







## RESEARCH NOTE

# Nasoseptal flap with extended pedicle dissection based on the maxillary artery: Clinical series of 55 cases

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Significance level 4

## KEYWORDS

endoscopic sinus surgery, endoscopic skull base surgery, nasopharyngectomy, pedicled nasoseptal flap

## Key points

- Nasoseptal flap with extended pedicle dissection is a low morbidity and high success rate flap.
- It is a flap that can be applied to reconstruct a wide range of ipsilateral skull base defects.

Alessandro Vinciguerra and Mario Turri-Zanoni contributed equally to this work and considered as first authors.

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## 1 | INTRODUCTION

Since its introduction, the nasoseptal flap (NSF) has been one of the most widely applied local reconstructive options not only for the skull base (SB) repair, but also to resurface areas such as the parapharyngeal space, oropharynx, and palatal region.<sup>1-3</sup> However, in some cases, it is difficult to use, especially in reconstructing postero-lateral or far anterior defects of the SB, so that some authors have described the extended dissection of its pedicle as far as the maxillary artery (NSFwEPD) in order to improve its versatility in terms of rotation and available surface.<sup>1,4</sup> The aim of this manuscript is to describe the clinical applicability of the NSFwEPD, analyzing the reliability of reconstruction and related complications.

## 2 | METHODS

This is a multicentric retrospective study performed at four tertiary-care referral centers. Patients treated for a sinonasal/SB pathology and reconstructed with a NSFwEPD to the pterygopalatine fossa were included in the study, which was approved by each respective review board of ethics. All included cases were treated with an up-front NSFwEPD since the performed surgical approaches would not have permitted an ipsilateral standard NSF.

Data concerning the pathology treated, surgical approach, outcomes, and complications (early and late, >30 days) were collected.

The surgical technique has been already described.<sup>4,5</sup> After performing the standard incision of the NSF at the level of the septum and rostrum, its pedicle is dissected to the sphenopalatine foramen by cutting the vidian, palate-vaginal and inferior/middle/superior turbinate branches of the sphenopalatine artery, maintaining its septal branch. Starting from the sphenopalatine foramen, the orbital process of the palatine bone and the posterior wall of the maxillary sinus are removed to expose the pterygopalatine fossa contents. The superior aspect of the perpendicular plate of the palatine bone is also removed in order to expose the medial part of the pterygopalatine fossa and the greater palatine canal containing the descending palatine artery, which is coagulated and divided to free the pedicle from its inferior attachment. The flap is then usually stored into the maxillary sinus, lateralized, and subsequently applied on the site of the reconstruction (Figure 1).

Statistical analyses were performed using SPSS 23.0. Chi-square test was used to compare the association of different clinical aspects with complications.

## 3 | RESULTS

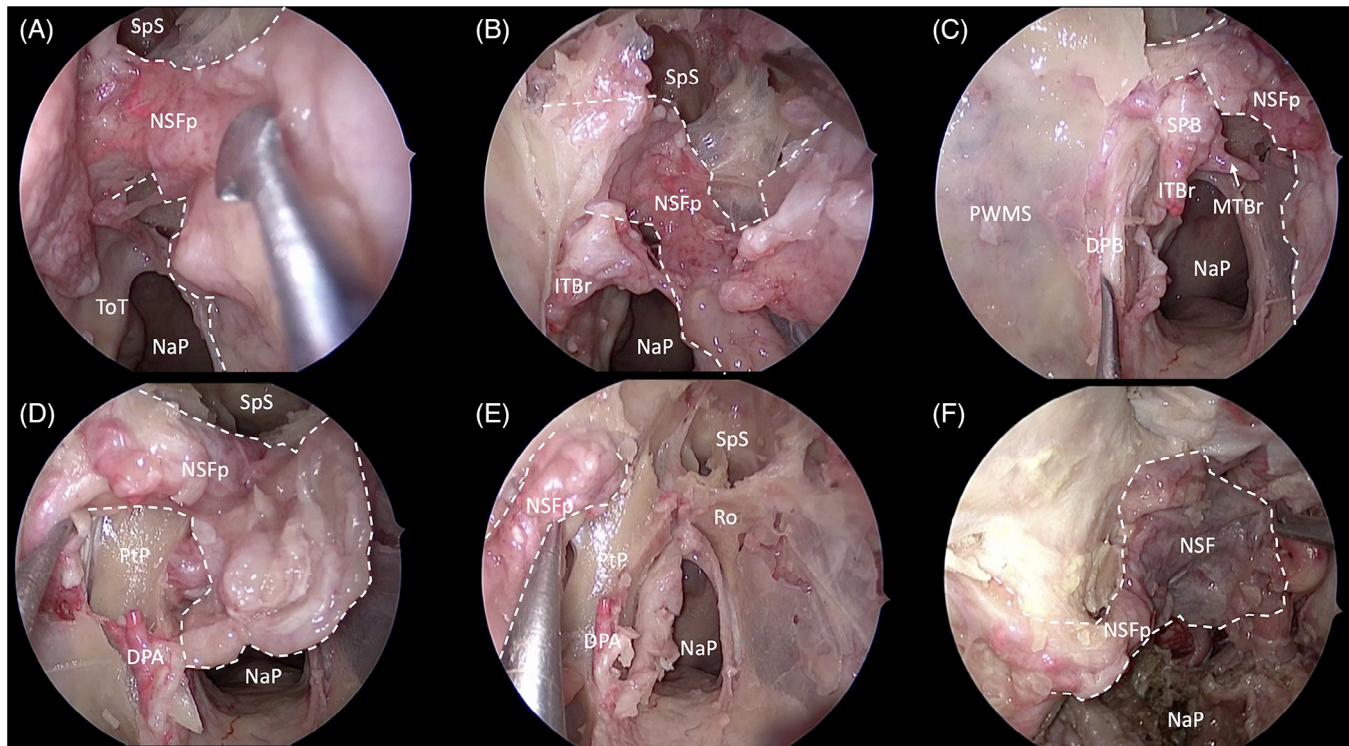
Fifty-five patients with surgical defects reconstructed with a NSFwEPD were included (Table 1). In the majority of cases (87.3%), the application of the NSFwEPD was sufficient to reconstruct the defect, whereas in seven patients (12.8%) an additional local flap (contralateral NSF) was needed. All cases of cerebrospinal fluid leak were successfully repaired.

Among all cases, only in two patients a partial/complete flap necrosis was observed (success rate 96.4%). Partial/complete necrosis was significantly associated with previous radiotherapy (RT) ( $p = 0.04$  and  $0.03$ ). Revision-versus-primary surgery, previous septoplasty, and previous RT were not significantly associated with an increase in early and late complications ( $p > 0.05$ , Table 1).

## 4 | DISCUSSION

The main finding of our manuscript is that NSFwEPD based on the maxillary artery is a reliable local flap (96.4% complete flap vitality), useful to reconstruct not only far anterior SB defects but also middle and posterior SB defects approached via ipsilateral transpterygoid corridor, and to resurface internal carotid artery after endoscopic nasopharyngectomy. To the best of our knowledge, this report is the first of its kind since we have demonstrated, with the largest case series of the literature, the applicability of this reconstructive solution for complex lesions of the SB, underlying its good outcomes and low rate of complications (Table 1).

The standard NSF is nowadays considered the workhorse among the local flaps to reconstruct defects of the SB and its surface area can be intraoperatively tailored, based on reconstructive needs.<sup>6-8</sup> However, the major limitation of the standard NSF is the arch of rotation and its attachment at the sphenopalatine foramen.<sup>5</sup> In recent years, some authors have demonstrated, through anatomical studies and small case series, that releasing the NSF pedicle from the sphenopalatine foramen and dissecting the pedicle as far as the maxillary artery improves the potential length and mobility of the flap.<sup>1,6</sup> In addition, others have underlined that by lateralizing the NSFwEPD, it can be used for reconstruction during ipsilateral transpterygoid approaches, overcoming previous limitations of the standard NSF.<sup>4</sup> In our study, we described a wide range of approaches where the NSFwEPD was successfully used (Table 1), and it has been described as a safe and effective local flap for transnasal endoscopic



**FIGURE 1** Anatomical study of a right nasal fossa in which a nasoseptal flap (highlighted with dotted line) was harvested with pedicle dissection to the maxillary artery (NSFwEPD). After having performed the standard incision of the nasoseptal flap at the level of the septum and rostrum, (A) the nasoseptal flap pedicle was clearly identified and preserved; to gain flap mobility, the sphenopalatine artery branches were cut, such as the turbinate branches (B) and the vidian and palato-vaginal branches, preserving the septal one; the superior aspect of the perpendicular plate of the palatine bone was also removed (C) and the descending palatine artery was coagulated and cut to free the flap from its inferior attachment (D). The medial portion of the posterior maxillary sinus wall was then removed and the flap was stored in the maxillary sinus exposing the pterygoid plates (E). After having performed a transpterygoid approach, a type III nasopharyngectomy and exposed the posterior cranial fossa through a transclival approach, the NSFwEPD was placed over the exposed homolateral internal carotid artery and dural defect. DPA, descending palatine artery; DPB, descending palatine bundle; ITBr, inferior turbinate branch; MTBr, middle turbinate branch; NaP, nasopharynx; NSF, nasoseptal flap; NSFp, nasoseptal flap pedicle; PtP, perpendicular process of the palatine bone; PWMS, posterior wall of the maxillary sinus; Ro, rostrum; SPB, sphenopalatine bundle; SpS, sphenoidal sinus; ToT, torus tubarius.

nasopharyngectomy and inferior maxillectomy, widening the clinical applicability of this flap. As a result, the NSFwEPD is a valid solution to reconstruct ipsilateral defect in the lateral sphenoid, pterygoid or upper parapharyngeal regions, or to cover other SB areas otherwise unreachable with the standard NSF, giving more reliable outcome compared to the free grafts. Nevertheless, one of the main weaknesses of the NSFwEPD is the potential risk of necrosis: indeed, by dissecting the NSF pedicle to the pterygopalatine fossa there is a potential risk of arterial bleeding, compromission of venous drainage, and late vessel dissection and rupture if some arterial branches are left exposed.<sup>6,9</sup> Nevertheless, in the literature, the frequency of these complications has not been clinically described so far, leaving its actual occurrence unknown. In our series, only two cases experienced partial/complete flap necrosis (3.6%), which was significantly associated with previous RT ( $p = 0.01$ ). However, none of our patients experienced a mild/severe postoperative epistaxis, underlying the low

risk of bleeding of this flap. Finally, neither previous septoplasty nor revision surgery directly influenced the occurrence of early and late complications.

One of the limitations of this manuscript is the absence of direct, objective assessment of flap vascularization (e.g., indocyanine green), which would have strengthened the result achieved; in addition to this, the real incidence of dry eye syndrome due to the NSFwEPD harvesting is difficult to describe since most of the applied surgical approaches of our series comprehend the transection of the vidian nerve.

Altogether, our results demonstrate the reliability of the NSFwEPD, increasing its range of clinical applicability while maintaining good outcomes even in patients who were already treated surgically and/or with (chemo)RT.

#### **AUTHOR CONTRIBUTIONS**

Alessandro Vinciguerra, Mario Turri-Zanoni, Marco Ferrari, Davide Mattavelli, Benjamin Verillaud, Vincenzo Abbate, and Vittorio Rampinelli made substantial con-

**TABLE 1** Main characteristics, outcomes, and complications.

	<b>N = 55</b>
Age (years), mean (SD)	49.5 (14.4)
Gender, male:female	26:29
Side, left:right	19:36
Primary versus revision surgery (%)	80:20
Previous radiotherapy, <i>n</i> (%)	14 (25.5%)
Previous septoplasty, <i>n</i> (%)	4 (7.3%)
Follow-up (months), mean (SD)	25.5 (21.4)
Type of surgical approach	
Transpterygoid, <i>n</i> (%)	32 (58.2%) <ul style="list-style-type: none"> <li>- 24 sphenoidal CSF/encephalo-meningocele</li> <li>- 6 PACG</li> <li>- 1 petro-occipital chondrosarcoma (associated with Eustachian tube transposition)</li> <li>- 1 lower clivus cranio-cervical junction chordoma</li> </ul>
Type II–III transnasal endoscopic nasopharyngectomy, <i>n</i> (%)	17 (30.9%) <ul style="list-style-type: none"> <li>- 5 recurrent nasopharyngeal squamous cell carcinoma</li> <li>- 2 nasopharyngeal adenoid cystic carcinoma</li> <li>- 9 recurrent non-keratinizing undifferentiated nasopharyngeal carcinoma</li> <li>- 1 mucoepidermoid carcinoma</li> </ul>
CSF leak of the anterior skull base, <i>n</i> (%)	5 (9.1%) <ul style="list-style-type: none"> <li>- 3 spontaneous CSF</li> <li>- 1 post-traumatic CSF</li> <li>- 1 iatrogenic CSF</li> </ul>
Inferior maxillectomy, <i>n</i> (%)	1 (1.8%) maxillary polymorphic adenocarcinoma involving the hard and soft palate
Outcomes and complications	
Nasoseptal flap with extended pedicle dissection was sufficient to reconstruct the defect, <i>n</i> (%)	48 (87.3%)
Nasoseptal flap with extended pedicle dissection complete necrosis, <i>n</i> (%)	1 (1.8%)
Nasoseptal flap with extended pedicle dissection partial necrosis, <i>n</i> (%)	1 (1.8%)
Flap-related early complications, <i>n</i> (%)	5 (9.1%) <ul style="list-style-type: none"> <li>- 4 infection of the donor site/sinus</li> <li>- 1 septal cartilage necrosis</li> </ul> No post-operative epistaxis was noted
Flap-related late complications, <i>n</i> (%)	2 (3.6%) <ul style="list-style-type: none"> <li>- 2 infections with extended nasal crusting</li> </ul>

Abbreviations: CSF, cerebrospinal fluid leak; PACG, petrous apex cholesterol granuloma; SD, standard deviation.

tributions to conception, design and acquisition of data, drafted the article, revised it critically for important intellectual content, gave final approval of the version to be published, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Alberto Schreiber, Maurizio Big-nami, Paolo Battaglia, Piero Nicolai, Paolo Castelnovo, and Philippe Herman made substantial contributions to

conception of the data, revised it critically for important intellectual content, gave final approval of the version to be published, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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