



Reconstruction of the Nose: Diverse Problems and Alternate Solutions

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Authors' contributions

This work was carried out in collaboration among all authors. Authors SS and Pradeep Gupta designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author Prateek Gupta managed the literature searches and analyses of the study. All authors read and approved the final manuscript.

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Case Study

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ABSTRACT

Background: The nose is the most prominent and defining feature of the face. Nasal reconstruction for a congenital or acquired defect is one of the most frequent and as well as the most challenging referral for the plastic surgeons as any asymmetry or irregularity in the nasal contour is readily noticeable.

Methods: In this case series, the authors present five different case illustrations of nasal defects and deformity involving lower third of nose with increasing complexity, and an overview of various surgical techniques applied for reconstruction of these nasal defects.

Results: Nose being a three-dimensional structure, nasal reconstruction occupies a unique position in facial plastic surgery. Loss of any of the structurally essential layers of the nose (skin, cartilaginous framework, inner lining) must be reconstructed following the principles of aesthetic surgery. For complex defects, minor surgical revisions should be anticipated to achieve the best cosmetic outcome.

Conclusion: Nasal reconstruction is a highly specialized surgery, and the operating surgeon must be well versed in this area. From the outset, a well-tailored and meticulous planning is of paramount

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importance to achieve good aesthetic and functional results. However, both the surgeon and patient should allow for flexibility and need for additional procedures, if necessary.

Keywords: Nasal reconstruction; nose; local nasal flaps; forehead flap; free radial forearm flap; alar cleft.

1. INTRODUCTION

The nose is the most prominent central aesthetic feature of the face and has a complex three-dimensional structure, serving an essential role in respiration, humidification, and olfaction. Anatomically, the nose is composed of the skin of varying thickness, muscular subcutaneous tissue, septum, scaffolding ranging from rigid bone to flexible cartilage, and inner epithelial lining. Both, the facial symmetry, and the relative facial attractiveness of an individual are highly dependent on the overall appearance of the nose, including its shape, size, and proportionality. Because of its prominent location, an anterior plane of projection, and delicate skin and soft tissue envelope, the nose is also particularly vulnerable to injury with resulting injuries that are readily noticeable. Thus, in cases of congenital or acquired nasal deformities, all components including cover, support, and lining, must be restored appropriately to provide an aesthetic and a functionally sound reconstruction.

The first documented account of nasal reconstruction dates to the sixth century BC, which was documented by Indian sage Sushruta, in his book called "Sushruta Samhita", describing the harvesting of a flap from forehead or cheek for nasal reconstruction (Indian method) [1,2]. After many centuries, several modifications followed which were recognized as the "Italian method" (Antonio Branca, 1442) and then the "German method" of nasal reconstruction (Carl Van Graefe, 1818) was described in the literature [3]. Later Millard, Menick and various others described methods and modifications for nasal reconstruction. In 1886, Konig reported use of iliac bone graft for nasal repair, which was further refined by Gilles and Millard by using chondrocutaneous grafts [4,5]. In mid-nineties, various local nasal flaps were described; bilobe flaps by Zitelli, dorsal nasal flap by Reiger et al., interpolated melolabial flap by Menick [6,7].

Recently, Burget and Menick proposed the concept of nasal aesthetic units, in which nose is divided into multiple topographic units by contour lines and zones of transition between nasal skin of varying thickness and textures. Flaps are now

designed to resurface that whole topographic unit if the defect involves more than half of it [8,9].

2. METHODS

From September 2017 to March 2020, five different cases of nasal defects of various etiologies viz. congenital, traumatic, or post tumour resection that presented in the Department of Plastic Surgery, SMS Medical College, Jaipur were selected. Inclusion criteria included defects and deformities involving lower third of the nose, tip, and ala; however nasal defect with syndromic associations or those secondary to cleft lip and palate were not included. Reconstruction was done with local nasal flaps, regional flaps, and even free flaps depending upon extent and depth of nasal defects. Patients who underwent reconstruction with local flaps were systematically followed up for six weeks while those in whom regional or free flap was used were kept under surveillance for three months, before planning any further revision surgery.

3. RECONSTRUCTION WITH LOCAL NASAL FLAPS

For the reconstruction of small cutaneous and soft-tissue defects of the nose, adjacent nasal tissue is often utilized. The colour and texture match provided by surrounding nasal skin is superior to that of any other source of skin. However, because of limited laxity of the nasal skin, local flaps are generally restricted to defects that do not exceed 2 cm.

3.1 Case I

The bilobe pivotal flap is one of the most common nasal cutaneous flaps. Described by Esser, and later modified by Zitelli; for small cutaneous defects (up to 1.5 cm in diameter) in the caudal or central nose, a bilobe flap gives an excellent cosmetic result [6,10]. Small skin defects in the zone of transition between the tip, ala, and caudal sidewall are also be repaired using this technique. Bilobe flaps have a precise geometric design and can be raised either as a laterally based or medially based. First, we measured the radius of the defect, and from its lateral border, a point is marked in the alar

groove. The point is at the same distance as the radius of the defect. This point represents the pivotal point for the two lobes and is used for designing both the lobes. Now, using a suture held with an artery forceps and a marking pen, two arcs are drawn with their centres at the marked point. The first arc passes through the centre of the defect. While the second is marked as a tangent to the defect most distant from the pivotal point. The base of both lobes' rests on the first arc. The height and width of the first or primary lobe matches with the defect size. The width of the second lobe is slightly less than that of the first lobe while its height is approximately 1.5–2 times more than the height of the first lobe. The first lobe has similar design as of the defect, and the second lobe is triangular. The axes of all three; the defect, first and second lobes make an angle of 45° respectively. The flap is dissected in the plane between nasal muscles and perichondrium, with extensive undermining. The donor site of the second lobe is closed first, followed by first flap inset. The eventual standing cutaneous deformity which is formed from the pivot of the first lobe is marked with its apex pointing laterally and excised parallel to alar groove. Finally, the excess part of the second flap is trimmed such that it fits snug in the defect created by the first lobe of bilobe flap. However, exclusion criteria include larger defects more than 2 cm or defects involving the infratip lobule, ala, or columella; reconstruction in these regions often results in retraction and distortion of the nostril margin. (Case Illustration 1, Fig. 1)

3.1.1 Case illustration 1

Most nasal tissue defects result from the resection of malignant tumours. Basal cell carcinoma is the most common type malignancy of skin. A 51-year-old woman presented with basal cell carcinoma on the distal third of the dorsum of the nose and in the forehead region. The tumour was excised and left a defect of size 1.5cm on the nasal dorsum. Reconstruction was done with a laterally based bilobe flap after marking the defect size, its radius, and dimensions of both the lobes of the flap. Standing cutaneous deformity was removed in the alar groove. Forehead BCC was excised and closed primarily. Patient was followed for next 6 weeks, in the biopsy margins were free from malignancy. No revision surgery was required.

3.2 Case II

Traumatic nasal defects are often caused by animal bites, injury with sharp weapons, road-

side accidents and rarely by human bites. In cases of nasal amputation, nasal tissue should be handled as a composite graft; and if tissues are not crushed and healthy vessels are available replantation should be tried. Cartilaginous tissue might need to be removed if they act as a barrier to revascularization. Here, we describe two cases of traumatic nasal injury involving nasal tip and the caudal end of the nose; in one, reconstruction was done with dorsal nasal flap and in other case interpolated paramedian flap was utilized.

The dorsal nasal flap, also known as Rieger's flap is an alternative to bilobe flap for repair of small defects involving the tip, caudal dorsum, or sidewall. This flap is a laterally based pivotal flap, based on end branch of the angular artery, which recruits skin from the redundant skin of glabella [7].

The pedicle is centred in the region of the medial canthus. The flap is marked by a curvilinear line, starting lateral to the defect to the junction of nose and cheek, and is traced upwards approximately 0.5cm medial to medial canthus and then extended into the glabellar region. A back cut can be given in the glabellar region towards opposite medial canthus to gain additional length. The height of the glabellar extension is about 1.5 to 2 times the height of the defect. The defect is triangulated, and standing cutaneous deformity is removed by excising parallel to alar groove. Flap inset is done with few dermal sutures, and the glabellar donor site is closed as a V-Y advancement flap. The disadvantage of flap includes cephalic displacement of the nostril margin and nasal tip, as well as medial canthus skin discrepancy, which can be avoided by aggressive thinning of the flap. However, defect involving upper third of nose, or naso-facial transition zone can be better dealt with other local flaps such as limberg or nasolabial flaps (Case Illustration 2, Fig. 2)

3.2.1 Case illustration 2

A man in his late thirties presented to trauma emergency with a history of accidental injury with a knife, involving right ala, nasal tip, columella, soft triangle, and part of the inner lining. The defect size was 2*2cm² and was planned to reconstruct with dorsal nasal flap. Because of the sharp cut, there was tissue loss 1*1cm² on the inner aspect, and the epithelial lining was resutured. A large pivotal dorsal nasal flap was swung from the dorsum of the nose and glabellar



Fig. 1. Basal cell Carcinoma dorsum nose and on forehead (a); Tumor was excised, and a laterally based bilobe flap was planned (b); immediate post op photo (c) late post-op with well healed flap (d)



Fig. 2. Injury with sharp weapon, involving Nasal tip, right ala, and columella (a); A dorsal nasal flap was marked with glabellar extension (b); immediate post op photo (c) late post-op with well healed flap (d)

region to cover the defect. Postoperatively, patient was followed for 6 weeks and developed cephalic retraction of alar margin. Patient was advised for minor surgery, but he denied.

3.3 Case III

A young adult of 24 years presented to our department with a rare case of congenital isolated unilateral alar cleft on the right side. During embryological development, face and cranium are derived from ventral migration of neuroectodermal crest cells. Failure of this ectomesodermal migration, the arrest of fusion of the facial processes, or defective development of the lateral nasal processes can cause such clefts, although the exact aetiology and morphogenesis on a molecular level remain unknown [11]. Atypical craniofacial clefts are extremely rare and can affect 1 per 100,000 live births, and the severity can vary from minor notching of soft tissue to severe disfigurement. Under the Tessier classification system, atypical craniofacial clefts involving the nasal ala are designated as number 1 and number 2. Because

of congenital deficiency of tissue and malpositioned cartilaginous framework, these deformities are extremely challenging for a reconstructive surgeon [12,13]. In our patient, the ala was reconstructed with rearrangement of local tissue, a laterally based rotational alar flap to reconstruct the ala and a medially based triangular flap to restore normal anatomy which provided an aesthetically pleasing and symmetrical result. (Case Illustration 3, Fig. 3)

3.3.1 Case illustration 3

A young adult of 24 years presented to our department with an exceptionally rare case of congenital isolated unilateral alar cleft on the right side; which involved part of the lateral crus of the lower lateral cartilage, lateral nasal wall, and soft triangle on the right side. The ala was reconstructed with rearrangement of local tissue, using a laterally based rotational alar flap and a medially based triangular flap to restore normal anatomy and provided an aesthetically pleasing and symmetrical result.



Fig. 3. A rare case of isolated alar cleft on right side, presented at 24 years(a); the ala was reconstructed with a laterally based rotational alar flap and a medially based triangular flap to restore normal anatomy (b); Immediate post op with bolster dressing to maintain flap approximation (c) late post-op with well healed flap (d)

4. NASAL RECONSTRUCTION WITH REGIONAL FLAP

4.1 Case IV

Historically, for the reconstruction of extensive defects of the nose the interpolated paramedian forehead flap is the workhorse flap. For extensive defects (more than 2 cm in width) which are too large for repair by local nasal cutaneous flaps, composite auricular grafts, or interpolated melolabial flaps; paramedian forehead flap is used. Additionally, nasal defects with exposed bone and cartilage, exposed periosteum, or perichondrium, post-radiotherapy defects, or in instances with exposed hardware are best repaired using this flap. Patients having smaller forehead, multiple staged reconstruction of the distal nose can be done by using expanded forehead flaps utilizing tissue expanders. The paramedian forehead flap is large enough to provide sufficient forehead skin to resurface the entire nose. Forehead skin has an excellent colour and texture match with the skin of the nose. Complex cutaneous defects involving multiple aesthetic units, such as portions of the nasal tip, columella, dorsum, and sidewall, are most repaired with this flap. The vertical vascular architecture of the forehead helps to construct the flap with a bridge of skin from the forehead containing a known blood vessel such as supratrochlear, supraorbital, and terminal branches of angular arteries. The supratrochlear artery runs 1.7-2.2 cm lateral to the midline and corresponds to the medial border of the brow position [14]. A 3-Dimensional template is formed, which is precisely duplicating the surface and contour of the region to be resurfaced. The flap is raised from superior to inferior in the subfascial plane, just superficial to the periosteum of the frontal bone, where the

supratrochlear vessel might be identified. The incision can be extended below the level of the eyebrow to increase the flap length. The flap is interpolated to cover the defect. The flap can be utilized in a two-staged procedure or as three staged technique, flap division is done after three weeks of the last operation, and final inset and contouring are done [15]. The donor site can be closed primarily, or if under tension, the donor site can be left to heal by the secondary intention of split skin grafting can be done. (Case Illustration 4, Fig. 4).

4.1.1 Case illustration 4

An 18-year-old male presented to the emergency department with the 3-day old history of assault and was bitten on the nose by another person with resultant amputation of the nasal tip, bilateral alae, and columella. Reconstruction was planned in two stages with left paramedian forehead flap based on supraorbital and supratrochlear arteries. In the second stage, the flap was divided after three weeks; final inset was done to re-create bilateral alae; we achieved the right colour and texture match, and donor scar healed well with primary intention.

5. NASAL RECONSTRUCTION WITH FREE FLAP

5.1 Case V

In cases of large complex defects which require total or near-total nasal reconstruction, local and regional flaps fail to provide the needed lining, support, and coverage. In these instances, the free radial forearm flap from the volar aspect of the distal forearm is an excellent substitute for nasal reconstruction. The radial forearm microsurgical flap has many advantages as it can

be easily dissected, has large donor vessels, and a long pedicle, all of which greatly simplify the technical aspects of flap transfer. The vascular pedicle is tunnelled beneath the melolabial fold to recipient's vessels in the upper neck. The flap is carefully designed such that it mimics the configuration and surface area of the nasal skin defect. Although the flap is most used to provide an internal lining for total or near-total nasal reconstruction in a staged procedure; it can be used for resurfacing nasal defect in cases of an extensively large defect [16,17]. We had a rare case of hyena bite to the central face, where reconstruction was done using free radial forearm flap while a paramedian forehead flap was used for lining purpose and for nasal support free bone graft was used. (Case Illustration 5, Fig. 5).

5.1.1 Case illustration 5

This report describes an unusual case of a 43-year-old man, resident of a rural part India, who sustained a massive injury in the central face after getting bitten by a hyena. The patient was brought to our tertiary centre within 24 hours with a huge defect and fractured zygomatic bone on the left side. Post debridement, the overall defect size was 9*8cm² with extensive loss of soft tissue. A free radial forearm flap was designed from non-dominant hand as a multiple folding, double paddle flap that was divided into several portions as we needed to address the reconstruction in three layers: soft tissue covering, bony and cartilaginous scaffolding, and mucosal inner lining. The folded portions of the flap were used to reconstruct the nose, oral



Fig. 4. An 18-year-old male presented with history of human bite with amputation of the nasal tip, bilateral alae, and columella (a) two staged procedure planned- marking of left paramedian flap (b) after 21 days, flap in situ prior to detachment (c) flap was divided and inset done with good colour and contour match (c)



Fig. 5. A 43-year-old man was bitten in the central face by a hyena, resulting in full-thickness loss of the nose, left cheek, left commissure, and upper lip. The teeth, gums, meatus nasi, and medial canthus were exposed (a); A free radial forearm flap (12*8 cm²) from the left forearm was designed according to the size and shape of the central face defect (b); Cantilever bone graft and nasal lining by forehead flap (c); The patient had bilaterally patent nasal airways 12 months postoperatively. The patient achieved good functional recovery and had a good aesthetic outcome (d)

mucosa, and the upper lip defects and while a downturned forehead flap provided the lining for nasal mucosa reconstruction, and a cantilever graft from olecranon process was used for bony support. The patient achieved a good functional recovery and had a fair aesthetic outcome.

6. CONCLUSION

In cases of the defect with multiple tissue layers involvement, aesthetic nasal reconstruction becomes one of the most challenging procedures in plastic surgery. Nasal reconstruction is a highly specialized surgery, and the operating surgeon must be a specialist and well versed in this area. For single stage reconstruction of the nose, several other options such as the Limberg flap, Rintala flap, nasolabial flaps, V-Y advancement flaps can be utilized. If the defect involves more than 50% of nasal subunit, it is advisable to enlarge the defect to an entire subunit of the nose (e.g., tip, nostril, or columella) before performing the reconstruction so that the repair looks symmetrical and pleasing. For all cosmetic and functional purposes, the cartilaginous scaffolding must be adequately reconstructed to prevent functional instability. Poor reconstruction of the inner mucosal lining can lead to cicatricial scarring of the airway ranging all the way to possible occlusion. From the outset, a well-tailored and meticulous planning is of paramount importance to achieve good aesthetic and functional results. However, both the surgeon and patient should allow for flexibility and need for additional procedures, if necessary

CONSENT

Written and informed consent was obtained from the patients for publication of this case series and any accompanying images.

ETHICAL APPROVAL

The study was conducted conforming to the Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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