

Surgical closure of nasoseptal perforations: predictive factors for success

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Abstract. *Objectives:* This study investigated the predictive factors for successful closure of a nasoseptal perforation (NSP) using bilateral advancement flaps via an external approach.

Methodology: A retrospective observational study was performed on the files of patients who underwent surgical closure of an NSP between 1999 and 2015 at the University Hospitals of Leuven, a single tertiary centre. Sex, underlying aetiology, characteristics of the perforation (location, size, and surgical technique used), and the pre- and postoperative symptoms were recorded and analyzed.

Results: The initial size of the NSP turned out to be the only significant factor. Complete closure of the NSP was achieved in 67% of the whole cohort and in 82%, 67%, and 15% of the sub-cohorts with small (< 1 cm), medium (1 – 1.9 cm), and large-sized (≥ 2 cm) NSPs, respectively. In case of a residual perforation, 44% of the patients had no postoperative symptoms.

Conclusions: A high surgical success rate can be obtained by using bilateral advancement flaps via an external approach to close small to medium-sized (< 2 cm) NSPs, but alternative techniques should be considered to repair large NSPs (≥ 2 cm). Good postoperative function could be achieved, even with incomplete closure.

Introduction

Nasoseptal perforations can have different underlying etiologies, but are often idiopathic (47% according to Diamantopoulos et al.)¹ or unclear (26% according to Moon et al.)² Trauma to the nasoseptal mucosa (self-inflicted by digital manipulation or iatrogenic by cauterization or septal surgery) (39%),³ intranasal drug abuse (5% of active cocaine users have an NSP;³ 36% of patients with an NSP had positive screening for cocaine use in an urban setting⁴) and inflammatory diseases like granulomatosis with polyangiitis, formerly known as Wegener's granulomatosis, can all cause NSPs. NSP patients suffer from a variety of symptoms, with nasal obstruction (71%), crusting (40%) and epistaxis (37%)² as cardinal symptoms. The disturbed laminar airflow causes drying of the mucosa and hence more crusting, the sensation of nasal obstruction, whistling, and/or discharge. The irritated mucosa and the manipulation of the crusts may cause epistaxis. The presence of chondritis in case of exposure of cartilage without overlying

mucosa can cause pain. However, a large fraction of individuals with an NSP are asymptomatic (15%).⁵ Conservative methods such as nasal irrigation and ointments, as well as avoidance of digital manipulation, are first line treatments to reduce symptoms.

In patients for whom conservative treatment results in inadequate control of symptoms, a surgical closure can be considered.⁶ In case of contra-indications or a patient's reluctance towards surgery, the placement of a silicone prosthesis or septal button can be an option, with symptom relief in a significant percentage of cases⁷: 64% according to Luff et al.,⁸ and 59% less crusting according to Price et al.⁹

Before planning a surgical intervention, it is important to determine the underlying aetiology and to examine the perforation carefully. In case of cocaine abuse, a laboratory confirmation of abstinence for at least 6 months is warranted because of the risk of surgical failure and anesthetic complications in patients with an active or recent abuse history.

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Clinical evaluation of the NSP should include a detailed analysis of its size, location, and remaining osseous-cartilaginous support, as these factors may alter the choice of surgical closure technique. However, in reality, the choice of the surgical closure technique is often based only on the surgeon's preference. With this study, we tried to gain some insight into factors predicting the success ratio of surgical NSP closure using bilateral advancement flaps via an external approach, and when alternative surgical closure techniques should be considered. As nasal septum perforations may cause a variety of symptoms, we also wanted to analyze patients' remaining complaints after surgery in comparison to preoperative symptoms. In this perspective, these data might lead to better pre-operative counselling of NSP patients.

Material and methods

Patients

This retrospective study included all symptomatic patients with an NSP who had an indication for surgical closure and who underwent this operation between September 1999 and December 2015 in a tertiary referral centre (University hospitals of Leuven) after informed consent.

All patients were operated by the same surgeon (MJ) using the same technique: an external approach with bilateral advancement flaps. Patients were excluded if they had active cocaine abuse, or systemic or oncological disease.

The patients' files were meticulously analyzed for the following variables: sex, underlying aetiology, characteristics of the perforation (location and size), and pre- and postoperative symptoms.

If the underlying aetiology was stated in the records, we subdivided the patients into the following groups: (1) accidental trauma, (2) medical procedure-related trauma (cauterization, septoplasty, and/or rhinoplasty), (3) self-inflicted trauma (digital manipulation), and (4) intranasal drug abuse (cocaine or medication).⁷ The type of previous nasal surgery was also analyzed (septoplasty, rhinoseptoplasty, multiple surgeries, or other types of surgeries on the nose). The NSP location was subdivided into three groups: anterior, central, or posterior. The size of the perforation was measured, and different subgroups were defined: small (< 1 cm), medium (1-1.9 cm) and large (\geq

2 cm) NSPs. All preoperative symptoms were collected, and each patient was asked about any residual complaints at the final consultation.

We analyzed the closure state at the time of the last postoperative appointment at the university hospitals of Leuven and categorized these as closed, incomplete mucosal closure, or residual NSP. The time elapsed since the operation was calculated to determine the follow-up time for each patient.

Surgery

The intervention was performed under general anesthesia with oral intubation, and was started as a classic external rhinoseptoplasty to provide sufficient access to the different aspects of the perforation.

We started with infiltration of local anesthesia and vasoconstriction to avoid bleeding. A Rethi incision was made, followed by an extension of the incision to bilateral marginal incisions and exposure of the caudal end of the septum and the alar cartilages. A meticulous dissection in the mucoperichondrial plane was conducted to release the mucosa from the septum extending to the sphenoid rostrum, and the edges of the perforation were renewed to remove granulation or scar tissue and to optimize the healing process.

When making mucoperichondrial and mucoperiosteal flaps, the inferior septal tunnel was extended to the nasal floor until the lateral wall of the nasal cavity, with a releasing incision below the insertion of the inferior turbinate in an anterior-to-posterior direction. The superior tunnel was extended underneath the nasal roof. Large dorsal humps were resected to provide more mucosa by lowering the nasal roof, and any deviated septal bone or cartilage was removed to increase the mobility of the mucosa.

An inferior bipedicle advancement flap was thus created, with blood supply from anterior and posterior. When this flap could not provide enough mucosa to close the perforation in a tension-free manner, a superior bipedicle advancement flap was made by dissecting the mucosa in the mucoperichondrial/periosteal plane at the under-surface of the upper lateral cartilage and nasal bones. If more mobility was necessary, an incision was made lateral to the flap, in an anterior-to-posterior direction.

During the intervention, we tried to achieve a tension-free closure with reconstruction of nasal

support and restoration of function.¹⁰ Because the nasal mucosa is inelastic, sufficient mucosal mobilization was needed perioperatively to prevent breakdown of the reconstruction during retraction of the healing scar.

Suturing of the mucosa with an absorbable thread and cutting needle in a postero-anterior fashion was executed carefully to prevent new tears. Autologous bone or cartilage grafts from the septum, dorsum, or ear were placed between the mucosal flaps to

Table 1
Demographics of the total cohort

		N (absolute patient number)	Percent (%)
Sex	Female	51	46
	Male	60	54
Underlying aetiology	Medical procedure-related trauma	40	36
	Self-inflicted trauma	23	21
	Accidental trauma	8	7
	Intranasal drug abuse	6	5
	Unknown	34	31
Previous surgery †	Septoplasty	18	16
	Rhinoplasty	4	4
	Multiple	20	18
	Other	20	18
Size of perforation ‡	None	49	44
	Small	39	35
	Medium	44	40
	Large	17	15
Location of perforation	Anterior	81	73
	Central	9	8
	Posterior	1	1
	Unknown	20	18
Preoperative symptoms §	Crusting	70	63
	Nasal obstruction	68	61
	Epistaxis	42	38
	Discharge	28	25
	Whistling	26	23
	Headache	17	15
	Post nasal drip	14	13
	Pain	11	10
	Hyposmia	11	10
Grafting material ¶	Septum or dorsum	78	70
	Ear	28	25
	Combination	2	2
	None	2	2
	Unknown	1	1

† A septoconchoplasty was categorized as a septoplasty. A septoplasty with cauterization was categorized as multiple surgeries on the septum. ‡ Perforation size was defined as small (<1 cm), medium (1-1.9 cm), or large (≥ 2 cm). § Of note regarding preoperative symptoms: one patient can have more than one symptom. ¶ Grafting material consisted of cartilage or bone from different donor sites.

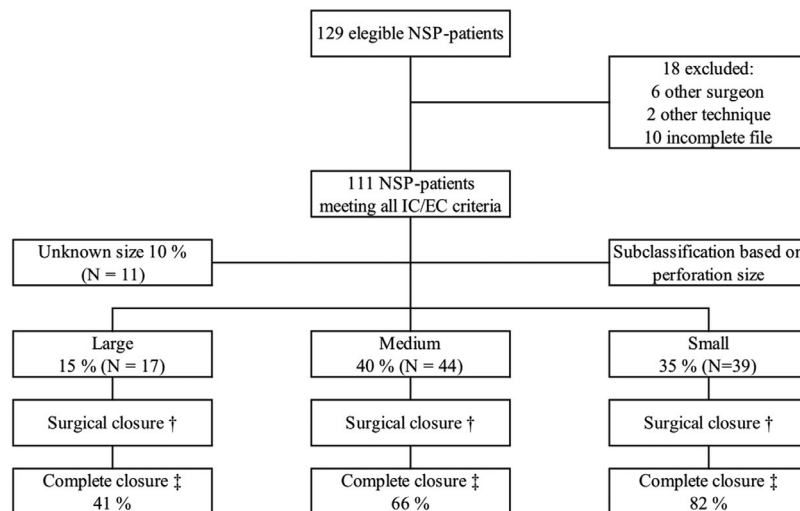


Figure 1

Schematic presentation of total cohort. † Surgical closure by the same surgeon, via an external approach using bilateral advancement flaps. ‡ Complete closure at the end of follow-up. NSP, Nasoseptal perforation.

act as a template during epithelialization. The graft extended beyond the borders of the perforation and was placed via the external approach. Closing of the donor side was unnecessary, because secondary healing could be expected.

To reduce the risk of hematoma formation and to aid in healing and revascularization, splints (silicone sheets) were placed and fixed in place with mattress sutures, for 2 weeks. Mattress sutures through the medial crurae and domes were used to reposition the lower laterals. A columellar strut was used in cases with insufficient tip support. The skin was closed by suturing the Rethi and marginal incisions. To prevent blood accumulation, we applied light packing with gauze in antibiotic ointment, and external taping and splinting. Postoperatively, the patient rinsed with saline, applied ointments, and used oral antibiotics for 1 week.^{7,10,11}

Statistical analysis

All statistical tests were conducted on SPSS version 24 (SPSS Inc., Chicago, Ill., USA) and the significance level was set as $p < 0.05$. The distribution of closure status at the end of follow-up was analyzed separately among the different perforation size groups using the Pearson Chi-square test (χ^2).

Results

Of the 129 NSP patients, 111 had their NSP closed surgically by the same surgeon and using the same

technique between September 1999 and December 2015 and had a complete patient file. A schematic presentation of the total cohort is shown in Figure 1.

The characteristics of the subjects are summarized in Table 1.

Forty-six percent of the patients were female ($N = 51$) and 54% were male ($N = 60$). The perforations were described by location and size. In 18% ($N = 20$), the location was not stated in the file. Perforations were anterior in 73% ($N = 81$), central in 8% ($N = 9$), and posterior in 1% ($N = 1$) of patients. The size ranged from 0.2 cm to 4 cm and was unknown for 11 patients (10%). Regarding size subclassification, 35%, 40%, and 15% of patients had a small (< 1 cm; $N = 39$); medium (1-1.9 cm; $N = 44$), or large (≥ 2 cm; $N = 17$) perforation, respectively.

The main underlying aetiology in this cohort was medical procedure-related trauma ($N = 40$; 36%); in our records, multiple or other surgeries in the past (cauterization, FESS, or conchotomy) (each $N = 20$; 18%) were the procedures that occurred most often.

The three cardinal preoperative symptoms were crusting ($N = 70$; 63%), nasal obstruction ($N = 68$; 61%) and epistaxis ($N = 42$; 38%).

All patients were operated via an external approach and with the intention of using bilateral advancement flaps. However, in two patients only an approximation was possible and in three patients only one side could be closed. In two patients, the operation was stopped without approximation or closure of the perforation because of tearing of the

Table 2
Postoperative symptoms with a residual NSP

Postoperative symptoms	N (Absolute patient number)	Percent (%)
Asymptomatic	10	44
Nasal obstruction	7	30
Crusting	7	30
Epistaxis	2	9
Pain	1	4
Headache	1	4
Whistling	1	4
Total	23	

A number of complaints may persist in patients with a residual nasal septal perforation (NSP) after surgical closure. However, 44% of these patients were asymptomatic.

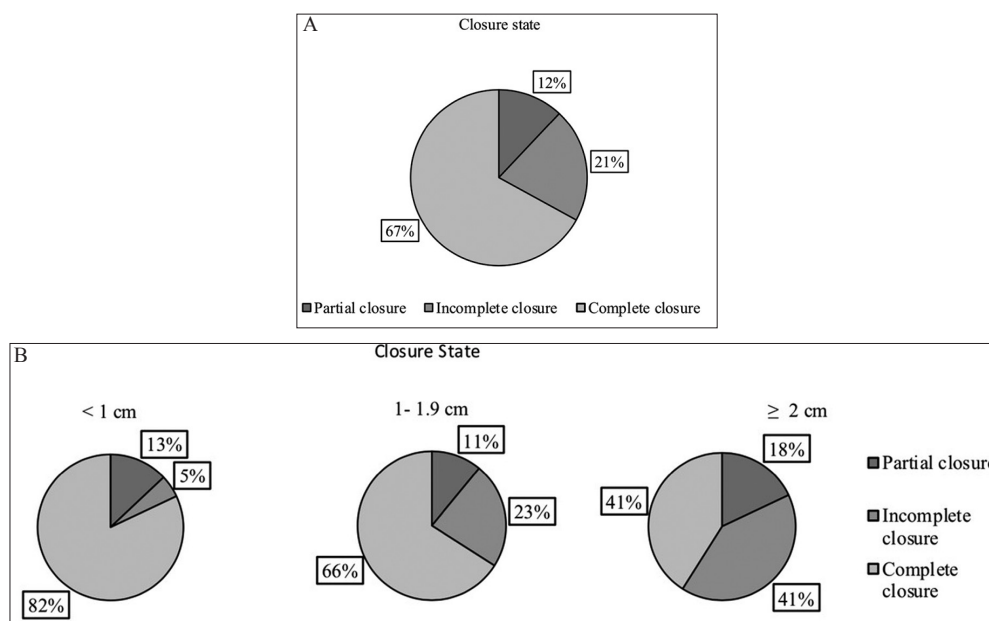


Figure 2

A. Status of the perforation at the last clinical control after surgical closure of the nasoseptal perforation.
B. Status of the perforation at the last clinical control after surgical closure of the nasoseptal perforation, stratified according to perforation size: Small = < 1 cm, Medium = 1-1.9 cm, and Large = ≥ 2 cm.

mucosa. Perioperatively, the majority of patients received a graft from the septum (bone or cartilage) (N = 78; 70%).

After a mean follow-up of 2.5 months (ranging from 0.5 to 12 months), the closure of the NSPs was evaluated clinically. A complete closure state was observed at the end of follow-up in 67% (N = 75), an incomplete mucosal closure state was observed in 12% (N = 13), and a residual NSP was found in 21% (N = 23) (Figure 2A). The two patients with perioperative failure of the surgery were categorized as residual NSP. The initial size of the perforation was fitted against the postoperative closure status, showing that surgical closure was successful for 82% of perforations smaller than

1 cm and 67% of medium-sized perforations. In larger NSPs (≥ 2 cm) a closure rate of 41% was observed (Figure 2B). The Chi-square test showed a significant correlation between the initial size of the NSP and the postoperative closure state ($\chi^2 = 12.005$; $p = 0.017$).

The statistical analysis of the other demographic factors did not demonstrate any significant effect (data not shown).

In patients with residual NSP, postoperative complaints included nasal obstruction, crusting, epistaxis, discharge, pain, headache, postnasal drip (PND), dryness, hyposmia, and whistling (Table 2). However, 44% of these patients were asymptomatic.

Discussion

In this retrospective study, we analyzed a very large homogeneous cohort of 111 consecutive patients with NSP who underwent a surgical closure using the same surgical technique (bilateral advancement flaps via an external approach) performed by a single surgeon. In this context, two important variables were already excluded, and consequently we were able to focus on the influence that NSP-related variables like size and location had on the closure success rate. In our study, the initial size of the perforation turned out to be the most important factor to predict the chance of success with this specific, but well-known, surgical technique. However, we do acknowledge that we have limited data on NSP characteristics, as only the anterior-posterior size was documented and not the height. Unfortunately, this limitation is inherent to the retrospective character of the study.

Postoperative evaluation of the closure state, after a relative short follow-up time, revealed incomplete mucosal closure in 12% of patients. Nevertheless, 44% of patients with a residual perforation had no residual symptoms. We know that crusting and dryness can persist after total surgical closure because metaplasia has occurred due to a long-lasting perforation.⁷ In future studies, symptom scores and quality of life questionnaires should be collected to provide better information regarding the remaining symptoms. In general, symptoms are reduced after surgical closure, whether or not full closure can be obtained.

A closing rate of 41% was achieved for larger NSPs (≥ 2 cm). For this type of perforation, or when there is a lack of underlying osseocartilaginous support, other techniques, such as inferior meatus or lateral wall flaps, or anterior ethmoidal artery rotation flaps, should be considered. With this last technique, good results are currently seen in our centre in patients with large NSP (> 2 cm) who have sufficient remaining osseocartilaginous support.

The advancement flaps used in our series can be used in perforations of various sizes and shapes, and using bilateral flaps provides a greater chance of success compared to unilateral flaps.² In our series, a lateral incision of the flaps was mostly unnecessary after extended mucosal mobilization on the nasal floor and roof and straightening of the remaining septum cartilage and bone, independent of the perforation size. Other authors have described

similar results with slightly different techniques, such as advancement flaps with autogenic grafting between the flaps for perforations up to 30 mm,¹² or releasing incisions along the floor of the nose.¹³

Looking at the underlying aetiology, 36% of our patients had a medical procedure-related trauma that probably caused the perforation. It is important that clinicians be aware of this risk when performing a (rhino)septoplasty.

In recent years, a strong increase in NSPs as a consequence of intranasal drug abuse has been noted. This observation could be attributed to the fact that (1) an overall increase in cocaine abuse in urban populations is noted⁴ together with (2) an increased awareness of ENT doctors with more laboratory testing before surgery. When the underlying aetiology is in doubt, extensive blood analysis and biopsies should be taken.

Conclusion

In conclusion, we may state that higher closure rates were observed if the initial perforation size was < 2 cm. However, even though a residual perforation persisted, good postoperative function was obtained. Based on these data, an alternative technique should be considered for patients with NSPs ≥ 2 cm, because a 50% drop in the success rate was observed in this patient population.

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