Rhinoplasty

38

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38.1 Introduction

The nose occupies the centre of the face and receives enormous attention as a key aesthetic element. It is also an important organ contributing to vital functions of breathing and olfaction. A nose with ideal proportions creates a harmonious balance of aesthetic and psychological wellness. Whilst a rhinoplasty can significantly improve the quality of life of patients, there may be associated complications and undesirable outcomes. It is imperative that the surgeon desiring to practise the art and science of rhinoplasty should be familiar with the essential basics before embarking on this journey.

The aim of this chapter is to provide a clinical overview of the spectrum of rhinoplasty in an easily comprehensible manner. The primary section is focussed on the key elements of anatomy, diagnosis and documentation prior to any surgical procedure on the nose. Basic operative techniques including approaches, septoplasty, osteotomies and grafts are described in the next section. The management of most common nasal deformities is covered in the last section.

38.2 Surgical Anatomy of the Nose

The nose is a complex anatomic unit composed of skin, subcutaneous tissue and fibro-fatty tissue draped over a complex osteocartilaginous framework [1]. Understanding its overall morphology along with other characteristics helps in accurate diagnosis and management of various deformities. Based on the framework, the nose can be divided into external nose and internal nose. The important landmarks (Figs. 38.1A, B and 38.2) related to nasal anatomy are highlighted in Box 38.1.

38.2.1 External Nose

A. **Skin and underlying tissues**: The features of nasal skin including color, consistency and thickness can vary between patients and are important determinants of outcome of rhinoplasty. Skin thickness varies in different parts of the nose and at different stages of life. The average skin thickness is the greatest at the radix (measuring 1.25 mm) and the least at the Rhinion (0.6 mm) [2]. The supratip area has abundant sebaceous glands especially in adolescent males. Skin thickness is reduced in the columella and mid-alar area and increased in the alar base area. Both the thickness of the skin and the presence of sebaceous glands in the caudal half of the nose make it difficult to achieve an ideal result in a predictable manner.

Beneath the skin and above the underlying osseocartilaginous framework are the layers of the superficial musculoaponeurotic system (SMAS), fibromuscular layer, deep fatty layer, and periosteum/perichondrium [3]. The SMAS of the nose is the continuation of the sheath that extends across the entire upper half of the face with adipose tissues, vertical fibres and septi, extending to the skin. Under the SMAS is a layer of thin fibrofatty tissue that divides the superficial and deep muscles of the nose [4]. The deep fatty layer separates the fibromuscular layer from the underlying nasal framework. Major blood vessels, lymphatics and nerves run within it. Deep to this layer is the periosteum of the nasal bones and the perichondrium of the cartilaginous frame. The avascular plane of dissection is in the supra perichondrial plane just below the fibrofatty SMAS layer.

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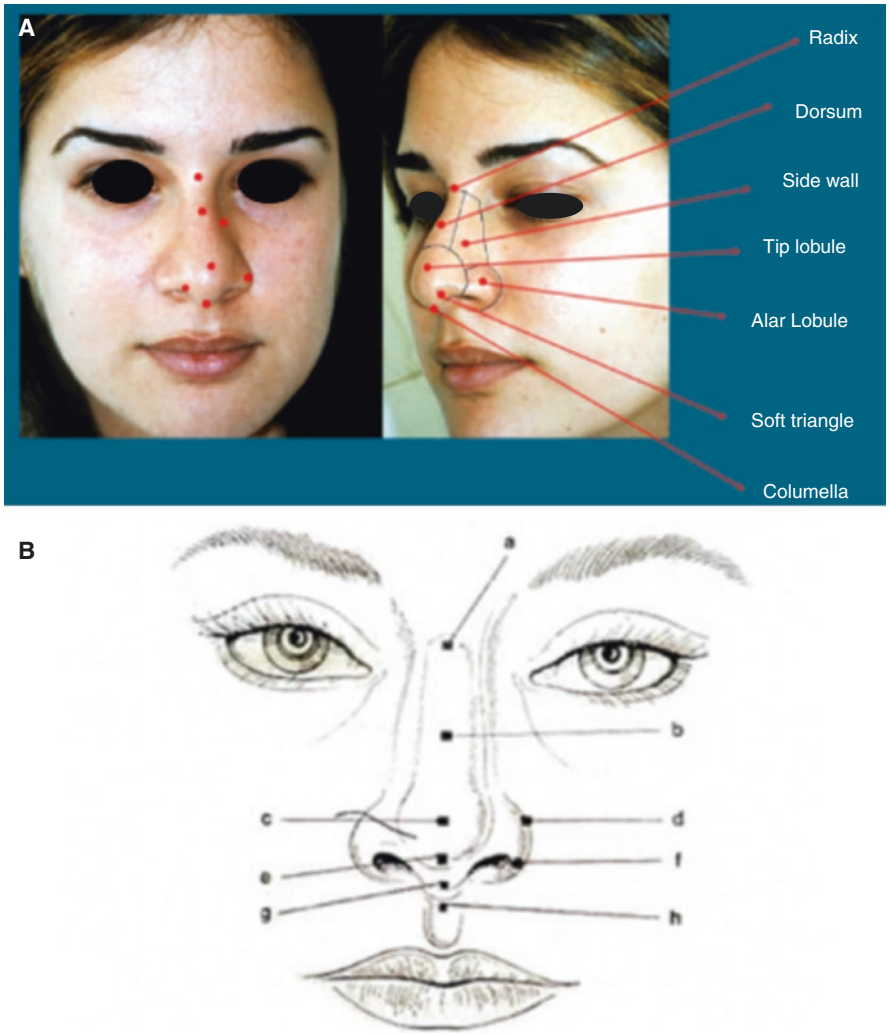


Fig. 38.1 Nasal anatomy landmarks—frontal view. (**A**) Clinical picture, (**B**) Line diagram: (**a**) Radix, (**b**) Dorsum, (**c**) Tip lobule, (**d**) Alar lobule, (**e**) Tip, (**f**) Alar base, (**g**) Columella, (**h**) Philtrum

B. **External Vault**

The nose is divided topographically into thirds as shown in Figs. 38.3 and 38.4.

Upper third: The nasal bones constitute the upper one third. This part of the nose is pyramidal in shape, the narrowest portion being at the intercanthal line. Nasal bones vary in length and become thinner as they extend caudally toward the Rhinion. The nasal bones are attached to the frontal bone above at the radix which forms the frontonasal angle. They articulate with the ascending process of the maxilla. Caudally, the nasal bones overlap the upper lateral cartilages [Keystone area] [5].

Middle third: This contains the paired upper lateral cartilages (ULCs) and is referred to as the cartilaginous vault. The ULCs are fixed above to the under-surface of the nasal bones and fused with the septum, and they separate from the septum as they extend inferiorly. An important surface landmark in this region is the external lateral triangle; bounded above by the upper lateral cartilages, laterally by the frontal process of the maxilla, and caudally the cephalic border of the lower lateral cartilage. The angle between the caudal border of the upper lateral cartilage and the septum is usually 10–15° and constitutes the internal nasal valve (Fig. 38.5a, b).

Lower Third: The lower third or lobule of the nose is further subdivided into the tip, supra tip and infra tip regions. These specific areas of the lobule are formed by variations in the shape, size, and angles of the lower lateral cartilages (LLCs). The form of the lobule is defined by the tip or apex of the nose. The area defining the overlap of the LLC and the caudal aspect of the ULC is called the "scroll" area and has a fibrous attachment. The size of the scroll area along with the slope of the lateral crus contributes to the bulbosity of the lobule.

The lower lateral cartilages have four essential components: the medial crus, intermediate crus, dome and the lateral crus (Fig. 38.6a, b, c): The cephalic edge of the domal segment of the intermediate crus is responsible for the aesthetic point known as the pronasale. The supra tip is immediately cephalic to the pronasale. The infra tip is located between the pronasale and the apex of the nostrils. The infra tip region should have a gentle curve that

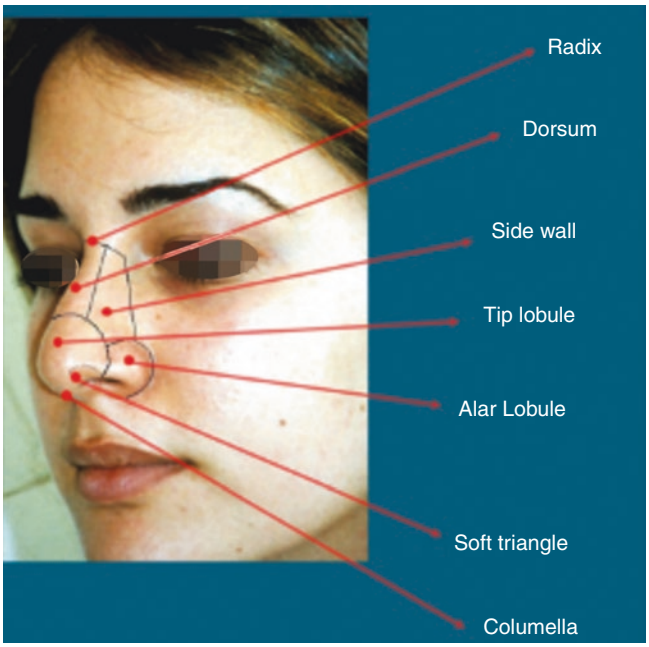


Fig. 38.2 Nasal anatomy landmarks—lateral view

Box 38.1 Rhinoplasty landmarks

Landmark	Definition
1. Nasion	Depression at the junction of the nose with the forehead Deepest point at the root of the nose
2. Radix	Area centred around the nasion.
3. Nasal pyramid	Part of the nasal frame made up of the bilateral nasal bone and frontal process of the maxilla
4. Keystone area	Junction of the perpendicular plate of the ethmoid with the septal cartilage at the dorsum of the nose
5. Rhinion	The point located at the osseocartilaginous junction over the dorsum of the nose
6. Nasal tip lobule	Caudal part of the nose bounded posteriorly by the anterior nostril edge, superiorly by the supra tip area and laterally by the alar grooves
7. Nasal tip	The most anterior point of the lobule
8. Anatomic dome	Most anterior projected portion of the lower lateral cartilages between the medial and lateral crus
9. Tip defining points (TDP)	Summit of the domes. Most projecting area on each side of the tip that produces external light reflection
10. Supratip area	Area just cephalad to the nasal tip at the caudal portion of the nasal dorsum
11. Infratip lobule	Portion of the tip between the tip defining points and apex of nostrils
12. Tip projection	Distance from the most projected portion of the tip to the most posterior point of the nasal–cheek junction
13. Alar groove	Oblique skin depression between the tip and the ala
14. Supra-alar crease	Groove immediately cephalad to the alar crease
15. Sub-nasale	Junction of columella with the lip

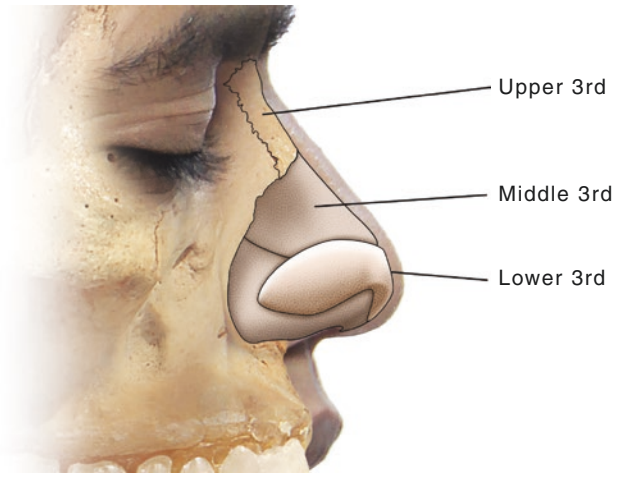


Fig. 38.3 External vault—lateral view

slightly projects inferiorly to the alar margins. The medial-lateral crura complex forms a tripod that is an essential concept to understand for correction of tip deformities. The lateral crura form the two cephalic lateral legs while the medial along with the intermediate crus form the caudal leg of the tripod (Fig. 38.7a, b, c).

Medial crus: The medial crus has two distinct segments: the footplate and the columella. The footplate varies in size and in the degree of lateral angulation, which governs the width of the columellar base.

Intermediate crus: It extends between the medial crus and the lateral crus. The length and width of the intermediate crus control the configuration of the infra-tip lobule.

Dome: The domal segment is the narrowest and thinnest portion of the lower lateral cartilage, yet is the most important in relation to the tip shape. In an ideal nose, the cephalic edges of the paradomal segments are in close approximation and the caudal portions are divergent. Whenever the cephalic margins diverge, they result in widening of the nasal tip. A wide domal angle with increased interdomal width results in a boxy tip.

Lateral Crus: It constitutes the larger component of the nasal lobule. It is narrow anteriorly, widens in the mid-portion and narrows again laterally. The anterior portion of this cartilage can curve with different angulations and controls the convexity of the ala. The lateral crus also provides support to the anterior half of the alar rim. This cartilage is usually oriented at a 45° angle to the vertical facial plane. Narrowing of the angle between the dorsum and the long axis of the lower lateral cartilage

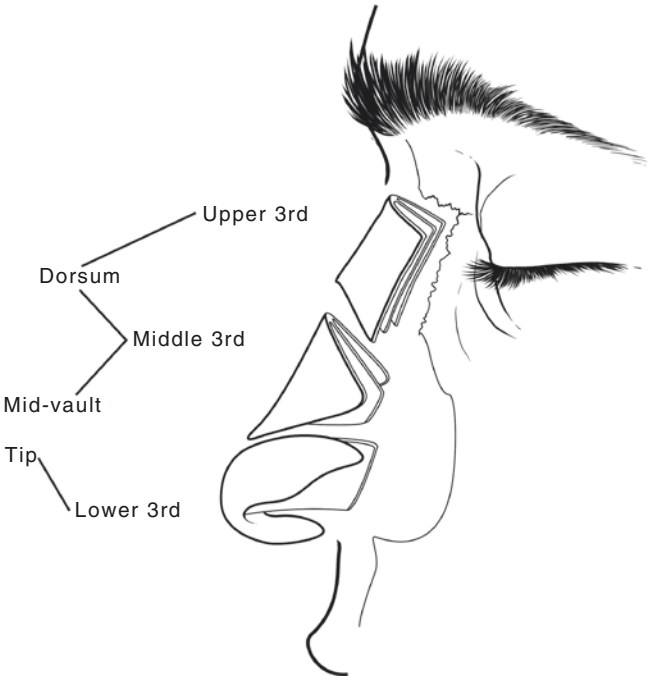


Fig. 38.4 External vault—lateral view. Line diagram showing the three divisions

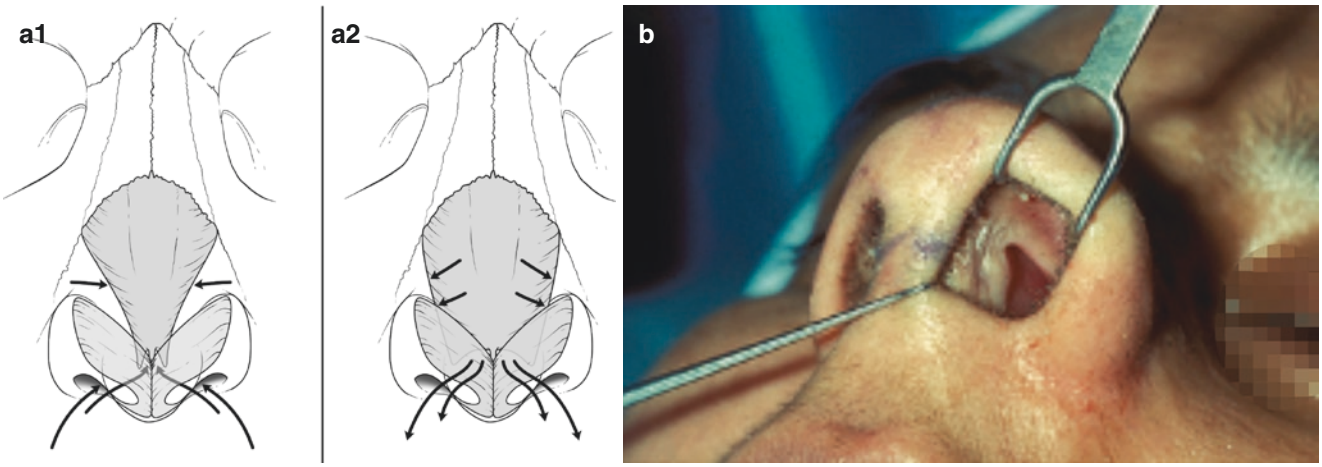


Fig. 38.5 Nasal valve; (**a1**, **a2**) line diagram, (**b**) clinical photograph

may cause dysmorphology of the tip called cephalic malposition or 'parenthesis deformity'.

Several fibrous attachments exist joining the cartilages to each other, namely, lower lateral cartilages to the upper lateral cartilage, from one lateral crus to the opposite in the supratip area (the Pitanguy ligament), dense fibrous bands between the caudal septum & the medial crura and between the medial crura themselves [6].

Muscles (Fig. 38.8): The muscles of the nose are divided by their functions into four categories; elevators, depressors, compressors, and dilators. The procerus, levator labii superioris alaeque nasi, elevates and shortens the nose. These muscles are important because they assist in opening the nasal valves. The depressor muscles consist of the nasalis and depressor septi. On contraction, this group of muscles adversely affect the tip rotation by displacing it inferiorly and elevating the lip superiorly [5]. The transverse nasalis muscle forms the compressor, while the dilator naris has the opposite function.

Blood Supply and innervation: Both external and internal carotid arteries contribute to the vasculature of the external nose (Fig. 38.9). The major blood supply is from

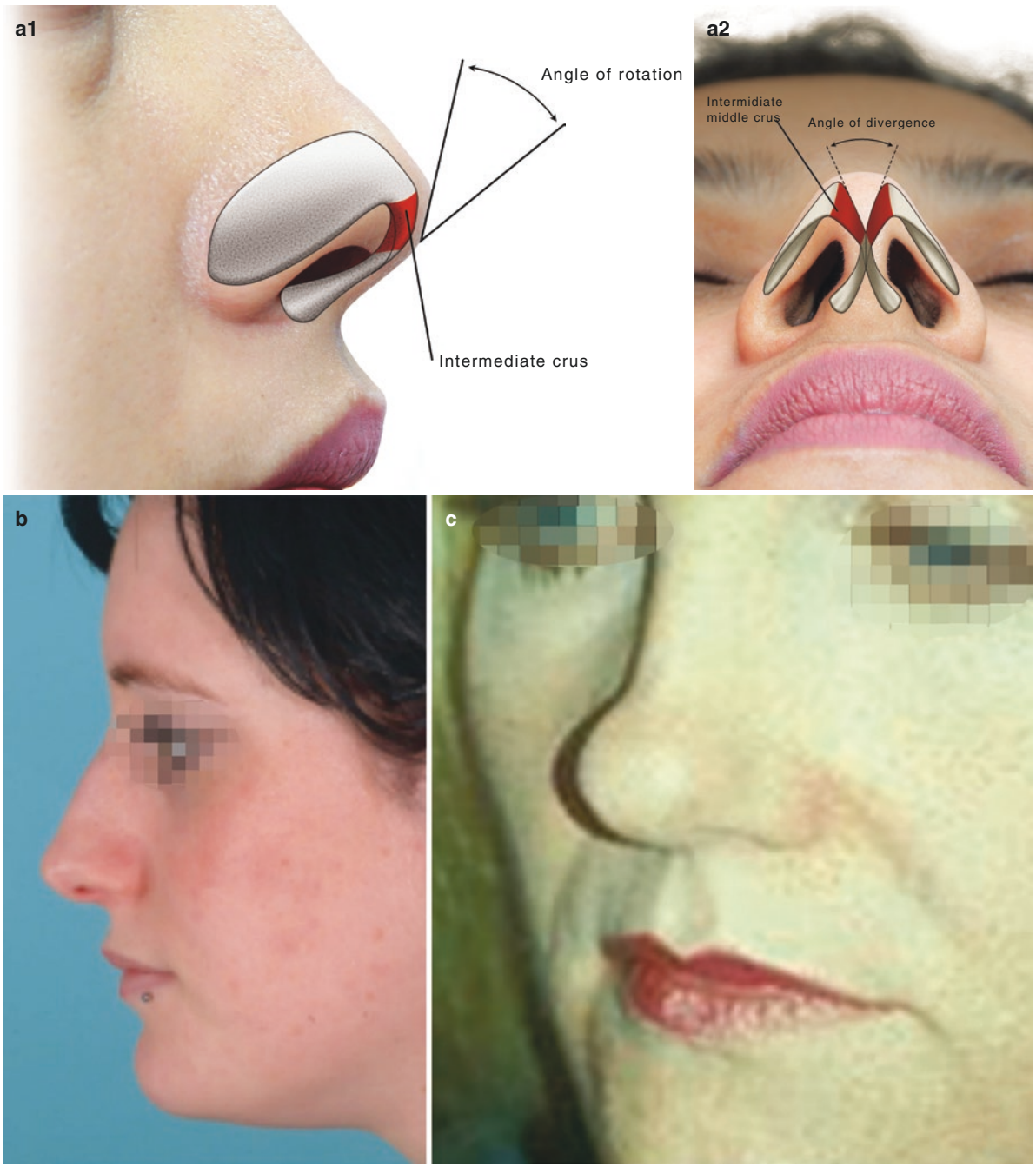


Fig. 38.6 Lower lateral cartilage (**a1**, **a2**) Diagrammatic representation and (**b**, **c**) clinical pictures

three vessels: the dorsal nasal artery—a terminal branch of the ophthalmic artery, the angular and superior labial arteries from the facial artery. The lateral nasal artery (branch of the angular artery) forms a plexus with the dorsal nasal artery, branches of infra-trochlear artery, and the external branches of the anterior ethmoidal artery. A small contribution is also received from the lateral branches of the infra-orbital artery.

Sensory innervation to the nose is provided by the maxillary and ophthalmic branches of the fifth cranial nerve [7].

38.2.2 Internal Anatomy

The internal nose is divided by the "midline" nasal septum. Anteriorly, the septum forms the medial boundary of the nasal vestibule whose lateral wall is formed by the lower lateral cartilages and their attachment to the pyriform rim.

The deeper part of the nasal cavity is bounded laterally by the medial wall of the antrum, medially by the osseocartilaginous septum, superiorly by the ethmoid and the sphenoid bones and inferiorly by the palatal process of the maxilla and

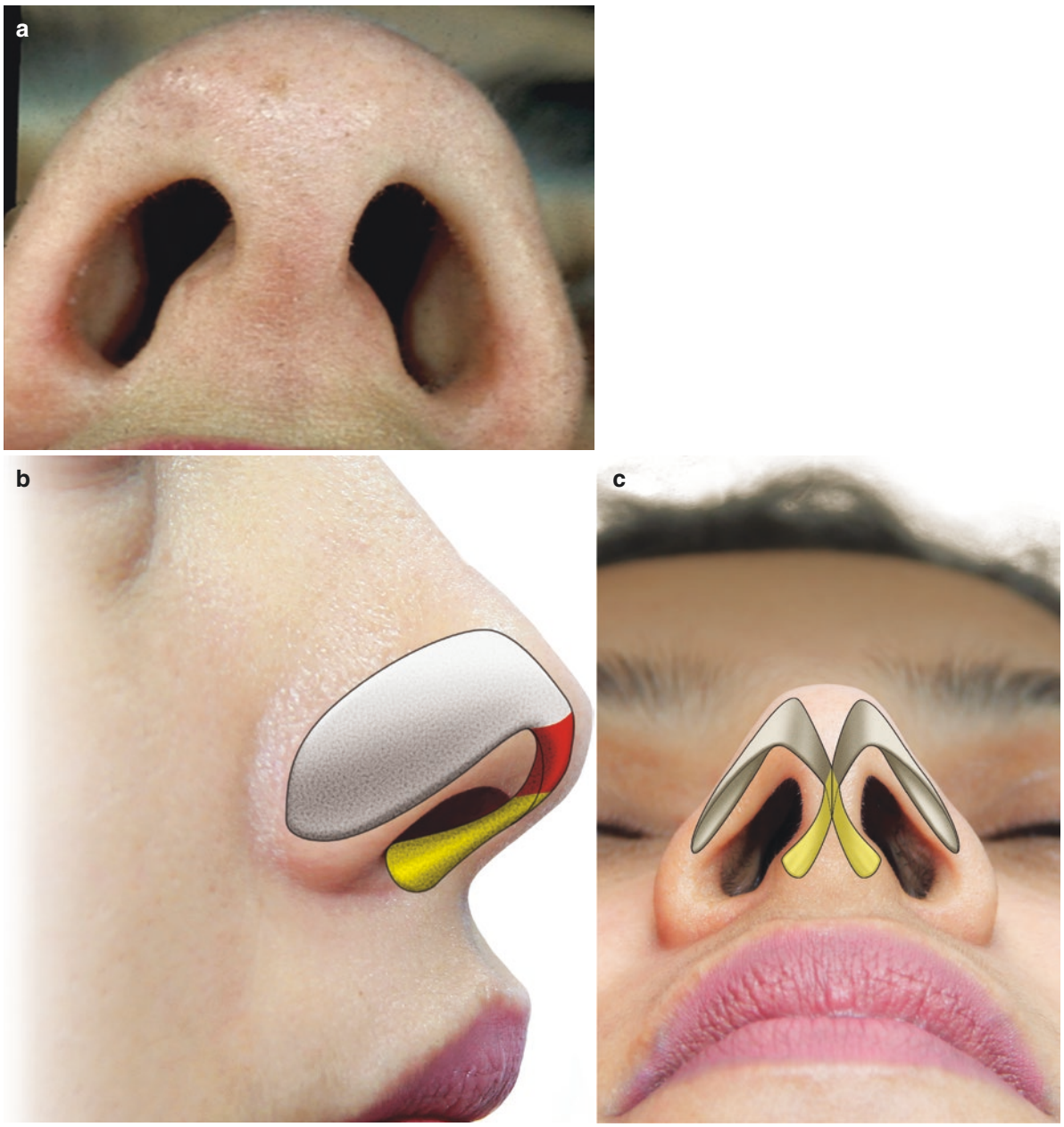


Fig. 38.7 Nasal tripod; (**a**) clinical photograph, (**b**) line diagram showing medial crus (yellow), intermediate crus (red) and lateral crus (grey) (**c**) line diagram showing basal view

the palatine bones. There are thin, curved, bony prominences in the lateral wall called the inferior, middle, and superior concha. The cephalic portion of the lateral nasal wall is bound with the ethmoid cells, interposed between the lateral wall of the nasal cavity and the medial wall of the orbit.

38.2.3 Nasal Septum

The septum is partly cartilaginous and partly bony. The ethmoid perpendicular plate forms the upper bony septum and is continuous with the frontal bone and the cribriform plate. The lower bony septum is composed of the vomer and nasal crest of the maxilla (Fig. 38.10a, b).

The cartilaginous septum is formed by the quadrangular cartilage that extends from Rhinion to the supratip area and supports the dorsum and the tip complex. Inferiorly, the cartilagenous septum is attached firmly to the anterior nasal spine and the maxillary crest. The junction between the dorsal and caudal portion of the cartilaginous septum is called the "anterior septal angle". There is tenuous attachment of the perichondrium and periosteum at the junction of the bony and cartilaginous septum. The membranous septum lies above the cephalic margins of the paired medial crura. It encases fibrous bands between two layers of soft tissue covering and the depressor septi muscle.

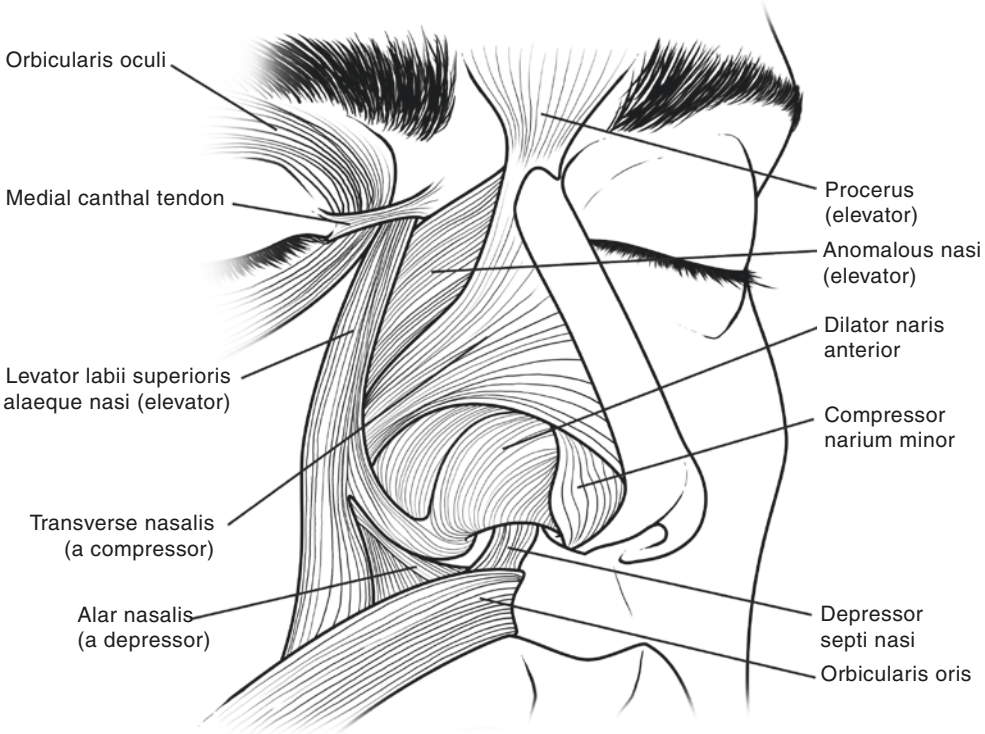


Fig. 38.8 Muscles of the nose

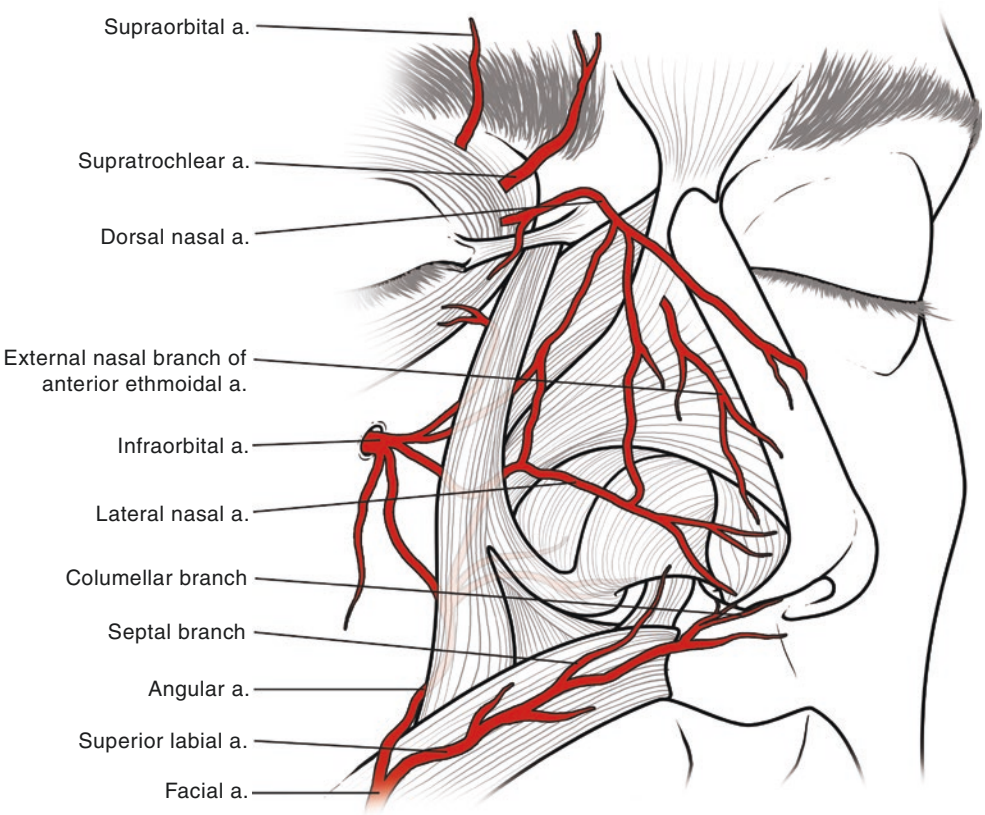


Fig. 38.9 Vascularity of the nose

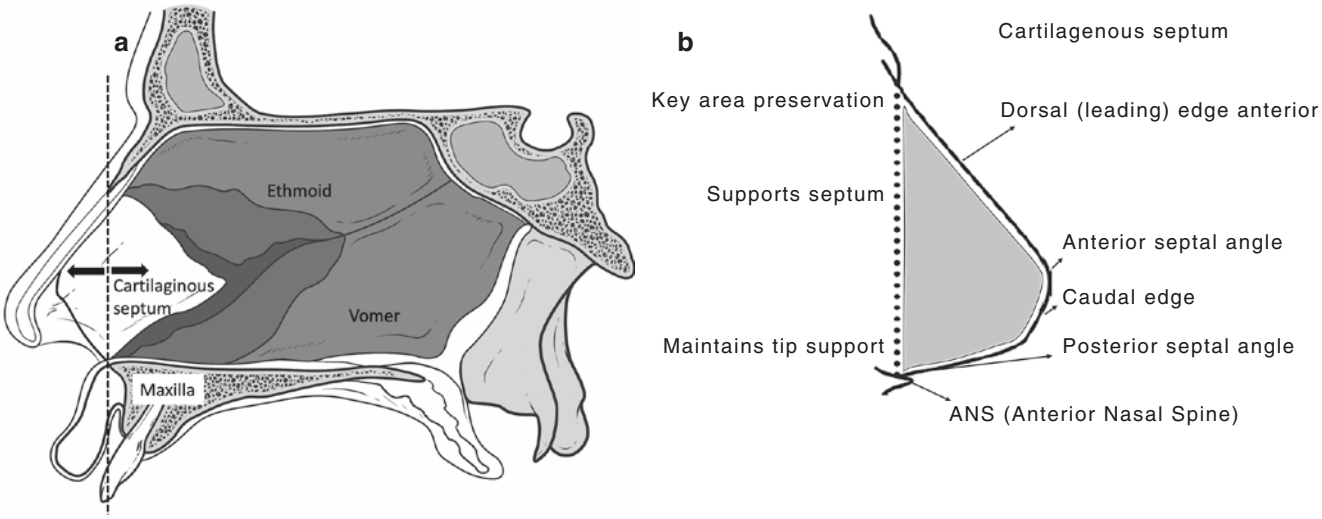


Fig. 38.10 (**a**) Anatomy of nasal septum, (**b**) line diagram with landmarks

Box 38.2 Clinical examination for Rhinoplasty

	Local	
General/Systemic	**Facial**	**Nose**
Airway/breathing Mouth breathing	Intercanthal distance	Skin quality
Bleeding disorders	Inter-eyebrow distance	Nasal bone—width, length and symmetry
Hypertension	Frontal-bossing/glabellar projection	ULC (Upper Lateral Cartilage)—width and symmetry
Diabetes/ immunosuppression	Upper lip position	LLC (Lower Lateral Cartilage) • Cephalic malposition • Interdomal distance • Asymmetry of light reflecting points • Lobule position • Nostril-columellar relation
Psychological assessment	Chin position	Alar base • Vertical and horizontal position (in repose and smile) • Inter alar distance (should be 2 mm wider than intercanthal distance) • Insertion of the alar base

38.2.4 Lateral Nasal Wall

The lateral aspect of the nasal cavity is composed of three anatomic structures: the inferior, middle, and superior turbinates. The inferior turbinate forms a boundary of the internal nasal valve, where its specially adapted erectile tissues regulate the air flow and facilitate heat and moisture exchange.

Branches of the anterior ethmoidal artery accompany the external nasal branch of the anterior ethmoid nerve, passing between the nasal bone and upper lateral cartilages, and supply the soft tissues of the dorsum and tip of the nose. The posterior ethmoidal branches supply the smaller area above the superior concha on the lateral wall and a corresponding area high on the septum [8]. The posterior part of the internal nose is supplied by branches of the sphenopalatine ganglion of the second division of the trigeminal nerve (the long sphenopalatine, the nasopalatine and part of the greater palatine nerves).

38.3 Clinical Examination

Clinical examination should be comprehensive and include the assessment of systemic diseases (Box 38.2) [9].

General examination would include ruling out any syndromic deformities [9]. Obtaining correct history of systemic disease and bleeding disorders are of paramount importance. The extensive vascular network in the nose, in the presence of a coagulation disorder, may predispose the patient to severe haemorrhage in the intra- or post-operative period.

Existing breathing difficulty or any allergy-related symptoms such as rhinorrhea, sneezing, watery eyes, itching and loss of sense of smell and taste are observed. Majority of successful rhinoplasties are reductive in nature; an undetected or uncorrected underlying airway compromise may cause further deterioration and convert an aesthetic concern to a functional predicament. If the presence of any sinus

infections and headaches is not recorded preoperatively, the patient may attribute these conditions to rhinoplasty [10].

38.3.1 Examination of the Face

The face in the frontal view is divided into thirds and fifths for assessment of proportion and harmony of various structures (Fig. 38.11a, b, c). In the upper third, the intercanthal distance and interpupillary distance is important in assessing the nasal bones, dorsum and radix. For a proper facial balance, the malar bone, maxilla, mandible and the nasal bones should be in an optimum spatial relationship. The length of the upper lip, its position during rest and smile, upper incisor show and its proportion in relation to the rest of the face are also assessed. The nose and chin may have a paradoxical relationship whereby a patient may have an overprojected nose and at the same time an underprojected chin and vice versa.

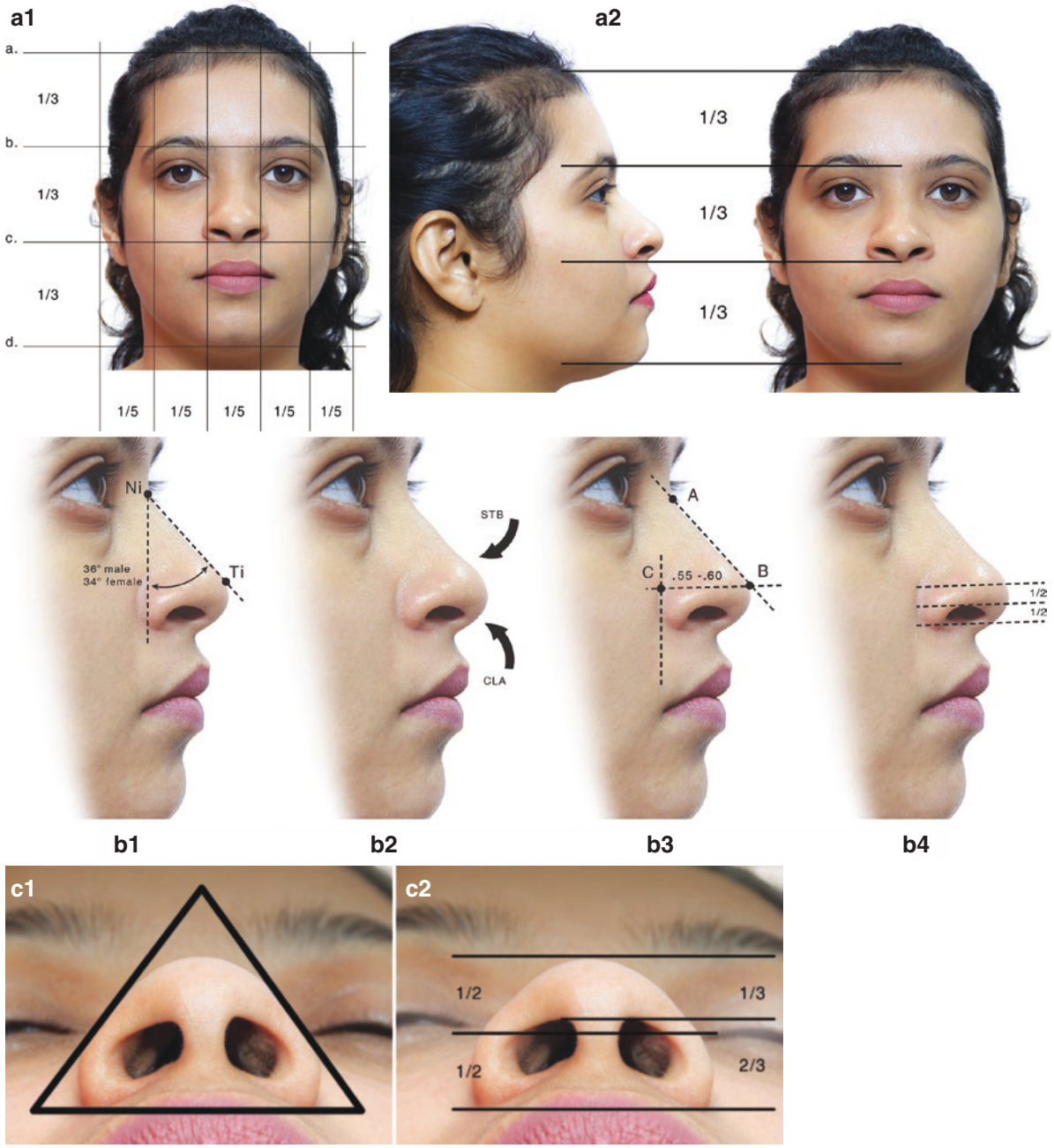


Fig. 38.11 (**a**)–(**c**) Examination of face and nose; frontal, lateral, basal. (**b1**) Ni - Ideal nasion, Ti Ideal tip. (**b2**) STB - Supra Tip Break, CLA - Columella Labial Angle. (**b3**) Nasal Length is measured from nasal radix to nasal tip (A–B), Nasal projection (C–B) is length from Naso-labial junction to nasal tip. The ratio between AB and CB (Goode's Ratio) should be ideally 0.55 to 0.60

38.3.2 Examination of the Nose

Visual analysis of the nose along with careful palpation allows the surgeon to assess the morphology and thickness of the skin and soft tissue envelope.

Frontal, profile and basal views should be used to assess the various components of the nose discussed above, individually.

38.3.3 Photographic Assessment

Patient's photographs are an important component of preoperative analysis and planning of the procedure. In addition, pre- and post-operative photographs are crucial for outcome monitoring and are indispensable from a medicolegal point of view [11]. With the advent of 3D imaging, image fusion and photogrammetry, preoperative and postoperative features can be compared in all dimensions [12].

There are four important photographic views that are used for analysis of the nose, namely, frontal, basal, lateral (at rest and smiling) and oblique views (Fig. 38.12). Photographs are standardised in relation to the Frankfurt horizontal plane. All four views are evaluated for the assessment of the facial horizontal thirds and vertical fifths. The quality of skin (thickness and Fitzpatrick type) and facial symmetry are also studied using all the views. The basic focus lies in the study of the loco-regional anatomy and the inter-relationships of the structures. The pictures are evaluated to assess any discrepancies in size, deviations or dorsal hump that may be immediately evident and recordable.

- **Frontal view**
  The length, width and the tip characteristics are well observed on the frontal views. The width is individually assessed in the upper, middle and lower thirds of the nose. Frontal views also show a straight or a crooked nose. The presence of a dorsal hump or a saddle deformity is noted as these may provide an illusion of the nose being narrow or wide, respectively. The presence of a truly wide nose may also demonstrate features of pseudo/true hypertelorism.

  The dorsal aesthetic lines should be studied in detail. They follow the eyebrows across the radix and along the dorsum to end at the tip defining points on either side.

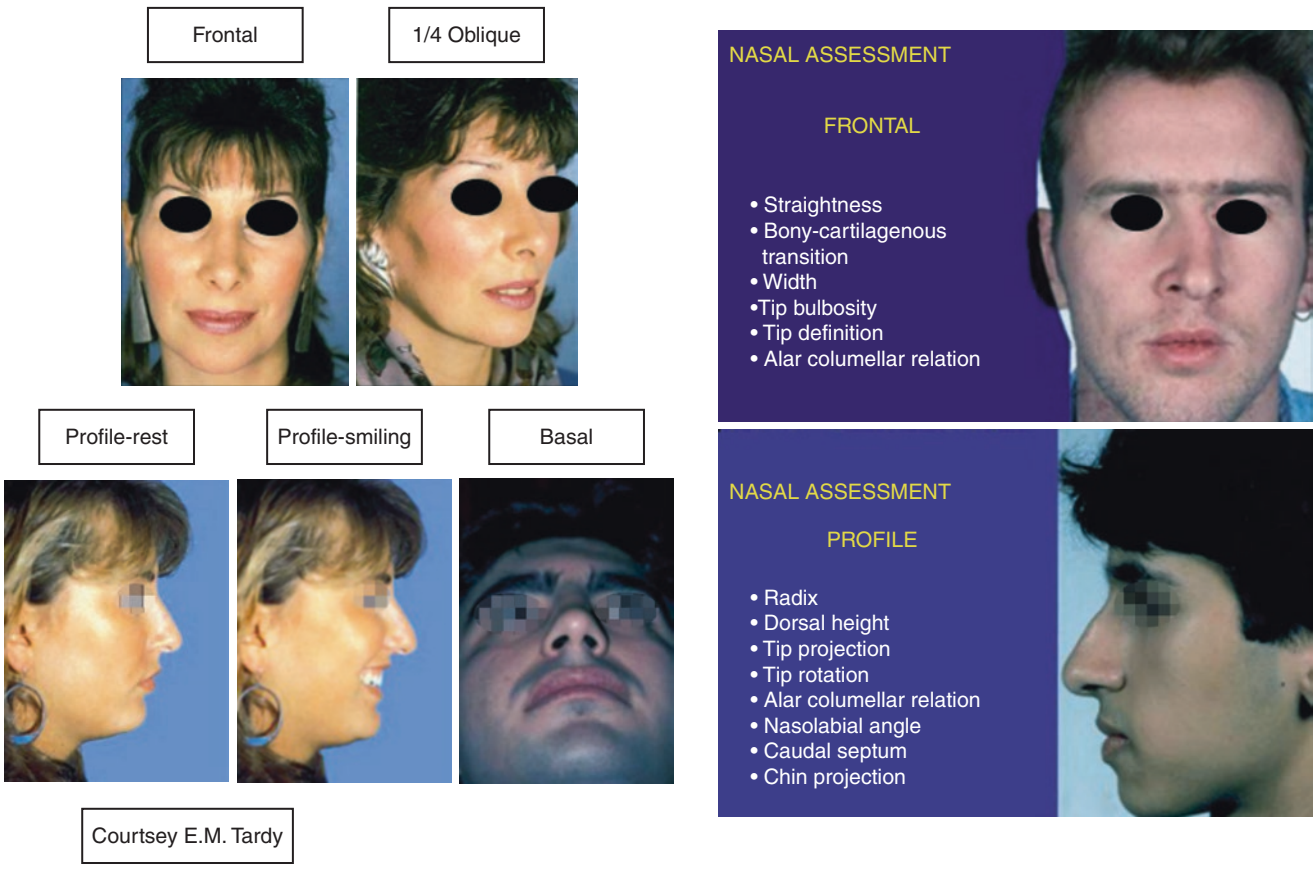


Fig. 38.12 Photographic analysis

The lines should be almost parallel with a smooth divergence at the brow but without any visible or perceptible breaks.

The nasal tip is assessed for symmetry and definition. The tip is also assessed for features of boxy appearance, bulbosity or bifidity. The alar base, ala and columella are also evaluated. The formation of a gentle "gull in flight" form should be appreciated for the relationship of the ala and the infratip lobule. An exaggerated curve may be indicative of a retracted ala or a plunging lobule. The position and insertion of both ala and their symmetry and direction are also noted.

- **Basal view**
  Assessment should include the study of lobule, columella, ala and the alar base. Emphasis should be placed on the evaluation of the triangular shape of the nasal base, symmetry and the ratios, namely, the columella/lobule ratio and the lobule to ala ratios. The nasal base should present as an isosceles triangle with a rounded apex. The alar sidewalls should demonstrate a gentle flare. Poor triangular form or a trapezoidal form is indicative of a broad dome. Nostril symmetry and the angulations are studied next. The nostrils are angulated at 30–45° to the midline and are pear shaped. The caudal septum is assessed for straightness and its position in relation to the maxillary crest and anterior nasal spine. The alar base width, flare and insertions are also assessed in this view.

- **Profile view**
  Key points that need to be evaluated from the lateral view include (1) a dorsal profile that may demonstrate a saddle/hump and the supratip break, (2) evaluation of the chin and mentolabial sulcus, (3) projection and rotation of the nasal tip, (4) nasal length, (5) assessment of the radix and (6) columellar show with double break.

  The ratio of nasal projection is evaluated by the method of Goode. The ideal ratio between the line joining the tip defining point and alar-facial groove tangent, to the line dropped from the nasion to the alar facial groove should be between 0.55 and 0.60. Rotation of the nasal tip is approximately considered 90º in Caucasian males and between 90 and 95° in Caucasian females.

  The length of the nose is relative to the person's facial profile and general stature. It may be categorized as the central nose length from the nasion to the nasal tip and lateral length from the nasion to the alar rims. A short or long lateral length may reflect as retracted or hooded ala, respectively. The nose may also show a relative increase or decrease in length depending on the depth of the radix. A deep radix may make the nose look short while a shallow radix makes the nose appear long.

  The columella is also assessed for over- and undervisibility with the evaluation of a columellar double break that is formed by the junction of the medial and intermediate crus.

- **Oblique view assesses the volume of the tip lobule and Brow tip aesthetic line.**
  Assessment of the oblique view may not provide objective details. However, the nose is most viewed at this angle thus making it an important view to assess the aesthetic balance of the face and nose. Important features that need to be assessed in this view include soft tissue facets, lateral aspect of the nasal bones, nasal length, dorsal contour and tip projection.

38.3.4 Investigations

- Inspection with speculum will demonstrate any septal curvatures, angulations or spurs.
- *Computed tomography* is helpful if sinus pathology is suspected.
- *Endoscopy* of the middle meatus should be done to rule out clinical evidence of sinus disease.
- *Tests for functions of internal nasal and external nasal valves* should be done. Careful observation of the nasal valves while the patient is asked to inspire will provide a significant amount of information. A speculum or Q tip facilitates proper examination. Cottle's Maneuver helps in localizing obstruction due to nasal valve dysfunction.
- *Acoustic rhinometry* is a recently developed objective technique for assessment of geometry of the nasal cavity. The technique is based on the analysis of sound waves reflected from the nasal cavities. It measures cross-sectional areas and nasal volume.
- *Rhinomanometry* has also been widely accepted and used as an objective method to assess nasal patency. However, these tools may not necessarily show clinical correlation [13].

38.4 General Operative Techniques

38.4.1 Surgical Approaches for Rhinoplasty

Rhinoplastic approaches: (1) open approach or the open structure rhinoplasty approach and (2) closed or the endonasal approach.

Open approach involves an external cutaneous incision while the closed approach involves intranasal incisions only (Fig. 38.13a, b).

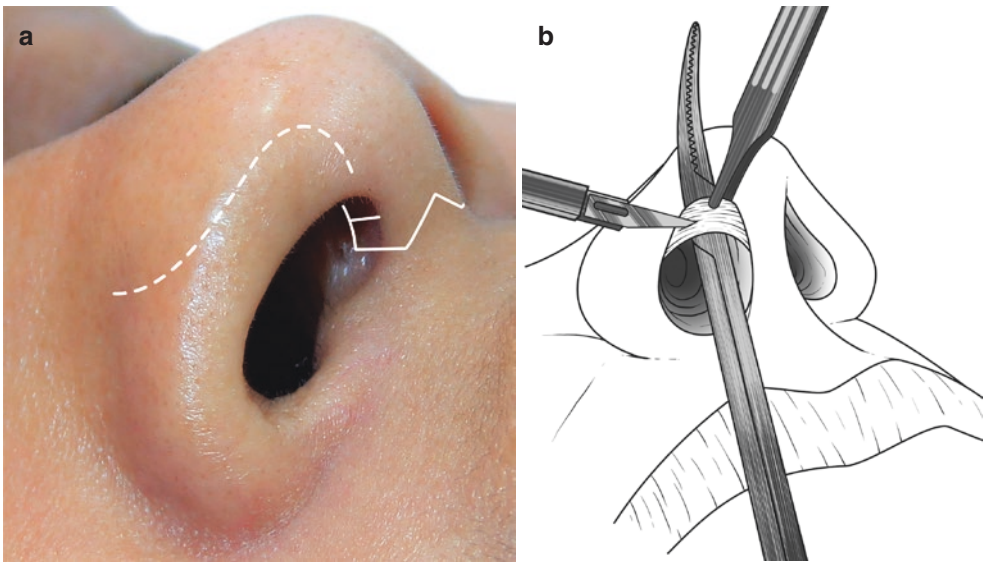


Fig. 38.13 Open (**a**) Vs Closed (**b**) approach

Choice of incision is based on the clinical problem to be corrected and the exposure required. The ideal incision must enable adequate and easy access to the nasal architecture without compromising the nasal structures. The differences between the different types of incisions are highlighted in Table 38.1.

A. **Open structure rhinoplasty**

The open structure approach is employed when extensive reconstruction is required. There is more emphasis on the preservation and realignment of structures of the lower third of the nose and also achieving balance of the nasal "tripod".

The open approach involves the use of a marginal and mid-columellar incision (Fig. 38.14b)

- *Marginal incision*
- The incision is placed along the caudal margins of the LLC, starting at the caudal margin of the medial crus, running along the entire dome and extended laterally along the caudal margin of the lateral crus.
- *Columellar incision*
- This is a transverse mid-columellar incision extending across to connect the marginal incisions on either side. Numerous modifications of the columellar incision have evolved over a long period (Fig. 38.15a, b, c).
  - Rethi transcolumellar incision 1931 (across the apex of the nostril aperture)
  - Sercer "nasal decortication" approach—1957
  - Bardach columellar base incision extending into prolabium (reserved for cleft rhinoplasty)
  - Goodman modification mid columellar 'V' facing upwards 1952
  - Johnson & Toriumi inverted 'V' midcolumellar incision
  - Stair-step mid columellar incision (Bahman Guyuron)

The **indications** for the open structure approach are highlighted in Box 38.3.

B. **The endonasal approach** (Fig. 38.14a)

Nondelivery/Partial delivery and delivery approaches (Fig. 38.16a, b).

1. **Nondelivery approaches are employed when** minimal reduction of the lateral crus or mild cephalic rotation of the tip complex is indicated.

   The technique in turn may involve either the cartilage splitting approach or the retrograde eversion approach.

- The *cartilage splitting method* involves a transcartilaginous incision through the most cephalic portion of the lower lateral cartilage that needs to be resected. However, extreme care is taken to preserve at least 8 mm of sound LLC to prevent structural compromise.
- The *retrograde eversion method* is difficult for beginners and hence not favoured in current practise, and most surgeons today prefer to use the delivery method.

2. The technique for the **delivery method** encompasses two incisions: the first inter-cartilaginous incision and the subsequent marginal incision to mark the chondrocutaneous unit of the LLC. The nonvestibular side of the LLC is

Table 38.1 Differences between the different types of incisions

	Open/external	Closed/endonasal	
		Nondelivery Cartilage splitting Retrograde eversion	**Delivery**
Incision	• Marginal • External (columellar)	• Transcartilaginous (Cartilage splitting) or • Intercartilaginous (Retrograde eversion)	• Marginal • Intercartilaginous
Exposure	Extensive	More of LLC exposure Less of tip exposure	Increased dome and interdomal visibility
Indications	Marked asymmetry Secondary rhinoplasty Need for structural grafting Post traumatic nasal deformity Nasal valve correction	Minimal tip correction Access to dorsum and middle vault Volume reduction of LLC Septal surgery Bony and cartilaginous hump removal	Allows more delicate tip work than the nondelivery approach septal surgery
Advantages	• Excellent visual control of entire nasal framework • Enhanced surgical access • Accurate structural grafting under direct vision • Ideal for demonstration and teaching • Predictable results	Less invasive Less disruption of support mechanisms of nasal tip May be used for septal cartilage harvesting	
Limitations	• External (transcolumellar) scar • Destabilization of tip support • Protracted edema • Risk of columellar necrosis (poor operative technique) • Sensory disturbances at the tip area	Steep learning curve No binocular vision Essential ENT experience Limits assistant's view of exposure Difficult to perform complex nasal tip surgery Spreader-grafts are difficult/impossible	

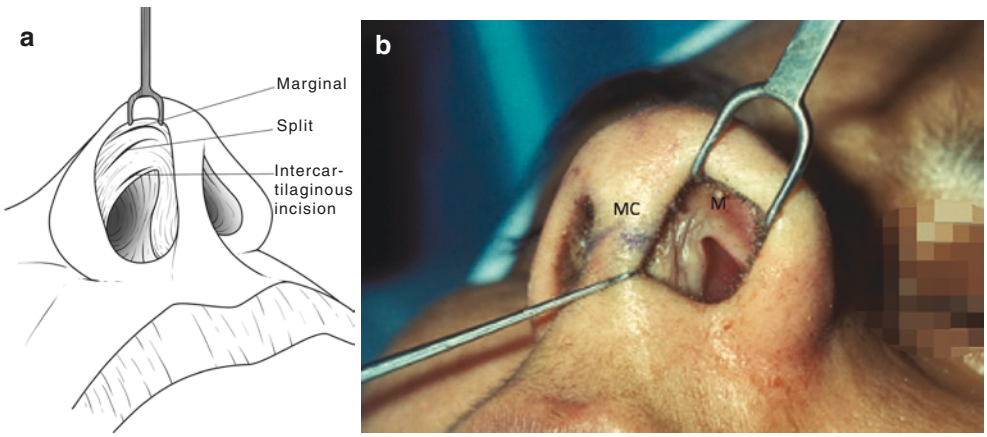
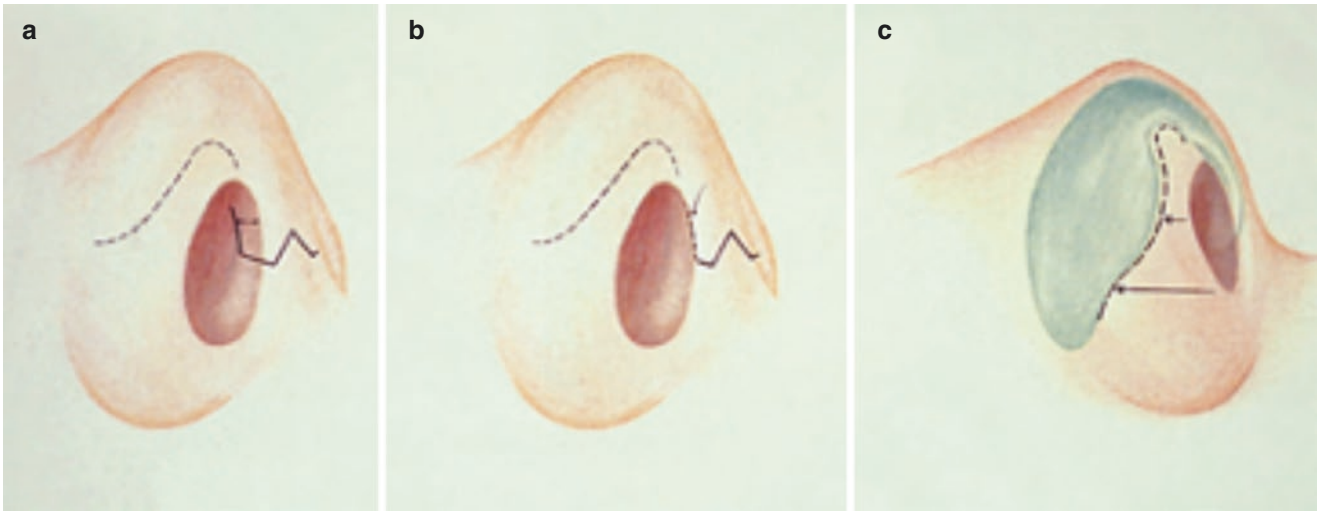


Fig. 38.14 Incisions for rhinoplasty: (**a**) closed and (**b**) open approach (MC- mid columellar, M- Marginal)

then dissected off the overlying SSTE permitting the delivery of the LLC chondrocutaneous unit as a bipedicled flap. Improperly positioned intercartilaginous incision may predispose to scarring at the valve area.

Incisions for the endonasal approach

- Intercartilaginous (limen-vestibular) incision
- Intracartilaginous (trans-cartilaginous/cartilage splitting) incision
- Infracartilaginous (alar marginal) incision
- Septal transfixion incision
  - Hemi-transfixion
  - Bilateral transfixion—partial/full
- Pyriform rim incisions for access to the lateral nasal wall
- Lateral nasal vestibular incisions for access to the paranasal premaxillary area
- Endonasal transmucosal medial osteotomy facilitated high up in the nasal vault.



Courtesy Rollin Daniel

Fig. 38.15 (**a**–**c**) Modifications of columellar incision

Box 38.3 Indications for open Rhinoplasty

- Secondary/revision rhinoplasty
- Post-traumatic nasal deformity
- Cleft nasal deformity
- Need for structural grafting
- Septal reconstruction
- Nasal valve surgery
- Dermoid cyst excision

Indications for the endonasal approach

- Symmetrical anatomy
- Good size nostrils
- Principal deformity at the nasal vault
- Ability to insert cartilage grafts

The endonasal approach is, however, unsuited for the novice surgeon and does depend on the surgeon's experience and prior training in Rhinoplasty for optimal outcomes.

38.4.2 Grafting in Rhinoplasty

Reduction rhinoplasty can weaken the underlying nasal tip framework with subsequent buckling and late structural deformity. Cartilage grafting during primary and revision procedures helps to prevent such a secondary deformity [14–17]. An open technique is preferred as it offers better visualization for placement of grafts. The grafts used in rhinoplasty can be summarised as follows (Fig. 38.17a, b) (Tables 38.2 and 38.3):

38.4.3 Septoplasty

38.4.3.1 Deformities of Nasal Septum

Deformities of the nasal septum may either be congenital or acquired. They are classified as shown in Box 38.4.

Septal deformities depend on alterations in the growth and direction of growth of the septal cartilage.

Deformities of the nasal septum may present clinically (Fig. 38.18a, b).

1. Dorsal excess may present as a tension nose
2. Dorsal deficiency causes concave or Saddle nose
3. Caudal excess causes increased columellar show
4. Caudal deficiency leads to columellar retraction
5. Lateral angulation of the septum is seen as a bent nose
6. Both lateral & AP curvatures give a twisted nose/crooked nose
7. Septal perforations and collapse may lead to a variety of deformities

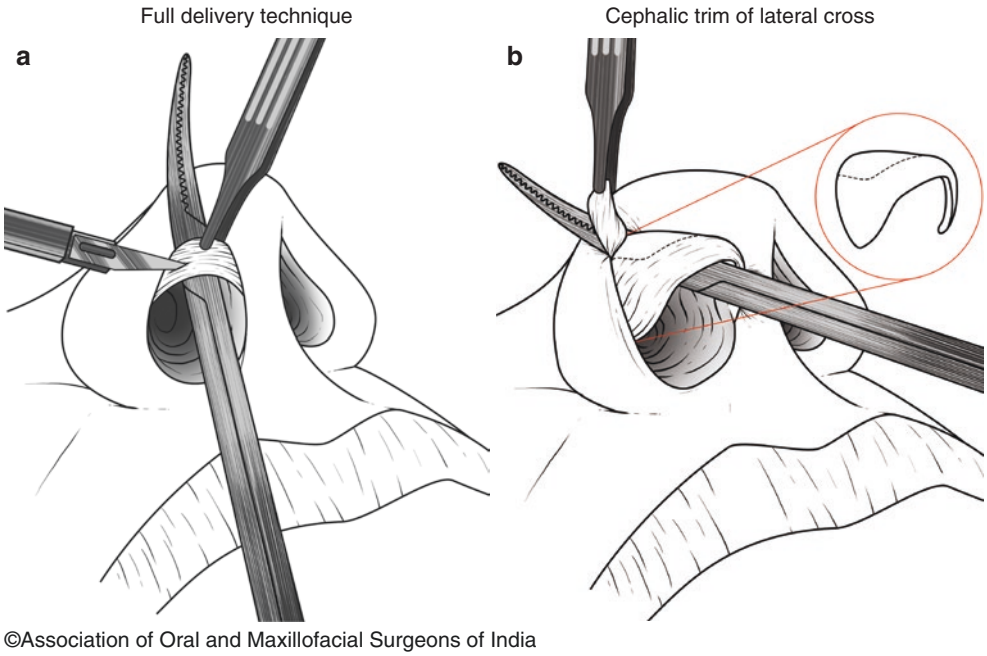


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Fig. 38.16 (**a**, **b**) Nondelivery vs. delivery method

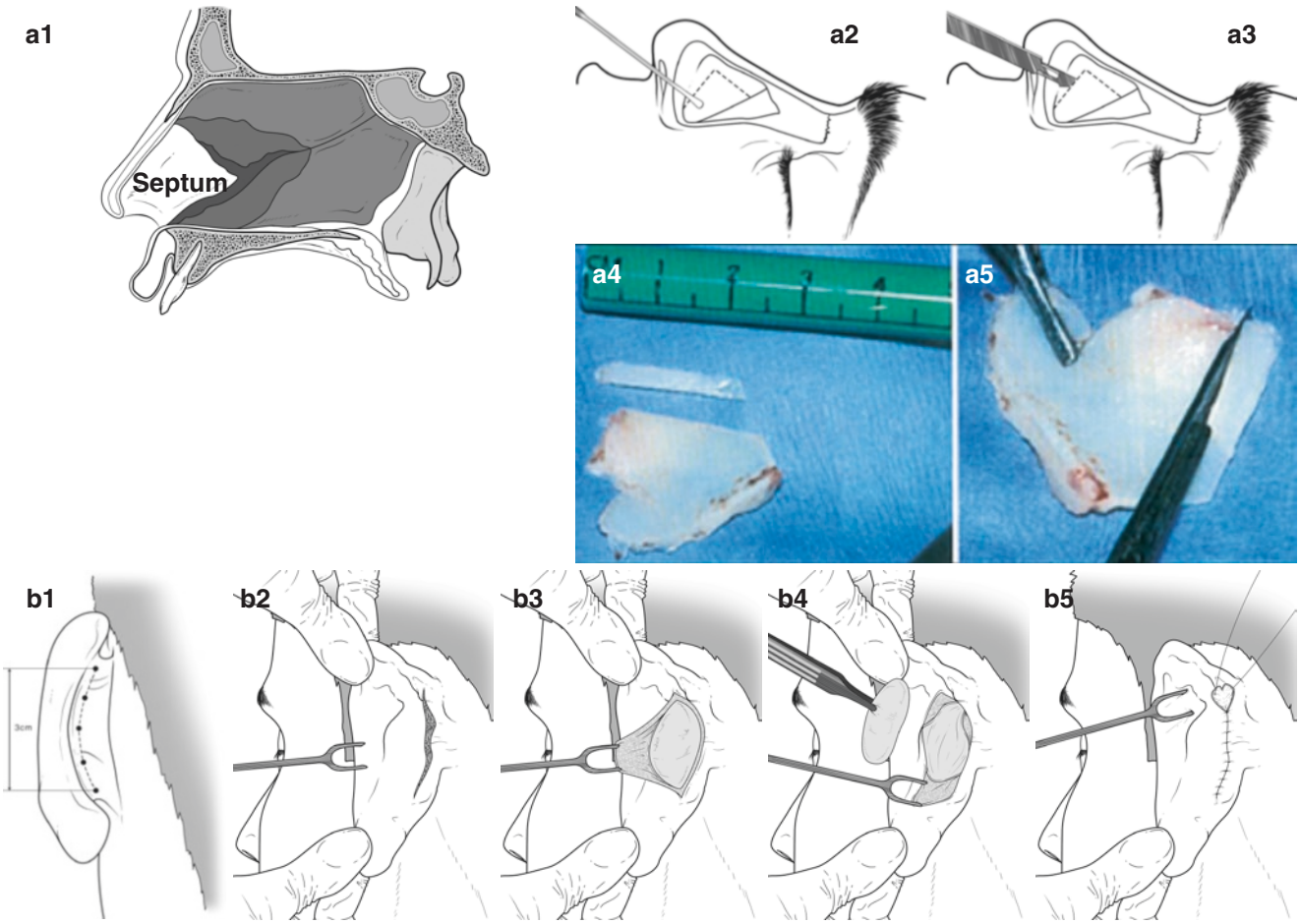

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Fig. 38.17 Sources of cartilage graft; (**a**) septal cartilage graft (**a1**) anatomy of septum (**a2**) marking for cartilage harvest preserving L shaped dorsal strut (**a3**) incision for cartilage harvest (**a4**) harvested cartilage (**a5**) carving of harvested cartilage and (**b**) Harvest of auricular cartilage; (**b**)- marking on the ear (**b2**)- incision (**b3**)- reflection of sub perichondrial flap to expose cartilage (**b4**) cartilage harvest (**b5**) closure of donor site

Table 38.2 Autologous graft materials

Autogenous grafts—Donor site morbidity, increased operating time, predictable long-term results, minimal risk for extrusion and infection	
Nasal septal cartilage	Considered to the best grafting material as it is easy to harvest and contour
	Intrinsic anatomy of septal cartilage [firmness, resiliency, flatness] provides optimal aesthetic results
	Sufficient rigidity to provide structural support
	No donor site morbidity with excellent long-term results
	Insufficient when large volumes are needed/previous septal surgery
Auricular/conchal cartilage	Easy to harvest but difficult to contour due to its brittle nature
	Low strength and hence provides poor structural support
	Low donor site morbidity and with good long-term results
	Intrinsic anatomy [curved shape with elastic memory] of auricular cartilage makes it difficult to provide optimal aesthetic results
	Used if nasal septal cartilage is not adequate e.g. extensive revision cases and simultaneous multiple grafting procedures
	Useful when elasticity is needed e.g. lateral crus reconstruction
	Insufficient when large volumes are needed
Costochondral grafts	Abundant supply
	Sufficient rigidity to provide structural support
	Can be reharvested
Temporalis fascia	Used for cartilage-fascia grafts in primary and revision rhinoplasty. For smoothening contour defects and irregularities on the nasal dorsum.
	Easy to harvest
	Adequate size available
	Shows minimal resorption and is stable in followup
Perichondrium over rib	Used for repair of septal perforations and for smoothening irregularities over the dorsum
	Easily available and harvested contiguous with rib cartilage which is a commonly used graft in rhinoplasty

Table 38.3 Alloplastic graft materials

Alloplastic grafts—No donor site morbidity, reduced operating time, unpredictable long-term results and increased risk of extrusion and infection	
Silicone	Pliable, elastic solid that causes little tissue reaction
	Easy to handle, comes in prefabricated shapes—most commonly used alloplastic graft material
	Increased risk of displacement/extrusion as its nonporous nature prevents surrounding tissue in-growth, instead, leading to the formation of a fibrous capsule
	Easy to remove even after a long time as a fibrous capsule will form around the implant, without ingrowth in to the graft
	Asymmetric contracture of the capsule around the implant can deform the implant over time
	Low strength and hence provides poor structural support
	Preferred in Asians with thicker dorsal nasal skin
Medpor [high density polyethylene]	Easy to carve and bend due to thermoplastic property
	Poor aesthetic results and comfort due to its stiffness
	Sufficient rigidity to provide structural support
	Minimal risk for displacement due to its porous nature with subsequent ingrowth of surrounding fibrovascular tissue
	Difficult to remove in the long term as there will be extensive tissue ingrowth
	Tends to shed particles, when implanted in stress-bearing and mobile areas may cause a chronic inflammatory response
Gore-tex [expanded poly-tetra-fluoro-ethylene (PTFE)]	Porous implant composed of carbon and fluorine molecules with pores
	Second most widely used alloplastic implant, after silicone
	Better comfort and aesthetics due to its softness
	Minimal risk for displacement due to its porous nature with subsequent ingrowth of surrounding fibro-vascular tissue
	Poor long-term aesthetics as it decreases in volume over time
	Difficult to remove in long term owing to extensive tissue ingrowth
	Low strength and hence provides poor structural support
Injectable filler materials—No donor site morbidity; reduced operating time; unpredictable long-term results and increased risk of extrusion, infection and embolization	
Bovine collagen, human-derived collagen, hydroxyapatite microspheres, hyaluronic acid	Mainly used for minor augmentations
	Necessary to overaugment by 20–30% to compensate for long-term absorption
	Provides poor structural support
	High complication rate including persistent redness, contour irregularity, swelling and necrosis of surrounding dermis or soft tissue, hypersensitivity reactions, extrusion
	Patients may object on religious grounds

Box 38.4 Classification of septal deformites

Congenital:

- Syndromic
  - Cleft lip and palate
- Congenital syphilis

Acquired:

- Developmental: midline dermoid cyst, short nose/long nose
- Post traumatic: bent nose/crooked nose
- Iatrogenic
  - Incorrect or aggressive rhino/septal surgery. Lefort I maxillary impaction with inadequate trimming of septum
- Cocaine misuse: destruction of cartilage and bony septum

38.4.3.2 Sequencing for Treatment

The sequence to be followed for planning a proper septoplasty includes

1. Establishing an accurate diagnosis. Apply Mladini classification for septal deformities (See additional Reading)
2. A thorough external and internal examination of the nose
3. Internal examination should include (1) anterior rhinoscopy and (2) nasendoscopy
4. Imaging of the nose, septum and the paranasal sinuses is mandatory. This should include CT scans with both soft tissue and bony windows [18].
5. It is preferable to perform the surgery "in conjunction with ENT colleagues"
6. Gross iatrogenic nasal deformities need careful evaluation of previous surgical records before treatment planning
7. Informed consents to be obtained for the harvest and use of grafts (Septum, Concha or Rib cartilage)
8. Care should be exercised to preserve the integrity of the turbinates and the internal nasal valve.

38.4.3.3 Surgical Approaches

Septoplasty may be performed in conjunction with a formal rhinoplasty using an open or closed approach.

Closed approaches for septoplasty include;

1. Endonasal caudal vestibular access via a right or a left hemi-transfixion incision or
2. Bilateral septal transfixion incision [19, 20].

38.4.3.4 Surgical Technique (Fig. 38.19a, b, c)

The local anaesthetic solution is infiltrated with adrenaline for optimal haemostasis. This not only provides a clear field for surgery but also aids in developing planes by the process of hydrodissection. An incision is made at the caudal margin of the septal cartilage, which may be unilateral or bilateral. Cautious, careful, unhurried dissection in the correct anatomical plane is done, using sharp precise instrumentation (Cottle/Masing, Freer or Joseph's elevator). It is imperative to identify and stay in a bloodless sub-mucoperichondrial plane. The light blue colour of the septal cartilage ensures the correct plane of dissection. An anterior tunnel is first made, followed by an inferior tunnel to expose the entire septum. The plane is then expanded and separated further with a Killian forceps. This offers bilateral exposure of the dissected tunnel and the septum. Sharp curvatures, angles and fracture lines are negotiated carefully also bearing in mind that the transition zone between the mucoperichondrium and the mucoperiosteum is an area vulnerable to tears. Tears over the mucoperichondrium require careful repair with vicryl sutures on a round body needle. However, tears in the inferior tunnel overlying bone need not be sutured and may act as drains. The flap elevation is extended posterior to chondrovomerine and chondroethmoid junctions for complete exposure of the bony septum.

Bony spurs or angulations and bends are identified, which may contribute to airway block. The osteocartilaginous junction is then separated to free the septum in the posterior aspect. Takayashu forceps are used to nibble away any bony/cartilage spurs. This may also be performed using thin chisels and osteotomes. Buckling of the septum may be corrected by resection of overhanging cartilage in the caudal aspect. Adequate relief thus allows the passive return of the septum to midline. Measures such as scoring, suturing or the use of PDS sheets/cartilage grafts may be required to correct and straighten residual curvatures. Harvest of septal cartilage may be performed at this juncture and should be done posterior to the key area (imaginary vertical line joining the tip of the nasal bone and the anterior nasal spine). Stabilisation to the midline is achieved by the use of a PDS suture anchoring the dissected septum to the anterior nasal spine. The flaps are reapposed with one or two transfixion sutures to prevent septal haematoma. Nasal packing is outdated and has been replaced by silastic sheets and intra-operative control with Merocel packs.

Advantages of the endonasal approach include

1. Minimal trauma to local tissues
2. Reduced post-surgical oedema and
3. A-faster-recovery-to-normalcy

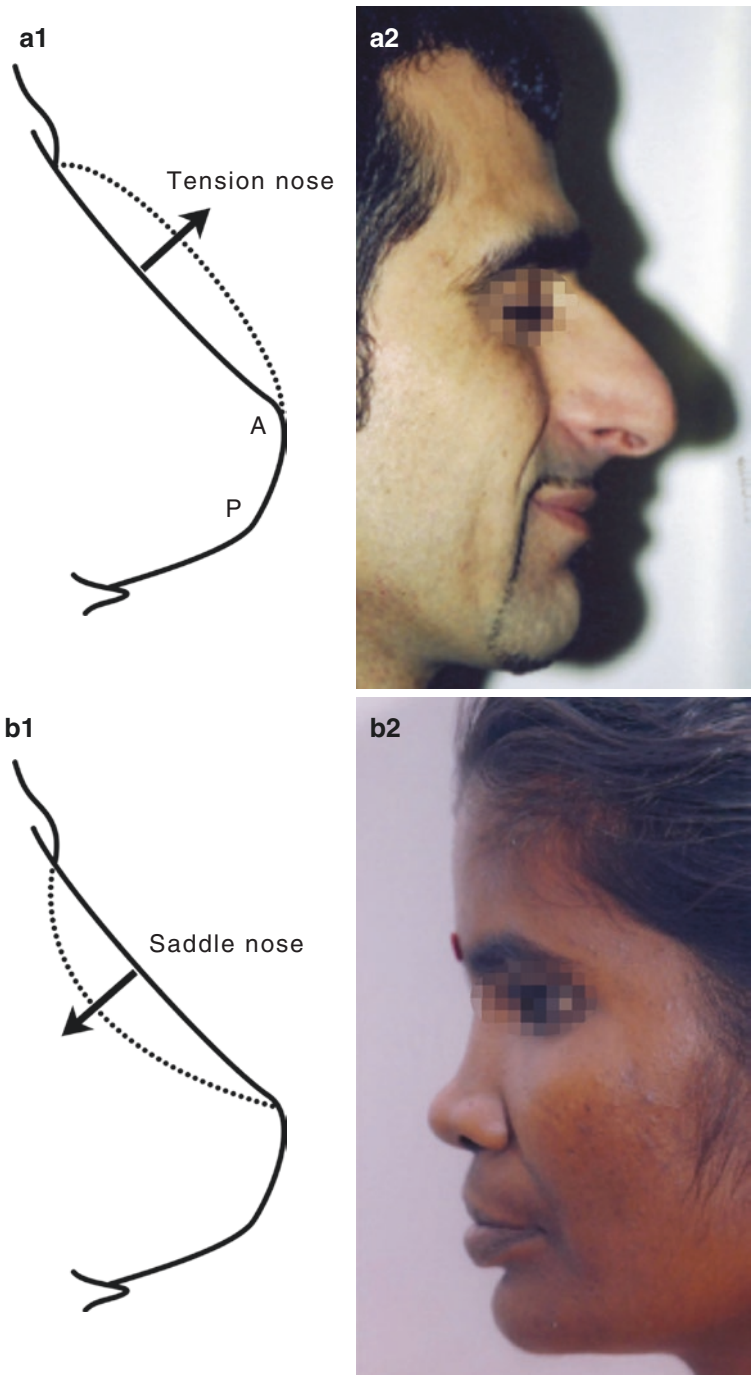

Fig. 38.18 Deformities of nasal septum; (**a**) tension nose and (**b**) saddle nose

Disadvantages of the endonasal approach are

1. Steep learning curve
2. Limited exposure & visualisation (headlight required)
3. Limited visualisation for the assistant
4. Difficult to place spreader grafts
5. Contour irregularities at the dorsal edge
6. Septal malposition/perforation
7. Increased risk for secondary deformities like saddling

38.4.4 Nasal Osteotomies

Nasal osteotomies are often required during correction of deformities of the nose as well as an adjunct to procedures which involve correction of the osseocartilaginous vault.

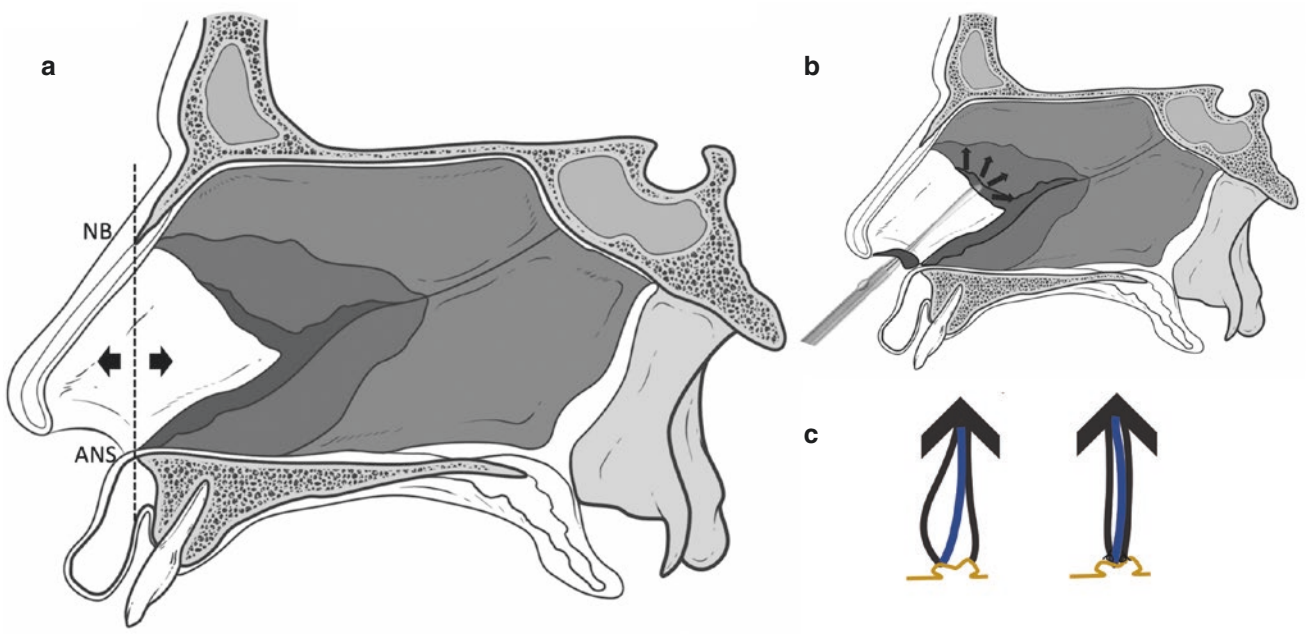

Fig. 38.19 Septoplasty intra-operative steps. (**a**) the part of the septum anterior to the line dropped from the tip of nasal bone (NB) to the anterior nasal spine (ANS) has tobe preserved. (**b**) Dysjunction of the cartilaginous septum from the bony septum. (**c**) Septal repositioning with sutures to the midline crest of the maxilla

38.4.4.1 Indications for Nasal Osteotomies

1. Close an open roof after dorsal hump removal
2. Correction of a deviated bony nasal vault (crooked nose/bent nose)
3. Correction of concave or convex nasal bones
4. Reduce or narrow bony base width
5. Mobilise malunited fractured nasal bones prior to reduction

Different types of nasal osteotomies (Fig. 38.20a, b) are utilised for a variety of clinical indications [21, 22]. They are enumerated in Box 38.5.

38.4.4.2 Armamentarium for Nasal Osteotomies

- Chisels/Osteotomes
  - Straight osteotomes—2 mm microosteotome
  - Curved osteotomes
  - Guarded osteotomes—Nievert, Silver
  - Angled blade osteotomes—Murray-Parkes
  - Notched osteotomes—Walter
- Power instruments
  - Oscillating/reciprocating saws
  - Piezo saw

38.4.4.3 Surgical Technique

The different techniques for performing nasal osteotomies are (1) endonasal, (2) percutaneous, (3) endoral and (4) nasofrontal

Percutaneous technique (Fig. 38.21a, b, c)

The percutaneous technique involves the completion of a lateral osteotomy and a transverse root(superior) osteotomy. The local anaesthetic solution is infiltrated with adrenaline 10–15 min earlier for good haemostasis.

The sites of the lateral and superior osteotomies are marked on the skin. The cephalic end of the cross-over of these two osteotomies should be kept no higher than the level of the intercanthal line.

A small 2–3 mm stab incision is made on the skin at the middle of the lateral osteotomy marking. The incision is deepened down and to bone. The osteotome is swept along the entire length of the marking to provide good release of the skin and subcutaneous tissue and keep the angular artery away from the line of osteotomy. The osteotome is then positioned supraperiosteally at 2 mm intervals and struck with a mallet to produce an interrupted line of punch holes. The osteotomies are started at the pyriform rim and continued superiorly to the nasofrontal junction. The same technique is followed for the transverse root(superior) osteotomy. The contra-lateral nasal wall is osteotomised in a similar

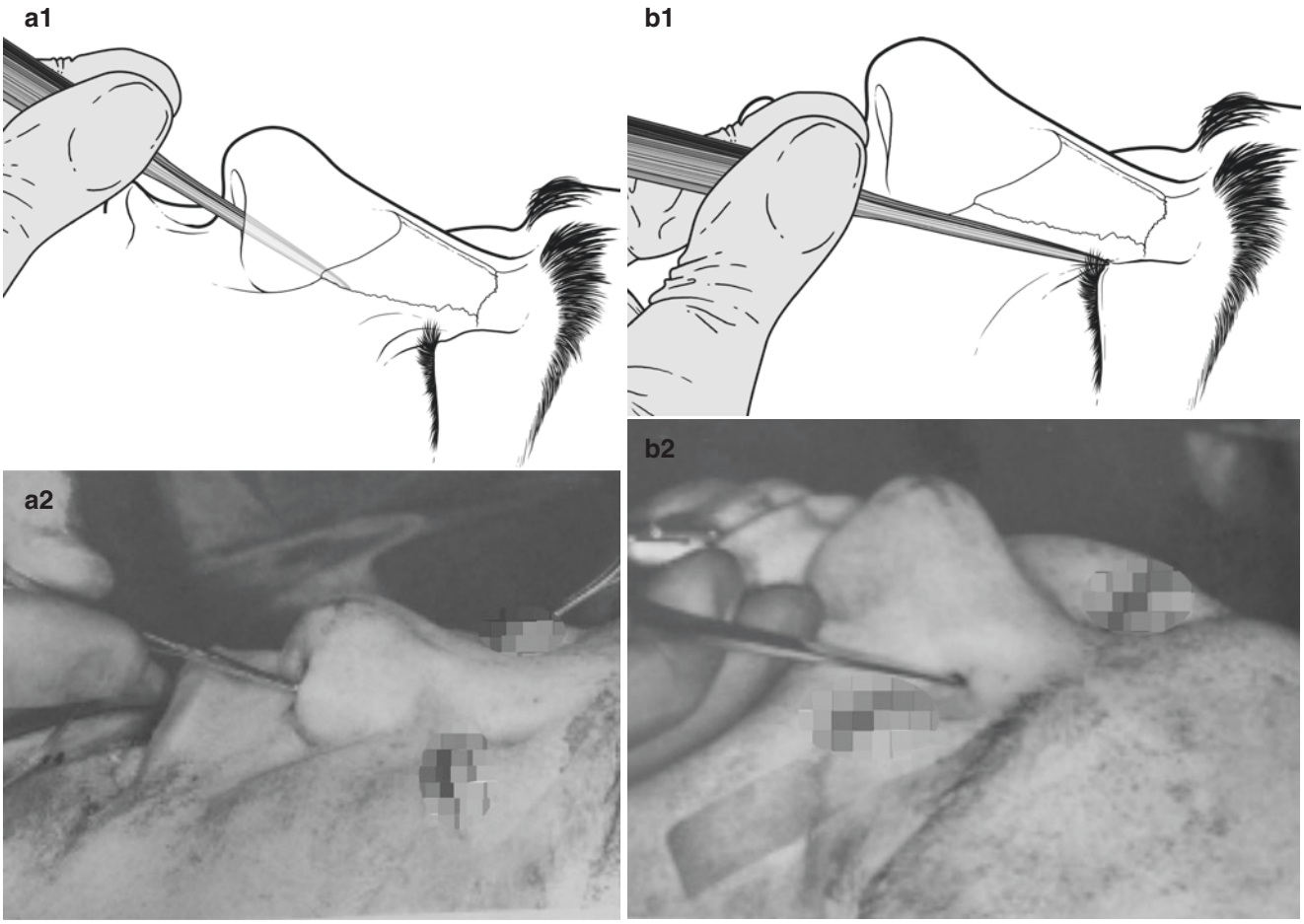

Fig. 38.20 Types of osteotomies. (**a**) Endonasal and (**b**) Percutaneous

Box 38.5 Osteotomies types

- Lateral osteotomy
  - Low to high
  - Low to low
- Medial osteotomy
  - Fading paramedian
  - True median
- Superior osteotomy
  - Transverse root
- Intermediate osteotomy
  - Vertical
  - Horizontal
- Fragmentation/comminution (largely outdated)

fashion. Once this is completed, the nasal bones are held with firm/controlled pressure between the thumb and the fore-fingers of both hands over a gauze square and then fractured along the already osteotomised punch holes. Moderate pressure over the wound helps with haemostasis and prevention of ecchymosis. No sutures are required and the skin is dressed with a Steri-Strip.

Complications include comminution, unpredictable fracture line, loss of lateral wall support, avulsion/displacement of upper laterals, step deformity, residual deformity and failure to in fracture/mobilise nasal bones.

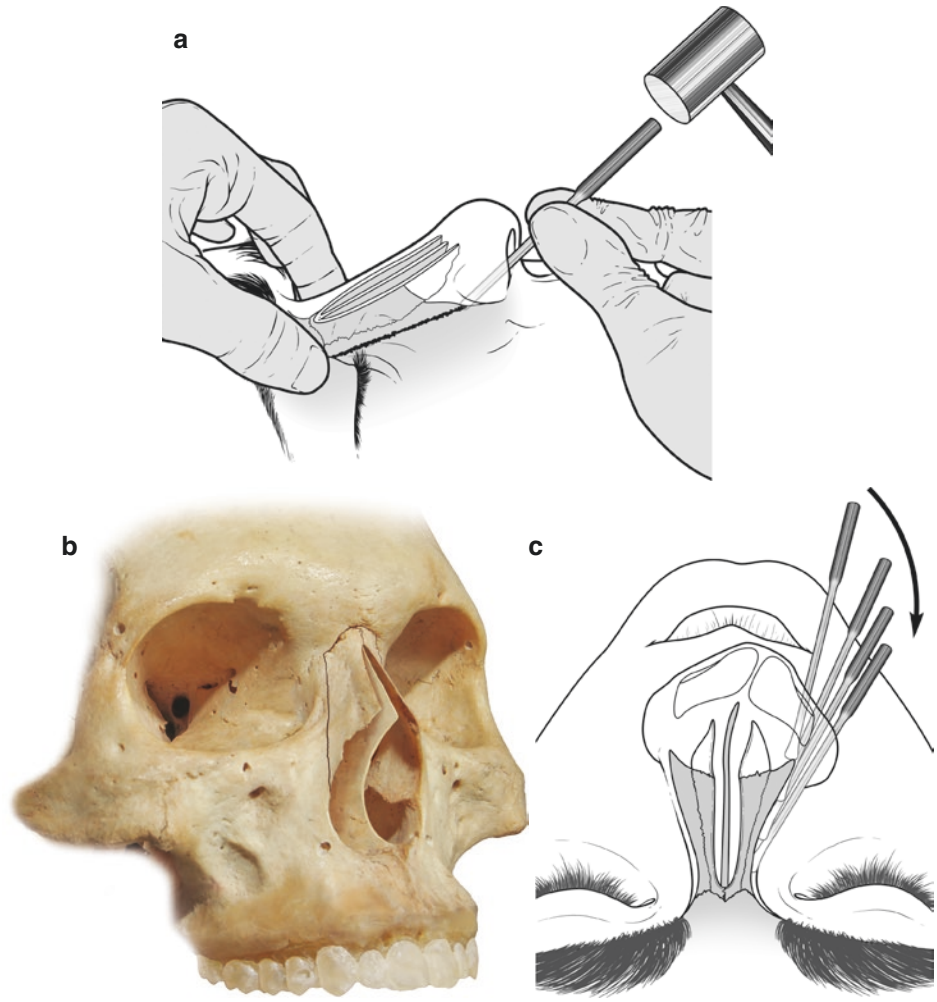

Fig. 38.21 Steps in nasal osteotomy. (**a**) Start of the lateral osteotomy. (**b**) Osteotomy marking on skull. (**c**) Movement of the osteotome for lateral osteotomy

38.5 Surgical Management of Basic Nasal Deformities

38.5.1 Dorsal Hump Deformity

The dorsal hump is the most common problem for which a patient may seek rhinoplasty. Based on the anatomical units involved, three main types of dorsal hump may be identified [23, 24];

1. Osseous/bony hump that exclusively involves the bony vault,
2. cartilaginous hump that involves the cartilaginous middle vault with septal and upper lateral cartilages and
3. the osseocartilagenous hump that is a combination of the two.

38.5.1.1 Types of Dorsal Humps

Dorsal humps can also be categorised as true and pseudo-humps. True humps may occur isolated or may occur in conjunction with other nasal deformities. The pseudohump may produce a relative appearance of a dorsal hump, while in reality, the appearance may be due to a high anterior septal angle, supratip prominence or tip ptosis (Box 38.6).

38.5.1.2 Clinical Assessment of a Dorsal Hump (Fig. 38.22a–d)

- Palpation of nasal bones, normal, long or short
- Ascertain area of hump requiring reduction
- Dorsal line—imaginary line from the radix extended along the nasal dorsum
- Assess if tip projection is adequate; reduced or increased, prior to hump reduction
- Assess if tip support is adequate; weak or strong, prior to hump reduction

38.5.1.3 Armamentarium for Dorsal Hump Reduction

The armamentarium required for dorsal hump reduction are shown in Box 38.7.

Box 38.6. True vs. Pseudo humps

True dorsal hump	Pseudo hump
Hump associated with the following clinical situations • high dorsum • low dorsum • short nasal bones • wide bony base • narrow bony base • deviated nasal bones • cleft nose deformity • under-projected nasal tip • over-projected nasal tip • short nose • long nose	• High anterior septal angle • Supra-tip prominence • Loss of tip projection

Box 38.7. Bony vs. Cartilaginous hump, (Armamentarium)

Bony hump	Cartilagenous hump
Manual nasal saw. • Joseph saw • Bull saw (guarded tip) Osteotomes. • Rubin (dorsal fin) • Cinnelli (guarded edges) • Aiach (wire guide) • McIndoe grooved chisel (not recommended) Bone cutters/nibblers • Sulsenti • Heanley Rasps • Graded two way tungsten carbide rasps (Rees) • Pull rasp/push rasp (Daniel) • Diamond rasps Power saw • Rhinobur (Toriumi) • Piezoelectric saw	• Scalpel (11 bard Parker) • Fomon scissors (angled on flat) • Turbinate scissors (angled on side) • Kaplan scissors (double action) • Cautious, conservative reduction at osteocartilaginous junction only • Preserve leading edges of ULC to create spreader flaps (prevent middle vault narrowing)

38.5.1.4 Dorsal Hump Reduction (Profile Lowering)

The procedure for dorsal hump reduction (profile lowering) is facilitated by two important steps, namely, (1) bony hump removal and (2) cartilaginous hump removal.

Bony hump removal (Fig. 38.23A–K)
En-bloc bony or cartilaginous hump removal requires experience as there is a high risk of excessive reduction when the surgeon may be inexperienced. The procedure begins with infiltration of lidocaine 2% with 1 in 100,000 adrenaline.

After exposure of the osteocartilaginous vault is completed, the osteotome is engaged at the caudal edge of the nasal hump (osteocartilaginous junction) and the bone is removed using an osteotome and mallet (18 oz Heath mallet) with firm blows to follow a careful alignment. It is better to always under-reduce, rather than over-reduce as it may cause severely compromised results. The dorsal edges can then be rasped down to the desired extent. Care is taken not to rasp the cartilage as it may produce irregularities, tears or avulsions.

When separation of a large hump is desired, placement of a superior stop-cut as described by Tardy allows precise and clear separation at the desired level. Diamond rasps are used to smooth irregularities at the dorsal edge of the nasal bones. Removal of an osteocartilagenous hump results in an open roof deformity of the nasal dorsum, which needs to be closed with an osteotomy [23].

38.5.1.5 Complications

- Unpredictable hump reduction
- Avulsion of upper lateral cartilages
- Fenestration of the skin envelope
- Residual irregularities
- Excessive overzealous hump reduction
  - Bony saddle
  - Loss of support to ULC
  - Loss of key area support to septum
- Inadequate hump reduction
  - Residual hump
  - Failure to follow dorsal line: superior bony spur

38.5.1.6 Preservation Technique of Hump Removal (Regnault & Daniel)

This technique advocates aggressive removal of the large hump with osteotome. The under-surface of the hump is then reduced extracorporeally with a bur. The reduced hump is replaced in the dorsal defect. This obviates the need for nasal osteotomy and provides optimal results of a corrected dorsum.

38.5.2 Saddle Nose Deformity

A saddle nose deformity is defined as a wide and flat nose with a concavity on the nasal dorsum.

Classical clinical presenting features of this deformity are

- Loss of height of the nasal dorsum (appearance of a shortened nose)
- Increased width of the nasal dorsum (wide nose)
- Underprojected tip due to inadequate septal support to the tip complex

38.5.2.1 Classification

Saddle nose deformity can be classified based on the underlying structural problem into

Fig. 38.22 Dorsal hump - clinical presentation. (**a**) Profile and (**b**) frontal pictures of patient 1. (**c**) Profile and (**d**) frontal pictures of patient 2

1. Bony saddle
2. Cartilaginous saddle
3. Combination of bony and cartilaginous elements

The causes responsible for saddle nose deformity are many, namely, septal hematoma following trauma, iatrogenic—inappropriate surgery to the septum, bony vault &

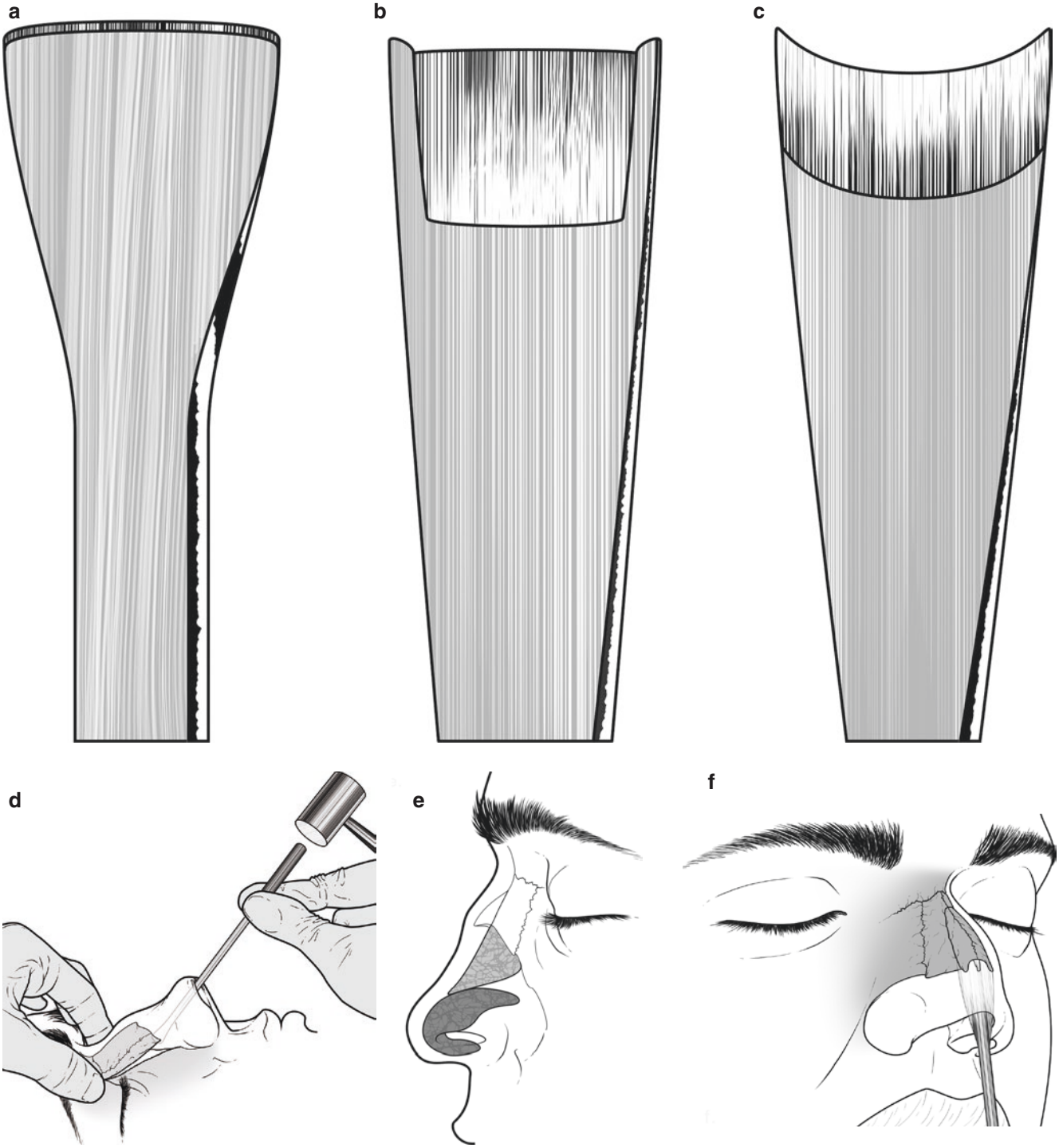

Fig. 38.23 Hump reduction technique: Armamentarium (**A**, **B** & **C**). Surgical technique (**D**, **E** & **F**) Removal of the dorsal hump with the osteotome, (**G**–**K**) Preparation of the "open roof" deformity for closure

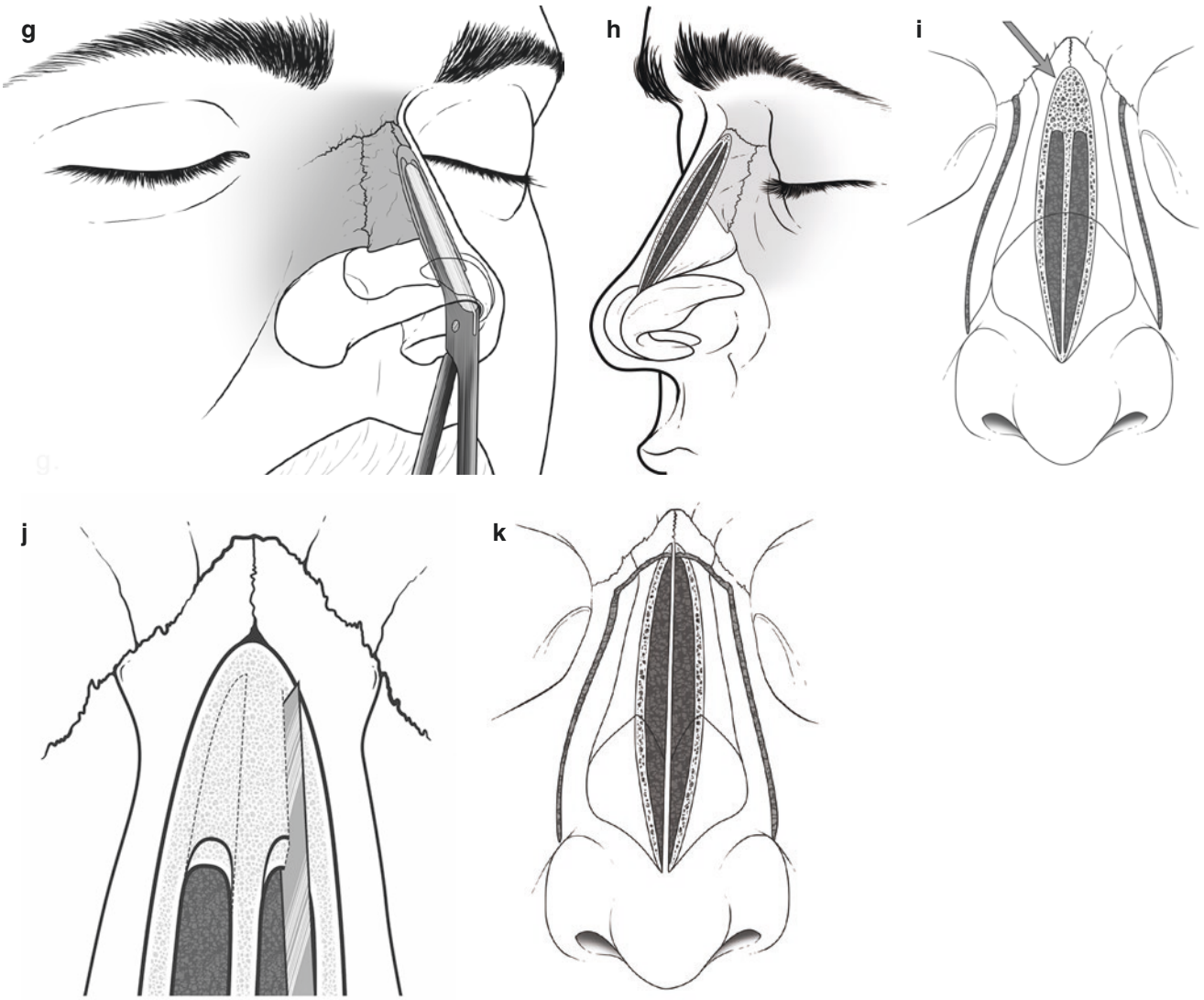

Fig. 38.23 (Continued)

middle vault and substance abuse (cocaine), diseases like congenital syphilis/leprosy and racial predisposition—African, Afro-American, and Asian.

38.5.2.2 Clinical Features

The salient features (Fig. 38.24) demonstrable on a patient with saddle nose deformity are enumerated in Box 38.8.

The septum may exhibit deformity with twisting/deficiency or at times may be totally absent.

The skin and soft tissue envelope may show a "concertina" effect due to loss of structural support.

38.5.2.3 Surgical Management (Fig. 38.25a, b)

Surgery for the correction of saddle nose deformity may be planned in a staged manner with the first stage involving the correction of the foundation of the nose and the second stage involving the aesthetic makeover [25, 26]. The aim of the procedure is to re-establish the tension between the nasal tip

Box 38.8 Features of saddle nose deformity

Frontal:

- Wide nasal dorsum
- Loss of dorsal lines
- Epicanthal folds due to the lateral movement of dorsal skin
- Loss of tip definition
- Increased tip width
- Presence of a flat alar-columellar line

Profile:

- Loss of dorsal height
- Marked concavity of the nasal dorsum
- Loss of tip support and projection
- Tip rotation may be increased or decreased
- Retraction of the columella
- Relative increase of the upper lip length (columellar skin migrates downward)

Basal:

- Wide alar base
- Shortened and deformed columella
- Loss of nostril orientation
- Ballooning of the internal nasal valve

Fig. 38.24 Saddle nose clinical photo

complex and the dorsum, which has been lost due to the concertina effect.

Surgical correction involves three essential steps that are independent of each other.

- Establish the height and length of the septum to restore structural support to the entire nose. This involves the use of a robust septal extension graft, fashioned from harvested rib cartilage (preferably the eighth rib).
- Correction of the dorsal deficiency using a dorsal strut graft that extends from nasion to under the domes.
- Provision of support for the tip complex. This is achieved with the use of a columellar strut graft to restore tip projection.

This procedure involves the use of strong and robust cartilage grafts. The eighth rib provides an adequate amount of cartilage which is ideal for this situation. Ear cartilage lacks rigidity, while banked cartilage tends to undergo resorption.

38.5.3 Correction of the Deviated Nose

Deviated noses can be of two types

1. "Bent" nose where the nasal bones and the upper lateral cartilages point to the same side, and
2. "Crooked" nose where the nasal bones and the upper laterals face in opposite directions

38.5.3.1 Aetiology

The most common causes of a deviated nose

1. Developmental—unilateral cleft nasal deformity
2. Post trauma to the face and nose—following road traffic accidents, sports injuries or interpersonal violence
3. Iatrogenic—as a result of earlier surgical procedures; Maxillary impaction by a LeFort 1 osteotomy without addressing the septum or septoplasty with excessive scoring, resection and weakening

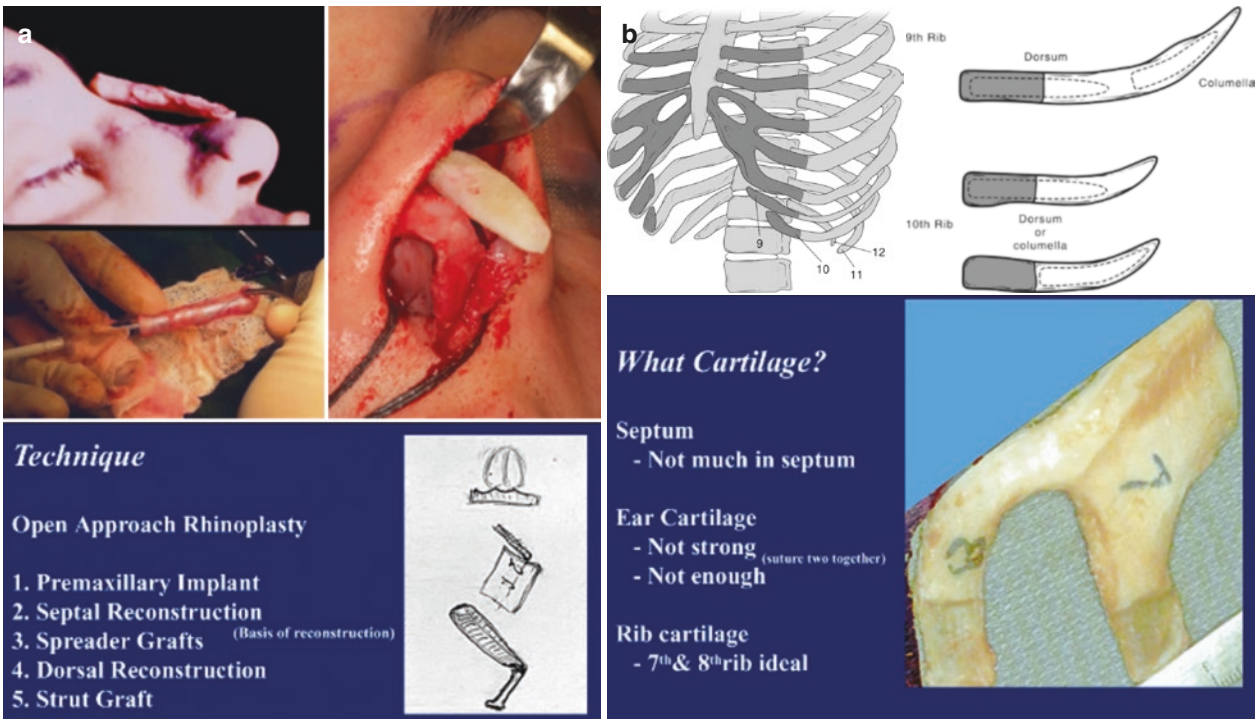

Fig. 38.25 Saddle nose-intra op. (**a**) intra-operative pictures demonstrating use of rib cartilage for dorsal nasal reconstruction. (**b**) Landmarks for rib harvest

38.5.3.2 Clinical Features

Clinical features of a deviated, bent or crooked nose include both functional and aesthetic issues

1. Blockage of the nasal airway, unilateral or bilateral
2. Visible deformities affecting the upper, middle and lower thirds of the nose
   (a) Frontal
      - Deformity of the nasal pyramid
      - Twisting or angulation of the nose
      - Constriction or bulge at the middle vault
      - Bending of the nose showing midline discrepancy
      - Unequal height of the nasal bones
      - Tip deformity secondary to the loss of septal support/angulation

   (b) Profile
      - Patient may present with a dorsal hump or a saddle deformity
      - Loss of tip projection
      - Nasal tip ptosis
      - Retraction of the columella

   (c) Basal
      - Deviation of the nasal tip or middle vault
      - Angulation or shortening of columella
      - Displacement of the caudal septum from the maxillary crest into the nasal vestibule
      - Nasal valve obstructions

   (d) Varied presentations of septal deformities (Mladini classification)

38.5.3.3 Treatment (Fig. 38.26a–g)

Septorhinoplasty is required to correct the deformity. Some prefer single-stage correction, while others may choose staged procedures (first stage septoplasty followed by a second stage external deformity correction). However, a single-stage correction is preferred. This is usually performed using an open structure approach with exposure and separation of the septum from the upper lateral cartilages. Straightening of the septal cartilage is performed by excision and/or partial division of the cartilage and may be followed by scoring or sutures as indicated. Some surgeons prefer the use of a PDS sheet to splint the corrected septum. However, costal cartilage may be harvested for reinforcement of the straightening

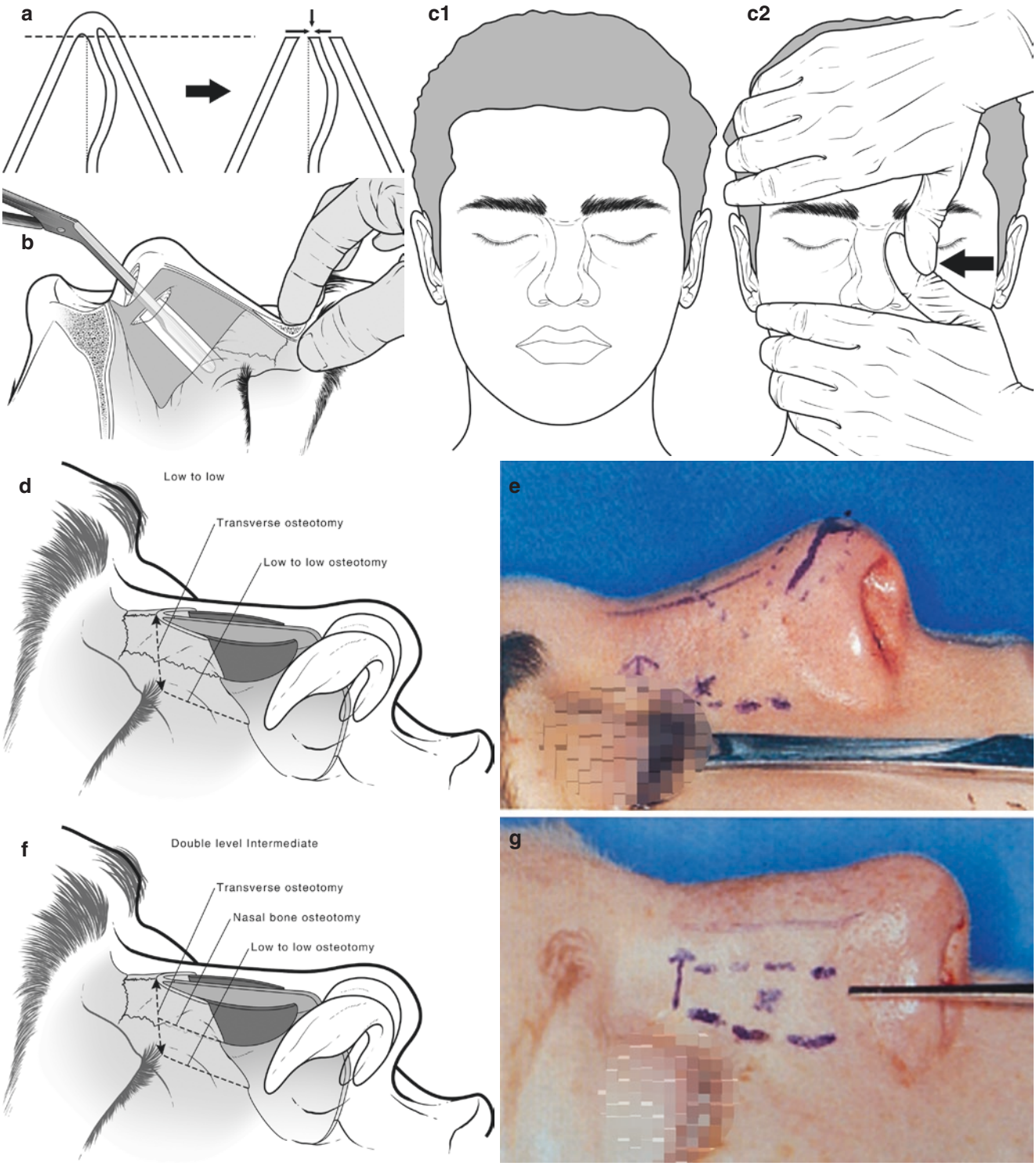

Fig. 38.26 Techniques of reduction of crooked nose deformity with twisting/angulation of septum, (**a**) differential reduction of hump prior to ostetotomy, (**b**) septal repositioning, (**c**) digital reduction/manipulation after osteotomy, (**d**) line diagram of "low-to-low" osteotomy, (**e**) intra-operative picture with osteotome positioning (low-to-low), (**f**) line diagram of "nasal bone osteotomy", (**g**) intra-operative picture with osteotome positioning (nasal bone osteotomy)

and to provide a spreader effect to correct the nasal valve simultaneously. Osteotomy of the nasal bones is often required to correct the angular deformity of the bony vault. A tip plasty may be necessary in most cases to correct the nasal tip tripod deformity secondary to nasal deviation.

It is to be borne in mind that the results for the correction of deviated noses are not always satisfactory. There is a possibility of residual deformity, recurrent deformity, loss of tip support and saddling.

38.5.4 Tip Plasty

The nasal tip is the centre of focus for both nasal anatomy and aesthetics. It is a very important anatomical subunit and can be most challenging to refine surgically.

Nasal tip deformities may show varied morphology and diverse clinical presentations (Fig. 38.27a–f). They may occur in isolation or concomitant with deformities of the dorsum or septum.

Fig. 38.27 Types of tip deformity. (**a**) Wide bulbous tip, (**b**) ball-ended amorphous tip, (**c**) plunging infra-tip lobule, (**d**) amorphous bulbous tip with deviation and constriction of right lower middle vault, (**e**) over-projection of nasal tip owing to prominent ANS & overtly long lower lateral cartilage with normal naso-labial angle, and (**f**) nasal tip over-projection with upward over-rotation

Tip deformities can be enumerated as follows as in Box 38.9.

38.5.4.1 Wide Nasal Tip

A tip is considered abnormally wide when the width of the tip is greater than the width of the dorsum. Normally, the tip width is equal to the width of the dorsum.

This can be further subclassified as mild, moderate or severe.

A wide nasal tip may be caused due to three morphological alterations:

1. increased interdomal width (wide interdomal angle)
2. increased intradomal width, where the domal angle is wide, and
3. increase in both intradomal width and interdomal width

Box 38.9 Types of tip deformities

- Wide
- Bulbous
- Over projected
- Under projected
- Over-rotated (piggy nose/toffee nose)
- Under-rotated (ptotic tip)
- Asymmetric

Surgical management

Surgery for the nasal tip can be performed either through a closed or open structure rhinoplasty approach. This may depend on the clinical indications involved as well as the skill and experience of the operating surgeon. Steps for correction of a wide nasal tip include reduction of the interdomal width by placing a permanent interdomal suture with 5-0 prolene or 5-0 PDS (semipermanent). This is followed by the creation of a new domal angle (transdomal suture followed by the interdomal suture). One should also consider surgical removal/excision of a segment of the intermediate crus for better tip definition (Fig. 38.28a, b).

38.5.4.2 Bulbous/Boxy Tip (Fig. 38.29)

Bulbous tips have problems associated with thick SSTE (skin & soft tissue envelope), excessive subcutaneous fat, strong convex and bulky lateral crura and a concertina effect of a shortened nose in general.

Surgical management

This involves careful degloving of the SSTE leaving the subcutaneous fibrofatty tissue on the lateral crura. Careful defattening and thinning of the subcutaneous plane should be performed. A modest cephalic trim is performed to correct the large and bulky lateral crura. As this is a more general deformity involving not only the tip but also the associated SSTE, a careful distribution of volume to produce balance may be required. This helps camouflage the deformity to a great extent while improving outcomes.

Excessive or injudicious defattening of the nasal tip may cause ischemia/necrosis of the skin of the nasal tip,

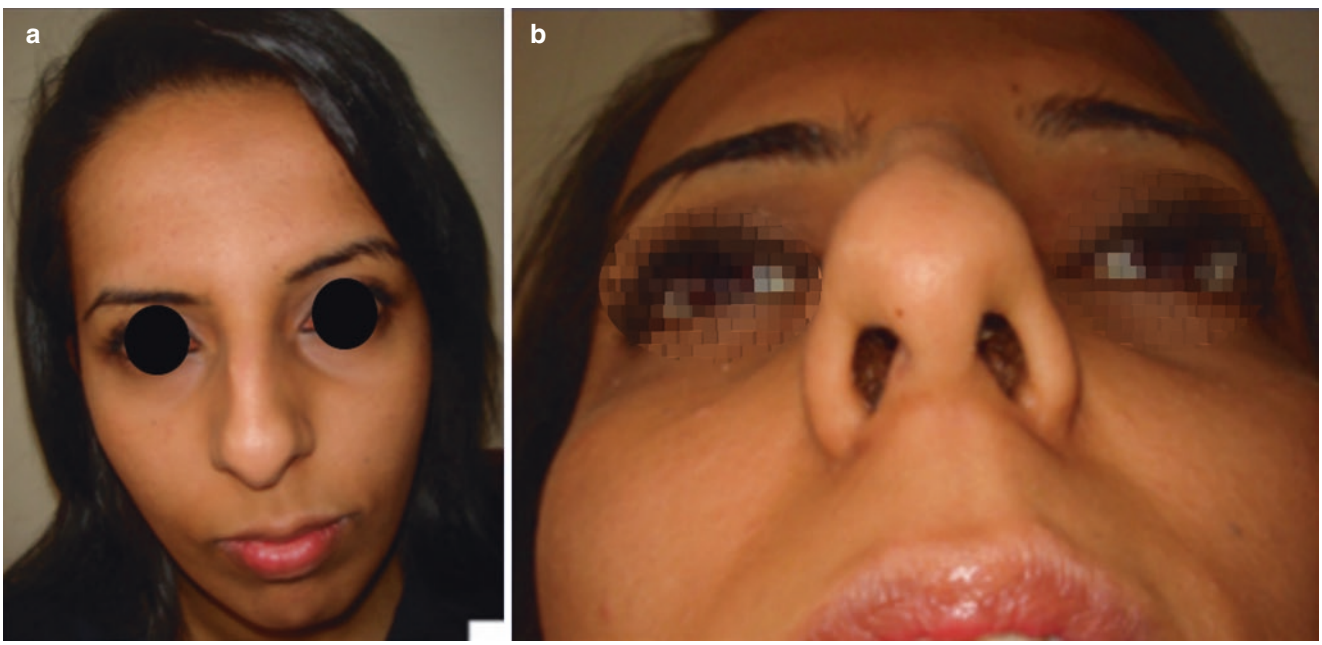

Fig. 38.28 (**a**, **b**) Wide nasal tip clinical

blanching of the tip skin with exposure to cold, contour irregularities of the underlying cartilage to become visible and may also lead to the skin pores communicating to the underlying tissues.

38.5.4.3 Overprojected Nasal Tip (Fig. 38.30a–c)

Nasal projection is defined as the distance along a perpendicular line from the vertical facial plane to the anterior most point on the nasal tip. The nose when not in normal facial balance can either be overprojected or underprojected.

The key to correction of the overprojected nasal tip is to establish the cause. This may be due to the increased length of the anterior nasal spine, excess caudal septal height or overtly long alar cartilages.

Fig. 38.29 Bulbous tip clinical

Surgical management

Surgery for the overprojected nose should be performed through a full bilateral septal transfixion incision with the aim of deprojecting the nose by 4–5 mm. The anterior nasal spine is reduced judiciously followed by the resuspension of the upper lip to the ANS. The anterior septal angle is lowered to achieve further deprojection. Deformities of the alar cartilage may be varied and may require division and overlap of the medial crura, division or resection of the medial footplates. A lateral crural overlap with resection of a segment is performed 1 cm from the dome. Domal resections are to be avoided as they may produce secondary deformities: irregularities, angulation, and bossa formation. They may produce a sharp angulation with a pointed tip (pinched nose), which may require a shield graft for tip camouflage. Care should be taken to avoid/prevent loss of tip support during these manoeuvres.

38.5.4.4 Underprojected Tip (Fig. 38.31a, b)

It is important to establish the cause for underprojection prior to treatment. Causes of underprojection may include

- Short medial crura (short columella)
- Underdeveloped lower lateral cartilages e.g. binders
- Deficient height of caudal septum

Fig. 38.30 Overprojected nasal tip (**a**) profile of patient 1, (**b**) profile of paitent 2 at repose and (**c**) profile of patient 2, smiling

- Deficient or absent anterior nasal spine/premaxilla
- Bilateral cleft lip nose

Surgical management

Surgery for the underprojected nose should follow the sequence provided below: the columella is strengthened with a strut graft, a transdomal suture is placed to project the dome. A shield, cap or an umbrella graft may be used to increase tip projection. A caudal septal extension graft is added to strengthen the septal support and increase projection. Finally, a transcolumellar suture is performed through the medial foot-plates. In patients with the deficiency of the premaxilla or the total bony maxilla (cleft maxillary hypoplasia) where loss of bone support contributes to the loss of nasal projection, advancement of the maxilla or Onlay grafting of the premaxillary segment may offer the correct solutions.

38.5.4.5 Over-Rotated Tip (Piggy Nose) (Fig. 38.32b)

Tip rotation denotes the angle formed by the columella to the upper lip. The point of reference here is the nasolabial angle. Deformities of the nasal tip related to the rotation can be either over-rotation or under-rotation (ptotic nose).

Over-rotation of the nose may arise due to various causes: post-traumatic (caudocephalic impact to the nose) or an inherently short nose. Over-rotation may also be a complication of prior rhinoplastic procedures due to over-zealous caudal septal reduction, excessive cephalic trim of the lateral crura or injudicious lowering of the anterior septal angle.

Surgical management

Surgery for the correction of over-rotation of the nasal tip should include techniques for de-rotation of the nose like placement of a caudal septal extension graft and/or extension of the dorsal graft beyond the domes. These procedures require extensive cartilage grafting to lengthen the shortened nose.

38.5.4.6 Under-Rotated Tip (Ptotic Nasal Tip) (Fig. 38.32a)

Under-rotation denotes cephalocaudal rotation of the nasal tip, which makes the tip point downward. This needs to be differentiated from an underprojected tip. However, occasionally both problems may co-exist. It is also important to identify the presence of pseudo-ptosis in which the tip is normal but a more prominent anterior septal angle makes the tip appear ptotic.

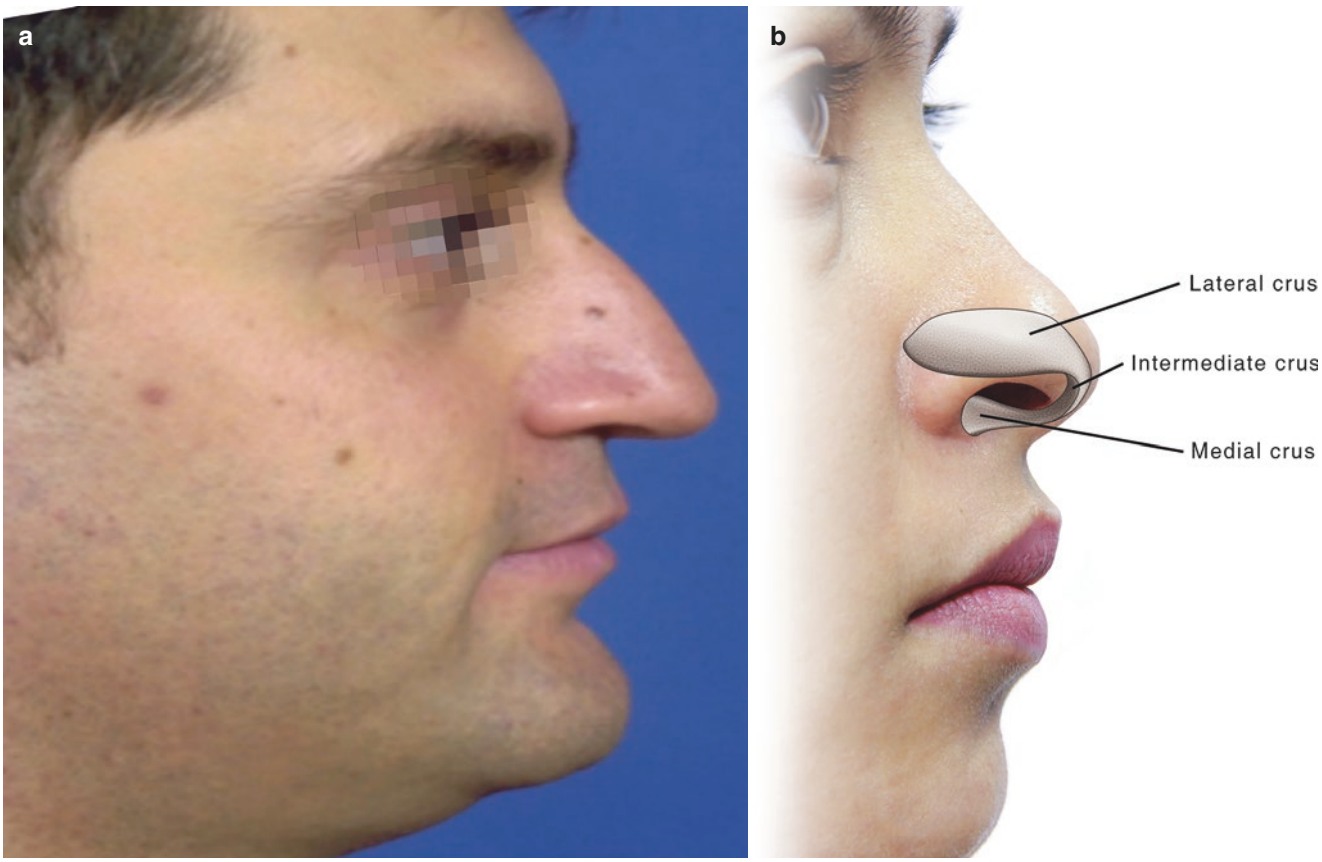

Fig. 38.31 Underprojected tip. (**a**) Clinical picture and (**b**) diagrammatic representation

Ptotic tips need to be examined both at rest and dynamically. The dynamic inferior movement of the nasal tip may occur due to the downward pull of a strong depressor septi muscle. Care should also be taken to look for any other associated deformities.

Causes for an under-rotated or ptotic tip may be hereditary as in the noses of people from the Mediterranean countries, developmental due to heavy SSTE and weak cartilages or the presence of excessive skin in the membranous columella. Patients with bilateral cleft lip deformities are predisposed to have underprojected and under-rotated noses due to columellar deficiency.

Iatrogenic causes for tip ptosis include: poorly planned and executed septorhinoplasty with loss of septal support, inadequate maintenance of tip support or reattachment of the tip support structures. It may also be a complication following (1) prolonged intubation with the nasotracheal tube not anchored well and (2) tumour ablations with inadequate reconstruction.

Surgical management

Correction of the ptotic tip should be based on the anatomy involved. It is best to follow an algorithm for planning the surgical procedure. The structures contributing will enable us to plan and perform the correct procedure.

- An elongated septum producing the ptosis is corrected by a wedge excision of the excessive septum and the overlying mucosa (Fred technique).
- Elongated lower lateral cartilages can be managed by two methods depending on the tip projection; in underprojected tips, a columellar strut is provided for enhancing support and augmented with the tip rotation suture, while in the case of an overprojected tip, transection of the LLC is performed with overlapping and suturing. The tip rotation suture may be optional depending on the clinical indication.
- In the case of a shortened medial crura, a columellar strut or a medial crural anchor suture is placed with the tip rotation suture again being optional.

38.5.5 Managing the Wide Ala

The normal width of the ala falls within or just beyond an imaginary vertical line dropped from the medial canthus to the upper lip. The ala may be either narrow or wide. A wide

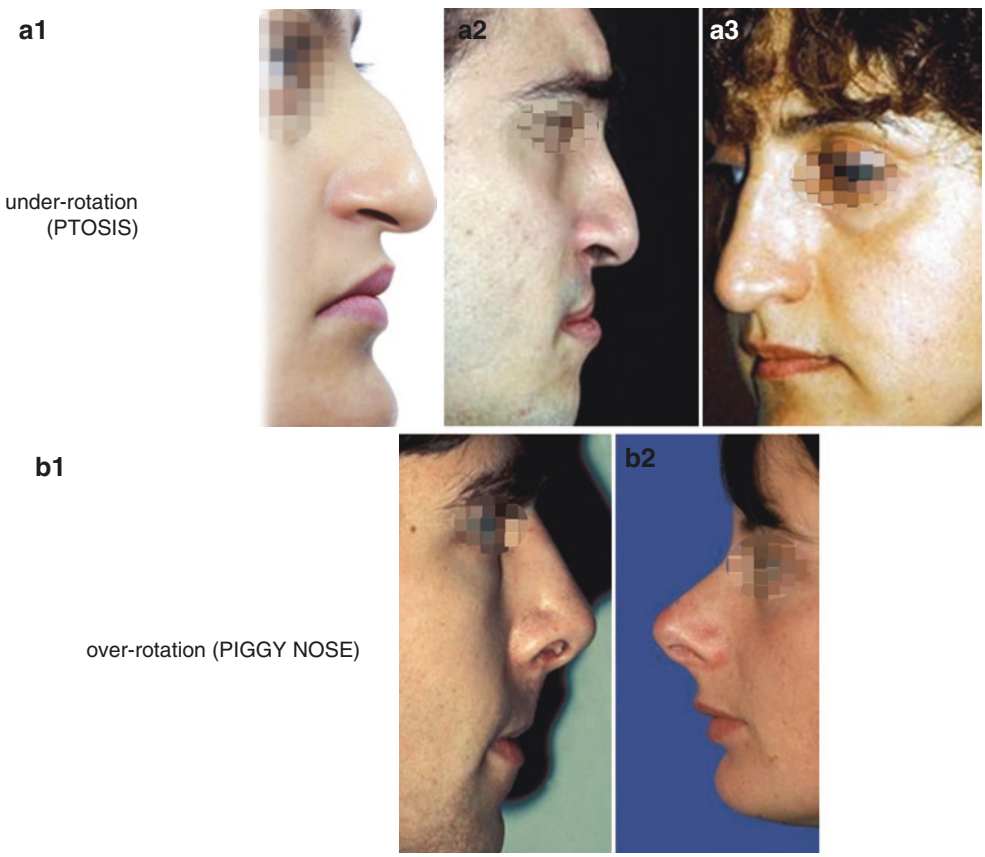

Fig. 38.32 Nasal tip rotations clinical. (**a1**, **a2**, **a3**) Under-rotation of tip and (**b1**, **b2**) Over-rotation of tip

ala compromises facial aesthetics and is often a complaint for which the patient seeks help.

38.5.5.1 Causes of Variations in Alar Base Width

A wide alar base may be a characteristic of racial variations, for example, African and Asian races exhibit increased width of the alar base. It may also be wide in patients with congenital anomalies like cleft lip and palate. Wide alar base may also be due to iatrogenic causes like

1. after a Le Fort 1 maxillary advancement or impaction surgery,
2. injudicious rhinoplasty with loss of tip projection due to loss of septal support

38.5.5.2 Clinical Features

Patients with a wide alar base exhibit a nose that looks flat and broad; the alar columellar line may be straight and they may have an associated wide nasal tip. In the basal view, the nose presents with reduced tip projection and short or distorted columella. The alar side walls show increased bulk and increased flare, and the alar insertion into the nasolabial area may be horizontal or oblique. The alar sill width may also show an increase. The premaxillary base that supports the alar complex may be normal, deficient or asymmetric.

38.5.5.3 Evaluation

The nose should be evaluated for the cause of alar widening. This is the basis on which the treatment may be planned. When there is a doubt regarding the width of the ala, it may be wise to abandon the idea during a primary rhinoplasty and perform the alar correction as an isolated secondary procedure.

38.5.5.4 Surgical Treatment (Fig. 38.33a, b)

Surgery for the wide ala needs to be sequenced after assessment of the cause; this may be a wide ala demonstrating

1. significant flaring,
2. flaring with increased sill width,
3. rarely isolated increase of sill width and
4. presence of a lateral insertion of ala on the face.

- The treatment of choice for the flaring ala is wedge excision (Weir) (Fig. 38.34), which helps to preserve the natural contour of the ala as well as provide a good camouflage

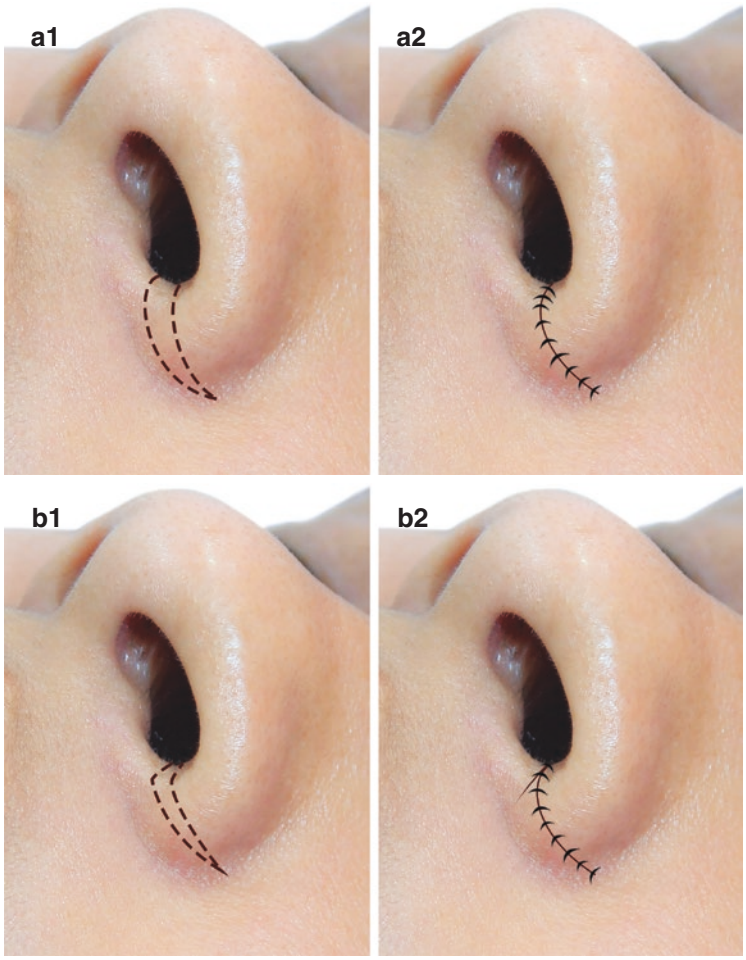

Fig. 38.33 Wide ala surgery techniques. (**a**) Traditional Weir excision (leaves a notch deformity) and (**b**) modified excision incorporating a lateral advancement which prevents notch deformity and restores continuity of alar rim

Fig. 38.34 Wedge technique for alar base reduction

of the scar. A medial flap excision technique as described by Sheen may also be a good alternative to this. The decision regarding medial repositioning of the alar base should be in accordance with Sheen, who recommends it only in cases of extreme lateral divergence.

- When flaring is associated with a wide sill then a wedge with a sill excision may be preferred to correct the deformity. In rare instances an isolated sill excision may be indicated for a problem of increased sill width alone.
- When the nose demonstrates a lateral insertion of the alar base on to the face, then a "V to Y" plasty is performed as described by Bernstein, which helps relocate the alar base medially.

38.5.6 Septal Perforations

Septal perforations are pathological defects in the nasal septum which form communications between the right and the left sides of the nasal cavity. These may present as anterior, mid-septal or posterior perforations (Fig. 38.35a, b).

The most common aetiological factors producing septal perforations are

1. Cocaine misuse
2. Trauma to the face and nose—e.g. NOE fractures
3. Iatrogenic—injudicious septal surgery or poor techniques during septorhinoplasty
4. Self induced—obsessional nasal toileting or habitual nose picking
5. Granulomatous diseases
6. Malignancy

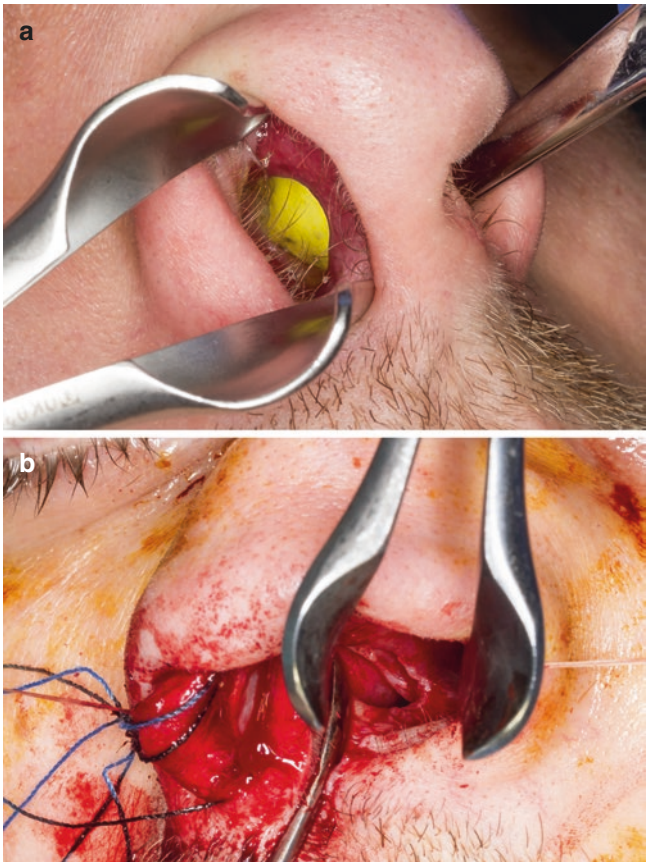

Fig. 38.35 Septal perforation; (**a**) clinical presentation, (**b**) intra-operative picture

38.5.6.1 Clinical Features

The occurrence of septal perforations also leads to a variety of sequelae that produce secondary deformities of not only the nose but also significantly affect the face and the oral structures. The nose may show a saddle deformity, columellar retraction and narrowing of the nasal valve. Furthermore, the loss of nasal cartilage and bony framework may lead to a concertina deformity of the skin envelope. Perforations may expand in an inferior direction with associated necrosis of the vomer and maxillary crest, thus causing a palatal fistula. Other symptoms include nasal airway block, nasal discharge, crusting, epistaxis, midfacial pain, and a characteristic whistling noise.

38.5.6.2 Investigations

Investigations for perforations of the nasal septum include a thorough clinical evaluation of the nasal cavity, oral cavity and the face for accurate diagnosis. The patient is also subjected to a rhinoscopy and a nasendoscopy for assessment of the intra-

nasal deformity. This is followed by a biopsy from the margins of the perforation. A swab may also be performed for culture and sensitivity when there are signs of acute infection of the region.

38.5.6.3 Treatment

Treatment is initiated in a conservative form with counselling, wound care and topical medication. This involves abstinence from cocaine use with rehabilitation under supervised care. Regular inspection of the nasal cavity and nasal toileting with seawater douches. Topical administration of Naseptin cream alternating every 2 weeks with Bactroban (Mupirocin) ointment is mandatory prior to surgical intervention.

Surgical management (Fig. 38.36a, b, c) for septal perforations is extremely challenging and often give disappointing results. Any treatment is bound to be compromised due to resurgence of the cocaine addiction and poor vascular status of the involved anatomy resulting in a high incidence of residual defects after surgery.

There are also risks of total failure of procedures with secondary donor site deformities, adding to the post-surgical morbidity in these patients.

38.5.7 Nasal Valve Problems

To understand the problems associated with the nasal valve, it is important to see the distinction between the "nasal valve area" or the internal nasal valve, the "nasal valve" and the external nasal valve: The nasal valve area is the empty triangular space that is bounded medially by the nasal septum, laterally and superiorly by the caudal margin of the upper lateral cartilage and its attachment to the pyriform rim and inferiorly by the bony nasal floor. The nasal valve specifically denotes the slit that is seen between the caudal end of the upper lateral cartilage and the nasal septum. Physiologically, the internal nasal valve is the area offering the highest resistance to airflow, and any deformities of this region may compromise the air-flow dynamics.

38.5.7.1 Anatomy of the Nasal Valves

The components of internal and external valves are projected in Box 38.10.

The aetiology of nasal valve problems are enumerated in Table 38.4.

Box 38.10. Components of nasal valves

Components of the external nasal valve	Components of the internal nasal valve
• Alar rim and alar side wall • Columella • Caudal septal margin • Nasal sill	• Caudal septum • Caudal margin of the upper lateral cartilage • Floor of the nose • Head of the inferior turbinate

Table 38.4 Etiology of nasal valve problems

External nasal valve	Internal nasal valve
• Inherently weak alar sidewall (collapsing on inspiration) • Caudal septal deflection • Deviated footplate of the medial crus • Narrow/scarred nasal sill • Wide columellar base • Iatrogenic causes (knock-knee deformity of the alar sidewall due to excessive cephalic trim) • Medialisation of lateral crus following domal suture	• Caudal septal deviation • Mid-septal bulge impinging on the upper lateral cartilage • Inferior turbinate hypertrophy • Iatrogenic causes – Misplaced intercartilagenous incisions – Medialisation of the inferior turbinate due to an injudicious lateral osteotomy – Narrowing of the middle vault due to closing of an open roof deformity

Fig. 38.36 (**a**–**c**) Septal perforation surgical technique

38.5.7.2 Clinical Examination of Nasal Valve Problems

It is extremely important to identify the exact location of the nasal obstruction to obtain the best surgical outcomes. This can be accomplished using

1. Clinical testing using "Cottle's sign"
2. Endonasal examination and rhinoscopy
3. Dynamic photographs or video recordings of the "external valve flutter"
4. Air-flow studies using CT scans and computer simulation models

38.5.7.3 Surgical Management

Sequencing of treatment for the management of nasal valve problems should include certain empirical steps. The first step is to perform an optimal septoplasty to relocate the septum to the midline. This is followed by straightening and strengthening of the alar sidewall using alar batten grafts and rim grafts. Narrowing of the columellar base may be performed in cases of true columellar widening. Collapse of the nasal valve can be corrected by the use of spreader grafts that help in widening. In certain cases, there may be webbing or scarring along the nasal valve area. This may need a "Z" plasty for release and correction. Finally, judicious removal of the inferior turbinate may be contemplated in indicated patients after due consultation with the ENT surgeon.

38.6 Complications Following Rhinoplasty

A sequela may be defined as a natural consequence following a disease process or a surgical procedure while a complication implies undesirable sequelae or process following surgery.

This section with dwell on the common sequelae and complications that may occur following rhinoplasty and will help providing tips for reducing or preventing complications.

Common sequelae following rhinoplasty may be tabulated as early and late in Box 38.11.

Box 38.11. Complications of Rhinoplasty

Early sequelae	Late sequelae
Swelling	Infra-orbital discoloration
Bruising	Loss of tip-lobule definition
Paraesthesia	Lateral shortening
Swelling of the tip and supratip area	False "polly-beak" deformity

Most sequelae are self-limiting and may not require any active intervention. However, it is imperative to follow certain steps to minimise or avoid complications as discussed below.

The key to minimising or preventing unfavourable outcomes depends on proper case selection after a thorough evaluation of the patient both physically and psychologically (perceived complaint vs objective deformity). A good clinical examination should follow with optimal documentation (clinical analysis and photographs). The subsequent consultation should include obtaining informed consent from the patients after discussion of the indications and anticipated complications associated with the surgical procedure. It is important to understand our limitations and accept them while not refraining from seeking professional help/support when needed.

Complications in rhinoplasty may depend on the area of surgery and the procedure performed as indicated below:

1. *Complications associated with the nasal dorsum* include loss of dorsal height, concavity or saddle deformity (due to over-resection), residual hump, supratip prominence or a true "polly-beak" deformity due to under-resection. There may be bony or cartilaginous irregularities (inadequate removal). An open roof deformity may present if the nasal bones are not infractured after hump reduction. An incomplete lateral osteotomy may result in a lateral wall step deformity, while medialisation of the upper lateral cartilages may result in an inverted "v" deformity. Another complication is the appearance of a visible dorsal septal edge.
2. *Complication of tip deformities* may present as a "pinched tip" or a "knock-knee" alar deformity (over-resection of the lateral crus). It may also show tip changes like "button-tip" deformity, tip/domal asymmetry, supra-alar concavity or alar retraction. Loss of tip support produces ptosis of the tip, loss of tip projection may produce infratip slip below the anterior septal angle and excess resection of the caudal septum may lead to over-rotation of the tip complex.
3. *Alar base reduction complications* may include narrowing of the nostril circumference, which may contribute to increased nasal airway pressure. The surgery by itself may cause a web scar at the alar-facial junction. It may also result in distortion and secondary deformity of the nose, cheek and lips.
4. *Complications following septal surgery* include failure to straighten, midline deviation, tip deviation secondary to caudal septal displacement and septal collapse leading to a saddle nose deformity. The columella may develop retraction or scarring and rarely necrosis.

   The skin and soft tissue envelope may also show scarring, ischemia/discolouration and at times telangiectasia.

Management of complications may be necessary when the deformity is visible to both the surgeon and the patient. This necessitates revision or secondary surgery which may be indicated in about 5–8% of the patients. Even when indicated, it is better to wait for a year prior to attempting revisions or secondary interventions. This is to facilitate a careful assessment of long-term changes following the procedure and the final outcome prior to intervention.

38.7 Conclusion

Rhinoplasty in most realms is considered as the epitome of aesthetic surgical skill. This burdens the surgeon with the responsibility of performing the surgery with accurate planning and prediction of outcomes. It is also important for both the young surgeon and the patient to understand that the final outcome of the surgery is not in the immediate future but is a culmination of all the surgical manoeuvres and their response over a period of time. This is the same fact that makes rhinoplasty among the most difficult to master. Rhinoplasty has transgressed from the early procedures of sole nasal reduction to encompassing not only the aesthetics of the nasal complex but also improvement of the function and establishing a balance for today's patient. This chapter is aimed to provide the reader with the basics of surgical techniques. Perhaps, this is one surgical skill where the surgeon still holds all the cards while the others are losing the battle to technology.

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