

Paramedian Forehead Flap for Complex Nasal Reconstruction: Clinical Application and Surgical Outcomes

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ABSTRACT

Background:

Reconstruction of major nasal defects is challenging because restoration of skin coverage alone is insufficient to reproduce nasal contour, structural support, and function. The paramedian forehead flap remains a versatile option for defects involving one or multiple nasal subunits and permits staged refinement before definitive pedicle division. This study describes the clinical application of the paramedian forehead flap in a Mexican patient population, with emphasis on reconstructive characteristics, staging, and surgical outcomes.

Methods:

An observational study was conducted in 30 patients treated at the Plastic Surgery Department of Hospital General de México between January 2019 and December 2023 for nasal defects requiring forehead flap reconstruction. Demographic characteristics, defect etiology, affected nasal subunits, pedicle laterality, number of reconstructive stages, donor-site management, and postoperative complications were analyzed. Descriptive statistics were used to summarize the study population and reconstructive characteristics.

Results:

Thirty patients were included: 18 men (60%) and 12 women (40%), with a mean age of 40.63 years. Oncologic resection was the most frequent etiology (40%), followed by animal or human bites (33.3%) and nasal trauma (20%). Multiple nasal subunits were involved in 70% of patients, with the nasal tip being the most frequently affected subunit (63.3%). An ipsilateral pedicle was used in 28 patients (93.3%). Three-stage reconstruction was performed in 20 patients (66.6%), whereas 10 (33.3%) underwent two-stage reconstruction. Primary donor-site closure was achieved in 28 patients (93.3%). Partial dehiscence occurred in two patients (6.6%), and one patient (3.3%) was considered to have a suboptimal aesthetic result. No total flap losses or major complications were observed.

Conclusions:

The paramedian forehead flap provided reliable reconstruction of complex nasal defects involving single or multiple aesthetic subunits, with no total flap losses and a low incidence of minor complications in this series. The versatility of pedicle design, staged reconstruction, and the opportunity for contour refinement support its role as an important reconstructive option for major nasal defects.

KEYWORDS: paramedian forehead flap, nasal reconstruction, nasal subunits, staged reconstruction, reconstructive surgery.

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INTRODUCTION

Major nasal defects represent a particularly demanding reconstructive problem because the nose occupies a central position in the face and combines complex aesthetic contours with essential functional roles. Successful reconstruction must therefore address more than simple wound coverage. Restoration of an appropriate skin envelope, structural support, nasal contour, airway function, and symmetry among the aesthetic subunits must all be considered when selecting and planning a reconstructive strategy [1,2].

Nasal defects may result from oncologic resection, trauma, congenital abnormalities, inflammatory or immunologic disease, and complications related to previous nasal surgery [1,3]. The reconstructive challenge varies considerably according to defect size, depth, location, involvement of cartilage or bone, loss of internal lining, skin characteristics, previous treatments, and the number of aesthetic subunits affected [1,3]. Careful preoperative analysis of these factors is essential because they influence not only flap selection but also pedicle design, the need for structural support, the number of reconstructive stages, and the likelihood of requiring secondary refinement [1,3].

Small superficial defects may be managed by secondary intention, skin grafting, or local flaps. In contrast, larger or more complex defects—particularly those involving the nasal tip, ala, columella, or multiple adjacent subunits—often require regional tissue transfer [3,4]. The paramedian forehead flap remains one of the most versatile options for these defects because it provides a robust vascular supply based on the supratrochlear system and offers tissue with favorable color, texture, and thickness for nasal resurfacing [4,5]. Its reliability also allows staged reconstruction, permitting modifications of flap thickness, contour, and structural support before final pedicle division [4,5].

The reconstructive value of the paramedian forehead flap depends not only on flap survival but also on a sequence of technical decisions made throughout the procedure. These include assessment of the defect, selection of the aesthetic subunits to reconstruct, flap design, pedicle laterality, donor-site management, choice between two- and three-stage reconstruction, and timing of contour refinement [1,5-7]. These factors are particularly relevant in complex defects in which restoration of three-dimensional nasal form may require repeated adjustments before reconstruction is completed [1,5-7].

The purpose of this study is to describe our clinical experience with paramedian forehead flap reconstruction in 30 patients treated for major nasal defects at a tertiary referral center in Mexico. We aimed to characterize the etiologies and anatomical patterns of the defects, describe the reconstructive approaches used in this population, and report surgical outcomes, with particular attention to pedicle laterality, reconstructive staging, donor-site management, and postoperative complications.

Surgical Technique

The forehead flap has long been considered a workhorse and a primary reconstructive option for the loss of nasal subunits because of its versatility and its ability to replace several subunits within the same reconstructive procedure. The technique was initially described in India, where nasal amputation was commonly used as punishment for minor offenses, and was documented in the medical treatise known as the *Sushruta Samhita*. It was subsequently introduced into Europe around the 1500s and later into the United States in 1830 by J. M. Warren. In the following decades, particularly around the 1930s, the vascular basis of the flap was better understood through the description of the supratrochlear artery. Several technical modifications were subsequently introduced until Millard proposed the paramedian variant, which improved flap dimensions while excluding the central glabellar skin, thereby reducing donor-site morbidity and improving flap viability [8].

Before flap elevation, the dimensions of the defect and the nasal subunits requiring reconstruction must be carefully defined. A template is frequently used to reproduce the dimensions and shape of the defect on the forehead skin. Prior to flap elevation, patency of the supratrochlear artery should also be confirmed using a Doppler device, and its course should be marked to provide an initial anatomical reference. Another important step in flap planning is identification of the pivot point and simulation of flap rotation to ensure that the entire defect can be reached and covered without excessive tension. This may be performed using a measuring tape or even a piece of gauze fixed at the pivot point and rotated in the same manner as the planned flap [4,6].

Anatomically, the supratrochlear artery courses approximately 1.7 to 2.2 cm lateral to the midline in a predominantly vertical direction [9]. From cephalad to caudal, it initially travels within the subcutaneous plane, subsequently enters a submuscular plane, and becomes subperiosteal approximately 1 cm above the eyebrow.

Based on these anatomical considerations, flap elevation should initially proceed in a submuscular plane and transition to a subperiosteal plane approximately 1 cm above the eyebrow. This approach allows appropriate inclusion and protection of the supratrochlear vascular pedicle and helps ensure adequate flap perfusion [4,9]. Once the nasal defect has been covered, the forehead skin is undermined to facilitate approximation of the wound edges and achieve primary closure whenever possible. If primary closure cannot be obtained without excessive tension, a skin graft may be used to cover the remaining donor-site defect [4,6].

The vascular pedicle should be protected with sterile dressings and maintained in an appropriately moist environment to reduce the risk of thrombosis, desiccation, or infection. Pedicle division is generally performed approximately three weeks after flap transfer, followed by final inset and completion of nasal defect coverage [4,6,7].

MATERIALS AND METHODS

An observational study was conducted in patients treated at the Plastic Surgery Department of Hospital General de México between January 2019 and December 2023. Thirty patients with nasal defects considered suitable for reconstruction using a forehead flap were included in the study.

The variables analyzed included patient age and sex, etiology of the nasal defect, number and location of affected nasal subunits, laterality of the forehead flap pedicle, donor-site management, number of reconstructive stages, and postoperative complications. Defects were categorized according to involvement of a single nasal subunit or multiple subunits.

Reconstructive procedures were classified as two-stage or three-stage according to the number of operative stages performed before completion of reconstruction. Donor-site management was recorded as primary closure or combined closure with skin grafting.

Data were analyzed using SPSS version 22. Descriptive statistics were used to summarize demographic and reconstructive characteristics. Continuous variables are reported using measures of central tendency and range where available, and categorical variables are presented as frequencies and percentages.

RESULTS

The study included 30 patients, of whom 18 (60%) were men and 12 (40%) were women. Patient age ranged from 3 to 82

years, with a mean age of 40.63 years. Twenty-two patients (73.3%) were younger than 60 years.

Oncologic resection was the most frequent cause of nasal defects and accounted for 12 cases (40%). These included defects following resection of basal cell carcinoma, squamous cell carcinoma, and Hodgkin lymphoma. Ten defects (33.3%) resulted from dog or human bites, whereas six (20%) were associated with nasal trauma, including traffic accidents and sequelae of rhinoplasty.

Most reconstructions involved anatomically complex defects. Twenty-one patients (70%) had involvement of multiple nasal subunits, whereas nine (30%) had defects confined to a single subunit. The nasal tip was involved most frequently, occurring in 19 patients (63.3%), followed by the ala in 13 (43.3%), dorsum in nine (30%), soft triangle in six (20%), and columella in five (16.6%).

An ipsilateral paramedian forehead flap was used in 28 patients (93.3%), whereas a contralateral pedicle was selected in two (6.6%). Primary closure of the forehead donor site was achieved in 28 patients (93.3%). The remaining two patients (6.6%) required combined closure and skin grafting.

Three-stage reconstruction was performed in 20 patients (66.6%), whereas 10 patients (33.3%) underwent two-stage reconstruction. The mean number of surgical procedures was 2.66.

No total flap losses or major complications were observed. Partial wound dehiscence occurred in two patients (6.6%). One additional patient (3.3%) was considered to have a poor aesthetic result.

Table 1. Demographic, defect-related, and reconstructive characteristics of the study population (n = 30)

Characteristic	Value
Sex, n (%)	
Male	18 (60.0)
Female	12 (40.0)
Age	
Mean age, years	40.63
Range, years	3 - 82
Reconstructive stages, n (%)	
Two-stage	10 (33.3)
Three-stage	20 (66.6)
Mean number of procedures	2.66
Pedicle laterality, n (%)	
Ipsilateral	28 (93.3)
Contralateral	2 (6.6)
Defect involvement, n (%)	
Single subunit	9 (30.0)
Multiple subunits	21 (70.0)
Tip	19 (63.3)
Ala	13 (43.3)
Dorsum	9 (30.0)
Soft triangle	6 (20.0)
Columella	5 (16.6)
Donor-site management, n (%)	
Primary closure	28 (93.3)

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Combined closure and skin grafting	2 (6.6)
Reported outcomes, n (%)	
Partial dehiscence	2 (6.6)
Suboptimal aesthetic result	1 (3.3)
Total flap loss	0

Representative Clinical Cases

The following cases illustrate the spectrum of nasal defects treated in this series and the principal stages of paramedian forehead flap reconstruction.

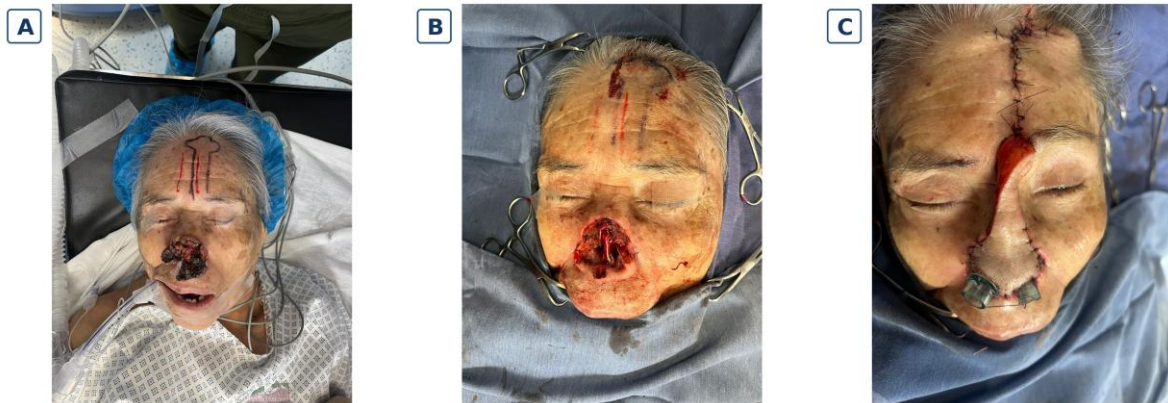


Figure 1. Representative reconstruction of a major nasal defect using a paramedian forehead flap. (A) Preoperative nasal lesion. (B) Resulting defect after resection. (C) Flap transfer and inset with temporary nasal stenting.

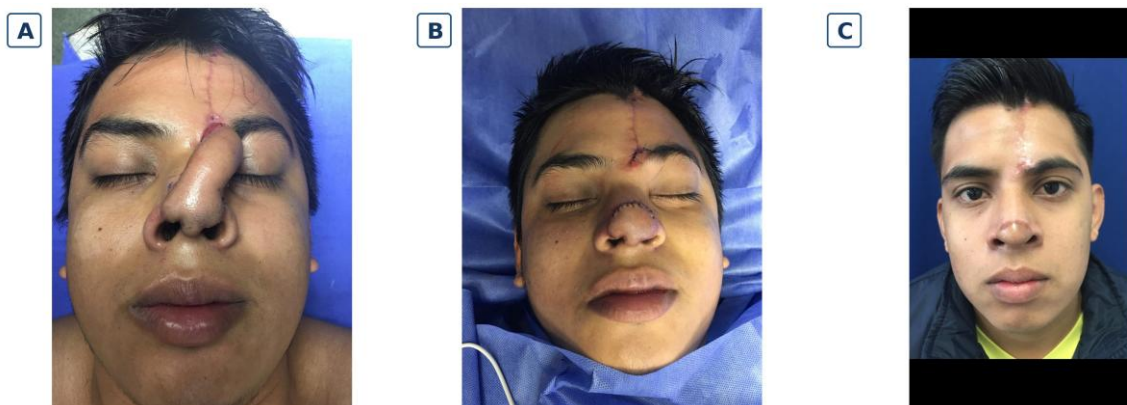


Figure 2. Representative staged paramedian forehead flap reconstruction in a younger patient. (A) Forehead flap following transfer to the nasal defect and before pedicle division. (B) Early postoperative appearance following pedicle division and final inset. (C) Follow-up demonstrating nasal contour and healing of the forehead donor site.

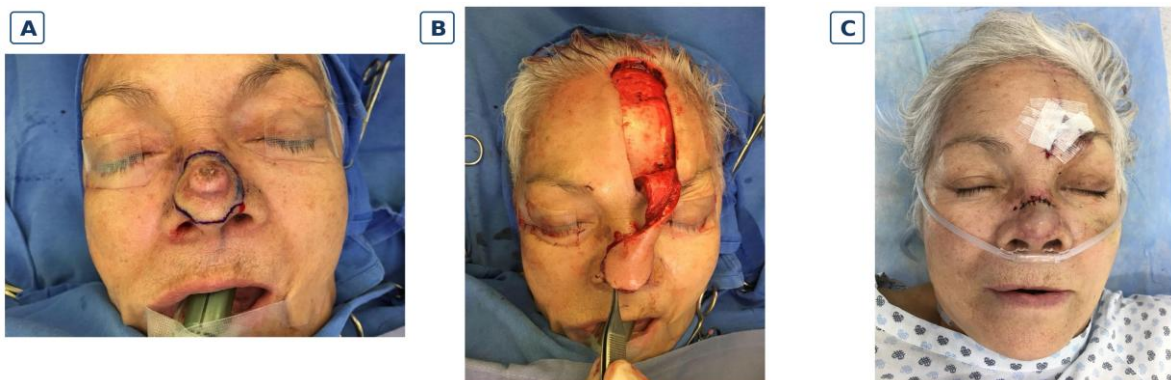


Figure 3. Representative reconstruction of a nasal tip defect in an older patient. (A) Preoperative lesion involving the nasal tip. (B) Intraoperative elevation and transfer of the paramedian forehead flap. (C) Early postoperative appearance following pedicle division and inset.

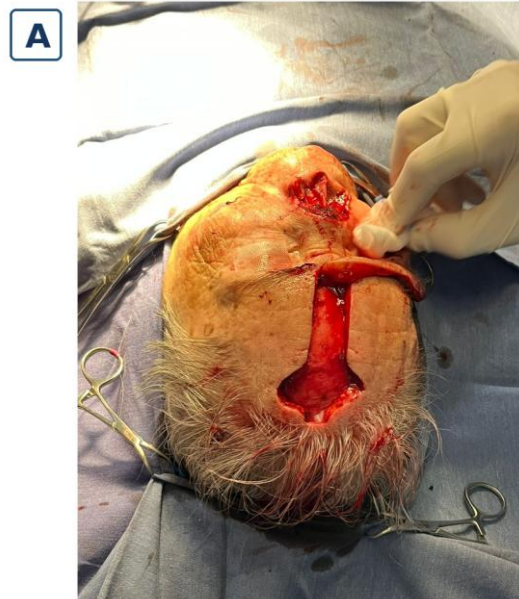


Figure 4. Intraoperative view demonstrating elevation of the paramedian forehead flap and preparation of the nasal recipient defect.

Discussion

The findings of this series illustrate the application of the paramedian forehead flap across a heterogeneous group of major nasal defects. Seventy percent of patients had involvement of multiple aesthetic subunits, and the nasal tip and ala were the most frequently affected regions. Despite this degree of anatomical complexity, no total flap losses occurred, supporting the vascular reliability of the technique when appropriately planned and executed [4,6,10].

Reconstruction at our center was guided by the aesthetic subunit principles originally described by Gonzalez-Ulloa and subsequently incorporated into modern nasal reconstruction [2,11]. Whenever feasible, reconstruction was planned so that scars were positioned along the borders between adjacent nasal subunits [1,2]. The principle of replacing an entire aesthetic subunit, however, should not be applied indiscriminately. When a defect involves less than approximately half of a subunit, excision of otherwise healthy remaining tissue may unnecessarily enlarge the defect and increase reconstructive requirements [1,11]. Preservation of uninvolved tissue may therefore be preferable when satisfactory contour and scar placement can still be achieved. Pedicle laterality represents another important component of flap planning. In the present series, an ipsilateral pedicle was used in 93.3% of patients. Potential advantages of the ipsilateral approach include a shorter distance between the donor tissue and an ipsilateral nasal defect, reduced pedicle rotation, greater effective flap reach, and preservation of the contralateral forehead as a potential future reconstructive option [4,6]. Nevertheless, the present study was not designed to compare ipsilateral and contralateral pedicles, and the marked imbalance between groups does not permit conclusions regarding superiority of either approach.

Staging provides an additional opportunity to tailor reconstruction to defect complexity. Two-thirds of the

patients in this series underwent three-stage reconstruction, whereas one-third underwent a two-stage procedure. The intermediate stage of a three-stage reconstruction can permit further modification of flap thickness, soft-tissue contour, and structural support before pedicle division [5,7,12]. These refinements may be particularly useful in complex defects in which restoration of the tip, ala, or other highly contoured regions requires more than simple skin coverage [5,7,12]. However, because the criteria used to select two- versus three-stage reconstruction were not evaluated as comparative variables in the present study, differences in outcome between these approaches cannot be established from this series.

Management of the forehead donor site is also an integral component of the reconstructive procedure. Primary closure was achieved in 93.3% of patients. Such closure should only be attempted when approximation can be accomplished without excessive tension, distortion of the eyebrow, or compromise of flap perfusion [4,6]. When complete primary closure is not appropriate, partial closure combined with secondary healing or skin grafting remains an alternative [4,6]. Only two patients in the present series required skin grafting of the donor site.

The low incidence of postoperative morbidity observed in this cohort is consistent with the recognized vascular reliability of the forehead flap [6,10]. Partial dehiscence occurred in two patients, while no total flap losses or other major complications were recorded. One patient was considered to have a poor aesthetic result. Importantly, flap survival alone should not be regarded as a complete measure of reconstructive success. Nasal contour, thickness, symmetry, scar quality, airway function, and patient perception are also relevant outcomes and may require secondary refinement after completion of the initial reconstructive sequence [1,12].

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Scar characteristics deserve particular consideration in populations with a broad range of skin pigmentation. Ultraviolet radiation may influence pigmentation during scar maturation, and dyspigmentation is a recognized consequence of cutaneous wound healing [13,14]. Post-inflammatory hyperpigmentation occurs more frequently and may be more persistent in individuals with darker skin phototypes [16]. Studies of cutaneous pigmentation in Mexican populations have demonstrated substantial variation in skin pigmentation and representation of intermediate-to-darker Fitzpatrick phototypes [15]. These considerations may therefore be clinically relevant when evaluating donor- and recipient-site scars after nasal reconstruction in Mexican patients. However, Fitzpatrick skin type and postoperative scar pigmentation were not systematically quantified in the present series. Consequently, this study cannot establish an association between skin phototype and aesthetic outcome. Prospective evaluation using standardized scar assessment, objective pigmentation measurements, and patient-reported outcome instruments would be required to investigate this question.

Several limitations of this study should be acknowledged. The cohort was relatively small and represented the experience of a single surgical service. The analysis was descriptive, and the study was not designed to compare reconstructive techniques, pedicle laterality, or two- versus three-stage procedures. In addition, standardized functional and aesthetic outcome measures were not available. These limitations restrict comparative conclusions but do not diminish the value of the series in demonstrating the broad clinical application and vascular reliability of the paramedian forehead flap across defects of different etiologies and anatomical complexity.

Future studies should incorporate standardized assessment of nasal function, scar quality, contour, patient satisfaction, and long-term aesthetic outcomes. A more detailed analysis of the technical criteria used to select pedicle laterality and reconstructive staging may also help define reproducible decision-making pathways for complex nasal reconstruction.

CONCLUSIONS

The paramedian forehead flap is a reliable and versatile option for reconstruction of major nasal defects involving one or multiple aesthetic subunits. In this series of 30 patients, most defects involved multiple subunits, with the nasal tip and ala among the most frequently affected regions. The ipsilateral pedicle was used in the large majority of cases, three-stage reconstruction was performed more frequently than a two-stage approach, and primary closure of the forehead donor site was achieved in most patients. Importantly, no total flap losses occurred and postoperative morbidity was limited to a small number of minor complications.

The value of the paramedian forehead flap extends beyond dependable tissue coverage. Its robust vascular anatomy and

staged nature allow the reconstructive plan to be adapted to defect size, location, depth, and anatomical complexity while providing opportunities for refinement of contour, thickness, and structural support before final pedicle division. This flexibility is particularly important in defects affecting the nasal tip, ala, columella, or several adjacent subunits, where satisfactory reconstruction depends on restoring three-dimensional form rather than simply closing the defect.

The findings of this series also highlight the importance of reconstructive planning and technical decision-making. Pedicle selection, staging strategy, and donor-site management should be individualized according to the characteristics of the defect and the requirements of the patient. Although the present study was not designed to compare different technical approaches, the low rate of complications observed supports the vascular reliability of the paramedian forehead flap when used within a carefully planned reconstructive sequence.

Further studies should incorporate standardized functional and aesthetic outcome measures, longer follow-up, and more detailed evaluation of the criteria used to select pedicle laterality and two- versus three-stage reconstruction. Such data would help define more reproducible decision-making pathways and clarify which technical variables most strongly influence long-term functional and aesthetic outcomes after complex nasal reconstruction.

Note-Informed Consent: Written informed consent was obtained from all participants or their legally authorized representatives prior to study participation and publication of clinical information and/or potentially identifiable images. Consent was obtained in accordance with applicable ethical and institutional requirements. The authors confirm that appropriate measures were taken to protect participant privacy and confidentiality and that any identifiable information or images published in this article were authorized for publication.

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