



Reconstruction of a subtotal septorhinectomy defect with a chimeric paramedian-pericranial forehead flap^{☆, ☆ ☆}

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ABSTRACT

The nose is a complex structure important for aesthetic appearance, social interaction, and respiration. Full thickness nasal defects with resection of the septum pose a significant challenge to the reconstructive surgeon due to the lack of local tissues to replace the nasal lining and significant risk of nasal collapse owing to the paucity of rigid infrastructure. The purpose of this paper is to present a unique case of nasal reconstruction utilizing a bilaminar paramedian forehead flap (combined pericranial flap and forehead flap) with embedded cantilever rib graft in a patient who underwent resection for an intranasal malignancy involving the septum and soft tissue envelope. This case serves to demonstrate the great utility in using chimeric flaps based on a single pedicle given the low patient morbidity, predictable results, and rapid recovery period.

1. Introduction

The nose is the centerpiece of the face and a complex pyramidal structure important for aesthetic appearance, social interaction, and the imperative function of respiration. Full thickness nasal defects from infection, trauma, or tumor extirpation pose a significant challenge to the reconstructive surgeon. When reconstructing these defects, all layers must be restored in order to provide the best functional and aesthetic outcome. Often, over the course of one or more operations, this requires the use of soft tissue flaps to create lining and coverage, as well as cartilage or bone grafts for support.

Careful planning is needed to select the best donor tissue for each layer. The paramedian forehead flap is widely regarded as a reliable option for external coverage of large defects. Based on the supratrochlear and supraorbital arteries, the forehead flap provides tissue similar in color and texture to the nasal tissue with minimal donor site morbidity [1]. Structural support is commonly provided by septal or conchal cartilage, with the use of rib if more stock is needed [2]. The vestibular lining has remained the most challenging layer, as it is the most likely to lead to reconstructive failure [3]. When the septum is present, nasal lining can be reconstructed using septal

muchoperichondrial flaps. When the septum is absent, a forehead flap can be turned-over or pre-laminated, and local or free flaps can be used to provide lining [4]. All of these options require multiple surgeries, which are time consuming and costly. They may also delay the placement of structural grafts and are daunting to the patient. The ideal reconstructive method allows placement of grafts at the initial surgery, limits donor site morbidity, and exposes the patient to minimal operating room visits.

One approach to the problem of reconstructing nasal lining is the inclusion of a pericranial flap, which provides the ideal thickness for internal lining and is a highly vascularized tissue. The pericranial flap can be raised as a composite with the paramedian forehead flap in a single stage, and support grafts can be placed in the same operation [5]. The purpose of this paper is to present a unique case of total nasal reconstruction utilizing a bilaminar forehead flap with embedded costal rib graft in a patient who underwent a subtotal septorhinectomy for malignancy.

* Prior presentation: This paper has not been previously presented in any format.

☆☆ All patient photos used with appropriate informed consent.

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2. Case report

2.1. Presenting information

A 76-year-old male with a 40 pack-year smoking history presented to the office with complaints of upper nasal fullness and irritation. The patient denied any weight loss, night sweats, or other related complaints. Examination of the nose with a speculum and 0 degree endoscope revealed a friable mass involving the mid to superior nasal septum adherent to the underside of the soft tissue envelope at the junction of the septum and nasal dorsal skin. The patient had a biopsy at an outside facility prior to his visit with us which was positive for squamous cell carcinoma. The neck examination was negative for an adenopathy. Maxillofacial and neck CT was obtained, showing growth through the nasal septum and partially into the soft tissue envelope. PET/CT was negative for regional or distant disease. After a long discussion with the patient, decision was made to proceed with nasal septectomy and rhinectomy, with reconstruction using a bilaminar paramedian-pericranial flap and rib cartilage.

2.2. Operative details

After the patient was prepped and draped for surgery, intranasal examination was performed again while the patient was asleep using a combination of endoscope and speculum. The findings of the office exam were unchanged, and importantly there was not tumor abutting the columella or the ala. Using a marking pen, the dorsal subunit was marked out with care to include a 1 cm margin for full resection. First, a transcolumellar incision was made with a needle tip bovie at approximately the mid-point. Once incised, the tumor was better visualized. The bovie was then used to incise along the septo-columellar junction and along the nasal floor to fully excise the septum with tumor adherent to it while also taking a 1 cm margin. Moving posteriorly, a bovie was used to further excise septum from the maxillary crest.

At this point, nasal dorsal skin incisions were made through and through in order to enter the nasal vestibule and exposed the septum (Fig. 1a). Once this was done, septal cuts were made posteriorly with a bovie as well to free the remaining septal attachments. After this was done, the entire tumor was removed *en bloc*, with the specimen including the nasal septum and overlying skin, the intervening cartilaginous framework, and the adherent tumor (Fig. 1b). This was sent to pathology for examination. Circumferential margins were taken, all of which were negative for remaining tumor.

In order to reconstruct the defect, inner lining, cartilage, and skin would all be required (Fig. 1c). A rib cartilage graft was harvested and fashioned into lateral crural struts, a columellar strut, and a dorsal buttress. After measuring the defect and transposing the drawing onto

the left forehead, the paramedian flap was planned (Fig. 1d). The skin furrow corresponding to the location of the supratrochlear vessels was found, and confirmed with a doppler. The distal portion of the flap was incised with a knife just through the subcutaneous tissue. Then, the lateral and medial scalp skin was elevated just off of the pericranium. A whole pericranial flap was concurrently elevated and incised as a second leaflet of the paramedian flap. With this chimeric construct, dissection proceeded subpericranially towards the pedicle rotation point with a combination of periosteal elevator and scalpel. Once the entire flap was elevated (Fig. 1e), bleeding at the distal tip was confirmed for both the skin and pericranium. The entire construct appeared to be viable.

First, the pericranium was used to recreate nasal lining and was sutured to the mucosa with interrupted vicryl sutures (Fig. 1f). Next, the rib cartilage grafts were appropriately secured with PDS sutures (Fig. 1g). Lastly, the skin from the paramedian flap was used to cover the cartilage construct and relined the external nasal skin. The flap was secured with vicryl and prolene sutures (Fig. 1h).

The patient was discharged home the same day. He did well in the immediate post-operative period. His pedicle division was scheduled in 1 month given that he had a smoking history. During the pedicle division, the flap appeared viable and the procedure was unremarkable.

(Fig. 1i). The patient continued to do well during the period following that. At 1 month following pedicle division and inset, he was almost completely healed and doing well (Fig. 1j). Interestingly, final pathology from the resection came back showing a basal cell carcinoma, obviating the need for radiation given the full resection.

3. Discussion

This paper describes the use of a bipedicle paramedian forehead flap for reconstruction of a full thickness nasal defect with septal involvement. The removal of a large segment of vestibular mucosa and septum presented a unique reconstructive challenge, which was reconciled using a pericranial flap for lining replacement transferred on the same pedicle as a paramedian forehead flap. Costal rib graft was placed as a cantilever graft at the initial operation, which was secured to the remaining dorsal nasal bone and tunneled in a pocket between the two flaps.

Reported techniques for reconstruction of the nasal lining are limited by poor tissue match, increased thickness, fragility, small size, inadequate vascular supply, and the requirement for multiple donor sites [2]. The septal mucoperichondrial hinge flap provides similar tissue type and thickness as nasal mucosa. Since the tissue is thin, the flap is fragile and can easily be damaged during manipulation with high rates of septal perforation [6]. Turn over flaps, which utilize deepithelialized skin adjacent to the defect that is flipped over, are limited by their small



Fig. 1. a: Photograph of exposed tumor after transcolumellar and dorsal skin incisions are made. b: Photograph of *en bloc* resection specimen. c: Post-resection examination revealing through and through defect of the nose with missing skin septum, and cartilaginous framework. d: Planned paramedian-pericranial flap. e: Chimeric paramedian-pericranial flap elevated. f: Inner lining of nose reconstructed with pericranial component of bilaminar flap. g: Cartilaginous framework inset on top of pericranial lining. h: Paramedian skin flap used to resurface external skin defect on top of cartilaginous framework. i: Immediate examination following division and inset of pedicle. j: Near-complete healing in patient 1 month following division and inset.

size and unreliable subdermal blood supply [7]. Free flaps provide significant soft-tissue bulk for coverage of large nasal defects, but require multiple procedures and multiple donor sites, and are often too thick for vestibular lining [8]. Menick described the use of a three-stage folded forehead flap which utilizes a distal extension of the flap folded into the nasal vault to reconstruct the lining. This technique requires multiple surgeries and folding the distal tip of the flap, which creates thickened alar border requiring further revision procedures [1]. Alagoz et al. described the use of a pre-laminated expanded forehead flap in which a silicone sheet was used to create a frontalis/galea flap for lining, and separate it from the overlying skin. This allowed lining, support, and skin to be reconstructed at the same time, but also required three separate surgeries to perform [9].

The technique of laminating a forehead flap was first described by Brackley and Jones in 2002 for reconstruction of a full thickness nasal defect from a septal squamous cell carcinoma in which septum, bony vault, upper lateral cartilages, and dorsal nasal skin were excised [10]. The pericranial flap was transferred separately from the forehead flap on its own broad vascular pedicle, and cartilage grafts were placed between the two flaps. The technique was further modified in 2005 by Potter, Ducic, & Ellis who transferred the pericranial and forehead flaps on the same pedicle and created a tunnel between the two flaps for placement of supporting cartilage grafts [5]. In 2018, Brunetti et al. described a bilaminar forehead flap very similar to that used by Ducic in their 2005 paper, in three patients with full thickness nasal defects [11]. However, none of the patients discussed in Brunetti's reports had septal involvement as in the previous two case studies.

Pericranial flaps have been widely used in anterior skull base reconstructive surgery for their ability to act as a sealant and barrier to infection, and their ability to limit the cyclical pressure changes that occur with breathing [12,13]. These qualities also make pericranial flaps useful for the internal lining in nasal reconstruction. The success of the internal lining is vital in preventing tissue retraction which can lead to deformity or functional nasal failure. The technique described in this paper allows for flap reconstruction of large full thickness defects using a single donor site raised on a single vascular pedicle. It includes the paramedian flap with the availability of large thin distal pericranial extensions ideal for folding into the nasal vestibule. The blood supply to these flaps is largely based on the supraorbital and supratrochlear arteries which provide effective vascularization for flap survival [14]. Based on cadaver studies by Rohrich et al. leaving 7 mm of pericranium attached above the supraorbital rim provides maximum preservation of vascular supply to the pericranial flap [15].

In summary, our technique using a bipedicle flap combining a paramedian forehead flap and a pericranial flap was successful in the

reconstruction of a full thickness nasal defect involving a large portion of nasal septum. The pericranial flap is an effective tool for lining of the nasal vestibule due to its size, availability, thinness, and well vascularized tissue. The bipedicle nature of the flap also allowed for placement of support grafts at the time of the initial surgery. This technique is beneficial because it allows replacement of nasal lining, support, and coverage with minimal donor site morbidity in a single surgery.

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