



Endoscopic unilateral anterior ethmoid artery flap with or without cartilage graft for nasal septal perforation repair

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Introduction: The septal perforation is a challenging condition that faces the otolaryngologist. The aim of our work was to evaluate this endoscopic repair of this septal perforation using a unilateral anterior ethmoid artery flap with or without a cartilage graft.

Patients and methods: The authors conducted a retrospective cohort study between June 2020 and June 2022. Our study included all adult patients with septal perforation due to trauma (operative and self-induced) lasting for more than one year. Patients underwent an endoscopic repair of a perforation and a questionnaire regarding subjective quality of life was completed at 3 months postoperatively.

Results: A total of 18 patients were included in our study. The main symptoms were crusting (100%), bleeding (38.85%), whistling (16.6%), anosmia (16.6), and nasal obstruction sensation (11%). The mean perforation size was 13.6 mm, ranging between 4 mm and 28 mm. Number of years with the perforation (ranged between 2 and 16 years) with a mean of 4.876 ± 1.645 years and a mode of 2 years. All cases were repaired using an endoscopic unilateral anterior ethmoid artery flap with or without cartilage. There were no intraoperative complications but postoperatively, these included pain, ranging between a score of 2 and 8 on the pain score chart, (the mean score was five and mode was four, appeared in six patients), which was treated with over-the-counter painkillers. In addition, there was one patient (5%) with a residual small perforation (2 mm). All patients were happy to fill out postoperative patient satisfaction questionnaires after 3 months. The mean was 21.8889 ± 1.655 points and the mode, 25 points (highest possible score), appeared four times. The lowest scoring questionnaire summated to 15 points.

Conclusions: The endoscopic unilateral anterior ethmoid artery nasal flap with or without cartilage graft has proven to be a reliable and a valuable graft that, with proper planning, can provide excellent results with minimal morbidity for nasal septal perforation repair.

Keywords: SEPTAL perforation repair, vascular flaps

Introduction

Surgical closure of a nasal septal perforation is one of the most challenging procedures in nasal surgery^[1].

Septal perforation is a condition characterized by the loss of cartilage and/or bony structures along with the mucoperichondrium and mucoperiosteum. The etiology includes a history of nasal surgery or trauma, nose picking, bilateral septal cauterization, overuse of nasal sprays, cocaine abuse, vasculitis, and malignancies^[2].

Iatrogenic septal perforation is a complication of nasal surgery. Small or posterior perforations cause few symptoms and need only conservative treatment. Large or anterior perforations

HIGHLIGHTS

- Endoscopic repair of septal perforation using an anterior ethmoid artery flap.
- A questionnaire regarding subjective quality of life was completed at 3 months postoperatively.
- Postoperatively included pain, ranging between 2 and 8 on the pain score chart.
- Endoscopic unilateral anterior ethmoid artery nasal flap proven to be reliable.

contribute to nasal airflow disturbances and external nasal deformities. When considering surgical candidacy, one should consider the severity of symptoms, location, and size of the perforation^[3].

A useful alternative is mechanical closure with a prosthesis such as the septal button. Traditional silicon buttons can alleviate epistaxis, whistling and nasal obstruction, but these prostheses cannot control the production of crusting around the margins of the button, which causes discomfort for the majority of patients. Newer silicon buttons and magnet-based buttons reduce the patient's discomfort and crusting^[1].

During the last decade, many endoscopic repair techniques have been described with a success of postoperative repair between 76.4 and 100%^[27]. The advantages of this approach are its minimal invasiveness (with no external scars), optimal

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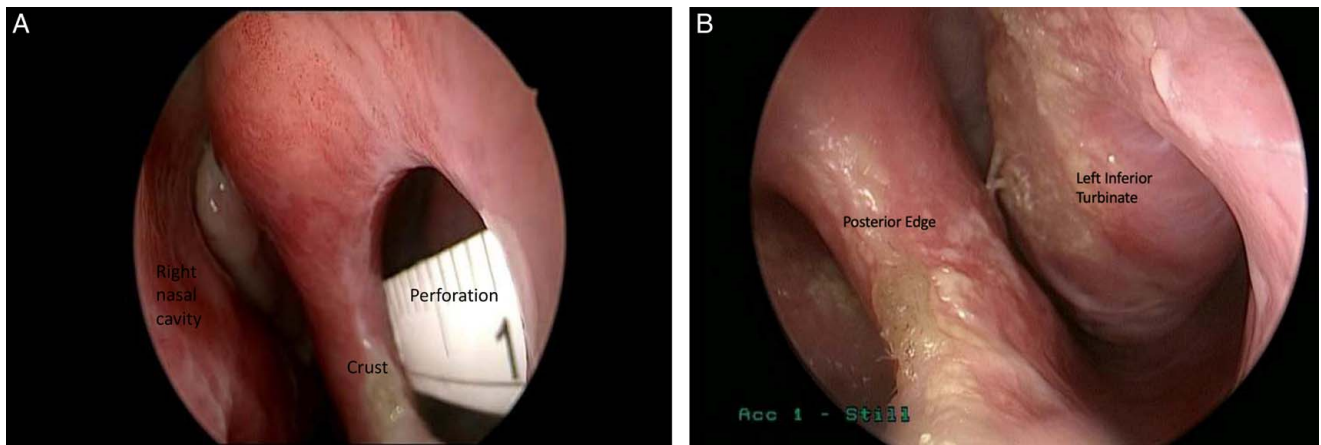


Figure 1. A, measuring the perforation intraoperatively. B, preoperative photograph showing septal perforation with crusting over the edge.

exposure of the operative field (with better visibility of structures), and good control of perforation margins. The limitations are that it is time-consuming and can be difficult to perform, requiring years of endoscopic experience^[4].

In this paper, we will describe our technique, which utilizes an endoscopic unilateral anterior ethmoidal artery flap to repair septal perforation with or without tragal cartilage. The aim of this paper is to evaluate this approach in comparison with existing techniques and evaluate the postoperative complications and quality of life (QoL) in these patients.

Patients and methods

A retrospective cohort study was performed of all adult patients who underwent an endoscopic repair of nasal perforation between June 2020 and June 2022. A questionnaire was completed by all patients 3 months postoperatively in order to assess QoL and morbidity following surgery. The questions included: previous use of the septal button (if applicable), compliance with the septal button (if applicable), overall quality of care, pain after surgery, symptoms and QoL now compared to prior to surgery, how the patients feel about themselves following the surgery, any

remaining symptoms, would they recommend the surgery, and are they happy with the surgery.

Inclusion criteria were adult patients with an endoscopically repaired nasal perforation regardless of whether a tragal flap was also used.

Patients were examined preoperatively for any previous nasal interventions, including septal cautery, septoplasty, septorhinoplasty, and use of decongestant or cocaine. A complete ENT examination using flexible nasal endoscopy was carried out. The edges of the perforation were assessed for crusting, granulation, fibrinous addition, or unhealed ulceration.

All work completed and reported in line with the current Strengthening the Reporting of Cohort Studies in Surgery (STROCCS) criteria^[5].

Surgical technique

The endoscopic approach to the septal perforation repair begins with thorough lavage with saline irrigation to debride crusting. A careful measurement is then taken of the perforation to accurately estimate the required size of the anterior ethmoid artery flap (as shown in Fig. 1).

Measuring the septal perforation by ruler in both horizontal and vertical planes, taking into account measurements found on

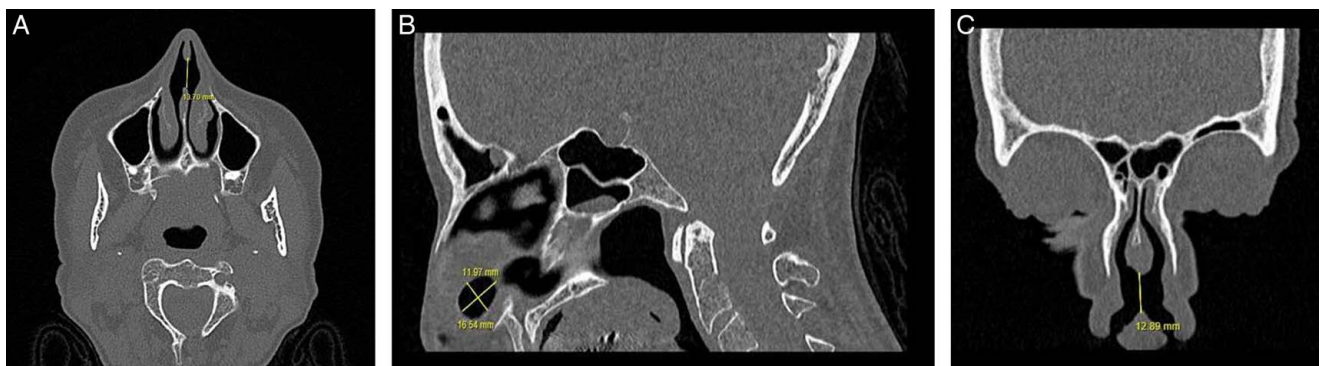


Figure 2. A, computed tomography (CT) scan axial cuts showing the perforation size. B, CT scan sagittal cuts showing the perforation size. C, CT scan coronal cuts, showing the perforation size.

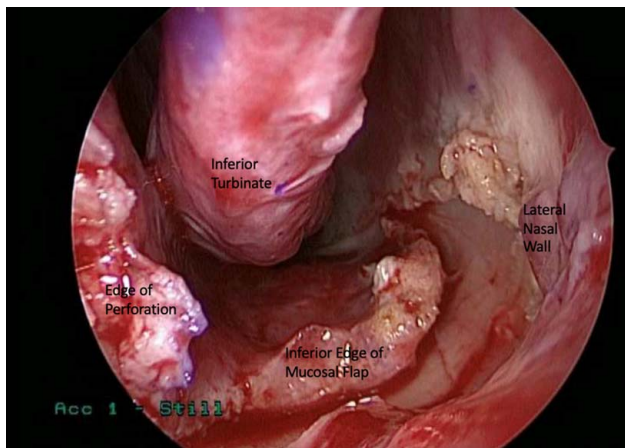


Figure 3. Intraoperative photograph showing fashioning of the flap.

computed tomography (CT) scans if completed, and then using the largest diameter to estimate the true size of the perforation (as shown in Fig. 2A, B, C).

Dissection and fashioning of the flap

The fashioning of a U-shaped flap starts with a longitudinal incision through the posterior edge of the perforation, followed by the dissection of a septal mucosal flap on either side. The incision is extended to the floor and lateral wall of the nasal cavity. The extent of this incision is dependent on the size of the perforation. The larger the perforation the higher the incision needs to be extended along the lateral nasal wall and transversely beneath the inferior turbinate (as shown in Fig. 3).

Care should be taken at this step to avoid encroaching on the opening of the nasolacrimal duct. Once the desired size has been achieved via a lateral incision, this should then be continued posteriorly to create another transverse incision parallel to the first. A vertical incision then elongates the posterior transverse incision along the posterior septal wall. The higher this is, the easier it is to mobilize the flap.

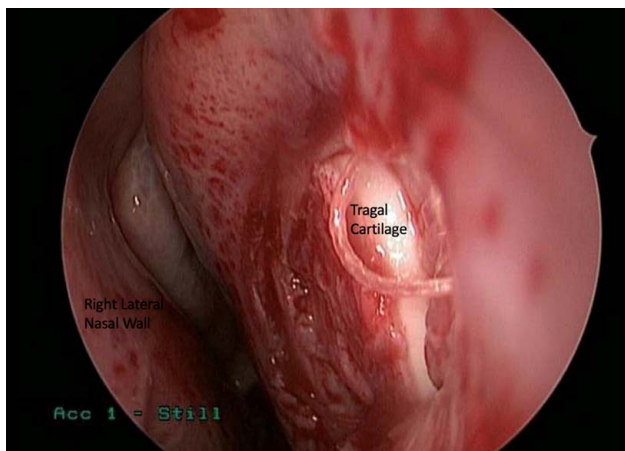


Figure 4. Intraoperative photograph showing the flap fixed to the edge of the perforation.

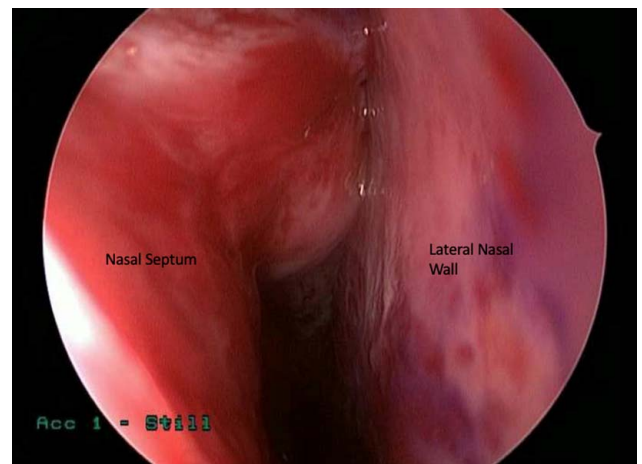


Figure 5. Intraoperative photograph showing the cartilage graft fixed to the edge of the perforation.

Dissection of the flaps should be done with care to avoid any tearing. Dissection of the mucoperichondrium on the alternate side should also be performed in the case that the decision is made to harvest a tragal cartilage graft for the purpose of flap fortification.

Fashioning and position of the cartilage graft

Depending on the size of the perforation, a tragal cartilage graft can be employed. This is generally done in perforations more than 10 mm in size.

Closure and timing

Closure is done by suturing the cartilage and the flap to the edge by 4/0 Ethicon Vicryl Rapide Sutures rapid (as shown in Fig. 4).

Results

The size of the perforation was measured by ruler in both the horizontal and vertical directions and compared to the measurement in the CT scan in axial and coronal cuts in most of the cases except for three cases where no CT scan was organized. The mean perforation size was 13.6 mm, ranging between 4 mm and 28 mm.

The mean age of the perforation was noted to be 4.876 ± 1.645 years, ranging from 2 to 16 years. In perforations sized 10 mm and above a CT scan was ordered (83.3%), as shown in Figure 2A, B, C.

Septal buttons had already been trialed by 66.6% of our patients, none of whom reported positive feedback and the majority showed poor compliance to the button's use.

In 14 patients (77.7%) harvesting of a tragal cartilage graft was performed for flap fortification (as shown in Fig. 5). In the remaining four patients this step was not required as the perforations were less than 10 mm in size.

The mean operative time in our cases was 95.8 min with the range being from 40 to 180 min.

A total of 18 patients underwent repair of nasal septal perforation using the anterior ethmoid artery flap. The majority of

Table 1
Preoperative patient assessment including septal button compliance assessment.

Cause of perforation	Main symptoms	Duration of the perforation	CT scan	Previous septal button	Blood or biopsy	Compliance with the SB
post/ S platy	crusting/anosmia	5 years	Yes	Yes	No	fair (5/10)
post/ S platy	crusting/bleeding	4 years	Yes	No	No	NA
post/ S platy	crusting/feeling nasal obstruction/anosmia	6 years	Yes	Yes	No	Not so bad (3/10)
post/ S platy	crusting/bleeding	12 years	Yes	Yes	No	worth (1/10)
post/ S platy	crusting/whistling	2 years	No	No	No	NA
post/ S platy	crusting/ nasal obstruction/anosmia	3 years	Yes	Yes	No	poor (1/10)
post/ S platy	crusting/bleeding	6 years	Yes	No	No	NA
spontaneously	crusting	16 years	Yes	Yes	Yes	fair (5/10)
post/ S platy	crusting/bleeding	2 years	Yes	Yes	No	On so bad(3/10)
post/ S platy	crusting/whistling	2 years	No	Yes	No	Fair (4/10)
post/ S platy	crusting	5 years	Yes	Yes	No	Fair (3/10)
post/ S platy	crusting/bleeding	6 years	Yes	No	No	NA
spontaneously	crusting	3 years	Yes	Yes	Yes	fair (5/10)
post/ S platy	crusting/bleeding	2 years	Yes	No	No	NA
post/ S platy	crusting/whistling	3 years	No	No	No	NA
post/ S platy	crusting	5 years	Yes	Yes	No	fair (5/10)
post/ S platy	crusting/bleeding	4 years	Yes	Yes	No	No so bad (3/10)
post/ S platy	crusting	2 years	Yes	Yes	No	fair (5/10)

these patients presented with typical symptoms including crusting (100%), bleeding (38.9%), whistling (16.6%), and the sensation of nasal obstruction (11%). The majority (89%) acquired a septal perforation as a complication of nasal septoplasty. In the remaining two cases (11%) the perforation was spontaneous. In both cases of spontaneous perforation, blood tests were performed to investigate the cause and in one case a biopsy was taken intraoperatively. (See Table 1).

The age of the patients ranged between 25 and 72 years olds with a mean of 42.4 years. Sixty-seven percent of cases were female patients.

There were no intraoperative complications. The most prevalent postoperative complication was severe pain (scoring either 9 or 10 out of 10 on the pain scale) in which two patients required the input of the pain team for medication reviews. This postoperative pain settled after 2 days. In two patients moderate pain was noted (scoring between 2 and 8 out of 10 on the pain scale), this was treated with regular analgesia.

A further postoperative complication of note was a small residual perforation (2 mm) seen in one patient, this was followed up with no further current surgical intervention needed. All patients were followed up between six and nine months depending on their symptoms and postoperative healing of the repair was assessed (as shown in Fig. 6A, B).

All patients included completed a patient satisfaction questionnaire 3 months postoperatively.(See Table 2). The maximum score for this patient questionnaire is 25 points. Following analysis of the completed responses the mean score was 21.8889 ± 1.655 ranging from 15 to 25 (See Table 3).

No relationship between size of the perforation and the duration of existence of the perforation. It can be noted from the results that larger perforations tended to yield more pain postoperatively (See Table 2).

When repairing the nasal septal perforation, a tragal auto-graft was utilized in perforations over 10 mm in size for structural support. This included a total of 14 patients (See Table 2).

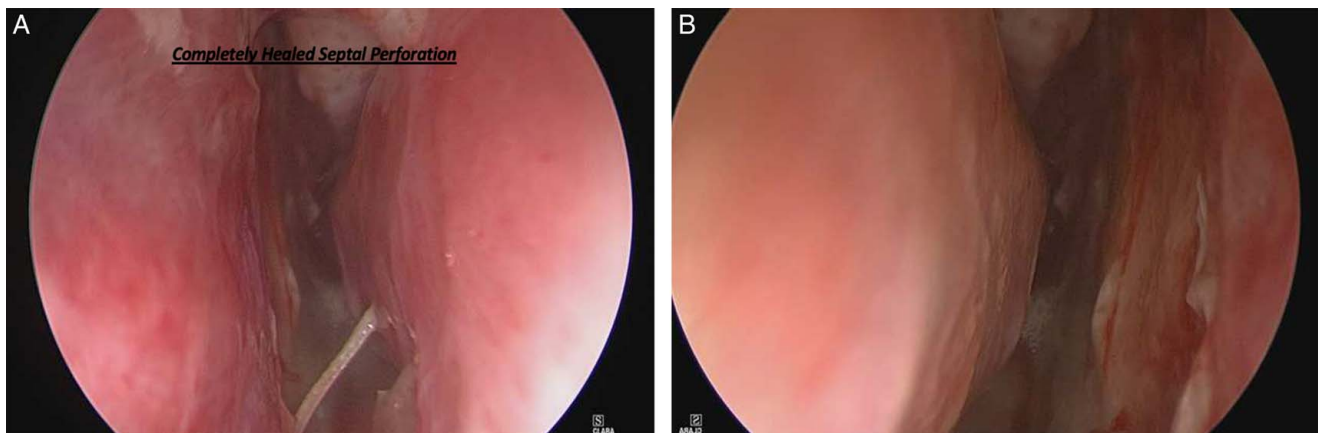


Figure 6. A, postoperative photograph showing healed flap on the left side. B, postoperative photograph showing healed flap on the right side.

Table 2
Perforation size and postoperative patient assessment, follow up, and patient satisfaction score.

Size of perforation	Duration of surgery	With tragal cartilage	Intraoperative complication	Pain score in day first 2 d	Postoperative complication	FU duration	NO attendance	Post operative patient satisfaction (QLQ) after 3 months 25 point
23 mm	180	Yes	NA	10	sever pain	9	4	20
15 mm	120	Yes	NA	9	sever pain	9	3	20
13 mm	75	Yes	NA	5	residual small perforation	6	6	15
11 mm	100	Yes	NA	4	No	6	3	25
5 mm	50	No	NA	4	No	9	3	25
21 mm	120	Yes	NA	8	pain	6	3	20
15 mm	150	Yes	NA	3	No	9	3	19
8 mm	75	No	NA	5	No	9	3	25
28 mm	150	Yes	NA	8	pain/min bleeding	9	3	18
19 mm	100	Yes	NA	7	No	6	4	23
10 mm	70	Yes	NA	4	No	6	3	24
13 mm	80	Yes	NA	3	No	6	4	23
12 mm	60	Yes	NA	4	No	9	4	22
8 mm	75	No	NA	3	No	9	3	23
4 mm	40	No	NA	2	No	6	3	25
14 mm	100	Yes	NA	4	No	6	3	21
17 mm	120	Yes	NA	5	No	6	3	22
10 mm	60	Yes	NA	4	No	6	3	24

The diameter of septal perforation, total vertical diameter of septum, and horizontal diameter of the perforation were measured in cm and compared to CT scan in coronal and axial cuts (in patients with CT sinus scan).

Discussion

Numerous techniques such as external, intranasal, endoscopic, midfacial degloving, or sublabial approach, with the use of various grafts (synthetic or auto-graft) and combined flaps (unilateral or bilateral) have been proposed as potential treatment options with each having advantages and disadvantages^[6].

The endoscopic endonasal approach has gained ground in the last decades with the studies of Hier and Ayshford^[7,8]. From these first reports, many studies have been published, reporting a percentage of postoperative repair variables between 76.4 1 and 100%^[5,6].

The use of an endoscopic approach has allowed a high percentage of success even in cases of unilateral flap repair^[9-11]; however, the unilateral flap was considered insufficient by some authors^[12,13]. Kridel stated that ‘a septal perforation is a hole in three distinct contiguous layers composed of both right and left septal mucoperichondrial flaps and the intervening cartilage, all three of which must be separated from each other and repaired individually’^[14].

The ear can provide both cartilage and perichondrium for use in septal perforation surgery^[15]. Also the use of the combination of an anterior ethmoidal artery flap with a collagen matrix inlay as a successful technique for nasal septal perforation repair^[16].

Preoperative evaluation is crucial. Prior to repair it is vital to exclude other systemic causes, malignancy, or other ongoing processes. A CT scan of the paranasal sinuses must be utilized to evaluate the nasal septum to determine the presence of concomitant paranasal sinus disease and it is mandatory, especially in cases with no previous surgery or trauma^[17]. For septal perforations diagnosed on CT scan as being over 10 mm, we suggest that the preoperative workup also includes blood tests to investigate if any inflammatory pathology is present. A biopsy of the margin of the septal perforation can also be taken to investigate the cause further, in our cases this was performed in the case of a spontaneous perforation.

Table 3
Postoperative patient satisfaction questioner (QoL Q).

Items	Low	High
Previous use of the septal button	Yes	No
Compliance with the septal button	Poor (1 or 2)	Excellent (9 or10)
Overall the quality of care	poor	excellent
Pain after surgery,	No pain (1 or 2)	Sever pain (9 or10)
Symptoms and QoL compared with before surgery	worse	more better
How the patient feels about themselves as a result of the surgery,	worse	more better
The present of symptoms	worse	more better
Their quality of life	worse	more better
From their experience, would have the surgery again	no	yes
Overall who happy were they with their surgery	no at all	extremity

The repair of a septal perforation through means of surgical or nonsurgical methods is an early decision that needs to be made. It has been shown that the use of artificial repair methods, like the septal button, are more predictable and reliable than conventional surgical methods^[18,19] They are; however, more associated with complications including epistaxis, crusting, and pain. Furthermore, they can contribute to progressive erosion at the perforation edges, which ultimately leads to a paradoxical enlargement of the initial defect^[20] From our results, we can also see that they scored consistently low with patient compliance and patient popularity.

Our method falls securely into the surgical intervention group; nasal mucosal flaps are used in surgical closure to maximize vascularity and make a successful repair more likely. Our technique utilizes an anterior ethmoidal artery flap to achieve this^[6,9,16]. Knowledge regarding the vascularization of the nasal septum is therefore crucial when harvesting the septal flap in aiming to preserve its vascularity during the incision of the mucoperichondrium and mucoperiosteum. In the intranasal segment of its route, the anterior ethmoid artery runs inside a bony canal named the anterior ethmoidal canal that itself leaves the orbit with the anterior ethmoidal nerve through the anterior ethmoidal foramen. This artery is responsible for the supply of the anterior and middle ethmoidal sinuses along with the lateral nasal wall and nasal septum^[21]. When harvesting the flap, it is important to consider the anatomical relation of the anterior ethmoid artery to the area where it penetrates the skull, in the anterior cranial fossa, as this is region is delicate and when injured can cause a CSF leak^[22].

The flap can then be fortified using an underlying tissue graft if the surgeon wishes; this combined flap/graft technique has been shown to produce a reliably greater success rate of perforation closure^[6,15]. We utilized a tragal cartilage graft for flap fortification in those patients whose perforation was larger than 10 mm in size on CT. Naturally, the use of large intranasal mucosal flaps leads to large, denuded areas; without proper treatment nonepithelialized areas will be prone to long term dryness or crusting and so proper treatment is important for healing by secondary intention^[22].

Other surgical methods have assessed the use of an inferior turbinate flap in repairing septal perforations up to 20 mm in diameter^[20]. Complications reported from this technique include adhesions between the septum and the remainder of the inferior turbinate, nasal obstruction from the physical bulk of the flap and a small possibility of complete flap necrosis and failure^[24]. The sublabial mucosal flap describes uses a graft from the ipsilateral oral buccal mucosa, the advantage of this being the greater relative amount of graft available in comparison to the tragal graft^[25]. The complications of this technique is the potential for a formation of an oral–nasal fistula. As with the inferior turbinate flap graft technique, there was also the possibility for the flap to become necrosed if pressure was applied on the tunneled mucosa. The facial artery musculomucosal flap has been used with success, the limitation being that in some cases patients reported postoperative tightness in the donor site; however, this normally settled with massage and time^[26–28].

Our endoscopic method uses a highly vascular nasal flap with the flexibility to employ a tragal graft in the management of larger septal perforations with excellent prognosis. No intraoperative complications were identified, and postoperative complications were few and easily managed. The advantages of this approach

are its minimal invasiveness (with no external scars), optimal exposure of the operative field (with better visibility of the structures) and good control of perforation margins. The interposition graft could be useful because it serves not only as a scaffold for the migration of respiratory mucosa, but also provides a second layer of protection. The advantage of using a unilateral flap is decreasing the time of dissection as well as the risk of further perforation. Also, a decrease postoperative pain and crustation than using bilateral flaps.

Conclusions

Using an anterior ethmoid artery flap with or without a cartilage graft has been proven to be a reliable and valuable tool that, with proper planning, can provide excellent results with minimal morbidity and better QoL for nasal septal perforation repair patients. The option for a supporting tragal cartilage graft gives added options for the surgeon in the case of a larger perforation. The surgery is relatively safe, has a feasible operating time and proves more popular than artificial repair methods such as the button. Post-operative complications, mainly pain, proved easy to manage and with this approach showed positive outcomes.

Limitation

A limitation to this study is that as the number of patients was small, therefore, we cannot definitively infer that the use of this technique will yield the same results with a larger patient cohort.

Ethical approval and consent to participate

Ethical approval is not applicable, consents to participate was done.

Consent for publication has been obtained

It is confidential in our country and cannot be published or distributed.

Sources of funding

No funding to declare.

Authors' contributions

All Authors with equal contribution in conception, design of the work, the acquisition, analysis, interpretation of data, and have drafted the work or substantively revised it.

A.B.: interpretation of data, creation of new software used in the work, analysis and substantial contributions to the conception; A.Y.Z.H.A.: design of the work, creation of new software used in the work, drafted the work, and substantively revised it; A.E.: interpretation of data, creation of new software used in the work in addition, writing; A.E.-S.: design of the work, creation of new software used in the work, drafted the work, and substantively revised it; A.E.E.: creation, design of the work, surgical performance, substantial contributions to the conception, interpretation of data and analysis.

Conflicts of interests disclosure

The authors have no conflicts of interest to declare.

Research registration unique identifying number (UIN)

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Guarantor

All authors, Abdelrahman E. Ezzat is correspondent authors.

Availability of data and material

In the supplement section

Extramural (Video)

<https://www.youtube.com/watch?v=OjeOPRuHvXY&list=PLJegUJ4Tkg-fGdilNwV13Qo7yt6PZVVFA&index=6>

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