

A thorough understanding of nasal anatomy is essential to successful nasal reconstruction. Addressing deficiencies of the external soft-tissue envelope, nasal framework, and internal mucosal lining is an important part of achieving an optimal aesthetic and functional outcome.

The nose is a highly contoured pyramidal structure situated centrally on the face. It is composed of skin, mucosa, bone, cartilage, and intervening supportive tissue, including fat, muscle, and connective tissue. The aesthetically pleasing nose provides a smooth and natural transition from the eyes to the lips. A distorted or deformed nose attracts attention away from the eyes and the lips, thus disrupting the aesthetic harmony of the face. Functionally, the nose is the gateway to the respiratory system. The nose warms, humidifies, and filters the air while allowing inhaled particles to come into contact with olfactory epithelium. Disruptions of normal nasal anatomy can impair nasal function and lead to complaints of nasal obstruction, nasal drainage, and compromised olfaction.

Topographic Analysis

Assessing the external nose requires an appreciation of the relationship between the nose and the rest of the face. In the frontal view, the face is divided into horizontal thirds. The upper third begins at the trichion and ends at the glabella. The middle third extends from the glabella to the subnasion. The lower third extends from the subnasion to the menton. Nasal height is measured from the radix to the subnasion and should represent 47% of the height of the face from the menton to the radix. In the vertical plane, the face is divided into fifths. Each division equals the horizontal width of a single palpebral aperture. The nasal base, the distance between the alar creases, is ideally equal to the intercanthal distance and represents one-fifth of the facial width. The nose occupies the central third of the face in the horizontal axis and the central fifth in the vertical axis and thus should lie precisely in the midline of the face. On the frontal view, a gentle, curved, unbroken line emanates from the eyebrow and courses along the lateral border of the dorsum to end at

the tip-defining point. Table 2.1 defines common topographic landmarks often referred to during nasal analysis and evaluation.

A number of geometric measures are used in nasal analysis. The nasofrontal angle is the obtuse angle between a line tangent to the glabella and a line tangent to the tip-defining point, or pronasale, with both lines originating at the nasion. This angle should measure between 115° and 130°. The nasofacial angle is the acute angle formed between a line drawn from the nasion to the pronasale and another line drawn from the nasion to the pogonion. The angle usually measures between 30° and 40°. The nasomental angle is the angle between a line extending from the nasion to the pronasale and a line extending from the pronasale to the menton. The nasomental angle usually measures between 120° and 132°. The nasolabial angle is the angle between the columella and upper lip; ideally it measures between 105° and 115° in females and 90° and 105° in males.

The aesthetic proportions of the ideal nasal shape and size have been established. On the lateral view, the distance from the vermilion border of the upper lip to the subnasale is equal to the distance from the subnasale to the pronasale.¹ The distance from the alar facial sulcus to the midpoint of the nares ideally equals that from the midpoint to the caudal border of the nasal tip. On the lateral view, a right-angle triangle with the ratios of its sides being 3:4:5, and the vertices being at the nasion, alar-facial sulcus, and tip has been described to illustrate the ideal nasal proportions and size.² Figure 2.1 illustrates the standard directional nomenclature.

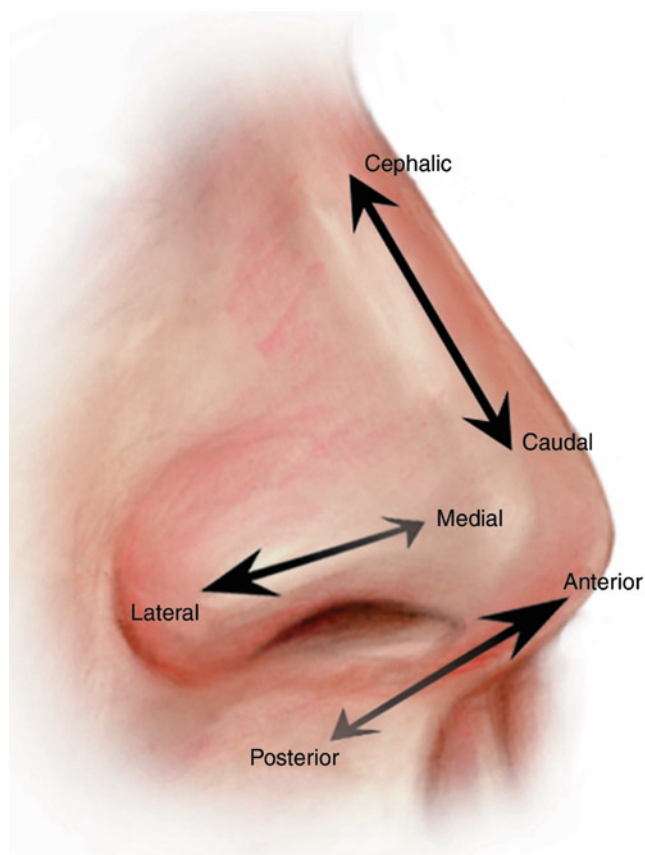
Aesthetic Units

The nose may be divided into aesthetic units by contour lines that mark zones of transition between nasal skin of differing textures and thicknesses.³ The aesthetic units include the nasal dorsum, sidewalls, tip lobule, nasal facets, alae, and columella (Fig. 2.2). These units are highlighted when incident light is cast on the nasal surface, creating shadows along the borders of each unit and topographic landmark.³ The

Table 2.1 Nasal topography

Topographic landmark	Description
Trichion	Superior margin of forehead at frontal hairline
Glabella	Most prominent point in midsagittal plane of forehead
Radix	Continuous curve that descends from the superior brow to lateral nasal wall
Nasion	Depression at root of the nose, corresponds to nasofrontal suture
Sellion	Deepest point of nasofrontal angle, intersection of forehead slope and the proximal bridge
Rhinion	Junction of bony and cartilaginous nasal dorsum
Tip-defining point (pronasalae)	Anterior-most projection of nasal tip, junction of intermediate and lateral crura
Infratip lobule	Located caudal to tip-defining point and cephalic to columellar breakpoint
Columellar breakpoint	Anterior-most point of soft tissue of nasal columella, junction of intermediate and medial crura
Alar groove (supra-alar crease)	Crease located at cephalic border of alar crease)
Alar margin	Margin along nostril rim, located at caudal aspect of ala
Alar facial sulcus	Junctional zone between cheek, upper lip, and alar base, represents lateral continuation of alar groove
Nasal facial sulcus	Junctional zone between sidewall and cheek
Subnasale	Junction of columella and upper lip
Philtrum	Midline depression in upper lip
Mentolabial sulcus	Point of depression between lower lip and chin
Pogonion	Most prominent anterior projection of chin
Menton	Lower border of soft-tissue contour of chin
Gnathion	Point located at junction of line tangent to pogonion and line tangent to menton
Cervical point	Junction of line tangent to anterior margin of neck and line tangent to menton

framework underlying the nasal skin is primarily responsible for these variations in light reflections. Therefore, precise restoration of the framework is important in the reconstruction of the nose so as to avoid contour irregularities and asymmetries. In addition, repair of nasal skin defects with a thin covering flap will help to maintain the definition of aesthetic units and anatomic landmarks.

**Fig. 2.1** Directional nomenclature of the nose

External Nasal Anatomy

The external nose consists of overlying skin, soft tissue, blood vessels, and nerves. Understanding the variations in skin thickness among the various regions of the nose is an essential aspect of reconstructive nasal surgery. Familiarity with the blood supply is a prerequisite to using local flaps for soft-tissue restoration of nasal defects.

Skin

Skin thickness varies widely among individuals and among the aesthetic units in any given individual (see Fig. 2.2). Lessard and Daniel analyzed 60 cadaver dissections and 25 patients undergoing septorhinoplasty and found the average skin thickness to be greatest at the radix (1.25 mm) and least at the rhinion (0.6 mm).⁴ Skin is thinner and more mobile over the dorsum; whereas, it is thicker and more adherent to the underlying nasal framework at the nasal tip and alae (see

Fig. 2.2 (a, b),
Aesthetic units of nose.
Blue represents
thin-skinned regions;
red represents
thicker-skinned regions

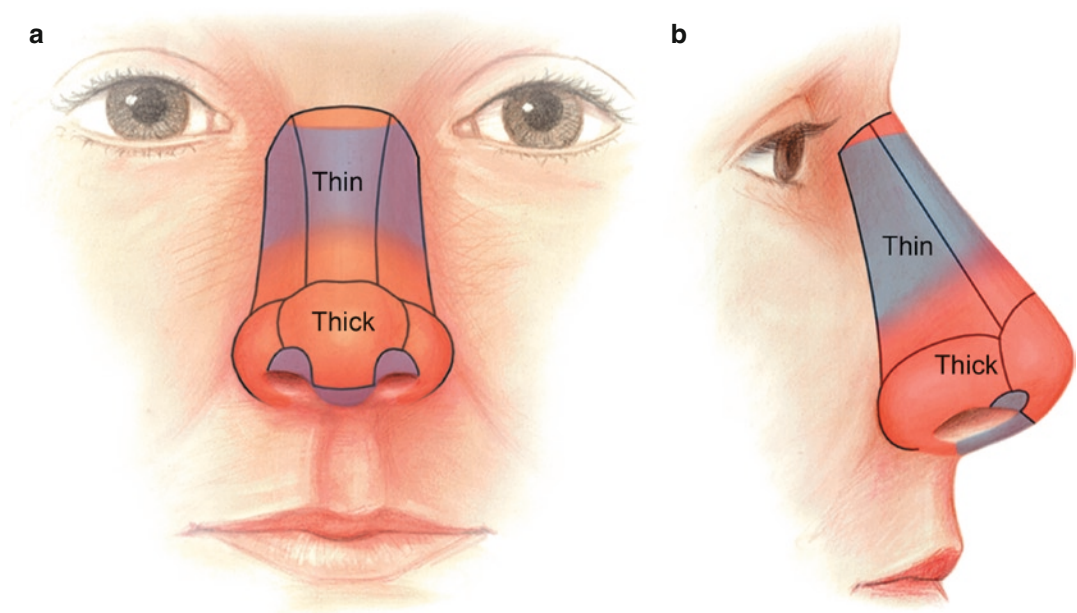


Fig. 2.2). At the cephalic portion of the nasal sidewalls, the skin is thin; however, caudally it becomes thicker in the vicinity of the alar groove. Despite being thicker at the nasal tip, the skin rapidly transitions to being very thin where it covers the nostril margins and columella. The close approximation of the dermis of the skin lining and covering the nasal facets and nostril margins makes these areas especially vulnerable to notching and contour irregularities after reconstruction.

Sebaceous glands are more numerous in the caudal half of the nasal skin. This is especially true in the non-Caucasian nose, which commonly displays a greater amount of subcutaneous fibrous fatty tissue. This dense layer of tissue, often measuring as much as 6 mm thick, obscures the contour of the underlying alar cartilages in the non-Caucasian nose.⁵

Subcutaneous Layer

Four layers compose the soft tissue between the skin and the bony cartilaginous skeleton of the nose: (1) the superficial fatty panniculus, (2) the fibromuscular layer, (3) the deep fatty layer, and (4) the periosteum/perichondrium.⁶ The superficial fatty panniculus is located immediately below the skin and consists of adipose tissue with interlacing vertical fibrous septi running from the deep dermis to the underlying fibromuscular layer. This layer is thicker in the glabellar and supratip areas. The fibromuscular layer contains the nasal musculature and the nasal subcutaneous muscular aponeurotic system (SMAS), which is a continuation of the facial SMAS. Histologically, the nasal SMAS is a distinct sheet of

collagenous bundles that envelops the nasal musculature. The deep fatty layer located between the SMAS and the thin covering of the nasal skeleton contains the major superficial blood vessels and nerves. This layer of loose areolar fat has no fibrous septae; as a result, immediately below it is the preferred plane for undermining nasal skin. The nasal bones and cartilages are covered with periosteum and perichondrium, which provide nutrient blood flow to these tissues, respectively. The periosteum of the nasal bones extends over the upper lateral cartilages and fuses with the periosteum of the piriform process laterally.⁷ Perichondrium covers the nasal cartilages, and dense interwoven fibrous interconnections can be found between the tip cartilages.

Muscles

The nasal musculature has been described and classified by Griesman and Letourneau (Fig. 2.3).^{8,9} The greatest concentration of muscle is located at the junction of the upper lateral and alar cartilages. This allows for muscular dilation and stenting of the nasal valve area. All nasal musculature is innervated by the zygomaticotemporal division of the facial nerve.⁹

The elevator muscles include the procerus, the levator labii superioris alaeque nasi, and the anomalous nasi. These muscles rotate the nasal tip in a cephalic direction and dilate the nostrils. The procerus muscle has a dual origin. The medial fibers originate from the aponeurosis of the transverse nasalis and the periosteum of the nasal bones. The lateral fibers originate from perichondrium of the upper lateral cartilages and

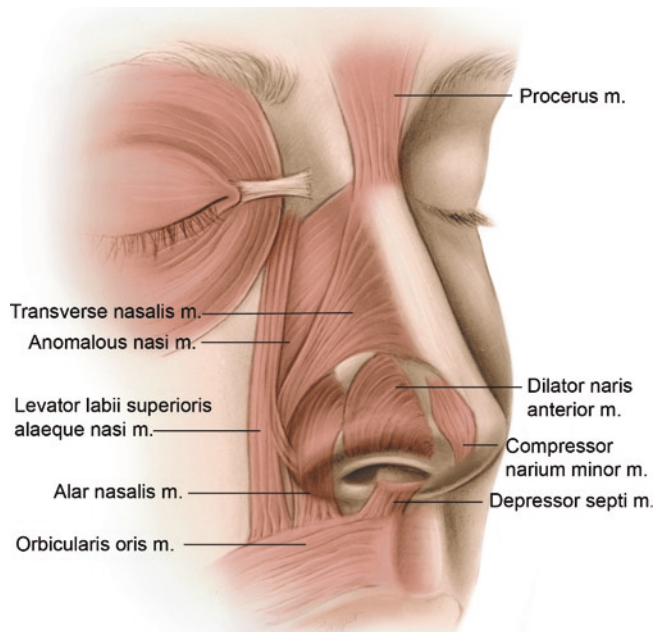


Fig. 2.3 Nasal muscles

the musculature of the upper lip. The procerus inserts into the glabellar skin. The levator labii superioris alaeque nasi originates from the medial part of the orbicularis oculi and frontal process of the maxilla and inserts into the melolabial fold, ala nasi, and skin and muscle of the upper lip. The anomalous nasi originates from the frontal process of the maxilla and inserts into the nasal bone, upper lateral cartilage, procerus, and transverse part of the nasalis.⁹

The depressor muscles of the nose include the alar nasalis and the depressor septi. These muscles lengthen the nose and dilate the nostrils. The alar nasalis originates from the maxilla above the lateral incisor tooth and inserts into the skin along the posterior circumference of the lateral crura. The depressor septi nasi originates from the maxillary periosteum above the central and lateral incisors and inserts into the membranous septum and the footplates of the medial crura. A minor dilator muscle is the dilator naris anterior, a fanlike muscle originating from the upper lateral cartilage and alar portion of the nasalis before inserting into the caudal margin of the lateral crura and the lateral alar skin.⁹

The compressor muscles rotate the nasal tip in a caudal direction and narrow the nostrils. These muscles include the transverse portion of the nasalis and the compressor narium minor. The transverse portion of the nasalis muscle originates from the maxilla above and lateral to the incisor fossa. Fibers from the transverse portion insert into the skin and procerus, and some fibers join the alar portion of the nasalis muscle. The compressor narium minor arises from the anterior part of the lower lateral cartilage and inserts into the skin near the margin of the nostrils.⁹

External Blood Supply

Both the internal and the external carotid arteries contribute to the superficial arterial supply of the nose and adjacent area (Fig. 2.4). The angular artery arises from the facial artery and provides a rich blood supply for the melolabial and subcutaneous hinge flaps used for alar reconstruction. A branch of the angular artery, the lateral nasal artery, supplies the lateral surface of the caudal nose. The lateral nasal artery passes deep to the nose in the sulcus between the ala and cheek and is covered by the levator labii superioris alaeque nasi. The artery branches multiple times to enter the subdermal plexus of the skin covering the nostril and cheek.

The dorsal nasal artery, a branch of the ophthalmic artery, pierces the orbital septum above the medial palpebral ligament and travels along the side of the nose to anastomose with the lateral nasal artery. The dorsal nasal artery provides a rich axial blood supply to the dorsal nasal skin and serves as the main arterial contributor to the dorsal nasal flap (see Chap. 10).

The nostril sill and columellar base are supplied by branches of the superior labial artery. A branch of the superior labial artery, the columellar artery, ascends superficial to the medial crura and is transected by a transcolumellar incision during an external rhinoplasty approach.

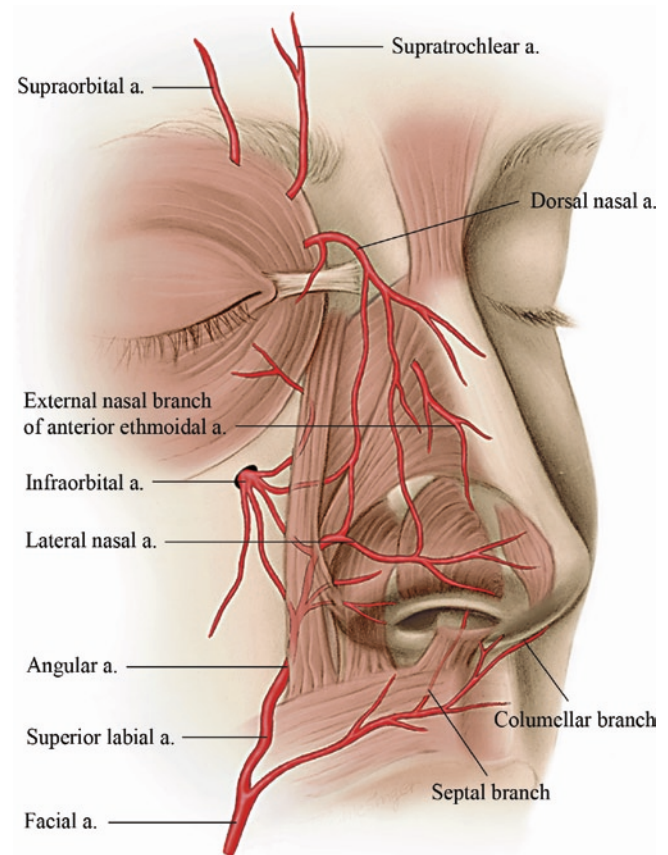


Fig. 2.4 Arterial supply of external nose

The nasal tip is supplied by the external nasal branch of the anterior ethmoidal artery as well as by the columellar artery. The anterior ethmoidal artery, a branch of the ophthalmic artery, pierces bone on the medial wall of the orbit at the point where the lamina papyracea of the ethmoid bone articulates with the orbital portion of the frontal bone (the frontoethmoid suture). The vessel enters the ethmoid sinuses to supply the mucosa and sends branches to the superior aspect of the nasal cavity. The external nasal branch of the anterior ethmoidal artery emerges between the nasal bone and the upper lateral cartilage to supply the skin covering the nasal tip. The blood supply of the nasal tip also receives contributions from the lateral nasal artery, a branch of the angular artery.

The venous drainage of the external nose consists of veins with names that correspond to the associated arteries. These veins drain via the facial vein, the pterygoid plexus, and ophthalmic veins.

External Sensory Nerve Supply

The sensory nerve supply of the nasal skin is by the ophthalmic and maxillary divisions of the fifth cranial nerve (Fig. 2.5). Branches of the supratrochlear and infratrochlear nerves supply the skin covering the radix, the rhinion, and the cephalic portion of the nasal sidewalls. The external nasal branch of the anterior ethmoidal nerve emerges between the nasal bone and the upper lateral cartilage to supply the skin over the caudal half of the nose. This nerve is usually transected by soft-tissue elevation during rhinoplasty. The infraorbital nerve provides sensory branches to the skin of the lateral aspect of the nose.

Nasal Skeletal Anatomy

A thorough understanding of the nasal skeleton is essential for proper reconstruction of the nose. When constructing framework grafts, errors in duplicating normal contour may compromise the repair, leading to contour irregularities and functional limitations. The nasal framework consists of both bony and cartilaginous components (Fig. 2.6).

Nasal Tip

The caudal third of the nose consists of the lobule (tip), columella, vestibules, and alae. It is structurally supported by paired alar (lower lateral) cartilages, the caudal septum, accessory cartilages, and fibrous fatty connective tissue. The

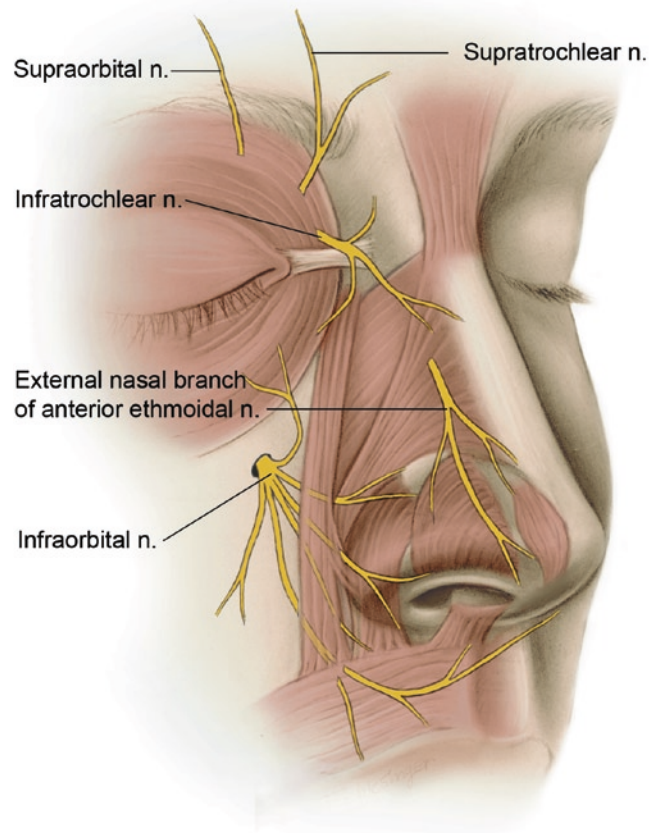


Fig. 2.5 Sensory nerve supply of external nose

variable configuration of the nasal tip depends on the size, shape, orientation, and strength of the alar and septal cartilages and on the quality and thickness of overlying soft tissue and skin. The alar cartilages are attached to the upper lateral cartilages and the septum, and they provide the majority of the support for the tip. The vestibule is bounded medially by the septum and columella and laterally by the alar base. It contains a protruding fold of skin with vibrissae and terminates at the caudal edge of the lateral crus.

The alar cartilage is subdivided into medial, intermediate, and lateral crura (Figs. 2.7 and 2.8). The medial crus consists of the footplate and columellar segments. The footplate is more posterior and accounts for the flared portion of the columellar base. The columellar segment begins at the upper limit of the footplate and joins the intermediate crus at the columellar breakpoint. The breakpoint represents the junction of the tip and the columella. The appearance and projection of the columella are influenced by the configuration of the medial crura as well as that of the caudal septum. Intervening soft tissue between the columellar segments of the medial crura may fill this space; however, in patients with thin skin, the columella may have a bifid appearance. Columellar asymmetries may be secondary to deflections of

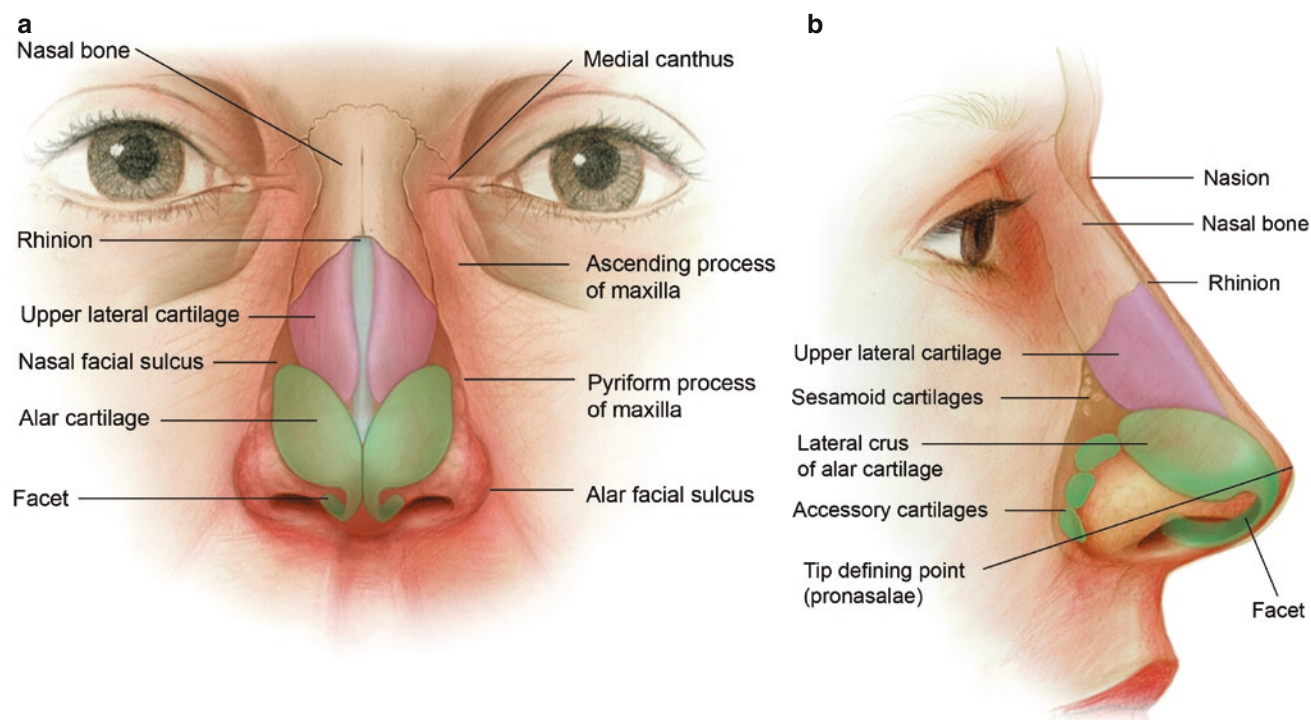


Fig. 2.6 (a, b) Nasal framework and soft-tissue relationships

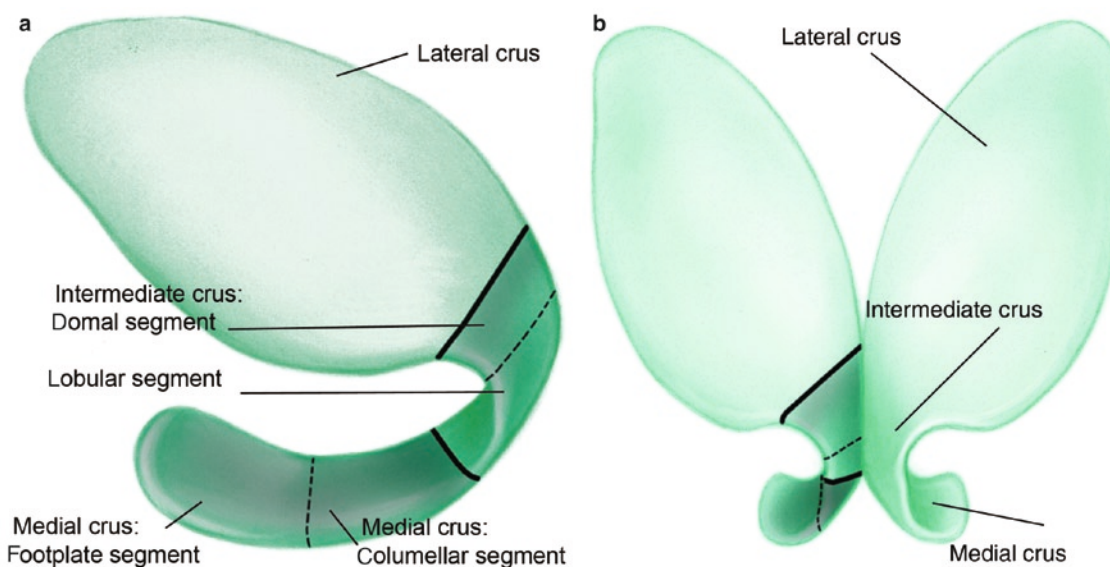


Fig. 2.7 (a) Lateral view of alar cartilage. (b) Frontal view of paired alar cartilages

the caudal septum or intrinsic asymmetries of the alar cartilages. In the aesthetically pleasing nose, the columella is positioned 2–4 mm caudal to the nostril margins, and the shape of the nasal base resembles an equilateral triangle. Attractive nostrils are teardrop-shaped, in the opinion of many.

The intermediate crura consist of a lobular and a domal segment. In the majority of noses, the cephalic borders of the lobular segment are in close approximation, and the caudal margins diverge.¹⁰ The intermediate crura are bound together by the interdomal ligament, and lack of intervening soft tissue may give the tip a bifid appearance. On a lateral view, the

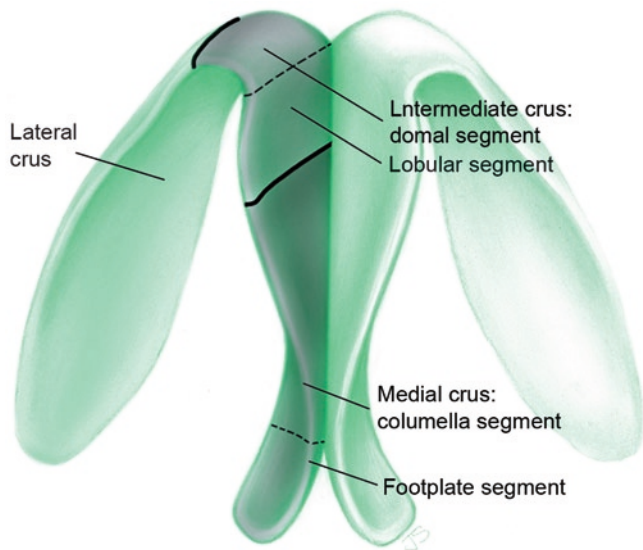


Fig. 2.8 Base view of paired alar cartilages

internal structure responsible for the prominence of the tip-defining point, or pronasale, is the cephalic border of the domal segment of the intermediate crus. Thus, the shape, length, and angulation of the intermediate crura determine the configuration of the infratip lobule and the position of the tip-defining point. The supratip breakpoint is the junction between the intermediate crus and the lateral crus.

The lateral crus is the largest component of the alar cartilage; it provides support to the anterior half of the nostril rim. Resection or weakening of the lateral crus causes a predisposition to nostril retraction and notching, an important consideration during nasal reconstruction. Laterally, small sesamoid cartilages are interconnected by a dense, fibrous connective tissue that is contiguous with the superficial and deep perichondrium of the upper lateral cartilage and lateral crus. Inferolaterally, the ala contains fat and fibrous connective tissue but no cartilage. The shape and resiliency of the nostril depend on the dense, fibrous, fatty connective tissue located within the confines of the ala, and the integrity of this area should be restored with cartilage grafting when necessary.

Cartilaginous Dorsum

The cartilaginous dorsum consists of paired upper lateral cartilages and the cartilaginous septum (see Fig. 2.6). The upper lateral cartilages are overlapped superiorly by the bony framework for a variable distance. The free caudal border of the nasal bones has fibrous connections to the cephalic margin of the upper lateral cartilages. The cephalic two-thirds of the cartilaginous dorsum is a single cartilaginous unit. However, caudally, there is gradual separation of the upper lateral cartilages from the septum. The lateral borders of the

upper lateral cartilages are rectangular in shape and are connected to the piriform aperture by an aponeurosis.¹⁰ The lateral border of the upper lateral cartilage creates a space known as the external lateral triangle. This space is defined by the lateral border of the upper lateral cartilage, the extreme lateral portion of the lateral crus, and the border of the piriform fossa. The space is lined by mucosa and covered by the transverse portion of the nasalis muscle. It may contain accessory cartilages and fibrous fatty tissue that contribute to the lateral aspect of the internal nasal valve. Nasal obstruction may occur as a result of medialization of this space by scar tissue or cartilage grafts used in nasal reconstruction.

Bony Dorsum

The bony dorsum consists of paired nasal bones and paired frontal processes of the maxillae (see Fig. 2.6). The bony vault is pyramidal in shape, and the narrowest part is at the level of the intercanthal line. The bony dorsum is divided approximately in half by the intercanthal line, and the nasal bones are much thicker above this level.¹¹ The sellion is the deepest portion of the curve of soft tissue between the glabella and nasal dorsum, and it marks the level of the nasofrontal suture line. The nasion is approximately at the level of the supratarsal fold of the upper eyelid. Laterally, the nasal bones articulate with the frontal processes of the maxillae.

Internal Nasal Anatomy

Reconstruction of full-thickness defects of the nose requires restoration of the external skin, the nasal framework, and the internal nasal lining. Failure to address deficiencies in nasal lining may lead to postoperative scarring contracture, and functional compromise. A brief description of the internal nasal anatomy pertinent to nasal reconstruction follows.

Nasal Cavities

The nose is the gateway to the respiratory system. Partitioned by the septum, the nose provides two independent passages between the nostrils and the nasopharynx. Each passage is lined circumferentially with ciliated pseudostratified columnar epithelium. The nasal cavities begin at the limen nasi, which is the junction between the vestibule, lined with squamous epithelium, and the nasal cavities, lined with respiratory epithelium.

Along the lateral aspect of the nasal passages, the turbinates create a complex of mucosally lined peaks and

valleys into which drain the ostia of the paranasal sinuses and the nasolacrimal duct. The superior aspect of the hard palate creates the floor of each nasal passage. The nasal roof is the underside of the nasal pyramid; it increases in vertical height anteroposteriorly from the nostril to the skull base. From this point, it decreases in height as it extends posteriorly along the face of the sphenoid to the choanal opening of the nasopharynx. The narrowest portion of each nasal passage is at the caudal margin of the upper lateral cartilage, an area referred to as the internal nasal valve.

Septum

The septum is constructed of bone posteriorly and cartilage anteriorly. The perpendicular plate of the ethmoid bone forms the bony septum. The cartilaginous septum is a flat plate of cartilage with an irregular quadrilateral shape that articulates with the perpendicular plate of the ethmoid bone, the vomer, and the premaxilla (Fig. 2.9). At the caudal septum, three angles are identified. The anterior septal angle can be palpated by depressing the nasal supratip area. The posterior septal angle is found just above the nasal spine articulation near the lip/nose junction. A midseptal angle is located halfway between

the anterior and the posterior septal angles. It is common practice to harvest septal cartilage for use as a cartilage graft in nasal reconstruction. The septum provides support to the nasal dorsum and tip, and a supporting L-shaped strut of caudal and dorsal septum should be preserved to maintain this support.

The cartilaginous septum is covered on both sides by a thin but highly vascular layer of mucoperichondrium. An ideal plane of dissection is located between it and the cartilage. The septal cartilage is, however, dependent on the lining of the mucoperichondrium for its blood supply, and septal cartilage lacking mucoperichondrium on both sides will eventually undergo necrosis. When mucoperichondrium is present on one side of the septal cartilage, the cartilage is likely to survive.

The blood supply to the septum consists of the septal branch of the superior labial artery, branches of the anterior and posterior ethmoidal arteries, and the posterior septal branch of the sphenopalatine artery (Fig. 2.10). Arising from the facial artery, the superior labial artery travels through the orbicularis oris at the level of the vermilion border roll. Lateral to the philtrum and columella, it gives off a septal branch that passes almost vertically upward and enters the nasal septum lateral to the nasal spine. It may travel on the cartilaginous septum as a discrete vessel before finally dispersing into the anterior septal vascular plexus. Given this arterial supply, a flap of septal mucoperichondrium can

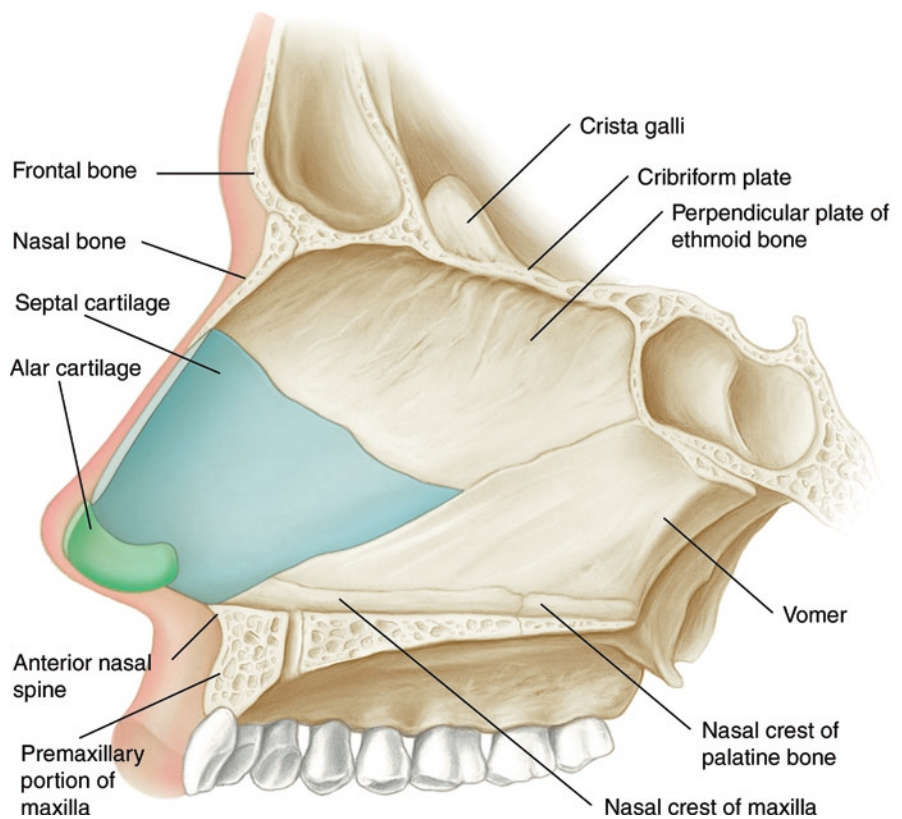
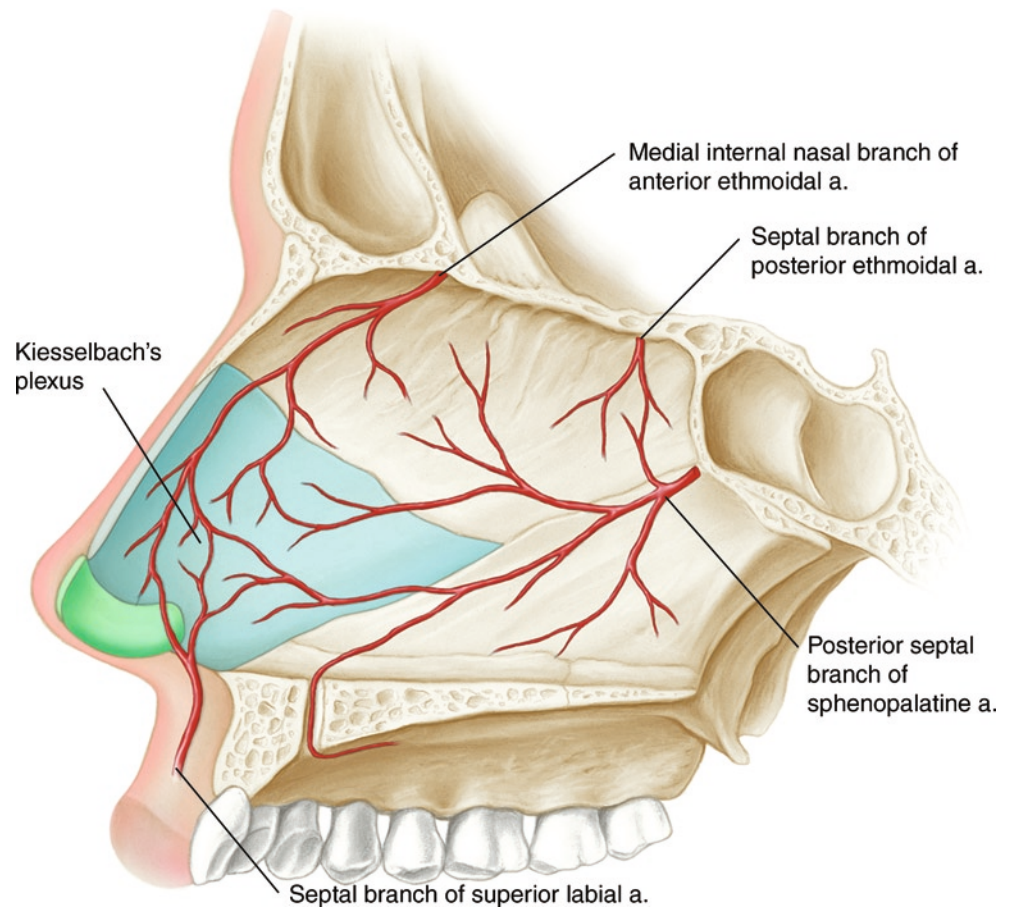


Fig. 2.9 Lateral view of left nasal septum

Fig. 2.10 Arterial blood supply of left nasal septum



survive based on a 1.3 cm pedicle located in the area between the anterior plane of the upper lip and the lower border of the pyriform aperture. This hinged mucoperichondrial flap may extend from the nasal floor superiorly to the level of the medial canthus and posteriorly to beyond the junction of the cartilaginous septum and the bony septum. Septal flaps based on the septal branch of the superior labial artery may be used to line full-thickness ipsilateral lower nasal vault defects.¹² Dorsally based septal flaps supplied by branches of the anterior and posterior ethmoidal arteries may be used to line full thickness defects of the contralateral nasal sidewalls.

Lateral Nasal Passage

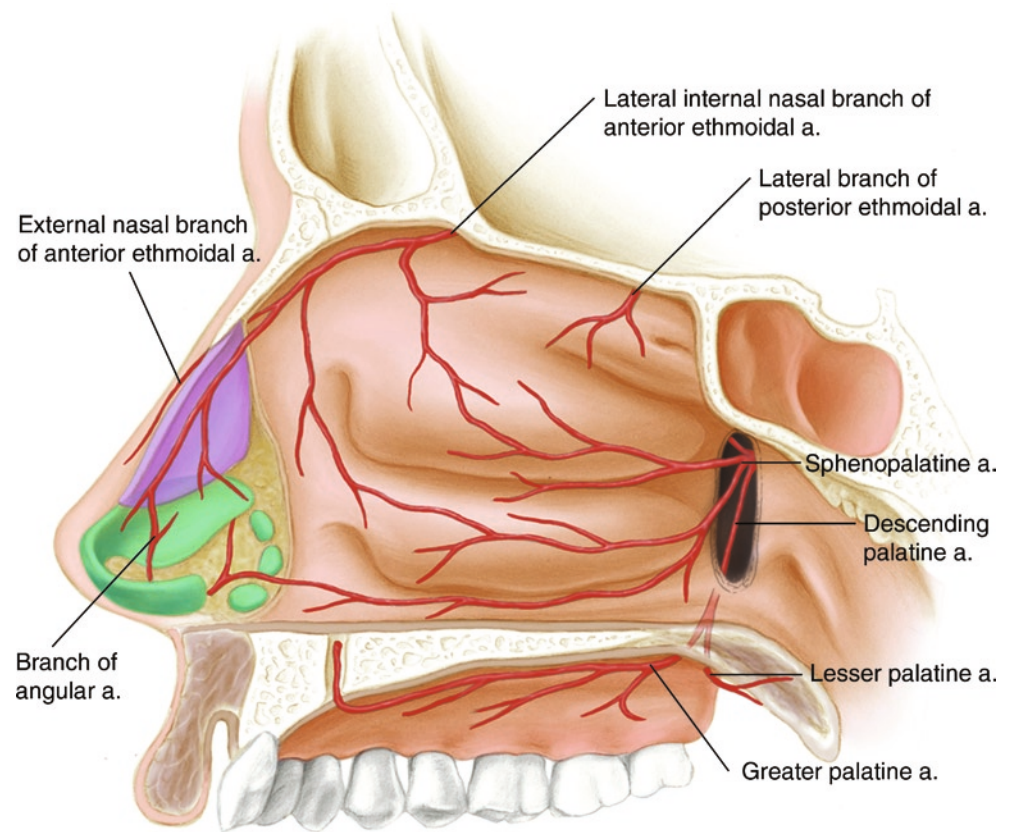
The lateral wall of the nasal cavity contains three turbinates: superior, middle, and inferior. The turbinates are scrolls of bone covered by mucosa. Mucoperiosteal flaps from the

inferior and middle turbinates may be used to repair small nasal lining defects. The blood supply to the lateral nasal passage is derived from branches of the anterior and posterior ethmoidal arteries, the angular artery, and the sphenopalatine artery (Fig. 2.11).

Nasal Valve

The internal nasal valve is the cross-sectional area bordered by the septum and the caudal margin of the inferior turbinate and the upper lateral cartilage. This area may be compromised during tumor resection by the removal or weakening of its structural components. In addition, scar contracture resulting from nasal reconstruction may contribute to partial valve collapse unless preventive measures are performed at the time of surgery. If valve compromise is anticipated, structural cartilage grafts are employed to reinforce the valve.

Fig. 2.11 Arterial blood supply of right lateral wall of nasal cavity



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