this is the first case series in which large septal perforations have been repaired using a combination of a PDS plate and tragal cartilage integrated with a TPF graft.

One of the distinguishing aspects of our study is the relatively large mean perforation size. Previous reports have indicated lower success rates in repairs of large septal perforations. For

TABLE 2 | Perforation sizes, follow-up times, surgical outcomes and complications.

Patient no.	Perforation size (mm)	Follow up (month)	Closure	Graft related complications
01	32	29	+	—
02	23	19	+	—
03	21	13	+	—
04	15	9	+	—
05	20	10	+	—
06	24	12	+	—
07	25	15	+	Temporal pain
08	20	14	+	—
09	22	11	+	—
10	14	12	—	—
11	20	25	+	—
12	13	12	+	—
13	30	9	—	—
14	17	13	+	—
15	21	9	+	—
16	23	13	+	—
17	24	10	+	Tragal sensitivity
18	14	18	+	—
19	20	12	+	—
20	20	13	—	—
21	11	9	+	—

instance, Delaney et al. [1] reported a 31% success rate in patients with perforations larger than 2 cm using mucosal approximation techniques, and a 71% success rate in those with perforations over 1.5 cm. Because most techniques rely on advancement of the surrounding intranasal mucosa, the difficulty of the procedure increases exponentially with the size of the perforation. The low success rate of mucosal rotation flaps in large perforations is primarily due to insufficient mobilization of the mucosa following elevation and advancement. When tension remains on the flap after suturing, it compromises vascular supply, thereby increasing the risk of residual perforation.

Autologous tissue is generally considered the first choice in most reconstructive procedures. However, limitations such as the insufficient quantity and quality of available donor cartilage often necessitate the use of synthetic materials in septal reconstruction. PDS plates, which have been widely used in rhinologic surgery for years, have more recently been adopted for use in septal perforation repair. Polydioxanone plates are composed of a crystalline, resorbable biopolymer that degrades fully through hydrolysis and is metabolized by the body [7]. While the PDS plate itself does not close the perforation, it serves as a scaffold for graft integration during healing and may also stimulate cartilage growth [7, 8]. PDS plates provide structural support to adjacent tissues such as cartilage and fascia, and promote mucosal regeneration across the septum, thereby contributing to perforation closure. The PDS plate (Ethicon, Johnson & Johnson Inc., New Brunswick, NJ) is composed of the same biodegradable polymer used in PDS sutures, offering favorable tensile strength, structural memory, and a degradation profile of approximately 25 weeks. It is commercially available in multiple thicknesses (0.15, 0.25, and 0.5 mm), with a range of sizes, shapes, and both perforated and solid configurations [9].

In the literature, the use of a PDS plate together with fascia or cartilage, and sometimes in combination with mucosal rotational flaps, has been reported to achieve success rates of 80%–88% in the repair of small and medium-sized NSPs [10–13]. In relatively large anterior NSPs, modified anterior ethmoidal artery approaches have yielded promising results; nevertheless, the presence of cartilage or bone tissue at the edges of the perforation is essential to facilitate flap elevation [5, 14]. Sometimes, extreme destructive approaches such as pericranial flap application can be exhibited as a surgical approach. In anterior NSDs, success rates have also been reported to be high in techniques such as upper lateral cartilage, mucosal flap application and inferior turbinate flap applications [15–17]. In our series of 21 patients, the smallest perforation measured 1.1 cm, with a mean diameter of 19.8 mm. While it is well established that larger perforation size is associated with lower success rates, our study achieved complete closure in 18 of 21 patients (85.7%). Successful results in posteriorly located NSDs, those with bone-cartilage support at the margins, and larger defects highlight the distinctiveness of our study.

7 | Conclusion

This study demonstrates that the combined use of fascia, cartilage, and PDS grafts is an effective and reliable method for the repair of nasal septal perforations. The applied technique

simplifies the surgical procedure, particularly for large perforations, while providing structural stability and supporting re-epithelialization.

Funding

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

References

1. S. W. Delaney and R. W. H. Kridel, "Contemporary Trends in the Surgical Management of Nasal Septal Perforations: A Community Survey," *Facial Plastic Surgery* 35, no. 1 (2019): 78–84, <https://doi.org/10.1055/s-0038-1676049>.
2. R. W. Kridel, "Considerations in the Etiology, Treatment, and Repair of Septal Perforations," *Facial Plastic Surgery Clinics of North America* 12, no. 4 (2004): 435–vi–450, <https://doi.org/10.1016/j.fsc.2004.04.014>.
3. A. Y. Goh and S. S. Hussain, "Different Surgical Treatments for Nasal Septal Perforation and Their Outcomes," *Journal of Laryngology and Otology* 121, no. 5 (2007): 419–426, <https://doi.org/10.1017/S002221510700566X>.
4. P. Castelnuovo, F. Ferreli, I. Khodaei, and P. Palma, "Anterior Ethmoidal Artery Septal Flap for the Management of Septal Perforation," *Archives of Facial Plastic Surgery* 13, no. 6 (2011): 411–414, <https://doi.org/10.1001/archfacial.2011.44>.
5. A. Santamaría-Gadea, C. Langdon, and I. Alobid, "Extended Anterior Ethmoidal Artery Flap: Novel Endoscopic Technique for Large Septal Perforation," *Laryngoscope* 132, no. 2 (2022): 298–300, <https://doi.org/10.1002/lary.29748>.
6. A. Santamaría-Gadea, M. Vaca, G. de Los Santos, I. Alobid, and F. Mariño-Sánchez, "Greater Palatine Artery Pedicled Flap for Nasal Septal Perforation Repair: Radiological Study and Case Series," *European Archives of Oto-Rhino-Laryngology* 278, no. 6 (2021): 2115–2121, <https://doi.org/10.1007/s00405-020-06230-1>.
7. J. Rimmer, L. M. Ferguson, and H. A. Saleh, "Versatile Applications of the Polydioxanone Plate in Rhinoplasty and Septal Surgery," *Archives of Facial Plastic Surgery* 14, no. 5 (2012): 323–330, <https://doi.org/10.1001/archfacial.2012.147>.
8. D. J. Tweedie, S. Lo, and J. M. Rowe-Jones, "Reconstruction of the Nasal Septum Using Perforated and Unperforated Polydioxanone Foil," *Archives of Facial Plastic Surgery* 12, no. 2 (2010): 106–113, <https://doi.org/10.1001/archfacial.2010.1>.
9. M. Boenisch, H. Tamás, and G. J. Nolst Trenité, "Influence of Polydioxanone Foil on Growing Septal Cartilage After Surgery in an Animal Model," *Archives of Facial Plastic Surgery* 5 (2003): 316–319.
10. J. Morse, J. Harris, S. Owen, J. Sowder, and S. Stephan, "Outcomes of Nasal Septal Perforation Repair Using Combined Temporoparietal Fascia Graft and Polydioxanone Plate Construct," *JAMA Facial Plast Surg* 21, no. 4 (2019): 319–326, <https://doi.org/10.1001/jamafacial.2019.0020>.
11. J. Hughes and S. Paun, "Repair of Nasal Septal Perforations Using Conjugate Polydioxanone Plate and Autologous Cartilage Interpositional Grafts," *Otolaryngology and Head and Neck Surgery* 146, no. 2 (2012): 323–325, <https://doi.org/10.1177/0194599811424045>.

12. J. P. Sand, S. C. Desai, and G. H. Branham, "Septal Perforation Repair Using Polydioxanone Plates: A 10-Year Comparative Study," *Plastic and Reconstructive Surgery* 136, no. 4 (2015): 700–703, <https://doi.org/10.1097/PRS.0000000000001571>.
13. L. Epprecht, C. Schlegel, D. Holzmann, M. Soyka, and T. Kaufmann, "Closure of Nasal Septal Perforations With a Polydioxanone Plate and Temporoparietal Fascia in a Closed Approach," *American Journal of Rhinology & Allergy* 31, no. 3 (2017): 190–195, <https://doi.org/10.2500/ajra.2017.31.4431>.
14. I. Alobid and M. Bernal-Sprekelsen, "Boot-On-Donut Procedure for Anterior and Large Septal Perforation," *European Archives of Oto-Rhino-Laryngology* 281, no. 5 (2024): 2761–2765.
15. R. Williams, M. K. Lee, and S. P. Most, "Large Septal Perforation Repair With Pericranial Flap and Intraoperative Fluorescence Angiography," *Craniofacial Trauma & Reconstruction* 9, no. 2 (2016): 181–184, <https://doi.org/10.1055/s-0035-1570073>.
16. S. F. Bansberg, C. M. Taylor, B. E. Howard, A. M. Courson, and A. Miglani, "Repair of Large Nasal Septal Perforations Using the Upper Lateral Cartilage Mucosal Flap," *Laryngoscope* 132, no. 5 (2022): 973–979, <https://doi.org/10.1002/lary.29901>.
17. S. Mirzai, A. H. Lee, and J. J. Chi, "Nasal Septal Perforation Repair With an Inferior Turbinate Flap and Acellular Dermal Matrix," *Surgical Journal* 7, no. 1 (2021): e26-e29, <https://doi.org/10.1055/s-0040-1713418>.