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REVIEW ARTICLE

# Endoscopic approach for management of septal perforation

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## Abstract

**Introduction** Septal perforation (SP) is a rather uncommondisorder and the most frequent aetiology of SP is nasal surgery, but they can also be secondary to drug abuse, inhaled substances, trauma, neoplasms, or inflammatory systemic diseases.

**Discussion** Despite some asymptomatic presentations, the majority of SPs cause intermittent epistaxis, nasal obstruction, crusting, dryness, purulent discharge, and/or nasal whistling. Patients who have SP and mild symptoms usually require medical treatment such as nasal irrigations and ointments. Septal buttons may also be used in these patients. No gold standard technique has been recognized for the surgical management of SPs. The literature describes many methods of closure of SP. Many endoscopic techniques are available for septal repair, and the choice depends on the osteo-cartilaginous support, characteristics of the perforation (size, location) and the experience of the surgeon.

**Conclusion** This article provides a meticulous review focusing on the endoscopic approaches to repair SP. Furthermore; educational drawings and tips and tricks are also discussed.

**Keywords** Endoscopic techniques · Nasal septum · Septal perforation · Surgery

## Introduction

A septal perforation (SP) consists of a communication between both nasal cavities caused by a defect of the septum as a result of damage of both mucoperichondrium and mucoperiostium followed by necrosis of the cartilage and/or the bone [1].

The estimated prevalence of SP is about 1%, although the exact prevalence is difficult to determine [2]. Almost 40% of the patients remain asymptomatic until incidental diagnosis in a routine ENT examination, while some others complain of bothersome symptoms such as epistaxis, crusting, nasal obstruction, whistling, pain or discomfort [3, 4].

SP modifies the aerodynamic of the laminar inspiratory airflow creating turbulence, damaging and drying the respiratory epithelia, consequently leading to impairment of sinonasal function [5].

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The main cause of the SP is the iatrogenic, as nasal surgery [1], self-inflicted trauma (nose picking); however, others iatrogenic causes can occur as septal cauterization and packing for epistaxis or nasotracheal intubation. SP has been associated with different granulomatous diseases (tuberculosis, leprosy, syphilis, Wegener or sarcoidosis), as with other local etiologies such as nasal drug abuse (cocaine, nasal corticoids, and decongestants), chemical and physical irritants and neoplasms [6, 7].

Patients who have SP and mild symptoms usually require medical treatment such as nasal irrigations and ointments [1]. Septal buttons may also be used in these patients. Unfortunately, septal buttons have been associated with many complications, like pain, epistaxis, irritation or crusting and may contribute to a steady erosion of the perforation edges and eventual enlargement of the defect [8, 9].

Large SPs may seriously compromise structural support of the anterior and middle third of the nose, leading to saddling, which may further impede nasal airflow.

Pre-operative evaluation is crucial for approaching the best therapeutic management. It is highly recommended to measure and to assess the remnant of osteo-cartilaginous support as this information can influence the selection of repair technique.

Biopsy is especially important in cases of suspected neoplasm or granulomatosis [1, 10]

The literature describes many methods of closure of SP with various rates of success. Grafts of various types and both local and regional flaps have been suggested. However, the plethora of operations described testifies the difficulties involved. Despite these techniques, the closure of SP is still a challenging and difficult procedure [11].

No high level of evidence-based medicine on surgical treatments is available for SP of different sizes and locations. Each case must be evaluated individually and techniques should be chosen according to size and location of SP, quality of nasal mucosa, personal history, previous surgery and surgeon's experience [12]. Therefore, we present a new algorithm by dividing SP into two groups: with and without osteo-cartilaginous support, and according to their size and location (Fig. 1a, b).

One of the main advantages of endoscopic techniques is the avoidance of the external rhinoplasty approach using endoscope-assist procedures. Therefore, the morbidity associated with the external approach is precluded and the duration of hospitalization and the costs can be reduced [13]. On the other hand, a retrospective chart review of patients with SP enlargements has found that, in select patients, enlarging perforation's edge posterior to the head of the middle turbinate has proven effective in relieving symptoms [14].

All endoscopic approaches in the present review are done under general anesthesia. All tissues are infiltrated with a solution with epinephrine (1:100,000) for homeostasis and hydro-dissection. Incisions are performed with a needle-tipped monopolar cautery, bent at 45° or with any sharp designed instrument or scalpel.

The silastic sheets are designed and sutured to cover the flaps and the area of the exposed septal dorsum and the nasal floor. The silastic sheets are removed at about 3–4 weeks postoperatively. Patients who smoke are asked to stop smoking in the peri-operative time.

## Perforations with osteo-cartilaginous support

### Mucosal advancement flaps

This approach is based on two flaps, superior and inferior, depending on the perforation's size and location. Vascularization of the inferior flap is given by septal branches of the posterior nasal artery (sphenopalatine), as well as superior labial (facial) and incisive (major palatine) arteries. However, the superior flap is mainly irrigated by anterior ethmoidal artery [15].

The inferior flap is easier to harvest and contributes with more mucosa. If the inferior flap is not enough to cover the perforation or cannot be created without tension, a superior flap can be added [16].

The dissection starts with a hemitransfixion incision and the caudal edge of the cartilaginous septum is exposed and bilateral mucoperichondrial flaps are elevated from the septum and extended around the perforation. The superior tunnel is created and the dissection continues under the nasal dorsum and superior lateral cartilage and then extends laterally below the inferior turbinate to create an inferior flap and facilitate the advancement without tension. The perforation is rimmed to obtain fresh margins and both mucoperichondrial flaps are approximated and sutured with absorbable sutures in a nonopposing way. Auricular cartilage, temporalis fascia human or dermal allograft are sometimes placed under the flaps on both sides of the septum and should ideally overlap the defect on all sides [17] (Fig. 2a–c).

Some authors do not make a flap in the contralateral side. The fascia graft, trimmed to size, is inserted through the hemitransfixion incision. The disadvantage of autogenous graft harvesting includes additional operative time and postoperative morbidity [18].

Denuded areas heal secondarily with proper treatment without long-term dryness or crusting.

### Bilateral "cross-over" technique

This flap has two parts. A racket or square incision is started at the middle of the perforation anteriorly, extending upwards making sure the size of the flap is sufficient to cover the defect, and finish the incision at the middle posterior part. The superior margin of the perforation must be left intact.

A lower flap is tailored with the same shape on the opposite side of the septum, leaving the lower margin intact. The incision begins at the middle of the perforation anteriorly extending the incision through the nasal floor until the inferior meatus. Both flaps are crossed to the opposite side through the perforation and their subperiosteal aspect will face each other to cover the defect. The flaps can be held in place with absorbable suture, or simply by adding fibrin glue around the flap (Fig. 2d–f) [1, 19].

### Anterior ethmoidal artery septal flap

The blood supply of this flap comes from septal branches of the anterior ethmoidal artery (AEA) [20]. The mean distance between the insertion of the middle turbinate at the level

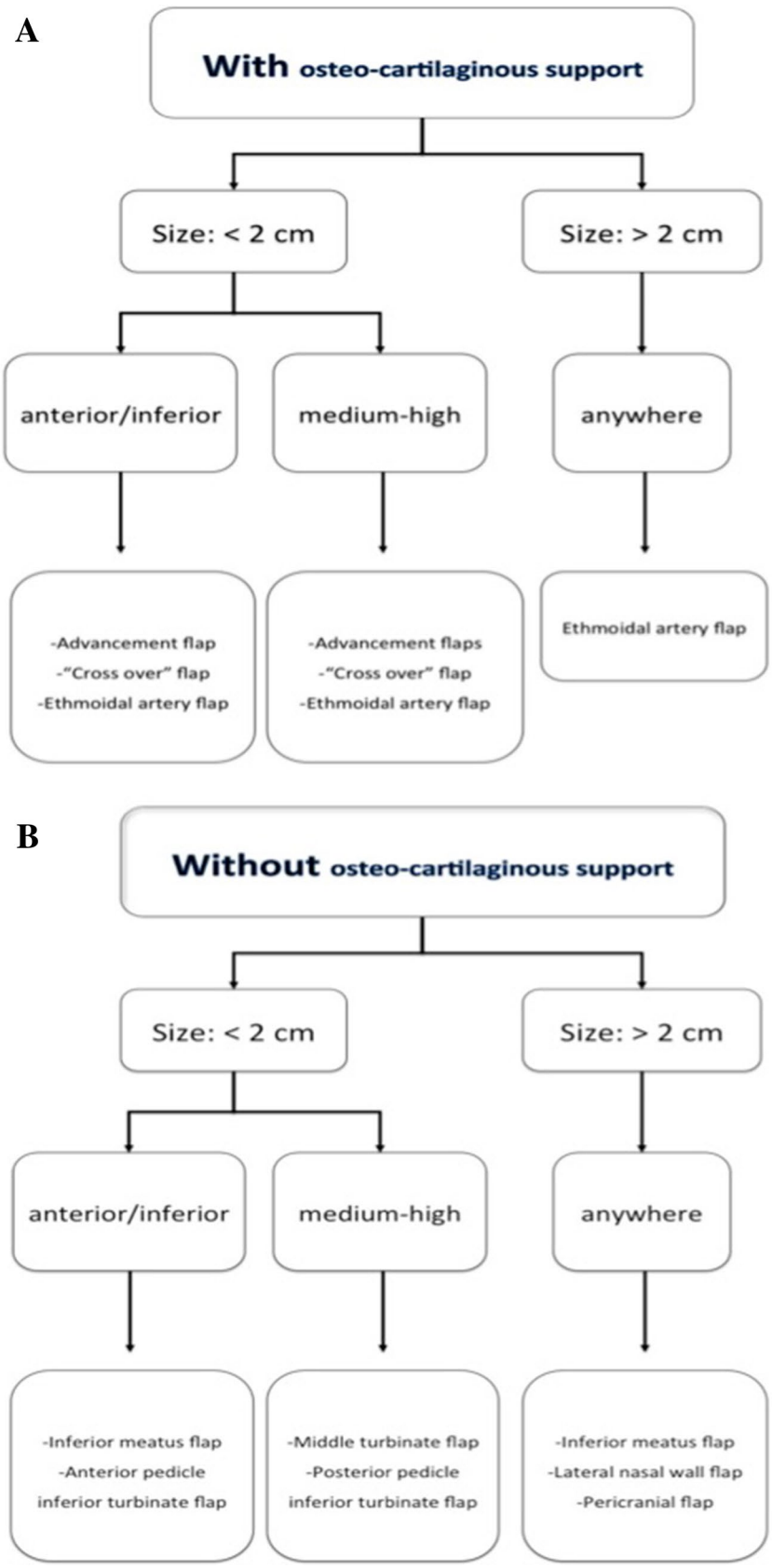



**Fig. 1** Algorithm to choose the suitable approach to repair septal perforation: **a** with osteo-cartilaginous support; and **b** without osteo-cartilaginous support

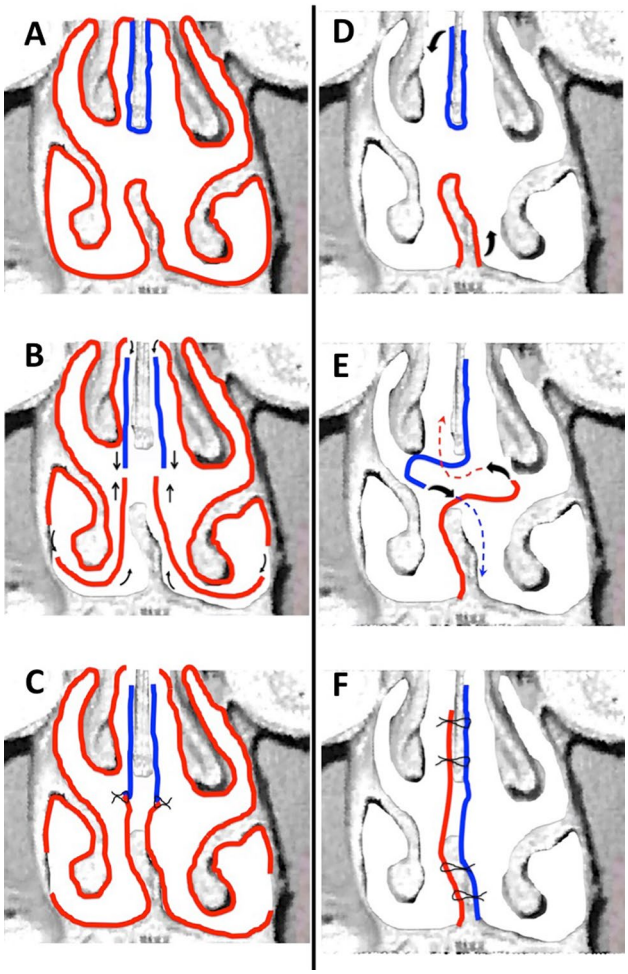



**Fig. 2** **a–c** Mucosal advancement flaps.**a** septal perforation (blue line = superior flap and red line = inferior flap). **b** Bilateral flaps are elevated from the septum. **c** Both flaps are approximated and sutured. **d–f** Bilateral "cross-over" technique. **d** Septal perforation. **e** A racket-shaped incision is tailored. An inferior flap is made with the same racket-shaped incision in the contralateral side. **f** Both flaps are crossed to the opposite side and suture in position

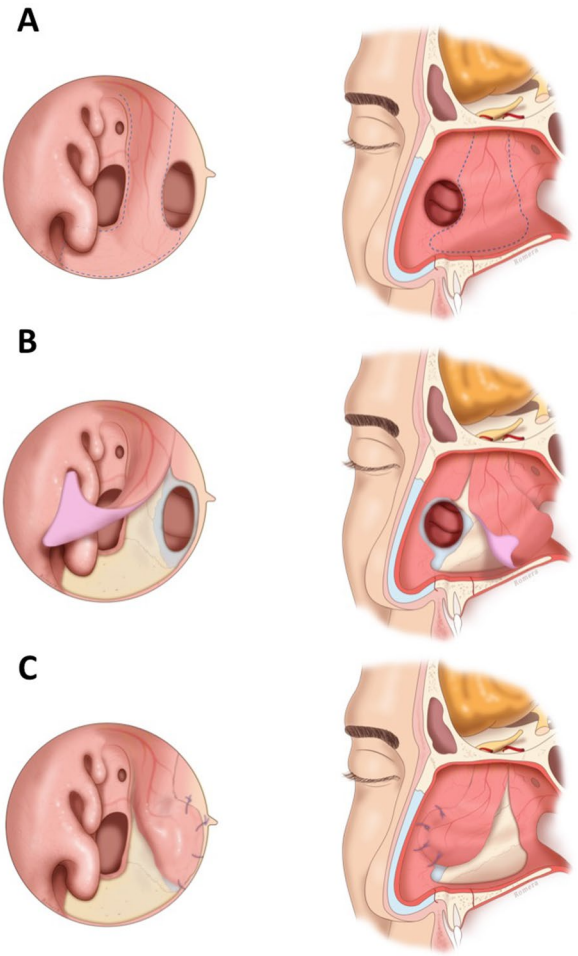



**Fig. 3** Anterior ethmoidal artery septal flap. Both endoscopic and sagittal views are shown. **a** Septal flap pedicled on septal branches of the anterior ethmoidal artery. **b** The incision starts 1 cm posteriorly to the axilla of the middle turbinate. This incision is continued along the nasal floor. Then, the incision turns parallel to the septum until it reaches the anterior portion. **c** The flap is rotated anteriorly

of nasal septum and the vertical line passing through the entrance of the AEA in the nasal septum is around 7.35 mm (range 5.5–8.7 mm) [21].

The edges of the perforation are freshened. The posterior margin of the perforation marks the beginning of the flap, which contains mucoperichondrium and mucoperiosteal. An incision of the posterior border of the flap is made, vertically along the septum, 1 cm posterior to the septal projection of the axilla of the middle turbinate. This incision is continued along the nasal floor and is expanded laterally and anteriorly within the inferior meatus. The lateral extension depends on the size and location of the perforation. At this point, the incision becomes perpendicular to the septum, reaching the inferior border of the perforation. The flap is then sutured anteriorly and superiorly to the remnant of septal mucosa [1, 20] (Fig. 3).

## Perforations without osteo-cartilaginous support

### Lateral nasal wall flap

The use of a pedicle lateral nasal wall flaps (PLNW) both anterior (APLNW) or posterior (PPLNW) has proven to be a reliable and versatile reconstructive option for extensive defects of the skull base [22, 23]. It is also called "extended inferior turbinate flap". The PPLNW is based on the

posterolateral nasal artery, which arises from the sphenopalatine artery. However, the blood supply for the APLNW flap comes from anterior ethmoidal and alar arteries. Two stages of reconstruction are needed. The first includes raising, transposition and fixation of the flap. In the second, the pedicle is sectioned.

The turbinate is harvested with the use of 0° and 30° endoscopes. It can be gently mediatized to better visualize its lateral surface and the mucosa from the inferior meatus, and then subsequently laterally fractured to gain access to the medial aspect. Previously operated turbinates or patients with atrophic rhinitis are not candidates for this technique.

### Posterior PLNW (PPLNW)

Two parallel incisions of nasal mucosa are made. Superior incision starts just before the sphenopalatine foramen, and continues anteriorly in a horizontal plane over the junction of the inferior turbinate on the lateral wall. At this point, the incision extends upwards to obtain the mucosa of the maxillary process. The lower incision begins behinds the sphenopalatine foramen, and descends vertically forward the Eustachian tube to the nasal floor. Then, this is carried forward to arch the inferior meatus to the head of the inferior turbinate. After removing the turbinal bone, the elevation of the mucoperiosteum continues in a posterior direction preserving the neurovascular pedicle. The nasolacrimal duct is then sacrificed to give more possibility of rotation to the flap. The anterior portion of the flap is opened to create a mucosal surface on one side and soft tissue on the other side. The edges of the perforation are refreshed and the flap is then turned towards the defect, where it is meticulously sutured to the mucosa around the perforation [24] (Fig. 4).

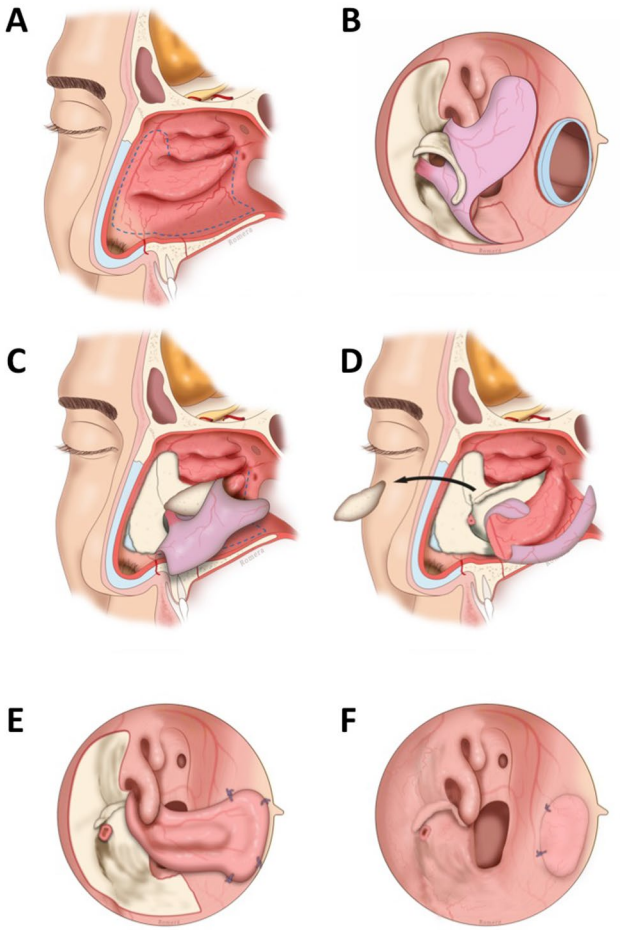



**Fig. 4** Posterior lateral nasal wall flap. Both endoscopic and sagittal views are shown. **a** Superior incision begins anteriorly to the sphenopalatine foramen and extends superiorly. **b** The inferior incision starts posteriorly to the sphenopalatine foramen and descends down to the nasal floor. **c**, **d** The turbinal bone is removed and the nasolacrimal duct is sacrificed. **e** The flap is sutured to the anterior margin of the perforation. **f** The pedicle is sectioned after 6 months

### Anterior PLNW flap (APLNW)

The anterior incision follows the caudal edge of the nasal bones and the anterior border of the ascending maxillary process (piriform arch). The posterior incision joins a sagittal oriented incision that extends over the superior aspect of the inferior turbinate. At the most posterior aspect of this incision, the sphenopalatine artery is cauterized. At this point, a perpendicular incision is travelled medially to cross the floor of the nose and reach the septum. The pedicle's anterior incision continues anterior to the head of the inferior turbinate and then intersects another perpendicular incision that also crosses the floor of the nose to reach the septum. The two horizontal incisions at the floor of the nose are joined to incorporate the mucoperiosteum of the nasal floor into the flap. The mucoperiosteum is elevated from both aspects of the inferior turbinate, inferior meatus and nasal floor until it joins the lateral wall at the level of the opening of the nasolacrimal duct. The distal portion of the inferior turbinate is opened similar to former flap and is rotated anteriorly and adjusted to fill the perforation [1].

The posterior incision is attached to a sagittal-oriented incision that extends over the superior aspect of the inferior turbinate. In the most posterior aspect of this incision, the sphenopalatine artery is cauterized. At this point, a perpendicular incision is moved medially to cross the floor of the nose and reach the septum. The anterior incision of the pedicle continues anterior to the head of the inferior turbinate and is then crossed with another perpendicular incision

that also crosses the floor of the nose to reach the septum. The two horizontal incisions on the floor of the nose join to incorporate the mucoperiosteum of the nasal floor into the flap. The mucoperiosteum rises from both aspects of the inferior turbinate, the inferior meatus and the nasal floor until it joins the lateral wall at the level of the opening of the nasolacrimal duct. The distal portion of the inferior turbinate opens similarly to the anterior flap and is rotated forward and adjusted to fill the perforation [1].

The contralateral side is left bare for closure by secondary intention. In the second stage (3–6 months later), the pedicle of the PPITF or APITF is sectioned and the excess pedicle is discarded. The posterior edges are again trimmed to obtain fresh margins. Finally the flap is rotated into the posterior rim to close the remnant septal defect.

### Nasal floor and inferior meatus flap

Nasal floor and inferior meatus flap (NFIM) could be either simple (SNFIM) or extended (ENFIM) to the inferior turbinate. Two parallel incisions (anterior and posterior) from the lateral limit of the inferior meatus to 2 mm below the inferior limit of the SP are done. The lateral limit of the SNFIM flap is incised at the most lateral aspect of the inferior meatus, just below the insertion of the inferior turbinate with the lateral wall. In case of an ENFIM flap, the lateral incision must be made in the lateral wall along the superior aspect of the inferior turbinate. The mucoperiosteum of the inferior meatus is carefully dissected and elevated from the lateral incision toward the septum. If an extended flap is needed, the dissection is started at the level of the superior aspect of the inferior turbinate. Then the mucosa is separated from the inferior turbinal bone. The incisive artery (branch of the greater palatine artery at the level of the incisive canal) of the same side of the flap is cut to increase the mobility of the flap. The dissection is continued throughout the septum to a few millimetres below the lower edge of the SP. At this level, a horizontal cut of the septal cartilage parallel to the inferior margin of the SP is done leaving a thin sheet of cartilage (2 mm) adhered to mucoperichondrium. At this step, the flap is transposed to the contralateral nasal cavity. A 2-mm mucosa of the superior aspect of the SP of the opposite side is removed to allow direct adhesion of the NFIM flap to the cartilage. The edges of the flap are stitched with the surrounding mucosa with an absorbable suture (Fig. 5) [1, 25].

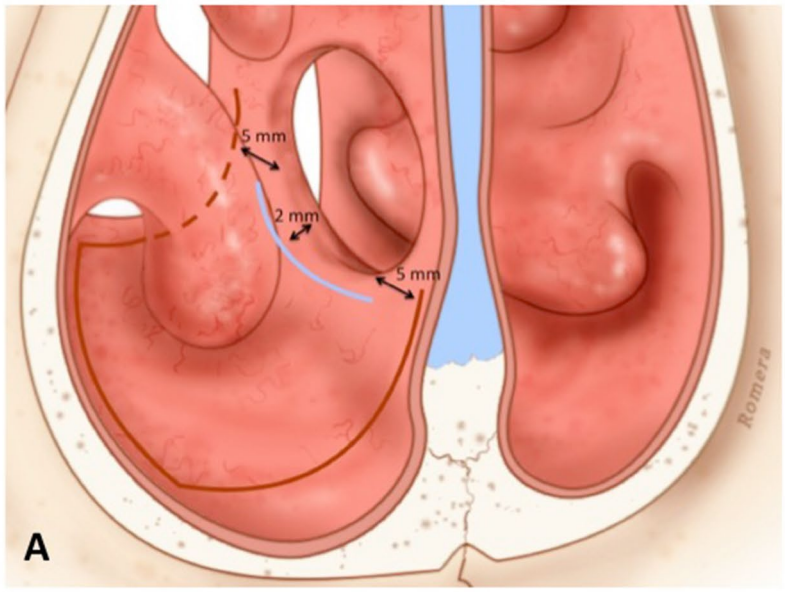
### Pericranial flap

The blood supply to the pericranial flap (PCF) is derived from supraorbital and supratrochlear vessels [26].

The first step is to carry out frontal sinusotomy Draf III using angulated endoscope (45º, Karl Storz). Once the coronal incision has been made and extended laterally to reach the level of the root of the helix, the plane between the subgaleal fascia and overlying galea is identified. If additional length of the pericranial flap posterior to the coronal incision is needed, care must be taken in making the coronal incision so that the PCF is not divided. One-third size of the flap is added assuming the scar and contraction process. Laterally, the PCF is incised along the temporal lines and then is reflected forwards to approximately 1 cm above the supraorbital rims. Then the flap is folded onto itself and fixed longitudinally with absorbable stiches. In this way, both external aspects of the neo-septum contain periosteal tissue (cranial aspect of the PCF). A beveled shape of the osteotomy through the external aspect of the frontal bone is confirmed and the drilling is monitored by transillumination of frontal sinuses. Two holes (1 mm) on sphenoid rostrum are created to fix the posterior edge of the PCF. The distal ends of the flap are marked with two suture threads to facilitate insertion and fixation. The needles of the thread suture, which are going to anchor the PCF to the sphenoid rostrum, are maintained. The flap is transposed into the nasal cavity and rotated 90º and sutured anteriorly to the remnant of membranous septum and inferiorly to the mucosa of the floor of the nose. The thread with the needles is passed through the holes of the sphenoid rostrum and fixed in place. In its most posteroinferior border, the PCF is fixed with a suture passing through the soft palate near the junction with the hard palate. Silicone splints are placed and soft bilateral nasal packing is used for 2 days. Subgaleal drainage is used for 2 days to prevent postoperative hematomas (Fig. 6) [1, 27, 28].

## Conclusion

Multiple approaches have been suggested to repair the SP; however, none has been accepted as the standard approach. The choice depends on the osteo-cartilaginous support, characteristics of the perforation (size, location) and the experience of the surgeon.



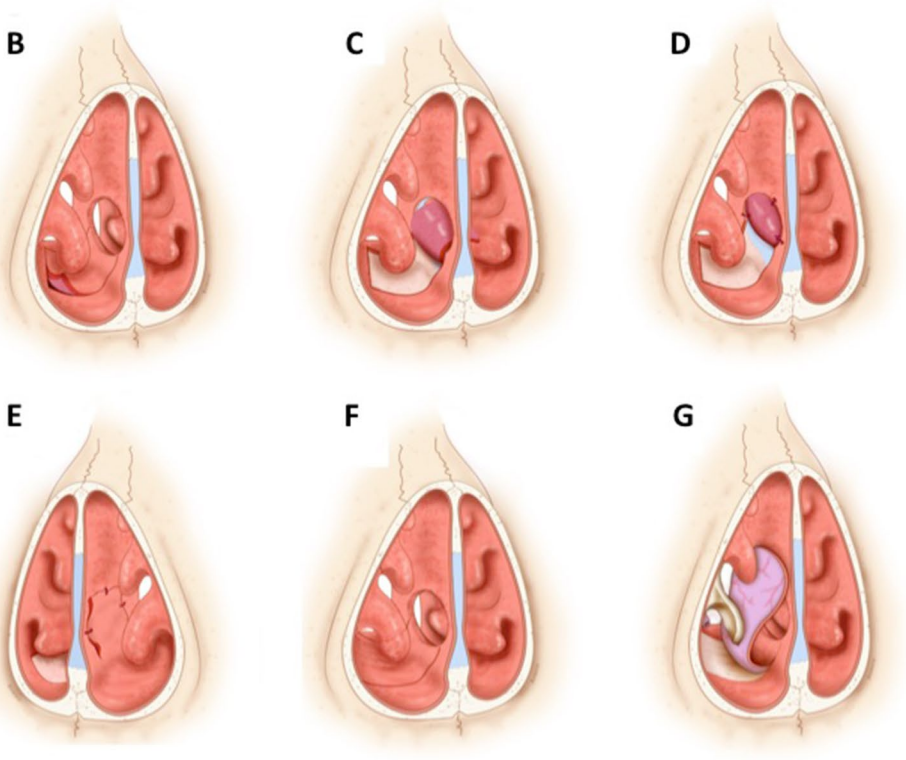




**Fig. 5** Nasal floor and inferior meatus flap. **a** two parallel incisions from the lateral limit of the inferior meatus to 2 mm below the inferior limit of the perforation are done. **b** The mucoperiosteum is elevated. **c** The dissection is continued throughout the septum. **d** the flap is transposed to the contralateral nasal cavity. **e** The flap is fixed. **f**, **g** In case of an extended flap to the inferior turbinate, the dissection must be made in the lateral wall along the superior aspect of the inferior turbinate

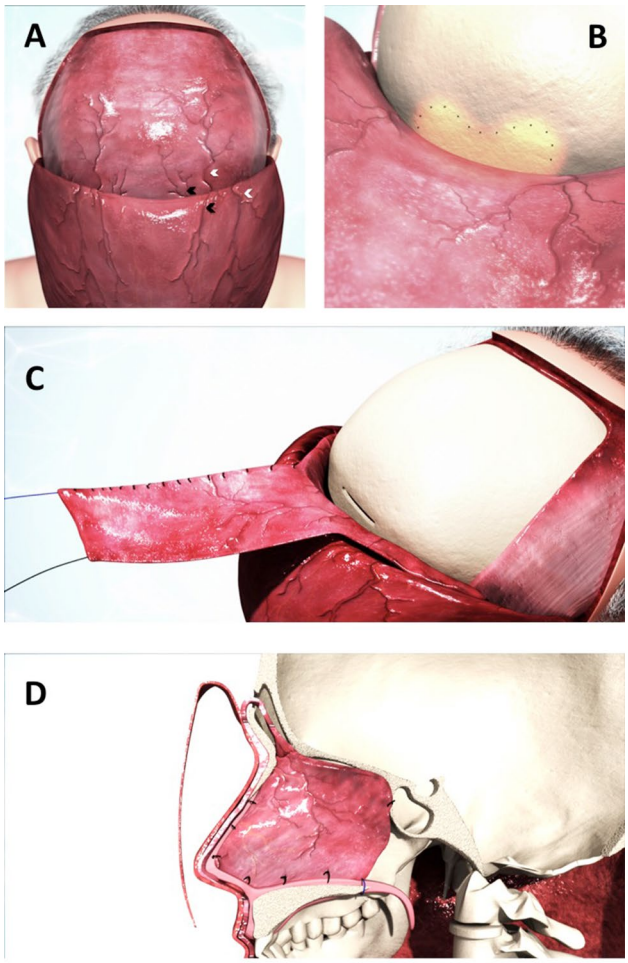



**Fig. 6** Pericranial flap. **a** the flap is based on superficial and deep branches of the supraorbital (white arrows) and supratrochlear arteries (black arrows). A coronal incision is extended laterally. **b**, **c** The flap is folded onto itself and a beveled shape of the osteotomy is confirmed through sinus transillumination. **d** The flap is transposed into the nasal cavity and fixed

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## Compliance with ethical standards

**Conflict of interest** Consultant for Roche lab.

**Research involving human participants and/or animals** Not applicable.

**Informed consent** Not applicable.

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