

Nasal septal perforation repair using intranasal rotation and advancement flaps

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ABSTRACT

Background: We aimed to present our experience with and algorithm for septal perforation repair using advancement and rotation flaps.

Methods: A retrospective chart review was performed on 14 patients who underwent septal perforation repair. Etiology, perforation size, presenting symptoms, reconstruction methods, combined operation, surgical results, and complications were evaluated.

Results: The mean postoperative follow-up duration was 36 ± 18 months. Among 14 cases, 9 had previous septoplasty or septorhinoplasty and 5 cases suffered from nasal trauma. The perforation sizes varied from 5 to 27 mm, with a 14-mm average. Two cases had multiple perforations. The main symptoms included nasal obstruction, crusting, epistaxis, and whistling. Perforations were repaired using advancement flaps in seven cases or combination of advancement and rotation flaps in seven cases, with or without an interposition graft. Bilateral mucosal closure was accomplished in all cases. Conchal cartilage, remnant septal cartilage, or septal bone was used for an interposition graft. Nine patients had a concurrent rhinoplasty with septal perforation repair. At last follow-up, complete perforation closure was achieved in 12 cases (85.7%). Septal perforation recurred in 2 large perforation cases, which were repaired without interposition grafts. Nasal symptoms disappeared or improved in 13 cases (92.9%). There were no serious complications after surgery.

Conclusion: Combined use of intranasal advancement and rotation flaps is a safe and promising option for surgical repair of moderate to large septal perforation. Bilateral tension-free mucosal closure with an interposition graft is important for the surgical success.

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Nasal septal perforation can occur from various causes such as previous septal surgeries, trauma, untreated septal hematomas, inflammatory diseases, tight nasal packing, and the use of nasal spray. Septal perforation can damage normal humidification function and disturb nasal airflow and pressure. It can result in many different symptoms including nasal obstruction, crusting, epistaxis, nasal discharge, and whistling.¹ Despite many patients remaining asymptomatic, some may suffer from debilitating symptoms and require treatment. Conservative management can be tried at first, such as nasal irrigation with isotonic saline, antibiotic ointment, or a septal button. If they have persistent complaints despite nonsurgical therapy, surgery should be considered.^{2,3}

Although many surgical techniques have been reported, there is no standardized technique that is supported by a statistically significant or high-level, evidence-based data, and the keys for successful closure have not been completely elucidated.⁴ Advancement of mucoperichondrial or mucoperiosteal flaps from the septal wall or nasal floor have been widely used.^{5–8} However, especially when the vertical diameter of a perforation is large, advancing tissues from above and below the perforation may not be enough for completely tension-free closure. A posteriorly or anteriorly based rotation flap, which recruits more tissue to close the perforation, can add another option to the advancement flap.^{3,9}

The purpose of this study is to present our experience with septal perforation repair using intranasal advancement and rotation flaps and to provide a surgical algorithm for successful closure.

METHODS

Fourteen patients that underwent septal perforation repair and were followed up for >6 months were retrospectively analyzed in this study. All operations were performed by one senior author

(J.H.R.). Medical charts including operation records were reviewed retrospectively. Twelve of the patients were male and two were female patients. Their mean age was 39.8 ± 16.9 years. Presenting symptoms, etiology of perforation, location and size of the perforation, reconstruction methods, combined operation, surgical results, and complications were reviewed. The vertical and horizontal diameters of a perforation were measured using a ruler before the operation and reevaluated after mucosal dissection in the operating field. Surgical results were assessed based on the perforation closure and symptom improvement. This study was approved by the Institutional Review Board of Seoul National University Boramae Medical Center.

Surgical Procedure

The surgery can be performed through an endonasal or an external approach depending on the size of the perforation and the types of combined operation. In general, an endonasal approach was preferred. The external approach was chosen for large perforations or when external rhinoplasty combined with perforation repair required an open approach. In either approach, bilateral mucoperichondrial dissection started from the anterior to posterior direction until the anterior perforation margin was reached. Dissection continued around and posterior to the perforation using a Freer elevator until complete bilateral tunnels are created anterior and posterior to the perforation. A 0° endoscope was used to help delicate dissection near the perforation. The flap elevation was extended inferiorly along with the maxillary crest and floor of the nasal cavity to the lateral nasal wall close to the attachment of the inferior turbinate. Superiorly, the flap was elevated to the junction of the upper lateral cartilage and septum. The perforation edges were trimmed using fine cutting forceps and scissors.

To make bipediced advancement flaps, upper and lower horizontal incisions were made following the dorsal margin of the septum superiorly and the most lateral portion of the inferior meatus inferiorly on the elevated mucosal flap (Fig. 1, A and B). The elevated flaps were advanced toward the perforation and sutured inside or outside of the elevated flap from the posterior to anterior direction using 5-0 chromic gut. Reshaping the round perforation to an ellipse by wedge excision facilitates linear closure without mucosal redundancy. The mucosa heals nicely after 2 weeks (Fig. 1, C and D).

Rotation flaps were used in cases in which the initial diameter of the perforation was >15 mm, especially when the vertical height was longer than 15 mm. Even with a perforation diameter <15 mm, a

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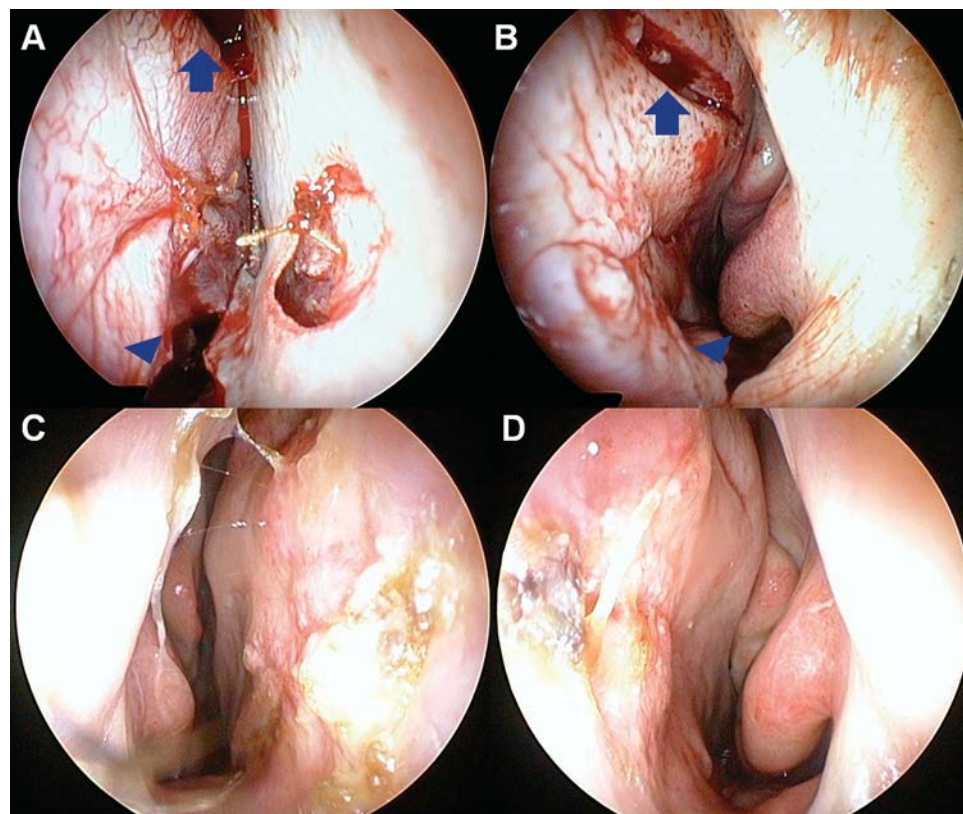


Figure 1. Bipediced advancement flaps were used to close the medium-sized perforation. (A) Bilateral flap closure with 5-0 chromic gut and the defect of the septal cartilage are observed. Superior (arrow) and inferior (arrowhead) incisions are observed (A) inside the elevated flap and (B) through the left nasal cavity. (C and D) Photographs taken 2 weeks after surgery show a well-repaired perforation and mucosalization at the site of flap recruitment.

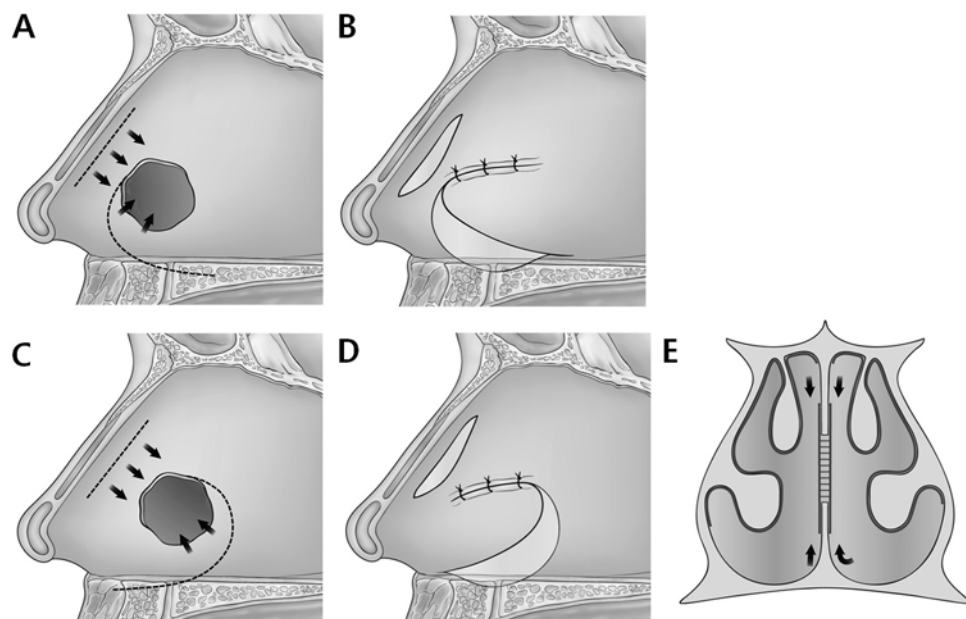


Figure 2. Schematic illustration of the (A and B) inferoposteriorly based and (C and D) inferoanteriorly based rotation flaps with superior flap advancement to cover the large perforation. (E) An illustration of the coronal view of the septal perforation repair with right bipediced advancement flap and left rotation flap combined with superior flap advancement.

rotation flap was used when the relative size of the perforation was considered large in a small nose. The decision of inferoposteriorly or inferoanteriorly based rotation flap depended on the location of perforation and the status of the mucosa. In general, an inferoposteriorly based rotation flap was mainly used, because it is easier to develop and the mucosa of the posterior perforation margin is weak and easily torn, thus facilitating the flap design (Figs. 2, A and B, and 3). An inferoposteriorly based rotation flap is supplied by the septal branch of the sphenopalatine artery. An incision starts from the anterior margin of the perforation and is extended inferiorly, laterally, and

posteriorly along the lateral wall of part of the inferior meatus (Fig. 2, A and B). An extension to the inferior meatus creates a larger mucosal flap, allowing rotation of the flap without tension, and maximizes its mobility without violating the feeding artery. An inferoanteriorly based rotation flap is supplied by the columella septal branch of the superior labial artery. The incision for an inferoanteriorly based rotation flap starts from the posterior perforation margin, runs posteriorly and inferiorly (Fig. 2, C and D). After running a certain distance, the incision is extended laterally and anteriorly, following the lateral wall of the inferior meatus until it reaches the anterior attachment of

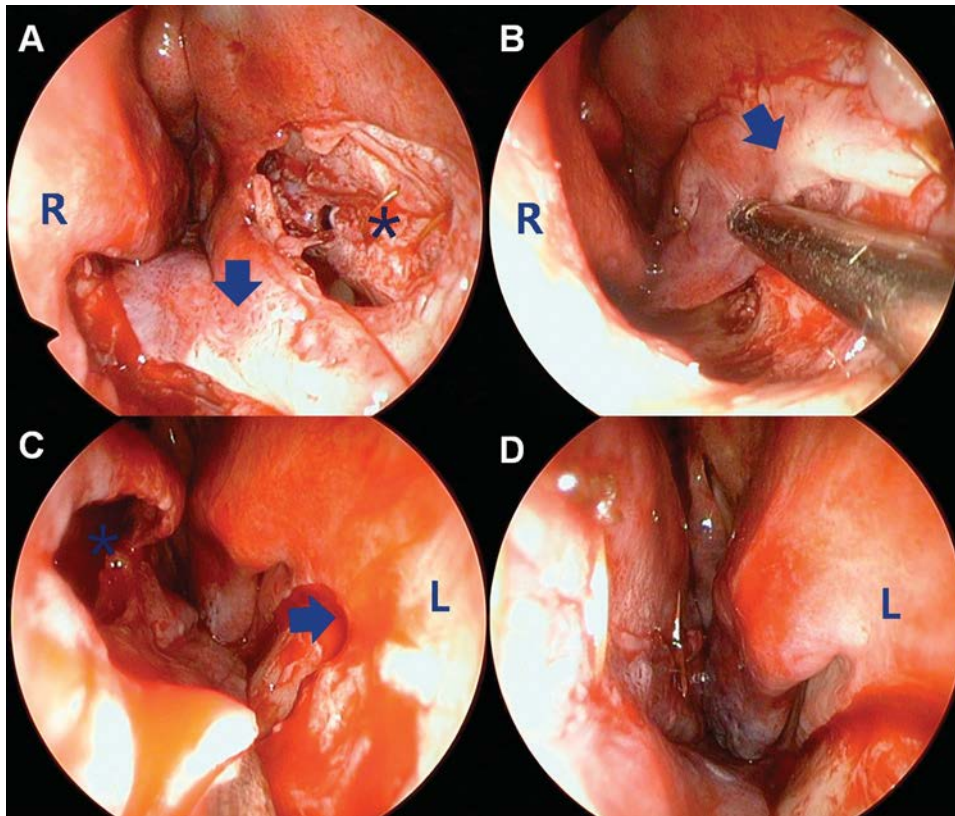


Figure 3. (A) On the right nasal cavity, a large perforation is observed on the cartilaginous septum (asterisk) and a inferoposteriorly based rotation flap (arrow) is being elevated. (B) The flap is rotated superomedially and covers the perforation completely. (C) On the left nasal cavity, an incision is made on the nasal floor for the advancement flap (arrow). (D) Inferior and superior bipedicle flaps are advanced and the perforation is closed.

inferior turbinate. Then, an elevated flap was turned superomedially and reached the superior margin of the perforation. For tensionless flap closure, the extent of mucosal elevation should be greater than the size of perforation to be covered. In addition, a superior releasing incision on the side with a rotation flap can be helpful in achieving tension-free sutures. The rotation flap and the prepared upper mucosal flap were advanced carefully to cover the perforation and the margins were sutured from posterior to anterior direction using 5-0 chromic gut. The bare bone area on the inferior, posterior portion of the septum and the nasal floor were left uncovered for secondary mucosal healing. An inferoanteriorly based rotation flap could not be made when a perforation was located anteriorly close to septal incision. Rotation flap on one side was always combined with bipedicle advancement flaps on the other side to prevent possible posterior perforation and opposing suture lines.

Additional interposition grafts were inserted using the remaining septal cartilage or conchal cartilage when tension-free closure was not expected or the flap mucosa was too thin. Silastic sheets were applied bilaterally and left in place for 2 weeks to avoid postoperative adhesion and facilitate mucosal healing. The nasal cavities were packed with Merocel (Merocel Corp., Mystic, CT), and the packs were removed 2 days after surgery.

RESULTS

All cases showed perforation on the cartilaginous septum. The longest diameter of the perforation size preoperatively measured varied from 5 to 27 mm, with an average of 13.9 mm. Demographics, clinical findings, surgical procedures, and results of each patient are summarized in Table 1. The mean postoperative follow-up period was 35.8 ± 17.9 months. At the final follow-up, complete perforation closure was achieved in 12 cases (85.7%). Rep perforation occurred in 2 patients. One patient (case 12), who had five perforations of variable size before surgery, showed two small perforations at 3 months after

surgery, but the nasal symptom improved greatly. The other patient (case 9), with a history of infected alloplast removal, had both revision rhinoplasty and perforation repair and showed middle-sized perforation at 6 months after surgery, although he was satisfied with the esthetic result of the nose. Nasal symptoms disappeared or improved in 13 cases except for 1 patient that presented with moderate-sized rep perforation. No serious complications developed either by septal perforation repair or by rhinoplasty. The algorithm of our surgical procedures and surgical results are summarized in Fig. 4.

DISCUSSION

Small-to-moderate-sized septal perforations are usually repaired with local advancement flaps with or without interposition graft and their success rate has been reported to range from 85 to 100%.^{5,9-11} On the other hand, large perforations with a diameter of >20 mm are considered to have high failure rates in surgical repair.⁴ Various surgical techniques including local, regional, or free flaps that have been designed to close large perforations¹²⁻¹⁴ have drawbacks; they leave a visible external scar at the donor site that may require a second-stage procedure for division of flaps; the perforation is often not closed with physiological respiratory epithelium; intranasal mucosal expansion needs multistaged procedures, scarring or formation of oronasal fistula. In this context, an ideal method even for large septal perforation repair may still be using an intranasal local flap, which obviates all the aforementioned drawbacks.

Compared with the advancement flap, the intranasal rotation flap brings more tissue to the perforation site with increased flap mobility; thus, closure of large perforation is facilitated. The concept of intranasal rotation flap for septal perforation repair is not a new one and the technique we used contains similar components of previously described techniques and shares same surgical principles.^{3,9,15,16} However, a few modifications were made in our technique to facilitate repair of large perforations. First, the rotation flap is mainly based on

Table 1 Demographics, clinical findings, reconstruction methods, and surgical outcome of patients with septal perforation ($n = 14$)

No.	Sex/Age yr	Chief Complaint	Etiology	Location	Size (mm)	Surgical Approach	Mucosal Closure	Reconstruction Procedure	Graft Material	Combined Operation	FU Period (mo)	Surgical Result
1	M/40	Nasal obstruction	Operation	Anterior	6	Endonasal	Bilateral	AF	Free mucosal graft	Rhinoseptoplasty	61.8	Closure
2	M/67	Nasal obstruction	Trauma	Anterior	7	External	Bilateral	AF	Septal cartilage	Rhinoseptoplasty	56.5	Closure
3	M/21	Nasal obstruction	Operation	Anterior	15	Endonasal	Bilateral	AF	Conchal cartilage	Rhinoplasty	52.9	Closure
4	M/32	Nasal obstruction	Trauma	Anterior	22	External	Bilateral	AF + RF		Rhinoplasty	50.4	Closure
5	F/63	Nasal obstruction	Operation	Anterior	9	Endonasal	Bilateral	AF + RF		Rhinoplasty and ESS	44.2	Closure
6	F/45	Epistaxis	Trauma	Anterior	5	Endonasal	Bilateral	AF			44.0	Closure
7	M/25	Nasal obstruction	Operation	Anterior	12	Endonasal	Bilateral	AF	Septal cartilage	Septoturbinoplasty	43.0	Closure
8	M/30	Nasal obstruction	Operation	Anterior	7	Endonasal	Bilateral	AF		Rhinoseptoplasty	35.0	Closure
9	M/21	Nasal deformity	Operation	Anterior	16	External	Bilateral	AF + RF		Rhinoplasty	33.2	Reperforation
10	M/52	Crusting	Operation	Anterior	15	Endonasal	Bilateral	AF + RF	Conchal cartilage	Rhinoseptoplasty	31.7	Closure
11	M/22	Nasal obstruction	Trauma	Anterior	26 (X2)	External	Bilateral	AF + RF	Septal cartilage	Rhinoplasty	17.3	Closure
12	M/68	Nasal obstruction	Operation	Anterior	27 (X5)	External	Bilateral	AF + RF		Rhinoplasty	17.0	Reperforation
13	M/37	Whistling	Operation	Anterior	7	Endonasal	Bilateral	AF + RF	Septal bone		7.8	Closure
14	M/34	Nasal deformity	Trauma	Anterior	20	Endonasal	Bilateral	AF	Septal bone	Septoplasty and NBR	6.2	Closure

The numbers in parenthesis indicate the number of perforations.

FU follow-up; AF advancement flap; RF rotation flap; ESS endoscopic sinus surgery; NBR nasal bone reduction.

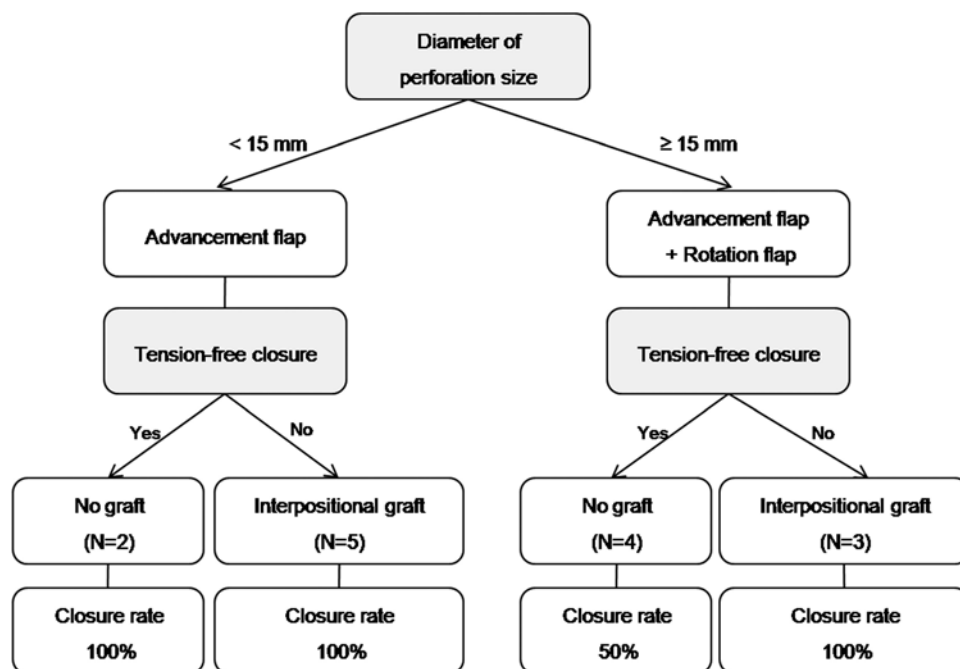


Figure 4. The surgical algorithm of septal perforation repair in our series.

inferiorly to maximize the recruitment of tissues from the nasal floor and lateral nasal wall. Most of the rotation flaps reported recruited either from septal mucoperichondrium alone or from limited areas of nasal floor mucosa, which sometimes is insufficient to cover large perforations.^{9,15} Second, superior pedicled advancement of the mucoperichondrium on the same side of rotation flap development facilitates tension-free closure of the perforation. Third, rotation flap in one side was combined with contralateral bipedicled advancement flap to prevent communication at the site of mucosal recruitment and to avoid opposing suture lines.

Inferiorly based rotation flap combining with superior pedicled mucosal advancement at the same side has an advantage over rotation flap or bipedicled advancement flaps alone in perforation closure, especially when the vertical diameter is longer than 15 mm, which pose a significant risk of surgical failure.¹⁷ Measuring the size of the perforation preoperatively is an important factor for planning the operation; however, the size usually increases with elevation of mucoperichondrial flap and trimming of margins. We used a rotation flap in 2 cases (cases 5 and 13), who had perforations <10 mm. The actual size of the perforation increased up to >15 mm after dissection and trimming, which necessitated the use of rotation flap to close the perforation without any undue tension. Bilaterally elevated rotation flap based on the same direction raise the risk of a septal perforation, especially when there is a defect of intervening septal cartilage around the perforation. Thus, combining the advancement flap at one side and the rotation flap at the other side is recommended instead of using the rotation flap bilaterally.

Recent studies have reported that the size of the perforation, bilaterality of flap repair, and interposition of graft materials were important determinants for the successful repair of the perforation.^{1,3,17,18} Although bilateral mucosal closure was accomplished in all of our cases, the two failed cases had no interposition graft because it seemed that a tension-free closure was possible at the time of surgery. Although they had a successful closure in the early postoperative period, re-perforation developed as time passed. Presumed causes for the failure are (1) large perforation with traumatized thin mucosa, (2) no interposition graft in perforation closure with slight tension remaining, and (3) poor blood supply of the flap caused by multiple previous surgeries. An interposition graft affords a template for mu-

cosal migration and minimizes the risk of re-perforation when a complete tension-free closure with healthy mucosal flap is not possible. Autologous and homologous tissue including temporalis fascia and acellular human dermis were used with similar efficiency.^{12,19}

The intranasal rotation flap we used is not always necessary for small perforations. This technique requires wider dissection and therefore takes longer time compared with bilateral advancement flaps. It also makes a larger denuded area from flap recruitment, which needs more time for mucosal healing. Thus, it is recommended to use the rotation flap when the perforation is >15 mm or when the perforation closure is not possible with advancement flaps because of various reasons. From our experience, key procedures for successful septal perforation repair using intranasal rotation flap include the following: (1) bilateral and tension-free closure by maximally recruiting tissue from nasal floor and lateral nasal wall to provide greater distance and movability than necessary, (2) combining rotation flap with contralateral bipedicled advancement flap, and (3) interposition graft when tension is anticipated in flap closure.

CONCLUSION

Combined use of intranasal advancement and rotation flaps is a safe and promising option for surgical repair of moderate-to-large septal perforation. Bilateral tension-free mucosal closure with an interposition graft is important for surgical success.

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