Dallas Rhinoplasty

Nasal Surgery by the Masters

Fourth Edition

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To my amazing parents, Katherine and Claude Rohrich, for sacrificing everything to make their children's lives better and for instilling my work ethic and focus at an early age.

To my wife for always being there for me and supporting me in all my lifelong academic ventures.

To my great children, Taylor and Rachel, who constantly bring me joy and reenforce why we are here on earth—to give back and leave this world a better place.

To my coeditors, Jamil, for always being there to finish the job and doing it first class, and Bill, who has been a lifelong friend and colleague since the first edition of this amazing book.

And to the late Jack P. Gunter, for always guiding us to do things right in both rhinoplasty and life and for being such an unparalleled role model. He made all of us better rhinoplasty surgeons by always seeking to be better each and every day.

Rod J. Rohrich, MD, FACS

To my beautiful wife, Agnete: Thank you for your love, friendship, and encouragement that make this journey meaningful.

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Jamil Ahmad, MD, FRCSC

To Jennifer, Luke, and Brooke and all those who keep it Full Throttle!

William P. Adams, Jr., MD

Contents

Preface

The first Dallas Rhinoplasty Symposium was held in 1984. Having trained in both otolaryngology and plastic surgery, Dr. Jack P. Gunter astutely recognized a need for true rhinoplasty education and an exchange of ideas to further knowledge about this complex surgery. He was among the first to champion the open approach, and to teach the principles and the art of rhinoplasty to plastic surgery and otolaryngology trainees, as well as practicing surgeons. Dr. Gunter organized the first symposium and has been an integral part of its growth and evolution into one of the most popular aesthetic plastic surgery meetings. The Dallas Rhinoplasty Symposium has evolved to include didactic lectures, panel discussions, case presentations, surgical video demonstrations, and the anatomy dissection laboratory.

Although attendance has grown dramatically over 40 years, Dallas Rhinoplasty continues to offer an intimate and interactive atmosphere where attendees and the experts in rhinoplasty have the chance to interact and discuss strategies and approaches for rhinoplasty surgery. Now in its 41st year, Dallas Rhinoplasty has hosted all the preeminent contributing rhinoplasty surgeons globally and has served as a catalyst to expand, innovate, and inspire the interest of young plastic surgeons and otolaryngologists with aspirations to develop the necessary knowledge and skillset to perform this complex yet fascinating surgery in a more consistent manner with excellent outcomes. I know that Dr. Gunter would be very proud of his amazing foresight and what he did to truly advance the art and science of rhinoplasty today.

In 2002, the first edition of *Dallas Rhinoplasty: Nasal Surgery by the Masters* was published to compile the knowledge and concepts that had been, in large part, developed by the faculty who had attended the Dallas Rhinoplasty Symposium. A second edition followed in 2007, with updates to existing chapters and new chapters covering the latest advances in rhinoplasty. The second and third editions included much enhanced video content, demonstrating anatomy dissections and surgical technique to enrich the multimedia experience for the user. In this fourth edition, 9 years later, we have completely updated the entire book with more concise video-rich concepts and key points for ease of reading and grasping of essential concepts. We have deleted old content and added numerous new chapters providing practical, new, and innovative approaches to key rhinoplasty concepts. We have focused on ideas and innovations that have been introduced over the recent years and have quickly become accepted and practiced including preservation rhinoplasty.

We have significantly improved the multimedia experience with greatly expanded video content and online access to these materials. Throughout the book, we present information in a clear and concise manner so that both novice and expert rhinoplasty surgeons will find this book an efficient and easy-to-use resource.

Although this book has grown as knowledge in our field has expanded, our objectives remain the same: to assist the nasal surgeon in attaining consistent results using careful preoperative analysis, precise operative planning, meticulous intraoperative execution, and long-term follow-up with critical evaluation of results.

It is our sincere hope that this amazing fourth edition of *Dallas Rhinoplasty: Nasal Surgery by the Masters* will continue to be a key resource for all rhinoplasty surgeons globally with an interest in becoming experts, teachers, and masters in rhinoplasty.

Rod J. Rohrich, MD, FACS
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Acknowledgments

The fourth edition of *Dallas Rhinoplasty: Nasal Surgery by the Masters* is truly a work of art and an amazing cooperative effort by many focused on excellence with one common goal—delivering the best book on modern rhinoplasty globally. We gratefully acknowledge all our incredible authors and Dr. Rohrich's superb Aesthetic Fellows, Drs. Matthew Novak and Roger Cason, for all their arduous work and effort to make this book the best of the best. We also thank the team at Thieme, who stood by our side to get this book done in a timely and efficient manner. Of course, our amazing task master and superb development editor, Judith Tomat, is simply the best of the best in what she does day and night to keep us on track and always moving forward. Judith is simply remarkable and totally indispensable in all she has done for us. Her tireless dedication and attention to detail are what make the difference between a medical textbook and a work of art that can be enjoyed by the reader.

We are grateful to the contributing authors who willingly gave of their time, talent, and knowledge to make this edition the best yet. We would like to thank the entire staff; Angela Martinez, Dr. Rohrich's office manager; and special thanks to Patricia Aitson whose expertise in photography, video, and graphic design is seen in many of our publications. We gratefully thank Diane Sinn, senior administrator to Dr. Rohrich for more than 34 years, whose tireless efforts and dedication have made all of us more focused and efficient so we could produce this remarkable book.

We are grateful to all the visiting surgeons who have participated as faculty for the Dallas Rhinoplasty Symposium over the past 40 years; your ideas and innovations have heavily influenced the evolution of *Dallas Rhinoplasty: Nasal Surgery by the Masters.*

We owe a tremendous debt of gratitude to the late Dr. Jack P. Gunter, Editor Emeritus of Dallas Rhinoplasty and Founder of our great global meeting, Dallas Rhinoplasty Symposium.

Dr. Gunter was instrumental in the evolution of rhinoplasty techniques and the dissemination of knowledge about this complex surgery. He was the driving force behind the annual Dallas Rhinoplasty Symposium. Over the past 40 years, the Symposium has become one of the most popular aesthetic plastic surgery meetings. Dr. Gunter's omnipotent presence and great sense of humor are a fundamental part of what makes the Symposium an excellent educational experience and so enjoyable to attend. Dr. Gunter provided a key impetus behind this textbook and brought the first edition to fruition in 2002. Since then, *Dallas Rhinoplasty: Nasal Surgery by the Masters* has become a global educational staple in rhinoplasty and has enjoyed great popularity among surgeons of all levels interested in learning more about rhinoplasty. Dr. Gunter's endless contributions to nasal surgery have elevated the standard of this surgery to a new stratosphere, ultimately to the benefit of patients and surgeons alike.

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Part I

Basic Perioperative Concepts

1 Preferred Anatomic Terms for Rhinoplasty

Rod J. Rohrich, Matthew Novak, and Jamil Ahmad

Abstract

Precise and universally understood terminology is essential for clear communication in any field. Rhinoplasty surgeons have individually developed and defined a variety of terms to use in nasal analysis and to describe their anatomic findings. As the field of rhinoplasty evolves and advances, new terminology is introduced, and certain terms fall out of favor. A comprehensive list of anatomical terms and definitions derived from and used by the leading educators of the present generation of rhinoplasty surgeons has been provided. We hope the terminology will provide a standardized and universal vocabulary for rhinoplasty surgeons.

Keywords: Rhinoplasty, terminology, anatomy

Key Points

- As rhinoplasty techniques evolve and advance, so does the terminology.
- Standardized terminology is paramount for clear and efficient communication among rhinoplasty surgeons.

1.1 Introduction

Over the past 40 years, the Dallas Rhinoplasty Symposium has hosted preeminent rhinoplasty surgeons providing a forum for regular exchange of ideas and innovations. Following is a comprehensive list of anatomical terms and definitions derived from and used by the leading educators of the present generation of rhinoplasty surgeons. We hope the following terminology will provide a standardized and universal vocabulary for rhinoplasty surgeons.

1.2 Anatomic Terms

- ***Accessory cartilages***: Cartilages connecting the lateral ends of the lateral crura to the piriform aperture edge (▶ Fig. 1.1a, b).
- ***Alae***: The lateral wings. The rounded eminence forming the lateral nostril wall that extends from the tip medially to the nasolabial fold laterally and from the nasal sidewall superiorly to the alar rim inferiorly.
- ***Alar base***: The point at which the ala meets the cheek.
- ***Alar flare***: Transverse distance between the alar base (point at which the ala meets the cheek) and lateral-most point of the alar rim.
- ***Alar groove***: The external oblique skin depression that follows the caudal margin of the lateral crus as it leaves the alar rim to run in a more cephalic direction. It separates the tip superomedially from the thickened portion of the ala inferolaterally and joins the face at the superior cheek–lip junction.
- ***Alar rim***: The inferior free edge of the ala that extends from the tip medially to the nasolabial fold laterally.
- ***Anatomic dome***: Junction of the medial and lateral crura, also known as the *middle crus*.
- ***Anterior nasal spine***: Protrusion of the maxilla at the base of the nose.
- ***Anterior septal angle***: The anterior edge of the cartilaginous septum at the juncture of the dorsal and caudal cartilaginous septum (▶ Fig. 1.2).
- ***Blocking point***: Anatomic points of resistance encountered in dorsal preservation rhinoplasty.
- ***Bony vault***: The superior third of the nose comprising the nasal bones, frontal processes of the maxilla, and nasal processes of the frontal bone.
- ***Caudal***: Means the same as inferior when referring to the nose.
- ***Caudal septum***: Free inferior border of the septum.

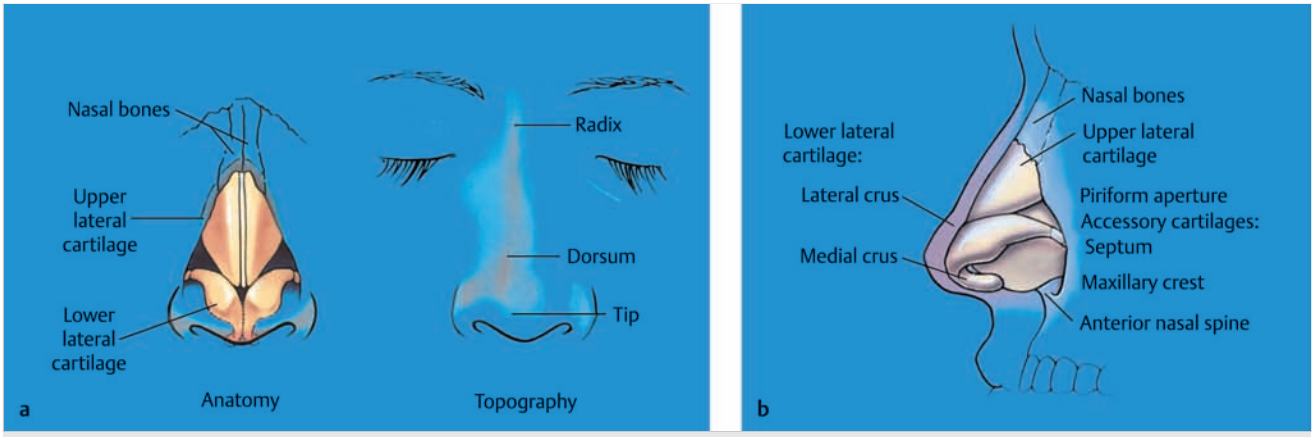

Fig. 1.1 (a, b) Accessory cartilages. The accessory cartilages of the nose connect the lateral ends of the lateral crura to the piriform aperture edge.

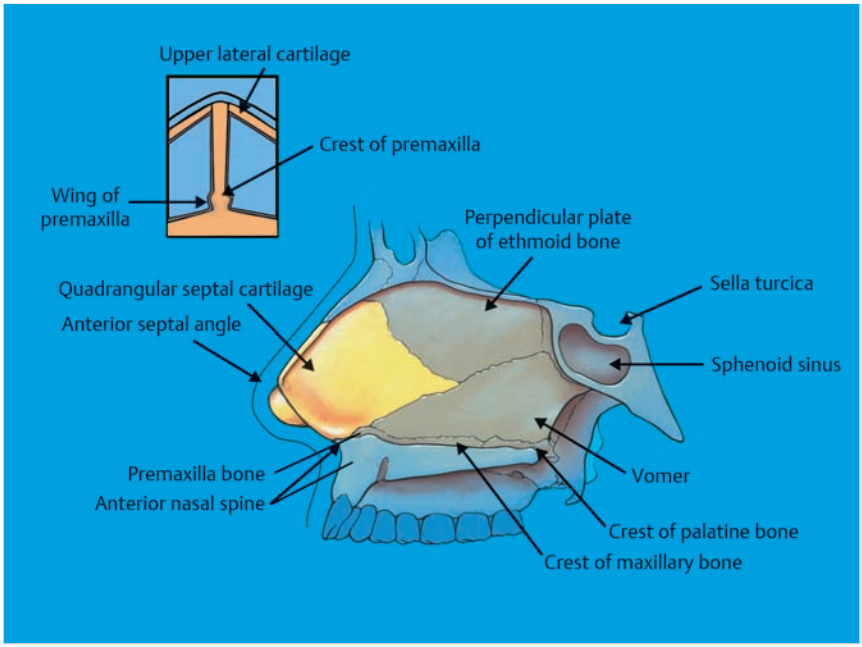

Fig. 1.2 Anterior septal angle. The anterior edge of the cartilaginous septum is located at the juncture of the dorsal and caudal cartilaginous septum.

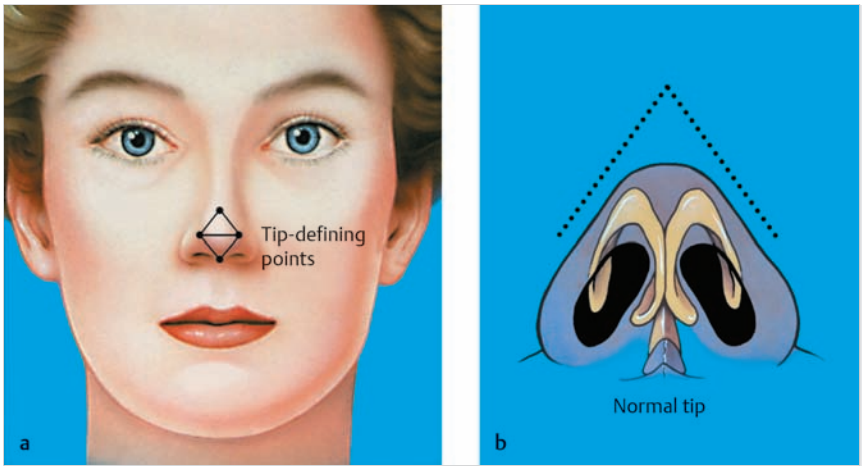

Fig. 1.3 (a, b) Clinical dome. The clinical dome is the anterior-most projecting portion of the lower lateral cartilage of the nose. The external projection of the dome is the tip-defining point.

- ***Cephalic***: Means the same as superior when referring to the nose.
- ***Clinical dome***: The anterior-most projecting portion of the lower lateral cartilage. The external projection of the dome is the tip-defining point (▶ Fig. 1.3).
- ***Columella***: The column at the base of the nose separating the nostrils and connecting the tip to the upper lip.
- ***Columellar–lobular angle***: The angle formed by the junction of the columella with the infratip lobule (see ▶ Fig. 1.4).
- ***Dorsal***: Means anterosuperior, in the direction of the nasal dorsum, when referring to the nose.
- ***Dorsal aesthetic lines***: Bilateral light reflexes from the medial aspects of the brow that proceed along the dorsum to the tip.
- ***Dorsum of the nose***: The portion where the lateral surfaces of the upper two-thirds of the nose join in the midline; located between the radix superiorly, the tip inferiorly, and the bilateral nasal sidewalls laterally.
- ***External nasal valve***: External opening of the nostril bordered by the columella medially, soft triangle anteriorly, alar rim laterally, and upper lip posteriorly (▶ Fig. 1.5a, b).

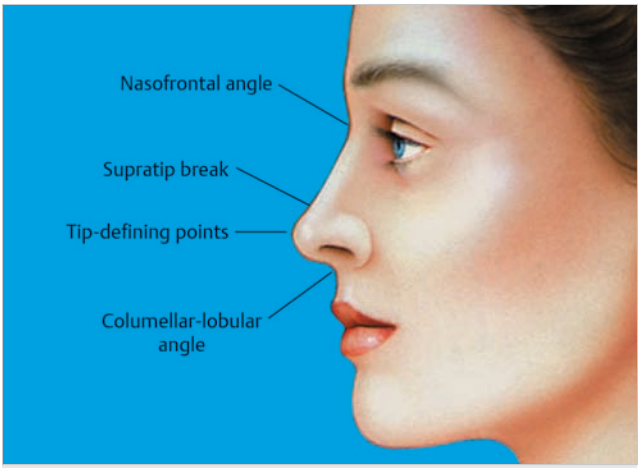

Fig. 1.4 Columellar–lobular angle. The columellar–lobular angle is formed by the junction of the columella with the infratip lobule.

- ***Hemitransfixion incision*:** An incision through the vestibular skin on one side of the membranous septum.
- ***Infracartilaginous (marginal) incision*:** An incision of varying length along the caudal border of the medial, middle, and lateral crus (▶ Fig. 1.6a–d).
- ***Infratip lobule*:** The portion of the lobule between the tip-defining points and the columellar–lobular angle.
- ***Intercartilaginous incision*:** An incision placed just on the lower lateral cartilage side of the junction of the upper lateral cartilage with the lateral crus of the lower lateral cartilage.

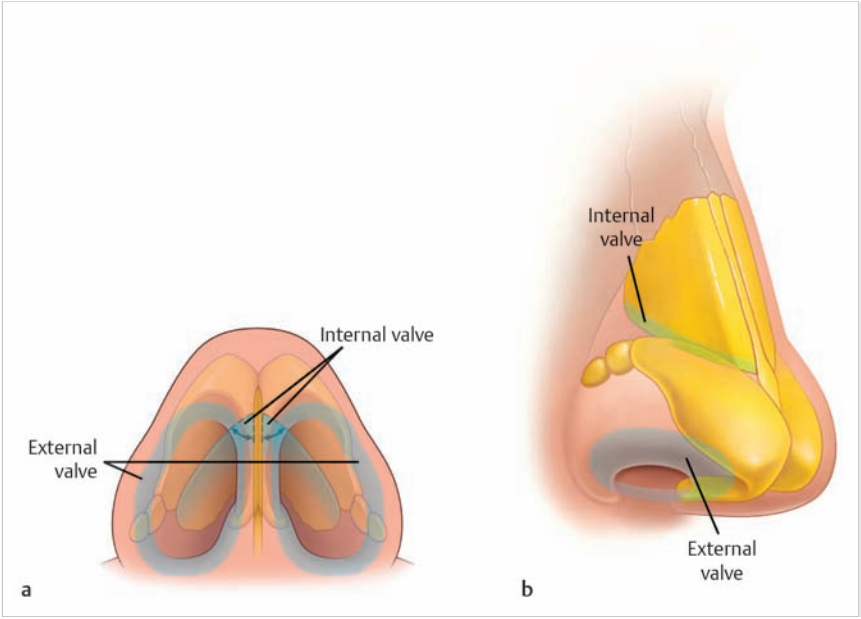

Fig. 1.5 (a, b) External nasal valve. The external opening of the nostril is bordered by the columella medially, the soft triangle anteriorly, the alar rim laterally, and the upper lip posteriorly.

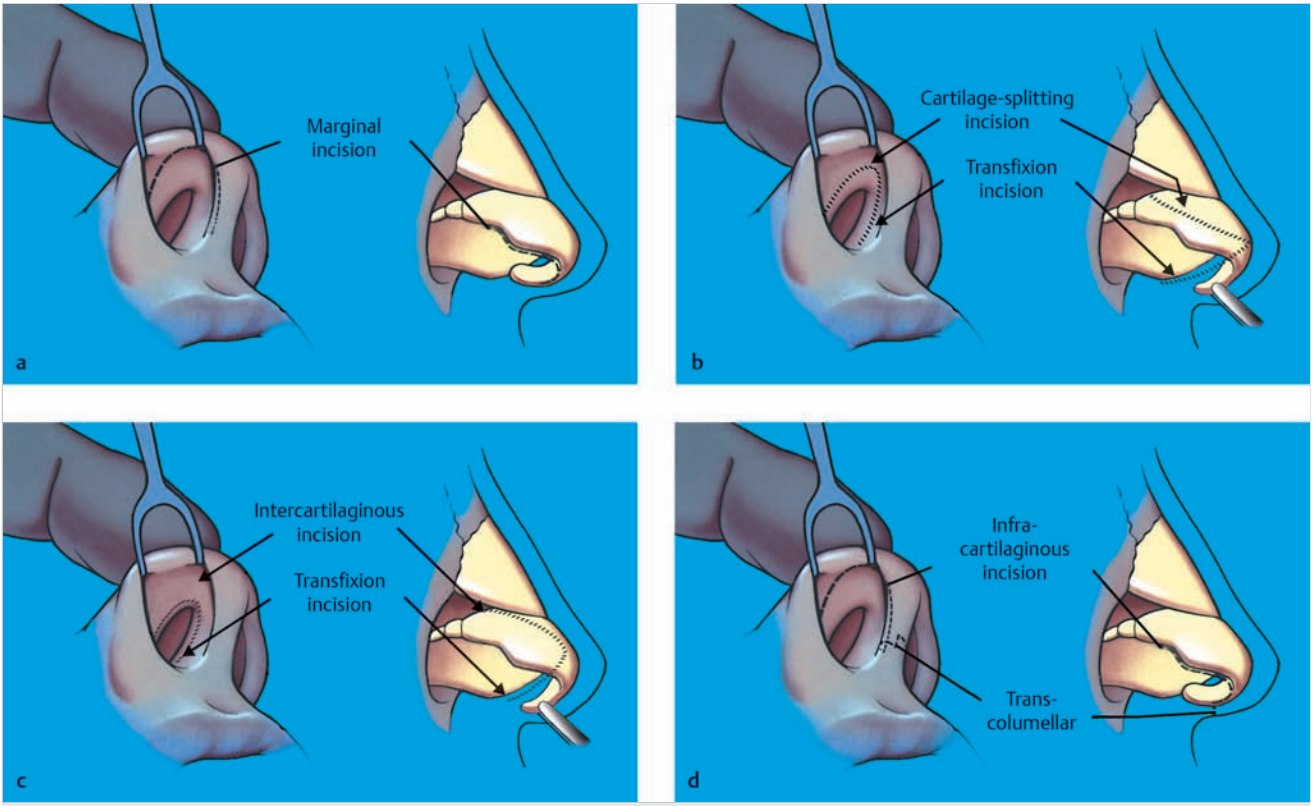

Fig. 1.6 (a–d) Infracartilaginous (marginal) incision. The infracartilaginous incision is made along the caudal border of the medial, middle, and lateral crus. It can be of varying length.

- ***Intercrural ligament*:** Connects the cephalic border of the entire lower lateral cartilages including the lateral, middle, and medial crura.
- ***Interdomal ligament*:** Connects the two middle crura of the lower lateral cartilages.
- ***Internal nasal valve*:** The area of the junction of the caudal edge of the upper lateral cartilage with the nasal septum.
- ***Intracartilaginous (cartilage-splitting) incision*:** An incision extending medial to lateral through the lateral crus separating the lateral crus into a superior and an inferior portion.
- ***Keystone area*:** Junction of the perpendicular plate of the ethmoid with the septal cartilage, nasal bones, and upper lateral cartilages at the dorsum of the nose (▶ Fig. 1.7).
- ***Lateral crus*:** The portion of the lower lateral cartilage extending from the anatomic dome medially to the accessory cartilages laterally.
- ***Limen vestibule*:** Line of the vestibule; junction of vestibular skin with nasal mucosa; line of junction of the cephalic margin of the lateral crus of the lower lateral cartilage with the caudal edge of the upper lateral cartilage.
- ***Lower cartilaginous vault*:** The lower third of the nose comprised of the paired lower lateral cartilages.
- ***Lower lateral cartilages*:** The paired inferior nasal cartilages consisting of the medial, middle, and lateral crura.
- ***Medial crus*:** The portion of the lower lateral cartilage extending from the upper lip posteriorly to the anatomic dome anteriorly.
- ***Middle crus*:** The portion of the lower lateral cartilage that forms the anatomic dome extending from the medial crus to the lateral crus.
- ***Naris*:** Nostril.
- ***Nasal lobule*:** The lower part of the nose bounded by the anterior nostril edge posteroinferiorly, the supratip area superiorly, and the alar grooves laterally.
- ***Nasal pyramid*:** The bony portion of the nose made up of the nasal bone bilaterally and frontal process of the maxilla.
- ***Nasal septum*:** Divides the nasal passage into two cavities. It consists of bony (perpendicular plate of ethmoid, vomer, and premaxillary crest), cartilaginous (quadrangular), and membranous portions.
- ***Nasal sidewall*:** The lateral surfaces of the upper two-thirds of the nose located between the dorsum medially, cheek laterally, and alae inferiorly.
- ***Nasofrontal angle*:** Angle of demarcation between the forehead and nasal dorsum; best seen on lateral view.
- ***Nasolabial angle*:** Angle seen on lateral view formed by a line drawn through the most anterior to the most posterior points of the nostril intersecting the vertical facial plane. The desired angle is 90 to 95 degrees in males and 95 to 110 degrees in females (▶ Fig. 1.8).
- ***Natural horizontal facial plane*:** A horizontal line extending through the lateral facial profile with the head in a normal relaxed position with the eyes looking straight ahead.
- ***Nostril sill*:** Soft tissue bounded superiorly by the naris and inferiorly by the cutaneous upper lip.
- ***Periapical hypoplasia*:** Maxillary bone or soft tissue deficiency at the inferior piriform aperture, most evident on the frontal and basal views of the nose.
- ***Piriform aperture*:** The pear-shaped external bony opening of the nasal cavity.
- ***Pitanguy's midline ligament*:** Part of the midline superficial musculoaponeurotic system (SMAS) that originates on the undersurface of the dermis at the supratip and divides into "superficial" and "deep" portions in relation to the interdomal ligament. The superficial portion becomes continuous with the superficial orbicularis oris nasalis and "deep portion" becomes continuous with the depressor septi nasalis (▶ Fig. 1.9).
- ***Radix*:** Junction between the frontal bone and the dorsum of the nose.
- ***Rim incision*:** An incision placed just within the vestibular edge of the rim of the naris.
- ***Scroll area*:** Area of recurvature of the lateral crus of the lower lateral cartilage at its junction with the upper lateral cartilage.
- ***Scroll ligament*:** Longitudinal fibrous attachment in the scroll area between the cephalic border of the lower

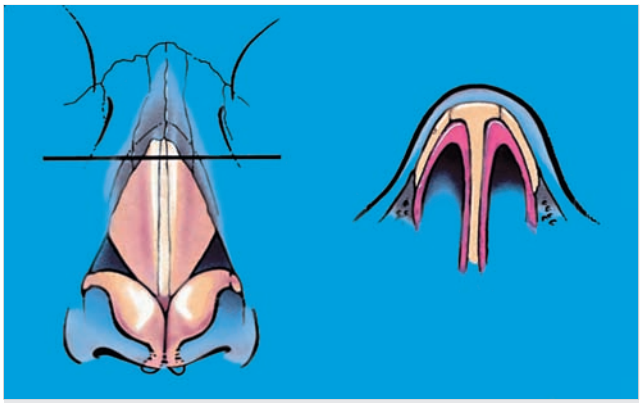

Fig. 1.7 Keystone area. The keystone area is found at the junction of the perpendicular plate of the ethmoid with the septal cartilage, the nasal bones, and the upper lateral cartilages at the dorsum of the nose.

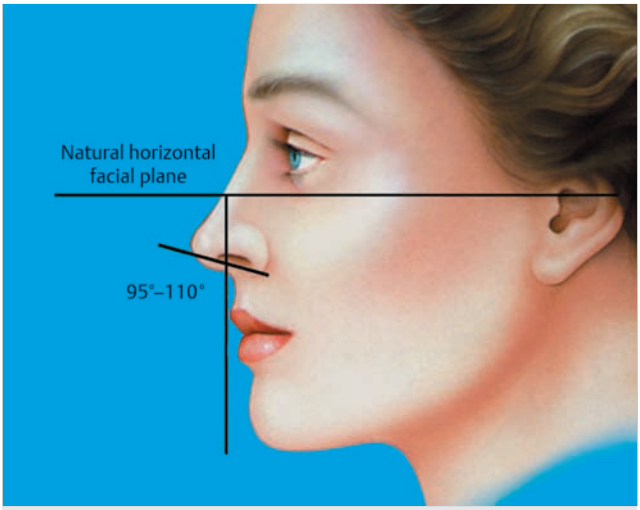

Fig. 1.8 Nasolabial angle. The nasolabial angle is seen on the lateral view. It is formed by a line drawn through the most anterior and posterior points of the nostril that also intersects the vertical facial plane. The desired angle in males is 90 to 95 degrees; in females, it is 95 to 110 degrees.

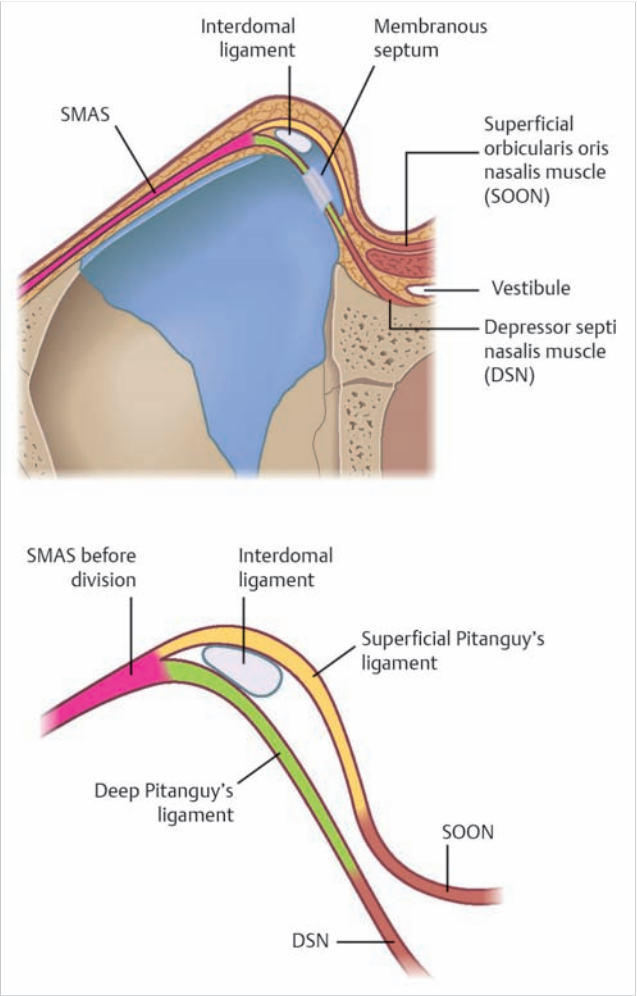

Fig. 1.9 Pitanguy's midline ligament. Part of the midline superficial musculoaponeurotic system (SMAS) that originates on the undersurface of the dermis at the supratip and divides into "superficial" and "deep" portions in relation to the interdomal ligament. The superficial portion becomes continuous with the superficial orbicularis oris nasalis and "deep portion" becomes continuous with the depressor septi nasalis.

lateral cartilage and the caudal border of the upper lateral cartilage.

- ***Sesamoid cartilages***: Small cartilages found in the lateral space between the upper and lower lateral cartilages.
- ***Sill–base junction***: The point at which the alar base joins the nostril sill in the same sagittal plane as the lateral extent of the naris.
- ***Soft tissue triangle***: Thin skin fold between the alar rim and the curved caudal border of the junction of the medial and lateral crura. When this is well defined, it is referred to as a facet.
- ***Supratip area***: The area just superior to the nasal tip at the inferior aspect of the nasal dorsum.
- ***Superficial musculoaponeurotic system (SMAS)***: A fibromuscular layer confluent with Pitanguy's midline ligament and continuous with homologs in the scalp, forehead, cheek, and neck.
- ***Tip***: Apex of the lobule; also frequently used when referring to the lobule.
- ***Tip projection***: Distance from the tip of the nose to the most posterior point of the nasal–cheek junction seen on lateral and basal views (the distance that the nose projects from the face) (▶ Fig. 1.10).
- ***Tip rotation***: Movement of the tip cephalad or caudad from the fixed alar base.
- ***Tip-defining points***: The most projecting area on each side of the tip, which produces an external light reflex.
- ***Transcolumellar incision***: An incision used for the open rhinoplasty approach through the thin skin of the columella connecting the medial terminations of the infracartilaginous incisions.
- ***Transfixion incision***: An incision in the membranous septum between the caudal border of the septal cartilage and the columella.
- ***Turbinates***: Three scrolls of bone (superior, middle, inferior) projecting from the lateral nasal wall (▶ Fig. 1.11).
- ***Upper cartilaginous (middle) vault***: The middle third of the nose comprised of the dorsal septum and upper lateral cartilages.
- ***Upper lateral cartilages***: The paired triangle-shaped superior nasal cartilages extending laterally from the

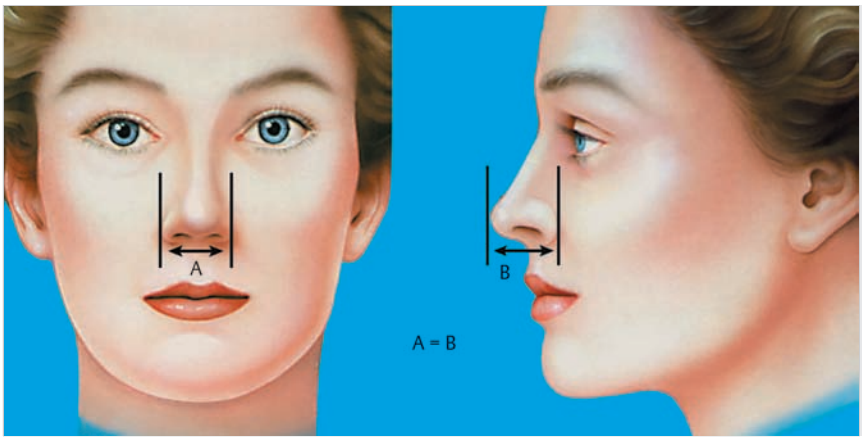

Fig. 1.10 Tip projection. The tip projection is the distance from the tip of the nose to the most posterior point of the nasal–cheek junction as seen on the lateral and basal views; it is the distance that the nose projects from the face.

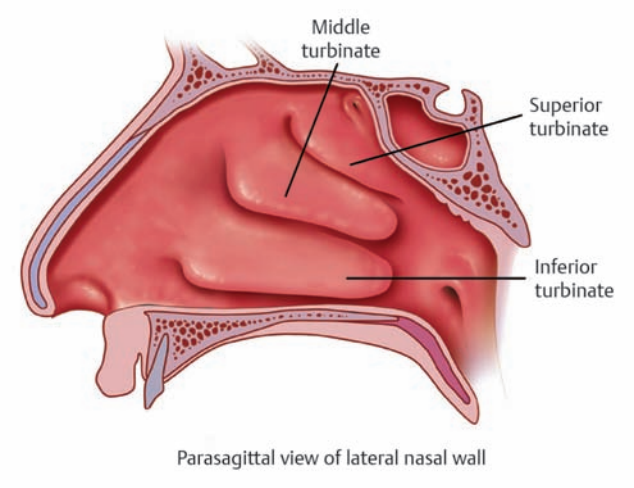

Fig. 1.11 Turbinates. The turbinates are three scrolls of bone (superior, middle, and inferior) that project from the lateral nasal wall.

dorsal septum which form the lateral walls of the middle third of the nose.

- ***Vertical facial plane***: A line perpendicular to the natural horizontal facial plane.
- ***Weak triangle (converse)***: Area superior to paired domes where the cephalic margins of the lower lateral cartilages separate to travel in a superolateral direction.
- ***W-point***: The point where the caudal upper lateral cartilages attach to the dorsal septum.
- ***W-ASA segment***: The intervening area between the W-point and the anterior septal angle.
- ***Webster's triangle***: A triangular bony projection along the pyriform aperture directly lateral to the anterior aspect of the inferior turbinate that is preserved during lateral osteotomies to prevent obstruction of the internal nasal valve.

1.3 Conclusion

A standardized and universal vocabulary for rhinoplasty allows clear and precise communication among rhinoplasty surgeons, particularly with respect to the process of surgical education and training. Our long experience with the Dallas Rhinoplasty Symposium has enabled us to assemble this glossary of anatomic terms that have been used by the most respected surgical educators in rhinoplasty and to refine them into a vocabulary that can be used and understood by all students of rhinoplasty. As rhinoplasty continues to evolve, so does the terminology. This chapter reflects the most current and universally accepted anatomic terms at the time of this publication.

2 Advanced Rhinoplasty Anatomy

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Abstract
Rhinoplasty is a precision surgery in which the margin of error is measured in millimeters. Therefore, excellent results can only be obtained if the surgeon has a thorough knowledge of nasal anatomy, its variations, and the surgical relevance of altering its structures. Lack of such understanding may result in inaccurate diagnosis and inappropriate surgical interventions, leading to unfavorable aesthetic outcomes and, sometimes, serious functional problems.

Keywords: Rhinoplasty, anatomy, upper lateral cartilage, lower lateral cartilage, lateral crural complex, nasal physiology, nasal anatomy

Key Points

- The type, texture, and sebaceous content of the skin must be carefully analyzed because it will influence the approach for modifying the framework and therefore the final result.
- An active depressor septi nasi muscle can be identified on preoperative clinical analysis, and its modification intraoperatively can enhance the tip–lip relationship.
- When the open approach is used, alar base excisions that extend more than 2 mm superior to the alar groove and defatting the nasal tip should be avoided to prevent vascular compromise of the nasal tip.
- The fibrous attachments of the lower lateral cartilages to the septal angle, upper lateral cartilages, piriform aperture, caudal septum, and premaxilla provide support and determine the position of the tip.

2.1 Introduction

The nose includes a *framework, supporting system, external coverage, and internal lining*. The framework consists of cartilage and bone, supported and held together by connective tissue and ligaments.[1,2,3,4,5,6] The skin and soft tissue provide the external covering of the nose. These components are intricately related and must be anatomically visualized in every step of the rhinoplasty sequence. The basic principles of this sequence include the following:

- Precise definition of anatomic goals preoperatively.
- Adequate anatomic exposure of the nasal deformity.
- Preservation/restoration of the normal anatomy.
- Correction of the specific deformity using incremental control.
- Maintenance/restoration of the nasal airway.

In this chapter, we review the clinically relevant anatomic structures encountered in rhinoplasty as well as their clinical applications.

Expert Tip

Excellent rhinoplasty results can only be obtained if the surgeon has a thorough knowledge of nasal anatomy and a grasp of the surgical relevance of alteration of the anatomic structures.

2.2 Skin

- Previous anatomic studies have demonstrated that the nose possesses distinct tissue layers.
- Proceeding from superficial to deep tissues, the layers encountered are epidermis, dermis, subcutaneous fat, muscle and fascia (musculoaponeurotic layer), areolar tissue, and perichondrium or periosteum overlying cartilage or bone, respectively.[7,8]
- In fact, three natural planes of dissection have been described (subcutaneous, deep areolar tissue planes, and subperichondrial),[9] separating the nose into the skin envelope, vascular musculoaponeurotic layer, and osteocartilaginous framework.
- The skin is thinner and more mobile in the upper two-thirds of the nose. In the lower third and especially at the nasal lobule, the skin becomes thicker, more sebaceous, and more adherent to the underlying structures (▶ Fig. 2.1).

2.2.1 Clinical Applications

- The type, texture, and sebaceous content of the skin must be carefully analyzed because it will influence the approach for modifying the framework and, therefore, the final result.
- For example, in patients with thin skin, overzealous alteration of the underlying framework may have adverse long-term effects. This is because thin nasal skin has a high capacity to contract and redrape over the sculpted framework. Additionally, slight imperfections of contour, symmetry, and graft edges are more likely to be visible and/or palpable postoperatively.
- In contrast, thick, sebaceous skin tends to undergo less postoperative contraction, warranting more aggressive alterations of the underlying framework in order to obtain significant definition.

Expert Tip

The type, texture, and sebaceous content of the skin must be carefully analyzed because it will influence the approach for modifying the framework and therefore the final result.

2.3 Muscles

- The muscles of the nose are divided into an *intrinsic group* of seven paired muscles (originating and inserting within the

perinasal area) and an *extrinsic group* containing three paired muscles (▶ Fig. 2.2a–c).

2.3.1 Intrinsic Group

- The procerus raises the dorsum and lowers the lateral cartilages.

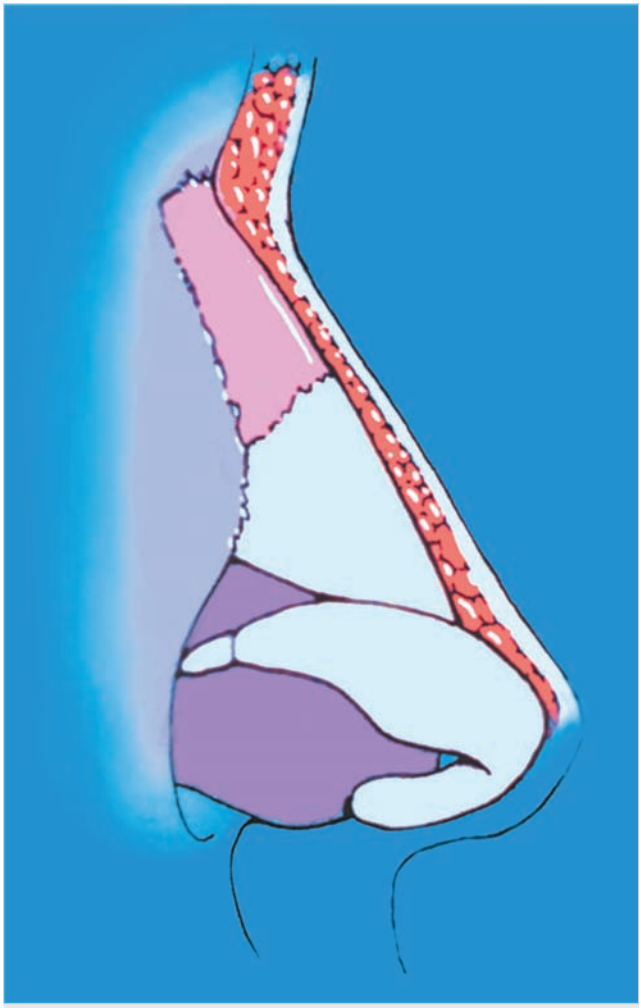

Fig. 2.1 Nasal tissue layers. The skin is thinner and more mobile in the upper two-thirds of the nose.

- Its distal aponeurosis blends with the pars transversa of the nasalis muscle to form the superficial musculoaponeurotic system (SMAS) of the nose.
- The pars transversa provides lateral wall rigidity and can even be a dilatory muscle.
- In contrast, the pars alaris is the primary dilatory muscle of the ala and is responsible for alar flaring.
- The remaining nasal intrinsic muscles are of doubtful importance in nasal airway patency.

2.3.2 Extrinsic Group

- The levator labii superioris alaeque nasi is the most important dilator of the extrinsic muscles.
- The zygomaticus minor and orbicularis oris secondarily provide lateral wall stability.
- When clinically significant, the depressor septi nasi muscle may play a role in accentuating drooping of the nasal tip and shortening of the upper lip on animation.
- We have previously performed a cadaver study to identify the three anatomic variations of the depressor septi nasi muscle (▶ Fig. 2.3):[10]
  - Type I muscles (62%) are visible and identifiable and can be traced to full interdigitation with the orbicularis oris from their origin at the medial crural footplate.
  - Type II muscles (22%) are visible and identifiable, but unlike the first group, they insert into the periosteum and demonstrate little or no interdigitation with the orbicularis oris.
  - Type III muscles (16%) have no, or only rudimentary, depressor septi nasi muscles visible.
- More recent anatomic studies have demonstrated a complex and dynamic relationship between muscles spanning between the nasal base and upper lip and cheek.[11] Thus, their exact contribution to dynamic changes of the nose observed with facial expression and functional effects on the external nasal valve are yet to be elucidated.

2.3.3 Clinical Applications

- Routine preoperative examination of the rhinoplasty patient should easily identify those patients who demonstrate a drooping nasal tip and shortened upper lip on animation, particularly when smiling.
- In such patients (with types I and II depressor septi nasi muscles), the attachments of the depressor septi nasi muscles

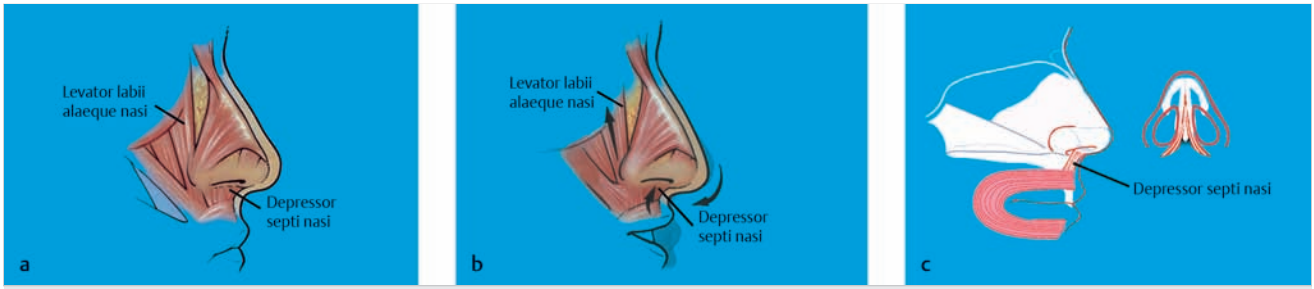

Fig. 2.2 Muscles of the nose. (**a–c**) The muscles of the nose are divided into an intrinsic group of seven paired muscles (originating and inserting within the perinasal area) and an extrinsic group of three paired muscles.

can be disinserted from the medial crural footplates and caudal septum through nasal incisions.
- If more lengthening of the upper lip is desired, through an upper gingivobuccal sulcus incision, dissection and transposition of the distal depressor septi nasi muscles and suturing together of the cut ends can be performed, thus reliably and effectively correcting this dynamic facial deformity.

Expert Tip

An active depressor septi nasi muscle can be identified on preoperative clinical analysis, and its modification intraoperatively can enhance the tip–lip complex.

2.4 Blood Supply

2.4.1 Arterial

- The arterial supply to the nose derives from two main arterial systems: the ophthalmic artery and the facial artery (▶ Fig. 2.4a, b).

Ophthalmic a. Contributions

- The main artery of the ophthalmic system is the dorsal nasal artery (also known as the anterior ethmoidal or terminal branch of the ophthalmic artery), which emerges from the medial orbit and courses over the anterior surface of the nasal bones toward the nasal tip.
- The dorsal nasal artery supplies the cranial portion of the nose and contributes to the subdermal plexus of the nasal tip.

Facial a. Contributions

- The nasal tip area is supplied primarily by the angular and the superior labial arteries (▶ Fig. 2.5a, b).
- In general, the angular artery provides the lateral nasal artery, which passes medially along the cephalic margin of the lateral crura and gives off caudal branches toward the nostril rim.
- The superior labial artery gives rise to the columellar artery, which courses up the columella to the region between the domes.
- The lateral nasal and columellar arteries then meet over the dorsal region, forming an alar arcade that runs along the cephalic margin of the lateral crura. This arcade runs superficial to the musculoaponeurotic layer.[7,12]

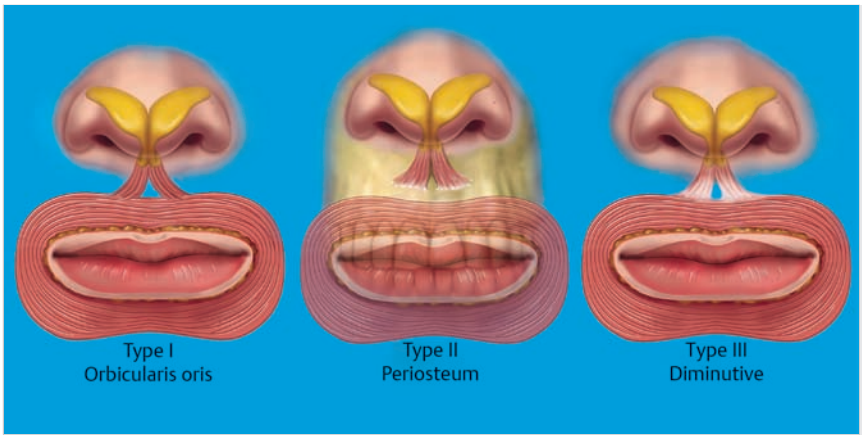

Fig. 2.3 The three types of depressor septi nasi muscles. Type I muscles are visible and identifiable and can be traced to full interdigitation with the orbicularis oris from their origin at the medial crural footplate. Type II muscles are also visible and identifiable; however, they insert into the periosteum and demonstrate little or no interdigitation with the orbicularis oris. In type III muscles, no, or only rudimentary, depressor septi nasi muscles are visible.

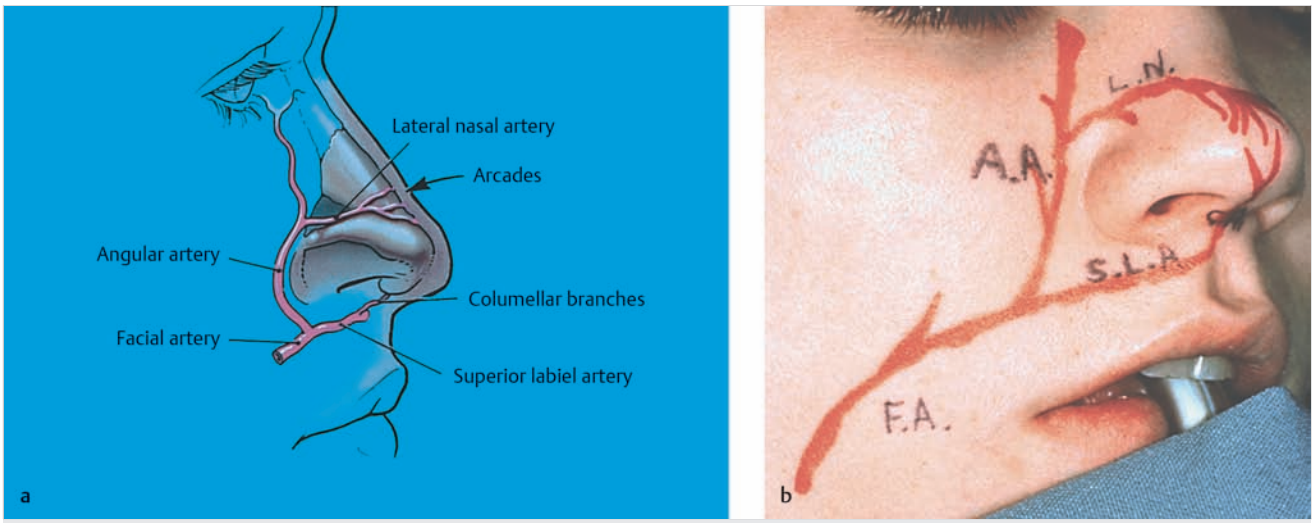

Fig. 2.4 Nasal arterial blood supply. (**a, b**) The arterial supply to the nose is derived from two main arterial systems: the ophthalmic artery and the facial artery. The main artery of the ophthalmic system is the dorsal nasal artery, which emerges from the medial orbit and courses over the anterior surface of the nasal bones toward the nasal tip. The dorsal nasal artery supplies the cranial portion of the nose and contributes to the subdermal plexus of the nasal tip.

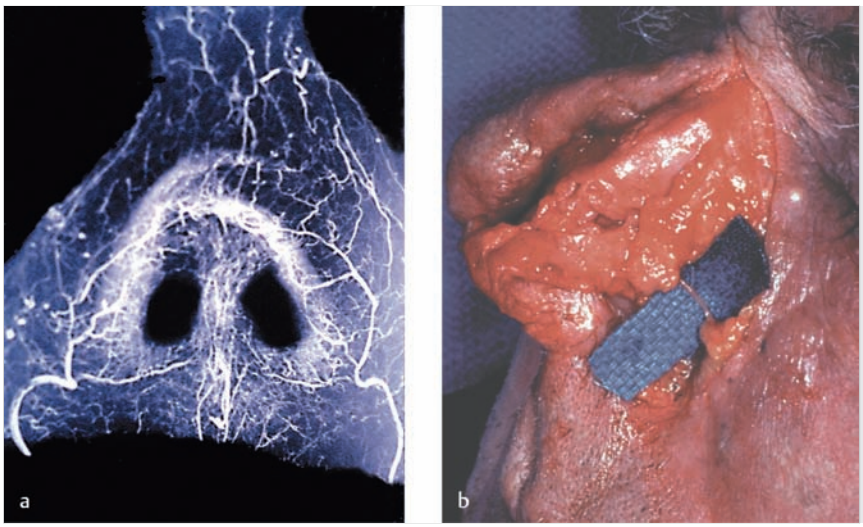

Fig. 2.5 Nasal arterial blood supply. (**a, b**) The nasal tip area is supplied primarily by the angular and the superior labial arteries, which are derived from the facial artery.

- Superficial to the alar arcade is the subdermal plexus of the nasal tip skin that is supplied by branches of both ophthalmic and facial artery systems.

2.4.2 Venous

- The venous drainage system also runs superficial to the musculoaponeurotic layer along the lateral wall, dorsum, and supratip regions of the nose.
- Although the anatomy of these veins is variable, most vessels drain into the facial vein inferiorly and/or the angular vein as it courses toward the medial orbit.
- One of the most important veins in the nose is the lateral nasal vein, which runs over the perichondrium of the middle nasal vault.
- There are no significant veins in the columellar region.

2.4.3 Lymphatic Drainage

- Previous anatomic studies have demonstrated that the lymphatic drainage system is also located superficial to the musculoaponeurotic layer.
- Drainage occurs dynamically along the lateral aspect of the nose, cephalad to the lateral crus, toward the piriform aperture and parotid lymph nodes.
- Lymphatic drainage does not occur in the columellar region.[7]

2.4.4 Clinical Applications

- With the growing popularity of open rhinoplasty, in the past there was concern that the transcolumellar incision may compromise nasal tip blood supply. However, the most recent anatomic studies have demonstrated the safety of this procedure.[8]
- Before flap elevation, only the columellar arteries are divided by the transcolumellar incision; adequate blood supply to the tip will derive primarily from the lateral nasal arteries and will be available as long as they are preserved during the procedure.
- Caution is advised if the alar base has been previously excised. If the alar base incisions extend more than 2 mm superior to the alar groove, the lateral nasal arteries can be damaged bilaterally.
- These studies have also shown that defatting may jeopardize the nasal tip supply. In nasal tip procedures, the surgeon should reconstruct the underlying framework first to redefine the tip prior to employing SMAS debulking techniques.

Expert Tip

When the open approach is used, alar base excisions that extend more than 2 mm superior to the alar groove and defatting the nasal tip should be avoided to prevent vascular compromise of the nasal tip.

- Surgical disruption of the venous and lymphatic vessels that run above the musculoaponeurotic layer of the nasal tip results in increased supratip edema.
- Therefore, dissection of the nasal skin flap during rhinoplasty should preserve the overlying the musculoaponeurotic layer, and if this is debulked, the superficial vessels should be preserved.
- This preserves the major arterial, venous, and lymphatic vessels supplying the nose, which run superficial to or within the musculoaponeurotic layer.
- Preservation of the vessels ensures tissue viability and more rapid resolution of the tissue edema that occurs postoperatively.
- Dissection in the deep areolar plane will not ensure preservation of the lateral nasal veins that pass over the perichondrium of the middle nasal vault.
- Although there are usually multiple veins draining the nasal tip, division of the lateral nasal veins may result in an increase in supratip edema. Therefore, blunt dissection of the soft tissue overlying the middle vault is recommended to preserve these vessels, in an attempt to maximize venous return and help minimize tip edema.

2.5 Nasal Vaults

- The nose possesses three vaults: bony, upper cartilaginous, and lower cartilaginous vaults (▶ Fig. 2.6).[13]

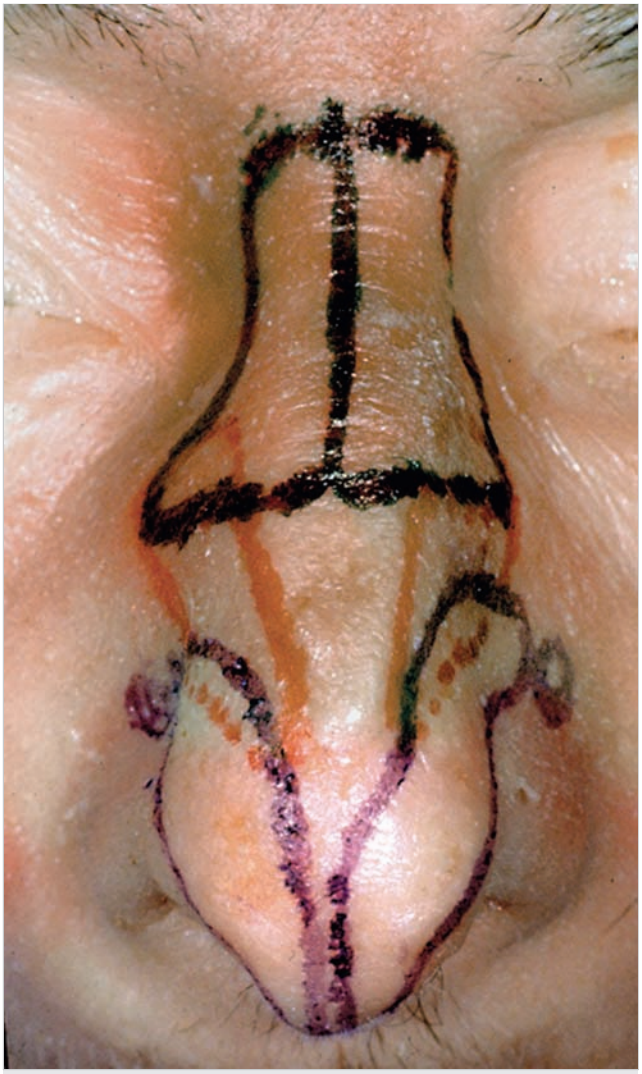

Fig. 2.6 The nasal vaults. The nose possesses three vaults: the bony vault, the upper cartilaginous vault, and the lower cartilaginous vault.

Fig. 2.7 The bony vault. The bony vault is the principal structural base for the nose. The vault consists of the paired nasal bones and the ascending frontal process of the maxilla. It acts as a cantilever by supporting the upper nose and the upper lateral cartilages.

2.5.1 Bony Vault

- The bony vault is the principal structural base for the nose (▶ Fig. 2.7).
- It is generally pyramidal in shape and constitutes one-third of the external nose.
- Consisting of the paired nasal bones and the ascending frontal process of the maxilla, the vault acts as a cantilever, supporting the upper nose and the upper lateral cartilages.
- The maxillary processes extend in a cephalad direction from the piriform aperture to the lacrimal crest, uniting with the frontal and nasal bones.
- The nasal bones articulate with each other medially, the frontal bone superiorly, the maxilla laterally, the perpendicular plate of the ethmoid posteriorly, and the upper lateral cartilages inferiorly.
- The average length of nasal bones is 2.5 cm, and they are much thicker and denser above the level of the medial canthus at the radix, and progressively thinner toward the tip. A transition zone of bony thickness exists along the frontal processes of the maxilla from the piriform aperture to the radix along the lateral nasal wall. The bone in this region is less than 2.5-mm thick.
- They are widest at the nasofrontal suture, narrowest at the nasofrontal angle, and tend to widen again inferior to the radix before narrowing near their inferior margin.

Clinical Applications

- Osteotomies may be performed to narrow or widen the nasal base, repair an open roof deformity after dorsal hump resection, and correct symmetrical or asymmetrical bone deformities.
- Reliable and predictable osteotomies may be executed at the transition zone of relatively thin bone along the frontal processes of the maxilla, from the piriform aperture to the radix along the lateral nasal wall. Osteotomies are rarely indicated superior to the level of the medial canthi because this area is quite narrow and has thick bone.[14,15,16]

- Osteotomies may be contraindicated in some patients with short nasal bones (distal border 1 cm beneath the intercanthal line) and in certain nonwhite races with extremely low and broad noses because of the risk of middle vault collapse and the associated functional airway compromise.
- In elderly patients with excessively thin nasal bones, patients with heavy glasses, and patients with thick skin over the dorsum, caution should be exercised if an osteotomy is considered.

2.5.2 Upper Cartilaginous Vault

- An important component of the upper cartilaginous vault is the internal nasal valve, which is bordered by the septum medially, the nasal floor inferiorly, the inferior turbinate laterally, and the caudal border of the upper lateral cartilage superiorly (▶ Fig. 2.8a, b).
- The keystone area is located at the junction of the upper lateral cartilages with the nasal bones and the septum (▶ Fig. 2.9a, b).
- The dorsal edge of the septum has a T-shaped contour in this region.
- The nasal bones actually overlap the cephalic edge of the upper lateral cartilages at the keystone area by 6 to 8 mm, thus producing a firm adherence between both the structures, enhancing support.
- The angle between the septum and upper lateral cartilage is normally 10 to 15 degrees.
- Caudally, the junction of the upper lateral cartilages with the cephalic edge of the lateral crus defines the scroll area. Most patients have some overlap of the lateral crura over the caudal edge of the upper lateral cartilages, which may enhance support at this level.

Clinical Applications

- Previous studies have indicated that the nasal valves contribute much more to obstruction than previously realized and that the septum may play a much smaller overall role.[17,18]
- Injury and/or destabilization of the keystone area during rhinoplasty must be avoided at all costs, because deformation

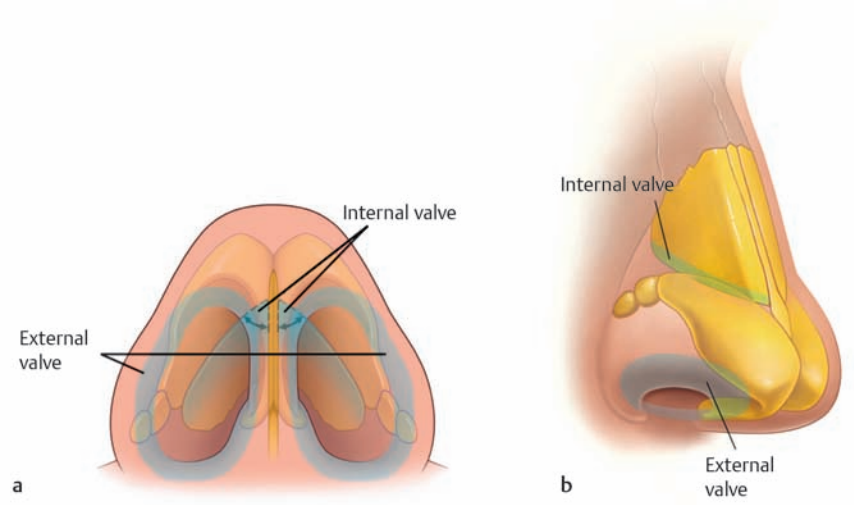

Fig. 2.8 The upper cartilaginous vault: anatomy. (**a, b**) An important component of the upper cartilaginous vault is the internal nasal valve, which is bordered by the septum medially, the nasal floor inferiorly, the inferior turbinate laterally, and the caudal border of the upper lateral cartilage superiorly.

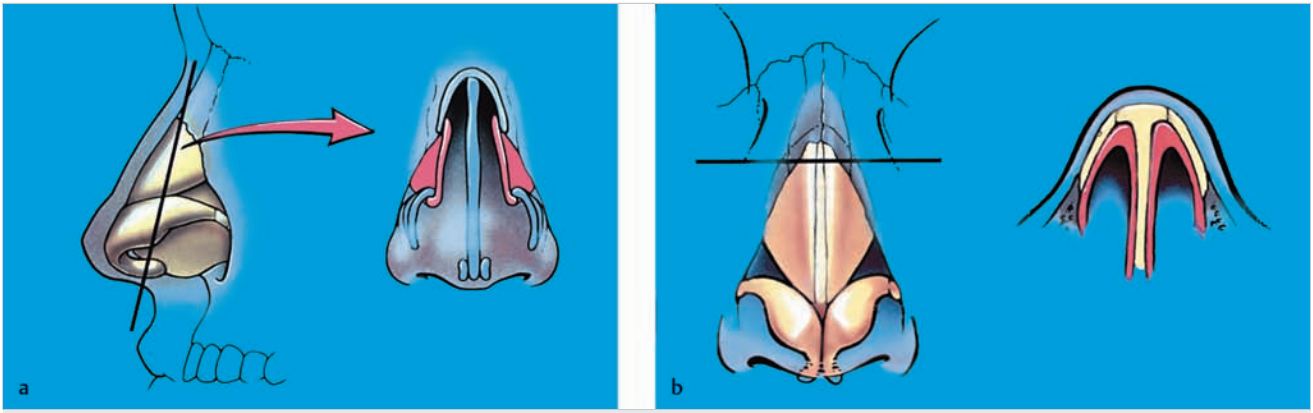

Fig. 2.9 The upper cartilaginous vault: anatomy. (**a, b**) The junction of the upper lateral cartilages with the nasal bones and the septum defines the keystone area. The dorsal edge of the septum has a T-shaped contour in this region. The nasal bones overlap the cephalic edge of the upper lateral cartilages by 6 to 8 mm, thereby producing a firm adherence between both the structures which enhances support.

of the normal 10- to 15-degree angle between the upper lateral cartilages and the septum will result in impaired airflow through the internal nasal valve (▶ Fig. 2.10).[19]

- For example, scarring in the internal nasal valve region resulting from violation of the mucosal lining during dorsal hump reduction or extension of an intercartilaginous incision to a transfixion incision will lead to obstruction of airflow through this critical area.
- Dorsal reductions should be performed using an incremental component dorsal hump reduction technique, which allows preservation of the upper lateral cartilages. The upper lateral cartilages can then be manipulated independent of the dorsal septum, allowing greater control and decreasing the risk of overresection. This will tend to preserve the internal nasal valve, avoiding disruption of the dorsal aesthetic lines, an inverted-V deformity, and airway compromise.
- In secondary rhinoplasty patients with these deformities, grafting, osteotomy, and suture techniques may be used to increase the cross-sectional area of the internal nasal valve, improving the functional and aesthetic status of the nose.

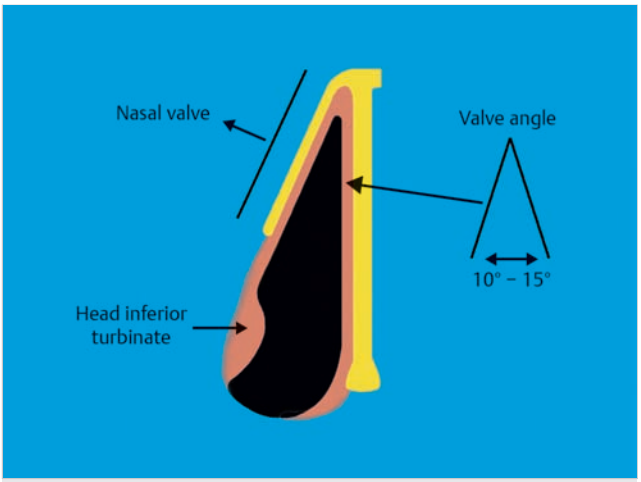

Fig. 2.10 The upper cartilaginous vault: clinical applications. The angle between the septum and upper lateral cartilage is normally 10 to 15 degrees. Caudally, the junction of the upper lateral cartilages with the cephalic edge of the lateral crus defines the scroll area. Most patients have some overlap of the lateral crura over the caudal edge of the upper lateral cartilages, which may enhance support at this level.

2.5.3 Lower Cartilaginous Vault

- The external nasal valve exists at the level of the inner nostril. It is formed by the caudal edge of the lateral crus of the lower lateral cartilage, the soft tissue alae, the membranous septum, and the sill of the nostril (▶ Fig. 2.11a).
- The framework of the nasal tip is formed by the medial, middle, and lateral crura of the lower lateral cartilages. Additionally, the accessory cartilages connect each lateral crus to the piriform aperture.
- All of these cartilages are bound together by a continuous perichondrium, which gives stability to the cartilages and causes them to act as a single structural and functional unit.
- This unit is referred to as the lateral crural complex. The shape and position of this unit, the thickness of the overlying skin, and the fibrous attachments to the adjacent anatomic structures are interrelated and determine the appearance of the tip (▶ Fig. 2.11b).[2,5,20,21,22,23]
- The lateral crural complexes are supported by the suspensory ligament of the tip, the ligamentous connection between the cephalic margins of the lower lateral crura as they diverge from each other in the supratip area and rest on the septal angle as well as the fibrous connections to the upper lateral cartilages, and abutment with the piriform aperture (▶ Fig. 2.12).

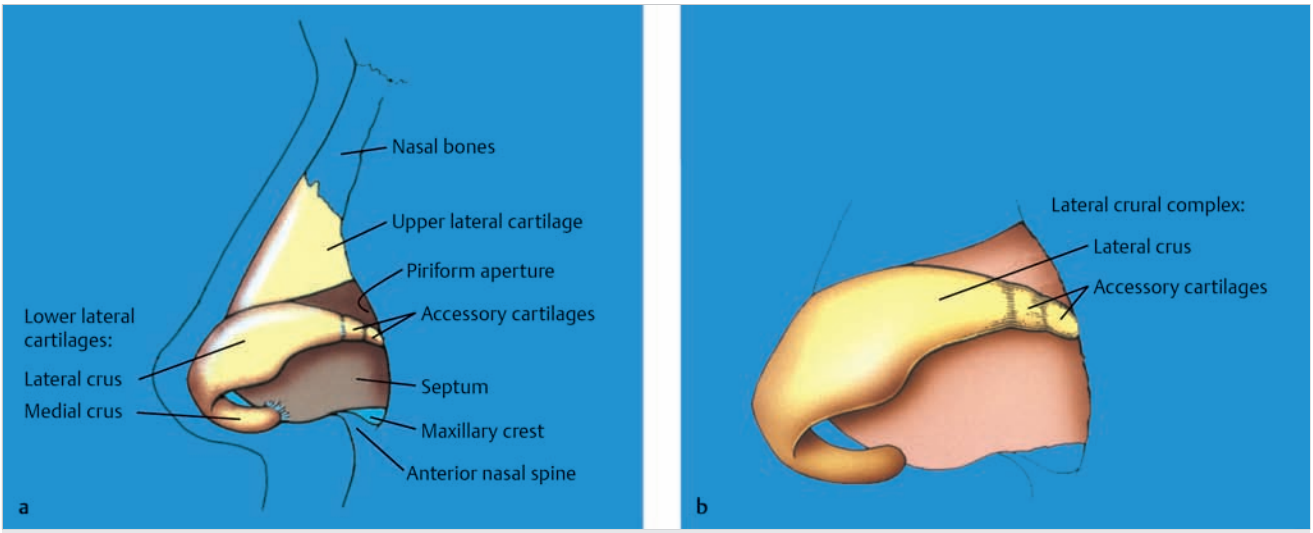

Fig. 2.11 The lower cartilaginous vault: anatomy. (**a, b**) The external nasal valve exists at the level of the inner nostril. It is formed by the caudal edge of the lateral crus of the lower lateral cartilage, the soft tissue alae, the membranous septum, and the sill of the nostril. The framework of the nasal tip is formed by the medial, middle, and lateral crura of the lower lateral cartilages. Additionally, the accessory cartilages connect each lateral crus to the piriform aperture. All of these cartilages are bound together by a continuous perichondrium, which gives stability to the cartilages and causes them to act as a single structural and functional unit. This unit is referred to as the lateral crural complex.

- The medial crura are supported by their elastic fibrous attachments to the caudal septum, the soft tissue interposed between their feet, and the premaxillary area.

Expert Tip

The fibrous attachments of the lower lateral cartilages to the septal angle, upper lateral cartilages, piriform aperture, caudal septum, and premaxilla provide support and determine the position of the tip.

- Recent studies of columellar anatomy show the complex anatomy of this area, which likely influences nasal tip support.[11,24] Our histologic study of the soft tissue of this area revealed the presence of multiple tissue types, including collagen, elastin, muscle, and adipocytes between the medial crura, septum, and skin (▶ Fig. 2.13a, b).
- The presence of these different tissue types may have significant clinical implications, including understanding how certain surgical maneuvers affect tip projection, external nasal valve function, development of changes in the nose seen with age, and columellar aesthetics.

Clinical Applications

- The external nasal valve is an occasional site of obstruction in rhinoplasty patients, particularly in secondary patients with a pinched alae deformity. This deformity may be caused by collapse of the lateral crura, which is generally caused by overresection of cartilage and injury to its supporting structures, facial nerve palsy, unstable lower lateral cartilages, and vestibular stenosis.
- In rhinoplasty, numerous surgical techniques have been proposed to shape the tip cartilages. Common reasons for modifying these structures are to change tip projection, alter tip rotation, decrease the distance between the tip-defining points, reduce tip fullness, create a supratip break, and adjust the relationship between the columella and the alar rims.
- The cartilaginous framework of the tip has been described as a tripod, with the lower leg represented by the paired medial crura and each upper leg consisting of a lateral crural complex based bilaterally on the piriform aperture (▶ Fig. 2.14). See Chapter 40 for further description of the tripod concept and techniques for altering tip shape and position.

2.5.4 Internal Nasal Anatomy: Septum and Turbinates

- The central supporting system of the nose is the septal cartilage, which articulates posteriorly with the perpendicular plate of the ethmoid superiorly and the vomer inferiorly.[17,25,26] The vomer itself rests on the maxillary–palatine crests. The tongue-and-groove articulation between the quadrangular cartilage and the maxillary and palatine crest deserves special mention (▶ Fig. 2.15).

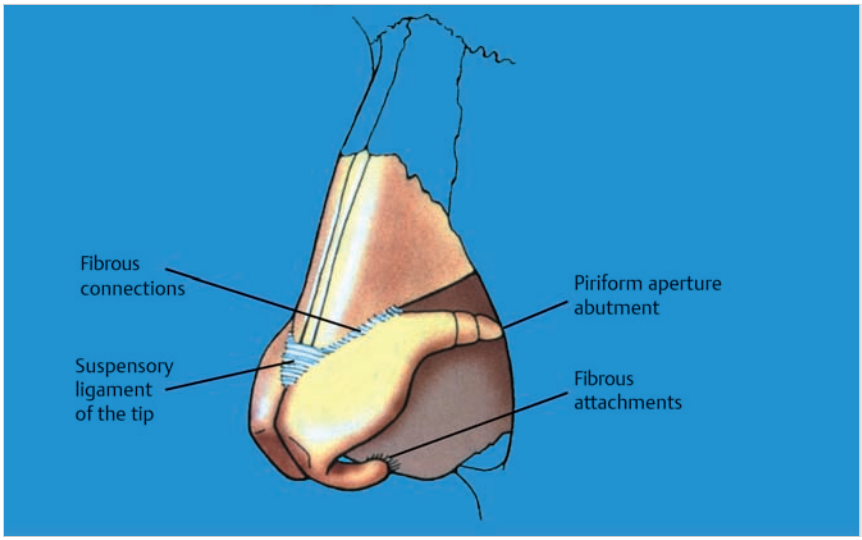

Fig. 2.12 The lower cartilaginous vault: anatomy. The lateral crural complexes are supported by the suspensory ligament of the tip; the ligamentous connection between the cephalic margins of the lower lateral crura as they diverge from each other in the supratip area and rest on the septal angle as well as the fibrous connections to the upper lateral cartilages; and abutment with the piriform aperture. The medial crura are supported by their elastic fibrous attachments to the caudal septum, the soft tissue interposed between their feet, and the premaxillary area.

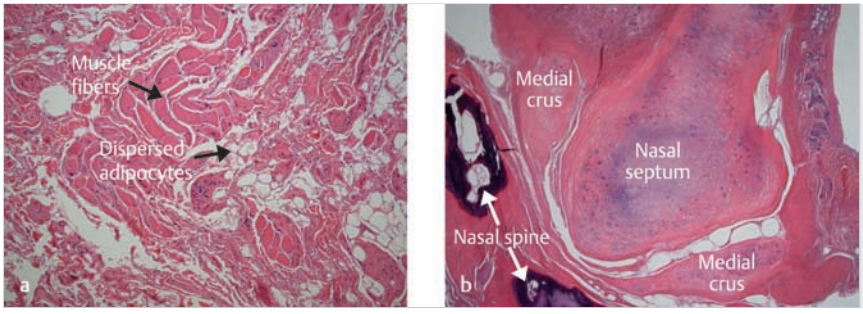

Fig. 2.13 The lower cartilaginous vault: histology. (**a, b**) The soft tissue of this area shows the presence of multiple tissue types, including collagen, elastin, muscle, and adipocytes between the medial crura, the septum, and the skin. The presence of these different tissue types may have significant clinical implications, including understanding how certain surgical maneuvers affect tip projection, external valve function, development of changes in the nose seen with age, and columellar aesthetics.

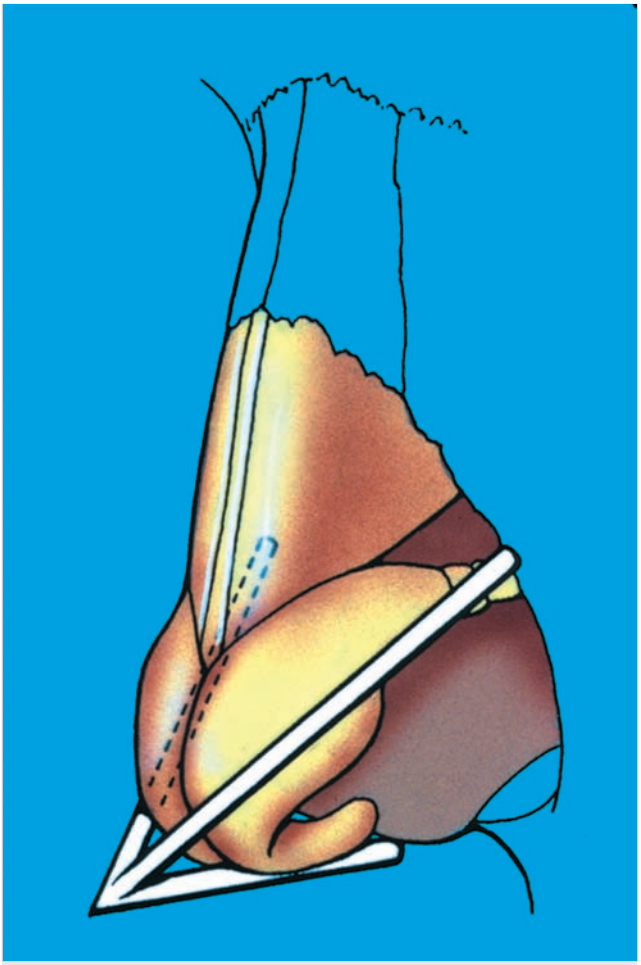

Fig. 2.14 The lower cartilaginous vault: clinical applications. The cartilaginous framework of the tip has been described as a tripod. With the patient upright, the tripod lies on its side with one caudal leg and two cephalic legs. The caudal leg is represented by the medial crura, whereas each cephalic leg consists of a lateral crural complex based bilaterally on the piriform aperture. In theory, if the base of the tripod is fixed, reduction (by resection and closing dead space) or augmentation (by using grafts or struts) of the length of the legs should change variables such as projection and tip rotation.

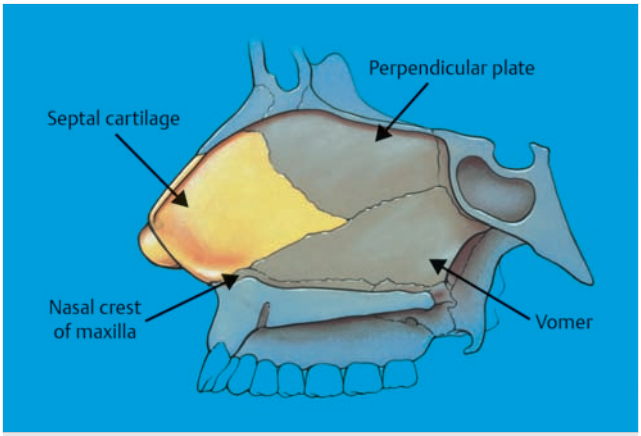

Fig. 2.15 Internal nasal anatomy: septum and turbinates. The central supporting system of the nose is the septal cartilage, which articulates posteriorly with the perpendicular plate of the ethmoid superiorly and the vomer inferiorly. The vomer itself rests on the maxillary–palatine crests. There is tongue-and-groove articulation between the quadrangular cartilage and the maxillary and palatine crest.

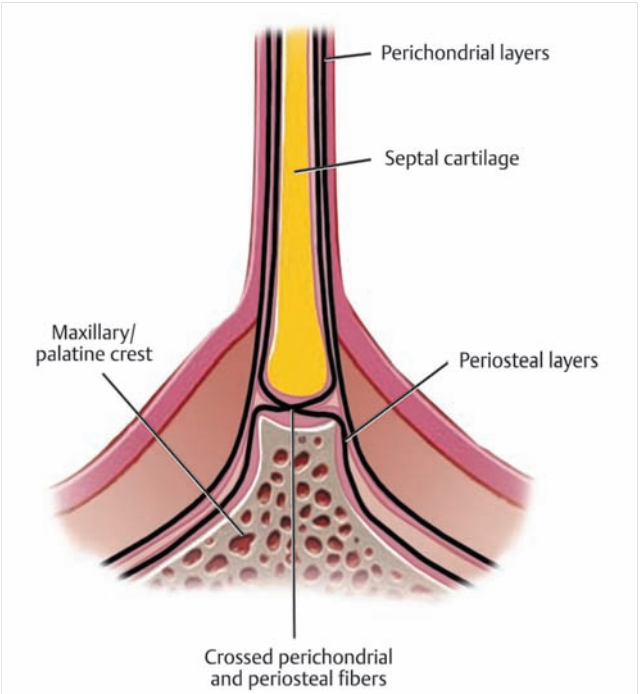

Fig. 2.16 Internal nasal anatomy: septum and turbinates. The perichondrium of the cartilage is only partially contiguous with the periosteum of the crests. Other fibers pass through the articulation to join the contralateral perichondrium. This crossed configuration makes a contiguous submucoperichondrial dissection difficult at the osteocartilaginous junctions.

- The perichondrium of the cartilage is only partially contiguous with the periosteum of the crests.[27] Other fibers pass through the articulation to join the contralateral perichondrium. This crossed configuration makes a contiguous submucoperichondrial dissection difficult at the osteocartilaginous junctions (▶ Fig. 2.16).
- This same anatomic configuration also allows some movement between the crest and the septum, and it is this instability that explains the frequent posttraumatic findings of a displaced quadrangular septal cartilage from the groove of the crest.
- The anterior septum articulates caudally with the anterior nasal spine.
- The inferior turbinates are a key functional component in nasal airway breathing because their anterior heads occupy a significant portion of the nasal passage (▶ Fig. 2.17a, b).
- They are composed of dense lamellar bone originating from the medial maxillae and are covered with erectile mucosal tissue.
- This tissue is under autonomic control, and chronic inflammation can lead to fibrous deposition and chronic hypertrophy of the turbinate soft tissues and/or bone.